FINAL

SUPPLEMENTAL PHASE II REPORT

NATIONAL FIREWORKS SITE
RTN 4-0000090
HANOVER, MA

Prepared for:
The Fireworks Site Joint Defense Group

Prepared by:

TETRA TECH

160 Federal Street
3rd Floor
Boston, MA 02110

June 2018

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ACRONYMS

Acronym	Definition
µg/L	micrograms per Liter
ASTM	American Society for Testing and Materials
AUL	Activity and Use Limitation
BAF	bioaccumulation factor
bgs	below ground surface
BSAF	biota-sediment accumulation factor
CAM	Compendium of Analytical Method protocols
CMR	Code of Massachusetts Regulations
COC	chain of custody
COEC	contaminant of ecological concern
CRREL	Cold Regions Research and Engineering Laboratory
CSA	Comprehensive Site Assessment
CSM	conceptual site model
CUG	clean-up goal
DRET	dredge elutriate testing
DTM	digital terrain model
ECC	Eastern Channel Corridor
ECCL	ECC Lower Overflow Area
ECCM	ECC Middle Overflow Area
ECCU	ECC Upper Overflow Area
EDD	Electronic Data Deliverable
EP	Extraction Procedure
EPA	United States Environmental Protection Agency
ERC	Environmental Risk Characterization
FWX	Fireworks Site
GC/MS-SIM	Gas Chromatography/Mass Spectroscopy- Selective Ion Monitoring
GPS	Global Positioning System
GW	Groundwater
HASP	Health and Safety Plan
HMX	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
IDW	investigation-derived waste
IHRC	Indian Head River Corridor
ISM	incremental sampling methodology
LDRC	Lower Drinkwater River Corridor
LLC	Limited Liability Company
LMB	largemouth bass
LSP	Licensed Site Professional
LUFP	Lily Pond / Upper Factory Pond
MA	Massachusetts
MassDEP	Massachusetts Department of Environmental Protection
MCP	Massachusetts Contingency Plan
MD	munitions debris
MDOH	Massachusetts Department of Health
MEC	munitions and explosives of concern

Acronym	**Definition**
MEPA	Massachusetts Environmental Policy Act
mg/Kg	milligrams per Kilogram
MGL	Massachusetts General Law
MLFP	Middle / Lower Factory Pond
MSL	Mean Sea Level
MUA	Marsh Upland Area
MUAU	MUA Upland Soil
NAD83	North American Datum 1983
NSRWA	North & South Rivers Watershed Association
ORS	Office of Research and Standards (MassDEP)
PAH	polycyclic aromatic hydrocarbon
PCBs	Polychlorinated biphenyls
PID	photoionization detector
PRG	preliminary remediation goal
PZ	piezometer
QA/QC	quality assurance/quality control
QC	quality control
RAA	Remedial Action Alternatives (MCP Phase III)
RAP	Remedial Action Plan (MCP Phase III)
RDA	Request for Determination of Applicability
RDX	cyclotrimethylenetrinitramine
SAV	Submerged aquatic vegetation
SBE	single-beam echo sounder
SCCA	Southern Conservation Commission Area
SDG	Sample Delivery Group
SOP	standard operating procedure
SOW	Scope of Work
SU	sampling unit
TAL	Target Analyte List
TCLP	Toxicity Characteristic Leaching Procedure
Tetryl	2,4,6-trinitrophenylmethylnitramine
TSS	Total Suspended Solids
UCL	Upper Concentration Limit
USACE	U.S. Army Corps of Engineers
USEPA	United States Environmental Protection Agency
UXO	unexploded ordnance
VOC	volatile organic compound

1.0 INTRODUCTION

1.1 Site and Project History

The Fireworks Site (Site) is approximately 240 acres of property generally located between King and Winter Streets in the Town of Hanover, Massachusetts. A portion of one of the water bodies associated with the Site is located in the Town of Hanson, Massachusetts. Environmental conditions that may have resulted from historic operations at the Site have been investigated for many years. Historical activities at the Site included research, development and the manufacturing of munitions and pyrotechnics for the United States Government and some commercial manufacturing of civilian fireworks. Lead, mercury, explosives, and some organic solvents, among other chemicals, were used in Site manufacturing operations. Several companies operated at the Site until it closed around 1970. Thereafter, the Town of Hanover purchased approximately 130 acres of the Site in the general area of Factory Pond for conservation land and a public works facility. The remaining acreage was sold in May 1983, and subsequently was subdivided into its present configuration. Presently, as shown in Figure 1-1, the northern portion of the Site is a multi-tenant, commercial/industrial park with some abandoned structures and the central and southern portions of the Site contain open fields, dense foliage areas, and wetlands. The Site is now owned by more than 40 different entities including individuals, companies, and the Town of Hanover. None of the entities identified by the Massachusetts Department of Environmental Protection (MassDEP) as potentially responsible parties owns any property at the Site.

The U.S. Environmental Protection Agency (USEPA) evaluated the Site in 1984 and determined that it should not be added to the National Priorities List as a Superfund Site. In 1986, USEPA required the former owner, Susquehanna Corporation, to investigate the southern portion of the Site and to remove some drums and other debris. In 1993 and 1995, MassDEP conducted limited surface water, sediment, and fish tissue sampling for mercury, lead, and other metals in portions of the streams, ponds, and wetlands on and adjacent to the Site. In October 1995, MassDEP issued Notices of Responsibility to the U.S. Department of Defense, Kerr-McGee Chemical Corporation, Susquehanna Corporation, National Coating Corporation, and the Massachusetts Institute of Technology as potentially responsible parties under Massachusetts General Laws Chapter 21E for environmental contamination at the Site. While not admitting liability, Kerr-McGee Chemical Corporation, National Coating Corporation and Massachusetts Institute of Technology formed the Fireworks Site Joint Defense Group (also known as the “Cooperating Parties”), and began investigating the environmental conditions at the Site. In 2000 the Cooperating Parties reached an agreement with the U.S. Department of Defense for reimbursement of the majority of the cost of the site investigation.

The Massachusetts Contingency Plan (MCP) establishes the process by which the MassDEP regulates the investigation and cleanup of contaminated properties in the Commonwealth. The MCP process has five components:

- Phase I is a preliminary site investigation to confirm whether the location is a "disposal site."
- Phase II is a systematic investigation of environmental conditions of the entire site, which provides the data necessary to assess site risks.
- The evaluation of cleanup options and selection of a remedy occurs in Phase III.
- In Phase IV, a plan to carry out the chosen remedy is prepared and implemented.
- Phase V includes operation, maintenance and/or monitoring of the remedy.

The cleanup process is completed when a condition of "no significant risk" has been achieved.

The Phase I investigation conducted by the Cooperating Parties focused on several locations identified by MassDEP based on historic operations at the Site. The field investigation began in July 1997. Soil borings were drilled on-site and a monitoring well installed in each of the five areas of interest: Fox Island, Building 80, Building 307, Waste Burn Pit, and Demolition Area Pit. The Site was ranked using these and other available data and classified as Tier 1A. The Tier 1A designation required every work plan and report to be approved by the MassDEP prior to progressing to the next phase of work. The Phase I Report, Tier Classification, and Tier 1A Permit Application were submitted to MassDEP in 1997 and MassDEP issued Permit No. 100233 to the Cooperating Parties. The regulations pertaining to Tier 1A sites have since changed and the Tier 1A Permit is not currently active.

The primary Phase II investigation was conducted in sub-phases (referred to as IIA, IIB, IIC, and IID) from 1998 through 2003 because of the size and complexity of the Site.

- The Phase IIA groundwater investigation focused on groundwater flow and quality across the Site. Field activities were conducted in November and December 1998. The results of the groundwater analyses indicated the sporadic presence of volatile organic compounds (VOCs) at several Site locations. Shortly thereafter, MassDEP requested that the Cooperating Parties install a fence around the Cold Waste Area, which had historically served as a burial area for spent metallic ordnance wastes and debris. Precipitation and runoff had eroded portions of the Cold Waste Area and exposed previously buried materials. The Cooperating Parties agreed to undertake an Immediate Response Action and erected a fence around the Cold Waste Area in July 1999 to isolate it from recreational users until the area could be remediated.
- The Phase IIB investigation characterized upland areas of the Site (soil and groundwater), including further defining groundwater quality at select locations and assessing soil conditions at locations related to historic operations across the Site. The Phase IIB field program ran from July through October 2000. The program established the distribution of lead and mercury in soils at the Site and identified elevated levels of VOCs in soils near the Waste Burn Pit and Demolition Pit Areas that required further analysis. Additionally, some VOCs were identified in the lower aquifer in the northern part of the Site and near Building 307.

- Phase IIC focused on the streams, ponds, and wetlands of the Drinkwater River system at the Site with some additional sampling to refine Phase IIB results. Field work began in November 2001 and concluded in April 2002. The field program mapped the location of lead and mercury in stream and pond sediments, while groundwater screening in the Building 307 Area narrowed down potential VOC source areas. Soil gas results showed VOCs in the Waste Burn Pit Area suggestive of disposal after Site operations ceased in 1970.
- The Phase IID investigation focused on collecting data to support the risk characterization. The program was conducted from August through October 2003 and collected data regarding the nature and extent of contamination by metals (primarily lead and mercury) in the sediment. Several samples were collected below Factory Pond Dam to evaluate whether any mercury had migrated off the Site. Biological specimens (fish and invertebrates) and additional soil and groundwater samples were collected to support human health and environmental risk characterizations. Results indicated that mercury was the primary contaminant of concern in Site sediments because of bioaccumulation in some of the fish and wildlife.

The Phase II Comprehensive Site Assessment Report was submitted to MassDEP in November 2005. The risk characterizations showed the potential for significant risk to benthic organisms, fish, reptiles, birds and mammals due mainly to the presence of mercury and lead. The greatest risks in magnitude and number to fish and wildlife receptors were in areas associated with historical sources of mercury and lead releases in the northern portion of the site. Risks observed for open-water habitats and wetlands were more pronounced than the upland areas of the Site. The human health risk characterization indicated a risk to sport fishermen eating the fish from the Site’s ponds and river channels due to the methylmercury accumulation in the fish (note that a fish advisory has been in effect since 1995). Potentially significant risks also were indicated for future Site users who might interact with the soil contamination in the northern source areas and in the disposal areas in the south. The risks posed by the soil in the south are attributable to polycyclic aromatic hydrocarbons (PAHs) and some organic compounds, in addition to mercury and lead.

A Draft Phase III Remedial Action Plan (RAP) was submitted to MassDEP in November 2007, which included a comprehensive evaluation of remedial options for the site’s sediment, soil and groundwater contamination. A recommended remedial program was proposed based on an analysis of the then available data. A conceptual remediation sequence along with a cost estimate and schedule also were developed. The draft generated several comments from MassDEP and the North & South Rivers Watershed Association.

The project team then determined that additional sampling, especially in the ponds, was necessary to support a defensible RAP given the magnitude of the projected cost. A Supplemental Phase III Sampling program was designed to fill characterization data gaps and provide greater sediment sampling data density in the ponds. The Supplemental Phase III Sampling was performed in the autumn of 2008 and the early winter of 2009, and the

Supplemental Phase III Sampling Report was submitted to MassDEP in March of 2009. Using the additional data, a Revised Draft Phase III RAP was prepared and submitted to MassDEP in June 2009. After submission of the Revised Draft Phase III RAP, some additional portions of the Site were identified as needing further evaluation. An exploratory trenching investigation of the Former Test Range and the Cold Waste Area was performed in January of 2012.

The conceptual site model (CSM) presented in the risk characterization conducted as part of the 2005 Phase II Comprehensive Site Assessment was revisited as part of the Phase II Re-Baselining effort. Previously, the risk characterization had analyzed the potential human health risk from exposure to mercury in sediment by evaluating the risk to sport fishermen eating fish from the Site ponds and river channels. Following this assessment, it was determined that human health risk should be evaluated by analyzing the risk to all populations from eating fish from the Site's waterbodies, including children. As such, Tetra Tech re-focused the assessment on the consumption of fish by people and relating fish tissue mercury concentrations to mercury in sediment. Detailed assessment of a variety of aspects of the acceptable body burden of mercury in fish tissue and the relationship between mercury in fish tissue and in the local surficial sediment were performed. The assessment focused on regional fish consumption rates, alternate sources of dietary fresh fish, statewide background fish tissue mercury contamination levels, biota-sediment accumulation factors (BSAFs), bioaccumulation factors (BAFs), mercury sediment-surface water partitioning, off-site mercury loading to the region and site, and watershed physicochemical characteristics and their effect on mercury methylation and uptake into fish. The mercury uptake relationship was estimated using several different approaches and independent data sets to identify a defensible consensus representation for the uptake relationship. A new proposed preliminary remedial goal (PRG) of 4 mg/Kg for mercury in surficial sediment was developed based on the remediation objective of reducing the on-site fish tissue mercury concentration in largemouth bass to a level consistent with the statewide background concentration. The development of this proposed PRG is presented in Appendix 3D.

In 2010, the site experienced two 100-year storm events in close succession that tripled the flow of water through the watershed. Extensive flooding was observed, and it was determined that the prior sediment characterization results and mercury concentration distribution throughout the Site's water bodies were no longer defensible due to the extremely high flows and the scouring and re-deposition of sediments that were observed. A proposal to re-baseline the mercury sediment concentrations and associated shoreline conditions at the Site and conduct some benchtop testing of the sediments to support the evaluation of alternatives was begun in January 2015.

1.2 Goals of the 2015 Re-Baselining Sampling Program

As noted, the re-baselining sampling program was determined to be necessary primarily because of a series of record-level high precipitation events and the subsequent flooding of the Site in 2010. This flooding was observed to deposit sediment contaminated with mercury from the stream channels onto the nearby stream banks and adjacent low-lying areas. The high flows also were suspected to have potentially transported mercury-contaminated sediment down-stream within the watershed with concurrent scouring and deposition in various locations, causing the existing characterization of the distribution of contaminated sediments to no longer be sufficiently representative to allow a revised Phase III analysis of remedial alternatives and cost estimates to be developed with confidence. In addition, a few areas associated with the Former Test Range had not been previously sampled during Phase IIA through IID and, thus, warranted a focused supplemental characterization effort to identify the presence and extent of contamination. Also, no groundwater sampling had been performed at the Site since late 2008 or early 2009. Therefore, it was important to determine if the limited Upper Concentration Limit (UCL) exceedances for groundwater observed at that time still existed. While mercury has been found to be the contaminant of most concern in the Site sediments and groundwater, other metals (including lead) have been found in the groundwater and soil at select locations at levels warranting assessment and possible response. Re-baselining sampling was performed for sediment, soil, and groundwater at specific locations where the collection of the data was likely to improve the recommendation of a remedy or allow a better estimate of the scale or cost of that recommended remedial alternative.

1.3 Approved Re-Baselining Scope of Work and Sampling Program

The timeline for design and implementation of the re-baselining sampling program was as follows:

- The scope of work (SOW) for the re-baselining sampling program was originally proposed to MassDEP on March 23, 2015.
- MassDEP reviewed and commented on the SOW for the re-baselining study.
- Based on comments received from MassDEP at a meeting on April 24, 2015, and the results of a subsequent site reconnaissance performed on April 30, 2015, the re-baselining sampling program was modified. A sampling program was identified on August 19, 2015, with support from MassDEP.
- The revised SOW was resubmitted to MassDEP on August 24, 2015.
- MassDEP provided conditional approval of the SOW on September 15, 2015 (Note: The conditions provided clarification on a variety of issues associated with the SOW but did not involve adjustments to the sampling program).
- Mobilization to implement the approved re-baselining sampling program began on September 28, 2015.
- This report represents Task 23 of the approved SOW.

The re-baselining sampling program for the Site soil, groundwater and sediment that was approved by MassDEP (included as Appendix 2A) is summarized below by environmental medium.

1.3.1 Soil Sampling and Testing

The following soil sampling and testing were included in the approved re-baselining sampling program:

- Sampling the surficial soil along the banks of the Eastern Channel Corridor (ECC) for mercury where record high surface water flows flooded the adjacent low-lying areas and may have deposited sediment from the impacted portions of the ECC;
- Sampling potential release areas associated with the Former Test Range in the Southern Conservation Commission Area (SCCA):
    - Area in front of the Far-Range Firing Position;
    - Area containing the heavy steel plates located down the hill from the Far-Range Firing Position;
    - Area in front of the Near-Range Firing Position;
    - Test Range Floor in front of the Target Berm;
    - Target Berm; and
    - Overshoot Area above/behind the Target Berm;
- Re-sampling to further delineate the Marsh Upland Area (MUA) surface and subsurface soil for metals, including mercury and lead. The MUA was previously tested for explosives as part of the Phase IIC Site Investigation (see Section 3.3.5.1), and as such was not re-sampled during the re-baselining efforts.
- Sampling to characterize the soil in the areas where the groundwater UCL exceedances were previously observed;
- Re-sampling the soil at locations in the 100-Year Floodplain Area on the western shoreline of Upper and Middle Factory Pond and analyzing for mercury;
- Testing to determine the leachability of contaminants from soil;
- Testing to determine other soil characteristics relative to anticipated disposal requirements and waste acceptance criteria; and
- Collecting the required quality control (QC) samples.

In addition to the approved re-baselining sampling program, the workplan specified that if additional areas of the Site that were historically used for storage, manufacturing, testing or disposal of munitions and explosives of concern (MEC) were identified, further assessment of the current soil conditions at these areas may be necessary. If MEC or munitions debris (MD) was present at locations where soil had not previously been characterized, additional soil sampling and analysis would be recommended for metals and explosives as well as waste characterization/waste acceptance parameters.

1.3.2 Groundwater Sampling

The following groundwater sampling was included in the approved re-baselining sampling program:

- Re-sampling groundwater from the existing monitoring wells and piezometers where the groundwater UCL exceedances were previously observed; and
- Collecting the required QC samples.

1.3.3 Sediment Sampling and Testing

The following sediment sampling and testing were included in the approved re-baselining sampling program:

- Re-sampling representative sediments from the ECC that were previously shown to be impacted by mercury and in selected downstream reaches;
- Re-measuring the thicknesses of the segments in the ECC to allow a re-estimation of the volume of mercury-contaminated sediments still present following the flooding;
- Re-sampling the sediments in Lily Pond, Upper Factory Pond, Middle Factory Pond, and Lower Factory Pond on a regular grid reference system with: (1) a horizontal spatial scale comparable to the average sample polygon size from the prior Supplemental Phase III sampling; and (2) at depth intervals guided by the prior sampling results and the patterns of indicated scouring and deposition from prior bathymetric studies;
- Sampling the sediments in additional marshy areas adjacent to Lily Pond where recent flooding occurred or where an alternate flow channel from the Site's release areas may previously have existed;
- Re-sampling the sediments in the MUA on a regular grid reference system with: (1) a horizontal spatial scale comparable to the average sample polygon size from the prior Phase II sampling; and (2) at depth intervals guided by the prior sampling and results;
- Sampling surficial sediments in depositional areas of the Indian Head River between Factory Pond Dam and a point upstream of the Luddam's Ford Dam and analyzing for mercury;
- Testing to determine the leachability of contaminants from the sediments;
- Testing to determine other sediment characteristics relative to anticipated disposal requirements and waste acceptance criteria;
- Sampling and geotechnical testing of representative sediment samples to determine dewatering water quality factors and amendment stabilization efficiency; and
- Collecting the required QC samples.

1.3.4 Bathymetric Survey

The approved re-baselining sampling program also included obtaining updated bathymetry and bottom elevation contours for the on-Site ponds.

1.3.5 Biota Sampling

During the review of the revised re-baselining SOW, it was understood that comparison of the future, post-remediation largemouth bass (LMB) fish tissue mercury concentrations to the currently available LMB fish tissue data collected at the Site in 2003 may not accurately reflect the positive effect of the mercury source removal because of fish tissue concentration reductions that may have resulted from other (non-remedial) actions and changes that have taken place since 2003. This type of comparison will be conducted at a future point in time closer to, and just before, the implementation of the selected pond and stream sediment remedy.

1.4 Organization of the Final Supplemental Phase II Report

The remainder of this Supplemental Phase II Report is organized as follows:

- Section 2 – Re-Baselining Scope of Work Task Breakdown and Project Team
- Section 3 - Supplemental Phase II Re-Baselining Sampling and Analytical Results
- Section 4 – Sediment and Soil Waste Characterization Results
- Section 5 – Sediment and Soil Geotechnical Parameters
- Section 6 – Sediment Stabilization / Amendment Testing Results
- Section 7 – Sediment Dredge Elutriate Testing Results
- Section 8 – Bathymetric Survey
- Section 9 – Risk Characterization Bridging
- Section 10 – Summary
- Section 11 – LSP Opinion
- Section 12 – References

2.0 RE-BASELINING SOW TASK BREAKDOWN AND PROJECT TEAM

2.1 Pre-Mobilization Tasks

Tasks 3 through 9 of the MassDEP-approved SOW addressed the pre-mobilization work that was required to implement the re-baselining sampling program. The pre-mobilization tasks were:

Task 3	Preparing a Request for Determination of Applicability Filing for the Conservation Commissions in both the Towns of Hanover and Hanson. These filings were made following some initial discussions with the respective Conservation Commissions. Public hearings were held with each Conservation Commission. A notification of abutters was required for the Hanson hearing.
Task 4	Verifying / Obtaining Valid Access Agreements Relative to the Revised Re-Baselining Sampling Program
Task 5	Meeting with State and Local Officials
Task 6	Updating and Tailoring Field Activity Standard Operating Procedures
Task 7	Subcontracting with an Analytical Laboratory, Geotechnical Laboratory, and Sediment Bench-Scale Testing Firm
Task 8	Obtaining the Required Field Equipment and Supplies
Task 9	Updating the Site-Specific Health and Safety Plan

Additional details regarding these tasks relative to the re-baselining sampling program are presented below.

2.1.1 Planning Documents

2.1.1.1 Approved SOW / Sampling Program

Sections 1.2 and 1.3 above provide the background on the development of the SOW for the re-baselining sampling and the approved re-baselining sampling program. The approved re-baselining sampling program is included as Appendix 2A.

2.1.1.2 Standard Operating Procedures

Given the passage of time since the last sampling performed at the Site (i.e., 2008), the standard operating procedures (SOPs) for several of the Site-specific sampling and sample handing procedures needed to be updated. The following SOPs were re-written or updated in September 2015:

SOP 1:	Mobilization / Demobilization and Site Access
SOP 2:	Soil Sampling
SOP 3:	Monitoring Well Redevelopment
SOP 4:	Groundwater Sampling [Low-Flow Purge Procedure]
SOP 5:	Stream Bed Thickness Measurement and Sediment Sample Collection
SOP 6:	Sediment Sampling
SOP 7:	Single Beam Echosounder Bathymetry Survey

SOP 8: Determination of Sample Quantities for Sediment Sample Collection
SOP 9: Investigation-Derived Waste
SOP 10: Decontamination of Sampling Equipment
SOP 11: Sample Documentation, Packing and Shipment
SOP 12: Munitions and Explosives of Concern (MEC) Avoidance Procedures for Sampling, Drilling and Low Risk Construction Support

Copies of these SOPs are kept in the Project File.

2.1.1.3 Health and Safety Plan

Given the passage of time since the last sampling performed at the Site, the Site-Specific Health and Safety Plan (HASP) also needed to be updated. In addition, several new activities needed to be addressed and their potential hazards identified and eliminated or mitigated. The updated and revised Site-Specific HASP was internally approved by the Tetra Tech Environment, Health and Safety Lead, Project Manager, and Environmental and Safety Manager on September 25, 2015.

A copy of the updated and revised Site-Specific HASP is kept in the Project File.

2.1.2 Access Agreements

The approved re-baselining sampling program required obtaining access to 12 parcels in the Town of Hanover and 7 parcels in the Town of Hanson either to collect samples or traverse property to get to the riverbank to collect samples. The original access agreements for the characterization activities to be performed at the Site were established between 1998 and 2000 for the parcels to be sampled early in the project. Existing access agreements for relevant parcels were reviewed for validity relative to the re-baselining work because each had somewhat different conditions and durations (e.g., through Phase IIA or through a specified date). New access agreements were required for most parcels. Property owners with valid access agreements from prior work were notified of the re-baselining work. Access agreements were eventually obtained for most parcels. A couple of parcel owners would not sign an agreement but gave permission to Tetra Tech to perform the re-baselining sampling on their property on a one-time basis. One parcel owner refused to sign an access agreement and refused to give permission to perform any sampling on its property. After discussions with MassDEP, a decision was made to forego further attempts to sample on this parcel at the time pending the results of the other sampling in the area. As sediment sampling from the surrounding parcels both upstream and downstream resulted in similar mercury concentrations, concentrations of mercury in this parcel are expected to be similar. Therefore, the inability to obtain sampling results from this parcel is not thought to have significantly affected the characterization of the sediments along the river bank.

2.1.3 Requests for Determination of Applicability Relative to the Wetlands Protection Act and/or Town Wetlands By-Laws and Regulations

2.1.3.1 Town of Hanover

Tetra Tech submitted a Request for Determination of Applicability (RDA) under the Massachusetts Wetlands Protection Act, M.G.L. c. 131 §40, and Hanover Wetlands Protection By-Law #6-14 to the Conservation Commission for the Town of Hanover on September 2, 2015 relative to the re-baselining sampling proposed within its jurisdiction. The Town did not require the project abutters to be notified of the hearing but required an advertisement for the public hearing to be published in the Hanover Mariner. This advertisement was published on September 9, 2015. The public hearing was held on September 16, 2015 at the Hanover Town Hall and the proposed re-baselining sampling was presented and discussed. A Negative Determination of Applicability was issued by the Hanover Conservation Commission on September 18, 2015.

2.1.3.2 Town of Hanson

Tetra Tech submitted a RDA under the Massachusetts Wetlands Protection Act to the Conservation Commission for the Town of Hanson on September 28, 2015 relative to the re-baselining sampling proposed within its jurisdiction. The Conservation Commission required abutters within 100 feet of the sampling activity to be notified of the public hearing. An advertisement for the hearing was published in the Hanson Express on October 1, 2015. The public hearing was held on October 13, 2015 at the Hanson Town Hall, and the proposed re-baselining sampling to occur within Hanson was presented and discussed. Some additional information relating to the proposed sampling and analytical methods to be employed was requested by the Conservation Commission. This information was supplied by Tetra Tech on October 19, 2015. A Negative Determination of Applicability was issued by the Hanson Conservation Commission on October 27, 2015.

2.1.4 Meetings with Towns

A meeting was held with the Hanover Town Manager and select other Town officials at the Hanover Town Hall on October 7, 2015. Representatives of the Massachusetts Office of the Attorney General and the Southeast Regional Office of MassDEP also participated. Tetra Tech presented a summary and rationale for the overall re-baselining sampling program to be performed and answered questions from the parties in attendance.

2.2 Implementation of the Re-Baselining Sampling Tasks

2.2.1 Tetra Tech Self-Performed Field Tasks

Tetra Tech self-performed most of the re-baselining sampling field tasks, including the bathymetric survey of the ponds, the soil sampling, the groundwater sampling, and the sediment coring and sampling. The Tetra Tech operation in Collinsville, IL performed the bench-scale sediment dredge elutriate testing (DRET).

2.2.2 Subcontracted Field Support

The following field support services were provided by local or regional subcontractors (listed in roughly the order of their contribution to the re-baselining sampling field effort):

- Surveying; Halnon Land Surveying, Inc., Norton, MA
- Mobilization / Site Preparation: Global Remediation Services, Inc., East Taunton, MA
- Temporary Field Office: The Eagle Leasing Company, Southborough, MA
- On-Site Sanitary Facilities: Bouse House Enterprises, Inc., Forestdale, MA
- Analytical Laboratory and Sample Courier Service: TestAmerica Laboratories, Inc., South Burlington, VT and PDC Laboratories, Inc., Florissant, MO
- Sediment Stabilization / Amendment Bench-Scale Testing: WaterSolve, LLC, Caledonia, MI
- Non-Hazardous Waste Transporter: Clean Venture, Inc., Framingham, MA
- Non-Hazardous Waste Disposal: Tradebe Treatment and Recycling, LLC, Newington, NH
- Demobilization: Global Remediation Services, Inc., East Taunton, MA

2.2.3 Field Supplies and Services

Necessary health and safety / field sampling supplies and services were obtained from local vendors in Hanover, suppliers in nearby towns, and firms with which Tetra Tech holds national accounts.

2.3 Field Task Implementation Schedule

The approved re-baselining sampling program was implemented according to the schedule shown in Table 2-1. The actual implementation schedule very closely matched the proposed schedule that was approved as Attachment D to the Re-Baselining SOW which had mobilization beginning on 9/28/15 and demobilization ending on 10/29/15.

2.4 Change Management

Two Change Orders were submitted to MassDEP relative to the implementation of the approved re-baselining sampling program:

Change Order #1 addressed the following changes of aspects of the approved work:

- Changes to laboratory analytical rates;
- Adjustments to the bench-scale DRET and amendment testing;
- Additions to the labor categories;
- Updates to the labor rates;
- Reconciliation of labor quantities by task; and
- Reconciliation of travel costs.

Change Order #1 was submitted to MassDEP on December 9, 2015 and was approved by MassDEP on December 18, 2015.

Change Order #2 addressed several changes associated with the reimbursables for individual tasks of the approved work:

- Leasing of the field office;
- Site preparation subcontractor costs;
- Travel and living duration adjustments;
- Adjustments to the type and quantity of field supplies needed;
- Adjustments to the type and quantity of field equipment needed; and
- Adjustments for waste disposal.

Change Order #2 was submitted to MassDEP on May 3, 2016 and was approved on May 26, 2016.

3.0 SUPPLEMENTAL PHASE II RE-BASELINING SAMPLING AND ANALYTICAL RESULTS

3.1 Environmental Sampling Data Generation and Reporting

3.1.1 Chain of Custody Forms

The majority of the soil, sediment and groundwater samples that were collected were packaged for shipment to TestAmerica in South Burlington, VT for analysis. This transport was provided by a courier arranged by TestAmerica that picked up the samples at the Site, typically twice per week. A total of nine pick-ups were made between 10/9/2015 and 10/29/2015.

The sediment collected for the DRET testing was shipped via FedEx to PDC Laboratories, Inc. in Florissant, MO on 10/29/2015. This chain of custody (COC) form was labeled "PDC Laboratories COC Scan 10292015 Elutriates". The sediment collected for the amendment testing was shipped via Fed Ex to WaterSolve, LLC in Caledonia, MI on 10/30/2015. This COC form was labeled "WaterSolve COC Scan 10302015".

The COC forms are included as Appendix 3A.

3.1.2 Reported Analytical Results

Data from the analytical laboratory, TestAmerica, was reported in reference to a series of analytical Sample Delivery Groups (SDGs). Table 3-1 identifies the full set of SDGs and sample numbers associated with the environmental sampling data, the waste characterization data and the geotechnical data. The sampling data was transmitted electronically to Tetra Tech via corresponding Electronic Data Deliverables (EDDs). In association with each EDD, the laboratory also provided two reports in electronic format. One was a full length (L4-Level 4) report with the results and all corresponding calibration data. The other was a more abbreviated report (L2-Level 2) that mimics the L4-Level 4 report but without the calibration data.

The analytical results from the EDDs were downloaded and formatted into a series of Excel tables to facilitate further analyses. Sampling data was placed into each of the tables based on the environmental medium sampled (i.e., soil, sediment or groundwater) and the suite of analytes reported for the samples (e.g., mercury only, metals and explosives, other specified analyte lists). Appendix 3B contains these data tables, which break down as shown in Table 3-2.

These data tables present the following information as applicable to the sampled medium / analyte(s) combination associated with each table:

- Sample ID;
- Sample Collection Date;
- Sample Depth (if appropriate);
- Matrix;
- Sample Type;
- Sample Basis (if appropriate);
- Percent Solids (if appropriate);

- Analytical Method;
- Analytical Result;
- Units; and
- Laboratory Qualifiers; and Reporting Limits.

3.1.3 Other Supporting Field Documentation

A Field Log Book was kept to record several key field parameters and observations during the re-baselining sampling activities. In addition, numerous photographs were taken of various phases of the sampling. Copies of the field notes and these photographs are kept in the Project File. Photographs were taken of each pond sediment core that was collected. The photographs of the cores associated with the sediment samples that were characterized for their geotechnical parameters are further discussed in Section 5.

3.2 Laboratory Analysis Review

This section briefly discusses the principal analytical and technical considerations that arose during the laboratory analysis support for the re-baselining sampling program. This discussion focuses on broad-spectrum issues that developed during the implementation of the field program, any potentially associated quality assurance/quality control (QA/QC) concerns, and any adjustments that were implemented to address the issues.

3.2.1 Data Quality and Validation

Off-site laboratory analyses were performed by TestAmerica, Inc. of Burlington, VT with support from the TestAmerica Buffalo, NY and Canton, OH laboratories. Supplemental laboratory support was provided to the Burlington laboratory due to the large number of sediment and soil samples that required analysis over a relatively short time frame and the complexity of the overall laboratory analysis program for mercury. Laboratory analyses were performed in accordance with MassDEP Compendium of Analytical Method (CAM) protocols for all analyses for which CAM protocols have been established. MassDEP Analytical Protocol Certification Forms were prepared by the TestAmerica Project Manager and were provided to Tetra Tech along with each analytical SDG as appropriate. The full set of these CAM Certifications is included as Appendix 3C. It should be noted that for certain Site analyses (including geotechnical analyses and certain analyses to support waste disposal) CAM protocols are not available. For these analyses standard analytical methods were utilized and all methods are identified in the associated TestAmerica Final Data Reports.

The data set is intended to support upcoming evaluations of Site sediment and soil remediation alternatives, as appropriate, and associated remedial program design. Therefore, formal data validation was not necessary or performed. Data validation would be conducted prior to any potential data use in support of future Site risk characterizations.

3.2.2 Technical Considerations

3.2.2.1 Sediment Moisture Content

Analyses of the initial sediment samples collected from the Site indicated that the sediment grab samples varied widely in their percent (%) solids and corresponding moisture content levels. This was found to be particularly true for the lacustrine pond sediments. A subset of the sediment samples collected from quiescent Factory Pond locations were determined to have low percent solids levels (<20%) and, correspondingly, high moisture contents (>80%). This is likely due to the sediment compositions of these samples being high in fine organic silts and/or clays. USEPA (including USEPA Region I) has expressed concerns generally regarding the data quality associated with the analyses of sediment samples containing high moisture contents and low percent solids contents. USEPA Region I guidance (USEPA, 2013) recommends automatically qualifying the analytical results from sediment samples containing <30% solids as “estimated” and rejecting (as unusable) sediment data from samples containing <10% solids. The concern is that for samples containing <10% solids, appropriate dry weight quantitation limits may not be achieved, resulting in a significant level of uncertainty in analytical concentration results particularly at low concentrations of the target analyte.

Decanting or drying the high moisture content sediment samples prior to extraction to increase their solids content such that they should not be automatically qualified as “estimated” or determined to be unusable was one option that was considered for the Site samples with low percent solids. It was understood at the outset that sediment drying prior to extraction is not typically performed (as it was not done as part of the last sediment sampling performed at the Site in 2008). Low percent solids sediment samples are typically extracted and analyzed “as received” and then the wet-basis concentrations are adjusted to a dry weight basis using the sample’s moisture content. Lowering the percent moisture prior to extraction potentially improve the quality of the data generated, but it also can lead to some loss of volatiles during the process. Since mercury is partially volatile in some forms, the decision of whether to dry or not dry the low percent solids sediment samples prior to analysis involved a trade-off relative to competing data quality considerations. This data quality trade-off was discussed with the project laboratory (TestAmerica) and other laboratories and chemists with experience in mercury analyses. Two technical solutions to the low sediment percent solids issue were considered.

The first solution considered was to alter field sampling procedures to allow freshly collected sediment samples to sit in the field upon collection for up to 24 hours. This would potentially allow suspended material to settle and the overlying water decanted prior to the sample being shipped to the laboratory. This approach was rejected as being inappropriate for the project for several reasons. Because of small silt/clay particle sizes, the suspended materials in these samples were not anticipated to settle out of solution quickly enough (i.e., within a few hours). Conversely, allowing samples to settle for 24 hours or more would adversely impact time-critical project field schedules and complicate the process of keeping samples at proper (cold) temperatures prior to shipment. In addition, the potential loss of some suspended sediment during liquid decanting (following the sediment settling) was considered technically unacceptable. It is probable that the higher sediment mercury concentrations are associated with smaller organic silt/clay sediment particle sizes due to significantly increased particle surface areas. Therefore, decanting could result in loss of the sediment fraction potentially containing the highest mercury concentrations and lead to an underestimation of overall sediment mercury concentrations for the dewatered sample. This loss could be particularly significant with respect to samples with the lower mercury concentrations.

Following discussions with the project's analytical laboratory, a second technical solution was devised and adopted. This solution was to collect and submit all sediment samples to the laboratory after applying the project-specific field sample collection SOP. Upon receipt at the laboratory, all sediment samples were immediately analyzed for percent solids. Sediment samples with <20% solids were then air-dried at the laboratory prior to extraction and analysis. Short duration room temperature air-drying at the laboratory was the technique selected for the Site's low percent solids sediment samples since it was unlikely to result in significant volatilization of the mercury present in the wet sediment. The air-drying process typically required three to seven days. This non-aggressive process reduced the sediment moisture content while minimizing the risk of a significant loss of mercury. Following air-drying, samples were analyzed in accordance with the standard laboratory analysis and MassDEP CAM protocols.

Project and Laboratory Considerations

The selection of air-drying (over other laboratory drying methods) as the moisture-reduction technique for the Site's low percent solids sediment samples was influenced by several project and laboratory considerations. First, the MassDEP CAM does not mandate a specific moisture reduction technique for sediments. Further, as indicated above, the need to perform moisture reduction on batches of multiple sediment samples concurrently was only recognized after the start of the sampling program. Given the large number of samples being generated and the aggressive sampling schedule, the performance of a detailed comparative laboratory evaluation of alternative sediment drying techniques (e.g., air-drying, freeze-drying and oven heating) at that point in time was not feasible.

From a laboratory standpoint, freeze-drying was not a practical option for the Site re-baselining sediment samples. Freeze-drying requires relatively specialized equipment. TestAmerica-Burlington (although a relatively large laboratory considering its many coordinated facilities) did not have the necessary equipment available within its collective locations. Calls to other commercial laboratories confirmed that drying sediment samples prior to extraction was not a common practice and that no commercial labs had experience in the freeze-drying of sediment samples to be analyzed for mercury (or for any other potentially volatile constituent) in large numbers. It was cautioned that there are a variety of different freeze-drying procedures and that they also can result in some loss of volatiles due to the drawing of air across or through the samples during the vacuum-creating step.

In the literature, researchers also suggest that if freeze-drying is to be used, it should be initiated immediately upon sample arrival at the laboratory. It would not have been feasible to process the large number of sediment samples undergoing mercury analysis from the Site (up to 300) in the short amount of time in which they were generated without many freeze-drying units being readily accessible. Sample analysis schedules and holding times would likely have been adversely impacted. Also, freeze-drying is a significantly more laboratory labor and equipment intensive process that would have substantially increased laboratory processing costs, even if a laboratory with the requisite equipment and procedures could have been identified.

Room temperature air-drying was selected over oven-heating the samples (see more discussion below) as the former was simpler and more practical to implement and involved a potentially less aggressive sample preparation approach. From a data usability standpoint, it also was judged to be important to minimize sample preparation differences between the dried and non-dried sediment samples to the greatest extent possible to facilitate subsequent data comparison even if some form of sample moisture reduction was required.

Air-Drying and Mercury Volatilization

As indicated above, several laboratory-drying procedures can be used for sediment and soil sample moisture reduction prior to extraction and analysis. The principal approaches include air-drying, oven-heating at elevated temperature, and freeze-drying. Each of these methods has been used by various researchers during sample preparation for mercury analysis (but not at commercial laboratories). Several researchers including Cragin and Foley (USACE, 1985) and Ettler et. al. (2007) have used air-drying in the analysis of mercury in sediments and/or soils.

Cragin and Foley (USACE 1985) at the U.S. Army Corps of Engineers (USACE) Cold Regions Research and Engineering Laboratory (CRREL) facility conducted a comparative evaluation of the potential impacts of air-drying, oven-heating and freeze-drying on mercury volatilization losses during sediment and soil sample preparation. In this study, air-drying, freeze-drying and three different oven-drying approaches were considered. The authors concluded that for the two river and pond sediments studied (i.e., the sampled media most similar to the sediments at the Site), air-drying and low-level heating (<60°C) demonstrated the lowest apparent mercury losses during sample preparation for the tested materials. The results indicated somewhat higher mercury volatilization losses for freeze-drying, which was hypothesized as possibly being due to the vacuum applied to the samples during the drying process. Oven-drying at the relatively higher temperatures was observed to result in more significant mercury losses. The authors also reported that mercury volatilization losses may vary depending upon the sediment composition and the sediment mercury concentration.

Hojdova, *et al*. (2015) compared three candidate sample drying techniques with respect to possible mercury volatilization loss for two different soil types (i.e., soil from the Lysina catchment in a pine forest in Czechoslovakia [which was affected in the twentieth century by high acid deposition loads] and soil from the Jedova´ Hora catchment in Czechoslovakia [which has been impacted by historical mercury sulfide (cinnabarite) mining]). No lacustrine or riverine sediment samples were included in the Hojdova study and the form of the mercury indicated to be present in the tested materials appears to be quite different than what is understood to be present at the Fireworks Site. The authors reported somewhat increased loss of mercury during air-drying (over a seven-day drying period) versus freeze-drying, particularly from certain mercury sulfide rich soils from a cinnabarite mining area. The magnitude of the oven-drying mercury losses was in between those of the air-drying and freeze-drying processes. Differences in mercury loss between air-dried and freeze-dried samples for non-mining area soils with lower native soil mercury concentrations appeared to be substantively less than for the mining area samples. It was hypothesized by the authors that microbial activity may have resulted in the transformation of native mercury species in the soil into a more volatile species (possibly elemental mercury) resulting in some volatilization. Freeze-drying was hypothesized by the authors as inhibiting microbial transformations of mercury resulting in reduced mercury losses. Their results suggested that mercury speciation, soil organic matter, microbial activity and soil mercury concentrations all might influence mercury volatilization losses during sample preparation. Since the form of mercury present (and its degree of volatility) would impact the relative magnitude of the loss for given moisture reduction conditions, translating the findings of the Hojdova study or any other study to the Fireworks Site sediments is not straightforward. It should also be noted that the air-drying times used for the Site samples (i.e., 3-7 days) were generally less than those used in the Hojdova, et al. study.

Overall, the available literature is not in complete agreement on the comparative magnitude of mercury volatilization losses resulting from various soil and sediment drying techniques. The literature suggests that some volatilization of mercury might occur during sample drying. However, the extent of any mercury loss appears likely to be strongly dependent on multiple factors, including drying time, sediment (or soil) composition, sediment organic content, microbial activity, mercury speciation and concentration, and drying temperature. Because of the potential for mercury loss from air-drying sediment samples with a high moisture content, the potential impacts of air-drying are discussed in more detail below to assess the magnitude of the uncertainty associated with the subset of air-dried sample results as well as the potential implications of using this data in sediment remediation planning and any future sediment sampling that may be performed at the Site.

As noted above, the geochemical speciation of mercury in the sediments at the Site is likely to be different from the soils analyzed in the Hojdova study referenced above. Although detailed information on current sediment mercury speciation at the Site is not available, historical information suggests that mercury was most likely deposited as mercury fulminate. Historical review of information and documents concerning the Fireworks Site by the Department of Defense (DEFP 1992) indicated that the ordnance manufactured at the Site included various types of detonators, fuses, primers, flares and igniters as well as some heavier ordnance. During most of the time frame of operation of the Fireworks Facility, mercury (as mercury fulminate) was used in fuses and/or other igniters and disposed of in various demolition pits at the Site. As such, it appears that this mercury species may have been the predominant form of mercury originally present at the Site. Mercury fulminate is a high boiling (boiling point: 673.9 °F) mercury species. It is a crystalline solid at ambient temperatures. Given its limited water solubility, mercury fulminate may have been deposited into Site soils and waters as relatively pure phase particulates. In contrast, mercury speciation in soils from historic mercury mining areas tend to be significantly different. Results of studies conducted by Hojdova, et al. (2008)

indicated that approximately 50%-80% of the total mercury in some soils in areas proximate to certain mercury mining operations was present as mercury sulfide. A significant fraction of the remaining mercury was reported as being present as mercury adsorbed onto mineral surfaces, iron oxy-hydroxides and clay surfaces. The authors of the Hojdova study suggested that mercury weakly adsorbed to mineral surfaces and oxy-hydroxides might be more mobile than particulate phase mercury species. Mercury speciation was not evaluated for the multiple soils and sediments examined in the USACE study (Cragin and Foley 1985). However, background information indicates that the soils were relatively uncontaminated samples from rural New Hampshire while the sediments originated from the Kewaunee River and Lake Michigan and a man-made settling pond at an Army ammunition plant in Louisiana.

Impact of Air-Drying

Understanding the degree to which some amount of in situ mercury may have been lost during sample drying performed prior to sample extraction and laboratory analysis for the noted subset of low percent solids sediment samples was important to being able to apply the sampling results in a defensible manner to judge where sediment should be removed to achieve a specified sediment mercury remediation goal or to estimate the required volume of sediment that must be removed for the revised Phase III analysis. As such, an initial check was made early in the sampling effort to gain a better understanding of the potential impacts of air-drying on the reported sediment mercury concentrations. Specifically, six of the initially collected sediment samples with relatively low percent solids levels (<25%) were analyzed for mercury both as-received and following air-drying. The objective of this initial check was to get a better understanding of whether and/or how much the air-drying process may adversely impact the mercury sample results. The results of this evaluation are summarized in Table 3-3.

As shown in Table 3-3, the reported mercury concentrations for the air-dried samples were similar to or greater than the as-received sediment mercury analyses for most of the sediment sample pairs. This finding is opposite to what might be expected assuming mercury volatilization losses during air-drying. It should be noted, however, that the analytical results presented in this table for both approaches were reported on a dry weight basis reflecting a weight correction calculation performed after the analysis by the laboratory. The relatively high moisture content of the as-received samples may have resulted in the weight correction for these samples having uncertainty as great or greater than the mercury concentration differences that may have existed between the paired as-received and air-dried samples. Although the results of this initial check suggested that air-drying the low percent solids sediment samples may potentially result in slightly greater mercury concentrations for the Site than analyzing the same samples as-received (expressed on a dry weight basis), the check was limited in size (i.e., six samples) and, therefore, would not support generally robust conclusions.

Implications for Sediment Remediation

The Fireworks Site sediment data set from the re-baselining sampling event was reviewed to evaluate whether the possibility of some mercury volatilization during sample air-drying could potentially impact future sediment mercury remediation (removal) decisions for the Site. Of the

308 sediment samples that were collected during the re-baselining sampling event, only 101 required air-drying (i.e., approximately one third). An assessment of the quantitative results for these 101 samples was performed to identify the implications that air-drying could potentially have on sediment remediation decisions at the specific locations where samples were air-dried. Of primary concern were instances where the air-dried sediment samples had mercury concentrations below or near the proposed mercury sediment preliminary remediation goal (PRG) of 4 mg/Kg (see Appendix 3D). Limited volatilization losses due to the air-drying of sediment samples containing mercury at concentrations well above the 4 mg/Kg proposed PRG would not be expected to have a significant impact on remediation planning or design. Conversely, if sediment samples containing reported mercury concentrations in the range of 2-4 mg/Kg had experienced mercury volatilization losses of 15-25% (as reported by Hojdova, et al.), the analytical results could conceivably impact remediation decisions if the uncertainty is not accounted for.

A review of the re-baselining sediment data indicated that only 14 of the 101 air-dried sediment samples had mercury concentrations less than the proposed PRG of 4 mg/Kg. Detailed location-specific and sample-specific evaluations indicated that limited mercury losses from a large majority of these air-dried samples would not impact remediation decisions because of the presence of spatially-adjacent “as-received” sediment samples with associated mercury data. Furthermore, only five of the 14 air-dried sediment samples with concentrations less than 4 mg/Kg, had mercury concentrations in the 2-4 mg/Kg range. These five samples were collected from one location in Lily/Upper Factory Pond and from three locations in Middle/Lower Factory Pond (i.e., two of the concentrations detected in the more critical 2-4 mg/Kg range in Middle/Lower Factory Pond were collected from the same sampling location at different depths). As such, there were very few sampled locations where the uncertainty related to potential mercury loss during sample drying could be important to decision-making.

Having identified these locations, the potential for some mercury to have been lost to volatilization from these samples during drying will be conservatively factored into future remediation design during the Phase III analysis. Since not drying these low percent solid sediment samples prior to extraction also would have caused the analytical results to be validated as “estimated” at best, consideration of the strength of a data set and its uncertainties must always be a part of deciding how to use collected data. Although there remain localized uncertainties because of the air-drying of sediments, mercury volatilization losses from the air-dried re-baselining sediment samples are not anticipated to have any substantive impact on the overall design or long-term effectiveness of the sediment remediation at the Fireworks Site given the current understanding of which sampling locations and results were most susceptible to losses. Appendix 3E presents further discussion on which samples and sampling locations may have reported mercury concentration results with the greatest potential uncertainty relative to future remediation design and how this uncertainty will be addressed during the use of this data in the Phase III.

3.2.2.2 Delayed Analysis Samples

In conjunction with the approved re-baselining sampling and analysis approach, a considerable number of sediment samples collected in the field for mercury analysis were initially placed on hold at the laboratory. In most cases, these sediment samples were placed on hold pending the results from the analyses of overlying surficial sediment samples. If the mercury result for an overlying sediment sample was greater than a mercury concentration decision trigger of 4 mg/Kg (i.e., the proposed PRG developed in Appendix 3D), then the underlying (on-hold) sample was analyzed to further assess the depth of contamination. If the surficial sediment mercury result was less than this trigger concentration, the next deeper sediment sample that was on hold was not analyzed.

During the initial (pre-field program) development of the sampling and analysis approach, it was anticipated that 25% of the samples originally placed on-hold would require analysis. However, as the field program progressed, it became necessary to analyze substantially more than 25% of the on-hold samples. The primary reason for this was that the number of surficial sediment samples with mercury concentrations greater than the mercury concentration decision trigger of 4 mg/Kg was higher than anticipated. In addition, the number of sediment samples at depth (12 inches or greater) with mercury concentrations greater than this trigger concentration also was somewhat higher than anticipated. Consequently, it was necessary to analyze a greater number of on-hold samples to determine the contamination distribution with respect to horizontal extent and depth in the ponds and streams.

A secondary reason for the greater than anticipated analysis of on-hold samples related to the laboratory analytical challenges. At the height of the field sampling program, the very large number of sediment samples being submitted for laboratory analyses somewhat strained the laboratory capacity. Even with two supporting internal laboratories, TestAmerica Burlington, VT was at times challenged to analyze mercury sediment samples and report preliminary results to support on-hold sample evaluation. Achieving the 28-day holding time for mercury also was significantly complicated by the need to air-dry many incoming sediment samples because of their low percent solids contents. As noted above, the air-drying process typically required several days.

In certain cases, a decision as to whether to analyze on-hold sediment samples for mercury had to be made to ensure that the sample's 28-day holding time would not be exceeded before preliminary mercury results for overlying sediment samples were available. These instances were reviewed on a case-by-case basis by Tetra Tech's project staff in real time. In those instances where it was determined that detailed knowledge of sediment mercury depth profiles would be important to the development of remediation approaches or designs, the on-hold samples were released for mercury analyses. Tetra Tech felt it was important to minimize the possibility of any significant remaining data gaps for mercury and the possible need to re-sample in these areas.

3.2.2.3 Multiple Increment Sample Preparation

As indicated in the approved re-baselining sampling and analysis approach and related SOPs, several multiple increment soil samples were collected primarily for the analysis of Target Analyte List (TAL) metals and explosives. TestAmerica applied its standard protocol for the preparation of multiple increment samples. This protocol is consistent with the overall sample preparation protocols recommended in EPA Method 8330B. This protocol differs somewhat from the preparation of grab samples. Specifically, upon arrival at the laboratory, multiple increment samples were air-dried and sieved through a #10 sieve (2 mm). The material retained on the sieve was reported as a percentage of the dry sample that was put through the sieve. The samples were then ground in a puck mill. After grinding, sub-samples were created from the original sample. Samples were subsequently analyzed in accordance with standard procedures and CAM protocols.

As noted above, sample grinding procedures were consistent with those recommended in EPA Method 8330B. A cool-down period following 90 seconds of grinding was incorporated into the grinding procedure to minimize sample heating and possible mercury volatilization losses. Also, as part of QA/QC, Ottawa sand grinding blanks were also ground in the puck mill and analyzed to monitor the effects of the grinding process on the analytical results. Finally, it should be noted that mercury at the Site is thought to have been deposited as mercury fulminate. This form of mercury has a relatively high boiling point of 674 °F which is higher than some of the organic explosives (such as cyclotrimethylenetrinitramine (RDX)) that are routinely prepared and analyzed using the grinding procedures recommended by EPA Method 8330B.

3.2.2.4 Possible False Positives for Explosives

The re-baselining sampling results indicate the presence of varying concentrations of one or more explosives in soils in some areas on-site. It should be recognized that some of these detections may be real and some low-level detections reported by the laboratory may be false positives. Low-level false positive detections of explosives are not uncommon for samples analyzed by EPA Method 8330B, especially when there is organic material in the soils. Separating and identifying false positives for explosives in EPA Method 8330B data can require considerable efforts for data evaluation and validation and/or re-analysis of the samples using EPA Method SW-846 8321A. EPA Method SW-846 8321A is a more intricate and expensive analytical method that is indicated to be more effective in avoiding false positives under these conditions. However, even using EPA Method 8330B (which is the industry standard) explosives residues were not found at concentrations high enough or over appreciable spatial extents that would suggest any remedial response based only on the explosives results.

3.2.3 Other QA-Related Considerations

This section briefly summarizes certain QA items noted during overall data review. However, as noted above, a formal data validation was not performed on this data set.

3.2.3.1 Matrix Spike Results

Results for certain sediment mercury matrix spikes were noted to be outside of standard compliance ranges. A few spike recoveries were noted to be above compliance ranges and others below compliance ranges. Matrix spikes provide a laboratory QC check on the effectiveness of the sample extraction process prior to analysis. The non-compliant results appear to reflect the nature of the sediment matrix at various sampling locations at the Site. During data validation, validators typically exercise professional judgment in interpreting and applying matrix spike data qualifiers to the results for associated samples. Validation guidance notes that low spike recoveries can suggest that associated non-detect data might underestimate actual concentrations and should be viewed with caution. However, the Site mercury data set contains only a small number of non-detect mercury results and only a small subset of these samples was associated with low spike sample recoveries. Overall, the matrix spike results are not considered to be a substantial concern with respect to Site data use.

3.2.3.2 Holding Times

TestAmerica closely monitored laboratory holding times and almost all samples from the Site were analyzed within their respective holding times. However, due to the large number of mercury sediment samples being concurrently analyzed, the placement of some mercury sediment samples on-hold prior to analysis, and the implementation of air-drying requirements, a few sediment samples (six) were not analyzed for mercury and/or metals within the specified holding times. For five of these samples, the 28-day holding time was exceeded by only 1-2 days. During data validation, validators typically exercise some professional judgment in evaluating the holding time exceedances. Given the relatively small hold time exceedances and the relative stability of inorganic mercury, results for these samples could be considered estimated but are acceptable to support project data evaluation efforts and project objectives.

3.2.4 Summary

The overall analytical data set developed in conjunction with the sampling program is acceptable to support the current project objectives. Individual MassDEP CAM Certification Forms have been prepared for each individual sample delivery group. The preponderance of the data meets MassDEP general criteria for Presumptive Certainty. As discussed above, only a few analytical issues were noted for certain samples during general review of the data set. However, the noted QA/QC items should not affect overall data usability.

3.3 Soil Sampling Results

Soil sampling results are presented in Tables 3-4 through 3-10. These tables also provide the applicable soil screening values for comparison to the analytical results. The selection of appropriate screening values is discussed below followed by a discussion of the objectives, sampling approach and sample results by sampled area and environmental medium.

3.3.1 Soil Screening Values

For metals and explosives, the MCP S-1, GW-3 standards were used as the soil screening values, if available. The MCP S-1 standards were used because they are based on a residential exposure scenario. The MCP S-1, GW-3 standards were selected because groundwater is not currently being used as drinking water and is not anticipated to be used as drinking water in the foreseeable future since the Site does not have GW-1 classification.

For the explosives compounds, MCP S-1, GW-3 standards are only available for five of the explosives analyzed for in the re-baselining samples (i.e., perchlorate, 1,3-dinitrobenzene, 2,4-dinitrotoluene, HMX, and RDX). As such, the sampling results for the explosives with no published MCP S-1, GW-3 standards were compared to USEPA RSLs for resident exposure to soil. The residential RSL soil screening values presented on Tables 3-5 and 3-7 correspond to an elevated lifetime cancer risk (ELCR) of $1x10^{-6}$ or a non-carcinogenic hazard quotient (HQ) of 0.2 to be consistent with the MCP S-1 standards that also are based on an HQ of 0.2. The RSL screening values based on an HQ of 0.2 were calculated by multiplying the published RSLs associated with non-cancer endpoints corresponding to an HQ of 0.1 by two. These non-cancer-based values were then compared to the published RSLs corresponding to an ELCR of $1x10^{-6}$. The lower of these two values was selected as the appropriate screening value for these explosives. It should be noted that there were no published MCP or USEPA RSL risk-based soil screening values for 2,4-diamino-6-nitrotoluene or 2,6-diamino-4-nitrotoluene. Therefore, the USEPA RSL screening value for 2-Amino-4,6-dinitrotoluene was used as a surrogate based on similarity of chemical structures (Pascoe et al. 2010).

3.3.2 Northern Area / Eastern Channel Corridor (ECC) Overbank Soil

3.3.2.1 Objectives

The surficial soil along the banks of the ECC where record high surface water flows in the ECC channel had over-spilled its banks and flooded the adjacent low-lying areas was sampled for mercury. The areas that were sampled were the lowest elevation areas adjacent to and downstream of the channel where high mercury concentrations have been previously measured in the ECC. A somewhat broad low-lying area borders the ECC on both sides of the channel, and then the ground rises significantly some distance laterally from the channel (creating a low-lying basin). A sampling grid was established within this topographically-defined low-lying basin since flooding may have deposited contaminated sediment on the ground surface in these areas.

3.3.2.2 Sampling Approach

Sampling procedures were identical for both sides of the ECC channel in the Upper, Middle, and Lower Bank Overflow Areas. There were 10 sample locations in the Upper Bank Overflow Area, 28 in the Middle Bank Overflow Area, and 13 in the Lower Bank Overflow Area. Two samples were collected at each sampling location from depths of 0-3" and 3-6" below ground surface (bgs). These samples were collected on October 14-16 and 19-21, 2015 and the locations are shown on Figure 3-1. A Trimble hand-held computer was preloaded with the Global Positioning

System (GPS) coordinates of the target sampling locations and was used to navigate to the appropriate locations. Surficial samples were collected using a plastic scoop, and deeper soil was exposed using a metal shovel. Nitrile gloves were worn and changed to prevent cross-contamination between samples. Samples were collected in Ziploc bags and transported to the staging area, where they were transferred to glass jars and packaged for pickup by TestAmerica. The non-disposable sampling equipment was decontaminated using a plastic brush and deionized water.

3.3.2.3 Results

In accordance with the approved re-baselining sampling program, each soil sample collected in the ECC was analyzed only for mercury. The results are presented in Table 3-4 and are depicted on Figure 3-1. Concentrations of mercury in the ECC overbank soil samples indicated that the stream had overflowed its banks and deposited contaminated material in the northeast corner of the ECC (i.e., soil sampling locations 58, 52, 50 and vicinity), the eastern near bank (i.e., soil sampling locations 48, 44, 40, 34, 32, 29, and vicinity), and the interior lowlands of the serpentine turn (i.e., soil sampling locations 25, 23, 22, 21, 20, 19, 18, 17 and vicinity). These results indicate that more soil will likely need to be removed from this area than was previously estimated.

3.3.3 Former Test Range Soil

The sections below present the descriptions and results of the soil sampling performed at the Former Test Range. The order of presentation of the soil sampling approach and results in each sub-area is from the Far-Range Firing Position (farthest west) to the Overshoot Area above and behind the Target Berm (farthest east).

3.3.3.1 Objectives

Several sub-areas associated with the Former Test Range had not been sufficiently characterized and delineated in prior sampling events. More recent reconnaissance led to a better identification of the different sub-areas associated with the Former Test Range, their purpose, and the potential that munitions-related contamination could have been released in them. These sub-areas were:

- Area in front of the Far-Range Firing Position;
- Area containing the heavy steel plates located down range from the Far-Range Firing Position nearer Factory Pond;
- Area in front of the Near-Range Firing Position;
- Test Range Floor in front of the Target Berm;
- Target Berm; and
- Overshoot Area above/behind the Target Berm.

There was still some uncertainty regarding what the heavy steel plates were used for relative to the operation of the Former Test Range. Documentation for this test range identified the presence of a small structure that looked like it was constructed of these plates at this relative location along the direction of fire of the range. The presence of holes and indentations of the approximate size of a 20mm round indicated that the plates had been impacted by 20mm projectiles. However, the area did not have the appearance of a target and was in an area that would be wet or soggy most of the year. Given the size and weight of the plates, it does not appear likely that they could have been used elsewhere and moved to this location. Another objective of the re-baselining sampling was to make more observations relative to the Heavy Steel Plate Area.

One objective of the re-baselining sampling was to determine if contamination had been released and is present in the sub-areas associated with the Former Test Range and, if so, to delineate its extent. Replicate multiple increment soil samples collected in the Former Test Range were analyzed for metals and explosives. The sampling approach for each sub-area is presented in Section 3.3.3.2 below. Complete results are presented in Table 3-5. The maximum detected concentrations of lead and mercury and a listing of detected explosives are tabulated in Table 3-6 and presented schematically in Figure 3-2 (for the Firing Positions and Heavy Steel Plate Area) and Figure 3-3 (for the Test Range Berm).

3.3.3.2 Sampling Approach

Far-Range Firing Position

The Far-Range Firing Position soil was sampled on October 12, 2015. Replicate multiple increment samples were collected using a small disposable plastic scoop and Ziploc bags as per the SOP. A 20’x30’ decision unit was laid out in front of the far-range firing position in the down range direction toward the Former Test Range Target Berm. An unexploded ordnance (UXO) technician initially swept the surface of the decision unit with an all-metals detector to avoid contacting items on the ground or in the near surface soil that could be potentially explosive. No munitions or munitions debris was found in the sampled areas during the implementation of the UXO avoidance procedure prior to sampling. Once an individual location was deemed safe for intrusive sampling, field technicians swept away the overlying vegetative matter before collecting three separate samples from the cleared spot from the depth interval of 0”-3” bgs. As each increment of the three replicate samples was collected, the soil was placed into the appropriate replicate sample Ziploc bag for later processing. A best effort was made to collect the sample increments in the proposed grid pattern. However, due to the large amount of metal debris and garbage in the area, several of the 30 required increments were collected off the proposed pattern but within the decision unit boundary. The replicate samples were transported to the Site staging area where they were transferred to glass jars and packaged for pickup by TestAmerica. The non-disposable sampling equipment was decontaminated using a plastic brush and deionized water.

Heavy Steel Plate Area

The Heavy Steel Plate Area soil was sampled on October 12, 2015. Replicate multiple increment samples were collected using a small disposable plastic scoop and Ziploc bags as per the SOP. Due to the local conditions encountered in the sampling area, a circular decision unit was established around the approximate center of the steel plates. The steel plates created a barrier to sampling with the central 8 to 10 feet radius of the center of the decision unit. The sample increments were all collected around the perimeter of a circle of approximately 10 feet radius. A UXO technician initially swept the surface of the decision unit with an all-metals detector to avoid contacting items on the ground or in the near surface soil that could be potentially explosive. Once an individual location was deemed safe for intrusive sampling, field technicians swept away the overlying vegetative matter before collecting three separate samples from the cleared spot from the depth interval of 0”-3” bgs. Several of the sampled locations were very damp. Sample increments were collected as uniformly as possible from around the entire perimeter of the decision unit (as the presence of the heavy steel plates precluded using the proposed grid pattern). As each increment of the three replicate samples was collected, the soil was placed into the appropriate replicate sample Ziploc bag for later processing. The replicate samples were transported to the Site staging area where they were transferred to glass jars and packaged for pickup by TestAmerica. The non-disposable sampling equipment was decontaminated using a plastic brush and deionized water. Soil samples collected in this area were analyzed for metals and explosives. The complete results are presented in Table 3-5. The maximum detected concentrations of lead and mercury and a listing of detected explosives are tabulated in Table 3-6 and presented schematically in Figure 3-2.

Near-Range Firing Position

The Near-Range Firing Position soil was sampled on October 12, 2015. Replicate multiple increment samples were collected using a small disposable plastic scoop and Ziploc bags as per the SOP. A 20’x30’ decision unit was laid out in the area in front of the firing position in the down range direction of the Former Test Range Target Berm. A UXO technician initially swept the surface of the decision unit with an all-metals detector to avoid contacting items on the ground or in the near surface soil that could be potentially explosive. Once an individual location was deemed safe for intrusive sampling, field technicians swept away the overlying vegetative matter before collecting three separate samples from the cleared spot from the depth interval of 0”-3” bgs. As each increment of the three replicate samples was collected, the soil was placed into the appropriate replicate sample Ziploc bag for later processing. A best effort was made to collect the sample increments in the proposed grid pattern. However, due to the large amount of metal debris and garbage in the area, a few of the 30 required increments were collected off of the proposed pattern but within the decision unit boundary. Figure 3-4 shows a field sketch of the decision unit established in front of the Near-Range Firing Position. The approximate locations where the 30 sample increments were collected are shown as the numbered circles. An area containing numerous heavy metallic debris items is seen directly in front of the concrete gun mount platform. Other areas within the decision unit boundary that are not shown on Figure 3-4 with an increment number had significant metal debris on or near the ground surface that precluded collecting a sample increment there. The replicate samples were transported to the Site staging area where they were transferred to glass jars and packaged for pickup by TestAmerica. The non-disposable sampling equipment was decontaminated using a plastic brush and deionized water.

Test Range Floor in Front of the Backstop Berm

The Test Range Floor soil was sampled on October 13, 2015. Replicate multiple increment samples were collected using a 6” long gardening trowel and Ziploc bags as per the SOP. A decision unit of approximately 250’ long x 25’ wide was established at the foot of the Target Berm. A UXO technician then swept the surface of the decision unit with an all-metals detector to avoid items on the ground or in the soil that could be unexploded 20mm rounds. A best effort was made to collect the sample increments in the proposed grid pattern. However, due to the large amount of metal debris and garbage in the northeastern half of the decision unit, a few of the 30 required increments were collected at points that deviated from the proposed standard pattern but all were collected within the decision unit boundary. Once an individual location was deemed safe for sampling, it was marked with a colored pin flag. When the 30 required sample increment locations had been cleared and flagged, the field technicians went to the flagged locations and swept away the overlying vegetative matter before collecting three separate samples from the cleared spot from the depth interval of 0”-3” bgs. As each of the three replicate samples was collected, the replicate increment was placed into the appropriate replicate sample Ziploc bag for later processing. The replicate sample bags were transported to the staging area where they were transferred to glass jars and packaged for pickup by TestAmerica. The non-disposable sampling equipment was decontaminated using a plastic brush and deionized water.

Test Range Berm

The Former Test Range Target Berm soil was sampled over a period of two days on October 12 and 13, 2015. The Target Berm was divided into four quadrant-based decision units for sampling, each approximately 125’ wide x 25’ long along the inclined face of the Berm (see Figure 3-3):

- Test Range Berm Quadrant 1 (Lower Left from the vantage point looking at the Target Berm from the Near-Field Firing Point)
- Test Range Berm Quadrant 2 (Lower Right)
- Test Range Berm Quadrant 3 (Upper Left)
- Test Range Berm Quadrant 4 (Upper Right)

Each quadrant / decision unit was sampled in two depth intervals: 0”-6” below the berm face and 6”-12” below the berm face. All sample increments for the 0”-6” replicate samples were collected using a 6” long gardening trowel and replicate-specific Ziploc bags as per the SOP. All sample increments for the 6”-12” replicate samples were collected using a spade hand shovel and combined in Ziploc bags. A total of 30 sample increments were collected from each quadrant / decision unit and depth interval for each of the three replicates. A best effort was made to collect the sample increments in the proposed grid pattern. However, due to the large amount of metal debris in portions of the Target Berm, several of the 30 required increments were collected at locations that deviated somewhat from the proposed pattern but still within the decision unit boundary. Figure 3-5 shows a field sketch of the decision unit established in Test Range Berm Quadrant 1 (Lower left). The approximate locations where the 30 sample increments were collected are shown as the numbered circles. Areas of concentrated metallic debris and construction rubble can be seen in the figure. A large area of metallic debris is shown in the lower right corner of the decision unit which precluded any sample increments from being collected there. The area of construction debris shown at the left is the remains of some type of steel and wooden beam structure. The slash lines represent the locations of trees. Once an individual location was cleared and determined to be safe for sampling, it was marked with a colored pin flag. When the required number of sample increment locations was identified, the field technicians went to the flagged locations and swept away the overlying vegetative matter before collecting three separate samples from the cleared spot from the depth interval of 0”-6” bgs. As each of the three replicate samples was collected, the replicate increment was placed into the appropriate replicate sample Ziploc bag for later processing. When the 0”-6” depth range sampling was completed for that increment location, field technicians then collected three replicate sample increments from 6”-12” depth range using the spade hand shovel. As each of these three replicate samples was collected, the replicate increment was placed into the appropriate replicate sample Ziploc bag for later processing. The replicate samples were transported to the staging area where they were transferred to glass jars and packaged for pickup by TestAmerica. The non-disposable sampling equipment was decontaminated using a plastic brush and deionized water.

Area Behind Test Range Berm

The soil in the Area behind Test Range Berm was sampled on October 13, 2015. Replicate multiple increment samples were collected using a 6” long gardening trowel and Ziploc bags as per the SOP. A decision unit of approximately 250’ long x 25’ wide was established along the upper edge and behind the Target Berm. The 30 required increments were collected along the proposed grid pattern within the decision unit boundary. A UXO technician initially swept the surface of the decision unit with an all-metals detector to avoid contacting items on the ground or in the near surface soil that could be potentially explosive. Once an individual location was deemed safe for sampling, it was marked with a colored pin flag. When the required number of sample increment locations had been identified, the field technicians went to the flagged locations and swept away the overlying vegetative matter before collecting three separate samples from the cleared spot from the depth interval of 0”-3” bgs. As each of the three replicate samples was collected, the replicate increment was placed into the appropriate replicate sample Ziploc bag for later processing. The replicate samples were transported to the staging area where they were transferred to glass jars and packaged for pickup by TestAmerica. The non-disposable sampling equipment was decontaminated using a plastic brush and deionized water.

3.3.3.3 Results

Far-Range Firing Position

The maximum detections of lead and mercury in the soil at the Far-Range Firing Position were 50.8 milligrams per kilogram (mg/Kg) and 0.27 mg/Kg, respectively. These concentrations are less than the MCP S-1, GW-3 soil standards (i.e., the soil cleanup standard for the MCP S-1, GW-3 soil category - 200 mg/Kg for lead and 20 mg/Kg for mercury). The detected explosives were perchlorate, 2,4-dinitrotoluene, 2,6-dintrotoluene and picric acid. The concentrations of perchlorate and 2,4-dinitrotoluene, the detected explosives for which there are MCP standards, did not exceed the MCP S-1 standards. Concentrations of 2,6-dintrotoluene and picric acid, for which there are residential RSLs, did not exceed these RSLs. These results would not indicate a need for additional metals or explosives sampling in this sub-area.

Heavy Steel Plate Area

The maximum detections of lead and mercury in the soil at the Heavy Steel Plate Area were 75.9 mg/Kg and 0.20 mg/Kg, respectively. These maximum concentrations are less than their respective MCP S-1, GW-3 standards. The detected explosives compounds were perchlorate, 1,3,5-trinitrobenzene, 1,3-dintrobenzene, 2-nitrotoluene, nitroglycerin, picric acid, and 2,4,6-trinitrophenylmethylnitramine (Tetryl). The detected concentrations of perchlorate and 1,3-dintrobenzene did not exceed the MCP S-1, GW-3 standards. The detected concentrations of 1,3,5-trinitrobenzene, 2-nitrotoluene, picric acid, and Tetryl (the compounds that do not have MCP S-1, GW-3 standards but do have residential RSLs), did not exceed their respective RSLs. However, the measured concentrations of nitroglycerin in all three replicate sampling results did exceed the residential RSL for nitroglycerin and two of the replicate results (i.e., SO-SHSP-03-RM1 and SO-SHSP-03-RM2) exceeded the industrial RSL based on an HQ of 0.2 (i.e., 16,400 ug/Kg) . These results would not indicate a need for additional metals sampling in the portion of the sub-area outside of the heavy steel plates. The elevated level of nitroglycerin in the Heavy Steel Plate area reflects range-related operations in this sub-area of the Former Test Range. Additional metals and explosives sampling beneath the plates may be warranted once they are removed.

Near-Range Firing Position

The maximum detections of lead and mercury in the soil at the Near-Range Firing Position were 332 mg/Kg and 0.33 mg/Kg, respectively. All three of the replicate lead concentrations exceeded the MCP S-1, GW-3 standard (i.e., 200 mg/Kg) but were less than the S-2, GW-3 standard (i.e., 600 mg/Kg). Mercury concentrations were less than its MCP S-1, GW-3 standard. The detected explosives were perchlorate, 2,4-dinitrotoluene, 2,6-dintrotoluene, 2-amino-4,6-dinitrotoluene, 4-nitrotoluene, nitrobenzene, nitroglycerin, picric acid, and Tetryl. The measured concentration of perchlorate and 2,4-dinitrotoluene did not exceed the MCP S-1, GW-3 standards. The measured concentrations of 2,6-dintrotoluene, 2-amino-4,6-dinitrotoluene, 4-nitrotoluene, nitrobenzene, picric acid, and Tetryl (the compounds that do not have MCP S-1, GW-3 standards but do have residential RSLs) did not exceed their respective RSLs. The measured concentrations of nitroglycerin in all three replicate sampling results did exceed the residential RSL for nitroglycerin, however, these results did not exceed the industrial RSL. As such, additional metals or explosives sampling of the soil in this sub-area is not warranted.

Test Range Floor in Front of the Backstop Berm

The maximum detections of lead and mercury in the soil at this area were 239 mg/Kg and 0.17 mg/Kg, respectively. The detected lead concentrations in two of the replicate samples exceeded the MCP S-1, GW-3 standard for lead but were below its S-2, GW-3 standard. Mercury concentrations were less than its MCP S-1, GW-3 standard. The detected explosives were perchlorate, 2,4,6-trinitrotoluene, 4-amino-2,6-dinitrotoluene, picric acid, and Tetryl. The measured concentrations of explosives did not exceed their respective MCP or RSL residential soil screening values. The majority, if not all, of the sampled surficial soil from this area was excavated, sifted and sampled. As such, additional metals or explosives sampling of the soil in this sub-area is not required.

Test Range Berm

The maximum detections of lead and mercury in the soil for each quadrant of the Test Range Berm for the two depth increments are reported separately in Table 3-6 (see sample Stations SO-STRB#) and are shown on Figure 3-3. The maximum concentrations of lead and mercury detected in the berm samples were 843 mg/Kg and 0.63 mg/Kg, respectively. Lead concentrations exceeded the MCP S-1, GW-3 and S-2, GW-3 standards in some locations. Mercury concentrations were less than its MCP S-1, GW-3 standard. Perchlorate was the only explosive detected in all quadrants, with 2-nitrotoluene and picric acid also detected in one or two quadrants, respectively. The measured concentrations of perchlorate in all quadrants were below the MCP S-1 standard. The measured concentrations of 2-nitrotoluene and picric acid did not exceed their respective residential RSLs. All of the sampled surficial soil from the berm was excavated, sifted and sampled. As such, additional metals or explosives sampling of the soil in this sub-area is not required.

Area Behind Test Range Berm

The maximum detections of lead and mercury in soil from the Area Behind Test Range Berm were 2,600 mg/Kg and 8.4 mg/Kg, respectively. Lead concentrations exceeded the MCP S-1, GW-3 and S-2, GW-3 standards. Mercury concentrations were less than its MCP S-1, GW-3 standard. The detected explosives were perchlorate, 1,3,5-trinitrobenzene, 2-amino-4,6-dinitrotoluene, 4-nitrotoluene, nitrobenzene, nitroglycerin, and picric acid. The measured concentrations of perchlorate did not exceed its MCP S-1, GW-3 standard. The measured concentrations of 1,3,5-trinitrobenzene, 2-amino-4,6-dinitrotoluene, 4-nitrotoluene, nitrobenzene, and picric acid did not exceed their respective residential RSLs. One sample (i.e., SO-STRD-03-RM1) had a detected nitroglycerin concentration that exceeded its residential RSL, but this concentration was below its industrial RSL.

Summary of Former Test Range Soil Sampling Results

Lead was detected at elevated levels (i.e., greater than the MCP S-1, GW-3 or S-2, GW-3 standards) throughout some of the sub-areas of the Former Test Range Berm (i.e., the Test Range Floor, all four quadrants of the Test Range Berm, and the Area behind the Berm), but mercury did not exceed its MCP S-1, GW-3 standard at any sampling location within the Former Test Range. Explosives compounds were detected at relatively low concentrations (except for nitroglycerin) in the surface soil (from the Far-Range Firing Position, Heavy Steel Plate Area, Test Range Floor and the Area behind the Berm) and the subsurface soil (from each quadrant of the Test Range Berm). Perchlorate was the only explosive compound that was detected in all sub-areas of the Former Test Range, but its concentrations were consistently less than its MCP S-1, GW-3 standard. The number of explosives detected in the Former Test Range soils ranged from one (in two of four quadrants sampled at the Test Range Berm) to nine (at the Front of the Near Range Firing Position). Nitroglycerin was found in exceedance of its EPA residential RSL in the surface soil in the Heavy Steel Plate Area, the Near-Range Firing Position, and the Area behind the Berm, and greater than its EPA industrial RSL in the Heavy Steel Plate Area.

Uncertainties Associated with ISM Sampling Methods

There is some uncertainty associated with the collection of the ISM sample increments at the Far-Range Firing Position, Near-Range Firing Positions, Test Range Floor, Test Range Berm, Overshoot Area and the Heavy Steel Plate Area. The soil samples that were collected in each of these areas were collected using the incremental sampling method (ISM). The locations of the 30 increments that were collected to form the ISM for each area were not geospatially recorded. Sampling increments were generally collected using the standard ISM back and forth pattern for the original sample and the replicates. However, the presence of a significant amount of metallic debris on or just below the ground surface or in the subsurface at these sampled areas required the sampling increments to be collected from locations that diverged somewhat from the standard pattern. This was because the spot where each increment was to be collected had to be cleared for metal as part of the UXO Avoidance procedure that was employed. Since eliminating all ferrous debris from these areas prior to sampling would have required extensive excavation and screening (i.e., comparable in approach and cost to the effort to separate and remove potential MEC or MPPEH), no change to future sampling beyond the surface inspection and implementing the UXO Avoidance procedure was warranted so long as a sufficient number of increments could be collected from within the decision unit boundary and from throughout the decision unit (i.e., not omitting any significant portion or amount of the area being sampled) so that a representative sample could be collected.

According to the ITRC, there are three separate approaches to ISM sampling (ITRC 2012):

- Systematic random sampling – This is one of the most common sampling approaches where the SU is divided in a grid. A random sampling location is identified within the first cell and then each of the required increments is collected from that same relative location within the remaining cells in a serpentine pattern.
- Random sampling within a grid – In this approach each increment is collected sequentially from adjacent grids, however, the increment locations within each cell are collected in a random location from within the cell.
- Simple random sampling – In this approach the SU is not divided into a grid and the increments for the ISM sample are collected randomly across the SU. In this approach, a random number generator or equivalent technique is required to select truly random sampling locations.

While all three sampling options are statistically defensible, simple random sampling is most likely to generate an unbiased estimate of the mean and variance while systematic random sampling can avoid the appearance that areas within a SU are not being represented in the SU (ITRC 2012). Random sampling within a grid is essentially a compromise as it uses elements of both simple random sampling and systematic random sampling. The divergence from a systematic random sampling method in these sampled sub-areas because of the presence of metallic debris more closely resembled a random sampling within a grid approach, although the samples were not truly random in nature (i.e., a formal approach to determining the random sample locations was not used). Therefore, the estimate of the mean and variance for the ISM results collected using this diverged strategy are not thought to have been significantly biased.

3.3.4 Southern Conservation Commission Area (SCCA) Soil

3.3.4.1 Objectives

The surficial soil in the SCCA sub-areas associated with the Southern Disposal Area (Demolition Pit) where the soil mercury UCL exceedance was observed and associated with the Waste Burn Pit near piezometer (PZ)-24 where the soil lead UCL exceedance was observed during the Phase IIB investigation were sampled. The area near PZ-24 was also where the groundwater lead UCL exceedance was previously observed. This sampling was performed to determine if these areas had been affected by the 2010 flooding and if the contaminant levels still indicated a UCL exceedance. The surface soil in two areas along the western shoreline of Upper and Middle Factory Pond that were indicated to be most prone to flooding also were sampled to determine if the record high surface water flows through the watershed had deposited contaminated sediment on the ground surface in these areas. This sampling was to determine if there had been any further spread of mercury contamination in these potential depositional shoreline sub-areas.

3.3.4.2 Sampling Approach

Southern Disposal Area Soil UCL Exceedance Areas

The soil UCL exceedance area in the Southern Disposal Area was sampled on October 23, 2015. A Trimble handheld computer was pre-loaded with GPS points of the locations to be sampled. These locations had been identified in the approved re-baselining sampling program (see Figure 3-6). The corners of the 50 ft. by 50 ft. square decision unit were marked with pin flags. The 30 required ISM increments were positioned within the decision unit boundary in accordance with the proposed replicate sampling pattern. However, the presence of dense vegetation in a few desired increment locations required minor lateral adjustments from this pattern. Once these locations had been marked, the field technicians went to the flagged locations and cleared away the overlying vegetative matter. Replicate ISM samples were collected at each location to provide an indication of the variability in the sampling results. The field technicians then collected the required increment samples from the depth interval of 3”-6” bgs using a hand auger. As each of the three replicate samples was collected, the replicate increment was placed into the appropriate replicate sample Ziploc bag for later processing. The replicate samples were transported to the staging area where they were transferred to glass jars and packaged for pickup by TestAmerica. The non-disposable sampling equipment was decontaminated using a plastic brush and deionized water after every increment. Soil samples collected from the Southern Disposal Area Soil UCL Exceedance Area and the PZ-24 Groundwater Exceedance Area were analyzed for metals and explosives.

100-Year Floodplain Areas

The same sampling procedures were used in both 100-Year Floodplain Areas. 100-Year Floodplain Area 1 was sampled on October 23, 2015 and 100-Year Floodplain Area 2 was sampled in October 29, 2015. A Trimble handheld computer was pre-loaded with GPS points was used to find and mark the corners of the 50 ft. by 50 ft. square decision unit associated with the 100-Year Floodplain Area 1. The GPS points for the 100-Year Floodplain Area 2 decision unit were underwater in a marsh on the sampling date, so the location for the decision unit for the 100-Year Floodplain Area 2 was shifted slightly to an adjacent area at the same elevation as 100-Year Floodplain Area 1. The GPS coordinates of the corners of this resulting 10 ft. by 8.3 ft. rectangular decision unit were recorded using the Trimble. Replicate ISM samples were collected at each location to provide an indication of the presence or absence of mercury in the soil and the variability in the sampling results. A total of 30 sample increment locations were marked in each decision unit using the proposed grid pattern. Field technicians went to the pin flagged locations and swept away the overlying vegetative matter before collecting three separate samples from the cleared spot from the depth interval of 0”-3” bgs. As each of the three replicate samples was collected, the replicate increment was placed into the appropriate replicate sample Ziploc bag for later processing. The replicate samples were transported to the staging area where they were transferred to glass jars and packaged for pickup by TestAmerica. The non-disposable sampling equipment was decontaminated using a plastic brush and deionized water. Soil samples collected in the 100-Year Floodplain Areas were analyzed only for mercury.

PZ-24 Groundwater UCL Exceedance Area

The soil at the PZ-24 Groundwater UCL Exceedance Area was sampled on October 29, 2015. A Trimble handheld computer with pre-loaded GPS points was used to find and mark the corners of the 50 ft. by 50 ft. square decision unit whose location had been identified in the approved re-baselining sampling program. Pin flags were placed as close as possible to the proposed ISM grid pattern. The presence of dense vegetation at some locations made it necessary to make minor lateral adjustments from this pattern. The locations of the 30 required increments were positioned within the decision unit boundary. Once these locations had been marked, the Field Technicians went to the flagged locations and cleared away the overlying vegetative matter. They then collected three separate samples from the cleared spot from the depth interval of 3”-6” bgs using a hand auger. As each of the three replicate samples was collected, the replicate increment was placed into the appropriate replicate sample Ziploc bag for later processing. The replicate samples were transported to the staging area where they were transferred to glass jars and packaged for pickup by TestAmerica. The non-disposable sampling equipment was decontaminated using a plastic brush and deionized water after every increment. Soil samples collected in the PZ-24 Groundwater UCL Exceedance Area were analyzed for metals and explosives.

3.3.4.3 Results

Southern Disposal Area Soil UCL Exceedance Area

The complete analytical results for the Southern Disposal Area Soil UCL Exceedance Area soil are presented in Table 3-7. The detected concentrations of lead and mercury are tabulated in Table 3-8 and illustrated in Figure 3-6. The detected ranges of lead and mercury were 1,810-2,320 mg/Kg and 1.2-1.4 mg/Kg, respectively. Lead and mercury results are less than the current MassDEP UCLs for both metals, indicating there is no longer a soil UCL Exceedance in this sub-area. The lead results were greater than the MCP S-1, GW-3 standard, but the mercury results did not exceed the MCP S-1, GW-3 standard. There also were MCP S-1, GW-3 exceedances of antimony, barium, chromium, and zinc in this area. Explosives were not analyzed for in 2009, but the explosives that were detected during the re-baselining sampling included 1,3,5-trinitrobenzene, 1,3-dintrobenzene, 2,4,6-trinitrotoluene, 2,4-dintrotoluene, 2,6-dinitrotoluene, 2-amino-4,6-dinitrotoluene, 4-amino-2,6-dinitrotoluene, 4-nitrotoluene, octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX), nitrobenzene, picric acid, and RDX. None of the measured explosive concentrations exceeded their respective MCP S-1, GW-3 standards or residential RSLs.

100-Year Floodplain Areas

The analytical results for the 100-Year Floodplain Area soil samples are presented in Table 3-7. Mercury was the only metal that was analyzed for at the two 100-Year Floodplain Areas. The detected concentrations of mercury are tabulated in Table 3-8 and illustrated in Figure 3-6. The maximum detected concentration of mercury in 100-Year Floodplain Area 1 was 0.15 mg/Kg, while the maximum detected concentration of mercury in 100-Year Floodplain Area 2 was 0.073 mg/Kg. These results do not exceed the MCP S-1, GW-3 standard for mercury, and suggest there was little flood deposition of mercury on the western shoreline of Lower Factory Pond.

PZ-24 Groundwater UCL Exceedance Area

The detected range of lead and mercury was 402-566 mg/Kg and 0.030-0.076 mg/Kg, respectively. Barium, chromium, and lead results exceeded their MCP S-1, GW-3 standards, but did not exceed their S-2, GW-3 standards. The mercury results did not exceed its MCP S-1, GW-3 standard. Lead and mercury results were below their respective MassDEP UCLs for both metals (i.e., 6,000 mg/Kg for lead and 300 mg/Kg for mercury), indicating that there is no longer a soil UCL Exceedance in this sub-area. The detected explosives were 1,3-dintrobenzene, 2-amino-4,6-dinitrotoluene, 3-nitrotoluene, HMX, RDX, and Tetryl. None of the measured explosive concentrations exceeded their respective MCP S-1, GW-3 standards or residential RSLs.

3.3.5 Marsh Upland Area (MUA) Soil

3.3.5.1 Objectives

The surface and subsurface soil in the MUA were sampled for metals, including mercury and lead, to further delineate the horizontal and vertical extent of contamination in this area. This data was collected to allow a more refined estimate of the volume of contaminated soil in this sub-area to be made to incorporate into a revised Phase III RAP. Soil borings were collected across the area from the ground surface to a maximum of 4.0 - 6.0 feet bgs (or refusal). Samples were collected from the 6”-12” and from successive 1-foot depth intervals along the length of each boring. In total, 47 samples were analyzed for metals.

The surface and subsurface soil samples collected in the MUA during the 2015 re-baselining sampling event were not tested for explosives because the soil in this area had been previously characterized for metals and explosives during the 2002 Phase IIC Site Investigation. During the 2002 Phase IIC Site Investigation sampling event, fifteen soil samples were collected across the area from the depth interval of 0 to 3.0 feet bgs (or refusal). All 15 samples collected in 2002 were analyzed for metals and eight of the 15 samples (those located nearest the adjacent MUA sediment area) also were analyzed for explosives. Tetryl was detected in one of the eight samples at 150 ug/Kg in 2002. There is no MCP Method 1 S-1, GW-3 for Tetryl, however, this detected concentration is much lower than the USEPA residential RSL of 32,000 ug/Kg (based on a non-cancer HI of 0.2). Nitroglycerin was previously reported in two of the MUA soil samples (i.e., 2,700 ug/Kg at S-MUA16 and 3,800 ug/Kg at S-MUA19). Again, there is no MCP Method 1 S-1, GW-3 standard for nitroglycerin, however, these two soil results exceeded the USEPA residential RSL of 1,260 ug/Kg (based on a non-cancer HI of 0.2). As the MUA is part of the Southern Conservation Commission Area, residential land use is not anticipated or likely. Both nitroglycerin results were less than the USEPA Industrial Soil RSL of 8,200 ug/Kg. In addition to the 2002 Phase IIC sampling event, one of the MUA sediment samples collected during the 2002 Phase IID Site Investigation also was analyzed for explosives. Nitroglycerin was the only detected explosive in this 2002 Phase IID sample, which was reported as 2,700 ug/kg. This concentration of nitroglycerin in sediment was consistent with the concentrations of nitroglycerin that were previously detected in MUA soil. As such, additional sampling of the MUA soil for explosives was not warranted for the re-baselining sampling because of the prior sampling performed during the 2002 Phase IIC Site Investigation sampling event.

3.3.5.2 Sampling Approach

Soil samples were collected in the MUA on October 28 and 29, 2015. A Trimble handheld computer with pre-loaded GPS sampling coordinates was used to find and mark the approved sampling locations with pin flags. These locations are shown in Figure 3-7. Once these locations had been marked, the field technicians cleared away any overlying vegetation and collected grab samples from the depth interval of 6”-12” bgs using a hand auger. As each sample was collected, it was placed into a marked Ziploc bag for later processing. The hand auger and non-disposable sampling equipment were decontaminated using a plastic brush and deionized water after each sample was collected and bagged. The process at each sampled location was repeated until the designated number of proposed samples was collected within successive 12" intervals down to a maximum of 4' to 6' bgs (depending on the location) or refusal at bedrock. If refusal was encountered at the location before the maximum proposed depth of the boring was reached, the sampling location was offset up to four times to reach the maximum specified sample depth. The bagged samples were then transported to the staging area where they were transferred to glass jars and packaged for pickup by TestAmerica. Soil samples collected in the MUA were analyzed for metals.

3.3.5.3 Results

The complete analytical results for the soil samples collected in the MUA are presented in Table 3-9. The detected concentrations of lead and mercury are presented in Table 3-10 and illustrated in Figure 3-7.

A summary of the results for lead and mercury in the soil in the MUA are as follows:

Depth Interval	Range of Lead Concentrations (mg/Kg)	Average Lead Concentrations (mg/Kg)	Range of Mercury Concentrations (mg/Kg)	Average Mercury Concentrations (mg/Kg)
6"-12"	14.1 - 882	228	0.052 – 109	36.0
12"-24"	4.9 - 516	143	0.067 – 360	54.1
24"-36"	3.3 – 677	158	0.53 – 267	62.7
36"-48"	3.3 – 305	86.5	0.11 – 278	76.3
48"-60"	5.0 – 11.1	8.05	0.34 – 1.90	1.12
60"-72"	5.2 – 5.2	5.2	0.37 – 0.37	0.37

The concentrations of lead and mercury exceeding their respective MCP S-1, GW-3 standards (i.e., 200 mg/Kg for lead and 20 mg/Kg for mercury) extend down to a depth of four feet below the ground surface at some locations. Samples in the 12"-24" bgs depth range had mercury concentrations exceeding the MCP UCL value of 300 mg/Kg for mercury. In many cases, this depth coincides with the beginning of the layer of dense glacial till underlying the looser surficial material. No other metals exceeded their respective MCP S-1, GW-3 standards.

The MUA soil exceedances of lead and mercury were further assessed for the potential for "hot spots". The MUA is not an area where future exposure for recreational activities or conservation use would be unique or greater than other areas in the SCCA. The MUA soil area is topographically confined to the north by a steep hillside and to the south by the marsh adjacent to Lower Factory Pond. Without the likelihood of preferential exposure, a "hotspot" under the MCP would be defined as an area with concentrations greater than 100x the adjacent concentrations. The MUA soil sampling results presented in the above table and displayed in Figure 3-7 indicate that this factor of 100x is not present for lead or mercury. Although sampling locations SO-MUAU1, SOMUAU-3, SOMUAU-4 and SO-MUAU-5 all resulted in soil lead concentrations greater than the MCP S-1, GW-3 standard of 200 mg/Kg in the 6"-12" depth interval (with lead exceedances in the 12"-24" depth interval for SO-MUAU1, SOMUAU-3 and SOMUAU-4), these exceedances were not greater than 100x the lead results of the adjacent sampling locations that were below the MCP S-1, GW-3 standard. As the area around these four sampling locations is very small (i.e., only approximately 0.05 acres) and the factor of 100x is not present, it was determined that the MUA does not present a significant “hotspot” relative to potential exposure.

3.4 Sediment Sampling

3.4.1 Eastern Channel Corridor Sediment

3.4.1.1 Objectives

The portions of the ECC that were previously shown to have sediment that was impacted by mercury were re-sampled as part of the re-baselining sampling program. In addition, the ECC sediments in segments farther downstream also were re-sampled and analyzed for mercury to determine if sediment scouring and subsequent downstream sediment (and mercury) deposition had occurred as the result of the record high surface water flows during the storm events in 2010. In association with the re-characterization of mercury in the ECC sediments, the thicknesses of the channel segments were re-measured near the banks and at the channel centerline to allow an updated estimate of the volume of mercury-contaminated sediments in the ECC following the flooding.

3.4.1.2 Sampling and Characterization Approach

Poling (i.e., the use of a pole that is marked with unit length graduations to measure sediment thickness) was conducted to determine the depth of any soft sediment present in the channel. The soft sediment thickness was determined as the difference between the elevation of the top of the deposited sediment and the elevation of refusal (bottom of sediment or bedrock). These sediment thickness data were collected at each sampling location in advance of the sediment sampling for chemical analysis to determine the proper length of core to be used on the sediment sampling device and/or to assess sediment sample recovery at each location.

The ECC investigations started on October 25, 2015 at the most down-stream location (see Figure 3-1) and proceeded progressively in the upstream direction so as not to alter or disturb the locations to be sampled during the collection of the poling measurements. Measurements were made at the left, center and right portions of the stream channel (defined looking in the upstream direction). Measurements were made at the toe of the bank slopes on the left and right, and at the approximate centerline of the stream channel. The recorded measurements are presented in Table 3-11.

The graduated pole or hand probe was pushed downward through the water column and loose sediment with a soft push (i.e., using arm strength only) until resistance inhibited additional advancement. This measurement was recorded as the top of sediment level and represented the depth of the water column at this location. The pole was then further advanced with a hard push (i.e., using arm strength and body weight). The pole position following the overall push (the combined soft and hard push) was recorded as the depth to refusal shown in Table 3-11. One field technician conducted the poling and called out the readings to the other field technician on the bank who recorded the information. The field technician doing the poling in the stream channel also called out observations of the type of sediment material encountered at that location (e.g., soft sediment, sand, gravel, rocks, rip rap, till). These observations also were recorded.

In addition to the measurement of sediment thickness along each ECC transect, composite sediment samples were collected across each transect. These samples were collected on October 25 and 26, 2015. The ECC sediment sampling team consisted of three members, two remaining onshore and one working in the stream. Waders were worn in the stream, and nitrile gloves were worn by all members of the sampling team. Surficial sediment material was collected on the right edge, left edge, and channel center at 18 channel transects (see Figure 3-1). These transect locations were identified in the approved re-baselining sampling program. Sediment samples could not be collected at a small number of locations (which are explicitly identified in Table 3-12) where there was no sediment present. Also, a core was not collected at the center of the channel at one transect because the high-water level made sampling unsafe using waders. Sample collection and water and sediment depth measurements were done in accordance with the SOP for "Stream Sediment Thickness Measurement and Sample Collection." Each sediment core was collected with the check valve sampler and transferred to a labeled Ziploc bag for compositing at each transect. Approximately equal amounts of sediment were collected at each of the three sampling points along each ECC transect. The sampler was decontaminated with de-ionized water after each sample. The bagged samples were then transported to the staging area where they were transferred to glass jars and packaged for pickup by TestAmerica. In accordance with the approved re-baselining objectives, sediment samples from the ECC were analyzed only for mercury.

Water depth and sediment thickness measurements, presented in Table 3-11, indicate that the sediment has shifted within the banks of the ECC since 2008, but no discernable pattern was determined. Refusal depths were generally less than those recorded in 2008 suggesting that sediment from the upper portions of the ECC had been washed downstream.

3.4.1.3 Results

The results of the ECC sediment sampling are presented in Table 3-12 and are illustrated in Figure 3-1. Detected mercury concentrations throughout the ECC exceeded the proposed surface sediment mercury PRG of 4 mg/Kg and ranged from 12.2 mg/Kg at Sampling Station 14 to 551 mg/Kg at Sampling Station 13. Elevated mercury levels (greater than the MCP S-1, GW-3 soil standard) were present throughout the ECC and were highest in the eastern run of the ECC (i.e., between Sampling Stations 9-13). The mercury concentrations in the sediment were lowest at the three most down-stream stations nearest the confluence of the ECC with the Lower Drinkwater River Corridor.

3.4.2 Pond and River Sediment

3.4.2.1 Objectives

The sediments in the Lower Drinkwater River Corridor (LDRC), Lily Pond, Upper Factory Pond, Middle Factory Pond, Lower Factory Pond, and the Indian Head River Corridor (IHRC) also were re-sampled and analyzed for mercury to determine to what extent contaminated sediment may have been re-suspended and transported downstream through the surface water system during the record high flow events. The sampling in the LDRC and the IHRC was focused primarily on depositional areas. The depositional areas sampled in the IHRC were selected in coordination with representatives of MassDEP following a reconnaissance of the river between the Factory Pond Dam and an area about two and a half miles away and just upstream of Luddam's Ford on April 30, 2015. The sampling locations within Lily Pond and Factory Pond were laid out in a regular grid reference system with a horizontal spatial scale comparable to the average sample polygon size from the prior Supplemental Phase III sediment sampling and at depth intervals guided by the prior sampling results and the patterns of indicated deposition and erosion from prior bathymetric studies (Tetra Tech 2009). Sediment sampling also was extended into the marsh areas adjacent to Lily Pond where recent flooding occurred or where an earlier alternate Drinkwater River flow channel may have been located.

3.4.2.2 Sampling Approach

Lower Drinkwater River Corridor

The LDRC was sampled on October 15, 2015. Three surficial sediment samples were collected using a piston sediment sampling device with a three-foot plastic tube attached. Samples were collected at depths 3"-6" and 6"-12" below the sediment surface at each location. The river corridor was accessed via the southern end of the reach using a flat-bottomed jon boat by a field technician wearing full chest waders and rubber gloves and carrying the piston sampling device. Once the approved sampling station was located, the field technician then used the piston sampling device to collect a sediment sample from the point along the cross-section at that sampling station with the greatest water depth (i.e., along the thalweg of the river corridor). The technician then returned the sampling device back into the jon boat where a cap was fastened to the sampling end of the plastic tube to avoid losing the sample in transport back to the processing area. The plastic tube with the collected sample was then removed from the piston sampling device, capped on the opposite end, and a new plastic tube attached after the piston was decontaminated with de-ionized water. At Sampling Station 1, a sediment sample could not be collected from the thalweg (i.e., the deepest point in the stream channel) because of the rocky bottom and lack of sediment. Accordingly, the sampling location was moved 5 feet from center closer to the right bank of the channel. At Sampling Station 2, only 0.7 feet of sample could be collected because of the rocky nature of the thalweg. At proposed Sampling Station 4, soft sediment did not exist across the span of the channel because of the rocky nature of the river bottom. Therefore, a sample could not be collected at this location. In accordance with the approved re-baselining objectives, sediment samples from the LDRC were analyzed only for mercury.

Lily Pond / Factory Pond

The sediment samples from Lily Pond and Upper Factory Pond were collected during the period October 7-14, 2015, while the sediment samples from Middle and Lower Factory Pond were collected during the period October 19-23, 2015. Cores were collected primarily using the piston sampler as it achieved the highest recovery (i.e., 80—100%) for the pond conditions encountered. Approximately ten percent of the cores were collected using the Vibracore sampler. Target locations were located using GPS as described in the Sediment Sampling SOP. The actual field core collection coordinates were captured in a GPS data collector. Cores were typically collected within 10 feet of the target coordinates. In the case of an obstruction or if the target location was on-shore, the target locations were offset to an area where accessible sediment was present.

Once a target sampling location was acquired, the larger pontoon boat with the mounted sampling rig was anchored in place and the water depth was measured and recorded. The water depth plus the target penetration depth were marked on the sampler and advanced to achieve either the target penetration depth or refusal. Once the core was advanced to the desired depth or refusal, the depth of core penetration was measured and recorded. Sediment was rinsed from the core barrel or liner to minimize sediment exposure to the coring personnel. Cores were capped, taped, and labeled with date, location identification, core advancement and recovery. The core was secured in an upright position on the vessel. The sampler was decontaminated following the procedures for decontaminating non-dedicated sampling equipment. The equipment that contacted the sediment was first grossly decontaminated, then washed with Alconox, and rinsed with distilled water. Cores were transported to the processing area while maintaining a vertical of a position (to the extent practical) during transport.

There were eight target locations where cores were not collected because of substrate type (typically rock). When this condition was encountered poling around the perimeter of the vessel was conducted to confirm the absence of soft sediment. The water depth and substrate type were recorded for these locations. In accordance with the approved re-baselining objectives, sediment samples from Lily Pond and Factory Pond were analyzed only for mercury.

Marsh Upland Area

Sediment samples were collected in the MUA on October 27 and 28, 2015. A Trimble hand-held computer with preloaded GPS points was used to navigate to the approved sampling locations. Typically, the approved sampling locations had a very wet sediment layer overlying a dense glacial till layer at a depth of 12 to 18 inches below the sediment surface. In addition, the sediment was not cohesive enough to collect with a check valve sampler as planned. Rain on October 28th added to the wetness of the sediment. As a result, a hand auger was used to collect the sediment samples in the MUA Sediment Area. Samples were collected at 23 locations, and were collected within 6” depth intervals until refusal was encountered. A total of 34 samples were collected: 26 from the depth interval of 0”-6”; 7 from the depth interval of 6”-12”; and 1 sample from the depth interval of 12”-18”. Refusal was encountered at the depth of the dense glacial till layer. The dense glacial till layer appeared to run continuously beneath the MUA sediment and soil layers. The sampling equipment was decontaminated after each sample was collected. In accordance with the approved re-baselining objectives, sediment samples from the MUA were analyzed only for mercury.

Indian Head River Corridor

The IHRC was sampled on October 26, 2015. Surficial sediment samples were collected using a piston sediment sampling device with a three-foot plastic tube attached. The river corridor was accessed via the embankment at the selected sampling locations by a field technician wearing full chest waders and rubber gloves and carrying the piston sampling device. Once the approved sampling location was acquired, the field technician then used the piston sampling device to collect a sediment sample from the depth interval of 0”-3” below the sediment surface. The technician then returned to the embankment where a cap was fastened to the sampling end of the plastic tube to avoid losing the sample in transport back to the processing area. The plastic tube with the collected sample was then removed from the piston sampling device, capped on the opposite end, and a new plastic tube attached after the piston was decontaminated with de-ionized water. At Sampling Stations 2, 3 and 5, a sediment sample from the 0”-3” depth interval was collected from the left, center, and right side of the channel corridor to form a composite sample for analysis. At Sampling Stations 1 and 2, surficial sediment samples were collected with the use of a spade shovel due to the sand and rock nature of the river bottom. The shovel was used to collect a sample down to a depth of three inches and then placed into a plastic Ziploc bag, after all rock material was removed by hand. Access to approved sediment Sampling Station 6 was not granted after several attempts. As noted above, the decision was made on October 13, 2015 with the concurrence of MassDEP to forego the planned sampling at this location pending the results from the other samples from this reach of the river. In accordance with the approved re-baselining objectives, sediment samples from the IHRC were analyzed only for mercury.

3.4.2.3 Results

Lower Drinkwater River Corridor

The sampling results for all locations and depths are presented in Table 3-13 and are shown in Figure 3-8. The maximum detected concentrations of mercury at each sampling location in the LDRC and the sample depth at which the maximum detected concentration was observed are presented in Table 3-14 (note that this table includes sediment sampling locations in addition to the LDRC). The shallowest depth at which the mercury concentration in the sediment was less than the surface sediment proposed PRG of 4 mg/Kg is identified in Table 3-14 and illustrated in Figure 3-9. Mercury concentrations in the 3”-6” depth range ranged from 0.97-62 mg/Kg. In the 6”-12” depth range, the mercury concentrations ranged from 0.27-1.7 mg/Kg. Mercury concentrations exceeded the surface sediment mercury proposed PRG of 4 mg/Kg in the two northern (most upstream) sampling locations in the LDRC where the detected mercury levels were similar to those found in the lower reaches of the ECC. The third sampling location in the LDRC (most downstream) was located at the boundary between the LDRC and Lily Pond and had the lowest level of detected mercury in the river and pond sediments.

Lily Pond / Factory Pond

The sampling results for all locations and depths in Lily Pond and Upper Factory Pond (LUFP) are presented in Table 3-15. The maximum detected concentration of mercury at each LUFP sampling location and the sample depth at which the maximum detected concentration was observed are presented in Table 3-14 and the maximum concentration is illustrated in Figure 3-8. The depth at which the mercury concentration in the sediment was less than the surface sediment proposed PRG of 4 mg/Kg is identified in Table 3-14 and is illustrated in Figure 3-9.

Representative results for the sediment in LUFP are as follows:

Depth Interval	Range of Mercury Concentrations (mg/Kg)	Average Mercury Concentrations (mg/Kg)
3”-6”	0.20 – 682	89.8
6”-12”	0.058 – 369	25.5
12”-18”	0.032 – 132	7.62

The sampling results for all locations and depths in Middle and Lower Factory Pond (MLFP) are presented in Table 3-16. The maximum detected concentration of mercury at each MLFP sampling location and the sample depth at which the maximum detected concentration was observed are presented in Table 3-17 and the maximum concentration is illustrated in Figure 3-10. The depth at which the mercury concentration in the sediment was less than the surface sediment proposed PRG of 4 mg/Kg also is identified in Table 3-17 and is illustrated in Figure 3-11.

Representative results for the sediment in MLFP are as follows:

Depth Interval	Range of Mercury Concentrations (mg/Kg)	Average Mercury Concentrations (mg/Kg)
3”-6”	0.043 - 335	37.7
6”-12”	0.021 - 326	21.8
12”-18”	0.021 – 207	14.6
18”-24”	0.09 – 348	58.3
24”-30”	0.22 – 0.33	0.28
30”-36”	0.20 – 0.71	0.46

In Lily Pond and Upper Factory Pond, mercury concentrations greater than 4 mg/Kg were generally found to extend to 6 inches below the surface of the sediment, with pockets of deeper sediment contamination found:

- in the northern portion of Lily Pond (i.e., where there is a depth of contamination of 12-24 inches);

- on the eastern shore of Upper Factory Pond above the Greenway foot bridge separating Upper Factory Pond and MLFP (i.e., where there is a depth of contamination of 12-18 inches); and
- at an inlet on the western shore of Upper Factory Pond (i.e., where there is a depth of contamination greater than 6 inches).

These areas of deeper mercury contamination may be indicative of recirculation/deposition zones.

Mercury in the MLFP is mostly at a depth of 6 inches except for deeper pockets of contamination near Factory Pond Dam (i.e., where there is mercury contamination in sediment to depths greater than 12 to 24 inches) and a location just below the Greenway foot bridge in an inlet on the western shore (i.e., where there is a depth of contamination of 12 inches). These areas may be characterized by a lower flow velocity which allows for greater settling of particulates.

Marsh Upland Area

Results of the MUA sediment sampling for all locations and sampling depths is presented in Table 3-18 and are illustrated in Figure 3-7.

Representative results for the sediment in the MUA are as follows:

Depth Interval	Range of Mercury Concentrations (mg/Kg)	Average Mercury Concentrations (mg/Kg)
3”-6”	0.95 – 551	88.9
6”-12”	1.5 – 602	144
12”-18”	0.29 – 0.29	0.29

Mercury concentrations in the MUA sediments were highest at Sampling Locations 27, 28, 23 and 24. These sediment sampling locations in the MUA Sediment Area are located proximate to the soil sampling locations in the MUA Soil Area where some of the highest mercury concentrations in soil were reported (see Figure 3-7). Mercury concentrations in the MUA sediments are somewhat higher than in the nearby MLFP sediments and are highest at the boundary with the MUA Soil Area, suggesting that the mercury detected in the MUA sediment may be from a different source or release scenario than the MLFP sediment. Mercury contamination is typically present to a depth of 6 to 12-inches, which is down to refusal at some locations.

Indian Head River Corridor

The results of the IHRC sediment sampling are presented in Table 3-19 and are illustrated in Figure 3-12. The detected mercury concentrations associated with the samples ranged from 0.084 mg/Kg to 4.3 mg/Kg. The maximum detection was from a duplicate sample collected at sampling station 8. A summary of the sediment mercury results collected from the IHRC is presented in Appendix 3F and as follows:

- Mercury concentrations detected in the first depositional areas within 1200 feet of the Factory Pond Dam at Sampling Stations 1 through 4 were very low (i.e., 0.084 to 0.78 mg/Kg).
- Within an intermediate reach of the Indian Head River between 1.0 and 1.6 miles downstream of the Factory Pond Dam (i.e., between Sampling Stations 5 and 7), the surficial sediment mercury concentrations ranged from 3.1 mg/Kg (detected at Sampling Station 7) to 3.45 mg/Kg (the average mercury concentration of the two paired samples collected at Sampling Station 5).
- Farther downstream at Sampling Station 8 (i.e., 2.5 miles below the Factory Pond Dam), the surficial sediment mercury concentration was 4.2 mg/Kg. Sampling Station 8 was located approximately 1000 feet above Luddam’s Ford Dam, a major impoundment and sediment deposition area.

The source of the mercury in the sediment between Factory Pond Dam and Luddam’s Ford Dam is unclear given the currently available data, however, investigation indicates that the likely sources of contamination were historic manufacturing operations along the IHRC. While some mercury-contaminated sediment may have possibly migrated past/over the Factory Pond Dam during periods of very high flow and deposited in the river channel below the dam, given the low concentrations detected nearest to Factory Pond Dam, it is equally likely that atmospheric deposition of mercury into the watershed areas between the dams may have washed into the river channel and been deposited in the sediment. As noted above, historic manufacturing activities involving mercury compounds in their operations at facilities formerly located along the river in this reach likely released mercury that has become trapped in the sediments. Research into the historical activities that took place between the two dams was performed to determine the potential sources of mercury detected in these sediments. Appendix 3F presents the finding of this research and a brief summary also is presented below.

As stated in Appendix 3F, mercury was likely associated with a number of operations at the Iron Forge, the Clapp Rubber Factory and other historical operations in the area such as the E. Phillips & Sons Tack and Shoe Manufacturers. At the Rubber Factory, mercuric iodide may have been used as an “accelerator” in the sulfur vulcanization process for natural rubber to improve its strength. The rubber was immersed in mercury iodide solutions for several days. These accelerators were added in quantities between 2.5 and 6 percent of the weight of the rubber [https://en.wikipedia.org/wiki/David_Spence (rubber_Chemistry)]. Mercuric oxide also was used for this purpose [http://www.kgk-rubberpoint.de/ai/resources/bcabd46ac82.pdf]. Accelerators were not the only possible use of mercury in the rubber industry during this time period. Mercury was also used in several types of red and brown dyes in the rubber dying process (such as vermilion pigmented by mercury sulfide, red chromate of mercury, sulfide of mercury, and iodide of mercury). During this time, mercury was also being used in rubber factories in mercury-vapor lamps. Due to the types of machinery used in rubber factories (e.g., open rollers) and the fact that rubber absorbs the light from conventional fixtures, these lamps allowed for better lighting that could be placed inside the fume hoods that were above the open rollers. Additionally, any large industrial operation of this era, especially one like the Clapp Rubber Factory that used boilers [as can be seen on Sanborn maps from 1917 and 1931 (presented in Appendix 3F)], would have also employed many mercury-filled thermometers and manometers (pressure measurement devices) that were subject to leakage or breakage.

The E. Phillips & Sons Tack and Shoe Manufacturers also was a historical operation located just downstream of the Cross Street / State Street Bridge, where a dam and two flumes passed by this location. A 1912 Sanborn Map (presented in Appendix 3F) shows that this operation included metal "bluing" since a "Blueing" building (spelled as labeled) was shown. Browning was an earlier form of bluing performed in the late 1800s and early 1900s that produced a reddish brown or reddish orange color on the metal (Shooters Forum, 2006). The browning and bluing formulas were comprised of corrosive solutions (typically involving nitric or hydrochloric acid) containing one or more metal salts. The exact solution composition and processing temperature and contact time were selected for a particular metal and to achieve the desired color and durability of the finish. R.H. Angier proposed a comprehensive browning solution classification scheme in 1936 and documented the "recipes" and processes for 148 browning solutions of which 46 included the very soluble mercuric chloride or mercuric nitrate as the primary metallic salt (see Appendix 3F). Mercury chloride was a key component of the majority of these solutions, especially the most common ones used for treating common iron and steel products. Because the E. Phillips & Sons Tack and Shoe Manufacturers facility was operational during the time that browning was used in the industry, mercury associated with the browning process used on the tacks and shoe nails was likely to have been released into the environment and the river during that time. Based on the evidence, it is more likely the historical operations of the rubber factory or the tack and shoe manufacturing operations previously located in this reach of the Indian Head River introduced mercury into the river sediments. A more detailed description of the research into the historical activities and the consideration of other potential sources of mercury in the sediments of the Indian Head River Corridor between the dams is presented in Appendix 3F.

In addition, continuing atmospheric deposition of mercury associated with coal-fired power plant emissions regionally and from the Midwest (recognized to be impacting water bodies throughout Massachusetts for many years) contributes mercury to the sediments in the IHRC. Moreover, the concentrations and distribution of mercury in the river sediment do not support a conclusion that mercury in this reach of the Indian Head River was transported from the Site.

Additional sampling of sediment in the Indian Head River Corridor between Factory Pond Dam and Luddam's Ford Dam is very unlikely to provide additional information that will allow a more definitive attribution to the source of the mercury now present in this reach. Certified laboratory analytical methods for mercury speciation relative to a broad range of mercury compounds are not commercially available, and speciation relative to a particular species or compound is accomplished typically at the bench-scale level for a specific compound of interest.

Currently, commercially applied analytical methods for different forms of mercury exist only for methyl mercury, ethyl mercury and phenyl mercury (Brooks Rand, 2018). No sediment contaminant (mercury or otherwise) that could not have been introduced into the sediments in this reach of the Indian Head River from other sources has been identified. In addition, the mercury does not appear to be widely distributed throughout this reach and the concentrations of mercury already measured in these sediments are not high enough to pose a significant risk to users of the river or the environment. As such, further sampling of the sediments in this reach for determining the nature and extent of contaminated sediment from the Site is not warranted.

3.5 Groundwater Sampling

3.5.1 Objectives

The groundwater from the locations where the groundwater UCL exceedances were observed during the last groundwater sampling event was re-sampled to see if the previously observed mercury and lead concentrations were still present. This sampling was proposed to be performed at one previously installed piezometer and one previously installed monitoring well in the Southern Conservation Commission Area (see Figure 3-13).

3.5.1.1 Sampling Approach

DP-MW1

Groundwater sample GW-DP-MW1 was collected from the existing monitoring well in the MUA on October 22, 2015 using USEPA low-flow sampling procedures in accordance with the project SOP. The field technician checked and recorded the condition of the well for any damage or evidence of tampering. The well cap was removed and the well headspace was measured with a photoionization detector (PID), then the reading was recorded in the field book and on the associated Low-Flow Data Sheet (see Appendix 3G). The field technician then measured and recorded the depth to water and total depth using a water level meter. The volume of the water column in the well was calculated and recorded on the Low-Flow Data Sheet and field logbook along with total depth and depth to water. Dedicated polyethylene tubing was then lowered down the well to a depth where the tubing intake was less than two feet above the bottom of the well. The tubing was then connected to a Solinst peristaltic pump and pumping began at a rate of approximately 0.3 to 0.4 liters per minute. The water level in the well was monitored periodically to ensure that drawdown did not exceed 0.3 feet. When drawdown was observed the pumping rate was lowered accordingly. Once the purge rate was achieved, the specified groundwater field parameters (i.e., temperature, pH, turbidity, specific conductivity, dissolved oxygen and oxygen redox potential) were collected every 5 minutes and recorded on the Low-Flow Data Sheet. A Horiba U-52 water quality meter with flow-through cell was used to monitor the field parameters. The field parameters were only measured after the flow-through cell was “flushed” with groundwater twice. Pumping continued, with readings every 5 minutes, until the parameters stabilized for three consecutive readings. The readings were recorded on the Low-Flow Data Sheet. Once the field parameters stabilized, the Horiba was removed and samples were collected directly from the end of the tubing. The samples were collected in pre-preserved (nitric acid) plastic jars. The samples were then labeled, recorded on the COC, and placed immediately into a cooler for shipment and maintained at 4°C. Lastly, the well was closed and locked. Groundwater sample GW-DP-MW1 was analyzed for total mercury (unfiltered).

PZ-24 / MW-B4

A groundwater sample was to be collected from the existing piezometer PZ-24 in the Southern Disposal Area (see Figure 3-13). On October 22, 2015, the field technicians cut their way into the heavily vegetated area containing PZ-24. Piezometer PZ-24 was installed using a Geoprobe vibratory drilling technique in November of 1998 as part of the Phase IIA field investigation. The piezometer was installed to a depth of six feet before hitting refusal and 1.32 inches diameter piezometer casing with a 15-slot screen was installed. Proper well development to remove fine sediment during sampling of a piezometer like this (an 18-year old piezometer installed with no sand filter pack placed around the one foot well screen with a larger slot size than the normal 10-slot screen for a monitoring well) would be difficult, and therefore, representative water quality samples for naturally occurring parameters, such as lead may not be obtainable. In fact, the Phase IIA Report indicates that there was difficulty in getting enough water for the sample and that some turbidity (sediment) was entrained in the sample that was collected on December 8, 1998. The Phase IIA indicates a concentration of 5,950 ug/L of lead in the collected groundwater. The report also states that the reported results may overstate the actual dissolved lead levels and could include some lead bound to particulate matter. It is common on an unfiltered sample to have the laboratory analysis include both the dissolved and particulate portion.

During the Phase IIC field investigation, a monitoring well (MW-B4) was installed approximately 10 feet from PZ-24 on August 1, 2000. Based on the boring log, the well was installed to a depth of approximately 22 feet and completed with a 10 foot, 10-slot screen that included a sand filter pack. The longer screen, filter pack and narrower slot size would allow for better development. Sampling during Phase IIC indicated a concentration of 2,580 ug/l in PZ-24 and 64.6 ug/l in MW-B4. While no soil sampling was performed during either of the above installations, soil evaluation was performed in the excavation of the Cold Waste Area immediately to the south along the shoreline in July of 2017. This evaluation identified discontinuous clay layers 1 to 2 feet below the ground surface. It is expected that both PZ-24 and MW-4B may be screened or partially screened in one of these layers allowing fine clay particles through the screen and/or sand pack without true low flow sampling conditions.

The Phase III Supplemental Sampling Data Report (2009) included sampling groundwater from PZ-24. The report indicates that PZ-24 did not yield a significant amount of water and, consequently, low flow sampling could not be performed. However, after a lengthy recharge period, the piezometer provided just enough water to collect a sufficient sample volume for primary sample and duplicate analysis before it went dry. The result of this sampling analysis collected on September 9, 2008 was 3,960 ug/l of lead.

On October 23, 2015 an attempt was made to collect a sample of groundwater from PZ-24. When inspected and gauged, the piezometer was found to be devoid of water.

A groundwater sample (GW-MW-B4) was then collected from the existing nearby monitoring well (i.e., located less than 10 feet to the east of PZ-24). The groundwater sample (GW-MW-B4) was collected from the existing monitoring well on October 23, 2015, using USEPA low-flow sampling procedures in accordance with the SOP. The field technician checked and recorded the condition of the well for any damage or evidence of tampering. The well cap was removed and the well headspace was measured with a PID, the reading was recorded in the field book and on the associated Low-Flow Data Sheet (see Appendix 3H). The field technician then measured and recorded the depth to water and total depth using a water level meter. The volume of the water column in the well was calculated and recorded on the Low-Flow Data Sheet and field logbook along with total depth and depth to water. Dedicated polyethylene tubing was then lowered down the well to a depth the where the tubing intake was less than two feet above the bottom of the well. The tubing was then connected to a Solinst peristaltic pump and pumping began at a rate of approximately 0.10 to 0.25 liters per minute. The water level in the well was monitored periodically to ensure that drawdown did not exceed 0.3 feet. When drawdown was observed the pumping rate was reduced accordingly. Once the purge rate was achieved, the specified groundwater field parameters (i.e., temperature, pH, turbidity, specific conductivity, dissolved oxygen and oxygen redox potential) were collected every 5 minutes and recorded on the Low-Flow Data Sheet. A Horiba U-52 water quality meter with flow-through cell was used to monitor the field parameters. The field parameters were only measured after the flow-through cell was “flushed” with groundwater twice. Pumping continued, with readings every 5 minutes, until the parameters stabilized for three consecutive readings. The readings were recorded on the Low-Flow Data Sheet. Once the field parameters stabilized, the Horiba was removed and samples were collected directly from the end of the tubing. The samples were collected in pre-preserved (nitric acid) plastic jars. The samples were then labeled, recorded on the chain-of-custody and placed immediately into a cooler for shipment and maintained at 4°C. Lastly, the well was closed and locked. Groundwater sample GW-MW-B4 was analyzed for total lead (unfiltered). The primary and duplicate samples reported lead detections of 2.8 and 1.9 ug/L, respectively.

Based on the above analysis it appears that PZ-24 never represented true concentrations of lead in the groundwater in the area because of the installation technique. In addition, based on its construction a piezometer like PZ-24 is only useful for several years and most likely had “silted up” by 2009 and was no longer viable. A properly constructed monitoring well like MW-B4 can be sampled for many years and can allow for accurate evaluation of lead levels using current USEPA/MassDEP approved sampling techniques.

3.5.1.2 Results

GW-DP-MW1

Table 3-20 and Figure 3-13 present the total mercury concentrations detected at DP-MW1. The primary and duplicate samples reported mercury detections of 1,170 and 1,230 ug/L, respectively. These results are consistent with the last sampling results conducted in 2009, remain above the MassDEP Groundwater (GW) UCL for mercury (i.e., 200 micrograms/Liter (ug/L)), and confirm the ongoing presence of mercury in the groundwater at this location.

GW-MW-B4

Table 3-20 and Figure 3-13 present the lead concentrations detected at MW-B4. The primary and duplicate samples reported lead detections of 2.8 and 1.9 ug/L, respectively. These results do not exceed the MassDEP GW UCL for lead (i.e., 150 ug/L) and are significantly lower than the results for the samples collected in 2009, when lead concentrations exceeded 3,900 ug/L. These results indicate the lead concentrations have become greatly reduced, although further monitoring is recommended to confirm these initial findings.

4.0 SEDIMENT AND SOIL WASTE CHARACTERIZATION RESULTS

4.1 Characterization Approach

In order to characterize the sediment and soil at the Site relative to potential handling and disposal requirements for any re-baselining investigation-derived waste or future remediation waste streams, samples of representative sediment and soil from different areas of the Site were subjected to a set of waste characterization analytical tests. These included:

- Flashpoint;
- Toxicity Characteristic Leaching Procedure (TCLP) Metals;
- Organic compounds analyses relative to the maximum concentrations associated with the various EPA Hazardous Waste “D” Codes or the relevant Extraction Procedure (EP) toxicity threshold;
- Free Cyanide;
- Reactive Sulfide;
- pH; and
- Free Liquid (Paint Filter Test).

Samples of the following sediment and soil were analyzed for waste characterization purposes:

- ECCU (Upper Overbank Area) soil;
- ECCM (Middle Overbank Area) soil;
- ECCL (Lower Overbank Area) soil;
- MUA soil;
- MUA sediment; and
- MLFP sediment.

4.2 Results

Table 4-1 presents the results of these analyses and compares the results to the four characteristic properties that define a waste as a characteristic hazardous waste. The results of these tests are as follows:

- Flashpoint – No samples were ignitable.
- TCLP Metals – No sample results exceeded their respective thresholds.
- Organic compounds analyses relative to the maximum concentrations associated with the various EPA Hazardous Waste “D” Codes and EP toxicity characteristic thresholds – No sample results exceeded their respective thresholds.
- Free Cyanide – USEPA has withdrawn its numeric threshold for free cyanide.
- Reactive Sulfide – USEPA has withdrawn its numeric threshold for reactive sulfide.
- pH – No sample results were outside of the non-hazardous range.

- Free Liquid (Paint Filter Test) – Only one sediment sample from the MUA failed the Paint Filter Test for free liquids.

Three drums of investigation-derived waste (IDW) were generated during the re-baselining sampling: (1) Factory Pond sediment; (2) ECC soil; and (3) Former Test Range Berm soil. The waste characterization results were used to compile a Generator Waste Stream Profile Sheet. This profile is included as Appendix 4A. Given this profile, the contents of the three drums were determined to be non-hazardous. These characterization results will be factored into the revised Phase III RAP.

Based on the determination that the waste was non-hazardous, Clean Venture, Inc. of Framingham, MA was selected as the transporter and Tradebe Treatment and Recycling, LLC was selected as the disposal facility for the IDW. The IDW drums were removed from the Site on December 1, 2015. A copy of the completed waste manifest also is included in Appendix 4B.

5.0 SEDIMENT AND SOIL GEOTECHNICAL PARAMETERS

5.1 Testing Approach

A number of geotechnical parameters are significant in the identification, evaluation and subsequent design of remedial alternatives for addressing sediment and soil contamination. In order to characterize these sediment and soil parameters, samples of representative sediment and soil from different areas of the Site were subjected to a set of geotechnical tests. These included:

- Classification
- Characterization Parameters

– Moisture Content	[ASTM D 2216]
– Moisture Content	[ASTM D 2974]
– Fractional Organic Matter	[ASTM D 2974]
– Total Organic Matter	[ASTM D 2974]
– Ash Content	[ASTM D 2974]
– Atterberg Limits: Liquid Limit	[ASTM D 4318]
– Atterberg Limits: Plastic Limit	[ASTM D 4318]
– Atterberg Limits: Plasticity Index	[ASTM D 4318]
– Specific Gravity	[ASTM D 854]

- Particle Size Analysis

Composite samples of the sediment or soil from the following sub-areas were analyzed to identify their geotechnical parameters:

- ECC sediment;
- LDRC sediment;
- LUFP sediment;
- MLFP sediment;
- MUA sediment; and
- MUA soil.

5.2 Results

Table 5-1 presents the results of these analyses and Appendix 5A presents the particle size distribution curves and soil classification breakdowns for these samples. Based on a Modified Burmister Soil Classification of the particle size analysis as shown in the Appendix 5A graphs:

- The sediment sample from the ECC, SD-ECCS-GT, was widely graded SAND with some GRAVEL and a trace of SILT and CLAY;
- The sediment sample from the LDRC, SD-LDRC-GT, was narrowly graded SAND with a trace of SILT and CLAY;
- The sediment sample from LUFP, SD-LUFP-GT, was widely graded SILT and CLAY with some SAND;

- The sediment sample from MLFP, SD-MLFP-GT, was widely graded SAND with SILT and CLAY and some GRAVEL;
- The sediment sample from the MUA, SD-MUAU-GT, was widely graded fine SAND with SILT and some CLAY with a trace of GRAVEL; and
- The soil sample from the MUA, SO-MUAU-GT, was widely graded fine SAND with some SILT and GRAVEL and a trace of CLAY.

In general, the ECC, LDRC and the MUA sediments are saturated fine to coarse sand and gravel. The Lily Pond and Factory Pond sediments are saturated clay to silt with lesser amounts of sand. In addition, the results of these tests are as follows:

- The ECC has the highest percentage of course material (i.e., gravel and coarse sand) of the reaches sampled.
- Factory Pond and the MUA sediments have much higher silt and clay compositions than the ECC and the LDRC streams.
- The percentages of silt and clay correlate with the percentage of organic matter. The percentage of organic matter increases with the amount of material with the smaller grain sizes (see Table 5-1).
- Specific gravity of the sediment is very consistent, with the exception of the sediment from LUFP. This is most likely the result of higher organic content and higher clay water saturation.
- The sediment from LUFP has appreciable mass in the smallest grain sizes.
- The MLFP and MUA sediments also display relatively smaller grain size distributions.
- The MUA sediment sample had the highest organic matter content.

A few photographs of the sediment samples that were subjected for geotechnical testing are included in Appendix 5B.

The percentages of silt and clay and organic matter should correlate to an appreciable degree with the mercury concentration in sediment and soil. These results will be factored into the revision of the Phase III RAP.

6.0 SEDIMENT STABILIZATION / AMENDMENT TESTING RESULTS

6.1 Sediment Stabilization / Amendment Testing Approach

Composite bulk sediment samples for sediment amendment and stabilization testing were collected from selected locations within the Site ponds and from the ECC. The samples were collected using the same procedures used to collect the samples for chemical analysis. Six five-gallon buckets of sediment (about 2 gallons of wet sediment from each location) and three five-gallon poly cubes of associated surface water (one from each location) were collected for these tests. The sediment and water sample identification values were identified as follows:

- SD-LUFP-BP
- SD-MLFP-BP
- SD-ECCS-BP

The sediment from each sampling location (composite for the water body) was homogenized with a paint stirrer and hand drill. Mechanical dredging was simulated by placing the sampled surface water over its corresponding sediment in large pails. A large spoon was used to simulate the dredging/removal of material from the pails. Several subsamples of this material were collected for the amendment and analytical testing. The solids concentration (% dry weight) per ASTM D2216-10, specific gravity, and organic matter testing per ASTM 2974 were performed on the simulated dredge spoils.

The simulated dredged sediment was then stabilized until it passed paint filter test with Calcimite, Portland cement, and the superabsorbent material Solve 1880 at different concentrations associated with each amendment rate. The solids concentration and unit weights of amended sediment were then determined. Any water released was tested for Total Suspended Solids (TSS). The data report from dewatering test is in Appendix 6A.

6.2 Results and Interpretation

The MFLP and LUFP sediment showed similar characteristics with solids content of 66.5%, organic matter of 1.5% to 3.0%, and with average specific gravity of 2.5. The ECC sediment had lower solids content (30.6%), a lower specific gravity (2.0) and a higher organic matter content (11.3%).

The results of the amendment testing relative to passing the paint filter test showed that:

- The MFLP sediment was able to pass the paint filter test when mixed with 15% Calcimite or 15% Portland cement or as little as 0.25% of the superabsorbent.
- The LUFP sediment passed the paint filter test when mixed with 10% Calcimite or 10% Portland cement or 0.25% of the superabsorbent.
- The ECC sediment passed the paint filter test when mixed with 10% Calcimite or 15% Portland cement or 0.5% of the superabsorbent.

The results of the amendment testing relative to the effect of the amendment addition on the unit weight and solids content showed that:

- Mixing ECC sediment with the superabsorbent does not appear to appreciably change the solids content or unit weight of the sediment mixture, while there was a more significant reduction in unit weight and increase in solids content of MLFP and LUFP sediment when mixed with the superabsorbent.
- The unit weight and solids content of ECC sediment increased when mixed with Calcimite and Portland cement.
- The unit weight of the MLFP and LUFP sediment remained the same with the addition of amendment, but the solid content increased when mixed with Calcimite and Portland cement.

The TSS for the Site water samples were:

- SD-MLFP-BP water 2 milligrams per liter (mg/L);
- SD-LUFP-BP water 5 mg/L; and
- SD-ECCS-BP water 2 mg/L.

The paint filter tests performed on sediments mixed with amendment did not release enough water for TSS analysis. However, the water that was released appeared to have a high TSS content.

A more detailed discussion of the testing approach and results is presented in Appendix 6A.

7.0 SEDIMENT DREDGE ELUTRIATE TESTING RESULTS

7.1 Dredge Elutriate Testing Approach

To develop definitive data for estimating the degree of contaminant release from the sediment into the surface water during sediment removal, a DRET was performed in accordance with the “Dredging Elutriate Test Procedure” published by the U.S. Army Corps of Engineers, ERDC/EC TR-08-29, “Technical Guidelines for Environmental Dredging of Contaminated Sediments”, September 2008 (USACE, 2008). The DRET method is particularly effective for examining short term contaminant release at the point of dredging. A copy of the general DRET procedure used during testing is included in Appendix 7A.

Composite bulk sediment samples for dredge elutriate testing were collected from selected locations within the Site ponds and from the ECC. The samples were collected using the same procedures used to collect the samples for chemical analysis. The samples were used to perform a DRET with supplemental treatment (filtration) of the generated elutriate. Three five-gallon buckets of sediment (about 1 gallon of wet sediment at each location) and 18 five-gallon poly cubes of surface water (about 30 gallons of surface water at each location) were collected for these tests. The sediment and water sample IDs were identified as follows:

- SD-LUFP-BP
- SD-MLFP-BP
- SD-ECCS-BP

The DRET assessed the potential impact(s) to surface water (i.e., mass transfer of contaminants from sediment to surrounding surface water) from the potential dredging or excavation of contaminated sediments. A total of 12 different potential elutriates were generated for these tests:

- Nine elutriates from the LUFP, MLFP, and ECC composite sediment samples (i.e., 3 elutriates with different compositions from each of the 3 samples):
  - 1.0% [10,000 mg/L target TSS concentration] sediment slurry with one-hour aeration and a one hour settling time
  - 0.5% [5,000 mg/L target TSS concentration] sediment slurry with one-hour aeration and a one hour settling time
  - 0.1% [1,000 mg/L target TSS concentration] sediment slurry with one-hour aeration and a one hour settling time
- Three additional elutriates (i.e., one each from the LUFP, MLFP, and ECC sediment samples):
  - 1.0% [10,000 mg/L target TSS concentration] sediment slurry with six-hour aeration and a one hour settling time

The sediment slurries referenced above were prepared by mixing the homogenized sediment media with the associated surface water samples. For each elutriate generated, Tetra Tech analyzed one total and one dissolved sample for:

- Total Priority Pollutant 13 metals by SW846 Method 6020 (including mercury by Method 7470);
- PAHs by USEPA Method 8270 (GC/MS-SIM); and
- Polychlorinated biphenyls (PCBs) by USEPA Method 8082 (Arochlors).

The data report from DRET testing is in Appendix 7A.

7.2 Results and Interpretation

The data showed that limited concentrations of PAHs and metals were released to the water column. The majority of the metals and PAH compounds detected in the unfiltered samples appeared to be removed to less than the MassDEP MCP groundwater GW-2 and GW-3 standards by filtration through 0.45 um filter media. No Arochlors were released into the water column (either filtered or unfiltered) during the DRETs. The MassDEP MCP Method 1 groundwater standards (i.e., GW-1, GW-2 and GW-3) were used for an initial comparison of the elutriate quality. Table 7-1 shows how these comparison criteria compare to other potentially relevant federal surface water criteria for human health or aquatic life protection. The various standards and criteria are presented to give the broadest possible perspective on the DRET results relative to the Phase III evaluation of dewatering water quality. It should be noted that the Site groundwater and surface water are not sources of drinking water. As such, those standards and criteria have been shaded in gray in Table 7-1.

During the DRET tests, antimony concentrations exceeded the relevant MCP groundwater standard in the unfiltered samples for the LUFP-BP and ECCS-BP samples. However, filtration through 0.45 um filter media reduced the antimony concentrations to less than the MCP groundwater standards for the LUFP-BP 0.5% DRET (1-hour aeration), but not for the LUFP-BP 1.0% DRET (1 hour and 6 hour).

The DRET data suggests that the majority of the detected metals concentrations are particulate-related with the exception of antimony and, to a lesser degree, arsenic. Therefore, the use of filtration will remove a significant amount of the contaminant waste load from the discharge of a potential future treatment system. These test results suggest that some controls (e.g., silt curtains, semi-permeable silt curtains, structural barriers) also should be considered for the dredging zone to remove or limit the dispersion of particulates that may contain metals (particularly antimony).

In general, the DRET results for each sediment (i.e., LUFP-BP, MLFP-BP, and ECCS-BP) were relatively similar between tests with different initial TSS concentrations.

The DRET data suggests that there is only limited potential for constituent release from the various sediment samples into the water column with the exception of antimony for the LUFP-BP and ECCS-BP sediments. The partition coefficients calculated from the total and dissolved DRET results are associated with COCs that generally have limited mobility. Therefore, when sediment gets re-suspended during dredging operations, the constituents are not likely to be transferred from sediment particles to the water column and negatively impact water quality.

A more detailed discussion of the testing approach and results is presented in Appendix 7A.

8.0 BATHYMETRIC SURVEY

8.1 Objective

The goal of the bathymetric survey was to map the elevation of the pond bottom within Lily and Factory Ponds. These ponds were first surveyed in March of 2002 by CR Environmental, and a portion of Lily Pond and the area near Factory Pond Dam was surveyed again in September of 2009. However, both of these surveys preceded the historical flows generated by the record precipitation events in 2010. As such, the bathymetric study was performed to re-establish the current bottom elevations for use in the Phase III evaluations.

8.2 Bathymetric Approach

A single beam bathymetric survey was conducted on Lily and Factory Ponds on October 2nd through 4th, 2015. The primary survey equipment consisted of a single beam echo sounder (SBE) sweep system and vessel positioning equipment. These systems were used to map bathymetry in these ponds, to the extent accessible by vessel and the sonar's ability to capture valid data. The SBE system and support sensors were installed on a small vessel. One sonar head was installed with the head approximately one foot below the waterline and directly below the positioning and elevation sensors. The other sonar, that was collecting data simultaneously, was fixed to the hull of the vessel.

These ponds were observed to have significant aquatic vegetation during the time of survey and extra measures were taken to ensure data collection and reduce stand-down time due to packed vegetation covering the sonar. However, it is likely that the bathymetric data in some shoreline areas has been affected by the presence of submerged aquatic vegetation (SAV). Additionally, due to the presence of heavy aquatic vegetation some areas were not able to be surveyed at all. However, the extents of the areas where no bathymetric information could be collected during this survey were limited and were almost exclusively on the boundaries of shallow areas that are routinely marshy and/or transitional to wetlands. As such, the lack of bathymetric data in these areas does not represent a significant data gap relative to performing the Phase III evaluations and no additional bathymetry is recommended.

Horizontal (X, Y) positioning data for the survey were collected in North American Datum 1983 (NAD83) U.S. State Plane Massachusetts Mainland. Elevation data were collected in Mean Sea Level (MSL) based on project monitoring well DP-MW1 top of riser elevation. Land-based control points re-established for the re-baselining sampling provided control verification for this and survey work. Daily bar checks and GPS waterline checks were conducted as a quality control procedure to confirm the sonar's ability to record accurate depth measurements.

8.3 Results and Observations

The bathymetric survey report and charts from the single beam bathymetry survey of Lily and Factory Ponds are provided in Appendix 8A. Charts are provided with the bathymetry presented as a digital terrain model (DTM) and sounding in each cell for a 3-foot cell size grid. Figure 8-1 shows the bathymetric chart from the 2015 survey. Figure 8-2 shows the bathymetric chart from the prior 2002 survey. The following are a few observations from a comparison of the results of the two surveys:

- The overall range of bottom elevations was the same in the two surveys: 39 to 48 feet MSL.
- Less of the shallowest portions of Lily Pond could be surveyed in 2015 due to thick vegetation and the low water levels (which had not fully recovered following the repair of the cracks in the control boards of Factory Pond Dam a couple of weeks prior to the bathymetric survey).
- There has been very little movement in the location of the primary channel from the southern end of Lower Drinkwater River through Upper Factory Pond.
- A pattern of counterclockwise (relative to facing in the direction of downstream flow) circulation caused by the constriction of flow at the Greenway foot bridge separating Upper from Middle Factory Pond appears to have deposited some additional sediment along the eastern shoreline just upstream of the bridge.
- There has been very little movement in the location of the primary channel through Middle and Lower Factory Pond.
- The deepest point in Lower Factory Pond in both 2002 and 2015 was located approximately 200 feet southeast of the Factory Pond Dam.
- A somewhat wider deeper area appears to have been scoured out behind Factory Pond Dam. The bathymetry results suggest that the material in this area may have been transported partway up into the delta of the tributary south of the dam and deposited there. The deposition appears to have been in the water-covered portion of this area and not at any shoreline.

9.0 RISK CHARACTERIZATION BRIDGING

9.1 Recognition of Changes and Need for Updates

The risk characterization prepared as part of the 2005 Phase II Comprehensive Site Assessment (CSA) presented the approach and results of a Method 3 risk characterization performed for the soil, groundwater, sediment, surface water, and fish tissue at the Site. The conceptual site model (CSM) for potential human and ecological exposures that was developed in 2005 reflected the current and the reasonably foreseeable future exposure pathways for the Site receptors to the impacted environmental media in each potential exposure area based on the information available at that time. Since then, the CSM and the content of the 2005 risk characterization have become out of date to different degrees and are no longer in complete accordance with the risk characterization components of the current MCP or the current conditions at the Site. Events that have occurred since the Phase II risk characterization and CSM that have contributed to the need for the current risk characterization "bridging" activities include:

- Phase III Supplemental Sampling and Revised Phase III RAP. June 2009 (Tetra Tech 2009);
- MCP updates and amendments;
- Extreme storm events that have affected conditions at the Site;
- Supplemental Phase II Re-Baselining sampling performed in 2015; and
- Release Abatement Measure (RAM) Plan for the Former Test Range Berm Area and the Cold Waste Area (Tetra Tech - Ongoing).

As new and additional information has become available, a risk characterization "bridging" effort was designed to update the CSM for the Site, reassess the chemicals of potential concern, and develop proposed PRGs for the constituents in the identified exposure media at the Site. Appendix 9A describes this risk characterization "bridging" effort and its findings. This set of risk characterization activities was performed to provide a linkage between the last formal risk characterization work performed for the Site and the updated PRGs that will be needed to revise the Phase III RAP. An updated CSM, updated remedial action objectives (RAOs) (Note: This acronym does not stand for "Response Action Outcome"), and associated proposed soil and sediment PRGs will be incorporated into the revised Phase III RAP analysis of remediation options. The Phase III RAP also will be revised to incorporate the additional site characterization data collected since 2009 and to reflect updated remediation methods and their associated costs.

9.2 Updated Conceptual Site Models

9.2.1 Updated Conceptual Site Model for Human Health Exposures

The 2005 CSM was reviewed to determine if the results from the subsequent soil and sediment sampling or changes that have occurred at the Site since 2005 required adjustments to be made to the CSM. Updating the previous CSM from 2005 also included the identification of any potential new receptors that were not previously identified, as well as any additional exposure points to an impacted environmental medium. Appendix 9A presents the updated CSMs for human health exposures to soil and sediment in the northern, central, and southern portions of the Site, respectively. A summary of the updated CSMs in these areas is presented below.

Northern Portion of the Site

The Potential Greenway Area was further developed since 2005 and is now part of the "Greenway Trail" that runs on both the eastern and western sides of the ponds north of the foot bridge and incorporates the foot bridge itself. In addition, the CSM was updated to include users of the Upper North Area who may be potentially exposed to the mercury-contaminated sediment on the ground surface in the Eastern Channel Corridor Over Bank Areas, since accessible soil exposures were not previously highlighted for these areas. Previously, the 2005 CSA identified mercury as the direct contact sediment "risk driver" for a trespasser in the ECC sediments, and mercury, benzo(a)pyrene and benzo(a)anthracene as the "risk drivers" for a recreational fisherman. Therefore, the potential risk to these receptors from direct contact exposure to the accessible soil containing the recent sediment deposits will be assessed for these receptors and chemicals. The additional sediment samples that were collected in the ECC, LUFP and MLFP during the 2015 re-baselining sampling event were only analyzed for mercury. As sediment mercury concentrations were the only new data collected, there were no changes to the CSM for these areas. The current and reasonably foreseeable future receptors for the northern portion of the Site were identified in the updated CSM as commercial workers, commercial customers, utility workers, construction workers, trespassers, recreational users and recreational fisherman (see Figure 7-1 of Appendix 9A).

Central Portion of the Site

The updated CSM for this area is similar to the one developed in the 2005 CSA (see Figure 7-2 of Appendix 9A). However, since the development of this 2005 CSM, there is a better understanding of the extent of contamination in this portion of the Site, which is now known to be limited to the land owned by the Town of Hanover Conservation Commission. As such, commercial workers and commercial customers are no longer potential receptors in this area. In addition, because this portion of the Site encompasses conservation land, potential exposure to a conservation manager is now considered in the updated CSM.

Southern Portion of the Site

The detection of metals and explosives in the area in front of the Test Range Berm, the Test Range Berm itself, and the Area Behind the Test Range Berm during the 2015 re-baselining sampling suggested that this area also needed to be explicitly incorporated into the updated CSM relative to potential exposure to these constituents. The current and reasonably foreseeable future receptors for this area are construction workers and utility workers who may interact with the soil in the future to build structures associated with the recreational and conservation uses of this area and any associated buried utilities. Adult and child recreational users also may be potentially exposed to the eventual surficial soil that will be present in this area in the future.

However, the Former Test Range Berm has undergone extensive soil removal activities along the berm face as part of the ongoing RAM/IRA in 2017. The removal of this soil and the restoration with clean material will make the direct contact exposure pathway incomplete for the Former Test Range Berm Area. Accordingly, soil PRGs were not developed for the metals or explosives detected in this area during the 2015 re-baselining sampling event.

An assessment of the current status and condition of each of the risk characterization areas identified in the 2005 CSA was performed because the subsequent site characterization and remediation activities have altered the conditions in these areas relative to the conditions that were reflected in the original CSM:

- There has been no change in the current or anticipated future land use or associated receptors for the SDA since 2005 relative to the soil. The top 18 inches of soil in the Cold Waste Area was excavated and removed. This remediation significantly reduced the concentrations of metals in the accessible soil in this area, especially those metals that had previously exhibited UCL exceedances (i.e., antimony, barium, zinc, and lead). Post-excavation confirmatory sampling of the remaining soil below the RAM excavation horizon yielded metals concentrations that did not exceed their MCP Method 1 S-1 Standards. Sidewall sampling in the Cold Waste Area excavation at the fence line indicated that two of four sidewall samples showed exceedances of the MCP Method 1 S-1 and S-2 Standards for total chromium and one sidewall sample result exceeded the MCP Method 1 S-1 and S-2 Standards for antimony. The only current or reasonably foreseeable future use of this area following site remediation is for conservation or recreation. Because activities associated with recreational or conservation land use are not typically intrusive into the soil past 18" (especially in this area with a relatively high groundwater table), the pathway for recreational exposure to contaminated soil is now considered to be incomplete within the Cold Waste Area fencing. Therefore, updated direct contact soil PRGs were not developed for the Cold Waste Area.
- Additional delineation soil sampling also took place in the MUA during the 2015 re-baselining sampling event where soil was tested for the presence of metals. There were no indicated changes to the potential receptors for this area.

The 2015 re-baselining sampling of the sediments in the IHRC and analysis for mercury was the first such sampling for most of this reach of the river. For reasons set forth in Appendix 3F, this area is not considered to be part of the Site.

The current and reasonably foreseeable future receptors for the subareas within the southern portion of the Site were identified in the updated CSM as utility workers, construction workers, trespassers, recreational users, recreational fisherman and conservation managers (see Figure 7-3 in Appendix 9A). As noted above, there are now incomplete pathways for some of these receptors in different subareas within the southern portion of the Site.

9.2.2 Updated Conceptual Site Model for Environmental Exposures

The 2005 environmental CSM presented in the Environmental Risk Characterization (ERC) Report also was reviewed to determine if the results from the 2015 re-baselining sampling events or changes that have occurred at the Site since 2005 warranted any changes or adjustments to the environmental CSM. Appendix 9A presents the updated CSMs for ecological exposures to soil and sediment in the northern, central, and southern portions of the Site, respectively.

The soil in the Upper North Area now includes soil in the Eastern Channel Corridor Over Bank Areas that has been impacted by the deposition of mercury-contaminated sediment. As such, the environmental CSM was updated to include these potential soil exposures. However, as the re-baselining only analyzed for mercury and mercury had already been identified as a Contaminant of Ecological Concern (COEC) for the Upper North Area in the 2005 ERC, no change to the COEC list was required for this area. Mercury was identified as a COEC for soil invertebrates, terrestrial plants, and microbial communities in the Upper North Area in the 2005 ERC.

The detection of metals and explosives at the FTRBA during the 2015 re-baselining sampling suggests that this area should be included in an updated environmental CSM. However, as stated previously, soil removal and restoration efforts at the berm ultimately will eliminate potential direct contact exposures of environmental receptors to impacted soil in this area. This will be confirmed through post-excavation confirmatory sampling at the final excavation face and the use of demonstrated clean backfill to restore the site. As such, there are no complete environmental exposure pathways included in the updated environmental CSM for this area.

9.3 Updated Soil and Sediment Human Health PRG Development

The updated soil PRGs associated with the exposure media and receptors highlighted by the updated CSM were developed using the current MassDEP ShortForms applying a single chemical modified “reverse” MCP Method 3 approach. Updated PRGs were calculated for the chemicals previously identified as direct contact “risk drivers” for the various receptors based on the Phase II HHRC results. The use of the current MassDEP ShortForms automatically factored into the PRG calculations several of the required changes and updates to the PRG development process that were previously noted in Section 9.1. These changes included the use of updated toxicity factors for chemicals, updated chemical and physical properties for chemicals, and the use of MassDEP default exposure factors for many of the common receptors of interest, when appropriate. These updates also reflected the elimination of calculated cancer risks for Class C carcinogens that no longer have published cancer toxicity values (such as 1,1-DCE) since the current MassDEP policy is to not estimate a carcinogenic risk for these chemicals.

Currently, relevant ShortForms have been published for soil exposures only for a construction worker and a park visitor. As no ShortForm has been published specifically for a utility worker, it is assumed that PRGs designed to be protective of the construction worker with appropriate exposure parameter inputs also would be protective of the utility worker who is typically assumed to have a shorter exposure duration (i.e., exposure during fewer days per event) but longer exposure period (i.e., exposure during events over multiple years) than the construction worker.

Although the utility worker may have a longer exposure period, the longer exposure duration and greater intensity of exposures to soil for a construction worker are anticipated to result in greater overall exposure and a risk-based PRG that is protective of a utility worker. Similarly, because no ShortForm has been published specifically for a recreational user or intermittent conservation worker, the ShortForm published for the park visitor was used to calculate the PRGs for the recreational user and intermittent conservation worker receptors using appropriate exposure parameter inputs. The particular surrogate receptor ShortForms were selected because they accounted for the appropriate combination of soil exposure pathways that would be expected for the actual Site receptor. The PRG ShortForm calculations for each receptor are presented in Attachment A of Appendix 9A.

To address the human health risks associated with exposure to accessible sediment at the Site, surficial shoreline sediment will be treated as accessible soil for purposes of calculating and applying an updated PRG in the Revised Phase III Report. The 2005 CSA identified a recreational fisherman and a trespasser as potentially being at risk from direct exposure to accessible sediment or shallow submerged sediment along the shoreline. As with the soil PRGs, updated sediment PRGs were calculated using the MassDEP ShortForms for soil exposures. Because ShortForms have not been published specifically for either of these two receptors, updated PRGs were calculated using a modified park visitor ShortForm for soil. Exposure parameters were selected that would be protective of a recreational fisherman or trespasser who would only infrequently be exposed to these surficial accessible sediments at the Site. The PRG ShortForm calculations for each receptor are presented in Attachment A of Appendix 9A.

9.4 Updated Environmental Soil and Sediment PRG Development

An assessment of the current status and condition of each of the ecological areas of concern outlined in the 2005 CSA was performed since the subsequent site characterization and remediation activities have altered the areas relative to the conditions originally reflected in the CSM. The environmental PRGs presented in the Revised Phase III RAP were updated, as needed. At this time, there has been no terrestrial update to the MCP ERC process relative to the use of screening values. As such, the Revised Phase III RAP environmental PRGs will be carried forward as the updated PRGs (see Appendix 9A).

10.0 SUMMARY

The Fireworks Site is approximately 240 acres of publicly- and privately-owned property generally located between King and Winter Streets in the Town of Hanover, MA. A portion of the waterbodies associated with the Site is located in the Town of Hanson, MA. The Site was extensively characterized over the period 1997-2009 in a series of MCP Phase II investigations that were focused successively on different environmental media and sub-areas of the Site. The Phase II Comprehensive Site Assessment Report was submitted to MassDEP in November 2005, and draft Phase III RAPs were developed in 2007 and 2009 based on the amassed data and information. In 2010, the Site experienced two 100-year storm events in succession that tripled the flow of water through the Site's river and ponds. Extensive flooding was observed, and it was determined that the prior sediment characterization results on which the 2009 Phase III RAP was based were no longer defensible as a result of the extremely high flows and resulting redistribution of sediments that were observed. A program to re-baseline a number of conditions at the Site and conduct selected benchtop testing of the sediments to support the evaluation of alternatives in the next phase of the MCP process was developed in January 2015. This sampling program was reviewed by MassDEP and revised in a cooperative process. The MassDEP-approved re-baselining sampling program was implemented in September through November of 2015. This re-baselining program included a significant amount of sediment and soil re-sampling to determine the impact of the flooding on the distribution of contaminants at the Site, additional focused sampling and investigation at the Former Test Range, limited groundwater re-sampling at locations previously showing UCL exceedances, a bathymetric survey of the Site ponds, and various sediment tests to support a future revised Phase III RAP. This Final Supplemental Phase II Report documents the results and findings of this re-baselining effort.

Several tasks were performed in preparation for the re-baselining field work. A scope of work was developed and refined through discussions with MassDEP. The approved scope of work was presented to the Conservation Commissions of the Towns of Hanover and Hanson in public meetings following the filing of Requests for Determination of Applicability relative to the Massachusetts Wetlands Protection Act and local wetlands by-laws and regulations. Access agreements with approximately 20 property owners who would be affected by the field activities were verified, updated, or newly obtained. Thereafter, project work plans (including a number of Standard Operating Procedures and updated Site-Specific Health and Safety Plans) were developed and the necessary subcontracts were put in place to accomplish the work. Analytical support compliant with the MassDEP CAM protocols was obtained.

The major findings of the re-baselining sampling and investigations of the various sub-areas of the Site are as follows:

- The layout of the Former Test Range is better understood and its various features (i.e., firing positions, the Heavy Steel Plate Area, the backstop berm, and surrounding buffers) have been located, delineated and characterized with respect to residual explosives and metals contamination. Considerable non-munitions related debris is now present in the Former Test Range in nearly all of the sub-areas. The Far-Range Firing Position did not have explosives or metals contamination greater than their corresponding MCP S-1, GW-3 soil standards or USEPA residential RSLs. At the Near-Range Firing Position, nitroglycerin was found in concentrations greater than the residential RSL, but less than the industrial RSL, and lead concentrations exceeding the MCP S-1, GW-3 standard (but less than the MCP S-2, GW-3 standard) were observed in front of the Near-Range Firing Position, however, this was in an area dense with cultural debris and trash within and on the soil. In the Heavy Steel Plate Area there were no metals concentrations exceeding MCP S-1, GW-3 standards, however, nitroglycerin was present at levels greater than MCP S-1, GW-3 and S-2, GW-3 standards. Lead was detected in and around the berm at concentrations exceeding the MCP S-1, GW-3, and sometimes S-2, GW-3, standard for lead. Nitroglycerin was detected in concentrations greater than the residential RSL in one of three ISM samples in the Area Behind the Berm. Explosives (other than nitroglycerin) were not indicated to be a concern at the Former Test Range. Previously identified concerns relative to explosive projectiles remaining in or near the berm remain.

- The re-baselining sampling of the soil in the Southern Disposal Area Soil UCL Exceedance Area revealed lead concentrations significantly greater than the MCP S-1, GW-3 and S-2, GW-3 standards for lead, but not greater than its UCL. This area also revealed concentrations of barium, chromium, and zinc that were greater than their respective MCP S-1, GW-3 standards. The re-baselining sampling of the soil in the PZ-24 Groundwater UCL Exceedance Area also revealed lead concentrations somewhat greater than the MCP soil standards for lead, but not greater than its UCL. This area also revealed barium and chromium concentrations that were greater than their respective MCP S1, GW-3 standards. There were no explosives exceedances of either MCP S-1, GW-3 standards or residential RSLs in either area. Sampling of the surficial soil in the two 100-Year Floodplain Areas along the western shoreline of Upper and Middle Factory Pond suggest there was little deposition of mercury-contaminated sediments in this area during the flooding. Soil in the Cold Waste Area was excavated and sifted as part of the process for removing munitions items. Any soil not meeting the MCP S-1, GW-3 standards was disposed of off-site. A significant amount of building demolition debris and trash remains in many locations within the SCCA. Although the source of this material would be difficult to identify with certainty, the majority of the building demolition debris appears to have originated at the Fireworks facility. Based on a review of historical aerial photographs, some of the building debris in the vicinity of the Former Test Range Area appears to be structures that were associated with the former test range. This range-related debris is being removed as part of the ongoing RAM at the Former Test Range Berm. The other building debris and solid wastes distributed throughout the SCCA typically contain ferrous metal and would represent physical obstacles for remediation equipment and personnel and confounding interferences relative to future sampling (especially relative to magnetometer or digital geophysical mapping for ordnance items). The investigation of areas for potential munitions that exhibit these confounding interferences will be addressed through a combination of visual inspection, instrument surveys, and focused intrusive exploration as each situation requires.

- A more complete delineation of the soil in the MUA was established. Mercury concentrations in soil down to 4 feet bgs in some locations exceeded the MCP S-1, GW-3, S-2, GW-3, and UCL standards for mercury. Lead concentrations also exceeded the MCP S-1, GW-3 standard for lead down to 4 feet bgs in a number of locations. Soil samples in the 12”-24” bgs depth range had mercury concentrations exceeding its MCP UCL. A layer of dense glacial till underlies the looser surficial material in this area. Previous soil sampling at the MUA included analysis for explosives and Tetryl was detected in one of the eight samples at 150 ug/Kg, which is less than the USEPA residential RSL of 32,000 ug/Kg (based on a non-cancer HQ of 0.2). Nitroglycerin was reported in two of the soil samples at 2,700 ug/Kg and 3,800 ug/Kg, which are greater than the USEPA residential RSL of 1,260 ug/Kg (based on a non-cancer HQ of 0.2). Because the MUA is part of the SCCA, residential land use is not likely. Both nitroglycerin results are less than the USEPA industrial RSL of 16,400 ug/Kg.

- There is evidence that contaminated sediments migrated downstream in the channel, overflowed, and deposited on the adjacent soil on the banks and adjacent lowlands of the ECC as a result of the flooding. This is particularly evident inside the lower elevation “S” bend or serpentine portion of the ECC channel. The mercury concentrations in some of these areas exceeded 500 mg/Kg. Shifts in the locations of thickest sediment deposition along the length of the ECC were seen relative to the earlier characterization results. Mercury-contaminated sediments were found a little farther upstream of the northeastern bend of the ECC (the previously indicated start of mercury contamination) than was previously documented. This may be the result of significant overland flow of run-off water observed to come down from the hillside to the north entering the ECC in this area and displacing the deposited sediments both upstream and downstream. Updated thicknesses of sediment and water level in the channel were obtained for use in a revised Phase III RAP.

- The mercury concentration in the sediments in the upstream portion of the LDRC were very similar to those in the lower (southwestern) portion of the ECC. Concentrations of mercury in the faster-flowing portion of the LDRC were less than the concentrations in the upstream portion.

- A considerable volume of mercury-contaminated sediment is present in Lily and Factory Ponds. Maximum mercury concentrations up to 700 mg/Kg were observed in the surficial sediment in Lily Pond and Upper Factory Pond, and up to 335 mg/Kg in Middle and Lower Factory Pond. Average mercury concentrations were greater than the surface sediment mercury proposed PRG of 4 mg/Kg to a depth of approximately two feet below the sediment surface. The bathymetric survey revealed thicker sediment deposits in many areas of the ponds relative to the previous bathymetric survey. Many of these depositional areas formed in relation to recirculation zones caused by flow restrictions like the

Greenway Trail foot bridge and natural obstructions. Mercury was found in sediments ubiquitously throughout the ponds. The data collected from Lily Pond and Factory Pond is sufficient to support the Phase III evaluations.

- Mercury concentrations in a few samples of MUA sediment were observed at levels comparable to the highest concentrations found in the pond sediments. The depth of the contamination in this area appears to be confined vertically by the underlying dense glacial till layer and horizontally to a localized footprint. The highest concentrations of mercury in the MUA Sediment Area were more clustered than in the ponds, and appeared, spatially, to be a continuation of the high soil mercury concentrations in the adjacent MUA Soil Area.
- Mercury concentrations in the sediment depositional areas of the IHRC just below Factory Pond Dam were very low (<0.8 mg/Kg). However, sediment samples taken at depositional areas farther downstream (between 1 and 2.5 miles from Factory Pond Dam) exhibited mercury concentrations between 3.1 and 4.2 mg/Kg. The overall average of all seven sediment samples collected between Factory Pond Dam and Luddam's Ford was 1.73 mg/Kg. The source of the mercury in the sediment in the IHRC downstream of the Factory Pond Dam is likely the result of the use of mercury in prolonged historical industrial activity along the river in this area and/or atmospheric deposition.
- The groundwater sampling performed at DP-MW1 showed that the mercury concentration at this monitoring well in the MUA still exceeds the MCP groundwater UCL for mercury. Groundwater sampling at MW-B4 showed no exceedance of the MCP groundwater UCL for lead that was reported based on the past sampling of groundwater from nearby PZ-24. Groundwater was sampled at MW-B4 (less than 10 feet to the east of PZ-24) after discovering that the PZ-24 well was devoid of water. An assessment of the installation technique of PZ-24 and the results suggest that the sample taken from PZ-24 during prior sampling was probably not representative of the local conditions. A properly constructed monitoring well like MW-B4 can allow for the accurate evaluation of lead using current USEPA/MassDEP approved sampling techniques.
- Fish tissue and other biota were not re-sampled during the re-baselining sampling event. Fish tissue and select biota will be re-sampled just before the implementation of the selected sediment remediation action for the Site so that the sampling will provide a more accurate baseline for pre-remediation fish tissue concentrations against which to monitor post-remediation changes.

The sediment mercury data collected during the re-baselining are sufficient to support the Phase III design and evaluation efforts. Much of the observed spatial heterogeneity can be explained by geomorphology and the shoreline configurations and flow paths. Confirmatory sampling will be specified and designed as part of the Phase III to be effective in demonstrating with sufficient confidence whether the ultimate sediment remediation goal has been achieved. It is unlikely that the confirmatory sampling will be performed on a uniform grid. It will need to consider to some degree pre-dredging contamination patterns and the physical features of the ponds and streams.

A number of samples of sediment and soil from different areas of the Site were tested and characterized relative to waste classification and disposal. None of these sediment samples were determined to be a RCRA "listed" hazardous waste or a hazardous waste because of their characteristics. Only one sediment sample from the MUA failed the Paint Filter Test for free liquids. A broad range of geotechnical parameters also were established for the sediments from various sub-areas of the Site. The sediments in the upper portions of the watershed were predominantly sand with a trace of silt and clay. The sediment in Lily and Upper Factory Ponds were more silt and clay with some sand. The sediments in Middle and Lower Factory Pond and the MUA were widely graded sand with traces of silt, clay and gravel. The sediments from each area were size fractionated. Correlations between particle size and organic matter content were observed.

Bench-top testing also was performed to gauge the ease with which the Site sediments may be stabilized through the addition of various amendments. The resulting properties of the amended sediments were documented. Typically, 10%-15% of Calcimite or Portland cement needed to be added to the sediments to get them to pass the Paint Filter Test. Less than 0.5% of a costlier but publicly available absorbent achieved the same result. The TSS concentrations in the Site surface water samples ranged between 2 and 5 mg/L. The DRET testing performed suggested that the majority of the detected metals concentrations in the simulated dredging wastewaters were particulate-related and not dissolved. As such, filtration would be expected to remove a significant amount of the contaminant load from the discharge of a potential future treatment system. The results also suggest that controls such as silt curtains, semi-permeable silt curtains, or temporary structural barriers may be needed for the dredging zone to remove or limit the dispersion of particulates that may contain metals.

The results of the re-baselining bathymetric survey were compared to the prior 2002 bathymetric survey. The overall range of bottom elevations was the same in the two surveys. There has been very little movement in the location of the primary channel from the southern end of Lower Drinkwater River through Upper Factory Pond. A pattern of counterclockwise circulation (relative to facing in the downstream flow direction), caused by the constriction of flow at the Greenway footbridge that separates Upper from Middle Factory Pond, appears to have deposited some additional new sediment along the eastern shoreline just upstream of the bridge. There also has been very little movement in the location of the primary channel through Middle and Lower Factory Pond. The deepest point in Lower Factory Pond in both 2002 and 2015 was located approximately 200 feet southeast of the Factory Pond Dam. A somewhat wider, deeper area now appears to have been scoured out behind Factory Pond Dam. The bathymetry results suggest that the material in this area may have been transported partway up into the delta of the tributary south of the dam and deposited there. The deposition appears to have been in the water-covered portion of this area and not on any shoreline.

11.0 LICENSED SITE PROFESIONAL (LSP) OPINION

Between September and November 2015, Tetra Tech conducted environmental sampling at the former National Fireworks Site in Hanover, Massachusetts. The sampling was performed in accordance with the Re-Baselining SOW prepared by Tetra Tech and approved by the MassDEP on September 15, 2015. The purpose of the sampling was to further delineate or re-delineate the extent of mercury contamination in the soil, sediment, surface water and groundwater at the Site and collect additional information needed to revise the Phase III RAP. The re-baselining sampling was performed in accordance with 310 CMR 40.0830, which describes the requirements and procedures for conducting Phase II - Comprehensive Site Assessments at disposal sites.

The results of the re-baselining sampling event confirmed that there was some redistribution of the mercury contamination at the Site, primarily with respect to sediments. However, the concentrations of mercury in the soil, sediment, surface water and groundwater at the Site were generally comparable in magnitude to what has been observed in previous sampling events. The results indicate that some of the sediment that was previously in the northeastern bend of the ECC has migrated father downstream in the channel and that other sediment washed out of the channel onto the soil in the low-lying areas adjacent to the channel during the very high precipitation events. Within the ponds, somewhat thicker sediment deposits appear to have accumulated in the depositional areas seen previously. The more recent deposits are likely to include some mercury-impacted sediment from upstream locations in the waterway. Deposition of mercury-impacted sediments on the shorelines of the 100-Year Floodplain areas of Factory Pond was not observed. In addition, previously observed soil and groundwater UCL exceedances at locations in the southern portion of the Site were not seen during the re-baselining sampling.

At the request of MassDEP, samples were collected in the Indian Head River Corridor farther downstream from the Factory Pond Dam. Previously, sediment samples had been collected and analyzed from the depositional areas of the river just downstream of the spillway of the Dam. The recent sampling included the previously sampled portion of the river and extended farther downstream to just above the Luddam's Ford Dam. Two sediment samples from the set of samples collected between Factory Pond Dam and Luddam's Ford Dam reported mercury concentrations marginally greater than the proposed mercury sediment PRG of 4 mg/Kg. One result (4.2 mg/Kg) was for the sample collected nearest to Luddam's Ford (i.e., farthest from the Site) and the other was for a duplicate pair sediment sample collected a little farther upstream. These paired values for the sample and its duplicate were 4.3 mg/Kg and 2.6 mg/Kg, such that the average result for that location was 3.45 mg/Kg. Based on historical manufacturing operations located along the river downstream of Factory Pond Dam, the source of mercury detected is not likely from the Site. Given the likelihood of historic industrial activity and atmospheric deposition as the source(s) of mercury in the below dam IHRC sediments, the definition of the Site has not changed and the nature and extent of contamination has been adequately delineated.

Consistent with the prior Phase II Comprehensive Site Assessment work performed at the Site, the new data indicates that concentrations of mercury at the Site pose a risk to human health and the environment as defined by the MCP. The need to perform remedial actions to reduce the amount of mercury at the Site was also confirmed by this re-baselining sampling event.

In January 2009, Tetra Tech performed exploratory trenching activities into the berm that was suspected to have been used as part of a range for test-firing of munitions manufactured at the former Fireworks facility. During these activities, Tetra Tech confirmed that the berm contained 20mm rounds. The re-baselining sampling also provided better characterization of the Former Test Range. During the recent re-baselining sampling event, soil samples were collected from the berm and other parts of the Former Test Range and analyzed for metals and explosive compounds. The results indicated that there are low-level concentrations of residual explosives in the soil at various locations within the Former Test Range, and lead in the soil at this berm at concentrations exceeding the MCP Method 1 S-1, GW-3 soil standard. Based on the presence of MEC in this berm and the presence of lead in the shallow soil, Tetra Tech recommended that this area and the Cold Waste Area be addressed through Release Abatement Measures. A RAM Plan for this purpose was developed in May 2017 and removal actions have since verified the presence of MPPEH and confirmed that a Risk to Safety exists in this area of the Site. The Risk to Safety also includes MPPEH that may be in parts of Factory Pond in the southern portion of the Site. For these reasons, Tetra Tech has been coordinating with the Town of Hanover Police and Fire Departments to restrict all public access to the southern portion of the Site and Factory Pond. This work has since transitioned to an IRA, commensurate with the finding of a Risk to Safety, and is on-going. A majority of the surficial soil at the Former Test Range and the Cold Waste Area that was sampled as part of the re-baselining sampling program has since been excavated, sampled and approximately 500 cubic yards that did not meet the MCP S-1, GW-3 standards were disposed off-site. The remaining soil meets the aforementioned standards and will be used during restoration of the disturbed areas.

It is the opinion of the Licensed Site Professional (LSP) of Record, and in conformance with 310 CMR 40.0840, to recommend the following:

- Revise the draft Phase III RAP (Identification and Selection of Remedial Action Alternatives) to incorporate the new data obtained from the re-baselining work and any advancements in remedial technology or approach that have occurred relative to remedial processing or disposal options since the 2009 draft. This revised Phase III study will be guided by the conclusions of the risk characterization that were presented in the Comprehensive Site Assessment Report and updated in Appendix 9A to this report and will establish a strategy for the Site that reflects the re-baselining data.

- Continue the removal actions proposed in the RAM and IRA Plans and approved by MassDEP for the FTRB and Cold Waste areas to reduce the Risk to Safety associated with potential MEC, explosives and lead in the soil. Since the Risk to Safety extends to Factory Pond in the southern portion of the Site, restrictions to the waterbody will need to remain in place and be enforced until the remedy can be selected and implanted.

This Final Supplemental Phase II Report is intended to update and supplement the Phase II studies previously conducted at the Site, which were referred to as Phase IIA, Phase IIB, Phase IIC, and Phase IID, and the Phase II Report submitted to MassDEP in 2005. Pursuant to the requirements set forth in 310 CMR 40.0836, the Phase II Comprehensive Site Assessment has been completed. The Final Supplemental Phase II Report conforms to applicable Phase II requirements, meets the Phase II performance standards and provides updated proposed soil and sediment PRGs for the Site, and does not disclose new or additional information which may affect the site’s Tier Classification or permit category without the concurrent filing of an application for a Major Permit Modification.

12.0 REFERENCES

Brooks Rand, 2018. Personal communications with Mr. Ben Wozniak, Senior Project Manager and Technical Services Specialist at Brooks Rand Laboratory (specialists in ultra-trace level metals analysis and metals speciation), Seattle, June 11.

Cragin, J. and B. Foley (USACE), 1985. Sample Digestion and Drying Techniques for Optimal Recovery of Mercury from Soils and Sediments. Special Report 85-16. U.S. Army Cold Regions Research and Engineering Laboratory, Hanover, NH

Defense Environmental Restoration Program, 1992. Formerly Used Defense Sites – Findings and Determination of Eligibility.

Hojdova, M., T. Navratil, J. Rohovec, V. Penizek, and T. Grygar, 2008. Mercury Distribution and Speciation in Soils Affected by Historic Mercury Mining. Water Air Soil Pollution 200:89-99.

Hojdova, M., J. Rohovec, V. Chrastny, V. Penizek, and T. Navratil, 2015. The Influence of Sample Drying Procedures on Mercury Concentrations Analyzed in Soils. Bull Environ Contam Toxicol 94 570-576.

Interstate Technology and Regulatory Council (ITRC), 2012. Increment Sampling Methodology, Technical Regulatory Guidance. Incremental Sampling Methodology Team. February 2012.

Pascoe, G.A., Kroeger, K., Leisle, D., and Feldpausch, R. J., 2010. Munition Constituents: Preliminary Sediment Screening Criteria for the Protection of Marine Benthic Invertebrates. U.S. Mavy Rsearch. 40.

Tetra Tech EC Inc. (Tetra Tech), 2009. Revised Phase III Remedial Action Plan. June 12, 2009

United States Army Corps of Engineers, 2008. Dredge Elutriate Test Procedure. *In:* Palermo, Michael R., Schroeder, Paul R., Estes, Trudy J., and Francingues, Norman R., “Technical Guidelines for Environmental Dredging of Contaminated Sediments”, ERDC/EC TR-08-29. September.

United States Environmental Protection Agency, 2013. EPA New England Environmental Data Review Supplement For Regional Data Review Elements and Superfund Specific Guidance/Procedures. EQADR-Supplement). April 22.

TABLES

Table 2-1. Implementation Schedule for the Approved SOW
Re-Baseline Sampling Field and Support Tasks

SOW Task	Description	Start – End Dates
Task 12	Mobilization and Site Preparation	9/28/15 – 10/6/15
Task 13	ECC Sediment Investigations	10/26/15 – 10/27/15
Task 14	Marsh Upland Area Soil Sampling	10/23/15 – 10/29/15
Task 15	Northern Area / Overbank Soil Sampling	10/14/15 – 10/16/15
Task 16	Southern Area / Test Range Soil Sampling	10/11/15 – 10/29/15
Task 17	Groundwater Sampling	10/22/15 – 10/23/15
Task 18	Indian Head River and Lower Drinkwater River Sediment Sampling	10/20/15 and 10/26/15
Task 19	Pond Bathymetry and Sediment Core Sampling	9/26/15 – 11/4/15
Task 20	Coordinating with Laboratories and Testing Firms	10/15/15 – 11/5/15
Task 21	Site Restoration and Demobilization	10/27/15 – 11/6/15

Notes:

ECC – Eastern Channel Corridor

SOW – Statement of Work

Table 3-1. Listing of the Sample Data Groups Encompassing the Test America Analytical Results

SDG	Lab Job ID	Sample Numbers	CAM Certification Date
200-30181	200-30181-1	200-30181-1 through 30181-11	10/22/2015
200-30182	200-30182-1	200-30182-1 through 30182-30	10/22/2015
200-30182	200-30182-2	200-30182-13; -19; -25	11/6/2015
200-30184	200-30184-2	200-30184 -3; -6 through 11; -13 through 17; -21; -25 through 26	11/3/2015
200-30211	200-30211-1	200-30211-1 through 30211-15	10/30/2015
200-30212	200-30212-1	200-30212-5; -19; -23	11/6/2015
200-30213	200-30213-2	200-30213 -2 through 3; -4; -5 through 6; -7 through 8; -10 through 12	11/3/2015
200-30309	200-30309-1	200-30309-1 through 30309-39	11/13/2015
200-30313	200-30313-2	200-30313 -4 through 10; -12 through 13; -16 through 18;-20 through 28	11/10/2015
200-30315	200-30315-1	200-30315-1 through 30315-4	11/11/2015
200-30316	200-30316-1	200-30316-1 through 30316-6	10/29/2015
200-30318	200-30318-1	200-30318-1 through 30318-48	11/11/2015
200-30340	200-30340-1	200-30340-1 through 30340-15	11/18/2015
200-30341	200-30341-2	200-30341-4; -6 through 8	11/16/2015
200-30342	200-30342-1	200-30342-1 through 30342-14	11/5/2015
200-30378	200-30378-1	200-30378-1 through 30378-11	11/19/2015
200-30379	200-30379-2	200-30379 -3; -8 through 11; -17; -20; -22; -25; -27 through 28; -30 through	11/17/2015
200-30379	200-30379-3	200-30379 -1 through 2; -6 through -7; -15	11/17/2015
200-30382	200-30382-1	200-30382-1 through 30382-49	11/5/2015
200-30385	200-30385-1	200-30385-1 through 30385-5	11/9/2015
200-30407	200-30407-1	200-30407-1 through 30407-22	11/25/2015
200-30408	200-30408-1	200-30408-1 through 30408-6	11/19/2015
200-30409	200-30409-1	200-30409-1 through 30409-21	11/17/2015
200-30410	200-30410-1	200-30410-1 through 30410-6	11/19/2015
200-30480	200-30480-1	200-30480-1 through 30480-26	11/25/2015
200-30482	200-30482-1	200-30482-1 through 30482-8	11/25/2015
200-30499	200-30499-1	200-30499 -3 through 4; -13 through 16; -19 through 21;-23 through 25; -28	11/13/2015
200-30499	200-30499-2	200-30499 -1 through 2; -5 through 12; -17 through 18; -22; -26 through 27	11/16/2015
200-30500	200-30500-1	200-30500-1 through 30500-4	11/13/2015
200-30503	200-30503-1	200-30503-1 through 30503-28	11/13/2015
200-30505	200-30505-1	200-30505-1 through 2; -5 through 19; -24 through 25	12/14/2015

Notes:

CAM - Compendium of Analytical Method protocols

ID - Identification Number

SDG - Sample Delivery Group

Table 3-2. Contents of the Appendix 3B-1 through 3B-5 Composite Data Tables			
Appendix	**Sampled Medium**	**Site Subarea(s)**	**Analytes**
3B-1	Sediment	ECC, LUFP, MLFP and Indian Head River Corridor	Mercury Only
3B-2	Soil	ECC Overbank Areas and 100-Year Floodplain Areas	Mercury Only
3B-3	Soil	Test Range Subareas and Soil UCL Exceedance Areas	Metals and Explosives
3B-4	Soil	MUA	Metals
3B-5	Groundwater	SCCA	Mercury and Lead

Notes:

ECC – Eastern Channel Corridor

LUFP – Lily / Upper Factory Pond

MLFP – Middle / Lower Factory Pond

MUA – Marsh Upland Area

SCCA – Southern Conservation Commission Area

UCL – Upper Concentration Limit

Table 3-3. Comparison of Pre-Air Dried and Post-Air Dried Sediment Sample Mercury Concentrations

Sample ID	Analysis	Initial Sediment Percent Solids (%)	Pre-Air Dry Concentration (mg/Kg)	Post-Air Dry Concentration (mg/Kg)
SD-LUFP69-06	Mercury	11.2	401	467
SD-LUFP8506	Mercury	11.9	7.3	29
SD-LUFP82-12	Mercury	21.2	1.3	1.5
SD-LUFP111-12	Mercury	19.8	0.18	18.3
SD-LUFP112-12	Mercury	22.6	1.6	2.4
SD-LUFP97-18	Mercury	11.4	132	55.7

Notes:

Conc. – concentration

mg/Kg – milligrams/Kilogram

Table 3-4. Mercury Results in Soil in the Eastern Channel Corridor

Sample ID	Sample Depth (inches)	Sample Date	Total Mercury Concentration (mg/Kg)	Lab Flag/ Qualifier	Reporting Limit (mg/Kg)	Sample Basis	Percent Solids (%)
ECC LOWER BANK OVERFLOW AREA							
SO-ECCL13-03	0-3	10/16/2015	56.6		7.1	DRY	28.7
SO-ECCL13-03-DUP	0-3	10/16/2015	65.7		8.1	DRY	29.2
SO-ECCL13-06	3-6	10/16/2015	181		32.7	DRY	34
SO-ECCL14-03	0-3	10/16/2015	51.1		7.1	DRY	32.6
SO-ECCL14-06	3-6	10/16/2015	55.2		9.8	DRY	51.2
SO-ECCL15-03	0-3	10/16/2015	32.5		3.3	DRY	16
SO-ECCL15-06	3-6	10/16/2015	24.5		5.0	DRY	20.9
SO-ECCL16-03	0-3	10/16/2015	0.59		0.15	DRY	62.7
SO-ECCL17-03	0-3	10/16/2015	119		40.3	DRY	27.6
SO-ECCL17-06	3-6	10/16/2015	97.0		16.2	DRY	32.5
SO-ECCL18-03	0-3	10/16/2015	763		57.5	DRY	37.3
SO-ECCL18-06	3-6	10/16/2015	421		98.7	DRY	49.8
SO-ECCL19-03	0-3	10/16/2015	74.4		7.3	DRY	29.3
SO-ECCL19-06	3-6	10/16/2015	90.5		17.0	DRY	33.2
SO-ECCL20-03	0-3	10/16/2015	47.0		3.1	DRY	30.9
SO-ECCL20-06	3-6	10/16/2015	8.4		2.0	DRY	55.4
SO-ECCL21-03	0-3	10/16/2015	50.8		3.8	DRY	29.3
SO-ECCL21-06	3-6	10/16/2015	128		34.0	DRY	32.7
SO-ECCL22-03	0-3	10/16/2015	97.2		25.7	DRY	37.6
SO-ECCL22-06	3-6	10/16/2015	1000		133	DRY	40.9
SO-ECCL23-03	0-3	10/16/2015	89.1		23.4	DRY	45
SO-ECCL23-06	3-6	10/16/2015	16.4		1.8	DRY	56.1
SO-ECCL24-03	0-3	10/16/2015	38.5		3.9	DRY	50.8
SO-ECCL24-06	3-6	10/16/2015	17.2		1.3	DRY	74.5
SO-ECCL25-03	0-3	10/16/2015	74.3		6.2	DRY	30.8
SO-ECCL25-03-DUP	0-3	10/16/2015	63.7		4.6	DRY	40.8
SO-ECCL25-06	3-6	10/16/2015	75.1		14.6	DRY	34.1
ECC MIDDLE BANK OVERFLOW AREA							
SO-ECCM26-03	0-3	10/16/2015	0.71		0.021	DRY	89
SO-ECCM26-03-DUP	0-3	10/16/2015	0.73		0.023	DRY	84.1
SO-ECCM27-03	0-3	10/16/2015	3.3		0.25	DRY	76.8
SO-ECCM28-03	0-3	10/16/2015	2.1		0.15	DRY	63.5
SO-ECCM29-03	0-3	10/16/2015	43.3		6.7	DRY	30.4
SO-ECCM29-06	0-3	10/16/2015	184		20	DRY	44.8
SO-ECCM30-03	0-3	10/16/2015	0.12		0.025	DRY	76.9
SO-ECCM31-03	0-3	10/16/2015	11.5		1.1	DRY	18.3
SO-ECCM31-03	0-3	10/20/2015	1.4		0.34	DRY	31.1
SO-ECCM31-03-DUP	0-3	10/20/2015	1.7		0.28	DRY	34
SO-ECCM31-06	3-6	10/16/2015	97.1		9.1	DRY	20.5
SO-ECCM32-03	0-3	10/16/2015	68.2		2.4	DRY	81.8
SO-ECCM32-06	3-6	10/16/2015	32.3		2.5	DRY	81.6
SO-ECCM33-03	0-3	10/20/2015	0.33		0.21	DRY	50.6

Table 3-4. Mercury Results in Soil in the Eastern Channel Corridor

Sample ID	Sample Depth (inches)	Sample Date	Total Mercury Concentration (mg/Kg)	Lab Flag/ Qualifier	Reporting Limit (mg/Kg)	Sample Basis	Percent Solids (%)
SO-ECCM34-03	0-3	10/20/2015	10.7		2.7	DRY	17.1
SO-ECCM34-06	3-6	10/20/2015	25.8		4.5	DRY	20.9
SO-ECCM35-03	0-3	10/16/2015	0.50		0.023	DRY	87.2
SO-ECCM36-03	0-3	10/20/2015	0.55		0.17	DRY	54.3
SO-ECCM37-03	0-3	10/20/2015	0.90		0.15	DRY	64.5
SO-ECCM38-03	0-3	10/16/2015	61.1		2.6	DRY	76.6
SO-ECCM38-06	3-6	10/16/2015	41.4		2.6	DRY	83.6
SO-ECCM39-03	0-3	10/20/2015	0.88		0.19	DRY	62.6
SO-ECCM40-03	0-3	10/20/2015	12.2		2.2	DRY	22.2
SO-ECCM40-06	3-6	10/20/2015	24.3		3.8	DRY	24.6
SO-ECCM41-03	0-3	10/20/2015	3.2		0.23	DRY	47.9
SO-ECCM42-03	0-3	10/20/2015	38.4		4.2	DRY	27
SO-ECCM42-06	3-6	10/20/2015	53.4		3.8	DRY	26.1
SO-ECCM43-03	0-3	10/20/2015	6.7		2.0	DRY	49.5
SO-ECCM43-06	3-6	10/20/2015	3.3		1.2	DRY	77.6
SO-ECCM44-03	0-3	10/20/2015	41.9		11.6	DRY	36.8
SO-ECCM44-03-DUP	0-3	10/20/2015	54.2		12.0	DRY	36.7
SO-ECCM44-06	3-6	10/20/2015	64.6		7.2	DRY	29.8
SO-ECCM45-03	0-3	10/20/2015	5.1		1.7	DRY	58.2
SO-ECCM45-06	3-6	10/20/2015	1.8		1.3	DRY	73.6
SO-ECCM46-03	0-3	10/20/2015	2.8		0.68	DRY	68.8
SO-ECCM47-03	0-3	10/21/2015	1.1		0.13	DRY	77.1
SO-ECCM47-03-DUP	0-3	10/21/2015	1.4		0.13	DRY	79.5
SO-ECCM48-03	0-3	10/21/2015	66.6		5.1	DRY	42.7
SO-ECCM48-06	3-6	10/21/2015	141		17.3	DRY	58.7
SO-ECCM49-03	0-3	10/21/2015	0.48		0.11	DRY	82.3
SO-ECCM49-03-DUP	0-3	10/21/2015	2.2		0.26	DRY	70.2
SO-ECCM49-06	3-6	10/21/2015	4.2		1.2	DRY	79.8
SO-ECCM50-03	0-3	10/21/2015	43.7		3.6	DRY	62.6
SO-ECCM50-06	3-6	10/21/2015	16.4		6.8	DRY	73.9
SO-ECCM51-03	0-3	10/21/2015	3.9		1.3	DRY	84.2
SO-ECCM51-06	3-6	10/21/2015	1.2		0.12	DRY	89.5
SO-ECCM52-03	0-3	10/21/2015	89.7		5.8	DRY	38.6
SO-ECCM52-03-DUP	0-3	10/21/2015	93.3		6.1	DRY	37.1
SO-ECCM52-06	3-6	10/21/2015	322		28.8	DRY	36
SO-ECCM53-03	0-3	10/21/2015	73.5		8.1	DRY	66.1
SO-ECCM53-06	3-6	10/21/2015	89.8		14.3	DRY	74.8
ECC UPPER BANK OVERFLOW AREA							
SO-ECCU54-03	0-3	10/15/2015	7.4		0.95	DRY	48.1
SO-ECCU54-06	3-6	10/15/2015	8.7		1.8	DRY	59.8
SO-ECCU55-03	0-3	10/15/2015	34.2		5.7	DRY	35.6
SO-ECCU55-06	3-6	10/15/2015	63.4		11.6	DRY	49.6

Table 3-4. Mercury Results in Soil in the Eastern Channel Corridor

Sample ID	Sample Depth (inches)	Sample Date	Total Mercury Concentration (mg/Kg)	Lab Flag/ Qualifier	Reporting Limit (mg/Kg)	Sample Basis	Percent Solids (%)
SO-ECCU56-03	0-3	10/15/2015	6.6		1.2	DRY	35.6
SO-ECCU56-06	3-6	10/15/2015	67.9		17.9	DRY	30.5
SO-ECCU57-03	0-3	10/15/2015	3.8		0.58	DRY	81.5
SO-ECCU57-03-DUP	0-3	10/15/2015	3.1		0.72	DRY	83.1
SO-ECCU57-06	3-6	10/15/2015	2.4		1.2	DRY	88.9
SO-ECCU58-03	0-3	10/15/2015	169		26.8	DRY	38.6
SO-ECCU58-06	3-6	10/15/2015	290		28.3	DRY	39.2
SO-ECCU59-03	0-3	10/15/2015	0.47		0.12	DRY	79.4
SO-ECCU60-03	0-3	10/15/2015	7.0		0.81	DRY	68.2
SO-ECCU60-06	3-6	10/15/2015	5.1		1.5	DRY	72.9
SO-ECCU61-03	0-3	10/15/2015	355		50.9	DRY	93.6
SO-ECCU61-06	3-6	10/15/2015	139		12.6	DRY	80.8
SO-ECCU62-03	0-3	10/15/2015	0.24		0.11	DRY	86.1
SO-ECCU63-03	0-3	10/15/2015	0.35		0.15	DRY	74.5

Notes:

Basis - Samples that are not air-dried prior to analysis are presumed to have a certain moisture content and are reported on a dry or wet basis with a percent solids measured by the laboratory and reported. Samples that are air-dried are presumed to have no moisture content and therefore no percent solids reported.

ECC - Eastern Channel Corridor

mg/Kg - milligrams/Kilogram

Table 3-5. Metals and Explosives Results in Soil at the Test Range Area

					Far-Range Firing Position						Heavy Steel Plate Area						Near-Range Firing Position						In Front of Test Range Berm						Test Range Berm - Quadrant 1											
Analyte	CAS	Soil Screening Value [1]	Soil Screening Value Source [2]	Basis	SO-SFRF-03-PM 10/13/2015 ISM SOIL 0-3		SO-SFRF-03-RM1 10/13/2015 ISM SOIL 0-3		SO-SFRF-03-RM2 10/13/2015 ISM SOIL 0-3		SO-SHSP-03-PM 10/14/2015 ISM SOIL 0-3		SO-SHSP-03-RM1 10/14/2015 ISM SOIL 0-3		SO-SHSP-03-RM2 10/14/2015 ISM SOIL 0-3		SO-SNRF-03-PM 10/13/2015 ISM SOIL 0-3		SO-SNRF-03-RM1 10/13/2015 ISM SOIL 0-3		SO-SNRF-03-RM2 10/13/2015 ISM SOIL 0-3		SO-STRF-03-PM 10/13/2015 ISM SOIL 0-3		SO-STRF-03-RM1 10/13/2015 ISM SOIL 0-3		SO-STRF-03-RM2 10/13/2015 ISM SOIL 0-3		SO-STRB1-06-PM 10/13/2015 ISM SOIL 3-6		SO-STRB1-06-RM1 10/13/2015 ISM SOIL 3-6		SO-STRB1-06-RM2 10/13/2015 ISM SOIL 3-6		SO-STRB1-12-PM 10/13/2015 ISM SOIL 6-12		SO-STRB1-12-RM1 10/13/2015 ISM SOIL 6-12		SO-STRB1-12-RM2 10/13/2015 ISM SOIL 6-12	
Metals (mg/Kg)																																								
Lead	7439-92-1	200	MCP	WET	38.7		39.4		50.8		63.7		63.9		75.9		317		332		262		171		203		239		240		327		232		309		685		264	
Mercury	7439-97-6	20	MCP	WET	0.15		0.15		0.27		0.15		0.16		0.2		0.31		0.32		0.33		0.14		0.14		0.17		0.029		0.032		0.045		0.048		0.059		0.047	
Explosives (ug/Kg)																																								
Perchlorate	14797-73-0	100	MCP	WET	0.71	B	0.86	B	1.5	B	1.54	U	0.31	B	0.47	B	0.85	B	1.69	B	2.3	B	1	B	0.95	B	0.77	J B	0.55	J B	0.48	J B	0.53	J B	0.84	B	0.48	J B	0.73	B
1,3,5-Trinitrobenzene	99-35-4	440000	RSL	WET	93.3	U	93.9	U	97.8	U	49.7		277		68.5		95.1	U	98.3	U	98.4	U	96.2	U	94.8	U	98.9	U	93.7	U	93.4	U	98.3	U	98.1	U	94.6	U	94.1	U
1,3-Dinitrobenzene	99-65-0	3000	MCP	WET	93.3	U	93.9	U	97.8	U	197	U	222		197		95.1	U	98.3	U	98.4	U	96.2	U	94.8	U	98.9	U	93.7	U	99.1	U	98.3	U	98.1	U	94.6	U	94.1	U
2,4,6-Trinitrotoluene	118-96-7	7200	RSL	WET	93.3	U	93.9	U	97.8	U	197	U	193	U	196	U	95.1	U	98.3	U	98.4	U	125		94.8	U	98.9	U	93.7	U	93.4	U	98.3	U	98.1	U	94.6	U	94.1	U
2,4-diamino-6-nitrotoluene	6629-29-4	30000	RSL [3]	WET	93.3	U	93.9	U	97.8	U	197	U	193	U	196	U	95.1	U	98.3	U	98.4	U	96.2	U	94.8	U	98.9	U	93.7	U	99.1	U	98.3	U	98.1	U	94.6	U	94.1	U
2,4-Dinitrotoluene	121-14-2	700	MCP	WET	106		174		231		197	U	193	U	196	U	95.1	U	288		98.4	U	96.2	U	94.8	U	98.9	U	93.7	U	99.1	U	98.3	U	98.1	U	94.6	U	94.1	U
2,6-diamino-4-nitrotoluene	59229-75-3	30000	RSL [3]	WET	93.3	U	93.9	U	97.8	U	197	U	193	U	196	U	95.1	U	98.3	U	98.4	U	96.2	U	94.8	U	98.9	U	93.7	U	99.1	U	98.3	U	98.1	U	94.6	U	94.1	U
2,6-Dinitrotoluene	606-20-2	360	RSL	WET	20.8		68.2		52.2		197	U	193	U	196	U	95.1	U	23.6	J	98.4	U	96.2	U	94.8	U	98.9	U	93.7	U	99.1	U	98.3	U	98.1	U	94.6	U	94.1	U
2-Amino-4,6-dinitrotoluene	35572-78-2	30000	RSL	WET	93.3	U	93.9	U	97.8	U	197	U	193	U	196	U	30.2	J	98.3	U	98.4	U	96.2	U	94.8	U	98.9	U	93.7	U	99.1	U	98.3	U	98.1	U	94.6	U	94.1	U
2-Nitrotoluene	88-72-2	3200	RSL	WET	93.3	U	93.9	U	97.8	U	191	J	141	J	146	J	95.1	U	98.3	U	98.4	U	96.2	U	94.8	U	98.9	U	93.7	U	99.1	U	98.3	U	98.1	U	94.6	U	94.1	U
3-Nitrotoluene	99-08-1	1260	RSL	WET	93.3	U	93.9	U	97.8	U	197	U	193	U	196	U	95.1	U	98.3	U	98.4	U	96.2	U	94.8	U	98.9	U	93.7	U	99.1	U	98.3	U	98.1	U	94.6	U	94.1	U
4-Amino-2,6-dinitrotoluene	19406-51-0	30000	RSL	WET	93.3	U	93.9	U	97.8	U	197	U	193	U	196	U	95.1	U	98.3	U	98.4	U	96.2	U	19.4	J	98.9	U	93.7	U	99.1	U	98.3	U	98.1	U	94.6	U	94.1	U
4-Nitrotoluene	99-99-0	34000	RSL	WET	93.3	U	93.9	U	97.8	U	197	U	193	U	196	U	48	J	98.3	U	98.4	U	96.2	U	94.8	U	98.9	U	93.7	U	99.1	U	98.3	U	98.1	U	94.6	U	94.1	U
HMX	2691-41-0	2000	MCP	WET	93.3	U	93.9	U	97.8	U	197	U	193	U	196	U	95.1	U	98.3	U	98.4	U	96.2	U	94.8	U	98.9	U	93.7	U	99.1	U	98.3	U	98.1	U	94.6	U	94.1	U
Nitrobenzene	98-95-3	5100	RSL	WET	93.3	U	93.9	U	97.8	U	197	U	193	U	196	U	27.8		98.3	U	98.4	U	96.2	U	94.8	U	98.9	U	93.7	U	99.1	U	98.3	U	98.1	U	94.6	U	94.1	U
Nitroglycerin	55-63-0	1260	RSL	WET	1870	U	1880	U	1960	U	6780		30000		19700		8780		14100		13900		1920	U	1900	U	1980	U	1870	U	1980	U	1970	U	1960	U	1890	U	1880	U
PETN	78-11-5	26000	RSL	WET	4660	U	4690	U	4890	U	9860	U	9650	U	9780	U	4750	U	4920	U	4920	U	4810	U	4740	U	4950	U	4690	U	4960	U	4920	U	4910	U	4730	U	4700	U
Picric acid	88-89-1	11400	RSL	WET	93.3		93.9	U	80.2		380		295		196	U	279		215		117		26.1	J	31.4	J	98.9	U	93.7	U	99.1	U	98.3	U	98.1	U	94.6	U	94.1	U
RDX	121-82-4	1000	MCP	WET	93.3	U	93.9	U	97.8	U	197	U	193	U	196	U	95.1	U	98.3	U	98.4	U	96.2	U	94.8	U	98.9	U	93.7	U	93.4	U	98.3	U	98.1	U	94.6	U	94.1	U
Tetryl	479-45-8	32000	RSL	WET	93.3	U	93.9	U	97.8	U	197	U	94.3	J	123	J	95.1	U	73		254		350		68.4	J	98.9	U	93.7	U	93.4	U	98.3	U	98.1	U	94.6	U	94.1	U

Notes:

Basis - Samples that are not air-dried prior to analysis are presumed to have a certain moisture content and are reported on a dry or wet basis with a percent solids measured by the laboratory and reported. Samples that are air-dried are presumed to have no moisture content and therefore no percent solids reported.

ISM - Incremental sampling methodology (ISM) is a structured composite sampling and processing protocol having specific elements designed to reduce data variability and increase sample representativeness for a specified volume of soil under investigation.

PM - primary

RM - replicate

mg/Kg - milligrams per Kilogram

ug/Kg - micrograms per Kilogram

[1] Massachusetts Contingency Plan (MCP) S-1,GW-3 Standards were selected as the applicable Soil Screening Values for metals and explosives. For explosives that did not have a published MCP S-1,GW-3 Standard, a U.S. Environmental Protection Agency (USEPA) Regional Screening Level (RSL) for residential exposure was selected.

[2] Soil Screening Value References:

MCP - 310 CMR 40.00: MCP S1-GW-3 Soil Standards; Excess Lifetime Cancer Risk (ELCR) = 1x10-6 or Hazard Index (HI) = 0.2
RSL - USEPA RSL Resident Soil Table (November 2017); ELCR = 1x10-6 or HI = 0.2
NC - No Criteria

[3] There were no published MCP or USEPA RSL risk-based soil screening values for 2,4-diamino-6-nitrotoluene nor 2,6-diamino-4-nitrotoluene. Therefore, the USEPA RSL screening value for 2-Amino-4,6-dinitrotoluene was used as a surrogate based on similarity of chemical structures.

Results that exceed the soil screening value are highlighted in yellow.

Table 3-5. Metals and Explosives Results in Soil at the Test Range Area

Analyte	Test Range Berm - Quadrant 2											
	SO-STRB2-06-PM		SO-STRB2-06-RM1		SO-STRB2-06-RM2		SO-STRB2-12-PM		SO-STRB2-12-RM1		SO-STRB2-12-RM2	
	10/13/2015 ISM SOIL 3-6		10/13/2015 ISM SOIL 3-6		10/13/2015 ISM SOIL 3-6		10/13/2015 ISM SOIL 6-12		10/13/2015 ISM SOIL 6-12		10/13/2015 ISM SOIL 6-12	
Metals (mg/Kg)												
Lead	215		302		127		152		102		109	
Mercury	0.25		0.22		0.19		0.28		0.34		0.47	
Explosives (ug/Kg)												
Perchlorate	0.86	B	0.66	J B	0.64	J B	0.79	B	0.83	B	0.81	B
1,3,5-Trinitrobenzene	97.2	U	93.7	U	97.3	U	93.4	U	96.9	U	92.9	U
1,3-Dinitrobenzene	97.2	U	93.7	U	97.3	U	93.4	U	96.9	U	92.9	U
2,4,6-Trinitrotoluene	97.2	U	93.7	U	97.3	U	93.4	U	96.9	U	92.9	U
2,4-diamino-6-nitrotoluene	97.2	U	93.7	U	97.3	U	93.4	U	96.9	U	92.9	U
2,4-Dinitrotoluene	97.2	U	93.7	U	97.3	U	93.4	U	96.9	U	92.9	U
2,6-diamino-4-nitrotoluene	97.2	U	93.7	U	97.3	U	93.4	U	96.9	U	92.9	U
2,6-Dinitrotoluene	97.2	U	93.7	U	97.3	U	93.4	U	96.9	U	92.9	U
2-Amino-4,6-dinitrotoluene	97.2	U	93.7	U	97.3	U	93.4	U	96.9	U	92.9	U
2-Nitrotoluene	97.2	U	93.7	U	97.3	U	93.4	U	96.9	U	92.9	U
3-Nitrotoluene	97.2	U	93.7	U	97.3	U	93.4	U	96.9	U	92.9	U
4-Amino-2,6-dinitrotoluene	97.2	U	93.7	U	97.3	U	93.4	U	96.9	U	92.9	U
4-Nitrotoluene	97.2	U	93.7	U	97.3	U	93.4	U	96.9	U	92.9	U
HMX	97.2	U	93.7	U	97.3	U	93.4	U	96.9	U	92.9	U
Nitrobenzene	97.2	U	93.7	U	97.3	U	93.4	U	96.9	U	92.9	U
Nitroglycerin	1940	U	1870	U	1950	U	1870	U	1940	U	1860	U
PETN	4860	U	4690	U	4860	U	4670	U	4840	U	4640	U
Picric acid	97.2	U	93.7	U	97.3	U	93.4	U	96.9	U	92.9	U
RDX	97.2	U	93.7	U	97.3	U	93.4	U	96.9	U	92.9	U
Tetryl	97.2	U	93.7	U	97.3	U	93.4	U	96.9	U	92.9	U

Analyte	Test Range Berm - Quadrant 3											
	SO-STRB3-06-PM		SO-STRB3-06-RM1		SO-STRB3-06-RM2		SO-STRB3-12-PM		SO-STRB3-12-RM1		SO-STRB3-12-RM2	
	10/13/2015 ISM SOIL 3-6		10/13/2015 ISM SOIL 3-6		10/13/2015 ISM SOIL 3-6		10/13/2015 ISM SOIL 6-12		10/13/2015 ISM SOIL 6-12		10/13/2015 ISM SOIL 6-12	
Metals (mg/Kg)												
Lead	278		185		75.9		209		46.1		843	
Mercury	0.051		0.042		0.2		0.025		0.032		0.03	
Explosives (ug/Kg)												
Perchlorate	0.59	J B	0.68	J B	0.47	J B	0.48	J B	0.6	J B	1.17	B
1,3,5-Trinitrobenzene	89.5	U	90.7	U	68.5	U	98.3	U	98	U	98.3	U
1,3-Dinitrobenzene	89.5	U	90.7	U	197	U	98.3	U	98	U	98.3	U
2,4,6-Trinitrotoluene	89.5	U	90.7	U	196	U	98.3	U	98	U	98.3	U
2,4-diamino-6-nitrotoluene	89.5	U	90.7	U	196	U	98.3	U	98	U	98.3	U
2,4-Dinitrotoluene	89.5	U	90.7	U	196	U	98.3	U	98	U	98.3	U
2,6-diamino-4-nitrotoluene	89.5	U	90.7	U	196	U	98.3	U	98	U	98.3	U
2,6-Dinitrotoluene	89.5	U	90.7	U	196	U	98.3	U	98	U	98.3	U
2-Amino-4,6-dinitrotoluene	89.5	U	90.7	U	196	U	98.3	U	98	U	98.3	U
2-Nitrotoluene	89.5	U	90.7	U	146	U	98.3	U	98	U	98.3	U
3-Nitrotoluene	89.5	U	90.7	U	196	U	98.3	U	98	U	98.3	U
4-Amino-2,6-dinitrotoluene	89.5	U	90.7	U	196	U	98.3	U	98	U	98.3	U
4-Nitrotoluene	89.5	U	90.7	U	196	U	98.3	U	98	U	98.3	U
HMX	89.5	U	90.7	U	196	U	98.3	U	98	U	98.3	U
Nitrobenzene	89.5	U	90.7	U	196	U	98.3	U	98	U	98.3	U
Nitroglycerin	1790	U	1810	U	19700	U	1970	U	1960	U	1970	U
PETN	4480	U	4530	U	9780	U	4920	U	4900	U	4920	U
Picric acid	16	J	16.2	J	196	J	98.3	U	98	U	98.3	U
RDX	89.5	U	90.7	U	196	U	98.3	U	98	U	98.3	U
Tetryl	89.5	U	90.7	U	123	U	98.3	U	98	U	98.3	U

Analyte	Test Range Berm - Quadrant 4											
	SO-STRB4-06-PM		SO-STRB4-06-RM1		SO-STRB4-06-RM2		SO-STRB4-12-PM		SO-STRB4-12-RM1		SO-STRB4-12-RM2	
	10/13/2015 ISM SOIL 3-6		10/13/2015 ISM SOIL 3-6		10/13/2015 ISM SOIL 3-6		10/13/2015 ISM SOIL 6-12		10/13/2015 ISM SOIL 6-12		10/13/2015 ISM SOIL 6-12	
Metals (mg/Kg)												
Lead	271		274		304		147		180		140	
Mercury	0.53		0.63		0.62		0.57		0.58		0.45	
Explosives (ug/Kg)												
Perchlorate	1.11	B	0.94	B	0.87	B	0.63	J B	0.64	J B	0.81	J B
1,3,5-Trinitrobenzene	96.5	U	97.2	U	98.8	U	99.1	U	98.3	U	97.4	U
1,3-Dinitrobenzene	96.5	U	97.2	U	98.8	U	99.1	U	98.3	U	97.4	U
2,4,6-Trinitrotoluene	96.5	U	97.2	U	98.8	U	99.1	U	98.3	U	97.4	U
2,4-diamino-6-nitrotoluene	96.5	U	97.2	U	98.8	U	99.1	U	98.3	U	97.4	U
2,4-Dinitrotoluene	96.5	U	97.2	U	98.8	U	99.1	U	98.3	U	97.4	U
2,6-diamino-4-nitrotoluene	96.5	U	97.2	U	98.8	U	99.1	U	98.3	U	97.4	U
2,6-Dinitrotoluene	96.5	U	97.2	U	98.8	U	99.1	U	98.3	U	97.4	U
2-Amino-4,6-dinitrotoluene	96.5	U	97.2	U	98.8	U	99.1	U	98.3	U	97.4	U
2-Nitrotoluene	23.7	J	97.2	U	98.8	U	99.1	U	98.3	U	97.4	U
3-Nitrotoluene	96.5	U	97.2	U	98.8	U	99.1	U	98.3	U	97.4	U
4-Amino-2,6-dinitrotoluene	96.5	U	97.2	U	98.8	U	99.1	U	98.3	U	97.4	U
4-Nitrotoluene	96.5	U	97.2	U	98.8	U	99.1	U	98.3	U	97.4	U
HMX	96.5	U	97.2	U	98.8	U	99.1	U	98.3	U	97.4	U
Nitrobenzene	96.5	U	97.2	U	98.8	U	99.1	U	98.3	U	97.4	U
Nitroglycerin	1930	U	1940	U	1980	U	1980	U	1970	U	1950	U
PETN	4830	U	4860	U	4940	U	4960	U	4920	U	4870	U
Picric acid	96.5	U	11.3	J	23.1	J	99.1	U	98.3	U	97.4	U
RDX	96.5	U	97.2	U	98.8	U	99.1	U	98.3	U	97.4	U
Tetryl	96.5	U	97.2	U	98.8	U	99.1	U	98.3	U	97.4	U

Analyte	Behind Test Range Berm					
	SO-STRD-03-PM		SO-STRD-03-RM1		SO-STRD-03-RM2	
	10/13/2015 ISM SOIL 0-3		10/13/2015 ISM SOIL 0-3		10/13/2015 ISM SOIL 0-3	
Metals (mg/Kg)						
Lead	1990		1290		2600	
Mercury	8.4		5.7		6	
Explosives (ug/Kg)						
Perchlorate	3.6	B	2.17	B	3.33	B
1,3,5-Trinitrobenzene	98.3	U	98.5	U	47.3	J
1,3-Dinitrobenzene	98.3	U	98.5	U	94.6	U
2,4,6-Trinitrotoluene	98.3	U	98.5	U	94.6	U
2,4-diamino-6-nitrotoluene	98.3	U	98.5	U	94.6	U
2,4-Dinitrotoluene	98.3	U	98.5	U	94.6	U
2,6-diamino-4-nitrotoluene	98.3	U	98.5	U	94.6	U
2,6-Dinitrotoluene	98.3	U	98.5	U	94.6	U
2-Amino-4,6-dinitrotoluene	98.3	U	15.3	J	15.2	J
2-Nitrotoluene	98.3	U	98.5	U	94.6	U
3-Nitrotoluene	98.3	U	98.5	U	94.6	U
4-Amino-2,6-dinitrotoluene	98.3	U	98.5	U	94.6	U
4-Nitrotoluene	128		236		445	
HMX	98.3	U	98.5	U	94.6	U
Nitrobenzene	98.3	U	98.5	U	34.8	J
Nitroglycerin	1210	J	3670		1890	U
PETN	4920	U	4930	U	4730	U
Picric acid	75.5	J	31.9	J	49.5	J
RDX	98.3	U	98.5	U	94.6	U
Tetryl	98.3	U	98.5	U	94.6	U

Notes:

Basis - Samples that are not air-dried prior to analysis are presumed to have a certain moisture content and are reported on a dry or wet basis with a percent solids measured by the laboratory and reported. Samples that are air-dried are presumed to have no moisture content and therefore no percent solids reported.

ISM - Incremental sampling methodology (ISM) is a structured composite sampling and processing protocol having specific elements designed to reduce data variability and increase sample representativeness for a specified volume of soil under investigation.

PM - primary

RM - replicate

mg/Kg - milligrams per Kilogram

ug/Kg - micrograms per Kilogram

[1] Massachusetts Contingency Plan (MCP) S-1,GW-3 Standards were selected as the applicable Soil Screening Values for metals and explosives. For explosives that did not have a published MCP S-1,GW-3 Standard, a U.S. Environmental Protection Agency (USEPA) Regional Screening Level (RSL) for residential exposure was selected.

[2] Soil Screening Value References:

MCP - 310 CMR 40.00: MCP S1-GW-3 Soil Standards; Excess Lifetime Cancer Risk (ELCR) = 1x10-6 or Hazard Index (HI) = 0.2

RSL - USEPA RSL Resident Soil Table (November 2017); ELCR = 1x10-6 or HI = 0.2

NC - No Criteria

[3] There were no published MCP or USEPA RSL risk-based soil screening values for 2,4-diamino-6-nitrotoluene nor 2,6-diamino-4-nitrotoluene. Therefore, the USEPA RSL screening value for 2-Amino-4,6-dinitrotoluene was used as a surrogate based on similarity of chemical structures.

Results that exceed the soil screening value are highlighted in yellow.

Table 3-6. Maximum Detected Concentrations of Lead and Mercury in the Test Range Area

Sample Station	Depth Inches	Maximum Lead Concentration [1] (mg/Kg)	Lab Flag/ Qualifier	Maximum Mercury Concentration [1] (mg/Kg)	Lab Flag/ Qualifier	Detected Explosives
SO-SFRF	0-3	50.8		0.27		Perchlorate, 2,4-Dinitrotoluene, 2,6-Dintrotoluene, Picric Acid
SO-SHSP	0-3	75.9		0.2		Perchlorate, 1,3,5-Trinitrobenzene, 1,3-Dintrobenzene, 2-Nitrotoluene, Nitroglycerin, Picric Acid, Tetryl
SO-SNRF	0-3	332		0.33		Perchlorate, 2,4-Dinitrotoluene, 2,6-Dintrotoluene, 2-Amino-4,6-dinitrotoluene, 4-Nitrotoluene, Nitrobenzene, Nitroglycerin, Picric Acid, Tetryl
SO-STRF	0-3	239		0.17		Perchlorate, 2,4,6-Trinitrotoluene, 2-Amino-4,6-dinitrotoluene, Picric Acid, Tetryl
SO-STRB1	3-6	327		0.045		Perchlorate
SO-STRB1	6-12	685		0.059		Perchlorate
SO-STRB2	3-6	302		0.25		Perchlorate
SO-STRB2	6-12	152		0.47		Perchlorate
SO-STRB3	3-6	483		0.051		Perchlorate, Picric acid
SO-STRB3	6-12	843		0.032		Perchlorate
SO-STRB4	3-6	304		0.63		Perchlorate, 2-Nitrotoluene, Picric acid
SO-STRB4	6-12	180		0.58		Perchlorate
SO-STRD	0-3	2,600		8.4		Perchlorate, 1,3,5-Trinitrobenzene, 2-Amino-4,6-dinitrotoluene, 4-Nitrotoluene, Nitrobenzene, Nitroglycerin, Picric Acid

Notes:

Lab - laboratory

mg/Kg - milligrams/Kilogram

SFRF - Far Range Firing Position

SHSP - Heavy Steel Plate Area

SNRF - Near Range Firing Position

STRF - Test Range Floor

STRB - Test Range Berm

STRD - Area Behind the Test Range Berm

[1] Massachusetts Contingency Plan (MCP) S-1,GW-3 Standards were selected as Soil Screening Values for mercury and lead.

Mercury S-1, GW-3 Soil Standard = 20 mg/Kg

Lead S-1, GW-3 Soil Standard = 200 mg/Kg

Results that exceed the soil screening value are highlighted in yellow.

Table 3-7. Metals and Explosives Results in Soil at the Southern Conservation Commission Area

					SDA Soil UCL Exceedance Area						100 Year Floodplain Area [1]												PZ-24 Groundwater UCL Exceedance Area					
Analyte	CAS	Soil Screening Value [2]	Soil Screening Value Source [3]	Basis	SO-SSDA1-06 10/23/2015 ISM 3-6		SO-SSDA2-06 10/23/2015 ISM 3-6		SO-SSDA3-06 10/23/2015 ISM 3-6		SO-OYFA1-06-PM 10/21/2015 ISM 3-6		SO-OYFA1-06-RM1 10/21/2015 ISM 3-6		SO-OYFA1-06-RM2 10/21/2015 ISM 3-6		SO-OYFA2-06-PM 10/23/2015 ISM 3-6		SO-OYFA2-06-RM1 10/23/2015 ISM 3-6		SO-OYFA2-06-RM2 10/23/2015 ISM 3-6		SO-SPZE1-06 10/23/2015 ISM 3-6		SO-SPZE2-06 10/23/2015 ISM 3-6		SO-SPZE3-06 10/23/2015 ISM 3-6	
Metals (mg/Kg)																												
Aluminum	7429-90-5	NC	NC	WET	8760		8690		9000														9720		10600		9440	
Antimony	7440-36-0	20	MCP	WET	48.9		42.9		61.3														0.50	U	0.50	U	0.50	U
Arsenic	7440-38-2	20	MCP	WET	12.4		10.2		11														3.9		3.1		4.0	
Barium	7440-39-3	1000	MCP	WET	1660		1910		1680														835		1910		671	
Beryllium	7440-41-7	90	MCP	WET	0.50		0.48		0.48														0.57		0.57		0.54	
Cadmium	7440-43-9	70	MCP	WET	11.5		11.2		10.9														2.2		2.1		1.3	
Calcium	7440-70-2	NC	NC	WET	3150	B	2760	B	3490	B													1700	B	1700	B	1640	B
Chromium	7440-47-3	100	MCP	WET	458		419		267														289		15		143	
Cobalt	7440-48-4	NC	NC	WET	8.9		7.7		8.0														9.4		7.7		6.8	
Copper	7440-50-8	NC	NC	WET	877		507		778														138		56.9		45.7	
Iron	7439-89-6	NC	NC	WET	44100		35000		44500														14900		16300		13700	
Lead	7439-92-1	200	MCP	WET	1960		1810		2320														566		557		402	
Magnesium	7439-95-4	NC	NC	WET	3750		3550		3690														3920		4530		3220	
Manganese	7439-96-5	NC	NC	WET	521	B	500	B	566	B													651	B	650	B	503	B
Nickel	7440-02-0	600	MCP	WET	90.8		73.7		106														23.7		24.4		21.8	
Potassium	7440-09-7	NC	NC	WET	1190		1160		1130														1200		1320		1250	
Selenium	7782-49-2	400	MCP	WET	5.4		3.5		5.0														0.84		0.62		0.91	
Silver	7440-22-4	100	MCP	WET	1.4		1.4		1.4														0.46	J	0.51		0.24	J
Sodium	7440-23-5	NC	NC	WET	286		269		255														326		320		271	
Thallium	7440-28-0	8	MCP	WET	1.0	U	1.0	U	5.0	U													0.99	U	1.0	U	1.0	U
Vanadium	7440-62-2	400	MCP	WET	21.9		21.2		21														19.4		20.5		19.4	
Zinc	7440-66-6	1000	MCP	WET	2290		2320		1610														94.8		101		69	
Mercury	7439-97-6	20	MCP	WET	1.4		1.2		1.2		0.12		0.15		0.13		0.068	J	0.073	J	0.060	J	0.039		0.076		0.03	
Explosives (ug/Kg)																												
Perchlorate	14797-73-0	100	MCP	WET	NA		NA		NA														NA		NA		NA	
1,3,5-Trinitrobenzene	99-35-4	440000	RSL	WET	99.6	U	28.5	J	99.2	U													94.3	U	99.9	U	96.7	U
1,3-Dinitrobenzene	99-65-0	3000	MCP	WET	39.9	J	20.5	J	27.5	J													27.2	J	15.8	J	185	
2,4,6-Trinitrotoluene	118-96-7	7200	RSL	WET	1080		1150		1240														94.3	U	99.9	U	96.7	U
2,4-diamino-6-nitrotoluene	6629-29-4	30000	RSL [4]	WET	99.6	U	98.4	U	99.2	U													94.3	U	99.9	U	96.7	U
2,4-Dinitrotoluene	121-14-2	700	MCP	WET	250		128		160														94.3	U	99.9	U	96.7	U
2,6-diamino-4-nitrotoluene	59229-75-3	30000	RSL [4]	WET	99.6	U	98.4	U	99.2	U													94.3	U	99.9	U	96.7	U
2,6-Dinitrotoluene	606-20-2	360	RSL	WET	43.4	J	40.2	J	57.2	J													94.3	U	99.9	U	96.7	U
2-Amino-4,6-dinitrotoluene	35572-78-2	30000	RSL	WET	314		605		325														94.3	U	99.9	U	17.9	J
2-Nitrotoluene	88-72-2	3200	RSL	WET	99.6	U	98.4	U	99.2	U													94.3	U	99.9	U	96.7	U
3-Nitrotoluene	99-08-1	1260	RSL	WET	99.6	U	98.4	U	99.2	U													60.7	J	99.9	U	96.7	U
4-Amino-2,6-dinitrotoluene	19406-51-0	30000	RSL	WET	277		501		300														94.3	U	99.9	U	96.7	U
4-Nitrotoluene	99-99-0	34000	RSL	WET	69.6	J	93.2	J	96.9	J													94.3	U	99.9	U	96.7	U
HMX	2691-41-0	2000	MCP	WET	20.8	J	18.3	J	14.3	J													15.5	J	14	J	9.01	J
Nitrobenzene	98-95-3	5100	RSL	WET	99.6	U	231		195														94.3	U	99.9	U	96.7	U
Nitroglycerin	55-63-0	1260	RSL	WET	1990	U	1970	U	1980	U													1890	U	2000	U	1930	U
PETN	78-11-5	26000	RSL	WET	4980	U	4920	U	4960	U													4720	U	5000	U	4840	U
Picric acid	88-89-1	11400	RSL	WET	99.6	U	35.9	J	57.5	J													94.3	U	99.9	U	96.7	U
RDX	121-82-4	1000	MCP	WET	21.4	J	17.6	J	29.6	J													27.8	J	25.1	J	96.7	U
Tetryl	479-45-8	32000	RSL	WET	99.6	U	98.4	U	99.2	U													94.3	U	99.9	U	44.6	J

Notes:

1) The 100-Year Floodplain was sampled only for total mercury.

Qualifiers:

B - Compound was found in the blank and sample
J -Approximate value less than the RL but greater than or equal to the MDL
U - Analyte wwas analyzed for but not detected

Basis - Samples that are not air-dried prior to analysis are presumed to have a certain moisture content and are reported on a dry or wet basis with a percent solids measured by the laboratory and reported. Samples that are air-dried are presumed to have no moisture content and therefore no percent solids reported.

CAS - Chemical Abstracts Service

HMX - Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine

ISM - Incremental sampling methodology (ISM) is a structured composite sampling and processing protocol having specific elements designed to reduce data variability and increase sample representativeness for a specified volume of soil under investigation.

mg/Kg - millgrams per Kilogram

ug/Kg - micrograms per Kilogram

PETN - Pentaerythritol tetranitrate

RDX - Hexahydro-1,3,5-trinitro-1,3,5-triazine

SDA - Southern Disposal Area

UCL - Upper Concentration Limit

[2] Massachusetts Contingency Plan (MCP) S-1,GW-3 Standards were selected as the applicable Soil Screening Values for metals and explosives. For explosives that did not have a published MCP S-1,GW-3 Standard, a U.S. Environmental Protection Agency (USEPA) Regional Screening Level (RSL) for residential exposure was selected.

[3] Soil Screening Value References:

MCP - 310 CMR 40.00: MCP S1-GW-3 Soil Standards; Excess Lifetime Cancer Risk (ELCR) = 1x10-6 or Hazard Index (HI) = 0.2
RSL - USEPA RSL Resident Soil Table (November 2017); ELCR = 1x10-6 or HI = 0.2
NC - No Criteria

[4] There were no published MCP or USEPA RSL risk-based soil screening values for 2,4-diamino-6-nitrotoluene nor 2,6-diamino-4-nitrotoluene. Therefore, the USEPA RSL screening value for 2-Amino-4,6-dinitrotoluene was used as a surrogate based on similarity of chemical structures.

Results that exceed the soil screening value are highlighted in yellow.

Table 3-8. Detected Concentrations of Lead and Mercury in Soil at the Southern Conservation Commission Area

Sample Station	Sample Replicate [1]	Lead Concentration [3] (mg/Kg)	Lab Flag/ Qualifier	Mercury Concentration [3] (mg/Kg)	Lab Flag/ Qualifier
SDA Soil UCL Exceedance Area	SO-SSDA1	1960		1.4	
	SO-SSDA2	1810		1.2	
	SO-SSDA3	2320		1.2	
100 Year Floodplain Area [2]	SO-OYFA1-PM			0.12	
	SO-OYFA1-RM1			0.15	
	SO-OYFA1-RM2			0.13	
	SO-OYFA2-PM			0.068	
	SO-OYFA2-RM1			0.073	
	SO-OYFA2-RM2			0.06	
PZ-24 Groundwater UCL Exceedance Area	SO-SPZE1	566		0.039	
	SO-SPZE2	557		0.076	
	SO-SPZE3	402		0.03	

Notes:

SDA - Southern Disposal Area

OYFA - 100-Year Floodplain Area

SPZE -Piezometer-24 Groundwater UCL Exceedance Area

UCL - Upper Concentration Limit

mg/Kg - millgrams/Kilogram

[1] All samples were collected at a depth of 3-6 inches.

[2] The 100-Year Floodplain was sampled only for total mercury.

[3] Massachusetts Contingency Plan (MCP) S-1,GW-3 Standards were selected as Soil Screening Values for mercury and lead.

Mercury S-1, GW-3 Soil Standard = 20 mg/Kg

Lead S-1,GW-3 Soil Standard = 200 mg/Kg

Results that exceed the soil screening value are highlighted in yellow.

Table 3-9. Metals Results in Soil at the Marsh Upland Area

Analyte	CAS	Soil Screening Value [1]	Soil Screening Value Source [2]	Basis	SO-MUAU1-12 10/28/2015 GRAB SOIL 6-12		SO-MUAU1-24 10/28/2015 GRAB SOIL 12-24		SO-MUAU1-24-DUP 10/28/2015 GRAB SOIL 12-24		SO-MUAU1-36 10/28/2015 GRAB SOIL 24-36		SO-MUAU1-48 10/28/2015 GRAB SOIL 36-48		SO-MUAU2-12 10/29/2015 GRAB SOIL 6-12		SO-MUAU2-24 10/29/2015 GRAB SOIL 12-24		SO-MUAU3-12 10/29/2015 GRAB SOIL 6-12		SO-MUAU3-24 10/29/2015 GRAB SOIL 12-24		SO-MUAU3-36 10/29/2015 GRAB SOIL 24-36		SO-MUAU3-48 10/29/2015 GRAB SOIL 36-48		SO-MUAU4-12 10/29/2015 GRAB SOIL 6-12	
Metals (mg/Kg)																												
Aluminum	7429-90-5	NC	NC	DRY	6430		8790		7410		12200		9290		8720		8970		6120		7310		3120		4410		5410	
Antimony	7440-36-0	20	MCP	DRY	6		1.8		6.8		0.8	J	1.8	U	0.52	U	0.57	U	4		6.5		1.7	U	3.1		10	
Arsenic	7440-38-2	20	MCP	DRY	2.9		1.9		2.7		1.9		2.4		2.2		2.9		2.9		3.1		1.3		1.3	J	2.5	
Barium	7440-39-3	1000	MCP	DRY	20.5		39.2		43.9		38.4		25.2		32.8		30.1		18.5		20.3		9.6	J	13.5	J	14.5	
Beryllium	7440-41-7	90	MCP	DRY	0.29		0.26		0.26		0.28	J	0.29	J	0.33		0.3		0.3		0.31		0.14	J	0.18	J	0.25	
Cadmium	7440-43-9	70	MCP	DRY	0.086	J	0.098	J	0.12	J	0.084	J	0.069	J	0.21	U	0.049	J	0.1	J	0.093	J	2.3		0.16	J	0.097	J
Calcium	7440-70-2	NC	NC	DRY	592	B	360	B	445	B	189	J	195	J	707	B	409	B	799	B	679	B	352	J	420	J	667	B
Chromium	7440-47-3	100	MCP	DRY	13.2	B	5.7	B	7.4	B	8.7	B	11.3	B	6.3	B	7.9	B	7.4	B	9.7	B	4.3	B	6.3	B	8.4	B
Cobalt	7440-48-4	NC	NC	DRY	1.8		0.94		1.6		1.4		2.7		2.6		2.7		2.6		2.5		3.1		1.7		2.7	
Copper	7440-50-8	NC	NC	DRY	150		67.9		166		6.6		5.2		32.5		70.4		139		148		59.3		243		144	
Iron	7439-89-6	NC	NC	DRY	7740		8210		7760		8500	B	11100		10900		9190		7720		9830		4060		5900		9120	
Lead	7439-92-1	200	MCP	DRY	882		71.9		303		17.4		8		33.6		4.9		444		351		677		305		436	
Magnesium	7439-95-4	NC	NC	DRY	1070		594		923		607		1650		1530		1170		1240		1400		876		1150		1240	
Manganese	7439-96-5	NC	NC	DRY	90.4	B	56.1	B	83	B	38.8		114		180	B	107	B	136	B	121	B	63.4		83.1		147	B
Nickel	7440-02-0	600	MCP	DRY	11.9		4.2		6.5		5.8		6.8		5.3		12.7		14.4		8		5.8		7		43.6	
Potassium	7440-09-7	NC	NC	DRY	443		294		370		155	J	224	J	421		485		647		521		204	J	284	J	578	
Selenium	7782-49-2	400	MCP	DRY	0.58	U	0.58	U	1.7		0.66	J	1.8	U	0.52	U	0.57	U	0.55	U	0.55	U	1.7	U	2.4	U	0.57	U
Silver	7440-22-4	100	MCP	DRY	0.58	U	0.58	U	0.56	U	1.1	U	0.91	U	0.52	U	0.57	U	0.55	U	0.55	U	0.84	U	1.2	U	0.57	U
Sodium	7440-23-5	NC	NC	DRY	67.5	J B	49.1	J B	47.4	J B	25.6	J	31.8	J	44.4	J B	46.2	J B	59.9	J B	51.8	J B	20.8	J	27	J	50.9	J B
Thallium	7440-28-0	8	MCP	DRY	1.2	U	1.2	U	1.1	U	2.2	U	1.8	U	1	U	1.1	U	1.1	U	1.1	U	1.7	U	2.4	U	1.1	U
Vanadium	7440-62-2	400	MCP	DRY	15.4		13.9		13.3		14.4		16.6		16.5		13.7		10.5		14		7.7		8.6		10.1	
Zinc	7440-66-6	1000	MCP	DRY	15.7		29.6		24.6		22		23.3	B	27		31.7		30.7		26.9		127	B	32.2	B	24.7	
Mercury	7439-97-6	20	MCP	DRY	27.1		24.2		92.3		0.8		0.11		1.2		0.067		28.2		105		48.7		146		18.4	

Notes:

Qualifiers:

B - Compound was found in the blank and sample

J -Less than the RL but greater than or equal to the MDL and the concentration is an approximate value

U - Analyte was analyzed for but not detected

Basis - Samples that are not air-dried prior to analysis are presumed to have a certain moisture content and are reported on a dry or wet basis with a percent solids measured by the laboratory and reported. Samples that are air-dried are presumed to have no moisture content and therefore no percent solids reported.

CAS - Chemical Abstracts Service

Grab - A grab sample is a sampling technique which is a single sample or measurement taken at a specific time or over as short a period, as feasible.

mg/Kg - millgrams per Kilogram

[1] Massachusetts Contingency Plan (MCP) S-1,GW-3 Standards were selected as the applicable Soil Screening Values for metals.

[3] Soil Screening Value References:

MCP - 310 CMR 40.00: MCP S1-GW-3 Soil Standards; Excess Lifetime Cancer Risk (ELCR) = 1x10-6 or Hazard Index (HI) = 0.2

NC - No Criteria

Results that exceed the soil screening value are highlighted in yellow.

Table 3-9. Metals Results in Soil at the Marsh Upland Area

Analyte	SO-MUAU4-24 10/29/2015 GRAB SOIL 12-24		SO-MUAU4-24-DUP 10/29/2015 GRAB SOIL 12-24		SO-MUAU4-36 10/29/2015 GRAB SOIL 24-36		SO-MUAU4-48 10/29/2015 GRAB SOIL 36-48		SO-MUAU4-60 10/29/2015 GRAB SOIL 48-60		SO-MUAU4-72 10/29/2015 GRAB SOIL 60-72		SO-MUAU5-12 10/29/2015 GRAB SOIL 6-12		SO-MUAU5-24 10/29/2015 GRAB SOIL 12-24		SO-MUAU5-36 10/29/2015 GRAB SOIL 24-36		SO-MUAU5-48 10/29/2015 GRAB SOIL 36-48		SO-MUAU5-60 10/29/2015 GRAB SOIL 48-60		SO-MUAU6-12 10/29/2015 GRAB SOIL 6-12		SO-MUAU6-24 10/29/2015 GRAB SOIL 12-24		SO-MUAU6-24-DUP 10/29/2015 GRAB SOIL 12-24	
Metals (mg/Kg																												
Aluminum	6470		6670		5270		2420		2600		2820		10200		9720	B	5530		4460		4930		6620	B	3880	B	5240	B
Antimony	10.6		11.3		3.5		1.7	U	1.8	U	2	U	0.48	J	0.55	U	1.9	U	2	U	1.9	U	1.9		1.5		1.1	
Arsenic	2.3		2.3		2.1		1.6		1.6		1.7		3		3.1		2.1		2.2		2.6		2		2.4		2.2	
Barium	16.9		16.3		34		7.9	J	7.3	J	18	J	26.2		25.8		11.9	J	8.9	J	11.8	J	21.1		17.5		18.9	
Beryllium	0.28		0.27		0.2	J	0.16	J	0.16	J	0.18	J	0.35		0.33		0.23	J	0.22	J	0.23	J	0.3		0.2		0.26	
Cadmium	0.1	J	0.12	J	0.53		0.03	J	0.049	J	0.15	J	0.094	J	0.2	J B	0.056	J	0.06	J	0.069	J	0.18	J B	0.14	J B	0.2	J B
Calcium	561	B	746	B	307	J	368	J	468		620		669	B	524	B	217	J	190	J	227	J	2260	B	587	B	565	B
Chromium	8.1	B	7.6	B	9	B	3.6	B	7.4	B	4.9	B	8	B	9.5		6.7	B	6.5	B	9.6	B	6		5.3		6.1	
Cobalt	2.7		3		2.5		2.3		1.9		2.3		2.7		2.5		3.7		3.4		4.4		4.3		2		2.6	
Copper	258		243		118		3.8		7.7		6.5		62.5		53.6		6.1		5.5		6		48.7		25		40.2	
Iron	8430		8270		7740	B	5330	B	5640	B	6340	B	10700		10100		7660	B	7070	B	8020	B	11200		6310		7110	
Lead	477		516		377		3.3		11.1		5.2		26.7		58.9		6.4		6.6		5		112		73.1		94.9	
Magnesium	1160		1250		1170		954		959		1050		1350		1380		1330		1280		1840		2240		1210		1230	
Manganese	131	B	135	B	111		105		88.2		100		130	B	123	B	127		148		226		172	B	115	B	123	B
Nickel	16.2		17.1		168		3.8		6.1		5.2		7.7		8.1		5.5		5.7		9.7		9.1		4.7		4.9	
Potassium	505		526		235	J	264	J	254	J	282	J	375		453		310	J	265	J	376	J	791		395		441	
Selenium	0.53	U	0.56	U	0.33	J	1.7	U	1.8	U	2	U	0.52	U	0.76		1.9	U	2	U	1.9	U	0.51	J	0.52		0.74	
Silver	0.53	U	0.56	U	0.93	U	0.85	U	0.9	U	0.99	U	0.52	U	0.55	U	0.93	U	1	U	0.95	U	0.53	U	0.48	U	0.63	U
Sodium	48.7	J B	47.1	J B	22.5	J	17.3	J	19.5	J	22.2	J	41.5	J B	33.1	J	20.6	J	19.8	J	19.4	J	265		26.7	J	33.5	J
Thallium	1.1	U	1.1	U	1.9	U	1.7	U	1.8	U	2	U	1	U	1.1	U	1.9	U	2	U	1.9	U	1.1	U	0.97	U	1.3	U
Vanadium	11.3		11.5		9.6		6.5		7.4		8.8		14		15.1		9.3		8		9		22.7		7.8		10.7	
Zinc	33.8		28		62.1	B	16.1	B	25.1	B	55.9	B	22		21.2		16.6	B	14.2	B	15.8	B	30		18.9		21.3	
Mercury	38.7		32.2		40.2		2.8		1.9		0.37		18.8		22		0.57		0.82		0.34		11.8		10.4		13.5	

Notes:

Qualifiers:

B - Compound was found in the blank and sample

J -Less than the RL but greater than or equal to the MDL and the concentration is an approximate value

U - Analyte was analyzed for but not detected

Basis - Samples that are not air-dried prior to analysis are presumed to have a certain moisture content and are reported on a dry or wet basis with a percent solids measured by the laboratory and reported. Samples that are air-dried are presumed to have no moisture content and therefore no percent solids reported.

CAS - Chemical Abstracts Service

Grab - A grab sample is a sampling technique which is a single sample or measurement taken at a specific time or over as short a period, as feasible.

mg/Kg - millgrams per Kilogram

[1] Massachusetts Contingency Plan (MCP) S-1,GW-3 Standards were selected as the applicable Soil Screening Values for metals.

[3] Soil Screening Value References:

MCP - 310 CMR 40.00: MCP S1-GW-3 Soil Standards; Excess Lifetime Cancer Risk (ELCR) = 1x10-6 or Hazard Index (HI) = 0.2

NC - No Criteria

Results that exceed the soil screening value are highlighted in yellow.

Table 3-9. Metals Results in Soil at the Marsh Upland Area

Analyte	SO-MUAU6-36 10/29/2015 GRAB SOIL 24-36		SO-MUAU6-48 10/29/2015 GRAB SOIL 36-48		SO-MUAU7-12 10/29/2015 GRAB SOIL 6-12		SO-MUAU7-24 10/29/2015 GRAB SOIL 12-24		SO-MUAU7-36 10/29/2015 GRAB SOIL 24-36		SO-MUAU7-48 10/29/2015 GRAB SOIL 36-48		SO-MUAU8-12 10/29/2015 GRAB SOIL 6-12		SO-MUAU8-12-DUP 10/29/2015 GRAB SOIL 6-12		SO-MUAU8-24 10/29/2015 GRAB SOIL 12-24		SO-MUAU8-36 10/29/2015 GRAB SOIL 24-36		SO-MUAU8-48 10/29/2015 GRAB SOIL 36-48		SO-MUAU9-12 10/29/2015 GRAB SOIL 6-12		SO-MUAU9-24 10/29/2015 GRAB SOIL 12-24		SO-MUAU10-12 10/29/2015 GRAB SOIL 6-12	
Metals (mg/K																												
Aluminum	5440		7370		4830	B	4110		3130		4020		5470		5910		4660		3900		7060		5270		5370		15600	
Antimony	0.47	J	2.5	U	1.6		2.4		1.4	J	2.2		4.7		7.4		0.69		1.5	U	3		0.52	U	0.55	U	0.63	U
Arsenic	1.4		2		1.7		2.3		1.7		2		3.1		2.9		2.1		1.8		2		2.5		2.7		2.7	
Barium	17.3	J	21.4	J	44.4		18.4		22.1	J	13.5	J	17.2		15.3		18.4		11.4	J	14.5	J	15.9		25		50.2	
Beryllium	0.2	J	0.25	J	0.24		0.27		0.15	J	0.19	J	0.44		0.28		0.23		0.17	J	0.23	J	0.29		0.33		0.43	
Cadmium	0.12	J	0.065	J	0.49	B	0.58		0.84		0.54	J	0.64		0.65		0.079	J	0.23	J	0.28	J	0.045	J	0.057	J	0.18	J
Calcium	290	J	221	J	788	B	778	B	374	J	456	J	638	B	523	B	547	B	422		288	J	740	B	1100	B	439	B
Chromium	5.9	B	8.1	B	7		6		4.7	B	6.6	B	10.7		7.5		4.9		8.5	B	11.5	B	11.2		11		10.4	
Cobalt	1.7		2.3		3.4		2.1		2.7		2.6		2.5		2.4		1.9		2.7		2.2		3.9		3		1.6	
Copper	23.3		4.4		107		191		153		178		131		109		40.9		32.6		329		11.6		7.8		14.6	
Iron	6880	B	9450	B	19900		7590		5900	B	8560	B	12500		7590		6900		6870	B	7590	B	8960		9800		13900	
Lead	46.5		7.5		118		137		106		157		419		331		23.1		29.7		201		24.4		7.2		27.7	
Magnesium	888		1000		1040		1210		1060		1370		1350	B	1210	B	1160	B	1180		1010		1960	B	1990	B	893	B
Manganese	97.3		87.7		168	B	112		197		122		139	B	144	B	110	B	105		97.9		172	B	158	B	86.8	B
Nickel	4.6		4.8	J	7.8		6.7		5.1		7.2		11.6		9.2		5		7.2		8.2		8.2		7.2		5.1	
Potassium	174	J	152	J	519		600		240	J	302	J	618		605		580		270	J	230	J	676		650		357	
Selenium	1.8	U	2.5	U	0.75		0.54	U	2.3	U	2.2	U	0.55	U	0.57	U	0.53	U	1.5	U	2.2	U	0.52	U	0.55	U	0.63	U
Silver	0.88	U	1.2	U	0.27	J	0.54	U	1.1	U	1.1	U	0.55	U	0.57	U	0.53	U	0.77	U	1.1	U	0.52	U	0.55	U	0.63	U
Sodium	25.5	J	29.1	J	74.7	J	40.5	J	28.5	J	29.8	J	34.4	J	32.9	J	31.6	J	18.3	J	555	U	37.6	J	41.7	J	44.1	J
Thallium	1.8	U	2.5	U	1.1	U	1.1	U	2.3	U	2.2	U	1.1	U	1.1	U	1.1	U	1.5	U	2.2	U	1	U	1.1	U	1.3	U
Vanadium	8.6		13.8		9.1		9.6		6.6		8.7		10.2		8.3		7.8		8.1		9		12.4		13.8		24.9	
Zinc	21.6	B	15.2	B	25.5		30.4		37.1	B	32.9	B	31.9		27.7		19.4		20.6	B	25.1	B	21.5		19.7		28.8	
Mercury	6.1		0.45		109		360		138		182		89.9		62.3		90.4		267		278		1.5		0.27		0.52	

Notes:

Qualifiers:

B - Compound was found in the blank and sample

J -Less than the RL but greater than or equal to the MDL and the concentration is an approximate value

U - Analyte was analyzed for but not detected

Basis - Samples that are not air-dried prior to analysis are presumed to have a certain moisture content and are reported on a dry or wet basis with a percent solids measured by the laboratory and reported. Samples that are air-dried are presumed to have no moisture content and therefore no percent solids reported.

CAS - Chemical Abstracts Service

Grab - A grab sample is a sampling technique which is a single sample or measurement taken at a specific time or over as short a period, as feasible.

mg/Kg - millgrams per Kilogram

[1] Massachusetts Contingency Plan (MCP) S-1,GW-3 Standards were selected as the applicable Soil Screening Values for metals.

[3] Soil Screening Value References:

MCP - 310 CMR 40.00: MCP S1-GW-3 Soil Standards; Excess Lifetime Cancer Risk (ELCR) = 1x10-6 or Hazard Index (HI) = 0.2

NC - No Criteria

Results that exceed the soil screening value are highlighted in yellow.

Table 3-9. Metals Results in Soil at the Marsh Upland Area

Analyte	SO-MUAU10-24 10/29/2015 GRAB SOIL 12-24		SO-MUAU11-12 10/29/2015 GRAB SOIL 6-12		SO-MUAU11-24 10/29/2015 GRAB SOIL 12-24		SO-MUAU11-36 10/29/2015 GRAB SOIL 24-36		SO-MUAU11-48 10/29/2015 GRAB SOIL 36-48		SO-MUAU12-12 10/29/2015 GRAB SOIL 6-12		SO-MUAU12-24 10/29/2015 GRAB SOIL 12-24	
Metals (mg/K														
Aluminum	15700		4130		3590		2690		2450		16000		15800	
Antimony	0.58	U	0.86		0.52	U	1.7	U	1.7	U	0.56	U	0.51	U
Arsenic	3.2		2.1		2		1.6		1.7		2.4		3	
Barium	54.1		13.8		14.8		9.6	J	8.7	J	27.9		39.3	
Beryllium	0.46		0.24		0.26		0.18	J	0.15	J	0.36		0.38	
Cadmium	0.054	J	0.085	J	0.084	J	0.1	J	0.02	J	0.093	J	0.081	J
Calcium	397	B	712	B	914	B	440		563		299	B	413	B
Chromium	15.2		5.2		4.8		3.7	B	3.6	B	8.6		11.4	
Cobalt	3.9		2.1		2.7		2		1.9		1.3		1.9	
Copper	4.1		56.4		29.2		8.1		3.9		53		4	
Iron	14500		7030		7210		5620	B	5890	B	11700		12400	
Lead	8.3		89.7		8.9		3.3		3.5		14.1		8.8	
Magnesium	2060	B	1170	B	1090	B	980		1030		551	B	1010	B
Manganese	137	B	113	B	116	B	95.4		102		66.5	B	79.8	B
Nickel	9.2		5		5.2		4.1		3.7		4.5		6.2	
Potassium	490		587		638		294	J	322	J	255		401	
Selenium	0.58	U	0.49	U	0.52	U	1.7	U	1.7	U	0.56	U	0.6	
Silver	0.58	U	0.49	U	0.52	U	0.83	U	0.85	U	0.56	U	0.51	U
Sodium	51.1	J	33.6	J	36.1	J	18.8	J	21.6	J	28.7	J	35.5	J
Thallium	1.2	U	0.98	U	1	U	1.7	U	1.7	U	1.1	U	1	U
Vanadium	25.6		8.9		10.7		6.3		6.2		18.4		22.3	
Zinc	28.6		18.7		17.1		19.8	B	12.9	B	18.7		24.1	
Mercury	0.15		93.3		20		0.53		0.13		5.9		2.6	

Notes:

Qualifiers:

B - Compound was found in the blank and sample

J -Less than the RL but greater than or equal to the MDL and the concentration is an approximate value

U - Analyte was analyzed for but not detected

Basis - Samples that are not air-dried prior to analysis are presumed to have a certain moisture content and are reported on a dry or wet basis with a percent solids measured by the laboratory and reported. Samples that are air-dried are presumed to have no moisture content and therefore no percent solids reported.

CAS - Chemical Abstracts Service

Grab - A grab sample is a sampling technique which is a single sample or measurement taken at a specific time or over as short a period, as feasible.

mg/Kg - millgrams per Kilogram

[1] Massachusetts Contingency Plan (MCP) S-1,GW-3 Standards were selected as the applicable Soil Screening Values for metals.

[3] Soil Screening Value References:

MCP - 310 CMR 40.00: MCP S1-GW-3 Soil Standards; Excess Lifetime Cancer Risk (ELCR) = 1x10-6 or Hazard Index (HI) = 0.2

NC - No Criteria

Results that exceed the soil screening value are highlighted in yellow.

Table 3-10. Detected Concentrations of Lead and Mercury in the Soil at the Marsh Upland Area

Sample Station	Depth Inches	Lead Concentration [1] (mg/Kg)	Lab Flag/ Qualifier	Maximum Mercury Concentration [1] (mg/Kg)	Lab Flag/ Qualifier
SO-MUAU1	6-12	882		27.1	
SO-MUAU1	12-24	303		92.3	
SO-MUAU1	24-36	17.4		0.8	
SO-MUAU1	36-48	8		0.11	
SO-MUAU2	6-12	33.6		1.2	
SO-MUAU2	12-24	4.9		0.067	
SO-MUAU3	6-12	444		28.2	
SO-MUAU3	12-24	351		105	
SO-MUAU3	24-36	677		48.7	
SO-MUAU3	36-48	305		146	
SO-MUAU4	6-12	436		18.4	
SO-MUAU4	12-24	516		38.7	
SO-MUAU4	24-36	377		40.2	
SO-MUAU4	36-48	3.3		2.8	
SO-MUAU4	48-60	11.1		1.9	
SO-MUAU4	60-72	5.2		0.37	
SO-MUAU5	6-12	26.7		18.8	
SO-MUAU5	12-24	58.9		22	
SO-MUAU5	24-36	6.4		0.57	
SO-MUAU5	36-48	6.6		0.82	
SO-MUAU5	48-60	5		0.34	
SO-MUAU6	6-12	112		11.8	
SO-MUAU6	12-24	94.9		13.5	
SO-MUAU6	24-36	46.5		6.1	
SO-MUAU6	36-48	7.5		0.45	
SO-MUAU7	6-12	118		109	
SO-MUAU7	12-24	137		360	
SO-MUAU7	24-36	106		138	
SO-MUAU7	36-48	157		182	
SO-MUAU8	6-12	419		89.9	
SO-MUAU8	12-24	23.1		90.4	
SO-MUAU8	24-36	29.7		267	
SO-MUAU8	36-48	201		278	
SO-MUAU9	6-12	24.4		1.5	
SO-MUAU9	12-24	7.2		0.27	
SO-MUAU10	6-12	27.7		0.52	
SO-MUAU10	12-24	8.3		0.15	

Table 3-10. Detected Concentrations of Lead and Mercury in the Soil at the Marsh Upland Area

Sample Station	Depth Inches	Lead Concentration [1] (mg/Kg)	Lab Flag/ Qualifier	Maximum Mercury Concentration [1] (mg/Kg)	Lab Flag/ Qualifier
SO-MUAU11	6-12	89.7		93.3	
SO-MUAU11	12-24	8.9		20	
SO-MUAU11	24-36	3.3		0.53	
SO-MUAU11	36-48	3.5		0.13	
SO-MUAU12	6-12	14.1		5.9	
SO-MUAU12	12-24	8.8		2.6	

Notes:

Lab. - Laboratory

mg/Kg - milligram/Kilogram

MUA - Marsh Upland Area

UCL - Upper Concentration Limit

[1] Massachusetts Contingency Plan (MCP) S-1,GW-3 Standards were selected as Soil Screening Values for mercury and lead.

Mercury S-1, GW-3 Soil Standard = 20 mg/Kg

Lead S-1,GW-3 Soil Standard = 200 mg/Kg

Results that exceed the soil screening value are highlighted in yellow.

For sampling locations where duplicate samples were taken, the highest concentration of lead and mercury resulting from either sample is shown for that sampliong location.

Table 3-11. Water Depth and Sediment Thickness Measurements from the Eastern Channel Corridor
[Comparison of 2008 and 2015 Measurements]

Sampling Station [2008 Station # (2015 Station #)]	Investigation Date	Field Measurements						Comments
		Parameter	Left Bank (1) (feet)	Channel Center (feet)	Right Bank (1) (feet)	Channel Width (feet)	Distance from Upstream Reference Point (feet)	
1	Nov. 2008	Water Depth	0.45	2.40	0.50	30.7	0	
		Sediment Thickness	0.10	0.00	2.40			
		Refusal	0.55	2.40	2.90			
2	Nov. 2008	Water Depth	0.50	2.70	0.20	29.2	50	
		Sediment Thickness	0.50	0.00	0.40			
		Refusal	1.00	2.70	0.60			
3	Nov. 2008	Water Depth	1.00	2.10	1.00	27.0	100	
		Sediment Thickness	0.30	0.20	1.50			
		Refusal	1.30	2.30	2.50			
	Oct. 2015	Water Depth	0.40	2.00	0.30			
		Sediment Thickness	0.10	1.10	1.50			
		Refusal	0.50	3.10	1.80			
4	Nov. 2008	Water Depth	0.70	1.80	2.60	25.7	150	
		Sediment Thickness	2.00	0.60	0.20			
		Refusal	2.70	2.40	2.80			
5	Nov. 2008	Water Depth	0.60	2.70	1.20	24.3	200	
		Sediment Thickness	1.70	0.00	0.10			
		Refusal	2.30	2.70	1.30			
6	Nov. 2008	Water Depth	1.00	2.00	1.50	20.4	250	
		Sediment Thickness	0.00	0.70	0.00			
		Refusal	1.00	2.70	1.50			
7 (17)	Nov. 2008	Water Depth	1.70	2.60	1.50	20.6	300	
		Sediment Thickness	0.00	0.10	0.30			
		Refusal	1.70	2.70	1.80			
	Oct. 2015	Water Depth	1.00	1.70	0.50			Petroleum odor and sheen observed
		Sediment Thickness	0.30	0.00	<0.1			
		Refusal	1.30	1.70	0.60			
8	Nov. 2008	Water Depth	2.60	2.90	2.80	13.5	350	River bank becomes rock lined with field stone ~ 350'
		Sediment Thickness	0.00	0.00	0.00			
		Refusal	2.60	2.90	2.80			

Table 3-11. Water Depth and Sediment Thickness Measurements from the Eastern Channel Corridor [Comparison of 2008 and 2015 Measurements]

Sampling Station [2008 Station # (2015 Station #)]	Investigation Date	Field Measurements						Comments
		Parameter	Left Bank (1) (feet)	Channel Center (feet)	Right Bank (1) (feet)	Channel Width (feet)	Distance from Upstream Reference Point (feet)	
9	Nov. 2008	Water Depth	2.70	2.70	2.30	13.5	400	
		Sediment Thickness	0.00	0.00	0.00			
		Refusal	2.70	2.70	2.30			
10	Nov. 2008	Water Depth	1.00	1.00	0.60	12.0	450	Concrete bridge at ~ 460'
		Sediment Thickness	0.00	0.00	0.00			
		Refusal	1.00	1.00	0.60			
11 (16)	Nov. 2008	Water Depth	2.20	2.50	1.50	12.0	500	Deep sediment pit adjacent to 500' (left side)
		Sediment Thickness	0.00	0.00	0.00			
		Refusal	2.20	2.50	1.50			
	Oct. 2015	Water Depth	0.00	3.80	3.20			No sediment from RDB or C (d/t used)
		Sediment Thickness	1.30	0.10	0.00			
		Refusal	1.30	3.90	3.20			
12	Nov. 2008	Water Depth	2.20	2.20	2.20	15.0	550	River bends northward
		Sediment Thickness	0.00	0.00	0.00			
		Refusal	2.20	2.20	2.20			
13	Nov. 2008	Water Depth	1.50	1.80	1.00	21.0	600	
		Sediment Thickness	0.00	0.00	0.00			
		Refusal	1.50	1.80	1.00			
14 (15)	Nov. 2008	Water Depth	0.80	2.30	0.90	21.0	650	
		Sediment Thickness	0.20	0.00	1.10			
		Refusal	1.00	2.30	2.00			
	Oct. 2015	Water Depth	0.50	2.20	0.20			Sand and rock at RDB and channel, sand LDB; No sample collected
		Sediment Thickness	0.10	0.30	0.00			
		Refusal	0.60	2.50	0.20			
15	Nov. 2008	Water Depth	0.70	1.50	0.60	19.0	700	
		Sediment Thickness	0.20	0.40	0.10			
		Refusal	0.90	1.90	0.70			
16	Nov. 2008	Water Depth	0.60	1.50	1.20	18.0	750	
		Sediment Thickness	0.00	0.00	1.30			
		Refusal	0.60	1.50	2.50			

Table 3-11. Water Depth and Sediment Thickness Measurements from the Eastern Channel Corridor
[Comparison of 2008 and 2015 Measurements]

Sampling Station [2008 Station # (2015 Station #)]	Investigation Date	Field Measurements						Comments
		Parameter	Left Bank (1) (feet)	Channel Center (feet)	Right Bank (1) (feet)	Channel Width (feet)	Distance from Upstream Reference Point (feet)	
17	Nov. 2008	Water Depth	0.80	1.10	1.00	20.0	800	Much debris in channel
		Sediment Thickness	0.20	0.40	0.30			
		Refusal	1.00	1.50	1.30			
18 (14)	Nov. 2008	Water Depth	0.20	0.00	1.00	23.0	850	Left side groundwater discharge noted for ~40' at surface
		Sediment Thickness	0.80	1.50	0.30			
		Refusal	1.00	1.50	1.30			
	Oct. 2015	Water Depth	0.30	1.50	0.10			
		Sediment Thickness	0.80	0.30	0.50			
		Refusal	1.10	1.80	0.60			
19	Nov. 2008	Water Depth	1.20	1.70	1.10	15.0	900	
		Sediment Thickness	0.30	0.00	0.00			
		Refusal	1.50	1.70	1.10			
20	Nov. 2008	Water Depth	1.00	1.50	1.00	18.0	950	
		Sediment Thickness	0.20	0.40	0.50			
		Refusal	1.20	1.90	1.50			
21	Nov. 2008	Water Depth	0.50	1.40	1.00	18.0	1000	
		Sediment Thickness	0.00	0.10	0.10			
		Refusal	0.50	1.50	1.10			
22 (13)	Nov. 2008	Water Depth	1.00	1.80	2.00	23.0	1050	
		Sediment Thickness	0.50	0.20	0.00			
		Refusal	1.50	2.00	2.00			
	Oct. 2015	Water Depth	0.10	1.70	0.10			No sediment collected from RDB or channel
		Sediment Thickness	1.40	0.10	0.10			
		Refusal	1.50	1.80	0.20			
23	Nov. 2008	Water Depth	2.00	3.00	1.30	24.0	1100	Pit on left side adjacent to station 23
		Sediment Thickness	2.50	1.50	0.00			
		Refusal	4.50	4.50	1.30			
24	Nov. 2008	Water Depth	1.50	2.50	2.80	16.0	1150	Bridge begins at 1143', ends at 1163'; Rock lined channel from 1120' to 1180'
		Sediment Thickness	0.00	0.00	0.00			
		Refusal	1.50	2.50	2.80			

Table 3-11. Water Depth and Sediment Thickness Measurements from the Eastern Channel Corridor [Comparison of 2008 and 2015 Measurements]

Sampling Station [2008 Station # (2015 Station #)]	Investigation Date	Field Measurements						Comments
		Parameter	Left Bank (1) (feet)	Channel Center (feet)	Right Bank (1) (feet)	Channel Width (feet)	Distance from Upstream Reference Point (feet)	
25 (12)	Nov. 2008	Water Depth	0.50	1.50	1.50	10.0	1200	Start of dense wetland at 1200' right side, 10' width
		Sediment Thickness	0.00	0.00	0.00			
		Refusal	0.50	1.50	1.50			
	Oct. 2015	Water Depth	0.20	0.90	0.10			No sediment collected from LDB
		Sediment Thickness	0.00	2.50	1.40			
		Refusal	0.20	3.40	1.50			
26	Nov. 2008	Water Depth	0.80	1.50	1.50	12.0	1250	Wetland to east, undetermined width
		Sediment Thickness	0.00	0.60	0.60			
		Refusal	0.80	2.10	2.10			
27	Nov. 2008	Water Depth	0.50	1.20	1.10	19.0	1300	GW discharge, left bank through gravel
		Sediment Thickness	0.00	0.80	0.40			
		Refusal	0.50	2.00	1.50			
28	Nov. 2008	Water Depth	0.70	1.00	0.80	23.0	1350	wetland both sides >20'
		Sediment Thickness	0.30	1.00	0.80			
		Refusal	1.00	2.00	1.60			
29 (11)	Nov. 2008	Water Depth	0.00	1.20	1.40	23.0	1400	Car chassis in channel at 1400'
		Sediment Thickness	1.50	1.00	1.20			
		Refusal	1.50	2.20	2.60			
	Oct. 2015	Water Depth	0.10	1.10	0.10			No sediment collected from LDB; Sheen observed upon poling
		Sediment Thickness	0.00	0.90	1.40			
		Refusal	0.10	2.00	1.50			
30	Nov. 2008	Water Depth	1.50	1.30	0.20	14.0	1450	
		Sediment Thickness	0.10	0.80	1.30			
		Refusal	1.60	2.10	1.50			
31	Nov. 2008	Water Depth	0.60	1.20	0.70	11.0	1500	Storm drain discharge left side
		Sediment Thickness	0.00	0.10	0.60			
		Refusal	0.60	1.30	1.30			

Table 3-11. Water Depth and Sediment Thickness Measurements from the Eastern Channel Corridor [Comparison of 2008 and 2015 Measurements]

Sampling Station [2008 Station # (2015 Station #)]	Investigation Date	Field Measurements						Comments
		Parameter	Left Bank (1) (feet)	Channel Center (feet)	Right Bank (1) (feet)	Channel Width (feet)	Distance from Upstream Reference Point (feet)	
32 (10)	Nov. 2008	Water Depth	0.00	1.60	1.40	15.0	1550	Start of small rock lined wall on left
		Sediment Thickness	0.00	0.00	0.50			
		Refusal	0.00	1.60	1.90			
	Oct. 2015	Water Depth	0.40	0.90	0.10			
		Sediment Thickness	1.40	0.60	0.80			
		Refusal	1.80	1.50	0.90			
33	Nov. 2008	Water Depth	1.40	1.50	1.20	12.0	1600	At 1600' wetlands extend 20-50' both sides, approx sample location
		Sediment Thickness	0.70	0.60	0.90			
		Refusal	2.10	2.10	2.10			
34	Nov. 2008	Water Depth	0.70	1.50	2.00	17.0	1650	
		Sediment Thickness	1.40	0.40	0.00			
		Refusal	2.10	1.90	2.00			
35 (9)	Nov. 2008	Water Depth	0.60	1.10	1.00	17.0	1700	
		Refusal	0.90	1.10	1.40			
		Sediment Thickness	0.30	0.00	0.40			
	Oct. 2015	Water Depth	0.20	1.90	0.40			
		Sediment Thickness	0.60	1.00	1.30			
		Refusal	0.80	2.90	1.50			
36	Nov. 2008	Water Depth	1.70	2.50	1.40	21.0	1750	
		Sediment Thickness	0.60	0.00	0.80			
		Refusal	2.30	2.50	2.20			
37	Nov. 2008	Water Depth	0.80	1.50	1.00	18.0	1800	3-5 drums in channel at 1800'
		Sediment Thickness	0.00	0.60	0.30			
		Refusal	0.80	2.10	1.30			
38	Nov. 2008	Water Depth	0.20	1.80	1.80	17.0	1850	
		Sediment Thickness	1.40	0.00	0.00			
		Refusal	1.60	1.80	1.80			

Table 3-11. Water Depth and Sediment Thickness Measurements from the Eastern Channel Corridor [Comparison of 2008 and 2015 Measurements]

Sampling Station [2008 Station # (2015 Station #)]	Investigation Date	Field Measurements						Comments
		Parameter	Left Bank (1) (feet)	Channel Center (feet)	Right Bank (1) (feet)	Channel Width (feet)	Distance from Upstream Reference Point (feet)	
39 (8)	Nov. 2008	Water Depth	1.30	1.30	1.30	18.0	1900	Car parts and rubble in channel at 1900'
		Sediment Thickness	0.00	0.00	0.00			
		Refusal	1.30	1.30	1.30			
	Oct. 2015	Water Depth	0.20	1.70	0.30			No sediment collected in channel (rock)
		Sediment Thickness	1.00	0.20	0.40			
		Refusal	1.20	1.90	0.70			
40	Nov. 2008	Water Depth	0.70	1.20	0.90	18.0	1950	Bridge spans from 1910' to 1922', rock lined 6' either side and ends
		Sediment Thickness	0.70	0.00	0.00			
		Refusal	1.40	1.20	0.90			
41	Nov. 2008	Water Depth	1.30	1.10	0.00	19.0	2000	
		Sediment Thickness	0.00	0.10	0.80			
		Refusal	1.30	1.20	0.80			
42 (7)	Nov. 2008	Water Depth	1.10	1.10	0.00	25.0	2050	Hummock islands from 2050' to 2100', wetlands left 20-30'
		Sediment Thickness	0.00	0.00	2.00			
		Refusal	1.10	1.10	2.00			
	Oct. 2015	Water Depth	0.10	1.10	0.10			No sediment collected in channel (rock)
		Sediment Thickness	0.80	0.10	1.00			
		Refusal	0.90	1.20	1.10			
43	Nov. 2008	Water Depth	0.00	0.20	0.70	42.0	2100	
		Sediment Thickness	2.10	2.20	1.30			
		Refusal	2.10	2.40	2.00			
44	Nov. 2008	Water Depth	0.20	0.20	0.00	35.0	2150	Right bank GW flow at 1' above current river level
		Sediment Thickness	1.90	1.90	1.50			
		Refusal	2.10	2.10	1.50			
45 (6)	Nov. 2008	Water Depth	1.30	1.00	0.00	20.0	2200	Wetlands both sides at 2200' > 20' both sides
		Sediment Thickness	1.20	0.50	1.10			
		Refusal	2.50	1.50	1.10			
	Oct. 2015	Water Depth	0.10	0.50	0.10			
		Sediment Thickness	1.80	1.50	0.70			
		Refusal	1.90	2.00	0.80			

Table 3-11. Water Depth and Sediment Thickness Measurements from the Eastern Channel Corridor [Comparison of 2008 and 2015 Measurements]

Sampling Station [2008 Station # (2015 Station #)]	Investigation Date	Field Measurements						Comments
		Parameter	Left Bank (1) (feet)	Channel Center (feet)	Right Bank (1) (feet)	Channel Width (feet)	Distance from Upstream Reference Point (feet)	
46	Nov. 2008	Water Depth	0.00	1.50	1.00	20.0	2250	
		Sediment Thickness	0.00	0.20	1.10			
		Refusal	0.00	1.70	2.10			
47	Nov. 2008	Water Depth	1.10	1.50	0.80	18.0	2300	
		Sediment Thickness	0.00	0.00	0.20			
		Refusal	1.10	1.50	1.00			Freeflowing GW/surface water right side 5' above water level
48 (5)	Nov. 2008	Water Depth	1.00	1.50	1.00	22.0	2350	
		Sediment Thickness	0.60	0.20	0.80			Tree dam formation at 2320'
		Refusal	1.60	1.70	1.80			
	Oct. 2015	Water Depth	0.10	1.00	0.20			
		Sediment Thickness	0.90	0.40	0.00			No sediment collected from RDB (Sand & Gravel)
		Refusal	1.00	1.40	0.20			
49	Nov. 2008	Water Depth	0.80	1.00	0.60	18.0	2400	
		Sediment Thickness	0.10	0.30	0.00			
		Refusal	0.90	1.30	0.60			
50	Nov. 2008	Water Depth	0.90	1.50	1.10	17.0	2450	
		Sediment Thickness	0.10	0.10	0.00			
		Refusal	1.00	1.60	1.10			
51 (4)	Nov. 2008	Water Depth	0.00	1.00	0.10	25.0	2500	
		Sediment Thickness	2.00	2.00	1.50			Old bridge supports with dugout left side at 2540'
		Refusal	2.00	3.00	1.60			
	Oct. 2015	Water Depth	0.10	1.10	0.40			
		Sediment Thickness	0.30	<0.1	0.00			No sediment collected from RDB or channel (Rock)
		Refusal	0.40	1.20	0.40			
52	Nov. 2008	Water Depth	1.10	1.10	0.00	20.0	2550	
		Sediment Thickness	0.20	0.50	1.00			
		Refusal	1.30	1.60	1.00			
53	Nov. 2008	Water Depth	0.30	2.00	1.50	20.0	2600	Bridge centered on 2600', rock lined wall begins 2575' on right, 2600' left side
		Sediment Thickness	0.80	0.20	0.00			
		Refusal	1.10	2.20	1.50			

Table 3-11. Water Depth and Sediment Thickness Measurements from the Eastern Channel Corridor [Comparison of 2008 and 2015 Measurements]

Sampling Station [2008 Station # (2015 Station #)]	Investigation Date	Field Measurements						Comments
		Parameter	Left Bank (1) (feet)	Channel Center (feet)	Right Bank (1) (feet)	Channel Width (feet)	Distance from Upstream Reference Point (feet)	
54 (3)	Nov. 2008	Water Depth	0.10	0.90	0.90	22.0	2650	8" iron discharge pipe on right bank, 2' above current water level; Concrete culvert at water level near 2675'
		Sediment Thickness	0.10	0.00	0.20			
		Refusal	0.20	0.90	1.10			
	Oct. 2015	Water Depth	0.50	0.80	0.40			No core collected (Sand & Gravel)
		Sediment Thickness	0.20	<0.1	<0.1			
		Refusal	0.70	0.90	0.50			
55	Nov. 2008	Water Depth	0.20	0.50	0.50	20.0	2700	
		Sediment Thickness	0.60	0.00	0.00			
		Refusal	0.80	0.50	0.50			
56	Nov. 2008	Water Depth	0.70	0.80	1.10	18.0	2750	
		Sediment Thickness	0.00	0.00	0.00			
		Refusal	0.70	0.80	1.10			
57 (2)	Nov. 2008	Water Depth	0.50	0.40	0.60	18.0	2800	4" sewer pipe left side, 1 ft above water level
		Sediment Thickness	0.00	0.00	0.00			
		Refusal	0.50	0.40	0.60			
	Oct. 2015	Water Depth	3.00	1.00	1.00			No core collected (rock)
		Sediment Thickness	0.00	0.00	0.00			
		Refusal	3.00	1.00	1.00			
58	Nov. 2008	Water Depth	0.20	0.50	1.00	15.0	2850	Staff gauge near 2850' reads 1.0', hand gauged at .9'
		Sediment Thickness	0.00	0.00	0.00			
		Refusal	0.20	0.50	1.00			
59	Nov. 2008	Water Depth	0.50	0.50	0.50	14.0	2900	
		Sediment Thickness	0.00	0.00	0.00			
		Refusal	0.50	0.50	0.50			
60 (1)	Nov. 2008	Water Depth	0.50	0.50	0.30	18.0	2950	Bridge at 2950', dugout area left side, 6" iron pipe right side ~2940'
		Sediment Thickness	0.00	0.00	0.00			
		Refusal	0.50	0.50	0.30			
	Oct. 2015	Water Depth	0.10	4.00	1.50			No sediment collected from RDB or channel
		Sediment Thickness	3.00	0.00	<0.1			
		Refusal	3.10	4.00	1.60			

Table 3-11. Water Depth and Sediment Thickness Measurements from the Eastern Channel Corridor [Comparison of 2008 and 2015 Measurements]

Sampling Station [2008 Station # (2015 Station #)]	Investigation Date	Field Measurements						Comments
		Parameter	Left Bank (1) (feet)	Channel Center (feet)	Right Bank (1) (feet)	Channel Width (feet)	Distance from Upstream Reference Point (feet)	
61	Nov. 2008	Water Depth	0.20	0.50	0.50	14.0	3000	
		Sediment Thickness	0.00	0.00	0.00			
		Refusal	0.20	0.50	0.50			
62	Nov. 2008	Water Depth	0.40	0.40	0.40	12.0	3050	
		Sediment Thickness	0.00	0.00	0.00			
		Refusal	0.40	0.40	0.40			
63	Nov. 2008	Water Depth	0.40	0.30	0.00	12.0	3100	Small dam formation at 3100' with ~4" elevation drop
		Sediment Thickness	0.00	0.00	0.00			
		Refusal	0.40	0.30	0.00			
64	Nov. 2008	Water Depth	0.20	0.20	0.30	12.0	3150	Wooden walking bridge at 3150'
		Sediment Thickness	0.00	0.00	0.00			
		Refusal	0.20	0.20	0.30			

Notes:

1) "Left" and "Right" are defined relative to a person looking in the up-stream direction

Nov. - November

Oct. - October

Table 3-12. Mercury Results in Sediment in the Eastern Channel Corridor

Sample ID	Field Note	Sampling Station # (1) (2015)	Sample Depth (inches)	Sample Date	Total Mercury Concentration (mg/Kg)	Lab Flag/ Qualifier	Reporting Limit (mg/Kg)	Sample Basis	Percent Solids (%)
SD-ECCS1-PC	No sample from RDB or channel	1	0-3	10/25/2015	14.6		3.9	As-Received	22.9
SD-ECCS4-PC	No sample from RDB or channel	4	0-3	10/25/2015	48.9		2	Air-Dried	18.4
SD-ECCS4-PC-DUP	No sample from RDB or channel	4	0-3	10/25/2015	33.6		1.9	Air-Dried	18.2
SD-ECCS5-PC	No sample from RDB	5	0-3	10/25/2015	186		18.3	As-Received	47.5
SD-ECCS6-PC	3 part composite	6	0-3	10/25/2015	16		2	As-Received	55.7
SD-ECCS7-PC	No sample from channel	7	0-3	10/25/2015	45.2		3.6	As-Received	28.1
SD-ECCS8-PC	No sample from channel	8	0-3	10/25/2015	84.8		6.4	As-Received	36.1
SD-ECCS9-PC	3 part composite	9	0-3	10/25/2015	261		28.4	As-Received	33.1
SD-ECCS10-PC	3 part composite	10	0-3	10/25/2015	125		12.9	As-Received	38.1
SD-ECCS11-PC	No sample from LDB	11	0-3	10/25/2015	453		38.7	As-Received	48.5
SD-ECCS12-PC	No sample from LDB	12	0-3	10/25/2015	71.6		6.4	As-Received	33
SD-ECCS12-PC-DUP	No sample from LDB	12	0-3	10/25/2015	156		18.4	As-Received	27.1
SD-ECCS13-PC	No sample from RDB or channel	13	0-3	10/25/2015	551		44	As-Received	46.2
SD-ECCS14-PC	3 part composite	14	0-3	10/25/2015	12.2		1.9	As-Received	58.1
SD-ECCS16-PC	No sample from RDB or channel	16	0-3	10/25/2015	28.6		3.6	As-Received	56.2
SD-ECCS17-PC	3 part composite	17	0-3	10/26/2015	49.4		15.7	As-Received	56.9
SD-ECCS18-PC	3 part composite	18	0-3	10/25/2015	45.6		3	As-Received	36.8
SD-ECCS18-PC-DUP	3 part composite	18	0-3	10/25/2015	66.2		4.1	As-Received	26.8

Notes:

1) No sample could be collected at Stations 1, 2, and 3

LDB - Left bank (when looking upstream)

mg/Kg - milligrams/Kilogram

RDB - Right bank (when looking upstream)

Sample Basis - Samples that are not "Air-Dried" prior to analysis are referred to as "As-Received" and presumed to have a certain moisture content and are reported on a dry or wet basis with a percent solids measured by the laboratory and reported. Samples that are Air-Dried are presumed to have no moisture content and therefore no percent solids reported. However, several air-dried samples were first analyzed at the laboratory for percent moisture and were found to exhibit greater than 80% moisture. These samples were air-dried, then analyzed for mercury. As such, for these air-dried samples the initial % solids reported by the laboratory are presented although the samples were subsequently air-dried.

Table 3-13. Mercury Results in Sediment in the Lower Drinkwater River Corridor

Sample ID	Sample Depth (inches)	Sample Date	Total Mercury Concentration (mg/Kg)	Lab Flag/ Qualifier	Reporting Limit (mg/Kg)	Sample Basis	Percent Solids (1) (%)
SD-LDRC1-06	3-6	10/15/2015	1.2		0.17	As-Received	68.6
SD-LDRC1-06-DUP	3-6	10/15/2015	0.97		0.15	As-Received	72.3
SD-LDRC2-06	3-6	10/15/2015	62		7.6	As-Received	26.4
SD-LDRC2-12	6-12	10/15/2015	1.7		0.26	As-Received	37.9
SD-LDRC3-06	3-6	10/15/2015	17.3		3.8	As-Received	23.0
SD-LDRC3-12	6-12	10/15/2015	0.27	J	0.38	As-Received	27.5

Notes:

Qualifiers:

J -Less than the RL but greater than or equal to the MDL and the concentration is an approximate value

1) There were no samples collected from the Lower Drinkwater River Corridor (LDRC) that were air-dried.

Lab - Laboratory

mg/Kg - milligrams/Kilogram

Sample Basis - Samples that are not "Air-Dried" prior to analysis are referred to as "As-Received" and presumed to have a certain moisture content and are reported on a dry or wet basis with a percent solids measured by the laboratory and reported.

Table 3-14. Maximum Detected Concentration and Depth to 4 mg/Kg of Mercury in the Lower Drinkwater Corridor and Lily Pond/Upper Factory Pond

Sample Station	Maximum Mercury Detected at Location (mg/Kg)	Depth of Detected Maximum (inches)	Depth Where Hg < 4 mg/Kg (inches)
SD-LUFP58	36.9	3-6	Deeper than 18
SD-LUFP59	1.1	3-6	All < 4 mg/Kg
SD-LUFP60	4.4	3-6	6
SD-LUFP63	369	6-12	18
SD-LUFP65	1.1	3-6	All < 4 mg/Kg
SD-LUFP66	5.8	3-6	6
SD-LUFP69	467	3-6	6
SD-LUFP70	0.32	3-6	All < 4 mg/Kg
SD-LUFP71	92.3	6-12	18
SD-LUFP74	109	3-6	12
SD-LUFP75	103	3-6	12
SD-LUFP76	367	3-6	12
SD-LUFP79	18.1	3-6	6
SD-LUFP80	0.81	6-12	All < 4 mg/Kg
SD-LUFP81	42	3-6	6
SD-LUFP82	155	3-6	6
SD-LUFP84	108	3-6	6
SD-LUFP85	7.3	3-6	6
SD-LUFP86	14.9	3-6	6
SD-LUFP87	222	3-6	6
SD-LUFP88	40.1	3-6	12
SD-LUFP89	124	3-6	6
SD-LUFP90	71.6	3-6	18
SD-LUFP91	63.4	3-6	6
SD-LUFP93	8.6	3-6	6
SD-LUFP95	58.8	3-6	6
SD-LUFP97	111	6-12	18
SD-LUFP98	281	6-12	Deeper than 24
SD-LUFP102	52.1	3-6	6
SD-LUFP103	43.8	3-6	6
SD-LUFP104	80.8	3-6	Deeper than 12
SD-LUFP106	0.26	3-6	All < 4 mg/Kg
SD-LUFP108	1.1	3-6	All < 4 mg/Kg
SD-LUFP110	10.8	3-6	6
SD-LUFP111	104	3-6	12
SD-LUFP112	60.4	3-6	6
SD-LUFP113	92.9	3-6	Deeper than 6
SD-LUFP114	63.5	3-6	Deeper than 12
SD-LUFP115	53.4	3-6	6
SD-LUFP116	84.6	6-12	Deeper than 12
SD-LUFP117	222	3-6	6
SD-LUFP118	125	3-6	6

Table 3-14. Maximum Detected Concentration and Depth to 4 mg/Kg of Mercury in the Lower Drinkwater Corridor and Lily Pond/Upper Factory Pond

Sample Station	Maximum Mercury Detected at Location (mg/Kg)	Depth of Detected Maximum (inches)	Depth Where Hg < 4 mg/Kg (inches)
SD-LUFP119	192	3-6	6
SD-LDRC1	1.2	3-6	All < 4 mg/Kg
SD-LDRC2	62.0	3-6	6
SD-LDRC3	17.3	3-6	6
SD-LUFP120	1.9	3-6	All < 4 mg/Kg
SD-LUFP121	39.4	6-12	Deeper than 12
SD-LUFP122	621	3-6	Deeper than 6
SD-LUFP123	682	3-6	Deeper than 6
SD-LUFP124	0.46	3-6	All < 4 mg/Kg

Notes:

Deeper than # - Mercury was detected above 4 mg/Kg at every sampled depth at this sampling station. The # is associated with the deepest sampling depth at that location.

All < 4 mg/Kg - Mercury was not detected above 4 mg/kg at any depth at this sampling station.

Hg - mercury

mg/Kg - milligrams/Kilogram

Table 3-15. Mercury Results in Sediment in Lily Pond/Upper Factory Pond

Sample ID	Sample Depth (inches)	Sample Date	Total Mercury Concentration (mg/Kg)	Lab Flag/ Qualifier	Reporting Limit (mg/Kg)	Sample Basis (mg/Kg)	Percent Solids (%)
SD-LUFP58-06	3-6	10/8/2015	36.9		3.4	As-Received	28.6
SD-LUFP58-12	6-12	10/8/2015	14.5		1.1	As-Received	36.8
SD-LUFP58-18	12-18	10/8/2015	12.8		2.5	As-Received	35.4
SD-LUFP59-06	3-6	10/7/2015	1.1		0.055	As-Received	35.9
SD-LUFP59-12	6-12	10/7/2015	0.72		0.027	As-Received	73.6
SD-LUFP60-06	3-6	10/7/2015	4.4		0.4	Air-Dried	
SD-LUFP60-06-DUP	3-6	10/7/2015	11.3		0.93	Air-Dried	
SD-LUFP60-12	6-12	10/7/2015	0.76		0.039	As-Received	49.1
SD-LUFP63-06	3-6	10/8/2015	26.8		1.9	Air-Dried	
SD-LUFP63-12	6-12	10/8/2015	369		14.9	As-Received	25.7
SD-LUFP63-18	12-18	10/8/2015	7.9		0.95	As-Received	20
SD-LUFP63-24	18-24	10/8/2015	0.25		0.25	As-Received	37
SD-LUFP63-30	24-30	10/8/2015	0.15	J	0.27	As-Received	35.6
SD-LUFP63-36	30-36	10/8/2015	0.13	U	0.13	As-Received	82.3
SD-LUFP65-06	3-6	10/7/2015	1.1		0.042	As-Received	44.7
SD-LUFP65-12	6-12	10/7/2015	0.21		0.029	As-Received	65.7
SD-LUFP66-06	3-6	10/8/2015	5.8		0.4	Air-Dried	
SD-LUFP66-12	6-12	10/8/2015	0.06		0.031	As-Received	64.4
SD-LUFP69-06	3-6	10/8/2015	401		17.7	As-Received	11.2
SD-LUFP69-06	3-6	10/8/2015	467		40.6	Air-Dried	11.2
SD-LUFP69-12	6-12	10/8/2015	0.31	J	0.44	As-Received	25.6
SD-LUFP70-06	3-6	10/8/2015	0.32		0.039	As-Received	50.3
SD-LUFP70-06-DUP	3-6	10/8/2015	0.2		0.038	As-Received	51.2
SD-LUFP71-06	3-6	10/8/2015	59.2		2	Air-Dried	
SD-LUFP71-12	6-12	10/8/2015	92.3		8.6	As-Received	22.5
SD-LUFP71-18	12-18	10/8/2015	12.9		3.1	As-Received	34.7
SD-LUFP71-24	18-24	10/8/2015	0.072	J	0.15	As-Received	56.6
SD-LUFP74-06	3-6	10/8/2015	109		4.1	Air-Dried	
SD-LUFP74-12	6-12	10/8/2015	6.7		0.39	As-Received	24.1
SD-LUFP74-18	12-18	10/8/2015	0.066	J	0.32	As-Received	29.7
SD-LUFP74-24	18-24	10/8/2015	0.16	U	0.16	As-Received	66.3
SD-LUFP75-06	3-6	10/8/2015	103		7.3	As-Received	26.9
SD-LUFP75-12	6-12	10/8/2015	5.3		0.46	As-Received	43.5
SD-LUFP75-18	12-18	10/8/2015	0.035	J	0.14	As-Received	73.9
SD-LUFP75-24	18-24	10/8/2015	0.05	J	0.2	As-Received	43.8
SD-LUFP76-06	3-6	10/9/2015	367		40.8	Air-Dried	
SD-LUFP76-12	6-12	10/9/2015	2.2		0.081	As-Received	24.4
SD-LUFP76-12-DUP	6-12	10/9/2015	9.9		0.73	As-Received	26.1
SD-LUFP76-18	12-18	10/9/2015	0.11	J	0.34	As-Received	35
SD-LUFP76-24	18-24	10/9/2015	0.11	J	0.33	As-Received	26.8
SD-LUFP79-06	3-6	10/9/2015	18.1		2	Air-Dried	

Table 3-15. Mercury Results in Sediment in Lily Pond/Upper Factory Pond

Sample ID	Sample Depth (inches)	Sample Date	Total Mercury Concentration (mg/Kg)	Lab Flag/ Qualifier	Reporting Limit (mg/Kg)	Sample Basis (mg/Kg)	Percent Solids (%)
SD-LUFP79-12	6-12	10/9/2015	0.51		0.079	As-Received	25.5
SD-LUFP80-06	3-6	10/8/2015	0.36		0.044	As-Received	45.3
SD-LUFP80-12	6-12	10/8/2015	0.81		0.042	As-Received	45.5
SD-LUFP81-06	3-6	10/8/2015	42		3.5	As-Received	27.2
SD-LUFP81-12	6-12	10/8/2015	0.37	F1	0.049	As-Received	40.7
SD-LUFP82-06	3-6	10/9/2015	155		9.5	Air-Dried	
SD-LUFP82-12	6-12	10/9/2015	1.3		0.091	As-Received	21.2
SD-LUFP82-12	6-12	10/9/2015	1.5		0.1	Air-Dried	21.2
SD-LUFP84-06	3-6	10/9/2015	108		3.8	Air-Dried	
SD-LUFP84-12	3-6	10/9/2015	0.22		0.055	As-Received	34.3
SD-LUFP85-06	3-6	10/8/2015	7.3		0.33	As-Received	11.9
SD-LUFP85-06	3-6	10/8/2015	29		2	Air-Dried	11.9
SD-LUFP85-12	6-12	10/8/2015	0.12		0.065	As-Received	30.4
SD-LUFP86-06	3-6	10/8/2015	14.9		1.4	As-Received	27.3
SD-LUFP86-12	6-12	10/8/2015	0.21	J	0.25	As-Received	41.4
SD-LUFP87-06	3-6	10/9/2015	222		18.8	Air-Dried	
SD-LUFP87-12	6-12	10/9/2015	0.15		0.063	As-Received	31.5
SD-LUFP88-06	3-6	10/9/2015	40.1		2	Air-Dried	
SD-LUFP88-12	6-12	10/9/2015	31.1		2	Air-Dried	
SD-LUFP88-18	12-18	10/9/2015	0.11		0.082	As-Received	22.9
SD-LUFP89-06	3-6	10/9/2015	124		9.9	Air-Dried	
SD-LUFP89-12	6-12	10/9/2015	0.81		0.055	As-Received	36.5
SD-LUFP90-06	3-6	10/12/2015	71.6		1.9	Air-Dried	
SD-LUFP90-12	6-12	10/12/2015	19.1		1.3	As-Received	15.6
SD-LUFP90-18	12-18	10/12/2015	6.7		0.2	As-Received	47.4
SD-LUFP90-24	18-24	10/12/2015	0.57		0.049	As-Received	39.2
SD-LUFP90-30	24-30	10/12/2015	0.83		0.049	As-Received	40.7
SD-LUFP90-36	30-36	10/12/2015	1.2		0.059	As-Received	34.5
SD-LUFP91-06	3-6	10/9/2015	63.4		2	Air-Dried	
SD-LUFP91-12	6-12	10/9/2015	0.1		0.048	As-Received	42.8
SD-LUFP93-06	3-6	10/12/2015	8.6		0.52	As-Received	18.3
SD-LUFP93-06-DUP	3-6	10/12/2015	1.2		0.085	As-Received	21.9
SD-LUFP93-12	6-12	10/12/2015	0.058		0.052	As-Received	36.6
SD-LUFP93-18	12-18	10/12/2015	0.075		0.059	As-Received	34.1
SD-LUFP93-24	18-24	10/12/2015	0.04	U	0.04	As-Received	49.8
SD-LUFP93-30	24-30	10/12/2015	0.032	U	0.032	As-Received	64
SD-LUFP95-06	3-6	10/9/2015	58.8		4.6	As-Received	21.7
SD-LUFP95-06-DUP	3-6	10/9/2015	59.5		4.6	As-Received	21.2
SD-LUFP95-12	6-12	10/9/2015	3		0.33	As-Received	29.4
SD-LUFP97-06	3-6	10/12/2015	44.2		2	Air-Dried	
SD-LUFP97-12	6-12	10/12/2015	111		6.9	As-Received	14.4

Table 3-15. Mercury Results in Sediment in Lily Pond/Upper Factory Pond

Sample ID	Sample Depth (inches)	Sample Date	Total Mercury Concentration (mg/Kg)	Lab Flag/ Qualifier	Reporting Limit (mg/Kg)	Sample Basis (mg/Kg)	Percent Solids (%)
SD-LUFP97-18	12-18	10/12/2015	55.7		2	Air-Dried	11.4
SD-LUFP97-18	12-18	10/12/2015	132		8.2	As-Received	11.4
SD-LUFP97-24	18-24	10/12/2015	3.2		0.15	As-Received	13.1
SD-LUFP98-06	3-6	10/12/2015	21.9		2	Air-Dried	
SD-LUFP98-12	6-12	10/12/2015	281		9.4	As-Received	21.5
SD-LUFP98-18	12-18	10/12/2015	4.1		0.18	As-Received	21.6
SD-LUFP98-24	18-24	10/12/2015	11.9		0.77	As-Received	26.7
SD-LUFP102-06	3-6	10/12/2015	52.1		1.9	Air-Dried	
SD-LUFP102-12	6-12	10/12/2015	0.066		0.061	As-Received	32.7
SD-LUFP102-18	12-18	10/12/2015	0.042	U	0.042	As-Received	46.9
SD-LUFP102-24	18-24	10/12/2015	0.079		0.046	As-Received	44.4
SD-LUFP103-06	3-6	10/12/2015	43.8		2	Air-Dried	
SD-LUFP103-12	6-12	10/12/2015	1.3		0.093	As-Received	20.4
SD-LUFP104-06	3-6	10/9/2015	80.8		10.1	Air-Dried	
SD-LUFP104-12	6-12	10/9/2015	39.9		1.9	As-Received	21.3
SD-LUFP106-06	3-6	10/14/2015	0.26	U	0.26	As-Received	39.2
SD-LUFP108-06	3-6	10/14/2015	1.1		0.13	As-Received	85
SD-LUFP108-06-DUP	3-6	10/14/2015	1.1		0.13	As-Received	80.9
SD-LUFP110-06	3-6	10/14/2015	10.8		1.9	Air-Dried	
SD-LUFP110-06-DUP	3-6	10/14/2015	14.1		1.9	Air-Dried	
SD-LUFP110-12	6-12	10/14/2015	0.5	U	0.5	As-Received	22.8
SD-LUFP111-06	3-6	10/12/2015	104		9.7	Air-Dried	
SD-LUFP111-12	6-12	10/12/2015	0.18		0.1	As-Received	19.8
SD-LUFP111-12	6-12	10/12/2015	18.3		1.9	Air-Dried	19.8
SD-LUFP111-18	12-18	10/12/2015	0.053	J	0.12	As-Received	16.3
SD-LUFP111-18-DUP	12-18	10/12/2015	0.12	U	0.12	As-Received	16
SD-LUFP111-24	18-24	10/12/2015	0.037	J	0.077	As-Received	25.6
SD-LUFP112-06	3-6	10/12/2015	60.4		2	Air-Dried	
SD-LUFP112-12	6-12	10/12/2015	1.6		0.18	As-Received	22.6
SD-LUFP112-12	6-12	10/12/2015	2.4		0.2	Air-Dried	22.5
SD-LUFP112-18	12-18	10/12/2015	0.05	J	0.051	As-Received	36.4
SD-LUFP112-24	18-24	10/12/2015	0.034	J	0.051	As-Received	38.7
SD-LUFP113-06	3-6	10/12/2015	92.9		10.2	Air-Dried	
SD-LUFP114-06	3-6	10/14/2015	63.5		1.9	Air-Dried	
SD-LUFP114-12	6-12	10/14/2015	4.2		0.4	As-Received	21.8
SD-LUFP114-12-DUP	6-12	10/14/2015	0.45		0.4	As-Received	25.2
SD-LUFP115-06	3-6	10/14/2015	53.4		4.1	As-Received	23.5
SD-LUFP115-12	6-12	10/14/2015	0.32		0.32	As-Received	32.5
SD-LUFP116-06	3-6	10/14/2015	8.8		1.9	As-Received	28.5
SD-LUFP116-12	6-12	10/14/2015	84.6		11.8	As-Received	74.5
SD-LUFP117-06	3-6	10/12/2015	222		20.1	Air-Dried	

Table 3-15. Mercury Results in Sediment in Lily Pond/Upper Factory Pond

Sample ID	Sample Depth (inches)	Sample Date	Total Mercury Concentration (mg/Kg)	Lab Flag/ Qualifier	Reporting Limit (mg/Kg)	Sample Basis (mg/Kg)	Percent Solids (%)
SD-LUFP117-12	6-12	10/12/2015	0.16		0.071	As-Received	25.9
SD-LUFP118-06	3-6	10/14/2015	125		9.5	Air-Dried	
SD-LUFP118-12	6-12	10/14/2015	0.089	J	0.44	As-Received	22.2
SD-LUFP119-06	3-6	10/14/2015	192		31.1	As-Received	32.1
SD-LUFP119-12	6-12	10/14/2015	0.2	U	0.2	As-Received	52.5
SD-LUFP120-06	3-6	10/14/2015	1.9		0.15	As-Received	66.3
SD-LUFP121-06	3-6	10/12/2015	0.56		0.02	Air-Dried	
SD-LUFP121-12	6-12	10/12/2015	39.4		2	As-Received	19.5
SD-LUFP122-06	3-6	10/14/2015	621		51.1	As-Received	20.6
SD-LUFP123-06	3-6	10/14/2015	682		45.2	As-Received	19.5
SD-LUFP124-06	3-6	10/14/2015	0.46		0.14	As-Received	70.3
SD-LUFP124-12	6-12	10/14/2015	0.093	J	0.22	As-Received	47.1

Notes:

Qualifiers: J -Less than the RL but greater than or equal to the MDL and the concentration is an approximate value

U - Analyte was analyzed for but not detected

Lab - Laboratory

mg/Kg - milligrams/Kilogram

Sample Basis - Samples that are not "Air-Dried" prior to analysis are referred to as "As-Received" and presumed to have a certain moisture content and are reported on a dry or wet basis with a percent solids measured by the laboratory and reported. Samples that are Air-Dried are presumed to have no moisture content and therefore no percent solids reported. However, several air-dried samples were first analyzed at the laboratory for percent moisture and were found to exhibit greater than 80% moisture. These samples were air-dried, then analyzed for mercury. As such, for these air-dried samples the initial % solids reported by the laboratory are presented although the samples were subsequently air-dried.

Table 3-16. Mercury Results in Sediment in Middle/Lower Factory Pond

Sample ID	Sample Depth (inches)	Sample Date	Total Mercury Concentration (mg/Kg)	Lab Flag/ Qualifier	Reporting Limit (mg/Kg)	Sample Basis (mg/Kg)	Percent Solids (%)
SD-MLFP3-06	3-6	10/19/2015	39.9		2	Air-Dried	
SD-MLFP3-12	6-12	10/19/2015	0.51		1	Air-Dried	
SD-MLFP5-06	3-6	10/19/2015	19		100	Air-Dried	
SD-MLFP5-12	6-12	10/19/2015	0.23		1	As-Received	56.3
SD-MLFP6-06	3-6	10/19/2015	7.3		1	Air-Dried	
SD-MLFP7-06	3-6	10/19/2015	44.7		2	Air-Dried	
SD-MLFP7-12	6-12	10/19/2015	1.3		0.094	Air-Dried	
SD-MLFP7-12-DUP	6-12	10/19/2015	1.9		0.098	Air-Dried	
SD-MLFP7-18	12-18	10/19/2015	0.086		0.019	Air-Dried	
SD-MLFP7-36	30-36	10/19/2015	0.2		0.02	Air-Dried	
SD-MLFP8-06	3-6	10/19/2015	91.9		10.1	Air-Dried	
SD-MLFP13-06	3-6	10/20/2015	5.0		0.4	Air-Dried	
SD-MLFP14-12	6-12	10/20/2015	63.2		2	Air-Dried	
SD-MLFP15-06	3-6	10/20/2015	1.9		0.2	Air-Dried	
SD-MLFP15-12	6-12	10/20/2015	2.8		0.19	Air-Dried	
SD-MLFP15-18	12-18	10/20/2015	0.14		0.019	Air-Dried	
SD-MLFP15-24	18-24	10/20/2015	0.32	J	0.78	As-Received	13.3
SD-MLFP15-30	24-30	10/20/2015	0.22	J	0.32	As-Received	32.2
SD-MLFP16-06	3-6	10/20/2015	8.9		2	Air-Dried	
SD-MLFP17-06	3-6	10/23/2015	49		2	Air-Dried	
SD-MLFP17-12	6-12	10/23/2015	3.1		0.35	As-Received	30.7
SD-MLFP17-12-DUP	6-12	10/23/2015	10		3.6	As-Received	29.1
SD-MLFP17-18	12-18	10/23/2015	0.18		0.16	As-Received	61.5
SD-MLFP18-06	3-6	10/23/2015	120		10.2	Air-Dried	
SD-MLFP18-12	6-12	10/23/2015	0.69		0.33	As-Received	32.6
SD-MLFP18-18	12-18	10/23/2015	0.23	J B	0.28	As-Received	31.3
SD-MLFP19-06	3-6	10/23/2015	112		9.9	Air-Dried	
SD-MLFP19-06-DUP	3-6	10/23/2015	63.8		2	Air-Dried	
SD-MLFP19-12	6-12	10/23/2015	2.3		0.2	Air-Dried	
SD-MLFP20-06	3-6	10/21/2015	38.5		10.2	As-Received	19.5
SD-MLFP20-12	6-12	10/21/2015	145		41.1	As-Received	26.5
SD-MLFP20-12-DUP	6-12	10/21/2015	326		34.3	As-Received	28.7
SD-MLFP20-18	12-18	10/21/2015	0.25	J	0.3	As-Received	29.6
SD-MLFP21-06	3-6	10/21/2015	0.043	J	0.19	As-Received	58.8
SD-MLFP21-06-DUP	3-6	10/21/2015	0.34		0.18	As-Received	50.5
SD-MLFP21-12	6-12	10/21/2015	0.077	J	0.15	As-Received	70.6
SD-MLFP21-18	12-18	10/21/2015	0.021	J	0.12	As-Received	77.6
SD-MLFP24-06	3-6	10/23/2015	27.4		5.8	As-Received	18.6
SD-MLFP24-12	6-12	10/23/2015	0.31	J	0.61	As-Received	18
SD-MLFP24-18	12-18	10/23/2015	0.16		0.019	Air-Dried	

Table 3-16. Mercury Results in Sediment in Middle/Lower Factory Pond

Sample ID	Sample Depth (inches)	Sample Date	Total Mercury Concentration (mg/Kg)	Lab Flag/ Qualifier	Reporting Limit (mg/Kg)	Sample Basis (mg/Kg)	Percent Solids (%)
SD-MLFP25-06	3-6	10/23/2015	26.9		1.8	Air-Dried	
SD-MLFP25-12	6-12	10/23/2015	76.2		2	Air-Dried	
SD-MLFP28-06	3-6	10/23/2015	11.8		1.8	Air-Dried	
SD-MLFP28-06-DUP	3-6	10/23/2015	21.8		1.8	Air-Dried	
SD-MLFP29-06	3-6	10/23/2015	24.6		1.9	Air-Dried	
SD-MLFP29-12	6-12	10/23/2015	0.12	J B	0.18	As-Received	55.2
SD-MLFP30-06	3-6	10/20/2015	10.2		1.9	As-Received	19.6
SD-MLFP30-12	6-12	10/20/2015	0.13	U	0.13	As-Received	72
SD-MLFP31-06	3-6	10/21/2015	32.7		2	Air-Dried	
SD-MLFP31-12	6-12	10/21/2015	0.25		0.18	As-Received	48.5
SD-MLFP32-06	3-6	10/21/2015	73.7		1.9	Air-Dried	
SD-MLFP32-12	6-12	10/21/2015	0.43		0.31	As-Received	36
SD-MLFP32-18	12-18	10/21/2015	0.049	J	0.14	As-Received	80.8
SD-MLFP33-06	3-6	10/21/2015	2		0.44	As-Received	24.1
SD-MLFP33-12	6-12	10/21/2015	0.041	J	0.12	As-Received	74.2
SD-MLFP35-06	3-6	10/23/2015	4.5		2	Air-Dried	
SD-MLFP35-12	6-12	10/23/2015	11.2		1.8	Air-Dried	
SD-MLFP35-12-DUP	6-12	10/23/2015	10		0.91	Air-Dried	
SD-MLFP35-18	12-18	10/23/2015	207	B	26.3	As-Received	20.4
SD-MLFP35-24	18-24	10/23/2015	348	B	43.3	As-Received	23.1
SD-MLFP37-06	3-6	10/23/2015	335		27	As-Received	20.5
SD-MLFP37-12	6-12	10/23/2015	0.034		0.019	Air-Dried	
SD-MLFP37-12-DUP	6-12	10/23/2015	0.024	J	0.15	As-Received	71.9
SD-MLFP39-06	3-6	10/20/2015	26.7		2.8	As-Received	20.5
SD-MLFP39-12	6-12	10/20/2015	0.021	J	0.13	As-Received	76.6
SD-MLFP40-06	3-6	10/20/2015	26		2	Air-Dried	
SD-MLFP40-12	6-12	10/20/2015	138		19.5	Air-Dried	
SD-MLFP41-06	3-6	10/20/2015	70.6		2	Air-Dried	
SD-MLFP41-12	6-12	10/20/2015	0.15	J	0.19	As-Received	51.3
SD-MLFP42-06	3-6	10/21/2015	23		7.5	As-Received	25.3
SD-MLFP42-12	6-12	10/21/2015	0.15	U	0.15	As-Received	69.1
SD-MLFP42-12-DUP	6-12	10/21/2015	0.13	J	0.15	As-Received	68.4
SD-MLFP43-06	3-6	10/23/2015	12.8		0.94	Air-Dried	
SD-MLFP43-12	6-12	10/23/2015	0.25	U	0.25	As-Received	45.7
SD-MLFP43-18	12-18	10/23/2015	0.08	J B	0.24	As-Received	45.9
SD-MLFP43-24	18-24	10/23/2015	0.09	J B	0.52	As-Received	18.2
SD-MLFP44-06	3-6	10/23/2015	8.2		1.9	Air-Dried	
SD-MLFP44-12	6-12	10/23/2015	20.3		1.9	Air-Dried	
SD-MLFP44-18	12-18	10/23/2015	3.7		0.5	As-Received	21.3
SD-MLFP44-24	18-24	10/23/2015	0.75		0.4	As-Received	28.1

Table 3-16. Mercury Results in Sediment in Middle/Lower Factory Pond

Sample ID	Sample Depth (inches)	Sample Date	Total Mercury Concentration (mg/Kg)	Lab Flag/ Qualifier	Reporting Limit (mg/Kg)	Sample Basis (mg/Kg)	Percent Solids (%)
SD-MLFP45-06	3-6	10/21/2015	19.6		1.9	Air-Dried	
SD-MLFP45-12	6-12	10/21/2015	0.53		0.29	As-Received	31.7
SD-MLFP46-06	3-6	10/20/2015	69.2		1.9	Air-Dried	
SD-MLFP46-12	6-12	10/20/2015	0.048	J	0.14	As-Received	67.9
SD-MLFP47-06	3-6	10/23/2015	6.1		2	Air-Dried	
SD-MLFP47-06-DUP	3-6	10/23/2015	9.5		1.9	Air-Dried	
SD-MLFP47-12	6-12	10/23/2015	4.3		0.33	As-Received	27.9
SD-MLFP47-18	12-18	10/23/2015	0.077	J	0.15	As-Received	68.7
SD-MLFP48-06	3-6	10/23/2015	7.5		2	Air-Dried	
SD-MLFP48-12	6-12	10/23/2015	11.2		2	Air-Dried	
SD-MLFP48-18	12-18	10/23/2015	5.4		1.8	As-Received	64.8
SD-MLFP48-24	18-24	10/23/2015	0.39		0.37	As-Received	30.5
SD-MLFP48-30	24-30	10/23/2015	0.33		0.29	As-Received	35.3
SD-MLFP48-36	30-36	10/23/2015	0.71	J	3.7	As-Received	31
SD-MLFP49-06	3-6	10/21/2015	9.5		0.74	As-Received	12.8
SD-MLFP49-12	6-12	10/21/2015	17.7		3.9	As-Received	13.3
SD-MLFP49-18	12-18	10/21/2015	0.36		0.63	As-Received	16.7
SD-MLFP49-24	18-24	10/21/2015	0.26	U	0.26	As-Received	36.4
SD-MLFP50-06	3-6	10/21/2015	30.3		2	Air-Dried	
SD-MLFP50-12	6-12	10/21/2015	13.2		5.1	As-Received	17.6
SD-MLFP50-18	12-18	10/21/2015	0.65	U	0.65	As-Received	15.4
SD-MLFP51-06	3-6	10/21/2015	9.5		1.4	As-Received	63
SD-MLFP51-12	6-12	10/21/2015	0.062	J	0.14	As-Received	78.4
SD-MLFP53-06	3-6	10/20/2015	34.6		2	Air-Dried	
SD-MLFP53-12	6-12	10/20/2015	2.0		0.064	As-Received	30
SD-MLFP53-12-DUP	6-12	10/20/2015	8.8		0.55	As-Received	16.8
SD-MLFP55-06	3-6	10/20/2015	15.7		1.8	As-Received	29.8

Notes:

Qualifiers:	B - Compound was found in the blank and sample
	J -Less than the RL but greater than or equal to the MDL and the concentration is an approximate value
	U - Analyte was analyzed for but not detected

Lab - Laboratory

mg/Kg - millgrams/Kilogram

Sample Basis - Samples that are not "Air-Dried" prior to analysis are referred to as "As-Received" and presumed to have a certain moisture content and are reported on a dry or wet basis with a percent solids measured by the laboratory and reported. Samples that are Air-Dried are presumed to have no moisture content and therefore no percent solids reported. However, several air-dried samples were first analyzed at the laboratory for percent moisture and were found to exhibit greater than 80% moisture. These samples were air-dried, then analyzed for mercury. As such, for these air-dried samples the initial % solids reported by the laboratory are presented although the samples were subsequently air-dried.

Table 3-17. Maximum Detected Concentration and Depth to 4 mg/Kg of Mercury in Middle/Lower Factory Pond

Sample Station	Maximum Mercury Detected at Location (mg/Kg)	Depth of Detected Maximum (inches)	Depth Where Hg < 4 mg/Kg (inches)
SD-MLFP3	39.9	3-6	6
SD-MLFP5	19.0	3-6	6
SD-MLFP6	7.3	3-6	Deeper than 6
SD-MLFP7	44.7	3-6	6
SD-MLFP8	91.9	3-6	Deeper than 6
SD-MLFP13	5.0	3-6	Deeper than 6
SD-MLFP14	63.2	6-12	Deeper than 12
SD-MLFP15	2.8	6-12	All < 4 mg/Kg
SD-MLFP17	49	3-6	6
SD-MLFP18	120	3-6	6
SD-MLFP19	112	3-6	Deeper than 6
SD-MLFP20	326	6-12	12
SD-MLFP21	0.34	3-6	All < 4 mg/Kg
SD-MLFP24	27.4	3-6	6
SD-MLFP25	76.2	6-12	Deeper than 12
SD-MLFP28	11.8	3-6	Deeper than 6
SD-MLFP29	24.6	3-6	6
SD-MLFP30	10.2	3-6	6
SD-MLFP31	32.7	3-6	6
SD-MLFP32	73.7	3-6	6
SD-MLFP33	2.0	3-6	All < 4 mg/Kg
SD-MLFP35	348	18-24	Deeper than 24
SD-MLFP37	335	3-6	6
SD-MLFP39	26.7	3-6	6
SD-MLFP40	138	6-12	Deeper than 12
SD-MLFP41	70.6	3-6	6
SD-MLFP42	23	3-6	6
SD-MLFP43	12.8	3-6	6
SD-MLFP44	20.3	6-12	12
SD-MLFP45	19.6	3-6	6
SD-MLFP46	69.2	3-6	6
SD-MLFP47	9.5	3-6	12
SD-MLFP48	11.2	6-12	18
SD-MLFP49	17.7	6-12	12
SD-MLFP50	30.3	3-6	12
SD-MLFP51	9.5	3-6	6
SD-MLFP53	8.8	6-12	Deeper than 12
SD-MLFP55	15.7	3-6	Deeper than 6

NOTES:

Deeper than # - Mercury was detected above 4 mg/Kg at every sampled depth at this sampling station. The # is associated with the deepest sampling depth at that location.

All < 4 mg/Kg = Mercury was not detected above 4 mg/Kg at any depth at this sampling station.

Hg - mercury

mg/Kg - milligrams/kilogram

Table 3-18. Mercury Results in Sediment at the Marsh Upland Area

Sample ID (1)	Depth (inches)	Sample Date	Total Mercury (mg/Kg)	Lab Flag	Reporting Limit	Sample Basis (mg/Kg)	Percent Solids (%)
SD-MUAU1-06	3-6	10/28/2015	21		1.4	As-Received	39.8
SD-MUAU1-12	6-12	10/28/2015	3.2		0.34	As-Received	63.3
SD-MUAU5-06	3-6	10/28/2015	0.95		0.24	As-Received	43.3
SD-MUAU5-06-DUP	3-6	10/28/2015	2		0.19	As-Received	53
SD-MUAU6-06	3-6	10/28/2015	5		0.44	As-Received	25
SD-MUAU6-06-DUP	3-6	10/28/2015	2.7		0.19	As-Received	49.9
SD-MUAU7-06	3-6	10/28/2015	7.3		0.86	Air-Dried	13.4
SD-MUAU7-06-DUP	3-6	10/28/2015	8.2		1.8	As-Received	61.4
SD-MUAU7-12	6-12	10/28/2015	46.3		4.2	As-Received	47.7
SD-MUAU8-06	3-6	10/28/2015	73.7		7.6	As-Received	26.8
SD-MUAU8-12	6-12	10/28/2015	11.7		0.99	As-Received	45.8
SD-MUAU10-06	3-6	10/28/2015	19.8		2.1	Air-Dried	12.4
SD-MUAU10-12	6-12	10/28/2015	1.5		0.24	As-Received	39.6
SD-MUAU10-18	12-18	10/28/2015	0.29		0.12	As-Received	72.3
SD-MUAU11-06	3-6	10/27/2015	28.2		2.4	Air-Dried	10.1
SD-MUAU12-06	3-6	10/28/2015	18		1.2	Air-Dried	8.9
SD-MUAU13-06	3-6	10/28/2015	137		11.5	Air-Dried	10.5
SD-MUAU14-06	3-6	10/28/2015	160		10.9	Air-Dried	18.4
SD-MUAU15-06	3-6	10/28/2015	115		10	Air-Dried	12.5
SD-MUAU17-06	3-6	10/28/2015	32.7		2.1	Air-Dried	17.5
SD-MUAU17-12	6-12	10/28/2015	4.4		1	Air-Dried	10.6
SD-MUAU18-06	3-6	10/28/2015	173		17.4	Air-Dried	9.6
SD-MUAU19-06	3-6	10/28/2015	38.2		4.9	As-Received	20.3
SD-MUAU20-06	3-6	10/28/2015	6.7		0.68	As-Received	25.4
SD-MUAU21-06	3-6	10/28/2015	14.8		0.97	Air-Dried	17
SD-MUAU22-06	3-6	10/28/2015	121		11.3	Air-Dried	11
SD-MUAU23-06	3-6	10/28/2015	237		22.6	Air-Dried	13.4
SD-MUAU24-06	3-6	10/28/2015	252		20.7	Air-Dried	13.8
SD-MUAU25-06	3-6	10/28/2015	11.3		1.3	As-Received	39.4
SD-MUAU26-06	3-6	10/28/2015	22.8		2.1	Air-Dried	10.5
SD-MUAU27-06	3-6	10/28/2015	551		39.5	As-Received	57.3
SD-MUAU27-12	6-12	10/28/2015	602		133	As-Received	34.8
SD-MUAU28-06	3-6	10/28/2015	253		15.8	As-Received	70.5
SD-MUAU28-12	6-12	10/28/2015	340		71.9	As-Received	65.2

Notes:

1) No data collected from MUAU2, MUAU3, MUAU4, MUAU9, and MUAU16.

ID - Identifiaction

Lab - Laboratory

mg/kg - milligrams/Kilogram

Sample Basis - Samples that are not "Air-Dried" prior to analysis are referred to as "As-Received" and presumed to have a certain moisture content and are reported on a dry or wet basis with a percent solids measured by the laboratory and reported. Samples that are Air-Dried are presumed to have no moisture content and therefore no percent solids reported. However, several air-dried samples were first analyzed at the laboratory for percent moisture and were found to exhibit greater than 80% moisture. These samples were air-dried, then analyzed for mercury. As such, for these air-dried samples the initial % solids reported by the laboratory are presented although the samples were subsequently air-dried.

Table 3-19. Mercury Results in Sediment in the Indian Head River Corridor

Sample ID	Sample Depth (inches)	Sample Date	Total Mercury Concentration (mg/Kg)	Lab Flag/ Qualifier	Reporting Limit (mg/Kg)	Sample Basis (mg/Kg)	Percent Solids (%)
SD-INRC1-03	0-3	10/26/2015	0.21		0.14	As-Received	79.9
SD-INRC2-03	0-3	10/26/2015	0.26		0.13	As-Received	80.9
SD-INRC3-03	0-3	10/26/2015	0.78		0.19	As-Received	56
SD-INRC4-03	0-3	10/26/2015	0.084	J	0.18	As-Received	54.8
SD-INRC5-03	0-3	10/26/2015	4.3		3.1	As-Received	35
SD-INRC5-03-DUP	0-3	10/26/2015	2.6		0.27	As-Received	34.5
SD-INRC7-03	0-3	10/26/2015	3.1		2.2	As-Received	40.8
SD-INRC8-03	0-3	10/26/2015	4.2		1.9	Air-Dried	9.7

NOTE:

No sample was collected from proposed sampling location #6

Lab - Laboratory

mg/kg - milligrams/Kilogram

Sample Basis - Samples that are not "Air-Dried" prior to analysis are referred to as "As-Received" and presumed to have a certain moisture content and are reported on a dry or wet basis with a percent solids measured by the laboratory and reported. Samples that are Air-Dried are presumed to have no moisture content and therefore no percent solids reported. However, several air-dried samples were first analyzed at the laboratory for percent moisture and were found to exhibit greater than 80% moisture. These samples were air-dried, then analyzed for mercury. As such, for these air-dried samples the initial % solids reported by the laboratory are presented although the samples were subsequently air-dried.

Table 3-20. Lead and Mercury Results in Groundwater

Sample ID	Sample Date	Total Lead Concentration (ug/L)	Lab Flag/ Qualifier	Total Mercury Concentration (ug/L)	Lab Flag/ Qualifier
GW-DP-MW1	10/22/2015	NA		1,170	
GW-DP-MW1-DUP	10/22/2015	NA		1,230	
GW-MW-B4	10/23/2015	2.8	J	NA	
GW-MW-B4-DUP	10/23/2015	1.9	J	NA	

NOTE:

Qualifiers:

J -Approximate value less than the RL but greater than or equal to the MDL

NA - This analyte was not tested for at this location.

Lab - Laboratory

ug/L - micrograms/Liter

Table 4-1. Analytical Results for the Waste Characterization Samples

Method	Analyte	CAS	Unit	Basis	USEPA Hazardous Waste Threshold	BERM-ISM-WD 10/13/2015 ISM		SD-ECCS-WD 10/26/2015 COMPOSITE SEDIMENT		SD-LDRC-WD 10/15/2015 GRAB SEDIMENT		SD-LUFP-WD 10/8/2015 COMPOSITE SEDIMENT		SD-MLFP-WD 10/20/2015 SEDIMENT		SD-MUAU-WD 10/28/2015 COMPOSITE SEDIMENT		SO-ECCL-WD 10/16/2015 GRAB SOIL	
1010A	Flashpoint		Degrees F	WET	<140	>176.0		>176.0		>176.0		>176.0		>176.0		>176.0		>176.0	
6010C	Arsenic	7440-38-2	mg/L	WET	5.0	0.0087	J	0.038		0.0074	J	0.015	U	0.012	J	0.015	U	0.015	U
6010C	Barium	7440-39-3	mg/L	WET	100.0	0.39	J	0.4	J	0.24	J	0.21	J	0.27	J	0.26	J	0.64	J
6010C	Cadmium	7440-43-9	mg/L	WET	1.0	0.0025		0.0069		0.002	U	0.002	U	0.002	U	0.0022		0.0039	
6010C	Chromium	7440-47-3	mg/L	WET	5.0	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U	0.02	U
6010C	Lead	7439-92-1	mg/L	WET	5.0	2.2		0.072		0.011	J	0.0044	J	0.0063	J	0.068		0.023	
6010C	Selenium	7782-49-2	mg/L	WET	1.0	0.025	U	0.025	U	0.025	U	0.025	U	0.025	U	0.025	U	0.025	U
6010C	Silver	7440-22-4	mg/L	WET	5.0	0.006	U	0.006	U	0.006	U	0.006	U	0.006	U	0.006	U	0.006	U
7470A	Mercury	7439-97-6	mg/L	WET	0.2	0.0002	U F1	0.00017	J	0.0002	U	0.0002	U	-		0.0002	U	0.0003	
8081B	Chlordane (technical)	57-74-9	mg/L	WET	0.03	0.002	U	0.002	U	0.002	U	-		0.002	U	0.002	U	0.002	U
8081B	Endrin	72-20-8	mg/L	WET	0.02	0.0002	U	0.0002	U	0.0002	U	-		0.0002	U	0.0002	U	0.0002	U
8081B	gamma-BHC (Lindane)	58-89-9	mg/L	WET	0.4	0.0002	U	0.000047	J	0.0002	U	-		0.0002	U	0.0002	U	0.0002	U
8081B	Heptachlor	76-44-8	mg/L	WET	0.008	0.0002	U	0.0002	U	0.0002	U	-		0.0002	U	0.0002	U	0.0002	U
8081B	Heptachlor epoxide	1024-57-3	mg/L	WET	*0.008*	0.0002	U	0.0002	U	0.0002	U	-		0.0002	U	0.0002	U	0.0002	U
8081B	Methoxychlor	72-43-5	mg/L	WET	10.0	0.0002	U	0.0002	U	0.0002	U	-		0.0002	U	0.0002	U	0.0002	U
8081B	Toxaphene	8001-35-2	mg/L	WET	0.5	0.002	U	0.002	U	0.002	U	-		0.002	U	0.002	U	0.002	U
8151A	2,4-D	94-75-7	mg/L	WET	10.0	0.002	U	0.002	U	0.002	U	-		0.002	U	0.002	U	0.002	U
8151A	Silvex (2,4,5-TP)	93-72-1	mg/L	WET	1.0	0.002	U	0.002	U	0.002	U	-		0.002	U	0.002	U	0.002	U
8260C	1,1-Dichloroethene	75-35-4	mg/L	WET	0.7	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U
8260C	1,2-Dichloroethane	107-06-2	mg/L	WET	0.5	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U
8260C	2-Butanone (MEK)	78-93-3	mg/L	WET	200.0	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U	0.05	U
8260C	Benzene	71-43-2	mg/L	WET	0.5	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U
8260C	Carbon tetrachloride	56-23-5	mg/L	WET	0.5	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U
8260C	Chlorobenzene	108-90-7	mg/L	WET	100.0	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U
8260C	Chloroform	67-66-3	mg/L	WET	6.0	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U
8260C	Tetrachloroethene	127-18-4	mg/L	WET	0.7	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U
8260C	Trichloroethene	79-01-6	mg/L	WET	0.5	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U
8260C	Vinyl chloride	75-01-4	mg/L	WET	0.2	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U	0.01	U
8270D	1,4-Dichlorobenzene	106-46-7	mg/L	WET	7.5	0.01	U	0.01	U	0.01	U	-		0.01	U	0.01	U	0.01	U
8270D	2,4,5-Trichlorophenol	95-95-4	mg/L	WET	400.0	0.005	U	0.005	U	0.005	U	-		0.005	U	0.005	U	0.005	U
8270D	2,4,6-Trichlorophenol	88-06-2	mg/L	WET	2.0	0.005	U	0.005	U	0.005	U	-		0.005	U	0.005	U	0.005	U
8270D	2,4-Dinitrotoluene	121-14-2	mg/L	WET	0.13	0.005	U	0.005	U	0.005	U	-		0.005	U	0.005	U	0.005	U
8270D	2-Methylphenol	95-48-7	mg/L	WET	200.0	0.005	U	0.005	U	0.005	U	-		0.005	U	0.005	U	0.005	U
8270D	3-Methylphenol	108-39-4	mg/L	WET	200.0	0.01	U	0.01	U	0.01	U	-		0.01	U	0.0059	J	0.01	U
8270D	4-Methylphenol	106-44-5	mg/L	WET	200.0	0.01	U	0.01	U	0.01	U	-		0.01	U	0.0059	J	0.01	U
8270D	Hexachlorobenzene	118-74-1	mg/L	WET	0.13	0.005	U	0.005	U	0.005	U	-		0.005	U	0.005	U	0.005	U
8270D	Hexachlorobutadiene	87-68-3	mg/L	WET	0.5	0.005	U	0.005	U	0.005	U	-		0.005	U	0.005	U	0.005	U
8270D	Hexachloroethane	67-72-1	mg/L	WET	3.0	0.005	U	0.005	U	0.005	U	-		0.005	U	0.005	U	0.005	U
8270D	Nitrobenzene	98-95-3	mg/L	WET	2.0	0.005	U	0.005	U	0.005	U	-		0.005	U	0.005	U	0.005	U
8270D	Pentachlorophenol	87-86-5	mg/L	WET	100.0	0.01	U	0.01	U	0.01	U	-		0.01	U	0.01	U	0.01	U
8270D	Pyridine	110-86-1	mg/L	WET	5.0	0.0012	J B	0.025	U	0.0023	J B	-		0.025	U	0.025	U	0.0017	J B
9012B	Cyanide, Total	57-12-5	mg/Kg	DRY	Withdrawn	1.3	U *	2.1	U	2	U *	2	U *	2.5	U	2.8	U	2.2	U *
9034	Sulfide, Reactive		mg/Kg	WET	Withdrawn	10	U	29.9		10	U	10		10	U	16		10	U
9045D	pH		SU	WET	<2 or >12.5	5.56	HF	5.85	HF	6.16	HF	6.3	HF	6.14	HF	5.11	HF	5.24	HF
9095B	Free Liquid		mL/100g	WET	pass	pass		passed		pass		pass		passed		failed		pass	

Table 4-1. Analytical Results for the Waste Characterization Samples

Analyte	CAS	Unit	SO-ECCM-WD 10/20/2015 GRAB SOIL		SO-ECCU-WD 10/15/2015 GRAB SOIL		SO-MUAU-WD 10/29/2015 GRAB SOIL	
Flashpoint		Degrees F	>176.0		>176.0		>176.0	
Arsenic	7440-38-2	mg/L	0.015	U	0.015	U	0.015	U
Barium	7440-39-3	mg/L	0.32	J	6.3		0.26	J
Cadmium	7440-43-9	mg/L	0.0019	J	0.011		0.0025	
Chromium	7440-47-3	mg/L	0.02	U	0.02	U	0.02	U
Lead	7439-92-1	mg/L	0.02		0.03		1	
Selenium	7782-49-2	mg/L	0.025	U	0.025	U	0.025	U
Silver	7440-22-4	mg/L	0.006	U	0.006	U	0.006	U
Mercury	7439-97-6	mg/L	0.0002	U	0.00032		0.014	
Chlordane (technical)	57-74-9	mg/L	0.002	U	0.002	U	0.002	U
Endrin	72-20-8	mg/L	0.0002	U	0.0002	U	0.000045	J
gamma-BHC (Lindane)	58-89-9	mg/L	0.0002	U	0.0002	U	0.0002	U
Heptachlor	76-44-8	mg/L	0.0002	U	0.0002	U	0.0002	U
Heptachlor epoxide	1024-57-3	mg/L	0.0002	U	0.0002	U	0.0002	U
Methoxychlor	72-43-5	mg/L	0.0002	U	0.0002	U	0.0002	U
Toxaphene	8001-35-2	mg/L	0.002	U	0.002	U	0.002	U
2,4-D	94-75-7	mg/L	0.002	U	0.002	U	0.002	U
Silvex (2,4,5-TP)	93-72-1	mg/L	0.002	U	0.002	U	0.002	U
1,1-Dichloroethene	75-35-4	mg/L	0.01	U	0.01	U	0.01	U
1,2-Dichloroethane	107-06-2	mg/L	0.01	U	0.01	U	0.01	U
2-Butanone (MEK)	78-93-3	mg/L	0.05	U	0.05	U	0.05	U
Benzene	71-43-2	mg/L	0.01	U	0.01	U	0.01	U
Carbon tetrachloride	56-23-5	mg/L	0.01	U	0.01	U	0.01	U
Chlorobenzene	108-90-7	mg/L	0.01	U	0.01	U	0.01	U
Chloroform	67-66-3	mg/L	0.01	U	0.01	U	0.01	U
Tetrachloroethene	127-18-4	mg/L	0.01	U	0.01	U	0.01	U
Trichloroethene	79-01-6	mg/L	0.0076	J	0.01	U	0.01	U
Vinyl chloride	75-01-4	mg/L	0.01	U	0.01	U	0.01	U
1,4-Dichlorobenzene	106-46-7	mg/L	0.01	U	0.01	U	0.01	U
2,4,5-Trichlorophenol	95-95-4	mg/L	0.005	U	0.005	U	0.005	U
2,4,6-Trichlorophenol	88-06-2	mg/L	0.005	U	0.005	U	0.005	U
2,4-Dinitrotoluene	121-14-2	mg/L	0.005	U	0.005	U	0.005	U
2-Methylphenol	95-48-7	mg/L	0.005	U	0.005	U	0.005	U
3-Methylphenol	108-39-4	mg/L	0.01	U	0.01	U	0.01	U
4-Methylphenol	106-44-5	mg/L	0.01	U	0.01	U	0.01	U
Hexachlorobenzene	118-74-1	mg/L	0.005	U	0.005	U	0.005	U
Hexachlorobutadiene	87-68-3	mg/L	0.005	U	0.005	U	0.005	U
Hexachloroethane	67-72-1	mg/L	0.005	U	0.005	U	0.005	U
Nitrobenzene	98-95-3	mg/L	0.005	U	0.005	U	0.005	U
Pentachlorophenol	87-86-5	mg/L	0.01	U	0.01	U	0.01	U
Pyridine	110-86-1	mg/L	0.0007	J B	0.003	J B	0.0017	J B
Cyanide, Total	57-12-5	mg/Kg	1.9	U	0.96	J *	1	U
Sulfide, Reactive		mg/Kg	10	U	10	U	16	
pH		SU	5.76	HF	5.62	HF	5.13	HF
Free Liquid		mL/100g	passed		pass		passed	

Notes:

Sample Basis - samples that are not air-dried prior to analysis are presumed to have a certain moisture content and are reported on a dry or wet basis with a percent solids measured by the laboratory and reported. Samples that are air-dried are presumed to have no moisture content and therefore no percent solids reported.

Composite Sample – Composite sampling is a technique whereby multiple temporally or spatially discrete samples are combined, thoroughly homogenized, and treated as a single sample.

ISM Sample - Incremental sampling methodology (ISM) is a structured composite sampling and processing protocol having specific elements designed to reduce data variability and increase sample representativeness for a specified volume of soil under investigation.

Grab Sample - A grab sample is a sampling technique which is a single sample or measurement taken at a specific time or over as short a period, as feasible.

Laboratory Data Qualifiers:

U – Indicates the analyte was analyzed for but not detected.

J – Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

B – Compound was found in the blank and sample.

H – Sample was prepped or analyzed beyond the specified holding time.

X – Surrogate is outside control limits.

F1 – MS and/or MSD recovery is outside acceptance limits.

F2 – MS/MSD RPD exceeds control limits.

p – The % RPD between the primary and confirmation column/detector is > 40%. The lower value has been reported.

*- Interference check standard or LCS/LCSD is outside acceptance limits.

^ - Instrument QC is outside acceptance limits.

4 – The analyte present in the original sample is greater than 4 times the matrix spike concentration, therefore the control limits are not applicable.

Table 5-1. Geotechnical Results for the Representative Site Sediment and Soil Samples Tested

Analysis Method	Analyte	Unit	SD-ECCS-GT 10/26/2015 Composite Sediment	SD-LDRC-GT 10/15/2015 Grab Sediment	SD-LUFP-GT 10/15/2015 Composite Sediment	SD-MLFP-GT 10/21/2015 Grab Sediment	SD-MUAU-GT 10/28/2015 Composite Sediment	SO-MUAU-GT 10/29/2015 Grab Soil
CLASSIFICATION								
D422	Gravel	%	7.5	0.3	0	12.7	2.7	4.3
D422	Coarse Sand	%	23.7	2.5	0	8.7	2.8	4.3
D422	Medium Sand	%	30.1	65.3	3.1	17.8	13.1	22.5
D422	Fine Sand	%	32.9	29.6	11.7	20.8	47.1	58.3
D422	Silt	%	4.3	1.7	56.6	25.3	25.6	9.3
D422	Clay	%	1.5	0.6	28.6	14.7	8.8	1.3
	Total	**%**	**100**	**100**	**100**	**100**	**100**	**100**
CHARACTERISTICS								
D2216-90	Moisture Content	wt %	47.5	22.9	197.9	34.9	93.4	-
D2974	Ash Content	%	95.2	99.7	83.8	97.1	80.3	-
D2974	Fractional Organic Carbon	%	2.8	0.2	9.4	1.7	11.4	-
D2974	Moisture Content	wt %	47.5	22.9	197.9	34.9	93.4	-
D2974	Total Organic Matter	%	4.8	0.3	16.2	2.9	19.7	-
D4318	Atterberg Limit - Liquid Limit	NONE	0	-	221	0	0	-
D4318	Atterberg Limit - Plastic Limit	NONE	0	-	124	0	0	-
D4318	Atterberg Limit - Plasticity Index	NONE	non-plastic	-	96	NP	NP	-
D854	Specific Gravity	NONE	2.63	2.67	2.19	2.68	2.53	-
D854	Specific Gravity at 20 deg Celsius	NONE	2.63	2.67	2.19	2.68	2.53	-

PARTICLE SIZE ANALYSIS								
D422	Sieve Size 3 inch - Percent Finer	% Passing	100	100	100	100	100	100
D422	Sieve Size 2 inch - Percent Finer	% Passing	100	100	100	100	100	100
D422	Sieve Size 1.5 inch - Percent Finer	% Passing	100	100	100	100	100	100
D422	Sieve Size 1 inch - Percent Finer	% Passing	100	100	100	100	100	100
D422	Sieve Size 0.75 inch - Percent Finer	% Passing	100	100	100	100	100	100
D422	Sieve Size 0.375 inch - Percent Finer	% Passing	98.7	100	100	88.9	98.6	99
D422	Sieve Size #4 - Percent Finer	% Passing	92.5	99.7	100	87.3	97.3	95.7
D422	Sieve Size #10 - Percent Finer	% Passing	68.8	97.2	100	78.6	94.5	91.4
D422	Sieve Size #20 - Percent Finer	% Passing	53.6	77.5	98.7	70.6	89.5	83.4
D422	Sieve Size #40 - Percent Finer	% Passing	38.7	31.9	96.9	60.8	81.4	68.9
D422	Sieve Size #60 - Percent Finer	% Passing	24.7	7.9	94.1	52.7	69.5	51
D422	Sieve Size #80 - Percent Finer	% Passing	17.2	3.7	91.7	48.7	61.1	39
D422	Sieve Size #100 - Percent Finer	% Passing	13.3	2.9	90.2	46.4	56.6	32.2
D422	Sieve Size #200 - Percent Finer	% Passing	5.8	2.4	85.2	40	34.3	10.6
D422	Hydrometer Reading 1 - Percent Finer	% Passing	6.1	0.6	42.2	35.3	32.3	7.9
D422	Hydrometer Reading 2 - Percent Finer	% Passing	4.3	0.6	36.7	28.3	19.9	4.2
D422	Hydrometer Reading 3 - Percent Finer	% Passing	2.4	0.6	34	21.3	15.8	3.2
D422	Hydrometer Reading 4 - Percent Finer	% Passing	2.4	0.6	28.6	18.3	13	2.3
D422	Hydrometer Reading 5 - Percent Finer	% Passing	1.5	0.6	28.6	14.7	8.8	1.3
D422	Hydrometer Reading 6 - Percent Finer	% Passing	0.6	0.3	15.7	10.1	4.6	0.3
D422	Hydrometer Reading 7 - Percent Finer	% Passing	0.1	0.3	10.2	6.6	0.2	0.1

Table7-1. Compendium of Groundwater and Surface Water Regulatory Criteria to be Considered Relative to the DRET Elutriate Concentrations

	MassDEP MCP Method 1 Groundwater Standards			USEPA National Recommended Surface Water Quality Criteria - Human Health		USEPA National Recommended Surface Water Quality Criteria - Aquatic Life		Comparison Criterion Cited in the DRET Testing Report [1]
	GW-1 Standard (ug/L)	GW-2 Standard (ug/L)	GW-3 Standard (ug/L)	Consumption of Water and Organisms (ug/L)	Consumption of Organisms Only (ug/L)	Freshwater Critical Maximum Concentration (Acute) (ug/L)	Freshwater Critical Continuous Concentration (Chronic) (ug/L)	(ug/L)
METALS								
Antimony	6	-	8000	5.6	640	-	-	6
Arsenic	10	-	900	0.018	0.14	340	150	10
Berylium	4	-	200	-	-	-	-	4
Cadmium	5	-	4	-	-	2.0	0.25	4
Chromium (III)	100	-	600	-	-	570	74	100
Copper	-	-		1300	-	-	-	-
Lead	15	-	10	-	-	65	2.5	10
Nickel	100	-	200	610	4600	470	52	100
Selenium	50	-	100	170	4200	-	5.0	*10*
Silver	100	-	7	-	-	3.2	-	7
Thallium	2	-	3000	0.24	0.47	-	-	2
Zinc	5000	-	900	7400	26000	120	120	900
Mercury	2	-	20	-	-	1.4	0.77	2
SEMIVOLATILE ORGANIC COMPOUNDS (PAHS)								
Acenaphthene	20	-	10000	70	90	-	-	20
Acenaphthylene	30	10000	40	-	-	-	-	30
Anthracene	60	-	30	300	400	-	-	30
Benzo(a)anthracene	1	-	1000	0.0012	0.0013	-	-	1
Benzo(a)pyrene	0.2	-	500	0.00012	0.00013	-	-	0.2
Benzo(b)fluoranthene	1	-	400	0.0012	0.0013	-	-	1
Benzo(k)fluoranthene	1	-	100	0.012	0.013	-	-	1
Benzo(g,h,i)perylene	50	-	20	-	-	-	-	20
Chrysene	2	-	70	0.12	0.13	-	-	2
Dibenzo(a,h)anthracene	0.5	-	40	0.00012	0.00013	-	-	0.5
Fluoranthene	90	-	200	20	20	-	-	90
Fluorene	30	-	40	50	70	-	-	30
Indeno(1,2,3-c,d)pyrene	0.5	-	100	0.0012	0.0013	-	-	0.5
Naphthalene	140	700	20000	-	-	-	-	140
Phenanthrene	40	-	10000	-	-	-	-	40
Pyrene	60	-	20	20	30	-	-	20
PCBs	0.5	5	10	0.000064	0.000064	-	0.014	0.5

NOTE:

-	No Value
▨	Criterion that is not applicable to the Site
[1]	Cited criterion was the lowest of the MassDEP MCP Method 1 GW-1, GW-2 and GW-3 Standards [typo for selenium]

FIGURES

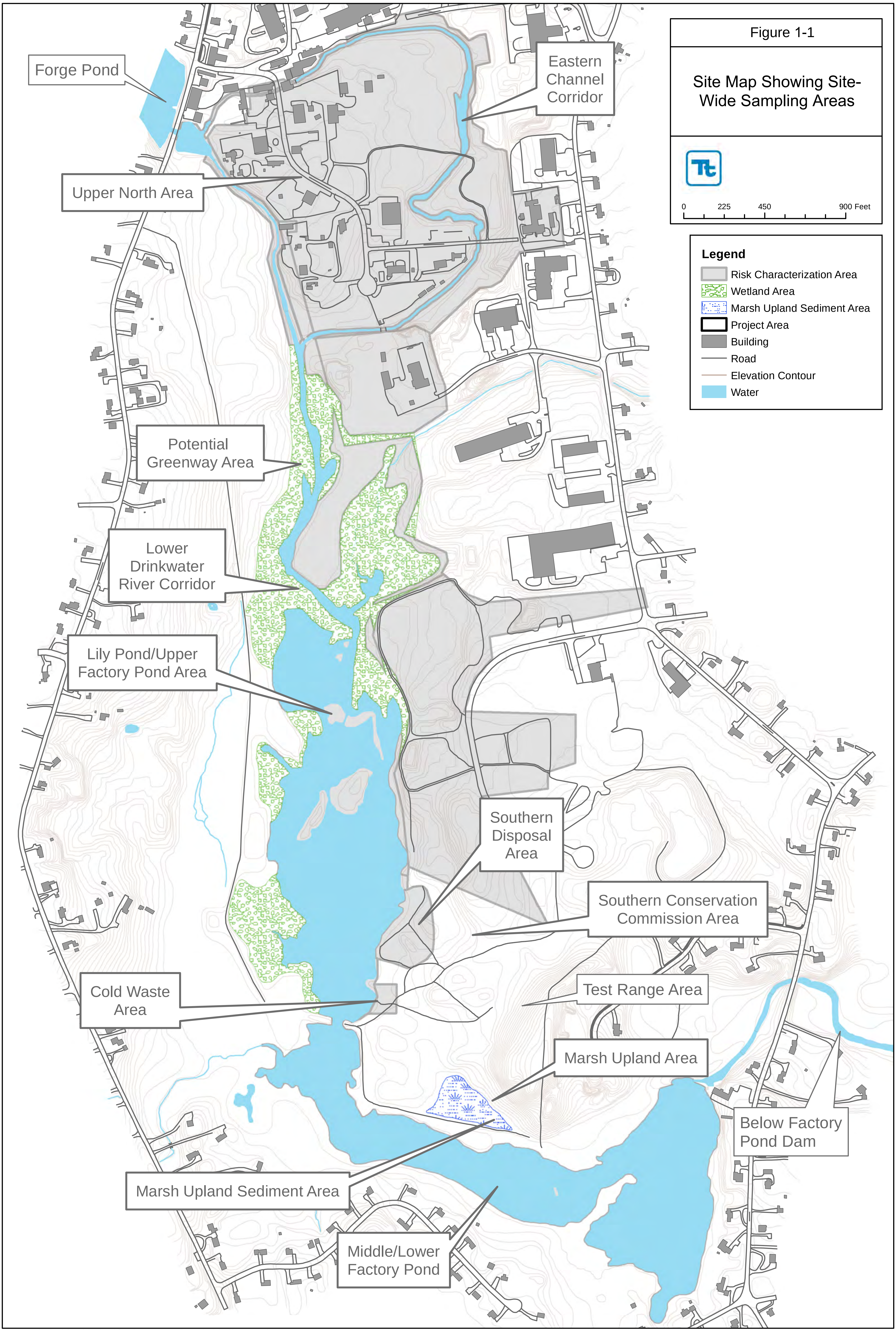
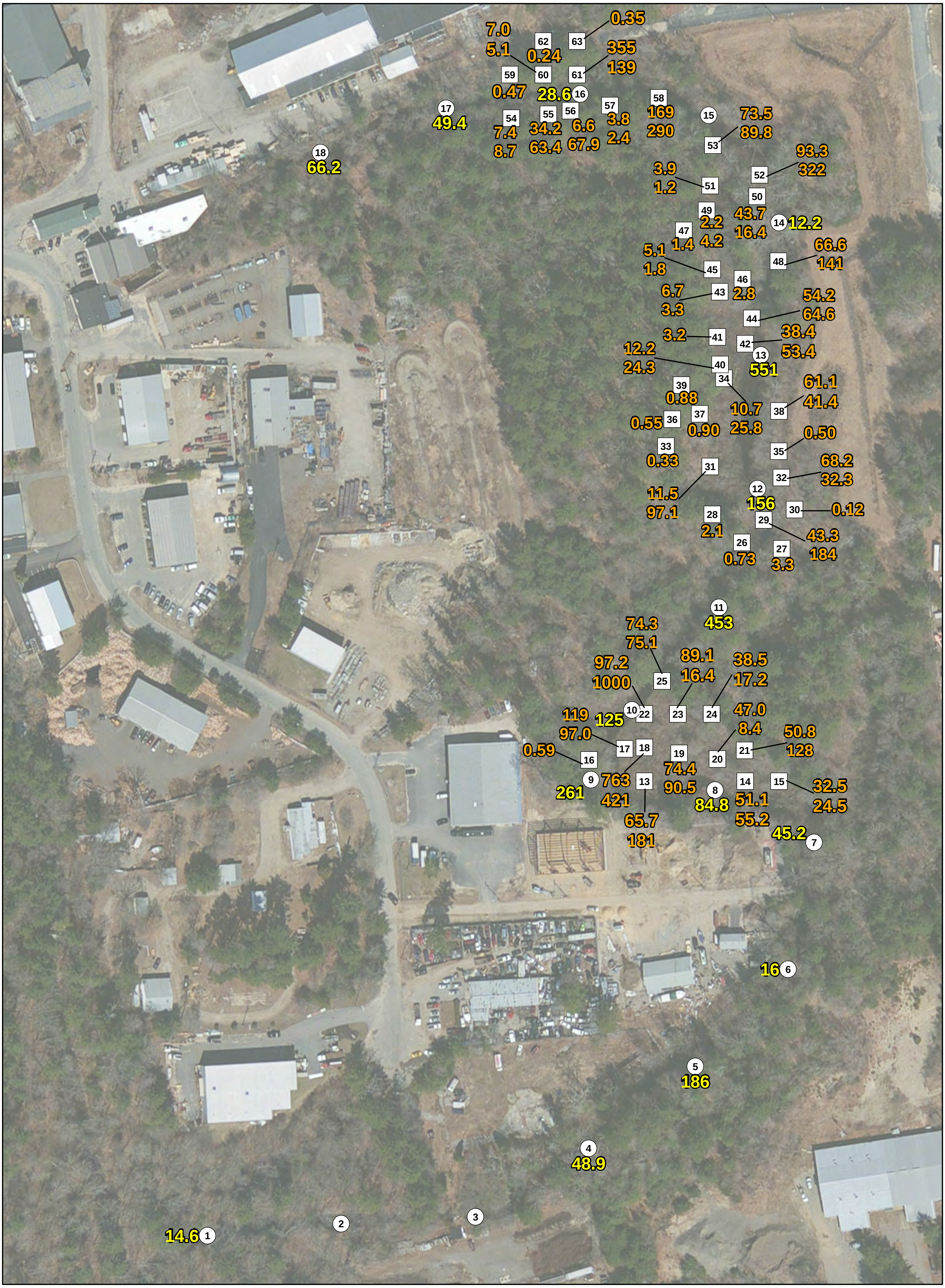


Figure 1-1

Site Map Showing Site-Wide Sampling Areas

Document Path: P:\GIS\Fireworks\GIS\Spatial\MXD\20150116_SamplingLocations\Sitewide_SMUs.mxd



Legend

① ECC Sediment Sampling Location with Hg Concentration - mg/Kg (yellow)

ECC Soil Sampling Location with Hg Concentration - mg/Kg (orange) 0-3" (top number) and 3-6" (bottom number)

Figure 3-1:
Mercury Concentrations in the Eastern Channel Corridor Sediment and Soil

Figure 3-2. Maximum Detected Concentrations of Lead and Mercury and Associated Explosives Compounds Detected in the Firing Positions and Heavy Steel Plate Area Soils

Fireworks Site, Hanover, MA

IN FRONT OF THE FAR RANGE FIRING POSITION
(SFRF)

Depth (In)	Mercury Conc. (mg/kg)	Lead Conc. (mg/kg)
0-3	0.27	50.8

Explosives Detected:
Perchlorate
2,4-Dinitrotoluene
2,6-Dinitrotoluene
Picric Acid

SURROUNDING THE HEAVY STEEL PLATE AREA
(SHSP)

Depth (In)	Mercury Conc. (mg/kg)	Lead Conc. (mg/kg)
0-3	0.20	75.9

Explosives Detected:
Perchlorate
1,3,5-Trinitrobenzene
1,3-Dinitrobenzene
2-Nitrotoluene
Nitroglycerin [2]
Picric Acid
Tetryl

IN FRONT OF THE NEAR RANGE FIRING POSITION
(SNRF)

Depth (In)	Mercury Conc. (mg/kg)	Lead Conc. [1] (mg/kg)
0-3	0.33	332

Explosives Detected :
Perchlorate,
2,4-Dinitrotoluene
2,6-Dintrotoluene
2-Amino-4,6-dinitrotoluene
4-Nitrotoluene
Nitrobenzene
Nitroglycerin [3]
Picric Acid
Tetryl

NOTES:
[1] Exceeds MCP S-1 but not S-2 Published Soil Standards
[2] Exceeds EPA RSL Residential and RSL Industrial Soil Standards
[3] Exceeds EPA RSL Residential but not RSL Industrial Soil Standards

Figure 3-3. Maximum Detected Concentrations of Lead and Mercury and Associated Explosives Compounds Detected in the Test Range Area Berm Soils

Fireworks Site, Hanover, MA

BEHIND THE BERM (STRD)

Depth (In)	Mercury Conc. (mg/kg)	Lead Conc. (mg/kg)
0-3	8.4	2,600 [2]

Explosives Detected:
- Perchlorate
- 1,3,5-Trinitrobenzene
- 2-Amino-4,6-dinitrotoluene
- 4-Nitrotoluene
- Nitrobenzene
- Nitroglycerin [3]
- Picric Acid

TEST RANGE BERM QUADRANT 3 (STRB3)

Depth (In)	Mercury Conc. (mg/kg)	Lead Conc. (mg/kg)
3-6	0.051	483 [1]
6-12	0.032	843 [2]

Explosives Detected:
- Perchlorate
- Picric Acid (3”-6”)

TEST RANGE BERM QUADRANT 4 (STRB4)

Depth (In)	Mercury Conc. (mg/kg)	Lead Conc. (mg/kg)
3-6	0.63	304 [1]
6-12	0.58	180

Explosives Detected:
- Perchlorate
- Picric Acid (3”-6”)
- 2-Nitrotoluene (3”-6”)

TEST RANGE BERM QUADRANT 1 (STRB1)

Depth (In)	Mercury Conc. (mg/kg)	Lead Conc. (mg/kg)
3-6	0.045	327 [1]
6-12	0.059	685 [2]

Explosives Detected:
- Perchlorate

TEST RANGE BERM QUADRANT 2 (STRB2)

Depth (In)	Mercury Conc. (mg/kg)	Lead Conc. (mg/kg)
3-6	0.25	302 [1]
6-12	0.47	152

Explosives Detected:
- Perchlorate

BERM FLOOR (STRF)

Depth (In)	Mercury Conc. (mg/kg)	Lead Conc. (mg/kg)
0-3	0.17	239 [1]

Explosives Detected:
- Perchlorate
- 2,4,6-Trinitrotoluene
- 4-Amino-2,6-dinitrotoluene
- Picric Acid
- Tetryl

NOTES:

[1] Exceeds S-1 Published Soil Standard

[2] Exceeds S-2 Published Soil Standard

[3] Exceeds EPA RSL Resident Soil Standard but not the RSL Industrial Soil Standard

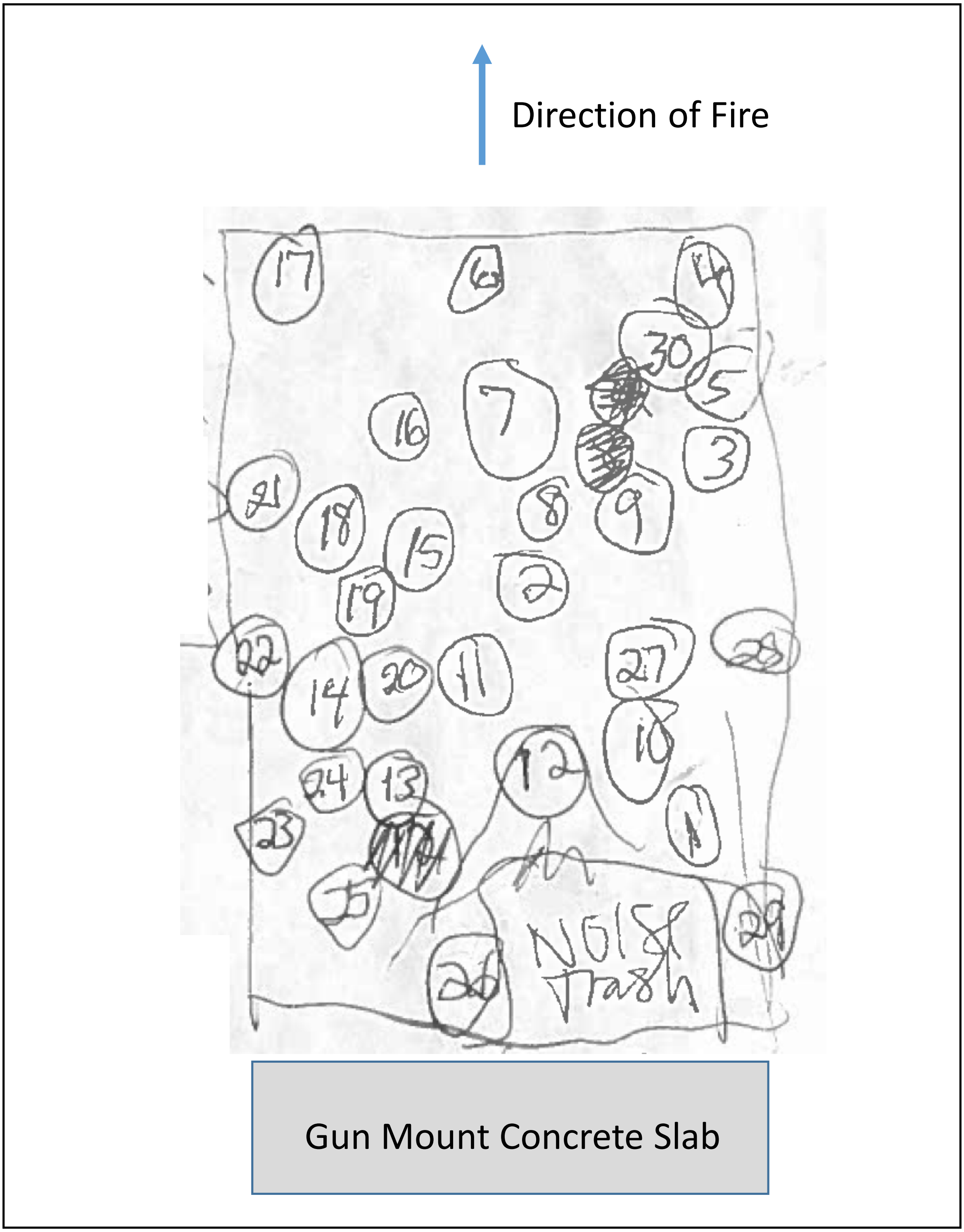


Figure 3-4. Field Sketch Showing Sample Increment Locations at the Near-Range Firing Position and the Areas Where Metallic Debris Prevented Sampling

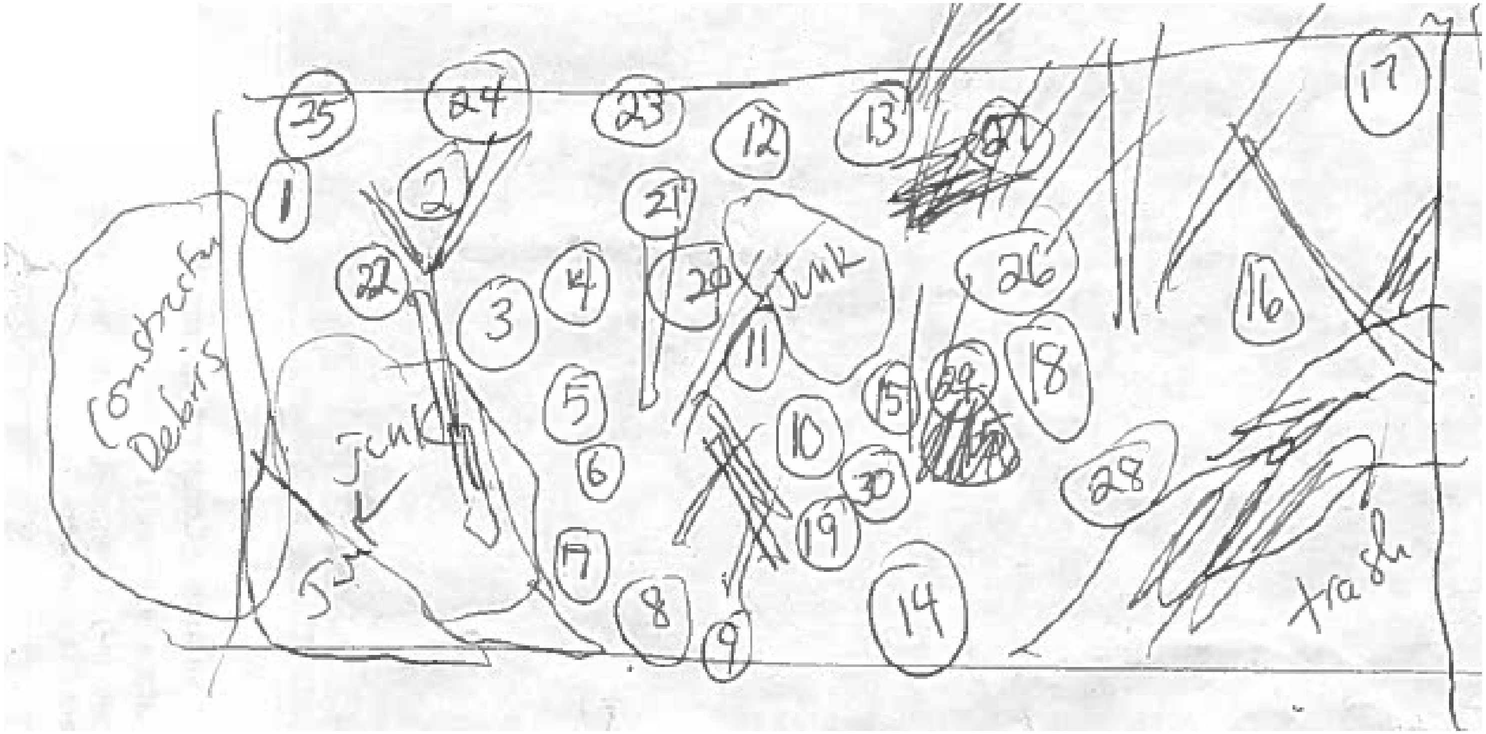
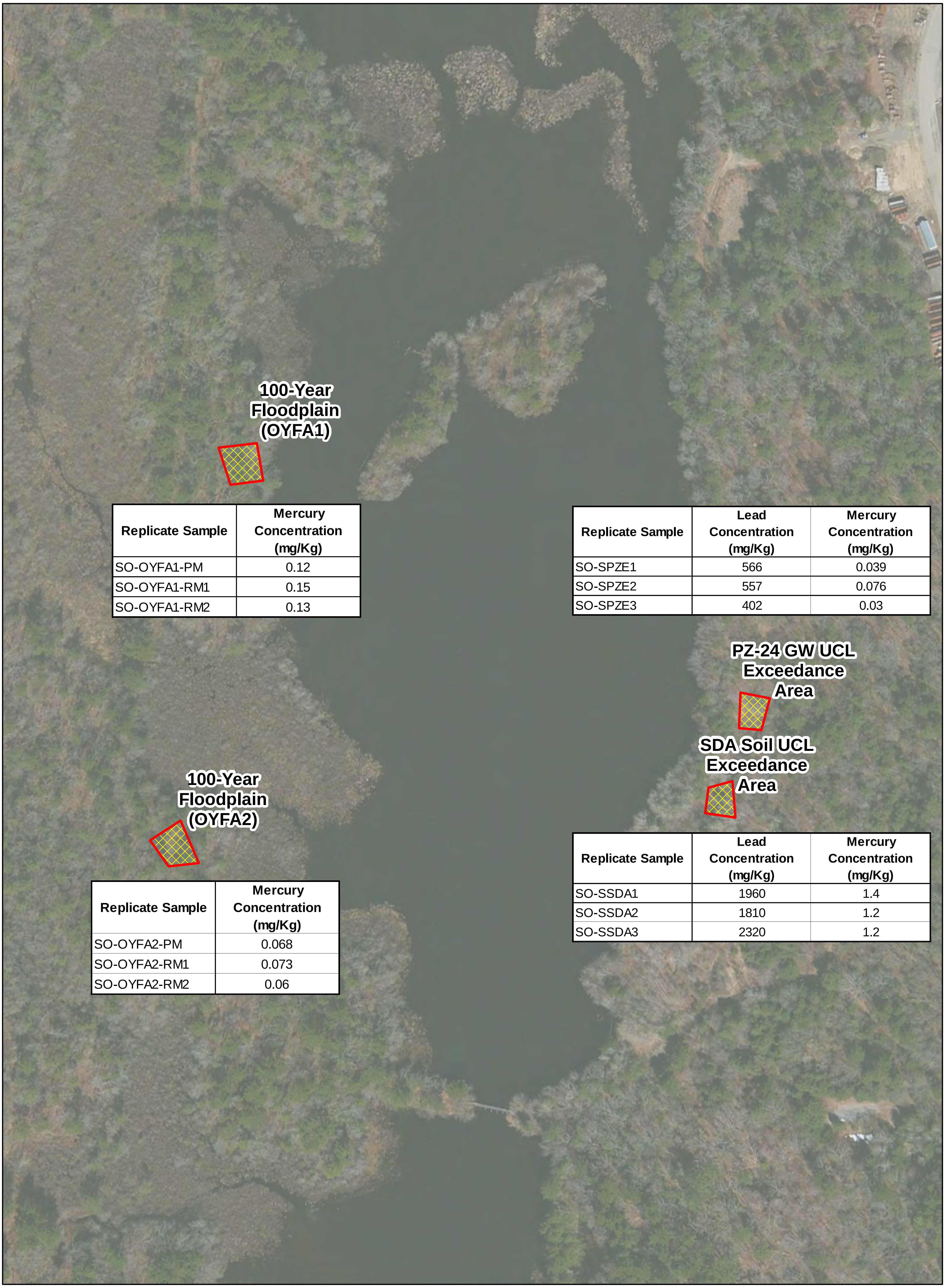


Figure 3-5. Field Sketch Showing Sample Increment Locations in the Lower Left Quadrant / Decision Unit of the Target Berm and the Areas Where Metallic Construction Debris and Trash Prevented Sampling (Quadrant 1: Lower Left When Looking at the Target Berm from the Near-Field Firing Point)



Replicate Sample	Mercury Concentration (mg/Kg)
SO-OYFA1-PM	0.12
SO-OYFA1-RM1	0.15
SO-OYFA1-RM2	0.13

Replicate Sample	Lead Concentration (mg/Kg)	Mercury Concentration (mg/Kg)
SO-SPZE1	566	0.039
SO-SPZE2	557	0.076
SO-SPZE3	402	0.03

Replicate Sample	Lead Concentration (mg/Kg)	Mercury Concentration (mg/Kg)
SO-SSDA1	1960	1.4
SO-SSDA2	1810	1.2
SO-SSDA3	2320	1.2

Replicate Sample	Mercury Concentration (mg/Kg)
SO-OYFA2-PM	0.068
SO-OYFA2-RM1	0.073
SO-OYFA2-RM2	0.06

Legend

Soil Sampling Areas

▨ Incremental Sampling Methodology (ISM)

Figure 3-6:
Lead and Mercury Concentrations
in the Soil UCL Exceedance Areas
and 100-Year Floodplain Areas

Document Path: P:\GIS\Fireworks\GIS\Spatial\MXD\20160107_ReBaseline_Mapping\Fig3-4_UCL_100yr_Soil_Sampling_Southern_Site.mxd

Sediment Sampling Location	Depth (Inches)	Mercury Concentration (mg/Kg)
1	3-6	21
	6-12	3.2
5	3-6	2
6	3-6	5
7	3-6	8.2
	6-12	46.3
8	3-6	73.7
	6-12	11.7
10	3-6	19.8
	6-12	1.5
	12-18	0.29
11	3-6	28.2
12	3-6	18
13	3-6	137
14	3-6	160
15	3-6	115
17	3-6	32.7
	6-12	4.4
18	3-6	173
19	3-6	38.2
20	3-6	6.7
21	3-6	14.8
22	3-6	121
23	3-6	237
24	3-6	252
25	3-6	11.3
26	3-6	22.8
27	3-6	551
	6-12	602
28	3-6	253
	6-12	340

Note: No data collected from 2, 3, 4, 9 or 16

Soil Sampling Location	Depth (Inches)	Lead Concentration (mg/Kg)	Mercury Concentration (mg/Kg)
1	6-12	882	27.1
	12-24	303	92.3
	24-36	17.4	0.8
	36-48	8	0.11
2	6-12	33.6	1.2
	12-24	4.9	0.067
3	6-12	444	28.2
	12-24	351	105
	24-36	677	48.7
	36-48	305	146
4	6-12	436	18.4
	12-24	516	32.2
	24-36	377	40.2
	36-48	3.3	2.8
	48-60	11.1	1.9
	60-72	5.2	0.37
5	6-12	26.7	18.8
	12-24	58.9	22
	24-36	6.4	0.57
	36-48	6.6	0.82
	48-60	5	0.34
6	6-12	112	11.8
	12-24	94.9	13.5
	24-36	46.5	6.1
	36-48	7.5	0.45
7	6-12	118	109
	12-24	137	360
	24-36	106	138
	36-48	157	182
8	6-12	419	89.9
	12-24	23.1	90.4
	24-36	29.7	267
	36-48	201	278
9	6-12	24.4	1.5
	12-24	7.2	0.27
10	6-12	27.7	0.52
	12-24	8.3	0.15
11	6-12	89.7	93.3
	12-24	8.9	20
	24-36	3.3	0.53
	36-48	3.5	0.13
12	6-12	14.1	5.9
	12-24	8.8	2.6

Legend

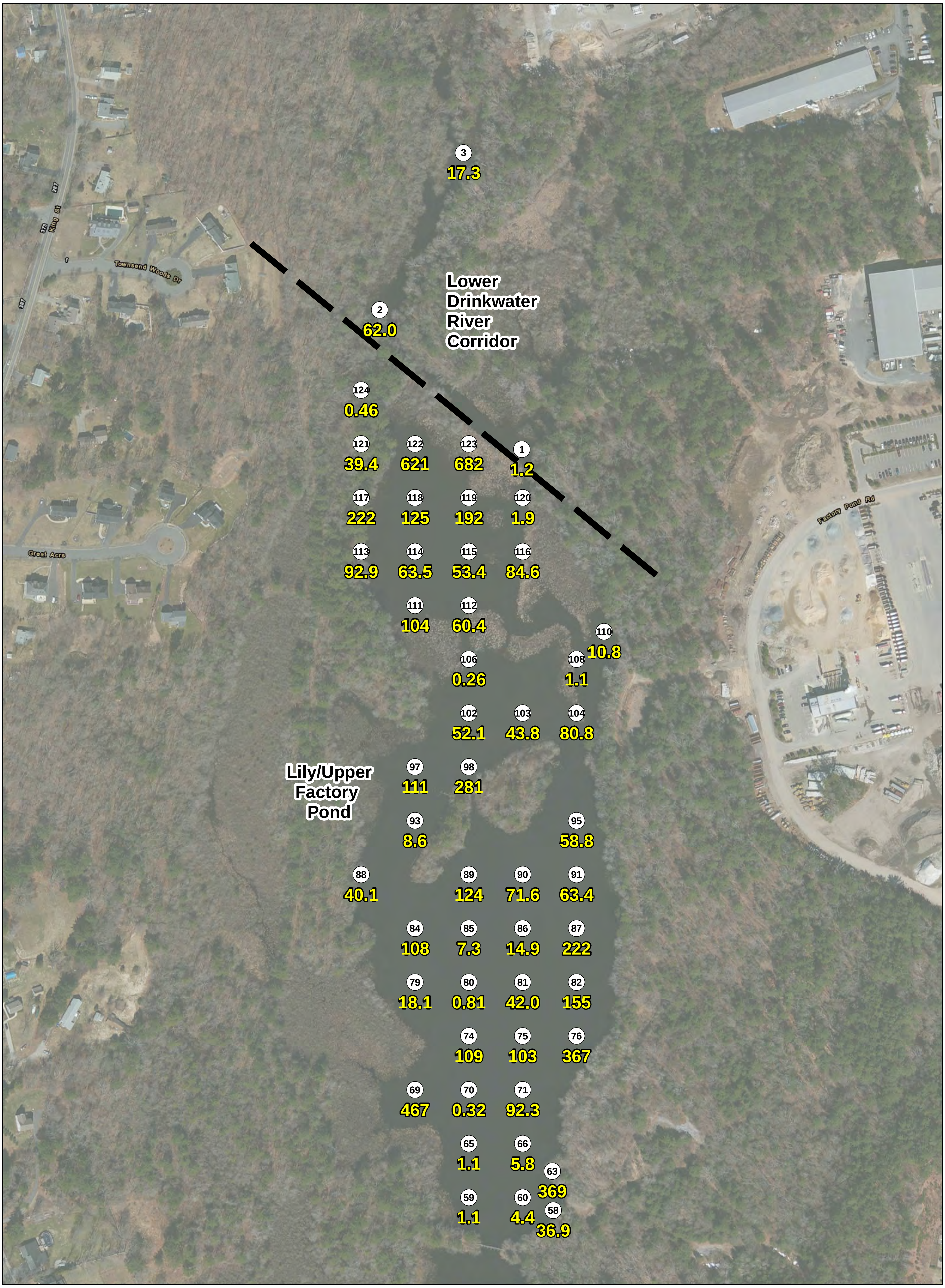
(#)	Sediment Sampling Location
#	Soil Sampling Location

Figure 3-7:
Lead and Mercury Concentrations
in the Marsh Upland Area
Soil and Sediment

N

Feet
0 50 100 150 200

Document Path: P:\GIS\Fireworks\GIS\Spatial\MXD\20160701_ReBaseline_Mapping\Fig3-7_Marsh_Upland_Area_Soil_and_Sed_Hg_and_Pb_Concentrations.mxd



Legend

Ⓘ Sediment Sampling Location with Hg Concentration Result - mg/Kg (yellow)

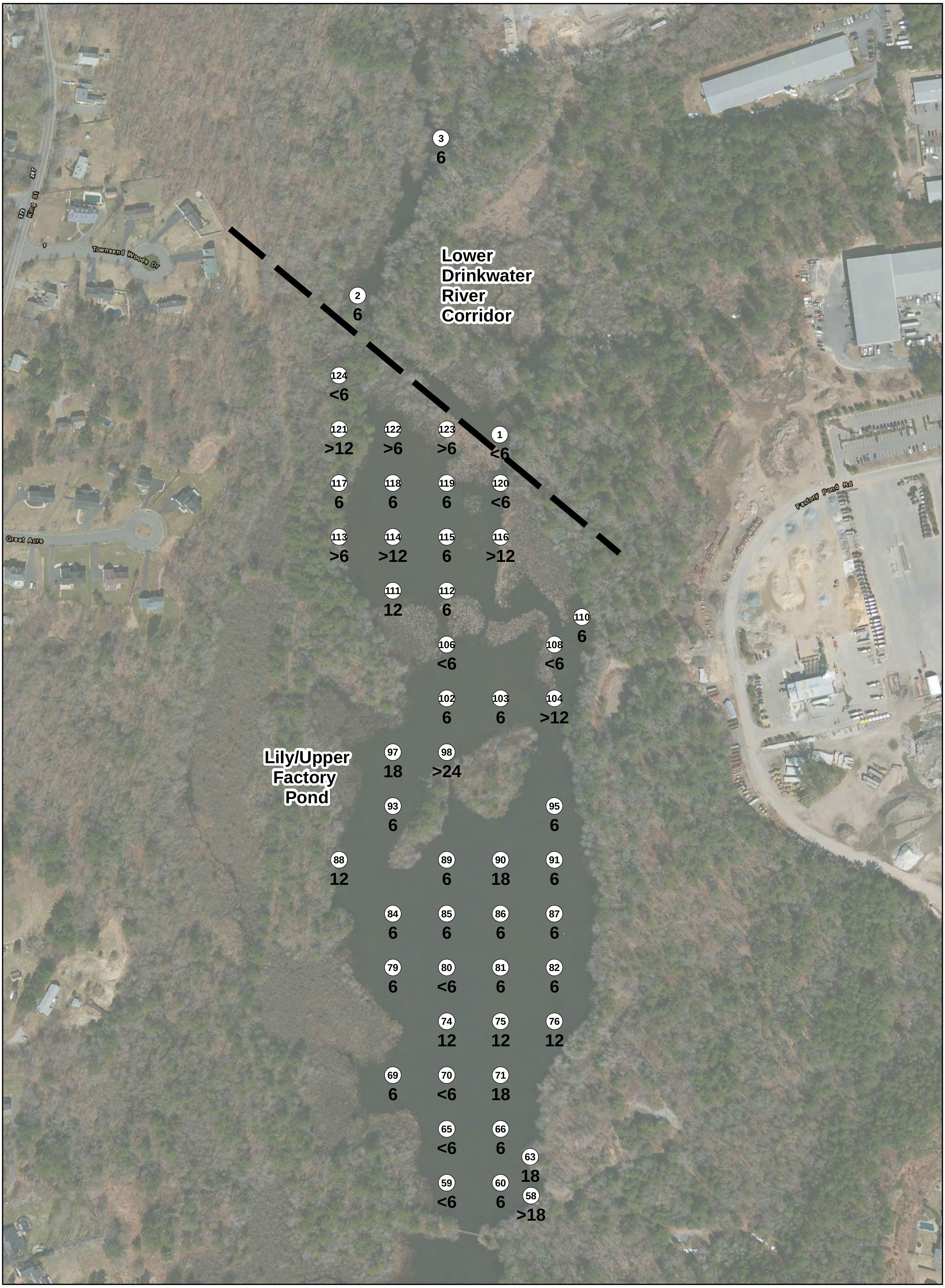
Note: Concentration shown is the maximum for any sample collected at any depth at that location.

Figure 3-8:
Maximum Mercury Concentrations in the Sediment in the Lower Drinkwater River Corridor and Lily/Upper Factory Pond

N

0 250 500 750 1,000 Feet

Document Path: P:\GIS\Fireworks\GIS\Spatial\MXD\20160701_ReBaseline_Mapping\Fig3-8_Sediment_Sampling_Max_Hg_LDRC_and_LUFP.mxd



Legend

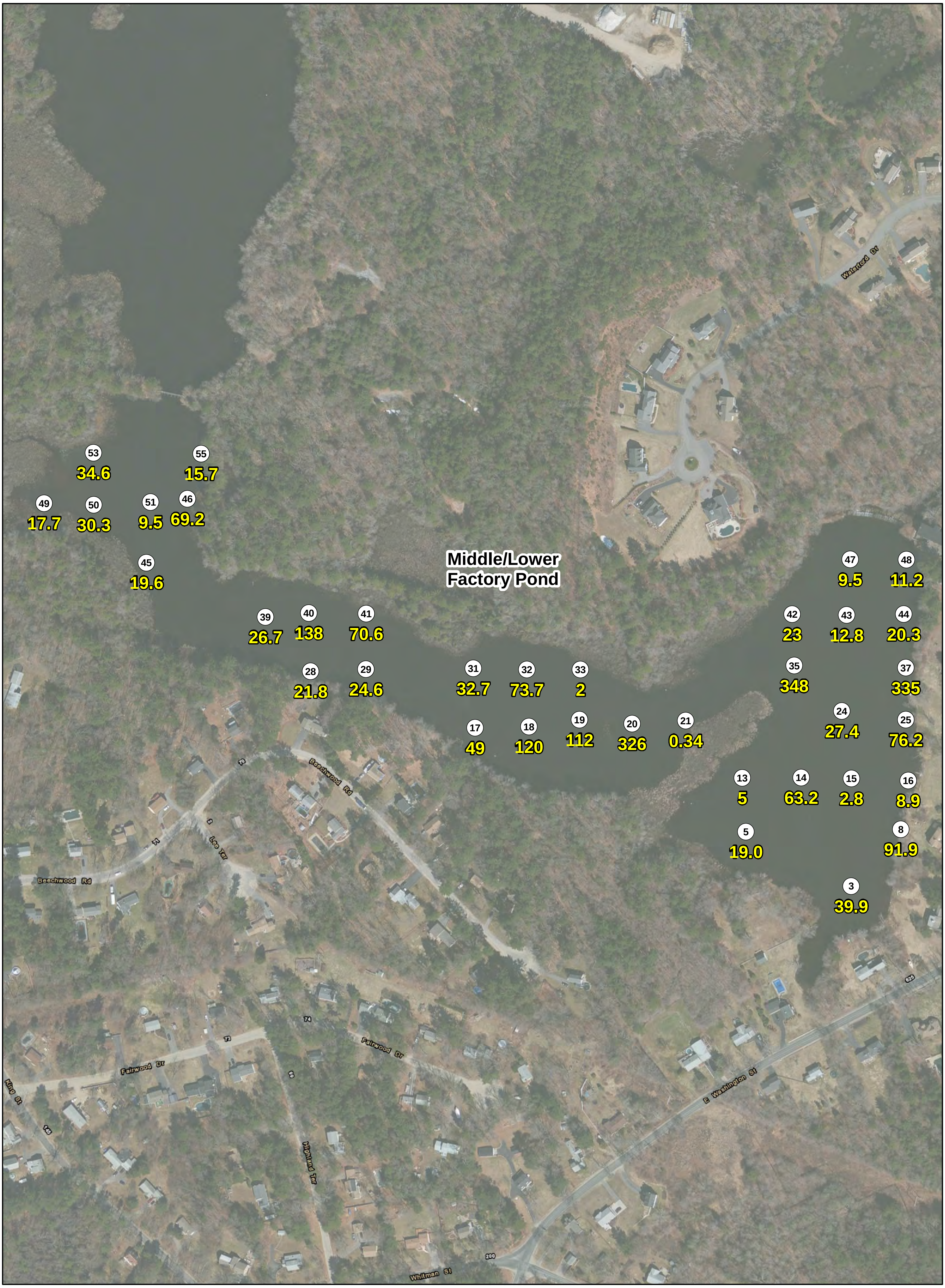
>6 Sediment Sampling Location and Depth (Inches)

Figure 3-9:
Shallowest Depth at Which
the Mercury Concentration
in Sediment is Less Than 4 mg/Kg

N

0 250 500 750 1,000 Feet

Document Path: P:\GIS\Fireworks\GIS\Spatial\MXD\20160701_ReBaseline_Mapping\Fig3-9_Sediment_Sampling_Shallowest_Depth_LDRC_and_LUFP.mxd



Legend

\# 49 Sediment Sampling Location with Hg Concentration Result - mg/Kg (yellow)

Note: Concentration shown is the maximum for any sample collected at any depth at that location.

Figure 3-10:
Maximum Mercury Concentration in the Sediment in Middle/Lower Factory Pond

Legend

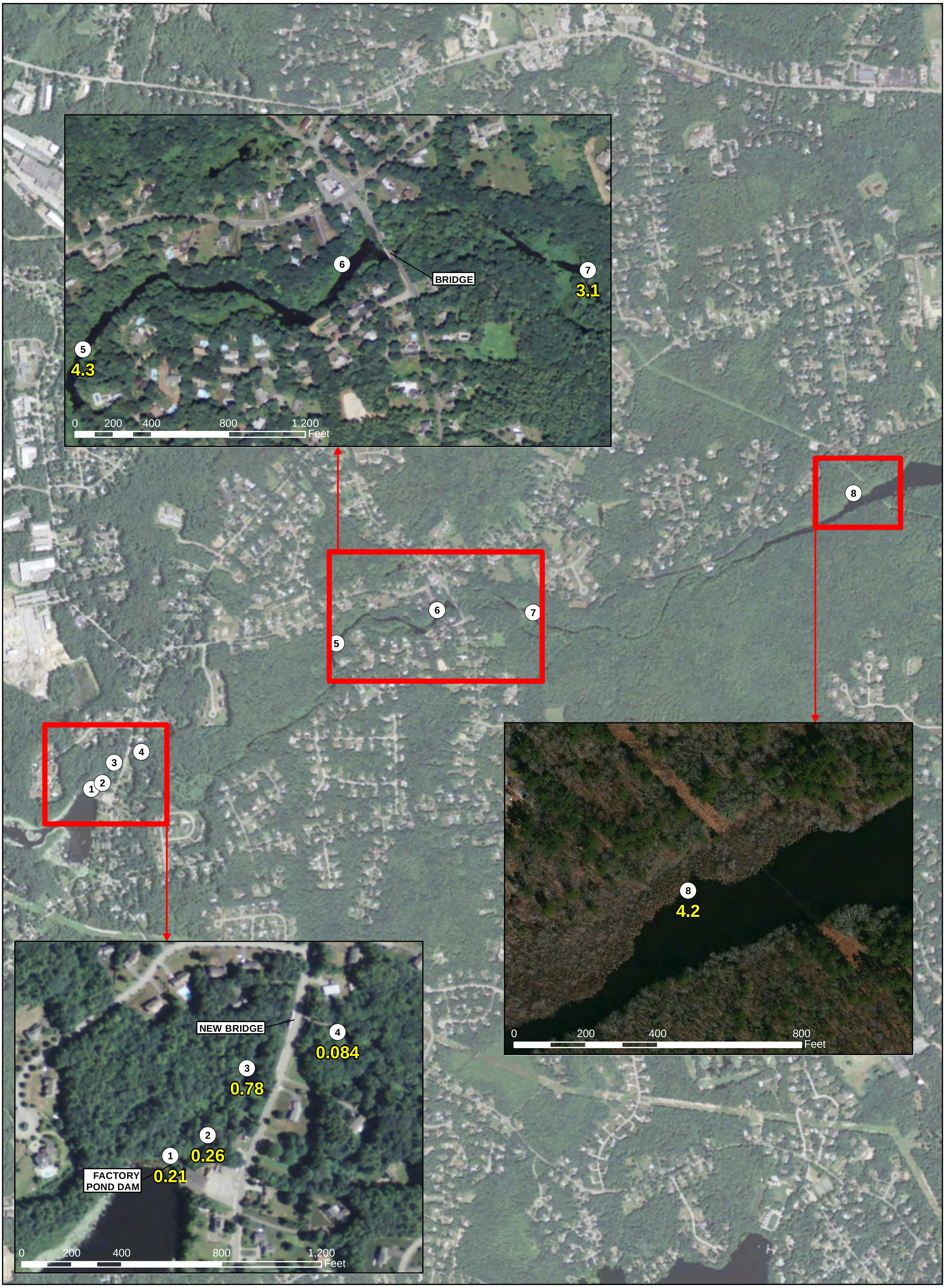
㊉ Sediment Sampling Location and Depth (Inches)
>6

Figure 3-11:
Shallowest Depth at Which
the Mercury Concentration
in Sediment is Less Than 4 mg/Kg

N

0 250 500 750 1,000 Feet

Document Path: P:\GIS\Fireworks\GIS\Spatial\MXD\20160701_ReBaseline_Mapping\Fig3-11_Sediment_Sampling_Shallowest_Depth_MLFP.mxd



Legend

Sediment Sampling Location with Hg Concentration - mg/Kg (yellow)

Figure 3-12:
Mercury Concentrations in the Indian Head River Surficial Sediment

N

0 1,200 2,400 3,600 4,800 Feet

Document Path: P:\GIS\Fireworks\GIS\Spatial\MXD\20160701_ReBaseline_Mapping\Fig3-12_Sediment_Sampling_Indian_Head_River.mxd

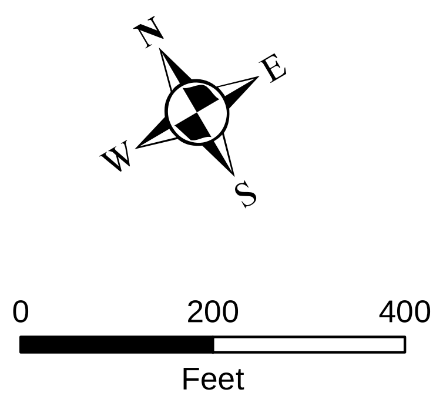
Legend

● Groundwater Sampling Location with Concentration (mg/L)

Figure 3-13:
Lead and Mercury Concentrations in the Groundwater at Locations Previously Exhibiting Groundwater UCL Exceedances

Document Path: P:\GIS\Fireworks\GIS\Spatial\MXD\20160701_ReBaseline_Mapping\Fig3-13_Groundwater_Sampling_Locations.mxd

Document Path: X:\2015_Tt_Fireworks\ArcGIS\maps\Bathy.mxd



NOTE: The data is based on a10ft uncertainty grid.

Geodetic Settings		Survey Equipment	
Horizontal Datum	North American Datum 1983	**Bathymetry Sensor**	Ross 875-X Singlebeam Sweep System
Projection	Massachusetts Mainland State Plane Zone 2001	**Positioning System**	Leica 1230 RTK GPS/ Trimble SPS 651
Horizontal Units	U.S. Survey Feet	**Sound Speed Profilers**	YSI Castaway
Vertical Units	U.S. Survey Feet		
Vertical Datum	MSL		
Base Station PID(s):	BM6 and DH Set, Halnon Land Surveying Inc.	**Dates Surveyed**	10/2/2015 - 10/4/2015

Fig. 8-1. 2015 Fireworks Bathymetry Survey Lily and Factory Pond

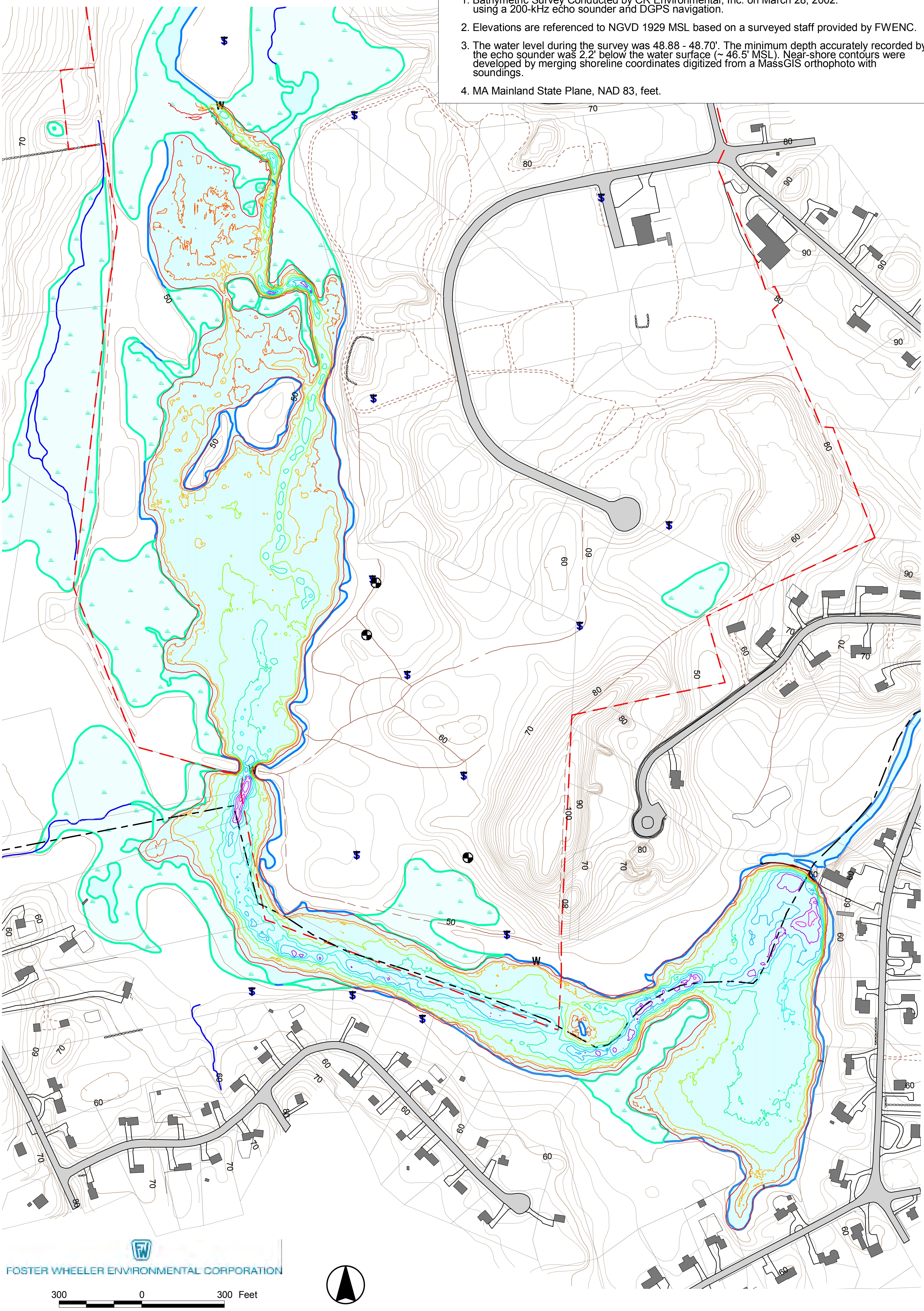
Tetra Tech
19803 North Creek Parkway
Bothell, WA 98012

TETRA TECH

Collection/Processing:	Kyle Enright	
Drafted by:	MJ Watson	SHEET
Reviewed by:	B. Bridge	1 of 2

Notes:

1. Bathymetric Survey Conducted by CR Environmental, Inc. on March 28, 2002. using a 200-kHz echo sounder and DGPS navigation.
2. Elevations are referenced to NGVD 1929 MSL based on a surveyed staff provided by FWENC.
3. The water level during the survey was 48.88 - 48.70'. The minimum depth accurately recorded by the echo sounder was 2.2' below the water surface (~ 46.5' MSL). Near-shore contours were developed by merging shoreline coordinates digitized from a MassGIS orthophoto with soundings.
4. MA Mainland State Plane, NAD 83, feet.



FOSTER WHEELER ENVIRONMENTAL CORPORATION

Contours
- 10Ft Contours
- 2Ft Contours

Buildings
- ■ Building
- ■ Tower
- ■ Trailer
- ■ Wharf/Pier
- 🟩 Swamp
- 🟦 Surface Water

Roadways
- Culvert
- Private Driveway
- Unpaved Driveway
- Paved Parking Lot
- Unpaved Parking Lot
- Path/Trail
- Paved Road
- Unpaved Road
- Public Sidewalk

- Town Boundary
- Project Boundary
- Dam
- Stream
- Monitoring Well
- Piezometer
- W Staff Gage

Bathymetry (MSL Feet)
- 39
- 40
- 41
- 42
- 43
- 44
- 45
- 46
- 47
- 48

FIREWORKS PROJECT
HANOVER and HANSON, MASSACHUSETTS

Fig. 8-2 2002 Bathymetry Survey (feet MSL) Lily and Factory Pond

Compiled on April 9, 2002 by
Foster Wheeler Environmental Corporation.

ArcView Project: p:\gis\Fireworks\sourcedata\shapes\fireworks-updated_3_27_02.apr: Layout Name: Bathymetry.Lyt

APPENDICES

APPENDIX 2A

Revised Fireworks Site Re-Baselining Sampling Program

August 19, 2015 – Revised September 25, 2015

REVISED FIREWORKS SITE RE-BASELINING SAMPLING PROGRAM

August 19, 2015 – Revised September 25, 2015

INTRODUCTION

This package contains the revised re-baselining sampling program proposed for the Fireworks Site (see Figure 1). This re-baselining sampling is necessary primarily because of a series of record-level high precipitation events and the subsequent flooding of the Site. This flooding was observed to deposit material from the channels believed to have contained mercury-contaminated sediment on the nearby channel banks and adjacent low-lying areas. The high flows may also have potentially transported mercury-contaminated sediment down-stream through the watershed with concurrent scouring and deposition in various locations, causing the existing characterization of the distribution of contaminated sediments to no longer be sufficiently accurate to allow a revised Phase III analysis of remedial alternatives and cost estimates to be developed with confidence. In addition, a few areas associated with the Test Range were not previously sampled during Phase II A through D and, thus, require a focused characterization effort to identify the presence and extent of contamination. Also, no groundwater sampling has been performed at the Site since late 2008/early 2009. Therefore, it is important to know if the limited Upper Concentration Limit (UCL) exceedances observed at that time still exist. While Total Mercury has been found to be the contaminant of most concern in the Site sediments and groundwater, other Metals (including Lead) have been found in the groundwater and soil at select locations at levels requiring a response. In the area of the Test Range, testing for Explosives-related compounds also will be performed. Re-baselining sampling is proposed for sediment, soil, and groundwater at specific locations where the collection of the data is likely to improve the selection of or allow a better estimate of the scale of the recommended remedial alternative.

OVERVIEW OF REVISED RE-BASELINING SAMPLING PROGRAM

An overview of the revised re-baselining sampling tasks for the Site soil, groundwater and sediment is presented below. No biota (i.e., largemouth bass fish tissue), sediment pore water, or soil gas re-baselining is proposed as part of this effort.

Soil

- Sampling the surficial soil along the banks of the Eastern Channel Corridor (ECC) for Total Mercury where record high surface water flows flooded the adjacent low-lying areas and may have deposited sediment from the impacted portions of the ECC
- Sampling potential release areas associated with the Test Range in the Southern Conservation Commission Area (SCCA):
  - Area in Front of the Near-Range Firing Position
  - Area in Front of the Far-Range Firing Position
  - Area containing the heavy steel plates located down the hill from the Far-Range Firing Position
  - Test Range Floor in Front of the Target Berm
  - Target Berm
  - Overshoot Area Above/Behind the Target Berm

- Re-sampling to further delineate the Marsh Upland Area (MUA) soil because the horizontal spatial coverage and density associated with prior samples were highly variable and the successive sampling depth intervals were wide and uneven at some locations, resulting in large incremental volumes of soil having to be earmarked for removal based on one sampling result. [This would be especially important if the local groundwater UCL in the MUA no longer exists and the soil removal in the MUA would then be based on eliminating the local soil UCL exceedances and meeting the surficial soil risk-based clean-up levels for recreational use. Soil samples from this area will be selected and analyzed based on the local groundwater sampling results.]
- Sampling to characterize the soil in the areas where the groundwater UCL exceedances were observed
- Re-sampling the soil at locations in the 100-Year Floodplain Area on the shoreline west of Upper and Middle Factory Pond and analyzing for Total Mercury
- Testing to determine soil leachability
- Testing to determine soil characteristics relative to anticipated disposal requirements and waste acceptance criteria
- Collecting the required Quality Control (QC) samples
- Re-baselining soil sampling shall be performed in a manner that maintains more consistent depth intervals that would yield more precise estimates of volumes requiring possible removal

Groundwater

- Re-sampling groundwater from the existing monitoring wells and piezometers where the groundwater UCL exceedances were observed
- Collecting the required QC samples

Sediment

- Obtaining updated bathymetry and bottom elevation contours for the on-Site ponds
- Re-sampling representative sediments in the segments of the ECC that were previously shown to have been impacted by mercury and in selected downstream reaches
- Re-measuring the thicknesses of the segments in the ECC to allow a re-estimation of the volume of mercury-contaminated sediments still present following the flooding
- Re-sampling the sediments in Lily Pond, Upper Factory Pond, Middle Factory Pond, and Lower Factory Pond on a regular grid reference system with a horizontal spatial scale comparable to the average sample polygon size from the prior Supplemental Phase III sampling and at depth intervals guided by the prior sampling results and the patterns of indicated deposition and erosion from prior bathymetric studies. [Note that the regular grid sampling points will be adjusted based on the results of a comparative bathymetry analysis.]
- Sampling the sediments in additional marshy areas adjacent to Lily Pond where recent flooding occurred or where an earlier alternate flow channel from the Site's release areas may have been located

- Re-sampling the sediments in the MUA on a regular grid reference system with a horizontal spatial scale comparable to the average sample polygon size from the prior Phase II sampling and at depth intervals guided by the prior sampling and results
- Sampling surficial sediments from transects across depositional areas of the Indian Head River between Factory Pond Dam and a point upstream of the Luddams Ford Dam and analyzing for Mercury
- Testing to determine sediment leachability
- Testing to determine sediment characteristics relative to anticipated disposal requirements and waste acceptance criteria
- Sampling and geotechnical testing of representative sediment samples to determine dewatering and stabilization characteristics
- Collecting the required QC samples

Biota (Largemouth Bass)

It is acknowledged and understood that comparison of the future, post-remediation largemouth bass (LMB) fish tissue concentrations to the currently available LMB fish tissue data collected at the Site in 2003 may not accurately reflect the positive effect of the mercury source removal because of fish tissue concentration reductions that may have resulted from other (non-remedial) actions that have taken place since 2003. However, re-baselining for this type of comparison is believed to be better done at a future point in time closer to and just before implementation of the remediation. Re-baselining the LMB fish tissue concentrations in Lily and Factory Pond is not required to revise the Phase III RAP. At an appropriate point in the future, activities such as the following could be considered for implementation by those who will track the longer-term reductions in fish tissue mercury levels over time following the sediment removal activity and restoration of the water bodies:

- Re-sampling creelable size LMB from Forge Pond to document the current local background LMB fish tissue Total Mercury concentrations
- Re-sampling creelable size LMB from Lily Pond, Upper Factory Pond, Middle Factory Pond, and Lower Factory Pond to document the current local LMB fish tissue Total Mercury concentrations
- Collecting the information needed to establish a defensible length-age relationship for LMB at the Site
- Re-sampling background stream and pond sediments to identify their Total Mercury levels
- Collecting Site and background sediment pore water samples
- Collecting the required QC samples

PRIOR SAMPLING OF ENVIRONMENTAL MEDIA AT THE SITE

Table 1 indicates when sampling or investigation of soil, sediment, groundwater and biota were previously performed at or in relation to the Site.

Table 1. Listing of Past Sampling and Investigation Activities at the Site by Environmental Medium

	Sampling and/or Investigation Activity			
	Soil	**Groundwater**	**Sediment**	**Biota (LMB)**
MassDEP (1995)	-	-	X	X
Phase I (1997)	X	X	-	-
Phase IIA (1998/1999)	-	X	-	-
Phase IIB (2000)	X	X	-	-
Phase IIC (2001)	X	X	X	-
Phase IID (2003)	X	X	X	X
Supplemental Phase III (2008/2009)	X	X	X	-
Test Range Investigation (2012)	X	-	-	-

PROPOSED RE-BASELINING SAMPLING PROGRAM

The following program of soil, groundwater and sediment sampling is proposed to re-baseline the conditions at the Site to allow the Phase III analyses and cost estimates to be performed with characterization data that are complete, up to date, and of high confidence or being representative of the current conditions at the Site. Understanding that constraints associated with the Site tend to favor a sediment and soil removal alternative with off-site disposal, the proposed re-baselining sampling reflects particular emphasis on the information needed to estimate defensible removal quantities of sediment and soil and to determine how to handle and dispose of the removed materials. Given the relatively high cost of the likely remedial alternatives under these constraints, the collected information must support a conceptual design and cost estimate somewhat more detailed and developed than what may typically be required for a Phase III RAP for a smaller, less technically complex Site with fewer stakeholder groups and interests. In addition to re-baselining the concentrations of Total Mercury in the soil, groundwater and sediment, the Site media in specific locations also will be selectively analyzed for:

Soil	– Metals, Explosives and Waste Disposal Characteristics
Groundwater	– Lead
Sediment	– Waste Disposal Characteristics, Geotechnical Parameters, and Stabilization Testing

Soil Sampling

Table 3 presents a summary of the proposed re-baselining soil sampling. Soil sampling is proposed along three segments of the ECC where flooding may potentially have deposited mercury-contaminated sediments on the soil over the banks of the normal channel. These areas have been named the ECC Upper, Middle and Lower Bank Overflow Areas, and are shown on Figure 2. Sampling in these areas is limited to the surficial or near-surface soil and analysis is limited to only Total Mercury. More samples (from deeper depths) will be collected than are expected to have been impacted by the sediment during the overbank flooding. An initial set of samples will be analyzed and the other samples will be preserved and held. If contamination is found that is not adequately delineated vertically or horizontally by the initial set of samples, additional samples that were on hold will be selected and analyzed prior to the holding time limit being exceeded. The proposed sampling includes the requisite QC samples and a small number of samples for leachability testing and waste disposal planning.

Table 3 also presents a summary of the re-baselining soil sampling proposed for the Test Range in the Southern Conservation Commission Area (SCCA), which had only been partially sampled during Phase IIB. The area in front of the Near-Range Firing Position and the Far-Range Firing Position will be sampled using the Incremental Sampling Methodology (ISM) approach. The area on the western wooded side of Factory Pond north of the foot bridge where the heavy steel plates were found (down the hill from the Far-Range Firing Position) also will be sampled using the ISM approach. The Backstop Berm and the areas just in front (range floor) and behind the berm (overshoot area) will be characterized using the ISM approach. These areas also are shown on Figure 3. These samples will be analyzed for Total Metals and Explosives (including propellants, nitroglycerin and perchlorate, as indicated). The proposed sampling includes the requisite QC and replicate samples and a small number of samples for leachability testing and waste characterization and disposal planning to be tested if the primary samples show any contamination.

In addition, the soil in the Soil UCL Exceedance Area and in the PZ-24 Groundwater Exceedance Area will be sampled. These areas also are shown on Figure 3. These samples will be analyzed for Total Mercury, Total Metals and Explosives. The proposed sampling includes the requisite replicate samples and samples for leachability testing and waste characterization and disposal planning to be tested if the primary samples show any contamination.

The soil in the MUA will be sampled (contingent on the results of the local groundwater sampling) with more uniform coverage and finer depth intervals so that potential removal volumes can be estimated with greater precision. These samples will be analyzed for Total Mercury and Total Metals. The proposed sampling includes the requisite QC samples and one sample for leachability testing and waste disposal planning.

Finally, surficial soil from the 100-Year Floodplain on the western shore of Upper Factory Pond and Middle Factory Pond will be sampled to determine if any impacted sediment from upstream locations has been deposited in this area of potentially greater public exposure (see Figure 3). ISM samples will be collected at each of these locations. These samples will be analyzed for Total Mercury. The proposed sampling includes the requisite replicate samples.

Groundwater Sampling

Table 4 presents a summary of the proposed re-baselining groundwater sampling. Groundwater sampling is proposed at one existing monitoring well and one existing piezometer, the locations of which are shown on Figure 4. The groundwater at monitoring well DP-MW1 and at piezometer PZ-24 will be sampled and analyzed for Total Mercury and Total Lead, respectively, to determine if the groundwater UCL exceedances observed in 2008/2009 still are present. The proposed sampling includes the requisite QC samples.

Only one round of re-baselining groundwater sampling is currently proposed. Note that if sampling results indicate a significant decrease in contaminant concentrations (e.g., below UCLs), then additional sampling will be conducted to confirm any observed decrease and establish the current contaminant concentrations with a high degree of confidence.

Sediment Sampling

Table 5 presents a summary of the proposed re-baselining sediment sampling. Sediment sampling is proposed in the ponds and streams and in the MUA Sediment Area. The proposed ECC sediment sampling transect locations are shown on Figure 5. The proposed pond and stream sediment sampling areas are shown on Figure 6 and the proposed sediment sampling locations in the MUA Sediment Area are shown on Figure 7. The proposed sediment sampling locations in the Indian Head River below Factory Pond Dam are shown in Figure 8.

In the ECC, sediment sampling is proposed to re-establish how far upstream the mercury-contaminated sediments are now located. This will be done by collecting a composite sample of sediment from across the channel at a subset of the stations that were investigated as part of the Supplemental Phase III investigation (see Figure 5). This sampling will be at every other station relative to the Supplemental Phase III locations. These samples will be analyzed only for Total Mercury. The proposed sampling includes the requisite QC samples, one representative sample for leachability testing and waste characterization for disposal planning, one sample for geotechnical parameters, and sediment for elutriate generation and dewatering performance evaluation. The sediment thicknesses and water depth at each station also will be estimated manually using a measuring stick.

A number of locations in the Lower Drinkwater River, Lily Pond, Upper Factory Pond, Middle Factory Pond and Lower Factory Pond also are proposed for coring and sampling (see Figure 6). This sampling is primarily to re-establish the mercury-contaminated sediment distribution (horizontally and vertically) in these ponds and streams following the extreme surface water flows and flooding of the watershed. A suspected earlier flow channel from the Lower Drinkwater River into Lily Pond also will be examined as part of this sampling. These samples will be analyzed only for Total Mercury. More samples will be collected at each location (at greater depths) than are expected to have been impacted by mercury. An initial set of samples will be analyzed and the others will be preserved and held. If contamination is found and not adequately delineated vertically by the initial set of samples, additional samples from the held set will be selected and analyzed prior to the holding time limit being exceeded. The proposed sampling includes the requisite QC samples and a small number of samples for leachability testing and waste characterization for disposal planning, one sample for geotechnical parameters, and sediment for elutriate generation and dewatering performance evaluation. The proposed bathymetric survey in the ponds will be used to focus the re-baselining sampling to some extent through comparisons of the results of the new bathymetry to the older bathymetric surveys. Areas of new or increased deposition will be targeted and heavily scoured areas may not be sampled as much or as deeply as indicated in Table 5. The numbers of samples projected for chemical analysis were estimated based on the current characterization data so that the cost of the re-baselining sediment sampling could be estimated.

A number of locations in the MUA Sediment Area also are proposed for sampling (see Figure 7). This sampling is proposed to fill in horizontal and vertical spatial gaps in the prior sampling results in this area. The increased spatial coverage, especially in the vertical direction, will allow a more precise estimate of the volume of sediment that will need to be removed and the associated cost. These samples will be analyzed only for Total Mercury. The proposed sampling includes the requisite QC samples, one representative sample for leachability testing and waste characterization for disposal planning, one sample for geotechnical parameters, and sediment for elutriate generation and dewatering performance evaluation. The water depth at each sampling location also will be estimated by using a measuring stick.

Sediments from depositional areas in the Indian Head River below Factory Pond Dam also are proposed for sampling (see Figure 8). Specific depositional areas were identified for sampling based on a site reconnaissance. These locations will be used to determine if mercury is present below Factory Pond Dam and, if so, whether the source of the mercury may have been the Site. Samples will be collected at the following locations:

1. Depositional area just downstream of Factory Pond Dam where the spillover pool flows into the outflow of the by-pass channel, adjacent to the vegetated deposits between the spillway and the by-pass structure
2. Depositional area approximately 200’ downstream of Factory Pond Dam in the northwest branch (“right” branch looking upstream) where the flow splits around a small island and runs slower
3. Depositional area approximately 500’ downstream of Factory Pond Dam at the point where there is a path down to the river from Winter St. through the undeveloped parcel
4. Depositional area on the south shoreline (“left” looking upstream, nearest the house) approximately 200’ downstream of the new bridge for Winter Street
5. Depositional area east of the house at the northwest corner of the Adams Circle loop on the edge of the Conservation Land located on Adams Circle
6. Depositional area on the northern side of the river just downstream of the first encountered island approximately 250’ upstream of the road bridge / old bridge structure on Cross Street
7. Depositional area on the southern side of the river (the side opposite of the railroad bed trail) approximately 100’ upstream of the former “dam” location / remains located downstream of the Cross St. bridge and upstream of Water Street

8. Depositional area approximately 1500’ upstream of the Luddams Ford Dam where the river channel begins to widen

These samples will be either composites of three grab samples collected on transects across the stream or a grab sample of the surficial sediment. These samples will be analyzed only for Total Mercury.

SUMMARY OF THE REVISED RE-BASELINING SAMPLING PROGRAM

The breakdown of the proposed re-baselining sampling program presented in Tables 3 through 5 is summarized by subarea of the Site in Table 6.

Table 3. Summary of the Proposed Re-Baselining Soil Sampling Program
Fireworks Site, Hanover MA

	Sample Location	Sample Description		Numbers of Samples				Chemistry						Waste Disposal and Leachability			
	Refer to Figure 2	Proposed Sampling Depth Increments	Sample Type	Number of Proposed Sampling Locations	Number of Samples to be Collected per Location	Number of Samples Expected to be Analyzed	Number of Samples to be Held for Possible Analysis	Total Mercury	TAL Metals (Totals)	Explosives (Does not include Perchlorate)	Total Mercury Quality Control	TAL Metals (Totals) Quality Control	Explosives Quality Control	Full Hazardous Waste Characterization Suite [2]	TCLP Metals (RCRA 8)	Percent Solids	Grain Size ASTM D 422
				(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)
Upper North Area																	
ECC Upper Bank Overflow Area																	
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0	1 Sample (sample TBD)	0	0	1	1	1	1
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
Subtotal				**10**	**20**	**10**	**10**	**10**	**0**	**0**	**1**	**0**	**0**	**1**	**1**	**1**	**1**
ECC Middle Bank Overflow Area																	
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0	3 Samples (samples TBD)	0	0	1	1	1	1
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
Subtotal				**28**	**56**	**28**	**28**	**28**	**0**	**0**	**3**	**0**	**0**	**1**	**1**	**1**	**1**
ECC Lower Bank Overflow Area																	
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0	2 Samples (samples TBD)	0	0	1	1	1	1
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
	-	3"	Grab of 3" Interval	1	2	1	1	1	0	0							
Subtotal				**13**	**26**	**13**	**13**	**13**	**0**	**0**	**2**	**0**	**0**	**1**	**1**	**1**	**1**

Table 3. Summary of the Proposed Re-Baselining Soil Sampling Program
Fireworks Site, Hanover MA

	Sample Location	Sample Description		Numbers of Samples				Chemistry						Waste Disposal and Leachability			
	Refer to Figure 3	Proposed Sampling Depth Increments	Sample Type	Number of Proposed Sampling Locations	Number of Samples to be Collected per Location	Number of Samples Expected to be Analyzed	Number of Samples to be Held for Possible Analysis	Total Mercury	TAL Metals (Totals)	Explosives (Includes Nitroglycerin and Perchlorate)	Total Mercury Quality Control	TAL Metals (Totals) Quality Control	Explosives Quality Control	Full Hazardous Waste Characterization Suite [2]	TCLP Metals (RCRA 8)	Percent Solids	Grain Size ASTM D 422
				(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)
Southern Conservation Commission Area																	
Near-Range Firing Position	-	3"	ISM of 3" Interval	1 Decision Unit 30 increment/ 20'x30' DU	3	3	0	0	1	1	0	Replicate Samples for each DU already accounted for in the number of samples to be collected	Replicate Samples for each DU already accounted for in the number of samples to be collected	1	1	1	1
Far-Range Firing Position	-	3"	ISM of 3" Interval	1 Decision Unit 30 increment/ 20'x30' DU	3	3	0	0	1	1							
Heavy Steel Plate Area	-	3"	ISM of 3" Interval	1 Decision Unit 30 increment/ 20'x30' DU	3	3	0	0	1	1							
Test Range Floor in Front of Berm	-	3"	ISM of 3" Interval	1 Decision Unit 50 increment/ 250'x25' DU	3	3	0	0	1	1							
Test Range Berm	-	6"	ISM of 6" Interval (2 depth intervals)	4 Decision Units 30 increment/ 125'x25' DU	12	12	0	0	4	4							
Area Behind Test Range Berm	-	3"	ISM of 3" Interval	1 Decision Unit 50 increment/ 250'x25' DU	3	3	0	0	1	1							
SDA Soil UCL Exceedance Area	-	6"	ISM of 6" Interval	1 Decision Unit 30 increment/ 50'x50' DU	3	3	0	0	1	1				0	0	0	0
PZ-24 Groundwater UCL Exceedance Area	-	6"	ISM of 6" Interval	1 Decision Unit 30 increment/ 50'x50' DU	3	3	0	0	1	1				0	0	0	0
Subtotal				**11**	**33**	**33**	**0**	**0**	**11**	**11**	**0**	**0**	**0**	**1**	**1**	**1**	**1**

	Sample Location	Sample Description		Numbers of Samples				Chemistry						Waste Disposal and Leachability			
	Refer to Figure 3	Proposed Sampling Depth Increments	Sample Type	Number of Proposed Sampling Locations	Number of Samples to be Collected	Number of Samples Expected to be Analyzed	Number of Samples to be Held for Possible Analysis	Total Mercury	TAL Metals (Totals)	Explosives (Does not include Perchlorate)	Total Mercury Quality Control	TAL Metals (Totals) Quality Control	Explosives Quality Control	Full Hazardous Waste Characterization Suite [2]	TCLP Metals (RCRA 8)	Percent Solids	Grain Size ASTM D 422
				(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)
Marsh Upland Area																	
	-	12"	Grab of 12" Interval	1	4	2	2	2	2	0	3	3 Samples (samples TBD)	0	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)
	-	12"	Grab of 12" Interval	1	4	2	2	2	2	0							
	-	12"	Grab of 12" Interval	1	4	2	2	2	2	0							
	-	12"	Grab of 12" Interval	1	6	2	4	2	2	0							
	-	12"	Grab of 12" Interval	1	6	2	4	2	2	0							
	-	12"	Grab of 12" Interval	1	4	2	2	2	2	0							
	-	12"	Grab of 12" Interval	1	4	2	2	2	2	0							
	-	12"	Grab of 12" Interval	1	6	2	4	2	2	0							
	-	12"	Grab of 12" Interval	1	4	2	2	2	2	0							
	-	12"	Grab of 12" Interval	1	4	2	2	2	2	0							
	-	12"	Grab of 12" Interval	1	4	2	2	2	2	0							
	-	12"	Grab of 12" Interval	1	4	2	2	2	2	0							
Subtotal				**12**	**54**	**24**	**30**	**24**	**24**	**0**	**3**	**3**	**0**	**1**	**1**	**1**	**1**

Table 3. Summary of the Proposed Re-Baselining Soil Sampling Program
Fireworks Site, Hanover MA

	Sample Location	Sample Description		Numbers of Samples				Chemistry						Waste Disposal and Leachability			
	Refer to Figure 3	Proposed Sampling Depth Increments	Sample Type	Number of Proposed Sampling Locations	Number of Samples to be Collected	Number of Samples Expected to be Analyzed	Number of Samples to be Held for Possible Analysis	Total Mercury	TAL Metals (Totals)	Explosives (Does not include Perchlorate)	Total Mercury Quality Control	TAL Metals (Totals) Quality Control	Explosives Quality Control	Full Hazardous Waste Characteriza-tion Suite ^{2}	TCLP Metals (RCRA 8)	Percent Solids	Grain Size ASTM D 422
				(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)
100-Year Floodplain Area																	
	-	3"	ISM of 3" Interval	1 Decision Unit 30 increment/ 50'x50' DU	3	3	0	1	0	0	Replicate Samples already accounted for in the number of samples to be collected	0	0	0	0	0	0
	-	3"	ISM of 3" Interval	1 Decision Unit 30 increment/ 50'x50' DU	3	3	0	1	0	0	Replicate Samples already accounted for in the number of samples to be collected						
Subtotal				**2**	**6**	**6**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
TOTALS				**76**	**195**	**114**	**81**	**77**	**35**	**11**	**9**	**3**	**0**	**5**	**5**	**5**	**5**

Table 4. Summary of the Proposed Re-Baselining Groundwater Sampling Program
Fireworks Site, Hanover MA

Sample Location		Sample Description		Analyses			
Risk Characterization Area	**Existing Monitoring Well / Piezometer ID [Refer to Figure 4]**	**Unfiltered/ Filtered**	**Sample Collection Method**	**Total Mercury (1)**	**Total Lead (1)**	**Total Mercury Quality Control**	**Total Lead Quality Control**
Southern Disposal Area							
	PZ-24	Unfiltered	Low-Flow	0	1	0	1
Marsh Upland Area							
	DP-MW1	Unfiltered	Low-Flow	1	0	1	0
TOTALS				**1**	**1**	**1**	**1**

NOTES:

(1) If sampling results indicate a significant decrease in contaminant concentrations (e.g., below UCLs), then additional sampling will be conducted at a later time to confirm any observed decrease and establish the current contaminant concentrations with a high degree of confidence.

Table 5. Summary of the Proposed Re-Baselining Sediment Sampling Program
Fireworks Site, Hanover MA

	Sample Location		Sample Description		Numbers of Samples				Chemistry		Waste Disposal and Leachability				Geotechnical Testing							Bench-Scale Performance Testing			Water Body Parameters	
River Reach, Pond Area or Risk Characterization Area	Re-Baselining Sample Location ID [Refer to Figure 5]	Sediment Management Unit (SMU) No.	Proposed Sampling Depth Increments	Sample Type	Number of Proposed Sampling Locations	Number of Samples to be Collected	Number of Samples Expected to be Analyzed	Number of Samples to be Held for Possible Analysis	Total Mercury	Total Mercury Quality Control	Full Hazardous Waste Characterization Suite ^{2}	TCLP Metals (RCRA 8)	Percent Solids	Paint Filter Test	Atterberg Limits ASTM D 4318	Specific Gravity ASTM D 854	Grain Size ASTM D 422	Moisture Content ASTM D 2216	Organic Matter ASTM D 2974	UU Triaxial Test ASTM D 2850	CU Triaxial Test ASTM D 4767	Dredge Elutriate Test	GeoTube Dewatering Test	Sediment Fixing/ Amendment Testing	Water Depth ^{1}	Sediment Thickness ^{1}
					(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)
Eastern Channel Corridor																										
	-	8	0" to Refusal	Composite across the stream channel	1	1	1	0	1	2 Samples (samples TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	3 Sticking (L-C-R)	3 Sticking (L-C-R)
	-	8	0" to Refusal	Composite across the stream channel	1	1	1	0	1																3 Sticking (L-C-R)	3 Sticking (L-C-R)
	-	8	0" to Refusal	Composite across the stream channel	1	1	1	0	1																3 Sticking (L-C-R)	3 Sticking (L-C-R)
	-	8	0" to Refusal	Composite across the stream channel	1	1	1	0	1																3 Sticking (L-C-R)	3 Sticking (L-C-R)
	-	7	0" to Refusal	Composite across the stream channel	1	1	1	0	1																3 Sticking (L-C-R)	3 Sticking (L-C-R)
	-	7	0" to Refusal	Composite across the stream channel	1	1	1	0	1																3 Sticking (L-C-R)	3 Sticking (L-C-R)
	-	6	0" to Refusal	Composite across the stream channel	1	1	1	0	1																3 Sticking (L-C-R)	3 Sticking (L-C-R)
	-	5	0" to Refusal	Composite across the stream channel	1	1	1	0	1																3 Sticking (L-C-R)	3 Sticking (L-C-R)
	-	5	0" to Refusal	Composite across the stream channel	1	1	1	0	1																3 Sticking (L-C-R)	3 Sticking (L-C-R)
	-	5	0" to Refusal	Composite across the stream channel	1	1	1	0	1																3 Sticking (L-C-R)	3 Sticking (L-C-R)
	-	5	0" to Refusal	Composite across the stream channel	1	1	1	0	1																3 Sticking (L-C-R)	3 Sticking (L-C-R)
	-	5	0" to Refusal	Composite across the stream channel	1	1	1	0	1																3 Sticking (L-C-R)	3 Sticking (L-C-R)
	-	4	0" to Refusal	Composite across the stream channel	1	1	1	0	1																3 Sticking (L-C-R)	3 Sticking (L-C-R)
	-	4	0" to Refusal	Composite across the stream channel	1	1	1	0	1																3 Sticking (L-C-R)	3 Sticking (L-C-R)
	-	3	0" to Refusal	Composite across the stream channel	1	1	1	0	1																3 Sticking (L-C-R)	3 Sticking (L-C-R)
	-	2	0" to Refusal	Composite across the stream channel	1	1	1	0	1																3 Sticking (L-C-R)	3 Sticking (L-C-R)
	-	2	0" to Refusal	Composite across the stream channel	1	1	1	0	1																3 Sticking (L-C-R)	3 Sticking (L-C-R)
	-	2	0" to Refusal	Composite across the stream channel	1	1	1	0	1																3 Sticking (L-C-R)	3 Sticking (L-C-R)
Subtotals					**18**	**18**	**18**	**0**	**18**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**54**	**54**

	Sample Location		Sample Description		Numbers of Samples				Chemistry		Waste Disposal and Leachability				Geotechnical Testing							Bench-Scale Performance Testing			Water Body Parameters	
River Reach, Pond Area or Risk Characterization Area	Re-Baselining Sample Location ID [Refer to Figure 6]	Sediment Management Unit (SMU) No.	Proposed Sampling Depth Increments	Sample Type	Number of Proposed Sampling Locations	Number of Samples to be Collected	Number of Samples Expected to be Analyzed	Number of Samples to be Held for Possible Analysis	Total Mercury	Total Mercury Quality Control	Full Hazardous Waste Characterization Suite ^{2}	TCLP Metals (RCRA 8)	Percent Solids	Paint Filter Test	Atterberg Limits ASTM D 4318	Specific Gravity ASTM D 854	Grain Size ASTM D 422	Moisture Content ASTM D 2216	Organic Matter ASTM D 2974	UU Triaxial Test ASTM D 2850	CU Triaxial Test ASTM D 4767	Dredge Elutriate Test	GeoTube Dewatering Test	Sediment Fixing/ Amendment Testing	Water Depth ^{1}	Sediment Thickness
					(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)
Lower Drinkwater River Corridor																										
	-	19	6"	Grab of 6" Interval	1	2	1	1	1	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	0	0	0	3 Sticking (L-C-R)	NA
	-	17	6"	Grab of 6" Interval	1	2	1	1	1																3 Sticking (L-C-R)	NA
	-	15	6"	Grab of 6" Interval	1	2	1	1	1																3 Sticking (L-C-R)	NA
	-	12	6"	Grab of 6" Interval	1	2	1	1	1																3 Sticking (L-C-R)	NA
Subtotals					**4**	**8**	**4**	**4**	**4**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**12**	**0**

Table 5. Summary of the Proposed Re-Baselining Sediment Sampling Program
Fireworks Site, Hanover MA

	Sample Location		Sample Description		Numbers of Samples				Chemistry		Waste Disposal and Leachability				Geotechnical Testing							Bench-Scale Performance Testing			Water Body Parameters	
River Reach, Pond Area or Risk Characterization Area	Re-Baselining Sample Location ID [Refer to Figure 6]	Sediment Management Unit (SMU) No.	Proposed Sampling Depth Increments	Sample Type	Number of Proposed Sampling Locations	Number of Samples to be Collected	Number of Samples Expected to be Analyzed	Number of Samples to be Held for Possible Analysis	Total Mercury	Total Mercury Quality Control	Full Hazardous Waste Characteriza-tion Suite [2]	TCLP Metals (RCRA 8)	Percent Solids	Paint Filter Test	Atterberg Limits ASTM D 4318	Specific Gravity ASTM D 854	Grain Size ASTM D 422	Moisture Content ASTM D 2216	Organic Matter ASTM D 2974	UU Triaxial Test ASTM D 2850	CU Triaxial Test ASTM D 4767	Dredge Elutriate Test	GeoTube Dewatering Test	Sediment Fixing/ Amendment Testing	Water Depth [1]	Sediment Thickness
					(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)
Lily Pond/Upper Factory Pond																										
	-	70	6"	Grab of 6" Interval	1	4	2	2	2	10 Samples (samples TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	Bathy-metry	NA
	-	70	6"	Grab of 6" Interval	1	4	2	2	2																	NA
	-	70	6"	Grab of 6" Interval	1	4	2	2	2																	NA
	-	23	6"	Grab of 6" Interval	1	2	1	1	1																	NA
	-	70	6"	Grab of 6" Interval	1	4	2	2	2																	NA
	-	21	6"	Grab of 6" Interval	1	2	1	1	1																	NA
	-	22	6"	Grab of 6" Interval	1	6	3	3	3																	NA
	-	25	6"	Grab of 6" Interval	1	4	2	2	2																	NA
	-	70	6"	Grab of 6" Interval	1	4	2	2	2																	NA
	-	21	6"	Grab of 6" Interval	1	2	1	1	1																	NA
	-	24	6"	Grab of 6" Interval	1	4	2	2	2																	NA
	-	26	6"	Grab of 6" Interval	1	4	2	2	2																	NA
	-	70	6"	Grab of 6" Interval	1	4	2	2	2																	NA
	-	26	6"	Grab of 6" Interval	1	4	2	2	2																	NA
	-	26	6"	Grab of 6" Interval	1	4	2	2	2																	NA
	-	28	6"	Grab of 6" Interval	1	2	1	1	1																	NA
	-	28	6"	Grab of 6" Interval	1	2	1	1	1																	NA
	-	31	6"	Grab of 6" Interval	1	2	1	1	1																	NA
	-	27	6"	Grab of 6" Interval	1	4	2	2	2																	NA
	-	27	6"	Grab of 6" Interval	1	2	1	1	1																	NA
	-	27	6"	Grab of 6" Interval	1	2	1	1	1																	NA
	-	31	6"	Grab of 6" Interval	1	2	1	1	1																	NA
	-	30	6"	Grab of 6" Interval	1	2	1	1	1																	NA
	-	29	6"	Grab of 6" Interval	1	8	3	5	3																	NA
	-	29	6"	Grab of 6" Interval	1	2	1	1	1																	NA
	-	31	6"	Grab of 6" Interval	1	2	1	1	1																	NA
	-	29	6"	Grab of 6" Interval	1	8	3	5	3																	NA
	-	29	6"	Grab of 6" Interval	1	8	3	5	3																	NA
	-	35	6"	Grab of 6" Interval	1	2	1	1	1																	NA
	-	29	6"	Grab of 6" Interval	1	8	3	5	3																	NA
	-	35	6"	Grab of 6" Interval	1	2	1	1	1																	NA
	-	34	6"	Grab of 6" Interval	1	4	3	1	3																	NA
	-	33	6"	Grab of 6" Interval	1	4	2	2	2																	NA
	-	37	6"	Grab of 6" Interval	1	2	1	1	1																	NA
	-	36	6"	Grab of 6" Interval	1	4	2	2	2																	NA
	-	36	6"	Grab of 6" Interval	1	4	2	2	2																	NA
	-	32	6"	Grab of 6" Interval	1	6	3	3	3																	NA
	-	39	6"	Grab of 6" Interval	1	4	2	2	2																	NA
	-	36	6"	Grab of 6" Interval	1	4	2	2	2																	NA
	-	38	6"	Grab of 6" Interval	1	4	2	2	2																	NA
	-	32	6"	Grab of 6" Interval	1	6	3	3	3																	NA
	-	40	6"	Grab of 6" Interval	1	2	1	1	1																	NA
	-	38	6"	Grab of 6" Interval	1	4	2	2	2																	NA
	-	38	6"	Grab of 6" Interval	1	4	2	2	2																	NA
	-	42	6"	Grab of 6" Interval	1	4	2	2	2																	NA
	-	41	6"	Grab of 6" Interval	1	2	1	1	1																	NA
	-	41	6"	Grab of 6" Interval	1	2	1	1	1																	NA
	-	42	6"	Grab of 6" Interval	1	4	2	2	2																	NA
	-	43	6"	Grab of 6" Interval	1	4	2	2	2																	NA
	-	45	6"	Grab of 6" Interval	1	2	1	1	1																	NA
	-	44	6"	Grab of 6" Interval	1	2	1	1	1																	NA
	-	43	6"	Grab of 6" Interval	1	4	2	2	2																	NA
	-	45	6"	Grab of 6" Interval	1	2	1	1	1																	NA
Subtotals					**53**	**192**	**93**	**99**	**93**	**10**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**Yes**	**0**

Table 5. Summary of the Proposed Re-Baselining Sediment Sampling Program
Fireworks Site, Hanover MA

	Sample Location		Sample Description		Numbers of Samples				Chemistry		Waste Disposal and Leachability				Geotechnical Testing							Bench-Scale Performance Testing			Water Body Parameters	
River Reach, Pond Area or Risk Characterization Area	Re-Baselining Sample Location ID [Refer to Figure 6]	Sediment Management Unit (SMU) No.	Proposed Sampling Depth Increments	Sample Type	Number of Proposed Sampling Locations	Number of Samples to be Collected	Number of Samples Expected to be Analyzed	Number of Samples to be Held for Possible Analysis	Total Mercury	Total Mercury Quality Control	Full Hazardous Waste Characterization Suite ^{2}	TCLP Metals (RCRA 8)	Percent Solids	Paint Filter Test	Atterberg Limits ASTM D 4318	Specific Gravity ASTM D 854	Grain Size ASTM D 422	Moisture Content ASTM D 2216	Organic Matter ASTM D 2974	UU Triaxial Test ASTM D 2850	CU Triaxial Test ASTM D 4767	Dredge Elutriate Test	GeoTube Dewatering Test	Sediment Fixing/ Amendment Testing	Water Depth ^{1}	Sediment Thickness
					(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)
Middle/Lower Factory Pond																										
	-	69	6"	Grab of 6" Interval	1	2	1	1	1	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	Bathy-metry	NA
	-	69	6"	Grab of 6" Interval	1	4	2	2	2																	NA
	-	67	6"	Grab of 6" Interval	1	2	1	1	1																	NA
	-	67	6"	Grab of 6" Interval	1	4	2	2	2																	NA
	-	67	6"	Grab of 6" Interval	1	4	2	2	2																	NA
	-	68	6"	Grab of 6" Interval	1	4	2	2	2																	NA
	-	58	6"	Grab of 6" Interval	1	2	1	1	1																	NA
	-	58	6"	Grab of 6" Interval	1	2	1	1	1																	NA
	-	58	6"	Grab of 6" Interval	1	2	1	1	1																	NA
	-	67	6"	Grab of 6" Interval	1	4	2	2	2																	NA
	-	67	6"	Grab of 6" Interval	1	4	2	2	2																	NA
	-	66	6"	Grab of 6" Interval	1	4	2	2	2																	NA
	-	66	6"	Grab of 6" Interval	1	4	2	2	2																	NA
	-	54	6"	Grab of 6" Interval	1	2	1	1	1																	NA
	-	59	6"	Grab of 6" Interval	1	4	2	2	2																	NA
	-	59	6"	Grab of 6" Interval	1	4	2	2	2																	NA
	-	59	6"	Grab of 6" Interval	1	4	2	2	2																	NA
	-	59	6"	Grab of 6" Interval	1	4	2	2	2																	NA
	-	66	6"	Grab of 6" Interval	1	4	2	2	2																	NA
	-	66	6"	Grab of 6" Interval	1	4	2	2	2																	NA
	-	66	6"	Grab of 6" Interval	1	4	2	2	2																	NA
	-	54	6"	Grab of 6" Interval	1	2	1	1	1																	NA
	-	55	6"	Grab of 6" Interval	1	2	1	1	1																	NA
	-	56	6"	Grab of 6" Interval	1	2	1	1	1																	NA
	-	57	6"	Grab of 6" Interval	1	2	1	1	1																	NA
	-	57	6"	Grab of 6" Interval	1	2	1	1	1																	NA
	-	60	6"	Grab of 6" Interval	1	4	2	2	2																	NA
	-	61	6"	Grab of 6" Interval	1	4	2	2	2																	NA
	-	63	6"	Grab of 6" Interval	1	4	3	1	3																	NA
	-	63	6"	Grab of 6" Interval	1	4	3	1	3																	NA
	-	63	6"	Grab of 6" Interval	1	4	3	1	3																	NA
	-	50	6"	Grab of 6" Interval	1	4	3	1	3																	NA
	-	52	6"	Grab of 6" Interval	1	4	3	1	3																	NA
	-	53	6"	Grab of 6" Interval	1	4	3	1	3																	NA
	-	56	6"	Grab of 6" Interval	1	2	1	1	1																	NA
	-	61	6"	Grab of 6" Interval	1	4	2	2	2																	NA
	-	62	6"	Grab of 6" Interval	1	4	2	2	2																	NA
	-	48	6"	Grab of 6" Interval	1	2	1	1	1																	NA
	-	51	6"	Grab of 6" Interval	1	4	3	1	3																	NA
	-	64	6"	Grab of 6" Interval	1	6	3	3	3																	NA
	-	46	6"	Grab of 6" Interval	1	4	2	2	2																	NA
	-	47	6"	Grab of 6" Interval	1	4	3	1	3																	NA
	-	48	6"	Grab of 6" Interval	1	2	1	1	1																	NA
	-	47	6"	Grab of 6" Interval	1	4	3	1	3																	NA
	-	48	6"	Grab of 6" Interval	1	2	1	1	1																	NA
	-	48	6"	Grab of 6" Interval	1	2	1	1	1																	NA
Subtotals					**46**	**154**	**86**	**68**	**86**	**9**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**Yes**	**0**

Table 5. Summary of the Proposed Re-Baselining Sediment Sampling Program
Fireworks Site, Hanover MA

	Sample Location		Sample Description		Numbers of Samples				Chemistry		Waste Disposal and Leachability				Geotechnical Testing										Water Body Parameters	
River Reach, Pond Area or Risk Characterization Area	Re-Baselining Sample Location ID [Refer to Figure 7]	Sediment Management Unit (SMU) No.	Proposed Sampling Depth Increments	Sample Type	Number of Proposed Sampling Locations	Number of Samples to be Collected	Number of Samples Expected to be Analyzed	Number of Samples to be Held for Possible Analysis	Total Mercury	Total Mercury Quality Control	Full Hazardous Waste Characteriza-tion Suite [2]	TCLP Metals (RCRA 8)	Percent Solids	Paint Filter Test	Atterberg Limits ASTM D 4318	Specific Gravity ASTM D 854	Grain Size ASTM D 422	Moisture Content ASTM D 2216	Organic Matter ASTM D 2974	UU Triaxial Test ASTM D 2850	CU Triaxial Test ASTM D 4767	Dredge Elutriate Test	GeoTube Dewatering Test	Sediment Fixing/ Amendment Testing	Water Depth [1]	Sediment Thickness
					(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)
Marsh Upland Area																										
	-	MUA 9	6"	Grab of 6" Interval	1	4	2	2	2	6 Samples (samples TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sample (sample TBD)	1 Sticking	NA
	-	MUA 14	6"	Grab of 6" Interval	1	8	3	5	3																1 Sticking	NA
	-	MUA 8	6"	Grab of 6" Interval	1	4	3	1	3																1 Sticking	NA
	-	MUA 11	6"	Grab of 6" Interval	1	4	3	1	3																1 Sticking	NA
	-	MUA 9	6"	Grab of 6" Interval	1	6	2	4	2																1 Sticking	NA
	-	MUA 15	6"	Grab of 6" Interval	1	6	3	3	3																1 Sticking	NA
	-	MUA 10	6"	Grab of 6" Interval	1	4	2	2	2																1 Sticking	NA
	-	MUA 10	6"	Grab of 6" Interval	1	4	2	2	2																1 Sticking	NA
	-	MUA 12	6"	Grab of 6" Interval	1	6	3	3	3																1 Sticking	NA
	-	MUA 8	6"	Grab of 6" Interval	1	4	3	1	3																1 Sticking	NA
	-	MUA 1	6"	Grab of 6" Interval	1	4	2	2	2																1 Sticking	NA
	-	MUA 13	6"	Grab of 6" Interval	1	8	3	5	3																1 Sticking	NA
	-	MUA 10	6"	Grab of 6" Interval	1	4	2	2	2																1 Sticking	NA
	-	MUA 3	6"	Grab of 6" Interval	1	8	3	5	3																1 Sticking	NA
	-	MUA 2	6"	Grab of 6" Interval	1	8	3	5	3																1 Sticking	NA
	-	MUA 2	6"	Grab of 6" Interval	1	8	3	5	3																1 Sticking	NA
	-	MUA 13	6"	Grab of 6" Interval	1	8	3	5	3																1 Sticking	NA
	-	MUA 4	6"	Grab of 6" Interval	1	4	2	2	2																1 Sticking	NA
	-	MUA 4	6"	Grab of 6" Interval	1	4	2	2	2																1 Sticking	NA
	-	MUA 3	6"	Grab of 6" Interval	1	8	3	5	3																1 Sticking	NA
	-	MUA 5	6"	Grab of 6" Interval	1	4	2	2	2																1 Sticking	NA
	-	MUA 5	6"	Grab of 6" Interval	1	4	2	2	2																1 Sticking	NA
	-	MUA 4	6"	Grab of 6" Interval	1	4	2	2	2																1 Sticking	NA
Subtotals					**23**	**126**	**58**	**68**	**58**	**6**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**0**	**0**

Table 5. Summary of the Proposed Re-Baselining Sediment Sampling Program
Fireworks Site, Hanover MA

	Sample Location		Sample Description		Numbers of Samples				Chemistry		Waste Disposal and Leachability				Geotechnical Testing										Water Body Parameters	
River Reach, Pond Area or Risk Characterization Area	Re-Baselining Sample Location ID [Refer to Figure 8]	Sediment Management Unit (SMU) No.	Proposed Sampling Depth Increments	Sample Type	Number of Proposed Sampling Locations	Number of Samples to be Collected	Number of Samples Expected to be Analyzed	Number of Samples to be Held for Possible Analysis	Total Mercury	Total Mercury Quality Control	Full Hazardous Waste Characterization Suite [2]	TCLP Metals (RCRA 8)	Percent Solids	Paint Filter Test	Atterberg Limits ASTM D 4318	Specific Gravity ASTM D 854	Grain Size ASTM D 422	Moisture Content ASTM D 2216	Organic Matter ASTM D 2974	UU Triaxial Test ASTM D 2850	CU Triaxial Test ASTM D 4767	Dredge Elutriate Test	GeoTube Dewatering Test	Sediment Fixing/ Amendment Testing	Water Depth [1]	Sediment Thickness
					(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)	(#)
Indian Head River																										
	1	NA	3"	Grab of 3" Interval	1	1	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	2	NA	3"	Composite of 3" Interval (Left-Center-Right)	1	1	1	0	1																	
	3	NA	3"	Composite of 3" Interval (Left-Center-Right)	1	1	1	0	1																	
	4	NA	3"	Grab of 3" Interval	1	1	1	0	1																	
	5	NA	3"	Composite of 3" Interval (Left-Center-Right)	1	1	1	0	1																	
	6	NA	3"	Grab of 3" Interval	1	1	1	0	1																	
	7	NA	3"	Grab of 3" Interval	1	1	1	0	1																	
	8	NA	3"	Grab of 3" Interval	1	1	1	0	1																	
Subtotals					**8**	**8**	**8**	**0**	**8**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
TOTALS					**152**	**506**	**267**	**239**	**267**	**29**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**5**	**4**	**4**	**4**	**66**	**54**

NOTES:
NA = Not Applicable
1 L= Near left bank; C = Center channel; R = Near right bank (referenced to facing upstream); Samples collected starting at the farthest downstream sampling location and working upstream
2 Exact set of analytes will be facility-specific

Table 6. Summary of the Proposed Re-Baselining Sampling Program by Subarea of the Site

		Chemistry Parameters	Waste Disposal Parameters	Leachability Parameters	Geotechnical Parameters	Physical Characteristics	Stabilization Testing	Water Depth	Sediment Thickness
Eastern Channel Corridor									
	Bank Overflow Surficial Soil	✓	✓	✓		✓			
	Sediment	✓	✓	✓			✓		✓
	Surface Water							✓	
Lower Drinkwater River Corridor									
	Sediment	✓	✓	✓	✓	✓		✓	✓
Test Range Area									
	Soil	✓	✓	✓		✓			
Marsh Upland Area									
	Soil	✓	✓	✓		✓			
	Sediment	✓	✓	✓	✓	✓	✓	✓	
Groundwater UCL Exceedance Area									
	Soil	✓							
	Groundwater	✓							
Soil UCL Exceedance Area									
	Soil	✓							
Lily Pond / Upper Factory Pond									
	Sediment	✓	✓	✓	✓	✓	✓		
	Surface Water							✓	
Middle / Lower Factory Pond									
	Sediment	✓	✓	✓	✓	✓	✓		
	Surface Water							✓	
100-Year Floodplain Area									
	Surficial Soil	✓							
Indian Head River									
	Surficial Sediment	✓							

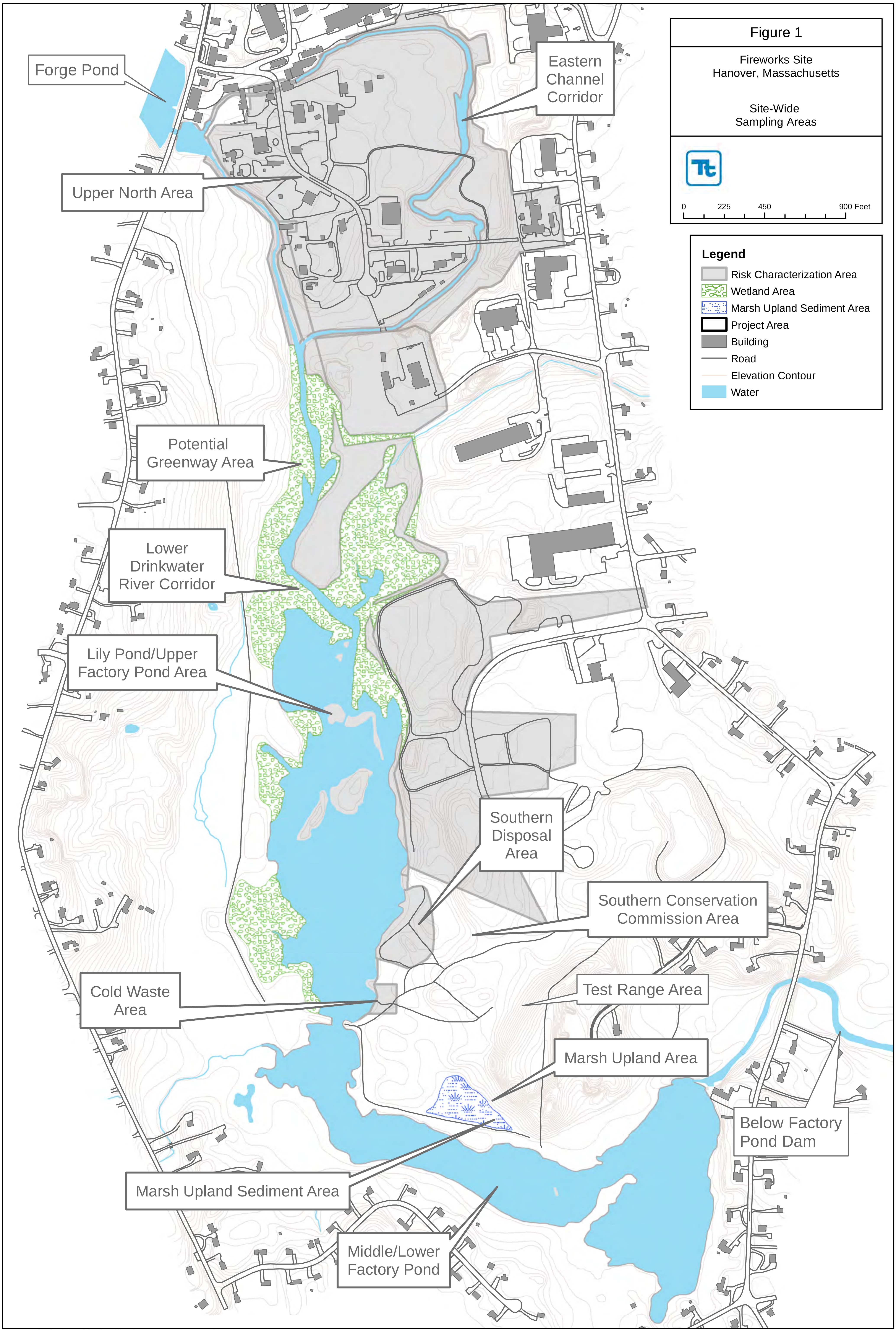


Figure 1

Fireworks Site
Hanover, Massachusetts

Site-Wide
Sampling Areas

Document Path: P:\GIS\Fireworks\GIS\Spatial\MXD\20150116_SamplingLocations\Sitewide_SMUs.mxd

Legend

● Proposed Re-Baselining Soil Grab Sampling Location

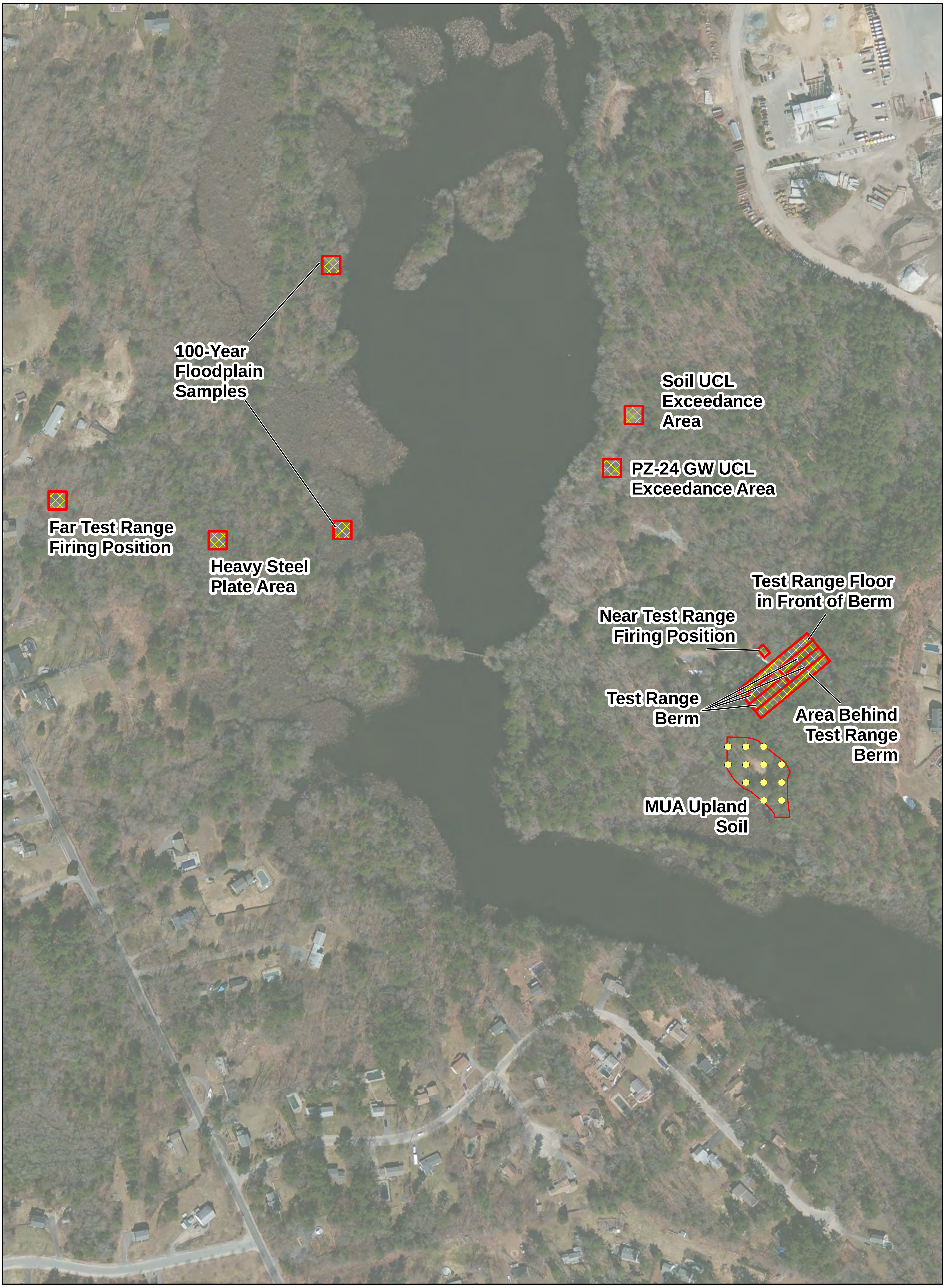
▭ Re-Baselining Soil Sampling Areas

Figure 2:
Proposed Re-Baselining Soil
Sampling Locations
(Northern Site)

N

0 100 200 300 400 Feet

Document Path: P:\GIS\Fireworks\GIS\Spatial\MXD\20150116_SamplingLocations\Fireworks_Soil_Sampling_North.mxd



Legend

● Proposed Re-Baselining Soil Grab Sampling Location

Soil Sampling Areas

▭ Re-Baselining

▨ Incremental Sampling Methodology (ISM)

Figure 3:
Proposed
Re-Baselining Soil
Sampling Locations
(Southern Site)

N

0 150 300 450 600 Feet

Document Path: P:\GIS\Fireworks\GIS\Spatial\MXD\20150727_ReBaseline_Mapping\Fig3_Soil_Sampling_Southern_Site_20150727.mxd

Legend

- ◕ DP-MW1
- ● PZ-24
- ☐ Re-Baselining Soil Sampling Areas
- ▨ Incremental Sampling Methdology (ISM) Soil Sampling Areas

Figure 4:
Proposed Re-Baselining Groundwater Sampling Locations

Document Path: P:\GIS\Fireworks\GIS\Spatial\MXD\20150116_SamplingLocations\Groundwater_Sampling.mxd

Legend

▬ ECC Sampling Transect with Composites of Left-Center-Right Channel Surface Sediment Grab Samples

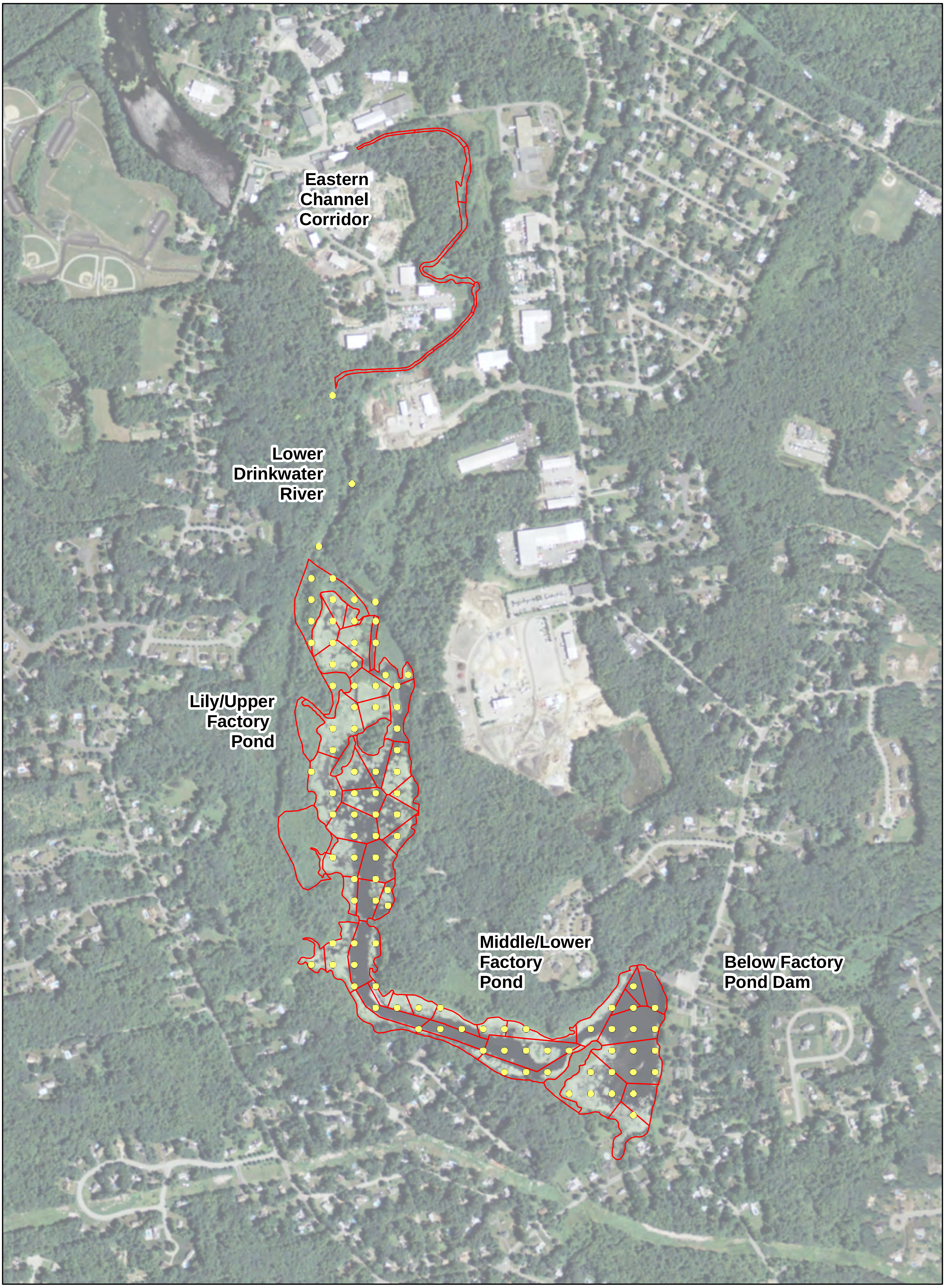
▭ Sediment Management Units (SMUs)

Figure 5:
Proposed Eastern Channel Corridor Sediment Sampling Transect Locations

N

0 200 400 Feet

Document Path: P:\GIS\Fireworks\GIS\Spatial\MXD\20150727_ReBaseline_Mapping\Fig5_Sediment_Sampling_Eastern_Channel_20150727.mxd



Legend

● Proposed Re-Baselining Sediment Sampling Location

☐ Supplemental Phase III Sediment Management Units (SMUs)

Figure 6:
Proposed Stream and Pond
Re-Baselining Sediment
Sampling Locations
(Not Including ECC)

N

0 500 1,000 1,500 2,000 Feet

Document Path: P:\GIS\Fireworks\GIS\Spatial\MXD\20150727_ReBaseline_Mapping\Fig6_Sediment_Sampling_Stream_Pond.mxd

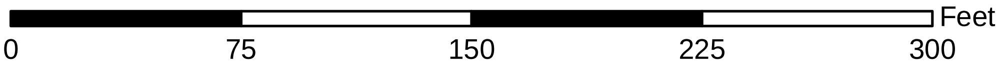
Legend

● Proposed Re-Baselining Sediment Sampling Location

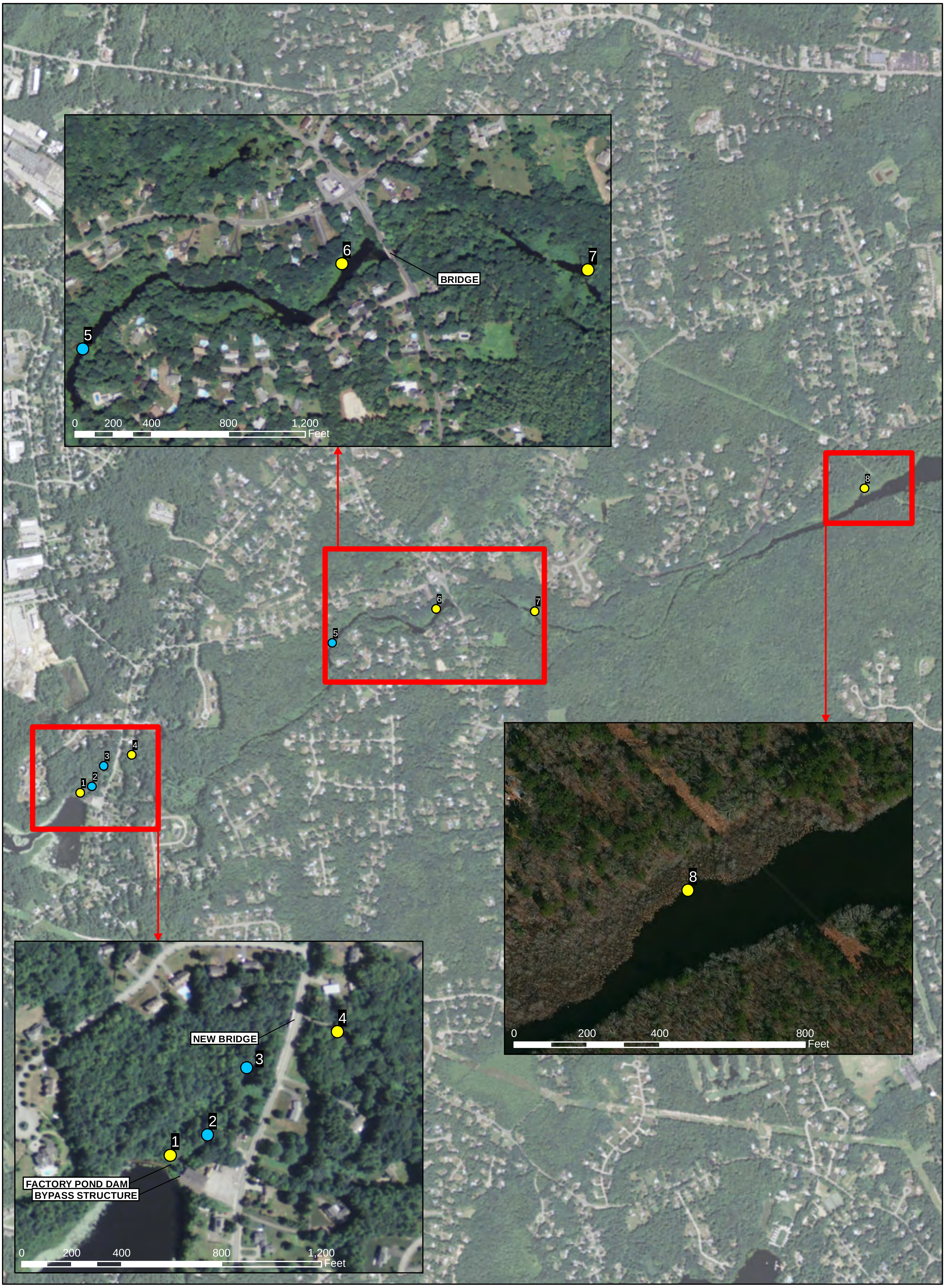
□ Phase II MUA Sediment Management Units (SMUs)

Figure 7:
Proposed Marsh Upland Area Re-Baselining Sediment Sampling Locations

N



Document Path: P:\GIS\Fireworks\GIS\Spatial\MXD\20150727_ReBaseline_Mapping\Fig7_Sediment_Sampling_Marsh_Upland_Area.mxd



Legend

Sediment Sampling Location Approach

● Grab Surface Sediment (0" - 3")

● Composite of Left-Center-Right Channel Surface Sediment Grab Samples

Figure 8:
Proposed Re-Baselining
Sediment Sampling Locations
on the Indian Head River

N

Feet
0 1,000 2,000

Document Path: P:\GIS\Fireworks\GIS\Spatial\MXD\20150727_ReBaseline_Mapping\Fig8_Sediment_Sampling_Indian_Head_River_20150727.mxd

APPENDIX 3A

Chain of Custody Forms for All Fireworks Samples

Appendix 3A. Chain of Custody Forms

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica Laboratories, Inc.

Client Contact	**Project Manager: Ron Marnicio**	**Site Contact: Alex Valli**	**Date:10/8/2015**	COC No:
Ron Marnicio Tetra Tech	**Tel/Fax:(617) 443-7551**	**Lab Contact: James Madison**	**Carrier:TA courier**	1 of 6 COCs
160 Federal Street, 3rd floor	**Analysis Turnaround Time**			Sampler:
Boston, MA 02110	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(617) 443-7551 Phone	TAT if different from Below ______			Walk-in Client:
(xxx) xxx-xxxx FAX	☑ 2 weeks			Lab Sampling:
Project Name: Fireworks	☐ 1 week			
Site: Hanover, MA	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	Sample Specific Notes:
SD-LUFP60-06	10/7/2015	1540	G	SD	1	N		X	Dry sample
SD-LUFP60-06-DUP	10/7/2015	1540	G	SD	1	N		X	Dry sample
SD-LUFP60-12	10/7/2015	1540	G	SD	1	N		X	
SD-LUFP59-06	10/7/2015	1600	G	SD	1	N		X	
SD-LUFP59-12	10/7/2015	1600	G	SD	1	N		X	
SD-LUFP59-18	10/7/2015	1600	G	SD	1	N		X	Hold
SD-LUFP65-06	10/7/2015	1620	G	SD	1	N		X	
SD-LUFP65-12	10/7/2015	1620	G	SD	1	N		X	
SD-LUFP65-18	10/7/2015	1620	G	SD	1	N		X	Hold
SD-LUFP58-06	10/8/2015	1222	G	SD	1	N		X	
SD-LUFP58-12	10/8/2015	1222	G	SD	1	N		X	
SD-LUFP58-18	10/8/2015	1222	G	SD	1	N		X	Hold

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ______

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for ______ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No
Custody Seal No.:
Cooler Temp. (°C): Obs'd: ______ Corr'd: ______
Therm ID No.: ______

Relinquished by: AV	Company: TETRA TECH	Date/Time: 10/9/15 1302	Received by:	Company: TA	Date/Time: 10/9/15 13:00
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐DW ☐NPDES ☐RCRA ☐Other:

TestAmerica Laboratories, Inc.

Client Contact	**Project Manager: Ron Marnicio**	**Site Contact: Alex Valli**	**Date:10/8/2015**	COC No:
Ron Marnicio Tetra Tech	**Tel/Fax:(617) 443-7551**	**Lab Contact: James Madison**	**Carrier:TA courier**	2 of 6 COCs
160 Federal Street, 3rd floor	**Analysis Turnaround Time**			Sampler:
Boston, MA 02110	☐CALENDAR DAYS ☐WORKING DAYS			**For Lab Use Only:**
(617) 443-7551 Phone	TAT if different from Below ______			Walk-in Client:
(xxx) xxx-xxxx FAX	☑ 2 weeks			Lab Sampling:
Project Name: Fireworks	☐ 1 week			
Site: Hanover, MA	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	Sample Specific Notes:
SD-LUFP66-06	10/8/2015	1246	G	SD	1	N		X	Dry sample
SD-LUFP66-12	10/8/2015	1246	G	SD	3	N		X	MS/MSD
SD-LUFP66-18	10/8/2015	1246	G	SD	1	N		X	Hold
SD-LUFP66-24	10/8/2015	1246	G	SD	1	N		X	Hold
SD-LUFP63-06	10/8/2015	1312	G	SD	1	N		X	Dry sample
SD-LUFP63-12	10/8/2015	1312	G	SD	1	N		X	
SD-LUFP63-18	10/8/2015	1312	G	SD	1	N		X	Hold
SD-LUFP63-24	10/8/2015	1312	G	SD	1	N		X	Hold
SD-LUFP63-30	10/8/2015	1312	G	SD	1	N		X	Hold
SD-LUFP63-36	10/8/2015	1312	G	SD	1	N		X	Hold
SD-LUFP71-06	10/8/2015	1332	G	SD	1	N		X	Dry Sample
SD-LUFP71-12	10/8/2015	1332	G	SD	1	N		X	

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ______

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.
☐Non-Hazard ☐Flammable ☐Skin Irritant ☐Poison B ☐Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐Return to Client ☐Disposal by Lab ☐Archive for ______ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No
Custody Seal No.:
Cooler Temp. (°C): Obs'd: ______ Corr'd: ______ Therm ID No.: ______

Relinquished by:	Company: TETRA TECH	Date/Time: 10/9/15 1302	Received by:	Company: TA	Date/Time: 10/9/15 13:00
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐DW ☐NPDES ☐RCRA ☐Other:

TestAmerica Laboratories, Inc.

Client Contact	**Project Manager: Ron Marnicio**	**Site Contact: Alex Valli**	**Date:10/8/2015**	COC No:
Ron Marnicio Tetra Tech	**Tel/Fax:(617) 443-7551**	**Lab Contact: James Madison**	**Carrier:TA courier**	3 of 6 COCs
160 Federal Street, 3rd floor	**Analysis Turnaround Time**			Sampler:
Boston, MA 02110	☐CALENDAR DAYS ☐WORKING DAYS			**For Lab Use Only:**
(617) 443-7551 Phone	TAT if different from Below			Walk-in Client:
(xxx) xxx-xxxx FAX	☑ 2 weeks			Lab Sampling:
Project Name: Fireworks	☐ 1 week			
Site: Hanover, MA	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	Sample Specific Notes:
SD-LUFP71-18	10/8/2015	1332	G	SD	1	N		X	Hold
SD-LUFP71-24	10/8/2015	1332	G	SD	1	N		X	Hold
SD-LUFP70-06	10/8/2015	1436	G	SD	1	N		X	
SD-LUFP70-06-DUP	10/8/2015	1436	G	SD	1	N		X	
SD-LUFP70-12	10/8/2015	1436	G	SD	1	N		X	Hold
SD-LUFP69-06	10/8/2015	1454	G	SD	1	N		X	
SD-LUFP69-12	10/8/2015	1454	G	SD	1	N		X	Hold
SD-LUFP74-06	10/8/2015	1508	G	SD	1	N		X	Dry Sample
SD-LUFP74-12	10/8/2015	1508	G	SD	1	N		X	
SD-LUFP74-18	10/8/2015	1508	G	SD	1	N		X	Hold
SD-LUFP74-24	10/8/2015	1508	G	SD	1	N		X	Hold
SD-LUFP75-06	10/8/2015	1521	G	SD	1	N		X	

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.
☐Non-Hazard ☐Flammable ☐Skin Irritant ☐Poison B ☐Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐Return to Client ☐Disposal by Lab ☐Archive for ________ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No	Custody Seal No.:		Cooler Temp. (°C): Obs'd: ____ Corr'd: ____		Therm ID No.: ____
Relinquished by:	Company: TETRA TECH	Date/Time: 10/9/15 13:2	Received by:	Company: TA	Date/Time: 10/9/15 13:00
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING
TestAmerica Laboratories, Inc.

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

Client Contact	**Project Manager: Ron Marnicio**	**Site Contact: Alex Valli**	**Date:10/8/2015**	COC No:
Ron Marnicio Tetra Tech	**Tel/Fax:(617) 443-7551**	**Lab Contact: James Madison**	**Carrier:TA courier**	4 of 6 COCs
160 Federal Street, 3rd floor	**Analysis Turnaround Time**			Sampler:
Boston, MA 02110	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(617) 443-7551 Phone	TAT if different from Below ______			Walk-in Client:
(xxx) xxx-xxxx FAX	☑ 2 weeks			Lab Sampling:
Project Name: Fireworks	☐ 1 week			
Site: Hanover, MA	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	Sample Specific Notes:
SD-LUFP75-12	10/8/2015	1521	G	SD	1	N		X	
SD-LUFP75-18	10/8/2015	1521	G	SD	1	N		X	Hold
SD-LUFP75-24	10/8/2015	1521	G	SD	1	N		X	Hold
SD-LUFP81-06	10/8/2015	1634	G	SD	1	N		X	
SD-LUFP81-12	10/8/2015	1634	G	SD	3	N		X	
SD-LUFP81-18	10/8/2015	1634	G	SD	1	N		X	Hold
SD-LUFP81-24	10/8/2015	1634	G	SD	1	N		X	Hold
SD-LUFP85-06	10/8/2015	1633	G	SD	1	N		X	
SD-LUFP85-12	10/8/2015	1633	G	SD	1	N		X	
SD-LUFP85-18	10/8/2015	1633	G	SD	1	N		X	Hold
SD-LUFP86-06	10/8/2015	1645	G	SD	1	N		X	
SD-LUFP86-12	10/8/2015	1645	G	SD	1	N		X	Hold

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ______

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for ______ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No	Custody Seal No.:		Cooler Temp. (°C): Obs'd: ______ Corr'd: ______		Therm ID No.: ______
Relinquished by:	Company: TETRA TECH	Date/Time: 10/9/15 1342	Received by:	Company: TA	Date/Time: 10/9/15 13:40
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica Laboratories, Inc.

Client Contact	**Project Manager: Ron Marnicio**	**Site Contact: Alex Valli**	**Date:10/8/2015**	COC No:
Ron Marnicio Tetra Tech	**Tel/Fax:(617) 443-7551**	**Lab Contact: James Madison**	**Carrier:TA courier**	5 of 6 COCs
160 Federal Street, 3rd floor	**Analysis Turnaround Time**			Sampler:
Boston, MA 02110	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(617) 443-7551 Phone	TAT if different from Below ______			Walk-in Client:
(xxx) xxx-xxxx FAX	☑ 2 weeks			Lab Sampling:
Project Name: Fireworks	☐ 1 week			
Site: Hanover, MA	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	TCLP Metals 6010C	Paint Filter	Mercury 7470A	Cyanide 9012B	pH 9045D	Ignitability 1020B	Calc-Sulfide 9034	TCLP Volatiles 8260C	Free Liquid 9095B	Sample Specific Notes:
SD-LUFP80-06	10/8/2015	1656	G	SD	1			X										
SD-LUFP80-12	10/8/2015	1656	G	SD	1			X										
SD-LUFP-WD	10/8/2015	1710	C	SD	5				X	X	X	X	X	X	X	X	X	
SD-LUFP87-06	10/9/2015	1133	G	SD	1			X										Dry Sample
SD-LUFP87-12	10/9/2015	1133	G	SD	1			X										
SD-LUFP87-18	10/9/2015	1133	G	SD	1			X										Hold
SD-LUFP82-06	10/9/2015	1147	G	SD	1			X										Dry Sample
SD-LUFP82-12	10/9/2015	1147	G	SD	1			X										
SD-LUFP82-18	10/9/2015	1147	G	SD	1			X										Hold
SD-LUFP82-24	10/9/2015	1147	G	SD	1			X										Hold
SD-LUFP76-06	10/9/2015	1205	G	SD	1			X										Dry Sample
SD-LUFP76-12	10/9/2015	1205	G	SD	1			X										

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for ______ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No
Custody Seal No.:
Cooler Temp. (°C): Obs'd:______ Corr'd:______ Therm ID No.:______

Relinquished by:	Company: TETRA TECH	Date/Time: 10/9/15 1302	Received by:	Company: TA	Date/Time: 10/9/15 13'06
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Form No. CA-C-WI-002, Rev. 4.6, dated 09/02/2015

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Laboratories, Inc.

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

Client Contact		
Ron Marnicio Tetra Tech		
160 Federal Street, 3rd floor		
Boston, MA 02110		
(617) 443-7551	Phone	
(xxx) xxx-xxxx	FAX	
Project Name: Fireworks		
Site: Hanover, MA		
P O #		

Project Manager: Ron Marnicio
Tel/Fax:(617) 443-7551

Analysis Turnaround Time
☐ CALENDAR DAYS ☐ WORKING DAYS
TAT if different from Below ________
☑ 2 weeks
☐ 1 week
☐ 2 days
☐ 1 day

Site Contact: Alex Valli
Lab Contact: James Madison
Date:10/8/2015
Carrier:TA courier

COC No:
6 of 6 COCs
Sampler:
For Lab Use Only:
Walk-in Client:
Lab Sampling:
Job / SDG No.:

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	Sample Specific Notes:
SD-LUFP76-12-DUP	10/9/2015	1205	G	SD	1			X	
SD-LUFP76-18	10/9/2015	1205	G	SD	1			X	Hold
SD-LUFP76-24	10/9/2015	1205	G	SD	1			X	Hold
SD-LUFP79-06	10/9/2015	1221	G	SD	1			X	Dry Sample
SD-LUFP79-12	10/9/2015	1221	G	SD	3			X	MS/MSD
SD-LUFP79-18	10/9/2015	1221	G	SD	1			X	Hold
SD-LUFP79-24	10/9/2015	1221	G	SD	1			X	Hold
SD-LUFP84-06	10/9/2015	1237	G	SD	1			X	Dry Sample
SD-LUFP84-06	10/9/2015	1237	G	SD	1			X	
SD-LUFP84-06	10/9/2015	1237	G	SD	1			X	Hold

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ________

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return to Client ☐ Disposal by Lab ☐ Archive for ________ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No
Custody Seal No.:
Cooler Temp. (°C): Obs'd:________ Corr'd:________ Therm ID No.:________

Relinquished by:	Company: TETRA TECH	Date/Time: 10/9/15 1302	Received by:	Company: TA	Date/Time: 10/9/15 13:[illegible]
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Form No. CA-C-WI-002, Rev. 4.6, dated 09/02/2015

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica Laboratories, Inc.

Client Contact	**Project Manager: Ron Marnicio**	**Site Contact: Alex Valli**	**Date:10/13/2015**	COC No:
Ron Marnicio Tetra Tech	**Tel/Fax:(617) 443-7551**	**Lab Contact: James Madison**	**Carrier:TA courier**	1 of 5 COCs
160 Federal Street, 3rd floor	**Analysis Turnaround Time**			Sampler:
Boston, MA 02110	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(617) 443-7551 Phone	TAT if different from Below ______			Walk-in Client:
(xxx) xxx-xxxx FAX	☑ 2 weeks			Lab Sampling:
Project Name: Fireworks	☐ 1 week			
Site: Hanover, MA	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	Sample Specific Notes:
SD-LUFP88-06	10/9/2015	1355	G	SD	1	N		X	Dry sample
SD-LUFP88-12	10/9/2015	1355	G	SD	1	N		X	Dry sample
SD-LUFP88-18	10/9/2015	1355	G	SD	1	N		X	
SD-LUFP88-24	10/9/2015	1355	G	SD	1	N		X	Hold
SD-LUFP89-06	10/9/2015	1420	G	SD	1	N		X	Dry Sample
SD-LUFP89-12	10/9/2015	1420	G	SD	1	N		X	Hold
SD-LUFP91-06	10/9/2015	1430	G	SD	1	N		X	Dry Sample
SD-LUFP91-12	10/9/2015	1430	G	SD	1	N		X	Hold
SD-LUFP95-06	10/9/2015	1445	G	SD	1	N		X	
SD-LUFP95-06-DUP	10/9/2015	1445	G	SD	1	N		X	
SD-LUFP95-12	10/9/2015	1445	G	SD	1	N		X	Hold
SD-LUFP104-06	10/9/2015	1534	G	SD	3	N		X	MS/MSD, Dry Sample

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ______

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for ______ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ [✓ Yes] ☐ No	Custody Seal No.:		Cooler Temp. (°C): Obs'd: ______ Corr'd: ______		Therm ID No.: ______
Relinquished by:	Company: TETRA TECH	Date/Time: 10/13/15 1303	Received by:	Company: TA	Date/Time: 10/13/15 13:03
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Form No. CA-C-WI-002, Rev. 4.6, dated 09/02/2015

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica Laboratories, Inc.

Client Contact
Ron Marnicio Tetra Tech
160 Federal Street, 3rd floor
Boston, MA 02110
(617) 443-7551 Phone
(xxx) xxx-xxxx FAX
Project Name: Fireworks
Site: Hanover, MA
P O #

Project Manager: Ron Marnicio
Tel/Fax:(617) 443-7551
Analysis Turnaround Time
☐ CALENDAR DAYS ☐ WORKING DAYS
TAT if different from Below ________
☑ 2 weeks
☐ 1 week
☐ 2 days
☐ 1 day

Site Contact: Alex Valli
Lab Contact: James Madison
Date:10/13/2015
Carrier:TA courier

COC No:
2 of 5 COCs
Sampler:
For Lab Use Only:
Walk-in Client:
Lab Sampling:
Job / SDG No.:

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	Sample Specific Notes:
SD-LUFP104-12	10/9/2015	1534	G	SD	1	N		X	Hold
SD-LUFP103-06	10/12/2015	1332	G	SD	1	N		X	Dry Sample
SD-LUFP103-12	10/12/2015	1332	G	SD	1	N		X	Hold
SD-LUFP97-06	10/12/2015	1344	G	SD	1	N		X	Dry Sample
SD-LUFP97-12	10/12/2015	1344	G	SD	1	N		X	
SD-LUFP97-18	10/12/2015	1344	G	SD	1	N		X	
SD-LUFP97-24	10/12/2015	1344	G	SD	1	N		X	Hold
SD-LUFP102-06	10/12/2015	1400	G	SD	1	N		X	Dry Sample
SD-LUFP102-12	10/12/2015	1400	G	SD	1	N		X	
SD-LUFP102-18	10/12/2015	1400	G	SD	1	N		X	
SD-LUFP102-24	10/12/2015	1400	G	SD	1	N		X	
SD-LUFP93-06	10/12/2015	1414	G	SD	1	N		X	

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ________

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return to Client ☐ Disposal by Lab ☐ Archive for ________ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No
Custody Seal No.:
Cooler Temp. (°C): Obs'd:________ Corr'd:________ Therm ID No.:________

Relinquished by:	Company: TETRA TECH	Date/Time: 10/13/15 1303	Received by:	Company: TA	Date/Time: 10/13/15 13:03
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Form No. CA-C-WI-002, Rev. 4.6, dated 09/02/2015

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica Laboratories, Inc.

Client Contact	**Project Manager: Ron Marnicio**	**Site Contact: Alex Valli**	**Date:10/13/2015**	COC No:
Ron Marnicio Tetra Tech	**Tel/Fax:(617) 443-7551**	**Lab Contact: James Madison**	**Carrier:TA courier**	3 of 5 COCs
160 Federal Street, 3rd floor	**Analysis Turnaround Time**			Sampler:
Boston, MA 02110	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(617) 443-7551 Phone	TAT if different from Below			Walk-in Client:
(xxx) xxx-xxxx FAX	☑ 2 weeks			Lab Sampling:
Project Name: Fireworks	☐ 1 week			
Site: Hanover, MA	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	Sample Specific Notes:
SD-LUFP93-06-DUP	10/12/2015	1414	G	SD	1	N		X	
SD-LUFP93-12	10/12/2015	1414	G	SD	1	N		X	
SD-LUFP93-18	10/12/2015	1414	G	SD	1	N		X	
SD-LUFP93-24	10/12/2015	1414	G	SD	1	N		X	
SD-LUFP93-30	10/12/2015	1414	G	SD	1	N		X	Hold
SD-LUFP93-36	10/12/2015	1414	G	SD	1	N		X	Hold
SD-LUFP90-06	10/12/2015	1451	G	SD	1	N		X	Dry Sample
SD-LUFP90-12	10/12/2015	1451	G	SD	1	N		X	
SD-LUFP90-18	10/12/2015	1451	G	SD	3	N		X	MS/MSD
SD-LUFP90-24	10/12/2015	1451	G	SD	1	N		X	Hold
SD-LUFP90-30	10/12/2015	1451	G	SD	1	N		X	Hold
SD-LUFP90-36	10/12/2015	1451	G	SD	1	N		X	Hold

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ______

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for ______ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No	Custody Seal No.:		Cooler Temp. (°C): Obs'd: ______ Corr'd: ______		Therm ID No.: ______
Relinquished by:	Company: TETRA TECH	Date/Time: 10/13/15 1303	Received by:	Company: TA	Date/Time: 10/13/15 13:03
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Form No. CA-C-WI-002, Rev. 4.6, dated 09/02/2015

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Laboratories, Inc.

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

Client Contact	**Project Manager: Ron Marnicio**	**Site Contact: Alex Valli**	**Date:10/13/2015**	COC No:
Ron Marnicio Tetra Tech	**Tel/Fax:(617) 443-7551**	**Lab Contact: James Madison**	**Carrier:TA courier**	4 of 5 COCs
160 Federal Street, 3rd floor	**Analysis Turnaround Time**			Sampler:
Boston, MA 02110	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(617) 443-7551 Phone	TAT if different from Below			Walk-in Client:
(xxx) xxx-xxxx FAX	☑ 2 weeks			Lab Sampling:
Project Name: Fireworks	☐ 1 week			
Site: Hanover, MA	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	Sample Specific Notes:
SD-LUFP98-06	10/12/2015	1532	G	SD	1	N		X	Dry Sample
SD-LUFP98-12	10/12/2015	1532	G	SD	1	N		X	
SD-LUFP98-18	10/12/2015	1532	G	SD	1	N		X	
SD-LUFP98-24	10/12/2015	1532	G	SD	1	N		X	
SD-LUFP98-30	10/12/2015	1532	G	SD	1	N		X	Hold
SD-LUFP113-06	10/12/2015	1537	G	SD	1	N		X	Dry Sample
SD-LUFP111-06	10/12/2015	1543	G	SD	1	N		X	Dry Sample
SD-LUFP111-12	10/12/2015	1543	G	SD	1	N		X	
SD-LUFP111-18	10/12/2015	1543	G	SD	1	N		X	
SD-LUFP111-18-DUP	10/12/2015	1543	G	SD	1	N		X	
SD-LUFP111-24	10/12/2015	1543	G	SD	1	N		X	
SD-LUFP112-06	10/12/2015	1558	G	SD	1	N		X	Dry Sample

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ________

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for ________ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No	Custody Seal No.:		Cooler Temp. (°C): Obs'd: ______ Corr'd: ______		Therm ID No.: ______
Relinquished by:	Company: PETRA TECH	Date/Time: 10/13/15 1313	Received by:	Company: TA	Date/Time: 10/13/15 13:03
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Form No. CA-C-WI-002, Rev. 4.6, dated 09/02/2015

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica Laboratories, Inc.

Client Contact	**Project Manager: Ron Marnicio**	**Site Contact: Alex Valli**	**Date:10/13/2015**	COC No:
Ron Marnicio Tetra Tech	**Tel/Fax:(617) 443-7551**	**Lab Contact: James Madison**	**Carrier:TA courier**	_5_ of _5_ COCs
160 Federal Street, 3rd floor	**Analysis Turnaround Time**			Sampler:
Boston, MA 02110	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(617) 443-7551 Phone	TAT if different from Below ____			Walk-in Client:
(xxx) xxx-xxxx FAX	☑ 2 weeks			Lab Sampling:
Project Name: Fireworks	☐ 1 week			
Site: Hanover, MA	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	Sample Specific Notes:
SD-LUFP112-12	10/12/2015	1558	G	SD	3	N		X	MS/MSD
SD-LUFP112-18	10/12/2015	1558	G	SD	1	N		X	
SD-LUFP112-24	10/12/2015	1558	G	SD	1	N		X	
SD-LUFP121-06	10/12/2015	1614	G	SD	1	N		X	Dry Sample
SD-LUFP121-12	10/12/2015	1614	G	SD	1	N		X	
SD-LUFP117-06	10/12/2015	1623	G	SD	1	N		X	Dry Sample
SD-LUFP117-12	10/12/2015	1623	G	SD	1	N		X	
SD-LUFP117-18	10/12/2015	1623	G	SD	1	N		X	Hold

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ____

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for ____ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No
Custody Seal No.:
Cooler Temp. (°C): Obs'd: ____ Corr'd: ____
Therm ID No.:

Relinquished by:	Company: TETRA TECH	Date/Time: 10/13/15 13:03	Received by:	Company: TA	Date/Time: 10/13/15 13:03
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica Laboratories, Inc.

Client Contact	**Project Manager: Ron Marnicio**	**Site Contact: Alex Valli**	**Date:10/16/2015**	COC No:
Ron Marnicio Tetra Tech	**Tel/Fax:(617) 443-7551**	**Lab Contact: James Madison**	**Carrier:TA courier**	_1_ of _4_ COCs
160 Federal Street, 3rd floor	**Analysis Turnaround Time**			Sampler:
Boston, MA 02110	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(617) 443-7551 Phone	TAT if different from Below ____			Walk-in Client:
(xxx) xxx-xxxx FAX	☑ 2 weeks			Lab Sampling:
Project Name: Fireworks	☐ 1 week			
Site: Hanover, MA	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	Explosives/Perchlorate 8330B	Sample Specific Notes:
SO-SFRF-03-PM	10/13/2015	1335	C	So	6			X	X	MS/MSD
SO-SFRF-03-RM1	10/13/2015	1340	C	So	2			X	X	
SO-SFRF-03-RM2	10/13/2015	1343	C	So	2			X	X	
SO-STRB1-06-PM	10/13/2015	1420	C	So	2			X	X	
SO-STRB1-06-RM1	10/13/2015	1423	C	So	2			X	X	
SO-STRB1-06-RM2	10/13/2015	1425	C	So	2			X	X	
SO-STRB1-12-PM	10/13/2015	1427	C	So	2			X	X	
SO-STRB1-12-RM1	10/13/2015	1430	C	So	2			X	X	
SO-STRB1-12-RM2	10/13/2015	1432	C	So	2			X	X	
SO-STRB2-06-PM	10/13/2015	1500	C	So	2			X	X	
SO-STRB2-06-RM1	10/13/2015	1505	C	So	2			X	X	
SO-STRB2-06-RM2	10/13/2015	1510	C	So	2			X	X	

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ____

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return to Client ☐ Disposal by Lab ☐ Archive for ____ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No
Custody Seal No.:
Cooler Temp. (°C): Obs'd:____ Corr'd:____ Therm ID No.:____

Relinquished by:	Company: TETRA TECH	Date/Time: 10/16/2015 1410	Received by:	Company: TA	Date/Time: 10/16/15 14:00
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Form No. CA-C-WI-002, Rev. 4.6, dated 09/02/2015

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Laboratories, Inc.

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

Client Contact	**Project Manager: Ron Marnicio**	**Site Contact: Alex Valli**	**Date:10/16/2015**	COC No:
Ron Marnicio Tetra Tech	**Tel/Fax:(617) 443-7551**	**Lab Contact: James Madison**	**Carrier:TA courier**	2 of 4 COCs
160 Federal Street, 3rd floor	**Analysis Turnaround Time**			Sampler:
Boston, MA 02110	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(617) 443-7551 Phone	TAT if different from Below ___			Walk-in Client:
(xxx) xxx-xxxx FAX	☑ 2 weeks			Lab Sampling:
Project Name: Fireworks	☐ 1 week			
Site: Hanover, MA	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	Explosives/Perchlorate 8330B	TCLP Volatiles	Paint Filter	Cyanide	Sulfide	pH	Full TCLP	Sample Specific Notes:
SO-STRB2-12-PM	10/13/2015	1515	C	So	2			X	X							
SO-STRB2-12-RM1	10/13/2015	1524	C	So	2			X	X							
SO-STRB2-12-RM2	10/13/2015	1531	C	So	2			X	X							
SO-SNRF-03-PM	10/13/2015	1530	C	So	6			X	X							MS/MSD
SO-SNRF-03-RM1	10/13/2015	1534	C	So	2			X	X							
SO-SNRF-03-RM2	10/13/2015	1540	C	So	2			X	X							
SO-STRF-03-PM	10/13/2015	1545	C	So	2			X	X							
SO-STRF-03-RM1	10/13/2015	1547	C	So	2			X	X							
SO-STRF-03-RM2	10/13/2015	1550	C	So	2			X	X							
BERM-ISM-WD	10/13/2015	1600	C	So	3					X	X	X	X	X	X	
SO-STRD-03-PM	10/13/2015	1615	C	So	2			X	X							
SO-STRD-03-RM1	10/13/2015	1618	C	So	2			X	X							

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ______

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return to Client ☐ Disposal by Lab ☐ Archive for ______ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No	Custody Seal No.:	10/16/2015	Cooler Temp. (°C): Obs'd: ______ Corr'd: ______		Therm ID No.: ______
Relinquished by:	Company: TETRA TECH	Date/Time: ~~[illegible]~~ 1410	Received by:	Company: TA	Date/Time: 10/16/15 1414
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica Laboratories, Inc.

Client Contact	**Project Manager: Ron Marnicio**	**Site Contact: Alex Valli**	**Date:10/16/2015**	COC No:
Ron Marnicio Tetra Tech	**Tel/Fax:(617) 443-7551**	**Lab Contact: James Madison**	**Carrier:TA courier**	3 of 4 COCs
160 Federal Street, 3rd floor	**Analysis Turnaround Time**			Sampler:
Boston, MA 02110	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(617) 443-7551 Phone	TAT if different from Below ______			Walk-in Client:
(xxx) xxx-xxxx FAX	☑ 2 weeks			Lab Sampling:
Project Name: Fireworks	☐ 1 week			
Site: Hanover, MA	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	Explosives/Perchlorate 8330B	TCLP Volatiles	Paint Filter	Cyanide	Sulfide	pH	Full TCLP	Sample Specific Notes:
SO-STRD-03-RM2	10/13/2015	1620	C	So	2			X	X							
SO-STRB3-06-PM	10/13/2015	1630	C	So	2			X	X							
SO-STRB3-06-RM1	10/13/2015	1632	C	So	2			X	X							
SO-STRB3-06-RM2	10/13/2015	1635	C	So	2			X	X							
SO-STRB4-06-PM	10/13/2015	1640	C	So	2			X	X							
SO-STRB4-06-RM1	10/13/2015	1642	C	So	2			X	X							
SO-STRB4-06-RM2	10/13/2015	1645	C	So	2			X	X							
SO-STRB3-12-PM	10/13/2015	1650	C	So	2			X	X							
SO-STRB3-12-RM1	10/13/2015	1653	C	So	2			X	X							
SO-STRB3-12-RM2	10/13/2015	1655	C	So	2			X	X							
SO-STRB4-12-PM	10/13/2015	1705	C	So	6			X	X							MS/MSD
SO-STRB4-12-RM1	10/13/2015	1708	C	So	2			X	X							

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ______

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for ______ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No

Custody Seal No.:

Cooler Temp. (°C): Obs'd: ______ Corr'd: ______ Therm ID No.: ______

Relinquished by:	Company: TETRA TECH	Date/Time: 10/16/2015 1410	Received by:	Company: TA	Date/Time: 10/16/15 14:00
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica Laboratories, Inc.

Client Contact	**Project Manager: Ron Marnicio**	**Site Contact: Alex Valli**	**Date:10/16/2015**	COC No:
Ron Marnicio Tetra Tech	**Tel/Fax:(617) 443-7551**	**Lab Contact: James Madison**	**Carrier:TA courier**	4 of 4 COCs
160 Federal Street, 3rd floor	**Analysis Turnaround Time**			Sampler:
Boston, MA 02110	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(617) 443-7551 Phone	TAT if different from Below ______			Walk-in Client:
(xxx) xxx-xxxx FAX	☑ 2 weeks			Lab Sampling:
Project Name: Fireworks	☐ 1 week			
Site: Hanover, MA	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	Explosives/Perchlorate 8330B	TCLP Volatiles	Paint Filter	Cyanide	Sulfide	pH	Full TCLP	Sample Specific Notes:
SO-STRB4-12-RM2	10/13/2015	1711	C	So	2			X	X							
SO-SHSP-03-PM	10/14/2015	1422	C	So	2			X	X							
SO-SHSP-03-RM1	10/14/2015	1425	C	So	2			X	X							
SO-SHSP-03-RM2	10/14/2015	1427	C	So	2			X	X							

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return to Client ☐ Disposal by Lab ☐ Archive for ______ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No	Custody Seal No.:		Cooler Temp. (°C): Obs'd: ______ Corr'd: ______		Therm ID No.: ______
Relinquished by:	Company: TETRA TECH	Date/Time: 10/16/2015 140	Received by:	Company: TA	Date/Time: 10/16/15 14:00
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Form No. CA-C-WI-002, Rev. 4.6, dated 09/02/2015

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica Laboratories, Inc.

Client Contact	**Project Manager: Ron Marnicio**	**Site Contact: Alex Valli**	**Date:10/15/2015**	COC No:
Ron Marnicio Tetra Tech	**Tel/Fax:(617) 443-7551**	**Lab Contact: James Madison**	**Carrier:TA courier**	1 of 2 COCs
160 Federal Street, 3rd floor	**Analysis Turnaround Time**			Sampler:
Boston, MA 02110	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(617) 443-7551 Phone	TAT if different from Below			Walk-in Client:
(xxx) xxx-xxxx FAX	☑ 2 weeks			Lab Sampling:
Project Name: Fireworks	☐ 1 week			
Site: Hanover, MA	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	Sample Specific Notes:
SD-ECCU54-03	10/15/2015	1515	G	SO	1	N	N	X	
SD-ECCU54-06	10/15/2015	1515	G	SO	1	N	N	X	Hold Sample
SD-ECCU55-03	10/15/2015	1515	G	SO	1	N	N	X	
SD-ECCU55-06	10/15/2015	1515	G	SO	1	N	N	X	Hold Sample
SD-ECCU56-03	10/15/2015	1520	G	SO	1	N	N	X	
SD-ECCU56-06	10/15/2015	1520	G	SO	1	N	N	X	Hold Sample
SD-ECCU57-03	10/15/2015	1525	G	SO	1	N	N	X	
SD-ECCU57-03-DUP	10/15/2015	1525	G	SO	1	N	N	X	
SD-ECCU57-06	10/15/2015	1525	G	SO	1	N	N	X	Hold Sample
SD-ECCU58-03	10/15/2015	1530	G	SO	3	N	Y	X	
SD-ECCU58-06	10/15/2015	1530	G	SO	1	N	N	X	Hold Sample

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other 1

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for ______ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No	Custody Seal No.:		Cooler Temp. (°C): Obs'd: ____ Corr'd: ____		Therm ID No.: ____
Relinquished by:	Company: TETRA TECH	Date/Time: 10/16/2015 1410	Received by:	Company: TA	Date/Time: 10/16/15 14:10
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica Laboratories, Inc.

Client Contact	**Project Manager: Ron Marnicio**	**Site Contact: Alex Valli**	**Date:10/15/2015**	COC No:
Ron Marnicio Tetra Tech	**Tel/Fax:(617) 443-7551**	**Lab Contact: James Madison**	**Carrier:TA courier**	2 of 2 COCs
160 Federal Street, 3rd floor	**Analysis Turnaround Time**			Sampler:
Boston, MA 02110	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(617) 443-7551 Phone	TAT if different from Below			Walk-in Client:
(xxx) xxx-xxxx FAX	☑ 2 weeks			Lab Sampling:
Project Name: Fireworks	☐ 1 week			
Site: Hanover, MA	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	TCLP Volatiles	Paint Filter	Cyanide	Sulfide	pH	Full TCLP	Sample Specific Notes:
SD-ECCU59-03	10/15/2015	1555	G	SO	1	N	N	X							
SD-ECCU59-06	10/15/2015	1555	G	SO	1	N	N	X							Hold Sample
SD-ECCU60-03	10/15/2015	1600	G	SO	1	N	N	X							
SD-ECCU60-06	10/15/2015	1600	G	SO	1	N	N	X							Hold Sample
SD-ECCU61-03	10/15/2015	1605	G	SO	1	N	N	X							
SD-ECCU61-06	10/15/2015	1605	G	SO	1	N	N	X							Hold Sample
SD-ECCU62-03	10/15/2015	1610	G	SO	1	N	N	X							
SD-ECCU62-06	10/15/2015	1610	G	SO	1	N	N	X							Hold Sample
SD-ECCU63-03	10/15/2015	1615	G	SO	1	N	N	X							
SD-ECCU63-06	10/15/2015	1615	G	SO	1	N	N	X							Hold Sample
SD-ECCU-WD	10/15/2015	1610	G	SO	2	N	N		X	X	X	X	X		

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other 1

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return to Client ☐ Disposal by Lab ☐ Archive for ______ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No	Custody Seal No.:		Cooler Temp. (°C): Obs'd: ______ Corr'd: ______	Therm ID No.:
Relinquished by:	Company: TETRA TECH	Date/Time: 10/16/2015 140	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica Laboratories, Inc.

Client Contact	**Project Manager: Ron Marnicio**	**Site Contact: Alex Valli**	**Date:10/15/2015**	COC No:
Ron Marnicio Tetra Tech	**Tel/Fax:(617) 443-7551**	**Lab Contact: James Madison**	**Carrier:TA courier**	__1__ of __3__ COCs
160 Federal Street, 3rd floor	**Analysis Turnaround Time**			Sampler:
Boston, MA 02110	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(617) 443-7551 Phone	TAT if different from Below ______			Walk-in Client:
(xxx) xxx-xxxx FAX	☑ 2 weeks			Lab Sampling:
Project Name: Fireworks	☐ 1 week			
Site: Hanover, MA	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	Sample Specific Notes:
SD-LUFP124-06	10/14/2015	1345	G	SD	1			X	
SD-LUFP124-12	10/14/2015	1345	G	SD	1			X	
SD-LUFP115-06	10/14/2015	1400	G	SD	1			X	
SD-LUFP115-12	10/14/2015	1400	G	SD	1			X	
SD-LUFP114-06	10/14/2015	1413	G	SD	1			X	Dry Sample
SD-LUFP114-12	10/14/2015	1413	G	SD	1			X	
SD-LUFP114-12-DUP	10/14/2015	1413	G	SD	1			X	
SD-LUFP122-06	10/14/2015	1430	G	SD	1			X	
SD-LUFP118-06	10/14/2015	1500	G	SD	1			X	Dry Sample
SD-LUFP118-12	10/14/2015	1500	G	SD	3			X	MS/MSD
SD-LUFP106-06	10/14/2015	1535	G	SD	1			X	
SD-LUFP106-12	10/14/2015	1535	G	SD	1			X	Hold

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ______

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for______ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No

Custody Seal No.:

Cooler Temp. (°C): Obs'd:______ Corr'd:______ Therm ID No.:______

Relinquished by:	Company: TETRA TECH	Date/Time: 10/16/2015 1410	Received by:	Company: TA	Date/Time: 10/16/15 1410
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica Laboratories, Inc.

Client Contact
Ron Marnicio Tetra Tech
160 Federal Street, 3rd floor
Boston, MA 02110
(617) 443-7551 Phone
(xxx) xxx-xxxx FAX
Project Name: Fireworks
Site: Hanover, MA
P O #

Project Manager: Ron Marnicio
Tel/Fax:(617) 443-7551
Analysis Turnaround Time
☐ CALENDAR DAYS ☐ WORKING DAYS
TAT if different from Below ______
☑ 2 weeks
☐ 1 week
☐ 2 days
☐ 1 day

Site Contact: Alex Valli
Lab Contact: James Madison
Date:10/15/2015
Carrier:TA courier

COC No:
2 of 3 COCs
Sampler:
For Lab Use Only:
Walk-in Client:
Lab Sampling:
Job / SDG No.:

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	Sample Specific Notes:
SD-LUFP116-06	10/14/2015	1537	G	SD	1	N	N	X	
SD-LUFP116-12	10/14/2015	1537	G	SD	1	N	N	X	
SD-LUFP110-06	10/14/2015	1554	G	SD	1	N	N	X	Dry Sample
SD-LUFP110-06-DUP	10/14/2015	1554	G	SD	1	N	N	X	Dry Sample
SD-LUFP110-12	10/14/2015	1554	G	SD	1	N	N	X	
SD-LUFP119-06	10/14/2015	1604	G	SD	1	N	N	X	
SD-LUFP119-12	10/14/2015	1604	G	SD	1	N	N	X	
SD-LUFP123-06	10/14/2015	1613	G	SD	1	N	N	X	
SD-LUFP120-06	10/14/2015	1619	G	SD	1	N	N	X	
SD-LUFP108-06	10/14/2015	1630	G	SD	1	N	N	X	
SD-LUFP108-06-DUP	10/14/2015	1630	G	SD	1	N	N	X	
SD-LUFP108-12	10/14/2015	1630	G	SD	1	N	N	X	Hold Sample

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other 1

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return to Client ☐ Disposal by Lab ☐ Archive for ______ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No
Custody Seal No.:
Cooler Temp. (°C): Obs'd:______ Corr'd:______
Therm ID No.:______

Relinquished by:	Company: PETRA TECH	Date/Time: 10/16/2015 1410	Received by:	Company: TA	Date/Time: 10/16/15 1400
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica Laboratories, Inc.

Client Contact	**Project Manager: Ron Marnicio**	**Site Contact: Alex Valli**	**Date:10/15/2015**	COC No:
Ron Marnicio Tetra Tech	**Tel/Fax:(617) 443-7551**	**Lab Contact: James Madison**	**Carrier:TA courier**	3 of 3 COCs
160 Federal Street, 3rd floor	**Analysis Turnaround Time**			Sampler:
Boston, MA 02110	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(617) 443-7551 Phone	TAT if different from Below			Walk-in Client:
(xxx) xxx-xxxx FAX	☑ 2 weeks			Lab Sampling:
Project Name: Fireworks	☐ 1 week			
Site: Hanover, MA	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	Atterberg	Specific Gravity	Grain Size	Moisture Content	Organic Matter	Sample Specific Notes:
SD-LUFP-GT	10/15/2015	1340	C	SD	3				X	X	X	X	X	

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other 1

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for ______ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No

Custody Seal No.:

Cooler Temp. (°C): Obs'd: ______ Corr'd: ______ Therm ID No.: ______

Relinquished by:	Company: TETRA TECH	Date/Time: 10/16/2015 1400	Received by:	Company: TA	Date/Time: 10/16/15 1400
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Form No. CA-C-WI-002, Rev. 4.6, dated 09/02/2015

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica Laboratories, Inc.

Client Contact	**Project Manager: Ron Marnicio**	**Site Contact: Alex Valli**	**Date:10/15/2015**	COC No:
Ron Marnicio Tetra Tech	**Tel/Fax:(617) 443-7551**	**Lab Contact: James Madison**	**Carrier:TA courier**	__1__ of __1__ COCs
160 Federal Street, 3rd floor	**Analysis Turnaround Time**			Sampler:
Boston, MA 02110	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(617) 443-7551 Phone	TAT if different from Below ______			Walk-in Client:
(xxx) xxx-xxxx FAX	☑ 2 weeks			Lab Sampling:
Project Name: Fireworks	☐ 1 week			
Site: Hanover, MA	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	TCLP Volatiles	Paint Filter	Cyanide	Sulfide	pH	Full TCLP	Specific Gravity	Grain Size	Moisture Content	Organic Matter	Sample Specific Notes:
SD-LDRC1-06	10/15/2015	1350	G	SD	1	N	N	X											
SD-LDRC1-06-DUP	10/15/2015	1350	G	SD	1	N	N	X											
SD-LDRC1-12	10/15/2015	1350	G	SD	1	N	N	X											Hold Sample
SD-LDRC2-06	10/15/2015	1405	G	SD	1	N	N	X											
SD-LDRC2-12	10/15/2015	1405	G	SD	1	N	N	X											Hold Sample
SD-LDRC3-06	10/15/2015	1411	G	SD	3	N	Y	X											
SD-LDRC3-12	10/15/2015	1411	G	SD	1	N	N	X											Hold Sample
SD-LDRC-WD	10/15/2015	1411	G	SD	3	N	N		X	X	X	X	X	X					
SD-LDRC-GT	10/15/2015	1411	G	SD	2	N	N								X	X	X	X	

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other __1______

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return to Client ☐ Disposal by Lab ☐ Archive for ______ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No
Custody Seal No.:
Cooler Temp. (°C): Obs'd: ____ Corr'd: ____ Therm ID No.: ____

Relinquished by:	Company: TETRA TECH	Date/Time: 10/16/2015 1400	Received by:	Company: TA	Date/Time: 10/16/15 14:00
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Laboratories, Inc.

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

Client Contact	**Project Manager: Ron Marnicio**	**Site Contact: Alex Valli**	**Date: 10/16/2015**	COC No:
Ron Marnicio Tetra Tech	**Tel/Fax:(617) 443-7551**	**Lab Contact: James Madison**	**Carrier:TA courier**	_1_ of _3_ COCs
160 Federal Street, 3rd floor	**Analysis Turnaround Time**			Sampler:
Boston, MA 02110	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(617) 443-7551 Phone	TAT if different from Below ____			Walk-in Client:
(xxx) xxx-xxxx FAX	☑ 2 weeks			Lab Sampling:
Project Name: Fireworks	☐ 1 week			
Site: Hanover, MA	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	Sample Specific Notes:
SO-ECCL13-03	10/16/2015	0820	G	S	1			X	
SO-ECCL13-03-DUP	10/16/2015	0820	G	S	1			X	
SO-ECCL13-06	10/16/2015	0820	G	S	1			X	Hold sample
SO-ECCL14-03	10/16/2015	0815	G	S	1			X	
SO-ECCL14-06	10/16/2015	0815	G	S	1			X	Hold sample
SO-ECCL15-03	10/16/2015	0808	G	S	3		Y	X	MS/MSD
SO-ECCL15-06	10/16/2015	0808	G	S	1			X	Hold sample
SO-ECCL16-03	10/16/2015	0825	G	S	1			X	
SO-ECCL16-06	10/16/2015	0825	G	S	1			X	Hold sample
SO-ECCL17-03	10/16/2015	0830	G	S	1			X	
SO-ECCL17-06	10/16/2015	0830	G	S	1			X	Hold sample
SO-ECCL18-03	10/16/2015	0835	G	S	1			X	

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ______

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for ____ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No	Custody Seal No.:		Cooler Temp. (°C): Obs'd: ____ Corr'd: ____		Therm ID No.: ____
Relinquished by:	Company: TETRA TECH	Date/Time: 10/16/2015 141	Received by:	Company: TA	Date/Time: 10/16/15 14:00
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Form No. CA-C-WI-002, Rev. 4.6, dated 09/02/2015

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica Laboratories, Inc.

Client Contact	Project Manager: Ron Marnicio	Site Contact: Alex Valli	Date: 10/16/2015	COC No:
Ron Marnicio Tetra Tech	Tel/Fax:(617) 443-7551	Lab Contact: James Madison	Carrier:TA courier	2 of 3 COCs
160 Federal Street, 3rd floor	Analysis Turnaround Time			Sampler:
Boston, MA 02110	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(617) 443-7551 Phone	TAT if different from Below			Walk-in Client:
(xxx) xxx-xxxx FAX	☑ 2 weeks			Lab Sampling:
Project Name: Fireworks	☐ 1 week			
Site: Hanover, MA	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	Sample Specific Notes:
SO-ECCL18-06	10/16/2015	0835	G	S	1			X	Hold sample
SO-ECCL19-03	10/16/2015	0840	G	S	1			X	
SO-ECCL19-06	10/16/2015	0840	G	S	1			X	Hold sample
SO-ECCL20-03	10/16/2015	0845	G	S	1			X	
SO-ECCL20-06	10/16/2015	0845	G	S	1			X	Hold sample
SO-ECCL21-03	10/16/2015	0850	G	S	1			X	
SO-ECCL21-06	10/16/2015	0850	G	S	1			X	Hold sample
SO-ECCL22-03	10/16/2015	0855	G	S	1			X	
SO-ECCL22-06	10/16/2015	0855	G	S	1			X	Hold sample
SO-ECCL23-03	10/16/2015	0900	G	S	3		Y	X	MS/MSD
SO-ECCL23-06	10/16/2015	0900	G	S	1			X	Hold sample
SO-ECCL24-03	10/16/2015	0905	G	S	1			X	

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return to Client ☐ Disposal by Lab ☐ Archive for ______ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No	Custody Seal No.:		Cooler Temp. (°C): Obs'd:______ Corr'd:______		Therm ID No.:______
Relinquished by:	Company: TETRA TECH	Date/Time: 10/16/2015 1410	Received by:	Company: TA	Date/Time: 10/16/15 14:10
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Form No. CA-C-WI-002, Rev. 4.6, dated 09/02/2015

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica Laboratories, Inc.

Client Contact
Ron Marnicio Tetra Tech
160 Federal Street, 3rd floor
Boston, MA 02110
(617) 443-7551 Phone
(xxx) xxx-xxxx FAX
Project Name: Fireworks
Site: Hanover, MA
P O #

Project Manager: Ron Marnicio
Tel/Fax:(617) 443-7551

Analysis Turnaround Time
☐ CALENDAR DAYS ☐ WORKING DAYS
TAT if different from Below ______
☑ 2 weeks
☐ 1 week
☐ 2 days
☐ 1 day

Site Contact: Alex Valli
Lab Contact: James Madison

Date: 10/16/2015
Carrier:TA courier

COC No:
3 of 3 COCs
Sampler:
For Lab Use Only:
Walk-in Client:
Lab Sampling:
Job / SDG No.:

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	TCLP Volatiles	Paint Filter	Cyanide	Sulfide	pH	Full TCLP	Sample Specific Notes:
SO-ECCL24-06	10/16/2015	0905	G	SD	1			X							Hold sample
SO-ECCL25-03	10/16/2015	0910	G	SD	1			X							
SO-ECCL25-03-DUP	10/16/2015	0910	G	SD	1			X							
SO-ECCL25-06	10/16/2015	0910	G	SD	1			X							Hold sample
SO-ECCL-WD	10/16/2015	1050	G	SD	3				X	X	X	X	X	X	

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ______

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return to Client ☐ Disposal by Lab ☐ Archive for ______ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No
Custody Seal No.:
Cooler Temp. (°C): Obs'd: ______ Corr'd: ______ Therm ID No.: ______

Relinquished by:	Company: Tetra Tech	Date/Time: 10/16/2015 1410	Received by:	Company: TA	Date/Time: 10/16/15 1400
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Laboratories, Inc.

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

Client Contact
Ron Marnicio Tetra Tech
160 Federal Street, 3rd floor
Boston, MA 02110
(617) 443-7551 Phone
(xxx) xxx-xxxx FAX
Project Name: Fireworks
Site: Hanover, MA
P O #

Project Manager: Ron Marnicio
Tel/Fax:(617) 443-7551

Analysis Turnaround Time
☐ CALENDAR DAYS ☐ WORKING DAYS
TAT if different from Below ______
☑ 2 weeks
☐ 1 week
☐ 2 days
☐ 1 day

Site Contact: Alex Valli
Lab Contact: James Madison
Date: 10/20/2015
Carrier: TA courier

COC No:
__1__ of __2__ COCs
Sampler:
For Lab Use Only:
Walk-in Client:
Lab Sampling:
Job / SDG No.:

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	Sample Specific Notes:
SO-ECCM26-03	10/16/2015	1250	G	SO	1			X	
SO-ECCM26-03-DUP	10/16/2015	1250	G	SO	1			X	
SO-ECCM26-06	10/16/2015	1250	G	SO	1			X	HOLD
SO-ECCM27-03	10/16/2015	1255	G	SO	3			X	MS/MSD
SO-ECCM27-06	10/16/2015	1255	G	SO	1			X	HOLD
SO-ECCM28-03	10/16/2015	1300	G	SO	1			X	
SO-ECCM28-06	10/16/2015	1300	G	SO	1			X	HOLD
SO-ECCM29-03	10/16/2015	1305	G	SO	1			X	
SO-ECCM29-06	10/16/2015	1305	G	SO	1			X	HOLD
SO-ECCM30-03	10/16/2015	1310	G	SO	1			X	
SO-ECCM30-06	10/16/2015	1310	G	SO	1			X	HOLD
SO-ECCM31-03	10/16/2015	1315	G	SO	1			X	

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ______

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return to Client ☐ Disposal by Lab ☐ Archive for ______ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No
Custody Seal No.:
Cooler Temp. (°C): Obs'd: ______ Corr'd: ______
Therm ID No.: ______

Relinquished by:	Company: TETRA TECH	Date/Time: 10/20/15 1354	Received by:	Company: TA	Date/Time: 10/20/15 1350
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica Laboratories, Inc.

Client Contact
Ron Marnicio Tetra Tech
160 Federal Street, 3rd floor
Boston, MA 02110
(617) 443-7551 Phone
(xxx) xxx-xxxx FAX
Project Name: Fireworks
Site: Hanover, MA
P O #

Project Manager: Ron Marnicio
Tel/Fax:(617) 443-7551

Analysis Turnaround Time
☐ CALENDAR DAYS ☐ WORKING DAYS
TAT if different from Below ________
☑ 2 weeks
☐ 1 week
☐ 2 days
☐ 1 day

Site Contact: Alex Valli
Lab Contact: James Madison
Date: 10/20/2015
Carrier:TA courier

COC No:
2 of 2 COCs
Sampler:
For Lab Use Only:
Walk-in Client:
Lab Sampling:
Job / SDG No.:

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	Sample Specific Notes:
SO-ECCM31-06	10/16/2015	1315	G	SO	1			X	HOLD
SO-ECCM32-03	10/16/2015	1320	G	SO	1			X	
SO-ECCM32-06	10/16/2015	1320	G	SO	1			X	HOLD
SO-ECCM35-03	10/16/2015	1325	G	SO	1			X	
SO-ECCM35-06	10/16/2015	1325	G	SO	1			X	HOLD
SO-ECCM38-03	10/16/2015	1330	G	SO	1			X	
SO-ECCM38-06	10/16/2015	1330	G	SO	1			X	HOLD

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ________

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return to Client ☐ Disposal by Lab ☐ Archive for ________ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No
Custody Seal No.:
Cooler Temp. (°C): Obs'd:________ Corr'd:________
Therm ID No.:________

Relinquished by:	Company: TETRA TECH	Date/Time: 10/20/15 1554	Received by:	Company: TA	Date/Time: 10/20/15 15:55
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Laboratories, Inc.

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

Client Contact	**Project Manager: Ron Marnicio**	**Site Contact: Alex Valli**	**Date: 10/20/2015**	COC No:
Ron Marnicio Tetra Tech	**Tel/Fax:(617) 443-7551**	**Lab Contact: James Madison**	**Carrier:TA courier**	1 of 2 COCs
160 Federal Street, 3rd floor	**Analysis Turnaround Time**			Sampler:
Boston, MA 02110	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(617) 443-7551 Phone	TAT if different from Below ____			Walk-in Client:
(xxx) xxx-xxxx FAX	☑ 2 weeks			Lab Sampling:
Project Name: Fireworks	☐ 1 week			
Site: Hanover, MA	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	Sample Specific Notes:
SD-MLFP3-06	10/19/2015	1504	G	SED	1			X	Dry Sample
SD-MLFP3-12	10/19/2015	1504	G	SED	1			X	Dry Sample
SD-MLFP5-06	10/19/2015	1522	G	SED	1			X	Dry Sample
SD-MLFP5-12	10/19/2015	1522	G	SED	1			X	
SD-MLFP6-06	10/19/2015	1526	G	SED	1			X	Dry Sample
SD-MLFP8-06	10/19/2015	1533	G	SED	1			X	Dry Sample
SD-MLFP7-06	10/19/2015	1540	G	SED	1			X	Dry Sample
SD-MLFP7-12	10/19/2015	1540	G	SED	1			X	Dry Sample
SD-MLFP7-12-DUP	10/19/2015	1540	G	SED	1			X	Dry Sample
SD-MLFP7-18	10/19/2015	1540	G	SED	3		Y	X	Dry Sample; MS/MSD
SD-MLFP7-24	10/19/2015	1540	G	SED	1			X	Hold sample
SD-MLFP7-30	10/19/2015	1540	G	SED	1			X	Hold sample

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ____

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return to Client ☐ Disposal by Lab ☐ Archive for ____ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No
Custody Seal No.:
Cooler Temp. (°C): Obs'd: ____ Corr'd: ____ Therm ID No.: ____

Relinquished by:	Company: TETRA TECH	Date/Time: 10/20/15 155	Received by:	Company: TA	Date/Time: 10/20/15 1805
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Laboratories, Inc.

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

Client Contact	
Ron Marnicio Tetra Tech	
160 Federal Street, 3rd floor	
Boston, MA 02110	
(617) 443-7551	Phone
(xxx) xxx-xxxx	FAX
Project Name: Fireworks	
Site: Hanover, MA	
P O #	

Project Manager: Ron Marnicio
Tel/Fax:(617) 443-7551
Site Contact: Alex Valli
Lab Contact: James Madison
Date: 10/20/2015
Carrier:TA courier

COC No:
2 of 2 COCs
Sampler:
For Lab Use Only:
Walk-in Client:
Lab Sampling:
Job / SDG No.:

Analysis Turnaround Time
☐ CALENDAR DAYS ☐ WORKING DAYS
TAT if different from Below ________
☑ 2 weeks
☐ 1 week
☐ 2 days
☐ 1 day

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	TCLP Volatiles	Paint Filter	Cyanide	Sulfide	pH	Full TCLP	Ignitability	Sample Specific Notes:
SD-MLFP7-36	10/19/2015	1540	G	SED	1			X								Dry Sample
SD-MLFP53-06	10/20/2015	1240	G	SED	1			X								Dry Sample
SD-MLFP53-12	10/20/2015	1240	G	SED	1			X								
SD-MLFP53-12-DUP	10/20/2015	1240	G	SED	1			X								
SD-MLFP53-18	10/20/2015	1240	G	SED	1			X								HOLD
SD-MLFP16-06	10/20/2015	1308	G	SED	1			X								Dry Sample
SD-MLFP-WD	10/20/2015	1320	C	SED	3				X	X	X	X	X	X	X	
SD-MLFP13-06	10/20/2015	1329	G	SED	1			X								Dry Sample
SD-MLFP14-06	10/20/2015	1338	G	SED	1			X								Dry Sample
SD-MLFP14-12	10/20/2015	1338	G	SED	1			X								Dry Sample

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ________

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return to Client ☐ Disposal by Lab ☐ Archive for ________ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No
Custody Seal No.:
Cooler Temp. (°C): Obs'd: ________ Corr'd: ________
Therm ID No.: ________

Relinquished by:	Company: TETRA TECH	Date/Time: 10/20/15 1354	Received by:	Company: TA	Date/Time: 10/20/15 13:55
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica Laboratories, Inc.

Client Contact
Ron Mamicio Tetra Tech
160 Federal Street, 3rd floor
Boston, MA 02110
(617) 443-7551 Phone
(xxx) xxx-xxxx FAX
Project Name: Fireworks
Site: Hanover, MA
P O #

Project Manager: Ron Marnicio
Tel/Fax:(617) 443-7551

Site Contact: Alex Valli
Lab Contact: James Madison

Date: 10/22/2015
Carrier:TA courier

COC No:
1 of 3 COCs
Sampler:
For Lab Use Only:
Walk-in Client:
Lab Sampling:
Job / SDG No.:

Analysis Turnaround Time
☐ CALENDAR DAYS ☐ WORKING DAYS
TAT if different from Below ______
☑ 2 weeks
☐ 1 week
☐ 2 days
☐ 1 day

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	Sample Specific Notes:
SO-ECCM36-03	10/20/2015	1554	G	SO	1			X	
SO-ECCM36-06	10/20/2015	1554	G	SO	1			X	Hold sample
SO-ECCM34-03	10/20/2015	1601	G	SO	1			X	
SO-ECCM34-06	10/20/2015	1601	G	SO	3			X	Hold Sample
SO-ECCM31-03	10/20/2015	1604	G	SO	1			X	
SO-ECCM31-03-DUP	10/20/2015	1604	G	SO	1			X	
SO-ECCM31-06	10/20/2015	1604	G	SO	1			X	Hold Sample
SO-ECCM33-03	10/20/2015	1609	G	SO	1			X	
SO-ECCM33-06	10/20/2015	1609	G	SO	1			X	Hold Sample
SO-ECCM42-03	10/20/2015	1611	G	SO	1			X	
SO-ECCM42-06	10/20/2015	1611	G	SO	1			X	Hold Sample
SO-ECCM41-03	10/20/2015	1612	G	SO	1			X	

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ______

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return to Client ☐ Disposal by Lab ☐ Archive for ______ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No
Custody Seal No.:
Cooler Temp. (°C): Obs'd: ______ Corr'd: ______
Therm ID No.: ______

Relinquished by:	Company: TETRA TECH	Date/Time: 10/22/15 1545	Received by:	Company: TA	Date/Time: 10/22/15 15:45
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Form No. CA-C-WI-002, Rev. 4.6, dated 09/02/2015

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica Laboratories, Inc.

Client Contact	**Project Manager: Ron Marnicio**	**Site Contact: Alex Valli**	**Date: 10/22/2015**	COC No:
Ron Marnicio Tetra Tech	**Tel/Fax:(617) 443-7551**	**Lab Contact: James Madison**	**Carrier:TA courier**	2 of 3 COCs
160 Federal Street, 3rd floor	**Analysis Turnaround Time**			Sampler:
Boston, MA 02110	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(617) 443-7551 Phone	TAT if different from Below			Walk-in Client:
(xxx) xxx-xxxx FAX	☑ 2 weeks			Lab Sampling:
Project Name: Fireworks	☐ 1 week			
Site: Hanover, MA	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	Sample Specific Notes:
SO-ECCM41-06	10/20/2015	1612	G	SO	1			X	Hold Sample
SO-ECCM40-03	10/20/2015	1614	G	SO	1			X	
SO-ECCM40-06	10/20/2015	1614	G	SO	1			X	Hold Sample
SO-ECCM37-03	10/20/2015	1617	G	SO	3		Y	X	MS/MSD
SO-ECCM37-06	10/20/2015	1617	G	SO	1			X	Hold Sample
SO-ECCM39-03	10/20/2015	1619	G	SO	1			X	
SO-ECCM39-06	10/20/2015	1619	G	SO	1			X	Hold Sample
SO-ECCM43-03	10/20/2015	1621	G	SO	1			X	
SO-ECCM43-06	10/20/2015	1621	G	SO	1			X	Hold Sample
SO-ECCM46-03	10/20/2015	1623	G	SO	3		Y	X	MS/MSD
SO-ECCM46-06	10/20/2015	1623	G	SO	1			X	Hold Sample
SO-ECCM44-03	10/20/2015	1628	G	SO	1			X	

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ______

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return to Client ☐ Disposal by Lab ☐ Archive for ______ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No	Custody Seal No.:		Cooler Temp. (°C): Obs'd: ______ Corr'd: ______		Therm ID No.: ______
Relinquished by:	Company: TETRA TECH	Date/Time: 10/22/15 1545	Received by:	Company: TA	Date/Time: 10/22/15 15:45
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Form No. CA-C-WI-002, Rev. 4.6, dated 09/02/2015

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Laboratories, Inc.

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

Client Contact	**Project Manager: Ron Marnicio**	**Site Contact: Alex Valli**	**Date: 10/22/2015**	COC No:
Ron Marnicio Tetra Tech	**Tel/Fax:(617) 443-7551**	**Lab Contact: James Madison**	**Carrier:TA courier**	3 of 3 COCs
160 Federal Street, 3rd floor	**Analysis Turnaround Time**			Sampler:
Boston, MA 02110	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(617) 443-7551 Phone	TAT if different from Below			Walk-in Client:
(xxx) xxx-xxxx FAX	☑ 2 weeks			Lab Sampling:
Project Name: Fireworks	☐ 1 week			
Site: Hanover, MA	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	TCLP Volatiles	Paint Filter	Cyanide	Sulfide	pH	Full TCLP	Ignitability	TCLP Metals	Sample Specific Notes:
SO-ECCM44-03-DUP	10/20/2015	1628	G	SO	1			X									
SO-ECCM44-06	10/20/2015	1628	G	SO	1			X									Hold Sample
SO-ECCM45-03	10/20/2015	1632	G	SO	1			X									
SO-ECCM45-06	10/20/2015	1632	G	SO	1			X									Hold Sample
SO-ECCM-WD	10/20/2015	1638	G	SO	3				X	X	X	X	X	X	X	X	

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ______

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return to Client ☐ Disposal by Lab ☐ Archive for ______ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No	Custody Seal No.:		Cooler Temp. (°C): Obs'd: ______ Corr'd: ______		Therm ID No.: ______
Relinquished by:	Company: Tetra Tech	Date/Time: 10/22/15 1545	Received by:	Company: TA	Date/Time: 10/22/15 15:45
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Form No. CA-C-WI-002, Rev. 4.6, dated 09/02/2015

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Laboratories, Inc.

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

Client Contact	**Project Manager: Ron Marnicio**	**Site Contact: Alex Valli**	**Date: 10/22/2015**	COC No:
Ron Marnicio Tetra Tech	**Tel/Fax:(617) 443-7551**	**Lab Contact: James Madison**	**Carrier:TA courier**	1 of 5 COCs
160 Federal Street, 3rd floor	**Analysis Turnaround Time**			Sampler:
Boston, MA 02110	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(617) 443-7551 Phone	TAT if different from Below			Walk-in Client:
(xxx) xxx-xxxx FAX	☑ 2 weeks			Lab Sampling:
Project Name: Fireworks	☐ 1 week			
Site: Hanover, MA	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	TCLP Volatiles	Paint Filter	Cyanide	Sulfide	pH	Full TCLP	Ignitability	Sample Specific Notes:
SD-MLFP15-06	10/20/2015	1454	G	SED	1			X								Dry sample
SD-MLFP15-12	10/20/2015	1454	G	SED	1			X								Dry sample
SD-MLFP15-18	10/20/2015	1454	G	SED	3		Y	X								Dry sample; MS/MSD
SD-MLFP15-24	10/20/2015	1454	G	SED	1			X								Hold sample
SD-MLFP15-30	10/20/2015	1454	G	SED	1			X								Hold sample
SD-MLFP46-06	10/20/2015	1508	G	SED	1			X								Dry sample
SD-MLFP46-12	10/20/2015	1508	C	SED	1			X								
SD-MLFP41-06	10/20/2015	1514	G	SED	1			X								Dry sample
SD-MLFP41-12	10/20/2015	1514	G	SED	1			X								
SD-MLFP30-06	10/20/2015	1520	G	SED	1			X								
SD-MLFP30-12	10/20/2015	1520	G	SED	1			X								Hold sample
SD-MLFP39-06	10/20/2015	1528	G	SED	1			X								

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ____________

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for ______ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No	Custody Seal No.:		Cooler Temp. (°C): Obs'd: ______ Corr'd: ______		Therm ID No.: ______
Relinquished by:	Company: TETRA TECH	Date/Time: 10/22/15 1345	Received by:	Company: TA	Date/Time: 10/22/15 15:45
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Form No. CA-C-WI-002, Rev. 4.6, dated 09/02/2015

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica Laboratories, Inc.

Client Contact	Project Manager: Ron Marnicio	Site Contact: Alex Valli	Date: 10/22/2015	COC No: 2 of 5 COCs
Ron Marnicio Tetra Tech	Tel/Fax:(617) 443-7551	Lab Contact: James Madison	Carrier:TA courier	
160 Federal Street, 3rd floor	**Analysis Turnaround Time**			Sampler:
Boston, MA 02110	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(617) 443-7551 Phone	TAT if different from Below			Walk-in Client:
(xxx) xxx-xxxx FAX	☑ 2 weeks			Lab Sampling:
Project Name: Fireworks	☐ 1 week			
Site: Hanover, MA	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	TCLP Volatiles	Paint Filter	Cyanide	Sulfide	pH	Full TCLP	Ignitability	Sample Specific Notes:
SD-MLFP39-12	10/20/2015	1528	G	SED	1			X								
SD-MLFP39-18	10/20/2015	1528	G	SED	1			X								Hold sample
SD-MLFP39-24	10/20/2015	1528	G	SED	1			X								Hold sample
SD-MLFP40-06	10/20/2015	1537	G	SED	1			X								Dry sample
SD-MLFP40-12	10/20/2015	1537	G	SED	1			X								Dry sample
SD-MLFP55-06	10/20/2015	1543	G	SED	1			X								
SD-MLFP31-06	10/21/2015	1409	G	SED	1			X								Dry sample
SD-MLFP31-12	10/21/2015	1409	G	SED	1			X								Hold sample; dry sample
SD-MLFP45-06	10/21/2015	1417	G	SED	1			X								Dry sample
SD-MLFP45-12	10/21/2015	1417	G	SED	1			X								
SD-MLFP33-06	10/21/2015	1420	G	SED	1			X								
SD-MLFP33-12	10/21/2015	1420	G	SED	1			X								Hold sample

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ______

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for ______ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No	Custody Seal No.:		Cooler Temp. (°C): Obs'd: ______ Corr'd: ______		Therm ID No.:
Relinquished by:	Company: TETRATECH	Date/Time: 10/22/15 1545	Received by:	Company: TA	Date/Time: 10/22/15 15:45
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Form No. CA-C-WI-002, Rev. 4.6, dated 09/02/2015

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica Laboratories, Inc.

Client Contact	
Ron Marnicio Tetra Tech	
160 Federal Street, 3rd floor	
Boston, MA 02110	
(617) 443-7551	Phone
(xxx) xxx-xxxx	FAX
Project Name: Fireworks	
Site: Hanover, MA	
P O #	

Project Manager: Ron Marnicio
Tel/Fax:(617) 443-7551

Analysis Turnaround Time
☐ CALENDAR DAYS ☐ WORKING DAYS
TAT if different from Below ______
☑ 2 weeks
☐ 1 week
☐ 2 days
☐ 1 day

Site Contact: Alex Valli
Lab Contact: James Madison
Date: 10/22/2015
Carrier:TA courier

COC No:
1 of 2 COCs
Sampler:
For Lab Use Only:
Walk-in Client:
Lab Sampling:
Job / SDG No.:

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	TCLP Volatiles	Paint Filter	Cyanide	Sulfide	pH	Full TCLP	Ignitability	Sample Specific Notes:
SO-ECCM47-03	10/21/2015	1625	G	SO	1			X								
SO-ECCM47-03-DUP	10/21/2015	1625	G	SO	1			X								
SO-ECCM47-06	10/21/2015	1625	G	SO	1			X								
SO-ECCM48-03	10/21/2015	1630	G	SO	3		Y	X								HOLD
SO-ECCM48-06	10/21/2015	1630	G	SO	1			X								MS/MSD
SO-ECCM49-03	10/21/2015	1635	G	SO	1			X								HOLD
SO-ECCM49-03-DUP	10/21/2015	1635	G	SO	1			X								
SO-ECCM49-06	10/21/2015	1635	G	SO	1			X								
SO-ECCM50-03	10/21/2015	1640	G	SO	1			X								HOLD
SO-ECCM50-06	10/21/2015	1640	G	SO	1			X								
SO-ECCM51-03	10/21/2015	1645	G	SO	3		Y	X								HOLD
SO-ECCM51-06	10/21/2015	1645	G	SO	1			X								MS/MSD

HOLD

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ______

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return to Client ☐ Disposal by Lab ☐ Archive for ______ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No
Custody Seal No.:
Cooler Temp. (°C): Obs'd: ______ Corr'd: ______ Therm ID No.: ______

Relinquished by:
Company: TETRA TECH
Date/Time: 10/22/15 1545
Received by:
Company:
Date/Time: 10/22/15 15:45

Relinquished by:
Company:
Date/Time:
Received by:
Company:
Date/Time:

Relinquished by:
Company:
Date/Time:
Received in Laboratory by:
Company:
Date/Time:

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica Laboratories, Inc.

Client Contact
Ron Marnicio Tetra Tech
160 Federal Street, 3rd floor
Boston, MA 02110
(617) 443-7551 Phone
(xxx) xxx-xxxx FAX
Project Name: Fireworks
Site: Hanover, MA
P O #

Project Manager: Ron Marnicio
Tel/Fax:(617) 443-7551

Analysis Turnaround Time
☐ CALENDAR DAYS ☐ WORKING DAYS
TAT if different from Below ______
☑ 2 weeks
☐ 1 week
☐ 2 days
☐ 1 day

Site Contact: Alex Valli
Lab Contact: James Madison
Date: 10/22/2015
Carrier:TA courier

COC No:
2 of 2 COCs
Sampler:
For Lab Use Only:
Walk-in Client:
Lab Sampling:
Job / SDG No.:

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	TCLP Volatiles	Paint Filter	Cyanide	Sulfide	pH	Full TCLP	Ignitability										Sample Specific Notes:
SO-ECCM52-03	10/21/2015	1650	G	SO	1			X																	
SO-ECCM52-03-DUP	10/21/2015	1650	G	SO	1			X																	
SO-ECCM52-06	10/21/2015	1650	G	SO	1			X																	HOLD
SO-ECCM53-03	10/21/2015	1655	G	SO	3		Y	X																	MS/MSD
SO-ECCM53-06	10/21/2015	1655	G	SO	1			X																	HOLD

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ______

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return to Client ☐ Disposal by Lab ☐ Archive for ______ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No
Custody Seal No.:
Cooler Temp. (°C): Obs'd: ______ Corr'd: ______
Therm ID No.: ______

Relinquished by:	Company: TETRA TECH	Date/Time: 10/22/15 1545	Received by:	Company: TA	Date/Time: 10/22/15 15:45
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Form No. CA-C-WI-002, Rev. 4.6, dated 09/02/2015

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Laboratories, Inc.

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

Client Contact	**Project Manager: Ron Marnicio**	**Site Contact: Alex Valli**	**Date: 10/22/2015**	COC No:
Ron Marnicio Tetra Tech	**Tel/Fax:(617) 443-7551**	**Lab Contact: James Madison**	**Carrier:TA courier**	3 of 5 COCs
160 Federal Street, 3rd floor	**Analysis Turnaround Time**			Sampler:
Boston, MA 02110	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(617) 443-7551 Phone	TAT if different from Below			Walk-in Client:
(xxx) xxx-xxxx FAX	☑ 2 weeks			Lab Sampling:
Project Name: Fireworks	☐ 1 week			
Site: Hanover, MA	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	TCLP Volatiles	Paint Filter	Cyanide	Sulfide	pH	Full TCLP	Ignitability	Sample Specific Notes:
SD-MLFP20-06	10/21/2015	1432	G	SED	1			X								
SD-MLFP20-12	10/21/2015	1432	G	SED	1			X								
SD-MLFP20-12-DUP	10/21/2015	1432	G	SED	1			X								
SD-MLFP20-18	10/21/2015	1432	G	SED	1			X								Hold sample
SD-MLFP49-06	10/21/2015	1445	G	SED	1			X								
SD-MLFP49-12	10/21/2015	1445	G	SED	1			X								
SD-MLFP49-18	10/21/2015	1445	G	SED	1			X								Hold sample
SD-MLFP49-24	10/21/2015	1445	G	SED	1			X								Hold sample
SD-MLFP50-06	10/21/2015	1453	G	SED	1			X								Dry sample
SD-MLFP50-12	10/21/2015	1453	G	SED	3		Y	X								MS/MSD
SD-MLFP50-18	10/21/2015	1453	G	SED	1			X								Hold sample
SD-MLFP42-06	10/21/2015	1502	G	SED	1			X								

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ______

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for ______ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No	Custody Seal No.:		Cooler Temp. (°C): Obs'd: ______ Corr'd: ______	Therm ID No.: ______
Relinquished by:	Company: TETRATECH	Date/Time: 10/22/15 1545	Received by: Company: TA	Date/Time: 10/22/15 15:45
Relinquished by:	Company:	Date/Time:	Received by: Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by: Company:	Date/Time:

Form No. CA-C-WI-002, Rev. 4.6, dated 09/02/2015

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Laboratories, Inc.

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

Client Contact	**Project Manager: Ron Marnicio**	**Site Contact: Alex Valli**	**Date: 10/20/2015**	COC No:
Ron Marnicio Tetra Tech	**Tel/Fax:(617) 443-7551**	**Lab Contact: James Madison**	**Carrier:TA courier**	4 of ____ COCs
160 Federal Street, 3rd floor	**Analysis Turnaround Time**			Sampler:
Boston, MA 02110	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(617) 443-7551 Phone	TAT if different from Below ______			Walk-in Client:
(xxx) xxx-xxxx FAX	☑ 2 weeks			Lab Sampling:
Project Name: Fireworks	☐ 1 week			
Site: Hanover, MA	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	Atterberg Limits	Specific Gravity	Grain Size	Moisture Content	Organic Matter	Sample Specific Notes:
SD-MLFP42-12	10/21/2015	1502	G	SED	1			X						
SD-MLFP42-12-DUP	10/21/2015	1502	G	SED	1			X						
SD-MLFP42-18	10/21/2015	1502	G	SED	1			X						Hold sample
SD-MLFP21-06	10/21/2015	1530	G	SED	1			X						
SD-MLFP21-06-DUP	10/21/2015	1530	G	SED	1			X						
SD-MLFP21-12	10/21/2015	1530	G	SED	1			X						
SD-MLFP21-18	10/21/2015	1530	G	SED	1			X						
SD-MLFP21-24	10/21/2015	1530	G	SED	1			X						Hold sample
SD-MLFP-GT	10/21/2015	1537	G	SED	3				X	X	X	X	X	
SD-MLFP51-06	10/21/2015	1545	G	SED	3		Y	X						MS/MSD
SD-MLFP51-12	10/21/2015	1545	G	SED	1			X						
SD-MLFP51-18	10/21/2015	1545	G	SED	1			X						Hold sample

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ______

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return to Client ☐ Disposal by Lab ☐ Archive for ______ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No	Custody Seal No.:		Cooler Temp. (°C): Obs'd: ______ Corr'd: ______		Therm ID No.: ______
Relinquished by:	Company: TETRA TECH	Date/Time: 10/22/15 1545	Received by:	Company: TA	Date/Time: 10/22/15 15:45
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Form No. CA-C-WI-002, Rev. 4.6, dated 09/02/2015

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica Laboratories, Inc.

Client Contact	**Project Manager: Ron Marnicio**	**Site Contact: Alex Valli**	**Date: 10/22/2015**	COC No:
Ron Marnicio Tetra Tech	**Tel/Fax:(617) 443-7551**	**Lab Contact: James Madison**	**Carrier:TA courier**	5 of 5 COCs
160 Federal Street, 3rd floor	**Analysis Turnaround Time**			Sampler:
Boston, MA 02110	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(617) 443-7551 Phone	TAT if different from Below			Walk-in Client:
(xxx) xxx-xxxx FAX	☑ 2 weeks			Lab Sampling:
Project Name: Fireworks	☐ 1 week			
Site: Hanover, MA	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	TCLP Volatiles	Paint Filter	Cyanide	Sulfide	pH	Full TCLP	Ignitability	Sample Specific Notes:
SD-MLFP32-06 *	10/21/2015	1556	G	SED	1			X								DRY
SD-MLFP32-12 *	10/21/2015	1556	G	SED	3		Y	X								MS/MSD
SD-MLFP32-18 *	10/21/2015	1556	G	SED	1			X								HOLD

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ______

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return to Client ☐ Disposal by Lab ☐ Archive for ______ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No
Custody Seal No.:
Cooler Temp. (°C): Obs'd: ______ Corr'd: ______
Therm ID No.: ______

Relinquished by:	Company: TETRA TECH	Date/Time: 10/22/15 1545	Received by:	Company: TA	Date/Time: 10/22/15 15:45
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica Laboratories, Inc.

Client Contact	**Project Manager: Ron Marnicio**	**Site Contact: Alex Valli**	**Date: 10/22/2015**	COC No:
Ron Marnicio Tetra Tech	**Tel/Fax:(617) 443-7551**	**Lab Contact: James Madison**	**Carrier:TA courier**	1 of 1 COCs
160 Federal Street, 3rd floor	**Analysis Turnaround Time**			Sampler:
Boston, MA 02110	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(617) 443-7551 Phone	TAT if different from Below			Walk-in Client:
(xxx) xxx-xxxx FAX	☑ 2 weeks			Lab Sampling:
Project Name: Fireworks	☐ 1 week			
Site: Hanover, MA	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	TCLP Volatiles	Paint Filter	Cyanide	Sulfide	pH	Full TCLP	Ignitability	Sample Specific Notes:
SO-OYFA1-06-PM	10/21/2015	1556	ISM	SO	1			X								
SO-OYFA1-06RM1	10/21/2015	1556	ISM	SO	1			X								
SO-OYFA-06RM2	10/21/2015	1556	ISM	SO	1			X								

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ________

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for ______ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No	Custody Seal No.:		Cooler Temp. (°C): Obs'd: ______ Corr'd: ______		Therm ID No.: ______
Relinquished by:	Company: TETRA TECH	Date/Time: 10/22/15 1545	Received by:	Company:	Date/Time: 10/22/15 15:45
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Form No. CA-C-WI-002, Rev. 4.6, dated 09/02/2015

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Laboratories, Inc.

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

Client Contact	**Project Manager: Ron Marnicio**	**Site Contact: Alex Valli**	**Date: 10/23/2015**	COC No:
Ron Marnicio Tetra Tech	**Tel/Fax:(617) 443-7551**	**Lab Contact: James Madison**	**Carrier:TA courier**	1 of 1 COCs
160 Federal Street, 3rd floor	**Analysis Turnaround Time**			Sampler:
Boston, MA 02110	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(617) 443-7551 Phone	TAT if different from Below ______			Walk-in Client:
(xxx) xxx-xxxx FAX	☑ 2 weeks			Lab Sampling:
Project Name: Fireworks	☐ 1 week			
Site: Hanover, MA	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	Total Lead	Sample Specific Notes:
GW-DP-MW1	10/22/2015	1302	G	GW	1			X		
GW-DP-MW1-DUP	10/22/2015	1302	G	GW	1			X		
GW-MW-B4	10/23/2015	1100	G	GW	1				X	
GW-MW-B4-DUP	10/23/2015	1100	G	GW	1				X	

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ______

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return to Client ☐ Disposal by Lab ☐ Archive for ______ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No	Custody Seal No.:		Cooler Temp. (°C): Obs'd: ______ Corr'd: ______		Therm ID No.: ______
Relinquished by:	Company: TETRA TECH	Date/Time: 10/23/15 1450	Received by:	Company: TA	Date/Time: 10/23/15 15:00
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Form No. CA-C-WI-002, Rev. 4.6, dated 09/02/2015

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica Laboratories, Inc.

Client Contact	**Project Manager: Ron Marnicio**	**Site Contact: Alex Valli**	**Date: 10/23/2015**	COC No:
Ron Marnicio Tetra Tech	**Tel/Fax:(617) 443-7551**	**Lab Contact: James Madison**	**Carrier:TA courier**	1 of 4 COCs
160 Federal Street, 3rd floor	**Analysis Turnaround Time**			Sampler:
Boston, MA 02110	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(617) 443-7551 Phone	TAT if different from Below			Walk-in Client:
(xxx) xxx-xxxx FAX	☑ 2 weeks			Lab Sampling:
Project Name: Fireworks	☐ 1 week			
Site: Hanover, MA	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	Sample Specific Notes:
SD-MLFP17-06	10/23/2015	1214	G	SED	1			X	Dry sample
SD-MLFP17-12	10/23/2015	1214	G	SED	1			X	
SD-MLFP17-12-DUP	10/23/2015	1214	G	SED	1			X	
SD-MLFP17-18	10/23/2015	1214	G	SED	1			X	
SD-MLFP18-06	10/23/2015	1223	G	SED	1			X	Dry sample
SD-MLFP18-12	10/23/2015	1223	G	SED	3		Y	X	
SD-MLFP18-18	10/23/2015	1223	G	SED	1			X	Hold sample
SD-MLFP19-06	10/23/2015	1240	G	SED	1			X	Dry sample
SD-MLFP19-06-DUP	10/23/2015	1240	G	SED	1			X	Dry sample
SD-MLFP19-12	10/23/2015	1240	G	SED	1			X	Dry sample
SD-MLFP25-06	10/23/2015	1249	G	SED	3		Y	X	Dry sample; MS/MSD
SD-MLFP25-12	10/23/2015	1249	G	SED	1			X	Dry sample

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ______

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for ____ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No

Custody Seal No.:

Cooler Temp. (°C): Obs'd: ____ Corr'd: ____ Therm ID No.: ____

Relinquished by:	Company: TETRA TECH	Date/Time: 10/23/15 1452	Received by:	Company: TA	Date/Time: 10/23/15 15[illegible]
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Form No. CA-C-WI-002, Rev. 4.6, dated 09/02/2015

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica Laboratories, Inc.

Client Contact	**Project Manager: Ron Marnicio**	**Site Contact: Alex Valli**	**Date: 10/23/2015**	COC No:
Ron Marnicio Tetra Tech	**Tel/Fax:(617) 443-7551**	**Lab Contact: James Madison**	**Carrier:TA courier**	2 of 4 COCs
160 Federal Street, 3rd floor	**Analysis Turnaround Time**			Sampler:
Boston, MA 02110	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(617) 443-7551 Phone	TAT if different from Below ______			Walk-in Client:
(xxx) xxx-xxxx FAX	☑ 2 weeks			Lab Sampling:
Project Name: Fireworks	☐ 1 week			
Site: Hanover, MA	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	Sample Specific Notes:
SD-MLFP28-06	10/23/2015	1258	G	SED	1			X	Dry sample
SD-MLFP28-06-DUP	10/23/2015	1258	G	SED	1			X	Dry sample
SD-MLFP29-06	10/23/2015	1306	G	SED	3		Y	X	Dry sample; MS/MSD
SD-MLFP29-12	10/23/2015	1306	G	SED	1			X	Hold sample
SD-MLFP37-06	10/23/2015	1317	G	SED	1			X	
SD-MLFP37-12	10/23/2015	1317	G	SED	1			X	Dry sample
SD-MLFP37-12-DUP	10/23/2015	1317	G	SED	1			X	
SD-MLFP24-06	10/23/2015	1330	G	SED	1			X	
SD-MLFP24-12	10/23/2015	1330	G	SED	3		Y	X	MS/MSD
SD-MLFP24-18	10/23/2015	1330	G	SED	1			X	Dry sample
SD-MLFP35-06	10/23/2015	1340	G	SED	1			X	Dry sample
SD-MLFP35-12	10/23/2015	1340	G	SED	1			X	Dry sample

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ______

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for______ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No	Custody Seal No.:		Cooler Temp. (°C): Obs'd:______ Corr'd:______		Therm ID No.:______
Relinquished by: AV	Company: TETRA TECH	Date/Time: 10/23/15 1457	Received by:	Company: TA	Date/Time: 10/23/15 1520
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Form No. CA-C-WI-002, Rev. 4.6, dated 09/02/2015

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica Laboratories, Inc.

Client Contact	**Project Manager: Ron Marnicio**	**Site Contact: Alex Valli**	**Date: 10/23/2015**	COC No:
Ron Marnicio Tetra Tech	**Tel/Fax:(617) 443-7551**	**Lab Contact: James Madison**	**Carrier:TA courier**	3 of 4 COCs
160 Federal Street, 3rd floor	**Analysis Turnaround Time**			Sampler:
Boston, MA 02110	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(617) 443-7551 Phone	TAT if different from Below ______			Walk-in Client:
(xxx) xxx-xxxx FAX	☑ 2 weeks			Lab Sampling:
Project Name: Fireworks	☐ 1 week			
Site: Hanover, MA	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	Sample Specific Notes:
SD-MLFP35-12-DUP	10/23/2015	1340	G	SED	1			X	Dry sample
SD-MLFP35-18	10/23/2015	1340	G	SED	1			X	Hold sample; dry sample
SD-MLFP35-24	10/23/2015	1340	G	SED	1			X	Hold sample; dry sample
SD-MLFP43-06	10/23/2015	1351	G	SED	1			X	Dry sample
SD-MLFP43-12	10/23/2015	1351	G	SED	3		Y	X	MS/MSD
SD-MLFP43-18	10/23/2015	1351	G	SED	1			X	Hold sample
SD-MLFP43-24	10/23/2015	1351	G	SED	1			X	Hold sample
SD-MLFP44-06	10/23/2015	1411	G	SED	1			X	Dry sample
SD-MLFP44-12	10/23/2015	1411	G	SED	1			X	Dry sample
SD-MLFP44-18	10/23/2015	1411	G	SED	1			X	
SD-MLFP44-24	10/23/2015	1411	G	SED	3		Y	X	MS/MSD
SD-MLFP47-06	10/23/2015	1420	G	SED	1			X	Dry sample

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ______

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for ______ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No	Custody Seal No.:		Cooler Temp. (°C): Obs'd:______ Corr'd:______		Therm ID No.:______
Relinquished by:	Company: TETRA TECH	Date/Time: 10/23/15 1452	Received by:	Company: TA	Date/Time: 10/23/15 15:40
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Form No. CA-C-WI-002, Rev. 4.6, dated 09/02/2015

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica Laboratories, Inc.

Client Contact	**Project Manager: Ron Marnicio**	**Site Contact: Alex Valli**	**Date: 10/23/2015**	COC No:
Ron Marnicio Tetra Tech	**Tel/Fax:(617) 443-7551**	**Lab Contact: James Madison**	**Carrier:TA courier**	4 of 4 COCs
160 Federal Street, 3rd floor	**Analysis Turnaround Time**			Sampler:
Boston, MA 02110	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(617) 443-7551 Phone	TAT if different from Below ______			Walk-in Client:
(xxx) xxx-xxxx FAX	☑ 2 weeks			Lab Sampling:
Project Name: Fireworks	☐ 1 week			
Site: Hanover, MA	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	Sample Specific Notes:
SD-MLFP47-06-DUP	10/23/2015	1420	G	SED	1			X	Dry sample
SD-MLFP47-12	10/23/2015	1420	G	SED	1			X	
SD-MLFP47-18	10/23/2015	1420	G	SED	1			X	
SD-MLFP48-06	10/23/2015	1425	G	SED	1			X	Dry sample
SD-MLFP48-12	10/23/2015	1425	G	SED	1			X	Dry sample
SD-MLFP48-18	10/23/2015	1425	G	SED	3		Y	X	MS/MSD
SD-MLFP48-24	10/23/2015	1425	G	SED	1			X	
SD-MLFP48-30	10/23/2015	1425	G	SED	1			X	
SD-MLFP48-36	10/23/2015	1425	G	SED	1			X	

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ______

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for ______ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No	Custody Seal No.:		Cooler Temp. (°C): Obs'd: ______ Corr'd: ______		Therm ID No.: ______
Relinquished by:	Company: TETRA TECH	Date/Time: 10/23/15 1452	Received by:	Company: TA	Date/Time: 10/23/15 1500
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica Laboratories, Inc.

Client Contact	**Project Manager: Ron Marnicio**	**Site Contact: Alex Valli**	**Date: 10/23/2015**
Ron Marnicio Tetra Tech	**Tel/Fax:(617) 443-7551**	**Lab Contact: James Madison**	**Carrier:TA courier**
160 Federal Street, 3rd floor	**Analysis Turnaround Time**		
Boston, MA 02110	☐ CALENDAR DAYS ☐ WORKING DAYS		
(617) 443-7551 Phone	TAT if different from Below ________		
(xxx) xxx-xxxx FAX	☑ 2 weeks		
Project Name: Fireworks	☐ 1 week		
Site: Hanover, MA	☐ 2 days		
P O #	☐ 1 day		

COC No:
__1__ of __1__ COCs
Sampler:
For Lab Use Only:
Walk-in Client:
Lab Sampling:
Job / SDG No.:

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	TAL Metals	Explosives	Sample Specific Notes:
SO-SPZE1-06	10/23/2015	1355	ISM	SO	1				X	X	
SO-SPZE2-06	10/23/2015	1355	ISM	SO	1				X	X	
SO-SPZE3-06	10/23/2015	1355	ISM	SO	1				X	X	

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ________

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return to Client ☐ Disposal by Lab ☐ Archive for ________ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No	Custody Seal No.:		Cooler Temp. (°C): Obs'd: / Corr'd: ________		Therm ID No.: ________
Relinquished by:	Company: TETRATECH	Date/Time: 10/23/2015 1457	Received by:	Company: TA	Date/Time: 10/23/15 15:00
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica Laboratories, Inc.

Client Contact	**Project Manager: Ron Marnicio**	**Site Contact: Alex Valli**	**Date: 10/23/2015**	COC No:
Ron Marnicio Tetra Tech	**Tel/Fax:(617) 443-7551**	**Lab Contact: James Madison**	**Carrier:TA courier**	__1__ of __1__ COCs
160 Federal Street, 3rd floor	**Analysis Turnaround Time**			Sampler:
Boston, MA 02110	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(617) 443-7551 Phone	TAT if different from Below ____			Walk-in Client:
(xxx) xxx-xxxx FAX	☑ 2 weeks			Lab Sampling:
Project Name: Fireworks	☐ 1 week			
Site: Hanover, MA	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	TAL Metals	Explosives	Sample Specific Notes:
SO-SSDA1-06	10/23/2015	1350	ISM	SO	1				X	X	
SO-SSDA2-06	10/23/2015	1350	ISM	SO	1				X	X	
SO-SSDA3-06	10/23/2015	1350	ISM	SO	1				X	X	

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ______

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return to Client ☐ Disposal by Lab ☐ Archive for ______ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No
Custody Seal No.:
Cooler Temp. (°C): Obs'd: ____ Corr'd: ____ Therm ID No.: ____

Relinquished by: AFV	Company: Tetra Tech	Date/Time: 10/23/15 145	Received by:	Company: TA	Date/Time: 10/23/15 15:06
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Form No. CA-C-WI-002, Rev. 4.6, dated 09/02/2015

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica Laboratories, Inc.

Client Contact	Project Manager: Ron Marnicio	Site Contact: Alex Valli	Date: 10/27/2015	COC No:
Ron Marnicio Tetra Tech	Tel/Fax:(617) 443-7551	Lab Contact: James Madison	Carrier:TA courier	1 of 2 COCs
160 Federal Street, 3rd floor	Analysis Turnaround Time			Sampler:
Boston, MA 02110	☐ CALENDAR DAYS ☐ WORKING DAYS			For Lab Use Only:
(617) 443-7551 Phone	TAT if different from Below ____			Walk-in Client:
(xxx) xxx-xxxx FAX	☑ 2 weeks			Lab Sampling:
Project Name: Fireworks	☐ 1 week			
Site: Hanover, MA	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	Full Haz Waste Char Suite	TCLP Metals	Paint Filter	Atterberg	Specific Gravity	Grain Size	Moisture Content	Organic Matter	Sample Specific Notes:
SD-ECCS1-PC	10/25/2015	1545	C	SED	3		Y	X									MS/MSD
SD-ECCS4-PC	10/25/2015	1600	C	SED	1			X									
SD-ECCS4-PC-DUP	10/25/2015	1600	C	SED	1			X									
SD-ECCS5-PC	10/25/2015	1455	C	SED	1			X									
SD-ECCS6-PC	10/25/2015	1439	C	SED	1			X									
SD-ECCS7-PC	10/25/2015	1421	C	SED	1			X									
SD-ECCS8-PC	10/25/2015	1403	C	SED	1			X									
SD-ECCS9-PC	10/25/2015	1335	C	SED	3		Y	X									MS/MSD
SD-ECCS10-PC	10/25/2015	1325	C	SED	1			X									
SD-ECCS11-PC	10/25/2015	1308	C	SED	1			X									
~~SD-ECCS12-PC~~	~~10/25/2015~~	~~1211~~	~~C~~	~~SED~~	~~1~~			~~X~~									
SD-ECCS12-PC-DUP	10/25/2015	1211	C	SED	1			X									

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ________

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for ________ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No	Custody Seal No.:	Cooler Temp. (°C): Obs'd: ______ Corr'd: ______	Therm ID No.: ______

Relinquished by:	Company: TETRA TECH	Date/Time: 10/27/2015 1520	Received by:	Company: TA 10/27/15	Date/Time: 1520
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Form No. CA-C-WI-002, Rev. 4.6, dated 09/02/2015

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica Laboratories, Inc.

Client Contact	**Project Manager: Ron Marnicio**	**Site Contact: Alex Valli**	**Date: 10/27/2015**	COC No:
Ron Marnicio Tetra Tech	**Tel/Fax:(617) 443-7551**	**Lab Contact: James Madison**	**Carrier:TA courier**	2 of 2 COCs
160 Federal Street, 3rd floor	**Analysis Turnaround Time**			Sampler:
Boston, MA 02110	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(617) 443-7551 Phone	TAT if different from Below ____			Walk-in Client:
(xxx) xxx-xxxx FAX	☑ 2 weeks			Lab Sampling:
Project Name: Fireworks	☐ 1 week			
Site: Hanover, MA	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	Full Haz Waste Char Suite	TCLP Metals	Paint Filter	Atterberg	Specific Gravity	Grain Size	Moisture Content	Organic Matter	Sample Specific Notes:
SD-ECCS13-PC	10/25/2015	1139	C	SED	1			X									
SD-ECCS14-PC	10/25/2015	1117	C	SED	3		X	X									MS/MSD
SD-ECCS18-PC	10/25/2015	1015	C	SED	1			X									
SD-ECCS18-PC-DUP	10/25/2015	1015	C	SED	1			X									
SD-ECCS16-PC	10/25/2015	1038	C	SED	1			X									
SD-ECCS17-PC	10/26/2015	0950	C	SED	1			X									
SD-ECCS-GT	10/26/2015	1039	C	SED	3							X	X	X	X	X	
SD-ECCS-WD	10/26/2015	1035	C	SED	4				X	X	X						

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ____

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return to Client ☐ Disposal by Lab ☐ Archive for ____ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No	Custody Seal No.:		Cooler Temp. (°C): Obs'd: ____ Corr'd: ____		Therm ID No.: ____
Relinquished by:	Company: Tetra Tech	Date/Time: 10/27/15 1520	Received by:	Company: TA 10/27/15	Date/Time: 1540
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica Laboratories, Inc.

Client Contact	**Project Manager: Ron Marnicio**	**Site Contact: Alex Valli**	**Date: 10/27/2015**	COC No:
Ron Marnicio Tetra Tech	**Tel/Fax:(617) 443-7551**	**Lab Contact: James Madison**	**Carrier:TA courier**	1 of 1 COCs
160 Federal Street, 3rd floor	**Analysis Turnaround Time**			Sampler:
Boston, MA 02110	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(617) 443-7551 Phone	TAT if different from Below			Walk-in Client:
(xxx) xxx-xxxx FAX	☑ 2 weeks			Lab Sampling:
Project Name: Fireworks	☐ 1 week			
Site: Hanover, MA	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	Sample Specific Notes:
SD-INRC1-03	10/26/2015	1525	G	SD	1			X	
SD-INRC2-03	10/26/2015	1527	C	SD	1			X	
SD-INRC3-03	10/26/2015	1535	C	SD	1			X	
SD-INRC4-03	10/26/2015	1540	G	SD	1			X	
SD-INRC5-03	10/26/2015	1545	C	SD	1			X	
SD-INRC5-03-DUP	10/26/2015	1545	C	SD	1			X	
SD-INRC7-03	10/26/2015	1550	G	SD	1			X	
SD-INRC8-03	10/26/2015	1550	G	SD	1			X	

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for ______ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No
Custody Seal No.:
Cooler Temp. (°C): Obs'd: ______ Corr'd: ______ Therm ID No.: ______

Relinquished by:	Company: TETRA TECH	Date/Time: 10/27/15 1520	Received by:	Company: TA 10/27/15	Date/Time: 1520
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Form No. CA-C-WI-002, Rev. 4.6, dated 09/02/2015

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica Laboratories, Inc.

Client Contact	**Project Manager: Ron Marnicio**	**Site Contact: Alex Valli**	**Date: 10/27/2015**	COC No:
Ron Marnicio Tetra Tech	**Tel/Fax:(617) 443-7551**	**Lab Contact: James Madison**	**Carrier:TA courier**	__1__ of __1__ COCs
160 Federal Street, 3rd floor	**Analysis Turnaround Time**			Sampler:
Boston, MA 02110	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(617) 443-7551 Phone	TAT if different from Below ______			Walk-in Client:
(xxx) xxx-xxxx FAX	☑ 2 weeks			Lab Sampling:
Project Name: Fireworks	☐ 1 week			
Site: Hanover, MA	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	Sample Specific Notes:
SO-OYFA2-06-PM	10/23/2015	1543	C	So	1			X	
SO-OYFA2-06-RM1	10/23/2015	1543	C	So	1			X	
SO-OYFA2-06-RM2	10/23/2015	1543	C	So	1			X	

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ________

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return to Client ☐ Disposal by Lab ☐ Archive for ______ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No
Custody Seal No.:
Cooler Temp. (°C): Obs'd:______ Corr'd:______ Therm ID No.:______

Relinquished by:	Company: TETRA TECH	Date/Time: 10/27/2015 1520	Received by:	Company: TA 10/27/15	Date/Time: 8:00
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Laboratories, Inc.

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

Client Contact
Ron Marnicio Tetra Tech
160 Federal Street, 3rd floor
Boston, MA 02110
(617) 443-7551 Phone
(xxx) xxx-xxxx FAX
Project Name: Fireworks
Site: Hanover, MA
P O #

Project Manager: Ron Marnicio
Tel/Fax:(617) 443-7551

Site Contact: Alex Valli
Lab Contact: James Madison

Date: 10/29/2015
Carrier:TA courier

COC No:
1 of 3 COCs
Sampler:
For Lab Use Only:
Walk-in Client:
Lab Sampling:
Job / SDG No.:

Analysis Turnaround Time
☐ CALENDAR DAYS ☐ WORKING DAYS
TAT if different from Below
☑ 2 weeks
☐ 1 week
☐ 2 days
☐ 1 day

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	Sample Specific Notes:
SD-MUAU11-06	10/27/2015	1230	G	SED	1			X	
SD-MUAU10-06	10/28/2015	1045	G	SED	1			X	
SD-MUAU10-12	10/28/2015	1045	G	SED	1			X	
SD-MUAU10-18	10/28/2015	1045	G	SED	1			X	
SD-MUAU12-06	10/28/2015	1115	G	SED	1			X	
SD-MUAU13-06	10/28/2015	1118	G	SED	1			X	
SD-MUAU14-06	10/28/2015	1129	G	SED	1			X	
SD-MUAU15-06	10/28/2015	1153	G	SED	1			X	
SD-MUAU17-06	10/28/2015	1231	G	SED	1			X	
SD-MUAU17-12	10/28/2015	1231	G	SED	1			X	
SD-MUAU22-06	10/28/2015	1246	G	SED	1			X	
SD-MUAU26-06	10/28/2015	1311	G	SED	1			X	

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return to Client ☐ Disposal by Lab ☐ Archive for ______ Months

Special Instructions/QC Requirements & Comments: Dry any samples that appear to have high moisture content.

Custody Seals Intact: ☐ Yes ☐ No
Custody Seal No.:
Cooler Temp. (°C): Obs'd: ______ Corr'd: ______
Therm ID No.: ______

Relinquished by:	Company: TETRA TECH	Date/Time: 10/29/15 1410	Received by:	Company: TA	Date/Time: 10/29/15 14:15
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Form No. CA-C-WI-002, Rev. 4.6, dated 09/02/2015

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Laboratories, Inc.

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

Client Contact	**Project Manager: Ron Marnicio**	**Site Contact: Alex Valli**	**Date: 10/29/2015**	COC No:
Ron Marnicio Tetra Tech	**Tel/Fax:(617) 443-7551**	**Lab Contact: James Madison**	**Carrier:TA courier**	2 of 3 COCs
160 Federal Street, 3rd floor	**Analysis Turnaround Time**			Sampler:
Boston, MA 02110	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(617) 443-7551 Phone	TAT if different from Below ______			Walk-in Client:
(xxx) xxx-xxxx FAX	☑ 2 weeks			Lab Sampling:
Project Name: Fireworks	☐ 1 week			
Site: Hanover, MA	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	Sample Specific Notes:
SD-MUAU27-06	10/28/2015	1337	G	SED	1			X	
SD-MUAU27-12	10/28/2015	1337	G	SED	1			X	
SD-MUAU28-06	10/28/2015	1347	G	SED	1			X	
SD-MUAU28-12	10/28/2015	1347	G	SED	1			X	
SD-MUAU23-06	10/28/2015	1401	G	SED	1			X	
SD-MUAU24-06	10/28/2015	1419	G	SED	1			X	
SD-MUAU25-06	10/28/2015	1435	G	SED	1			X	
SD-MUAU20-06	10/28/2015	1443	G	SED	1			X	
SD-MUAU19-06	10/28/2015	1452	G	SED	1			X	
SD-MUAU18-06	10/28/2015	1459	G	SED	1			X	
SD-MUAU5-06	10/28/2015	1513	G	SED	3		Y	X	MS/MSD
SD-MUAU5-06-DUP	10/28/2015	1513	G	SED	1			X	

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ______

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for ______ Months

Special Instructions/QC Requirements & Comments: Dry any samples that appear to have high moisture content.

Custody Seals Intact: ☐ Yes ☐ No	Custody Seal No.:	Cooler Temp. (°C): Obs'd: ______ Corr'd: ______		Therm ID No.: ______
Relinquished by:	Company: TETRA TECH	Date/Time: 10/29/15 1410	Received by:	Company: TA	Date/Time: 10/29/15 14:15
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica Laboratories, Inc.

Client Contact	**Project Manager: Ron Marnicio**	**Site Contact: Alex Valli**	**Date: 10/29/2015**	COC No:
Ron Marnicio Tetra Tech	**Tel/Fax:(617) 443-7551**	Lab Contact: James Madison	**Carrier:TA courier**	3 of 3 COCs
160 Federal Street, 3rd floor	**Analysis Turnaround Time**			Sampler:
Boston, MA 02110	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(617) 443-7551 Phone	TAT if different from Below ______			Walk-in Client:
(xxx) xxx-xxxx FAX	☑ 2 weeks			Lab Sampling:
Project Name: Fireworks	☐ 1 week			
Site: Hanover, MA	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	Atterberg	Specific Gravity	Grain Size	Moisture Content	Organic Matter	Full Haz Waste Characterization	TCLP Metals	Paint Filter	Sample Specific Notes:
SD-MUAU6-06	10/28/2015	1525	G	SED	3		Y	X									MS/MSD
SD-MUAU21-06	10/28/2015	1533	G	SED	1			X									
SD-MUAU7-06	10/28/2015	1600	G	SED	3		Y	X									MS/MSD
SD-MUAU7-12	10/28/2015	1605	G	SED	1			X									
SD-MUAU8-06	10/28/2015	1557	G	SED	1			X									
SD-MUAU8-12	10/28/2015	1557	G	SED	1			X									
SD-MUAU1-06	10/28/2015	1610	G	SED	1			X									
SD-MUAU1-12	10/28/2015	1610	G	SED	1			X									
SD-MUAU-GT	10/28/2015	1620	C	SED	3				X	X	X	X	X				
SD-MUAU-WD	10/28/2015	1625	C	SED	3									X	X	X	
SD-MUAU6-06-DUP	10/28/2015	1525	G	SED	1			X									
SD-MUAU7-06-DUP	10/28/2015	1600	G	SED	1			X									

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ______

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for ______ Months

Special Instructions/QC Requirements & Comments: Dry any samples that appear to have high moisture content.

Custody Seals Intact: ☐ Yes ☐ No	Custody Seal No.:		Cooler Temp. (°C): Obs'd: ______ Corr'd: ______		Therm ID No.: ______
Relinquished by: A V	Company: TETRA TECH	Date/Time: 10/29/15 1412	Received by:	Company: TA	Date/Time: 10/29/15 14:15
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica Laboratories, Inc.

Client Contact	Project Manager: Ron Marnicio	Site Contact: Alex Valli	Date: 10/29/2015	COC No:
Ron Marnicio Tetra Tech	Tel/Fax:(617) 443-7551	Lab Contact: James Madison	Carrier: TA courier	1 of 5 COCs
160 Federal Street, 3rd floor	**Analysis Turnaround Time**			Sampler:
Boston, MA 02110	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(617) 443-7551 Phone	TAT if different from Below ______			Walk-in Client:
(xxx) xxx-xxxx FAX	☑ 2 weeks			Lab Sampling:
Project Name: Fireworks	☐ 1 week			
Site: Hanover, MA	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	TAL Metals	Sample Specific Notes:
SO-MUAU1-12	10/28/2015	1619	G	So	2			X	X	
SO-MUAU1-24	10/28/2015	1623	G	So	2			X	X	
SO-MUAU1-24-DUP	10/28/2015	1623	G	So	2			X	X	
SO-MUAU1-36	10/28/2015	1625	G	So	2			X	X	Hold Sample
SO-MUAU1-48	10/28/2015	1630	G	So	2			X	X	Hold Sample
SO-MUAU2-12	10/29/2015	0900	G	So	4		Y	X	X	MS/MSD
SO-MUAU2-24	10/29/2015	0905	G	So	2			X	X	
SO-MUAU2-36	10/29/2015	0910	G	So	2			X	X	Hold Sample
SO-MUAU2-48	10/29/2015	0915	G	So	2			X	X	Hold Sample
SO-MUAU3-12	10/29/2015	0920	G	So	2			X	X	
SO-MUAU3-24	10/29/2015	0925	G	So	2			X	X	
SO-MUAU3-36	10/29/2015	0930	G	So	2			X	X	Hold Sample

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ______

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for ______ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No	Custody Seal No.:		Cooler Temp. (°C): Obs'd: ______ Corr'd: ______		Therm ID No.: ______
Relinquished by:	Company: TETRA TECH	Date/Time: 10/29/15 141	Received by:	Company: TA	Date/Time: 10/29/15 14:15
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica Laboratories, Inc.

Client Contact	**Project Manager: Ron Marnicio**	**Site Contact: Alex Valli**	**Date: 10/29/2015**	COC No:
Ron Marnicio Tetra Tech	**Tel/Fax:(617) 443-7551**	**Lab Contact: James Madison**	**Carrier:TA courier**	2 of 5 COCs
160 Federal Street, 3rd floor	**Analysis Turnaround Time**			Sampler:
Boston, MA 02110	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(617) 443-7551 Phone	TAT if different from Below			Walk-in Client:
(xxx) xxx-xxxx FAX	☑ 2 weeks			Lab Sampling:
Project Name: Fireworks	☐ 1 week			
Site: Hanover, MA	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	TAL Metals	Sample Specific Notes:
SO-MUAU3-48	10/29/2015	0930	G	So	2			X	X	Hold Sample
SO-MUAU4-12	10/29/2015	0935	G	So	2			X	X	
SO-MUAU4-24	10/29/2015	0940	G	So	2			X	X	
SO-MUAU4-24-DUP	10/29/2015	0940	G	So	2			X	X	
SO-MUAU4-36	10/29/2015	0945	G	So	2			X	X	Hold Sample
SO-MUAU4-48	10/29/2015	0950	G	So	2			X	X	Hold Sample
SO-MUAU4-60	10/29/2015	0955	G	So	2			X	X	Hold Sample
SO-MUAU4-72	10/29/2015	1000	G	So	2			X	X	Hold Sample
SO-MUAU5-12	10/29/2015	1005	G	So	4		Y	X	X	MS/MSD
SO-MUAU5-24	10/29/2015	1010	G	So	2			X	X	
SO-MUAU5-36	10/29/2015	1015	G	So	2			X	X	Hold Sample
SO-MUAU5-48	10/29/2015	1020	G	So	2			X	X	Hold Sample

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ______

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for ______ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No
Custody Seal No.:
Cooler Temp. (°C): Obs'd: ______ Corr'd: ______
Therm ID No.: ______

Relinquished by:	Company: TETRA TECH	Date/Time: 10/29/15 1410	Received by:	Company: TA	Date/Time: 10/29/15 19:15
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

TestAmerica Laboratories, Inc.

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

Client Contact	**Project Manager: Ron Marnicio**	**Site Contact: Alex Valli**	**Date: 10/29/2015**	COC No:
Ron Marnicio Tetra Tech	**Tel/Fax:(617) 443-7551**	**Lab Contact: James Madison**	**Carrier:TA courier**	3 of 5 COCs
160 Federal Street, 3rd floor	**Analysis Turnaround Time**			Sampler:
Boston, MA 02110	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(617) 443-7551 Phone	TAT if different from Below ______			Walk-in Client:
(xxx) xxx-xxxx FAX	☑ 2 weeks			Lab Sampling:
Project Name: Fireworks	☐ 1 week			
Site: Hanover, MA	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	TAL Metals	Sample Specific Notes:
SO-MUAU5-60	10/29/2015	1025	G	So	2			X	X	Hold Sample
SO-MUAU6-12	10/29/2015	1155	G	So	2			X	X	
SO-MUAU6-24	10/29/2015	1200	G	So	2			X	X	
SO-MUAU6-24-DUP	10/29/2015	1205	G	So	2			X	X	
SO-MUAU6-36	10/29/2015	1210	G	So	2			X	X	Hold Sample
SO-MUAU6-48	10/29/2015	1215	G	So	2			X	X	Hold Sample
SO-MUAU7-12	10/29/2015	1217	G	So	4		Y	X	X	MS/MSD
SO-MUAU7-24	10/29/2015	1220	G	So	2			X	X	
SO-MUAU7-36	10/29/2015	1223	G	So	2			X	X	Hold Sample
SO-MUAU7-48	10/29/2015	1225	G	So	2			X	X	Hold Sample
SO-MUAU8-12	10/29/2015	1228	G	So	2			X	X	
SO-MUAU8-12-DUP	10/29/2015	1228	G	So	2			X	X	

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ______

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for ______ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No
Custody Seal No.:
Cooler Temp. (°C): Obs'd: ______ Corr'd: ______
Therm ID No.: ______

Relinquished by:	Company: TETRA TECH	Date/Time: 10/29/15 1410	Received by:	Company: TA	Date/Time: 10/29/15 14:15
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Form No. CA-C-WI-002, Rev. 4.6, dated 09/02/2015

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica Laboratories, Inc.

Client Contact
Ron Marnicio Tetra Tech
160 Federal Street, 3rd floor
Boston, MA 02110
(617) 443-7551 Phone
(xxx) xxx-xxxx FAX
Project Name: Fireworks
Site: Hanover, MA
P O #

Project Manager: Ron Marnicio
Tel/Fax:(617) 443-7551

Analysis Turnaround Time
☐ CALENDAR DAYS ☐ WORKING DAYS
TAT if different from Below ________
☑ 2 weeks
☐ 1 week
☐ 2 days
☐ 1 day

Site Contact: Alex Valli
Lab Contact: James Madison

Date: 10/29/2015
Carrier: TA courier

COC No:
4 of 5 COCs
Sampler:
For Lab Use Only:
Walk-in Client:
Lab Sampling:
Job / SDG No.:

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	TAL Metals	Sample Specific Notes:
SO-MUAU8-24	10/29/2015	1230	G	So	2			X	X	
SO-MUAU8-36	10/29/2015	1232	G	So	2			X	X	Hold Sample
SO-MUAU8-48	10/29/2015	1235	G	So	2			X	X	Hold Sample
SO-MUAU9-12	10/29/2015	1237	G	So	2			X	X	
SO-MUAU9-24	10/29/2015	1240	G	So	4		Y	X	X	MS/MSD
SO-MUAU9-36	10/29/2015	1243	G	So	2			X	X	Hold Sample
SO-MUAU9-48	10/29/2015	1245	G	So	2			X	X	Hold Sample
SO-MUAU10-12	10/29/2015	1247	G	So	2			X	X	
SO-MUAU10-24	10/29/2015	1250	G	So	2			X	X	
SO-MUAU10-36	10/29/2015	1253	G	So	2			X	X	Hold Sample
SO-MUAU10-48	10/29/2015	1255	G	So	2			X	X	Hold Sample
SO-MUAU11-12	10/29/2015	1257	G	So	2			X	X	

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ________

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.
☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return to Client ☐ Disposal by Lab ☐ Archive for ________ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No
Custody Seal No.:
Cooler Temp. (°C): Obs'd:________ Corr'd:________ Therm ID No.:________

Relinquished by:	Company: TETRA TECH	Date/Time: 10/29/15 1113	Received by:	Company: TA	Date/Time: 11/29/15-14:15
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Form No. CA-C-WI-002, Rev. 4.6, dated 09/02/2015

TestAmerica Burlington
30 Community Drive
Suite 11
South Burlington, VT 05403-6809
phone 802.660.1990 fax 802.660.1919

Chain of Custody Record

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

TestAmerica Laboratories, Inc.

Client Contact	**Project Manager: Ron Marnicio**	**Site Contact: Alex Valli**	**Date: 10/29/2015**	COC No:
Ron Marnicio Tetra Tech	**Tel/Fax:(617) 443-7551**	**Lab Contact: James Madison**	**Carrier:TA courier**	5 of 5 COCs
160 Federal Street, 3rd floor	**Analysis Turnaround Time**			Sampler:
Boston, MA 02110	☐ CALENDAR DAYS ☐ WORKING DAYS			**For Lab Use Only:**
(617) 443-7551 Phone	TAT if different from Below ____			Walk-in Client:
(xxx) xxx-xxxx FAX	☑ 2 weeks			Lab Sampling:
Project Name: Fireworks	☐ 1 week			
Site: Hanover, MA	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	Total Mercury 7471MCP	TAL Metals	Full Haz Waste Characterization	TCLP Metals	Grain Size	Sample Specific Notes:
SO-MUAU11-24	10/29/2015	1300	G	So	2			X	X				
SO-MUAU11-36	10/29/2015	1303	G	So	2			X	X				Hold Sample
SO-MUAU11-48	10/29/2015	1305	G	So	2			X	X				Hold Sample
SO-MUAU12-12	10/29/2015	1307	G	So	2			X	X				
SO-MUAU12-24	10/29/2015	1310	G	So	2			X	X				
SO-MUAU12-36	10/29/2015	1313	G	So	2			X	X				Hold Sample
SO-MUAU-GT	10/29/2015	1315	G	So	3							X	
SO-MUAU-WD	10/29/2015	1317	G	So	3					X	X		

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ____

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☐ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☐ Disposal by Lab ☐ Archive for ____ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No

Custody Seal No.:

Cooler Temp. (°C): Obs'd: ____ Corr'd: ____ Therm ID No.: ____

Relinquished by: ~~Tetra Tech~~ (AV)	Company: Tetra Tech	Date/Time: 10/29/15 14	Received by:	Company: TA	Date/Time: 10/29/15 14:15
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Form No. CA-C-WI-002, Rev. 4.6, dated 09/02/2015

PDC Laboratories, Inc. – St. Louis
3278 N. Highway 67 (Lindbergh)
Florissant, MO 63033
www.pdclab.com www.environmetrics.net

CHAIN OF CUSTODY RECORD

Phone (314) 432-0550 or (314) 921-4488
Fax (314) 432-4977 or (314) 921-4494

State where samples collected MA

(Instructions/Sample Acceptance Policy on Reverse)

ALL SHADED AREAS MUST BE COMPLETED BY CLIENT (PLEASE PRINT)

① CLIENT: Tetra Tech
ADDRESS: 160 Federal Steet, 3rd Floor
CITY STATE ZIP: Boston, MA 02110
CONTACT PERSON: Ron Marnicio

PROJECT NUMBER: 106-4383
P.O. NUMBER:
MEANS SHIPPED: FedEx
PHONE NUMBER: 617-443-7500
FAX NUMBER:
EMAIL ADDRESS: Ron.Marnicio@tetratech.com
SAMPLER: Alex Valli
SAMPLER'S SIGNATURE:
MATRIX TYPES: [illegible]

③ ANALYSIS REQUESTED: Dredge Elutriate Test

④ (FOR LAB USE ONLY)
LOGIN # ________
LOGGED BY: ________
LAB PROJ #
TEMPLATE:
PROJ. MGR:

② SAMPLE DESCRIPTION AS YOU WANT ON REPORT	DATE COLLECTED	TIME COLLECTED	SAMPLE TYPE GRAB	SAMPLE TYPE COMP	MATRIX TYPE	Bottle Count	Dredge Elutriate Test	REMARKS
SD-LUFP-BP	10/29/2015	1330		C	Sed	7	X	5 gal Sed, 30Gal H2O
SD-MLFP-BP	10/29/2015	1345		C	Sed	7	X	5 gal Sed, 30Gal H2O
SD-ECCS-BP	10/29/2015	1400		C	Sed	7	X	5 gal Sed, 30Gal H2O

⑤ TURNAROUND TIME (RUSH TAT IS SUBJECT TO PDC LABS APROVAL AND SURCHARGE)
☒ Normal (8-10 Bus. Days) ☐ Rush (5 Bus. Days) ☐ Fastrak (3 Bus. Days) ☐ 1-2 Bus. Days ☐ Same Day
DATE DUE ________
RESULTS BY: ☒ E-MAIL ☐ FAX ☐ PHONE CALL PHONE/FAX # IF DIFFERENT FROM ABOVE

⑥ The sample temperature will be measured upon receipt at the lab. By initialing this area, you request that the lab notify you, before proceeding with analysis, if the sample temperature is outside of the range of 0.1-6.0°C. By not initialing this area, you allow the lab to proceed with analytical testing regardless of the sample temperature. ________

⑦ RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY	DATE	TIME
RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY:	DATE	TIME
RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY	DATE	TIME
RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY	DATE	TIME

⑧ COMMENTS: (FOR LAB USE ONLY)

SAMPLE TEMPERATURE UPON RECEIPT ______ °C

CHILL PROCESS STARTED PRIOR TO RECEIPT	Y OR N
SAMPLE(S) RECEIVED ON ICE	Y OR N
PROPER BOTTLES RECEIVED IN GOOD CONDITION	Y OR N
BOTTLES FILLED WITH ADEQUATE VOLUME	Y OR N
SAMPLES RECEIVED WITHIN HOLD TIME(S) (EXCLUDES TYPICAL FIELD PARAMETERS)	Y OR N
DATE AND TIME TAKEN FROM SAMPLE BOTTLE	

Thank you for using PDC Laboratories, Inc. Locations in Peoria, IL; St. Louis, MO; and Springfield, MO

PAGE ______ OF ______

Chain of Custody Record

WaterSolve, Llc.
5031 68th St. SE
Caledonia, MI 49316

Regulatory Program: ☐ DW ☐ NPDES ☐ RCRA ☐ Other:

Client Contact	**Project Manager: Ron Marnicio**	**Site Contact: Alex Valli**	**Date: 10/30/2015**	COC No:
TetraTech, Inc.	**Tel/Fax: 617.443.7551**	**Lab Contact: Gregg Lebster**	**Carrier: FedEx**	1 of 1 COCs
160 Federal St., 3rd Floor	**Analysis Turnaround Time**			Sampler:
Boston, MA	☐ CALENDAR DAYS ☑ WORKING DAYS			**For Lab Use Only:**
(617)443-7551 Phone	TAT if different from Below ______			Walk-in Client:
(xxx) xxx-xxxx FAX	☐ 2 weeks			Lab Sampling:
Project Name: Fireworks	☐ 1 week			
Site: Hanover, MA	☐ 2 days			Job / SDG No.:
P O #	☐ 1 day			

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	DeWatering Sampling	Amendment Sampling	Sample Specific Notes:
SD-LUFP-BP	10/30/2015	1200	C	Sed	3			X	X	
SD-MLFP-BP	10/30/2015	1215	C	Sed	3			X	X	
SD-ECCS-BP	10/30/2015	1230	C	Sed	3			X	X	

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ______

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.

☑ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)

☐ Return to Client ☒ Disposal by Lab ☐ Archive for ______ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No	Custody Seal No.:	Cooler Temp. (°C): Obs'd: ______ Corr'd: ______	Therm ID No.: ______

Relinquished by:	Company: TETRA TECH	Date/Time: 10/30/15 1300	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

APPENDIX 3B-1

Analytical Results for Mercury in Sediments

Appendix 3B-1. Analytical Results for Mercury in Sediments

Sample ID	Sampling Date	Depth (inches	Sample Matrix	Sample Type	Sample Basis	Percent Solids	Analysi Metho	Total (mg/Kg)	Lab Flag	Dilution Factor	Reporting Limit (mg/Kg)
SD-ECCS10-PC	10/25/2015	0-3	SEDIMENT	COMPOSITE	As-Received	38.1	7471A	125		50	12.9
SD-ECCS11-PC	10/25/2015	0-3	SEDIMENT	COMPOSITE	As-Received	48.5	7471A	453		200	38.7
SD-ECCS12-PC	10/25/2015	0-3	SEDIMENT	COMPOSITE	As-Received	33	7471A	71.6		20	6.4
SD-ECCS12-PC-DUP	10/25/2015	0-3	SEDIMENT	COMPOSITE	As-Received	27.1	7471A	156		50	18.4
SD-ECCS13-PC	10/25/2015	0-3	SEDIMENT	COMPOSITE	As-Received	46.2	7471A	551		200	44
SD-ECCS14-PC	10/25/2015	0-3	SEDIMENT	COMPOSITE	As-Received	58.1	7471A	12.2		10	1.9
SD-ECCS16-PC	10/25/2015	0-3	SEDIMENT	COMPOSITE	As-Received	56.2	7471A	28.6		20	3.6
SD-ECCS17-PC	10/26/2015	0-3	SEDIMENT	COMPOSITE	As-Received	56.9	7471A	49.4		100	15.7
SD-ECCS18-PC	10/25/2015	0-3	SEDIMENT	COMPOSITE	As-Received	36.8	7471A	45.6		10	3
SD-ECCS18-PC-DUP	10/25/2015	0-3	SEDIMENT	COMPOSITE	As-Received	26.8	7471A	66.2		10	4.1
SD-ECCS1-PC	10/25/2015	0-3	SEDIMENT	COMPOSITE	As-Received	22.9	7471A	14.6		10	3.9
SD-ECCS4-PC	10/25/2015	0-3	SEDIMENT	COMPOSITE	Air-Dried	18.4	7471A	48.9		100	2
SD-ECCS4-PC-DUP	10/25/2015	0-3	SEDIMENT	COMPOSITE	Air-Dried	18.2	7471A	33.6		100	1.9
SD-ECCS5-PC	10/25/2015	0-3	SEDIMENT	COMPOSITE	As-Received	47.5	7471A	186		100	18.3
SD-ECCS6-PC	10/25/2015	0-3	SEDIMENT	COMPOSITE	As-Received	55.7	7471A	16		10	2
SD-ECCS7-PC	10/25/2015	0-3	SEDIMENT	COMPOSITE	As-Received	28.1	7471A	45.2		10	3.6
SD-ECCS8-PC	10/25/2015	0-3	SEDIMENT	COMPOSITE	As-Received	36.1	7471A	84.8		20	6.4
SD-ECCS9-PC	10/25/2015	0-3	SEDIMENT	COMPOSITE	As-Received	33.1	7471A	261		100	28.4
SD-INRC1-03	10/26/2015	0-3	SEDIMENT	GRAB	As-Received	79.9	7471A	0.21		1	0.14
SD-INRC2-03	10/26/2015	0-3	SEDIMENT	COMPOSITE	As-Received	80.9	7471A	0.26		1	0.13
SD-INRC3-03	10/26/2015	0-3	SEDIMENT	COMPOSITE	As-Received	56	7471A	0.78		1	0.19
SD-INRC4-03	10/26/2015	0-3	SEDIMENT	GRAB	As-Received	54.8	7471A	0.084	J	1	0.18
SD-INRC5-03	10/26/2015	0-3	SEDIMENT	COMPOSITE	As-Received	35	7471A	4.3		10	3.1
SD-INRC5-03-DUP	10/26/2015	0-3	SEDIMENT	COMPOSITE	As-Received	34.5	7471A	2.6		1	0.27
SD-INRC7-03	10/26/2015	0-3	SEDIMENT	GRAB	As-Received	40.8	7471A	3.1		10	2.2
SD-INRC8-03	10/26/2015	0-3	SEDIMENT	GRAB	Air-Dried	9.7	7471A	4.2		100	1.9
SD-LUFP102-06	10/12/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	52.1		100	1.9
SD-LUFP102-12	10/12/2015	6-12	SEDIMENT	GRAB	As-Received	32.7	7471A	0.066		1	0.061
SD-LUFP102-18	10/12/2015	12-18	SEDIMENT	GRAB	As-Received	46.9	7471A	0.042	U	1	0.042
SD-LUFP102-24	10/12/2015	18-24	SEDIMENT	GRAB	As-Received	44.4	7471A	0.079		1	0.046
SD-LUFP103-06	10/12/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	43.8		100	2
SD-LUFP103-12	10/12/2015	6-12	SEDIMENT	GRAB	As-Received	20.4	7471A	1.3		1	0.093
SD-LUFP104-06	10/9/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	80.8		500	10.1
SD-LUFP104-12	10/9/2015	6-12	SEDIMENT	GRAB	As-Received	21.3	7471A	39.9		20	1.9
SD-LUFP106-06	10/14/2015	3-6	SEDIMENT	GRAB	As-Received	39.2	7471A	0.26	U	1	0.26
SD-LUFP108-06	10/14/2015	3-6	SEDIMENT	GRAB	As-Received	85	7471A	1.1		1	0.13
SD-LUFP108-06-DUP	10/14/2015	3-6	SEDIMENT	GRAB	As-Received	80.9	7471A	1.1		1	0.13
SD-LUFP110-06	10/14/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	10.8		100	1.9
SD-LUFP110-06-DUP	10/14/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	14.1		100	1.9
SD-LUFP110-12	10/14/2015	6-12	SEDIMENT	GRAB	As-Received	22.8	7471A	0.5	U	1	0.5
SD-LUFP111-06	10/12/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	104		500	9.7
SD-LUFP111-12	10/12/2015	6-12	SEDIMENT	GRAB	As-Received	19.8	7471A	0.18		1	0.1
SD-LUFP111-12	10/12/2015	6-12	SEDIMENT	GRAB	Air-Dried	19.8	7471A	18.3		100	1.9
SD-LUFP111-18	10/12/2015	12-18	SEDIMENT	GRAB	As-Received	16.3	7471A	0.053	J	1	0.12
SD-LUFP111-18-DUP	10/12/2015	12-18	SEDIMENT	GRAB	As-Received	16	7471A	0.12	U	1	0.12
SD-LUFP111-24	10/12/2015	18-24	SEDIMENT	GRAB	As-Received	25.6	7471A	0.037	J	1	0.077
SD-LUFP112-06	10/12/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	60.4		100	2
SD-LUFP112-12	10/12/2015	6-12	SEDIMENT	GRAB	As-Received	22.6	7471A	1.6	F1 F2	2	0.18
SD-LUFP112-12	10/12/2015	6-12	SEDIMENT	GRAB	Air-Dried	22.5	7471A	2.4		10	0.2
SD-LUFP112-18	10/12/2015	12-18	SEDIMENT	GRAB	As-Received	36.4	7471A	0.05	J	1	0.051
SD-LUFP112-24	10/12/2015	18-24	SEDIMENT	GRAB	As-Received	38.7	7471A	0.034	J	1	0.051
SD-LUFP113-06	10/12/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	92.9		500	10.2
SD-LUFP114-06	10/14/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	63.5		100	1.9
SD-LUFP114-12	10/14/2015	6-12	SEDIMENT	GRAB	As-Received	21.8	7471A	4.2		1	0.4
SD-LUFP114-12-DUP	10/14/2015	6-12	SEDIMENT	GRAB	As-Received	25.2	7471A	0.45		1	0.4
SD-LUFP115-06	10/14/2015	3-6	SEDIMENT	GRAB	As-Received	23.5	7471A	53.4	H	10	4.1
SD-LUFP115-12	10/14/2015	6-12	SEDIMENT	GRAB	As-Received	32.5	7471A	0.32		1	0.32

Appendix 3B-1. Analytical Results for Mercury in Sediments

SD-LUFP116-06	10/14/2015	3-6	SEDIMENT	GRAB	As-Received	28.5	7471A	8.8		5	1.9
SD-LUFP116-12	10/14/2015	6-12	SEDIMENT	GRAB	As-Received	74.5	7471A	84.6		100	11.8
SD-LUFP117-06	10/12/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	222		1000	20.1
SD-LUFP117-12	10/12/2015	6-12	SEDIMENT	GRAB	As-Received	25.9	7471A	0.16		1	0.071
SD-LUFP118-06	10/14/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	125		500	9.5
SD-LUFP118-12	10/14/2015	6-12	SEDIMENT	GRAB	As-Received	22.2	7471A	0.089	J	1	0.44
SD-LUFP119-06	10/14/2015	3-6	SEDIMENT	GRAB	As-Received	32.1	7471A	192		100	31.1
SD-LUFP119-12	10/14/2015	6-12	SEDIMENT	GRAB	As-Received	52.5	7471A	0.2	U	1	0.2
SD-LUFP120-06	10/14/2015	3-6	SEDIMENT	GRAB	As-Received	66.3	7471A	1.9		1	0.15
SD-LUFP121-06	10/12/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	0.56		1	0.02
SD-LUFP121-12	10/12/2015	6-12	SEDIMENT	GRAB	As-Received	19.5	7471A	39.4		20	2
SD-LUFP122-06	10/14/2015	3-6	SEDIMENT	GRAB	As-Received	20.6	7471A	621		100	51.1
SD-LUFP123-06	10/14/2015	3-6	SEDIMENT	GRAB	As-Received	19.5	7471A	682		100	45.2
SD-LUFP124-06	10/14/2015	3-6	SEDIMENT	GRAB	As-Received	70.3	7471A	0.46		1	0.14
SD-LUFP124-12	10/14/2015	6-12	SEDIMENT	GRAB	As-Received	47.1	7471A	0.093	J	1	0.22
SD-LUFP58-06	10/8/2015	3-6	SEDIMENT	GRAB	As-Received	28.6	7471A	36.9		50	3.4
SD-LUFP58-12	10/8/2015	6-12	SEDIMENT	GRAB	As-Received	36.8	7471A	14.5		20	1.1
SD-LUFP58-18	10/8/2015	12-18	SEDIMENT	GRAB	As-Received	35.4	7471A	12.8		10	2.5
SD-LUFP59-06	10/7/2015	3-6	SEDIMENT	GRAB	As-Received	35.9	7471A	1.1		1	0.055
SD-LUFP59-12	10/7/2015	6-12	SEDIMENT	GRAB	As-Received	73.6	7471A	0.72		1	0.027
SD-LUFP60-06	10/7/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	4.4		20	0.4
SD-LUFP60-06-DUP	10/7/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	11.3		50	0.93
SD-LUFP60-12	10/7/2015	6-12	SEDIMENT	GRAB	As-Received	49.1	7471A	0.76		1	0.039
SD-LUFP63-06	10/8/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	26.8		100	1.9
SD-LUFP63-12	10/8/2015	6-12	SEDIMENT	GRAB	As-Received	25.7	7471A	369		200	14.9
SD-LUFP63-18	10/8/2015	12-18	SEDIMENT	GRAB	As-Received	20	7471A	7.9		2	0.95
SD-LUFP63-24	10/8/2015	18-24	SEDIMENT	GRAB	As-Received	37	7471A	0.25		1	0.25
SD-LUFP63-30	10/8/2015	24-30	SEDIMENT	GRAB	As-Received	35.6	7471A	0.15	J	1	0.27
SD-LUFP63-36	10/8/2015	30-36	SEDIMENT	GRAB	As-Received	82.3	7471A	0.13	U	1	0.13
SD-LUFP65-06	10/7/2015	3-6	SEDIMENT	GRAB	As-Received	44.7	7471A	1.1		1	0.042
SD-LUFP65-12	10/7/2015	6-12	SEDIMENT	GRAB	As-Received	65.7	7471A	0.21		1	0.029
SD-LUFP66-06	10/8/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	5.8		20	0.4
SD-LUFP66-12	10/8/2015	6-12	SEDIMENT	GRAB	As-Received	64.4	7471A	0.06	F1	1	0.031
SD-LUFP69-06	10/8/2015	3-6	SEDIMENT	GRAB	As-Received	11.2	7471A	401		100	17.7
SD-LUFP69-06	10/8/2015	3-6	SEDIMENT	GRAB	Air-Dried	11.2	7471A	467		2000	40.6
SD-LUFP69-12	10/8/2015	6-12	SEDIMENT	GRAB	As-Received	25.6	7471A	0.31	J	1	0.44
SD-LUFP70-06	10/8/2015	3-6	SEDIMENT	GRAB	As-Received	50.3	7471A	0.32		1	0.039
SD-LUFP70-06-DUP	10/8/2015	3-6	SEDIMENT	GRAB	As-Received	51.2	7471A	0.2		1	0.038
SD-LUFP71-06	10/8/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	59.2		100	2
SD-LUFP71-12	10/8/2015	6-12	SEDIMENT	GRAB	As-Received	22.5	7471A	92.3		100	8.6
SD-LUFP71-18	10/8/2015	12-18	SEDIMENT	GRAB	As-Received	34.7	7471A	12.9		10	3.1
SD-LUFP71-24	10/8/2015	18-24	SEDIMENT	GRAB	As-Received	56.6	7471A	0.072	J	1	0.15
SD-LUFP74-06	10/8/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	109		200	4.1
SD-LUFP74-12	10/8/2015	6-12	SEDIMENT	GRAB	As-Received	24.1	7471A	6.7		5	0.39
SD-LUFP74-18	10/8/2015	12-18	SEDIMENT	GRAB	As-Received	29.7	7471A	0.066	J	1	0.32
SD-LUFP74-24	10/8/2015	18-24	SEDIMENT	GRAB	As-Received	66.3	7471A	0.16	U	1	0.16
SD-LUFP75-06	10/8/2015	3-6	SEDIMENT	GRAB	As-Received	26.9	7471A	103		100	7.3
SD-LUFP75-12	10/8/2015	6-12	SEDIMENT	GRAB	As-Received	43.5	7471A	5.3		10	0.46
SD-LUFP75-18	10/8/2015	12-18	SEDIMENT	GRAB	As-Received	73.9	7471A	0.035	J	1	0.14
SD-LUFP75-24	10/8/2015	18-24	SEDIMENT	GRAB	As-Received	43.8	7471A	0.05	J	1	0.2
SD-LUFP76-06	10/9/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	367		2000	40.8
SD-LUFP76-12	10/9/2015	6-12	SEDIMENT	GRAB	As-Received	24.4	7471A	2.2		1	0.081
SD-LUFP76-12-DUP	10/9/2015	6-12	SEDIMENT	GRAB	As-Received	26.1	7471A	9.9		10	0.73
SD-LUFP76-18	10/9/2015	12-18	SEDIMENT	GRAB	As-Received	35	7471A	0.11	J	1	0.34
SD-LUFP76-24	10/9/2015	18-24	SEDIMENT	GRAB	As-Received	26.8	7471A	0.11	J	1	0.33
SD-LUFP79-06	10/9/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	18.1		100	2
SD-LUFP79-12	10/9/2015	6-12	SEDIMENT	GRAB	As-Received	25.5	7471A	0.51		1	0.079
SD-LUFP80-06	10/8/2015	3-6	SEDIMENT	GRAB	As-Received	45.3	7471A	0.36		1	0.044
SD-LUFP80-12	10/8/2015	6-12	SEDIMENT	GRAB	As-Received	45.5	7471A	0.81		1	0.042

Appendix 3B-1. Analytical Results for Mercury in Sediments

SD-LUFP81-06	10/8/2015	3-6	SEDIMENT	GRAB	As-Received	27.2	7471A	42		50	3.5
SD-LUFP81-12	10/8/2015	6-12	SEDIMENT	GRAB	As-Received	40.7	7471A	0.37	F1	1	0.049
SD-LUFP82-06	10/9/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	155		500	9.5
SD-LUFP82-12	10/9/2015	6-12	SEDIMENT	GRAB	As-Received	21.2	7471A	1.3		1	0.091
SD-LUFP82-12	10/9/2015	6-12	SEDIMENT	GRAB	Air-Dried	21.2	7471A	1.5		5	0.1
SD-LUFP84-06	10/9/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	108		200	3.8
SD-LUFP84-12	10/9/2015	3-6	SEDIMENT	GRAB	As-Received	34.3	7471A	0.22		1	0.055
SD-LUFP85-06	10/8/2015	3-6	SEDIMENT	GRAB	As-Received	11.9	7471A	7.3		2	0.33
SD-LUFP85-06	10/8/2015	3-6	SEDIMENT	GRAB	Air-Dried	11.9	7471A	29		100	2
SD-LUFP85-12	10/8/2015	6-12	SEDIMENT	GRAB	As-Received	30.4	7471A	0.12		1	0.065
SD-LUFP86-06	10/8/2015	3-6	SEDIMENT	GRAB	As-Received	27.3	7471A	14.9		20	1.4
SD-LUFP86-12	10/8/2015	6-12	SEDIMENT	GRAB	As-Received	41.4	7471A	0.21	J	1	0.25
SD-LUFP87-06	10/9/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	222		1000	18.8
SD-LUFP87-12	10/9/2015	6-12	SEDIMENT	GRAB	As-Received	31.5	7471A	0.15		1	0.063
SD-LUFP88-06	10/9/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	40.1		100	2
SD-LUFP88-12	10/9/2015	6-12	SEDIMENT	GRAB	Air-Dried	-	7471A	31.1		100	2
SD-LUFP88-18	10/9/2015	12-18	SEDIMENT	GRAB	As-Received	22.9	7471A	0.11		1	0.082
SD-LUFP89-06	10/9/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	124		500	9.9
SD-LUFP89-12	10/9/2015	6-12	SEDIMENT	GRAB	As-Received	36.5	7471A	0.81		1	0.055
SD-LUFP90-06	10/12/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	71.6		100	1.9
SD-LUFP90-12	10/12/2015	6-12	SEDIMENT	GRAB	As-Received	15.6	7471A	19.1		10	1.3
SD-LUFP90-18	10/12/2015	12-18	SEDIMENT	GRAB	As-Received	47.4	7471A	6.7		5	0.2
SD-LUFP90-24	10/12/2015	18-24	SEDIMENT	GRAB	As-Received	39.2	7471A	0.57		1	0.049
SD-LUFP90-30	10/12/2015	24-30	SEDIMENT	GRAB	As-Received	40.7	7471A	0.83		1	0.049
SD-LUFP90-36	10/12/2015	30-36	SEDIMENT	GRAB	As-Received	34.5	7471A	1.2		1	0.059
SD-LUFP91-06	10/9/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	63.4		100	2
SD-LUFP91-12	10/9/2015	6-12	SEDIMENT	GRAB	As-Received	42.8	7471A	0.1		1	0.048
SD-LUFP93-06	10/12/2015	3-6	SEDIMENT	GRAB	As-Received	18.3	7471A	8.6		5	0.52
SD-LUFP93-06-DUP	10/12/2015	3-6	SEDIMENT	GRAB	As-Received	21.9	7471A	1.2		1	0.085
SD-LUFP93-12	10/12/2015	6-12	SEDIMENT	GRAB	As-Received	36.6	7471A	0.058		1	0.052
SD-LUFP93-18	10/12/2015	12-18	SEDIMENT	GRAB	As-Received	34.1	7471A	0.075		1	0.059
SD-LUFP93-24	10/12/2015	18-24	SEDIMENT	GRAB	As-Received	49.8	7471A	0.04	U	1	0.04
SD-LUFP93-30	10/12/2015	24-30	SEDIMENT	GRAB	As-Received	64	7471A	0.032	U	1	0.032
SD-LUFP95-06	10/9/2015	3-6	SEDIMENT	GRAB	As-Received	21.7	7471A	58.8		50	4.6
SD-LUFP95-06-DUP	10/9/2015	3-6	SEDIMENT	GRAB	As-Received	21.2	7471A	59.5		50	4.6
SD-LUFP95-12	10/9/2015	6-12	SEDIMENT	GRAB	As-Received	29.4	7471A	3		5	0.33
SD-LUFP97-06	10/12/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	44.2		100	2
SD-LUFP97-12	10/12/2015	6-12	SEDIMENT	GRAB	As-Received	14.4	7471A	111		50	6.9
SD-LUFP97-18	10/12/2015	12-18	SEDIMENT	GRAB	Air-Dried	11.4	7471A	55.7		100	2
SD-LUFP97-18	10/12/2015	12-18	SEDIMENT	GRAB	As-Received	11.4	7471A	132		50	8.2
SD-LUFP97-24	10/12/2015	18-24	SEDIMENT	GRAB	As-Received	13.1	7471A	3.2		1	0.15
SD-LUFP98-06	10/12/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	21.9		100	2
SD-LUFP98-12	10/12/2015	6-12	SEDIMENT	GRAB	As-Received	21.5	7471A	281		100	9.4
SD-LUFP98-18	10/12/2015	12-18	SEDIMENT	GRAB	As-Received	21.6	7471A	4.1		2	0.18
SD-LUFP98-24	10/12/2015	18-24	SEDIMENT	GRAB	As-Received	26.7	7471A	11.9		10	0.77
SD-LDRC1-06	10/15/2015	3-6	SEDIMENT	GRAB	As-Received	68.6	7471A	1.2		1	0.17
SD-LDRC1-06-DUP	10/15/2015	3-6	SEDIMENT	GRAB	As-Received	72.3	7471A	0.97		1	0.15
SD-LDRC2-06	10/15/2015	3-6	SEDIMENT	GRAB	As-Received	26.4	7471A	62		20	7.6
SD-LDRC2-12	10/15/2015	6-12	SEDIMENT	GRAB	As-Received	37.9	7471A	1.7		1	0.26
SD-LDRC3-06	10/15/2015	3-6	SEDIMENT	GRAB	As-Received	23	7471A	17.3		10	3.8
SD-LDRC3-12	10/15/2015	6-12	SEDIMENT	GRAB	As-Received	27.5	7471A	0.27	J	1	0.38
SD-MUAU10-06	10/28/2015	3-6	SEDIMENT	GRAB	Air-Dried	12.4	7471A	19.8		20	2.1
SD-MUAU10-12	10/28/2015	6-12	SEDIMENT	GRAB	As-Received	39.6	7471A	1.5		1	0.24
SD-MUAU10-18	10/28/2015	12-18	SEDIMENT	GRAB	As-Received	72.3	7471A	0.29		1	0.12
SD-MUAU1-06	10/28/2015	3-6	SEDIMENT	GRAB	As-Received	39.8	7471A	21		5	1.4
SD-MUAU11-06	10/27/2015	3-6	SEDIMENT	GRAB	Air-Dried	10.1	7471A	28.2		20	2.4
SD-MUAU1-12	10/28/2015	6-12	SEDIMENT	GRAB	As-Received	63.3	7471A	3.2		2	0.34
SD-MUAU12-06	10/28/2015	3-6	SEDIMENT	GRAB	Air-Dried	8.9	7471A	18		10	1.2
SD-MUAU13-06	10/28/2015	3-6	SEDIMENT	GRAB	Air-Dried	10.5	7471A	137		100	11.5

Appendix 3B-1. Analytical Results for Mercury in Sediments

SD-MUAU14-06	10/28/2015	3-6	SEDIMENT	GRAB	Air-Dried	18.4	7471A	160		100	10.9
SD-MUAU15-06	10/28/2015	3-6	SEDIMENT	GRAB	Air-Dried	12.5	7471A	115		100	10
SD-MUAU17-06	10/28/2015	3-6	SEDIMENT	GRAB	Air-Dried	17.5	7471A	32.7		20	2.1
SD-MUAU17-12	10/28/2015	6-12	SEDIMENT	GRAB	Air-Dried	10.6	7471A	4.4		10	1
SD-MUAU18-06	10/28/2015	3-6	SEDIMENT	GRAB	Air-Dried	9.6	7471A	173		200	17.4
SD-MUAU19-06	10/28/2015	3-6	SEDIMENT	GRAB	As-Received	20.3	7471A	38.2		10	4.9
SD-MUAU20-06	10/28/2015	3-6	SEDIMENT	GRAB	As-Received	25.4	7471A	6.7		2	0.68
SD-MUAU21-06	10/28/2015	3-6	SEDIMENT	GRAB	Air-Dried	17	7471A	14.8		10	0.97
SD-MUAU22-06	10/28/2015	3-6	SEDIMENT	GRAB	Air-Dried	11	7471A	121		100	11.3
SD-MUAU23-06	10/28/2015	3-6	SEDIMENT	GRAB	Air-Dried	13.4	7471A	237		200	22.6
SD-MUAU24-06	10/28/2015	3-6	SEDIMENT	GRAB	Air-Dried	13.8	7471A	252		200	20.7
SD-MUAU25-06	10/28/2015	3-6	SEDIMENT	GRAB	As-Received	39.4	7471A	11.3		5	1.3
SD-MUAU26-06	10/28/2015	3-6	SEDIMENT	GRAB	Air-Dried	10.5	7471A	22.8		20	2.1
SD-MUAU27-06	10/28/2015	3-6	SEDIMENT	GRAB	As-Received	57.3	7471A	551		200	39.5
SD-MUAU27-12	10/28/2015	6-12	SEDIMENT	GRAB	As-Received	34.8	7471A	602		500	133
SD-MUAU28-06	10/28/2015	3-6	SEDIMENT	GRAB	As-Received	70.5	7471A	253		100	15.8
SD-MUAU28-12	10/28/2015	6-12	SEDIMENT	GRAB	As-Received	65.2	7471A	340		500	71.9
SD-MUAU5-06	10/28/2015	3-6	SEDIMENT	GRAB	As-Received	43.3	7471A	0.95		1	0.24
SD-MUAU5-06-DUP	10/28/2015	3-6	SEDIMENT	GRAB	As-Received	53	7471A	2		1	0.19
SD-MUAU6-06	10/28/2015	3-6	SEDIMENT	GRAB	As-Received	25	7471A	5	F2	1	0.44
SD-MUAU6-06-DUP	10/28/2015	3-6	SEDIMENT	GRAB	As-Received	49.9	7471A	2.7		1	0.19
SD-MUAU7-06	10/28/2015	3-6	SEDIMENT	GRAB	Air-Dried	13.4	7471A	7.3		10	0.86
SD-MUAU7-06-DUP	10/28/2015	3-6	SEDIMENT	GRAB	As-Received	61.4	7471A	8.2		10	1.8
SD-MUAU7-12	10/28/2015	6-12	SEDIMENT	GRAB	As-Received	47.7	7471A	46.3		20	4.2
SD-MUAU8-06	10/28/2015	3-6	SEDIMENT	GRAB	As-Received	26.8	7471A	73.7		20	7.6
SD-MUAU8-12	10/28/2015	6-12	SEDIMENT	GRAB	As-Received	45.8	7471A	11.7		5	0.99
SD-MLFP13-06	10/20/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	5		20	0.4
SD-MLFP14-12	10/20/2015	6-12	SEDIMENT	GRAB	Air-Dried	-	7471A	63.2		100	2
SD-MLFP15-06	10/20/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	1.9	*	10	0.2
SD-MLFP15-12	10/20/2015	6-12	SEDIMENT	GRAB	Air-Dried	-	7471A	2.8	*	10	0.19
SD-MLFP15-18	10/20/2015	12-18	SEDIMENT	GRAB	Air-Dried	-	7471A	0.14	* F1	1	0.019
SD-MLFP15-24	10/20/2015	18-24	SEDIMENT	GRAB	As-Received	13.3	7471A	0.32	J	1	0.78
SD-MLFP15-30	10/20/2015	24-30	SEDIMENT	GRAB	As-Received	32.2	7471A	0.22	J	1	0.32
SD-MLFP16-06	10/20/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	8.9		100	2
SD-MLFP17-06	10/23/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	49		100	2
SD-MLFP17-12	10/23/2015	6-12	SEDIMENT	GRAB	As-Received	30.7	7471A	3.1		1	0.35
SD-MLFP17-12-DUP	10/23/2015	6-12	SEDIMENT	GRAB	As-Received	29.1	7471A	10		10	3.6
SD-MLFP17-18	10/23/2015	12-18	SEDIMENT	GRAB	As-Received	61.5	7471A	0.18		1	0.16
SD-MLFP18-06	10/23/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	120		500	10.2
SD-MLFP18-12	10/23/2015	6-12	SEDIMENT	GRAB	As-Received	32.6	7471A	0.69		1	0.33
SD-MLFP18-18	10/23/2015	12-18	SEDIMENT	GRAB	As-Received	31.3	7471A	0.23	J B	1	0.28
SD-MLFP19-06	10/23/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	112		500	9.9
SD-MLFP19-06-DUP	10/23/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	63.8		100	2
SD-MLFP19-12	10/23/2015	6-12	SEDIMENT	GRAB	Air-Dried	-	7471A	2.3		10	0.2
SD-MLFP20-06	10/21/2015	3-6	SEDIMENT	GRAB	As-Received	19.5	7471A	38.5		20	10.2
SD-MLFP20-12	10/21/2015	6-12	SEDIMENT	GRAB	As-Received	26.5	7471A	145		100	41.1
SD-MLFP20-12-DUP	10/21/2015	6-12	SEDIMENT	GRAB	As-Received	28.7	7471A	326		100	34.3
SD-MLFP20-18	10/21/2015	12-18	SEDIMENT	GRAB	As-Received	29.6	7471A	0.25	J	1	0.3
SD-MLFP21-06	10/21/2015	3-6	SEDIMENT	GRAB	As-Received	58.8	7471A	0.043	J	1	0.19
SD-MLFP21-06-DUP	10/21/2015	3-6	SEDIMENT	GRAB	As-Received	50.5	7471A	0.34		1	0.18
SD-MLFP21-12	10/21/2015	6-12	SEDIMENT	GRAB	As-Received	70.6	7471A	0.077	J	1	0.15
SD-MLFP21-18	10/21/2015	12-18	SEDIMENT	GRAB	As-Received	77.6	7471A	0.021	J	1	0.12
SD-MLFP24-06	10/23/2015	3-6	SEDIMENT	GRAB	As-Received	18.6	7471A	27.4		10	5.8
SD-MLFP24-12	10/23/2015	6-12	SEDIMENT	GRAB	As-Received	18	7471A	0.31	J	1	0.61
SD-MLFP24-18	10/23/2015	12-18	SEDIMENT	GRAB	Air-Dried	-	7471A	0.16		1	0.019
SD-MLFP25-06	10/23/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	26.9	F2	100	1.8
SD-MLFP25-12	10/23/2015	6-12	SEDIMENT	GRAB	Air-Dried	-	7471A	76.2		100	2
SD-MLFP28-06	10/23/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	11.8		100	1.8
SD-MLFP28-06-DUP	10/23/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	21.8		100	1.8

Appendix 3B-1. Analytical Results for Mercury in Sediments

SD-MLFP29-06	10/23/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	24.6		100	1.9
SD-MLFP29-12	10/23/2015	6-12	SEDIMENT	GRAB	As-Received	55.2	7471A	0.12	J B	1	0.18
SD-MLFP30-06	10/20/2015	3-6	SEDIMENT	GRAB	As-Received	19.6	7471A	10.2	F2	4	1.9
SD-MLFP30-12	10/20/2015	6-12	SEDIMENT	GRAB	As-Received	72	7471A	0.13	U	1	0.13
SD-MLFP3-06	10/19/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	39.9	H	100	2
SD-MLFP31-06	10/21/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	32.7	*	100	2
SD-MLFP31-12	10/21/2015	6-12	SEDIMENT	GRAB	As-Received	48.5	7471A	0.25		1	0.18
SD-MLFP3-12	10/19/2015	6-12	SEDIMENT	GRAB	Air-Dried	-	7471A	0.51	H	1	0.019
SD-MLFP32-06	10/21/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	73.7	*	100	1.9
SD-MLFP32-12	10/21/2015	6-12	SEDIMENT	GRAB	As-Received	36	7471A	0.43		1	0.31
SD-MLFP32-18	10/21/2015	12-18	SEDIMENT	GRAB	As-Received	80.8	7471A	0.049	J	1	0.14
SD-MLFP33-06	10/21/2015	3-6	SEDIMENT	GRAB	As-Received	24.1	7471A	2		1	0.44
SD-MLFP33-12	10/21/2015	6-12	SEDIMENT	GRAB	As-Received	74.2	7471A	0.041	J	1	0.12
SD-MLFP35-06	10/23/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	4.5		100	2
SD-MLFP35-12	10/23/2015	6-12	SEDIMENT	GRAB	Air-Dried	-	7471A	11.2		100	1.8
SD-MLFP35-12-DUP	10/23/2015	6-12	SEDIMENT	GRAB	Air-Dried	-	7471A	10		50	0.91
SD-MLFP35-18	10/23/2015	12-18	SEDIMENT	GRAB	As-Received	20.4	7471A	207	B	50	26.3
SD-MLFP35-24	10/23/2015	18-24	SEDIMENT	GRAB	As-Received	23.1	7471A	348	B	100	43.3
SD-MLFP37-06	10/23/2015	3-6	SEDIMENT	GRAB	As-Received	20.5	7471A	335		50	27
SD-MLFP37-12	10/23/2015	6-12	SEDIMENT	GRAB	Air-Dried	-	7471A	0.034		1	0.019
SD-MLFP37-12-DUP	10/23/2015	6-12	SEDIMENT	GRAB	As-Received	71.9	7471A	0.024	J	1	0.15
SD-MLFP39-06	10/20/2015	3-6	SEDIMENT	GRAB	As-Received	20.5	7471A	26.7		5	2.8
SD-MLFP39-12	10/20/2015	6-12	SEDIMENT	GRAB	As-Received	76.6	7471A	0.021	J	1	0.13
SD-MLFP40-06	10/20/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	26	*	100	2
SD-MLFP40-12	10/20/2015	6-12	SEDIMENT	GRAB	Air-Dried	-	7471A	138	*	1000	19.5
SD-MLFP41-06	10/20/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	70.6	*	100	2
SD-MLFP41-12	10/20/2015	6-12	SEDIMENT	GRAB	As-Received	51.3	7471A	0.15	J	1	0.19
SD-MLFP42-06	10/21/2015	3-6	SEDIMENT	GRAB	As-Received	25.3	7471A	23		20	7.5
SD-MLFP42-12	10/21/2015	6-12	SEDIMENT	GRAB	As-Received	69.1	7471A	0.15	U	1	0.15
SD-MLFP42-12-DUP	10/21/2015	6-12	SEDIMENT	GRAB	As-Received	68.4	7471A	0.13	J	1	0.15
SD-MLFP43-06	10/23/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	12.8		50	0.94
SD-MLFP43-12	10/23/2015	6-12	SEDIMENT	GRAB	As-Received	45.7	7471A	0.25	U	1	0.25
SD-MLFP43-18	10/23/2015	12-18	SEDIMENT	GRAB	As-Received	45.9	7471A	0.08	J B	1	0.24
SD-MLFP43-24	10/23/2015	18-24	SEDIMENT	GRAB	As-Received	18.2	7471A	0.09	J B	1	0.52
SD-MLFP44-06	10/23/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	8.2		100	1.9
SD-MLFP44-12	10/23/2015	6-12	SEDIMENT	GRAB	Air-Dried	-	7471A	20.3		100	1.9
SD-MLFP44-18	10/23/2015	12-18	SEDIMENT	GRAB	As-Received	21.3	7471A	3.7		1	0.5
SD-MLFP44-24	10/23/2015	18-24	SEDIMENT	GRAB	As-Received	28.1	7471A	0.75		1	0.4
SD-MLFP45-06	10/21/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	19.6	*	100	1.9
SD-MLFP45-12	10/21/2015	6-12	SEDIMENT	GRAB	As-Received	31.7	7471A	0.53		1	0.29
SD-MLFP46-06	10/20/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	69.2	*	100	1.9
SD-MLFP46-12	10/20/2015	6-12	SEDIMENT	COMPOSITE	As-Received	67.9	7471A	0.048	J	1	0.14
SD-MLFP47-06	10/23/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	6.1		100	2
SD-MLFP47-06-DUP	10/23/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	9.5		100	1.9
SD-MLFP47-12	10/23/2015	6-12	SEDIMENT	GRAB	As-Received	27.9	7471A	4.3		1	0.33
SD-MLFP47-18	10/23/2015	12-18	SEDIMENT	GRAB	As-Received	68.7	7471A	0.077	J	1	0.15
SD-MLFP48-06	10/23/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	7.5		100	2
SD-MLFP48-12	10/23/2015	6-12	SEDIMENT	GRAB	Air-Dried	-	7471A	11.2		100	2
SD-MLFP48-18	10/23/2015	12-18	SEDIMENT	GRAB	As-Received	64.8	7471A	5.4		10	1.8
SD-MLFP48-24	10/23/2015	18-24	SEDIMENT	GRAB	As-Received	30.5	7471A	0.39		1	0.37
SD-MLFP48-30	10/23/2015	24-30	SEDIMENT	GRAB	As-Received	35.3	7471A	0.33		1	0.29
SD-MLFP48-36	10/23/2015	30-36	SEDIMENT	GRAB	As-Received	31	7471A	0.71	J	10	3.7
SD-MLFP49-06	10/21/2015	3-6	SEDIMENT	GRAB	As-Received	12.8	7471A	9.5		1	0.74
SD-MLFP49-12	10/21/2015	6-12	SEDIMENT	GRAB	As-Received	13.3	7471A	17.7		5	3.9
SD-MLFP49-18	10/21/2015	12-18	SEDIMENT	GRAB	As-Received	16.7	7471A	0.36	J	1	0.63
SD-MLFP49-24	10/21/2015	18-24	SEDIMENT	GRAB	As-Received	36.4	7471A	0.26	U	1	0.26
SD-MLFP50-06	10/21/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	30.3	*	100	2
SD-MLFP50-12	10/21/2015	6-12	SEDIMENT	GRAB	As-Received	17.6	7471A	13.2	F2	10	5.1
SD-MLFP50-18	10/21/2015	12-18	SEDIMENT	GRAB	As-Received	15.4	7471A	0.65	U	1	0.65

Appendix 3B-1. Analytical Results for
Mercury in Sediments

SD-MLFP5-06	10/19/2015	3-6	SEDIMENT	GRAB	Air-Dried		7471A	19	H	100	1.9
SD-MLFP51-06	10/21/2015	3-6	SEDIMENT	GRAB	As-Received	63	7471A	9.5	F2	10	1.4
SD-MLFP51-12	10/21/2015	6-12	SEDIMENT	GRAB	As-Received	78.4	7471A	0.062	J	1	0.14
SD-MLFP5-12	10/19/2015	6-12	SEDIMENT	GRAB	As-Received	56.3	7471A	0.23		1	0.033
SD-MLFP53-06	10/20/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	34.6		100	2
SD-MLFP53-12	10/20/2015	6-12	SEDIMENT	GRAB	As-Received	30	7471A	2		1	0.064
SD-MLFP53-12-DUP	10/20/2015	6-12	SEDIMENT	GRAB	As-Received	16.8	7471A	8.8		5	0.55
SD-MLFP55-06	10/20/2015	3-6	SEDIMENT	GRAB	As-Received	29.8	7471A	15.7		5	1.8
SD-MLFP6-06	10/19/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	7.3	H	50	1
SD-MLFP7-06	10/19/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	44.7	H	100	2
SD-MLFP7-12	10/19/2015	6-12	SEDIMENT	GRAB	Air-Dried	-	7471A	1.3		5	0.094
SD-MLFP7-12-DUP	10/19/2015	6-12	SEDIMENT	GRAB	Air-Dried	-	7471A	1.9		5	0.098
SD-MLFP7-18	10/19/2015	12-18	SEDIMENT	GRAB	Air-Dried	-	7471A	0.086		1	0.019
SD-MLFP7-36	10/19/2015	30-36	SEDIMENT	GRAB	Air-Dried	-	7471A	0.2		1	0.02
SD-MLFP8-06	10/19/2015	3-6	SEDIMENT	GRAB	Air-Dried	-	7471A	91.9		500	10.1

Notes:

Laboratory Data Qualifiers:

J – Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.
U – Indicates the analyte was analyzed for but not detected.
B – Compound was found in the blank and sample.
H – Sample was prepped or analyzed beyond the specified holding time.
F1 – MS and/or MSD recovery is outside acceptance limits.
F2 – MS/MSD RPD exceeds control limits.
*- Interference check standard or LCS/LCSD is outside acceptance limits.

Sample Basis - Samples that are not "Air-Dried" prior to analysis are referred to as "As-Received" and presumed to have a certain moisture content and are reported on a dry or wet basis with a percent solids measured by the laboratory and reported. Samples that are Air-Dried are presumed to have no moisture content and therefore no percent solids reported. However, several air-dried samples were first analyzed at the laboratory for percent moisture and were found to exhibit greater than 80% moisture. These samples were air-dried, then analyzed for mercury. As such, for these air-dried samples the initial % solids reported by the laboratory are presented although the samples were subsequently air-dried.

Composite Sample – Composite sampling is a technique whereby multiple temporally or spatially discrete samples are combined, thoroughly homogenized, and treated as a single sample.

Grab Sample - A grab sample is a sampling technique which is a single sample or measurement taken at a specific time or over as short a period, as feasible.

Lab - Laboratory

mg/kg - millgrams/kilogram

APPENDIX 3B-2

Analytical Results for Mercury in Soils in the ECC Overbank Areas and the 100-Year Floodplain Areas

Appendix 3B-2. Analytical Results for Mercury in Soils in the ECC Overbank Areas and the 100-Year Floodplain Area

Sample ID	Sampling Date	Depth (inches)	Sample Matrix	Sample Type	Sample Basis	Percent Solids	Analysis Method	Total Mercury (mg/Kg)	Lab Flag	Dilution Factor	Reporting Limit (mg/Kg)
SO-OYFA1-06-PM	10/21/2015	3-6	SOIL	ISM	Air-dried	-	7471A	0.12		1	0.091
SO-OYFA1-06-RM1	10/21/2015	3-6	SOIL	ISM	Air-dried	-	7471A	0.15		1	0.098
SO-OYFA1-06-RM2	10/21/2015	3-6	SOIL	ISM	Air-dried	-	7471A	0.13		1	0.097
SO-OYFA2-06-PM	10/23/2015	3-6	SOIL	ISM	Air-dried	-	7471A	0.068	J	1	0.11
SO-OYFA2-06-RM1	10/23/2015	3-6	SOIL	ISM	Air-dried	-	7471A	0.073	J	1	0.11
SO-OYFA2-06-RM2	10/23/2015	3-6	SOIL	ISM	Air-dried	-	7471A	0.06	J	1	0.097
SO-ECCL13-03	10/16/2015	0-3	SOIL	GRAB	DRY	28.7	7471A	56.6		20	7.1
SO-ECCL13-03-DUP	10/16/2015	0-3	SOIL	GRAB	DRY	29.2	7471A	65.7		20	8.1
SO-ECCL13-06	10/16/2015	3-6	SOIL	GRAB	DRY	34	7471A	181		100	32.7
SO-ECCL14-03	10/16/2015	0-3	SOIL	GRAB	DRY	32.6	7471A	51.1		20	7.1
SO-ECCL14-06	10/16/2015	3-6	SOIL	GRAB	DRY	51.2	7471A	55.2		50	9.8
SO-ECCL15-03	10/16/2015	0-3	SOIL	GRAB	DRY	16	7471A	32.5		5	3.3
SO-ECCL15-06	10/16/2015	3-6	SOIL	GRAB	DRY	20.9	7471A	24.5		10	5
SO-ECCL16-03	10/16/2015	0-3	SOIL	GRAB	DRY	62.7	7471A	0.59		1	0.15
SO-ECCL17-03	10/16/2015	0-3	SOIL	GRAB	DRY	27.6	7471A	119		100	40.3
SO-ECCL17-06	10/16/2015	3-6	SOIL	GRAB	DRY	32.5	7471A	97		50	16.2
SO-ECCL18-03	10/16/2015	0-3	SOIL	GRAB	DRY	37.3	7471A	763		200	57.5
SO-ECCL18-06	10/16/2015	3-6	SOIL	GRAB	DRY	49.8	7471A	421		500	98.7
SO-ECCL19-03	10/16/2015	0-3	SOIL	GRAB	DRY	29.3	7471A	74.4		20	7.3
SO-ECCL19-06	10/16/2015	3-6	SOIL	GRAB	DRY	33.2	7471A	90.5		50	17
SO-ECCL20-03	10/16/2015	0-3	SOIL	GRAB	DRY	30.9	7471A	47		10	3.1
SO-ECCL20-06	10/16/2015	3-6	SOIL	GRAB	DRY	55.4	7471A	8.4		10	2
SO-ECCL21-03	10/16/2015	0-3	SOIL	GRAB	DRY	29.3	7471A	50.8		10	3.8
SO-ECCL21-06	10/16/2015	3-6	SOIL	GRAB	DRY	32.7	7471A	128		100	34
SO-ECCL22-03	10/16/2015	0-3	SOIL	GRAB	DRY	37.6	7471A	97.2		100	25.7
SO-ECCL22-06	10/16/2015	3-6	SOIL	GRAB	DRY	40.9	7471A	1000		500	133
SO-ECCL23-03	10/16/2015	0-3	SOIL	GRAB	DRY	45	7471A	89.1		100	23.4
SO-ECCL23-06	10/16/2015	3-6	SOIL	GRAB	DRY	56.1	7471A	16.4		10	1.8
SO-ECCL24-03	10/16/2015	0-3	SOIL	GRAB	DRY	50.8	7471A	38.5		20	3.9
SO-ECCL24-06	10/16/2015	3-6	SOIL	GRAB	DRY	74.5	7471A	17.2		10	1.3
SO-ECCL25-03	10/16/2015	0-3	SOIL	GRAB	DRY	30.8	7471A	74.3		20	6.2
SO-ECCL25-03-DUP	10/16/2015	0-3	SOIL	GRAB	DRY	40.8	7471A	63.7		20	4.6
SO-ECCL25-06	10/16/2015	3-6	SOIL	GRAB	DRY	34.1	7471A	75.1		50	14.6
SO-ECCM26-03	10/16/2015	0-3	SOIL	GRAB	DRY	89	7471A	0.71		1	0.021
SO-ECCM26-03-DUP	10/16/2015	0-3	SOIL	GRAB	DRY	84.1	7471A	0.73		1	0.023
SO-ECCM27-03	10/16/2015	0-3	SOIL	GRAB	DRY	76.8	7471A	3.3		10	0.25
SO-ECCM28-03	10/16/2015	0-3	SOIL	GRAB	DRY	63.5	7471A	2.1		5	0.15
SO-ECCM29-03	10/16/2015	0-3	SOIL	GRAB	DRY	30.4	7471A	43.3		100	6.7
SO-ECCM29-06	10/16/2015	0-3	SOIL	GRAB	DRY	44.8	7471A	184		100	20
SO-ECCM30-03	10/16/2015	0-3	SOIL	GRAB	DRY	76.9	7471A	0.12		1	0.025
SO-ECCM31-03	10/16/2015	0-3	SOIL	GRAB	DRY	18.3	7471A	11.5		10	1.1
SO-ECCM31-03	10/20/2015	0-3	SOIL	GRAB	DRY	31.1	7471A	1.4		1	0.34
SO-ECCM31-03-DUP	10/20/2015	0-3	SOIL	GRAB	DRY	34	7471A	1.7		1	0.28
SO-ECCM31-06	10/16/2015	3-6	SOIL	GRAB	DRY	20.5	7471A	97.1		20	9.1

Appendix 3B-2. Analytical Results for Mercury in Soils in the ECC Overbank Areas and the 100-Year Floodplain Area

Sample ID	Sampling Date	Depth (inches)	Sample Matrix	Sample Type	Sample Basis	Percent Solids	Analysis Method	Total Mercury (mg/Kg)	Lab Flag	Dilution Factor	Reporting Limit (mg/Kg)
SO-ECCM32-03	10/16/2015	0-3	SOIL	GRAB	DRY	81.8	7471A	68.2		100	2.4
SO-ECCM32-06	10/16/2015	3-6	SOIL	GRAB	DRY	81.6	7471A	32.3		20	2.5
SO-ECCM33-03	10/20/2015	0-3	SOIL	GRAB	DRY	50.6	7471A	0.33		1	0.21
SO-ECCM34-03	10/20/2015	0-3	SOIL	GRAB	DRY	17.1	7471A	10.7		5	2.7
SO-ECCM34-06	10/20/2015	3-6	SOIL	GRAB	DRY	20.9	7471A	25.8		10	4.5
SO-ECCM35-03	10/16/2015	0-3	SOIL	GRAB	DRY	87.2	7471A	0.5		1	0.023
SO-ECCM36-03	10/20/2015	0-3	SOIL	GRAB	DRY	54.3	7471A	0.55		1	0.17
SO-ECCM37-03	10/20/2015	0-3	SOIL	GRAB	DRY	64.5	7471A	0.9	F1	1	0.15
SO-ECCM38-03	10/16/2015	0-3	SOIL	GRAB	DRY	76.6	7471A	61.1		100	2.6
SO-ECCM38-06	10/16/2015	3-6	SOIL	GRAB	DRY	83.6	7471A	41.4		20	2.6
SO-ECCM39-03	10/20/2015	0-3	SOIL	GRAB	DRY	62.6	7471A	0.88		1	0.19
SO-ECCM40-03	10/20/2015	0-3	SOIL	GRAB	DRY	22.2	7471A	12.2		5	2.2
SO-ECCM40-06	10/20/2015	3-6	SOIL	GRAB	DRY	24.6	7471A	24.3		10	3.8
SO-ECCM41-03	10/20/2015	0-3	SOIL	GRAB	DRY	47.9	7471A	3.2		1	0.23
SO-ECCM42-03	10/20/2015	0-3	SOIL	GRAB	DRY	27	7471A	38.4		10	4.2
SO-ECCM42-06	10/20/2015	3-6	SOIL	GRAB	DRY	26.1	7471A	53.4		10	3.8
SO-ECCM43-03	10/20/2015	0-3	SOIL	GRAB	DRY	49.5	7471A	6.7		10	2
SO-ECCM43-06	10/20/2015	3-6	SOIL	GRAB	DRY	77.6	7471A	3.3		10	1.2
SO-ECCM44-03	10/20/2015	0-3	SOIL	GRAB	DRY	36.8	7471A	41.9		50	11.6
SO-ECCM44-03-DUP	10/20/2015	0-3	SOIL	GRAB	DRY	36.7	7471A	54.2		50	12
SO-ECCM44-06	10/20/2015	3-6	SOIL	GRAB	DRY	29.8	7471A	64.6		20	7.2
SO-ECCM45-03	10/20/2015	0-3	SOIL	GRAB	DRY	58.2	7471A	5.1		10	1.7
SO-ECCM45-06	10/20/2015	3-6	SOIL	GRAB	DRY	73.6	7471A	1.8		10	1.3
SO-ECCM46-03	10/20/2015	0-3	SOIL	GRAB	DRY	68.8	7471A	2.8		5	0.68
SO-ECCM47-03	10/21/2015	0-3	SOIL	GRAB	DRY	77.1	7471A	1.1		1	0.13
SO-ECCM47-03-DUP	10/21/2015	0-3	SOIL	GRAB	DRY	79.5	7471A	1.4		1	0.13
SO-ECCM48-03	10/21/2015	0-3	SOIL	GRAB	DRY	42.7	7471A	66.6		20	5.1
SO-ECCM48-06	10/21/2015	3-6	SOIL	GRAB	DRY	58.7	7471A	141		100	17.3
SO-ECCM49-03	10/21/2015	0-3	SOIL	GRAB	DRY	82.3	7471A	0.48		1	0.11
SO-ECCM49-03-DUP	10/21/2015	0-3	SOIL	GRAB	DRY	70.2	7471A	2.2		2	0.26
SO-ECCM49-06	10/21/2015	3-6	SOIL	GRAB	DRY	79.8	7471A	4.2		10	1.2
SO-ECCM50-03	10/21/2015	0-3	SOIL	GRAB	DRY	62.6	7471A	43.7		20	3.6
SO-ECCM50-06	10/21/2015	3-6	SOIL	GRAB	DRY	73.9	7471A	16.4		50	6.8
SO-ECCM51-03	10/21/2015	0-3	SOIL	GRAB	DRY	84.2	7471A	3.9		10	1.3
SO-ECCM51-06	10/21/2015	3-6	SOIL	GRAB	DRY	89.5	7471A	1.2		1	0.12
SO-ECCM52-03	10/21/2015	0-3	SOIL	GRAB	DRY	38.6	7471A	89.7		20	5.8
SO-ECCM52-03-DUP	10/21/2015	0-3	SOIL	GRAB	DRY	37.1	7471A	93.3		20	6.1
SO-ECCM52-06	10/21/2015	3-6	SOIL	GRAB	DRY	36	7471A	322		100	28.8
SO-ECCM53-03	10/21/2015	0-3	SOIL	GRAB	DRY	66.1	7471A	73.5		50	8.1
SO-ECCM53-06	10/21/2015	3-6	SOIL	GRAB	DRY	74.8	7471A	89.8		100	14.3
SO-ECCU54-03	10/15/2015	0-3	SOIL	GRAB	DRY	48.1	7471A	7.4		5	0.95
SO-ECCU54-06	10/15/2015	3-6	SOIL	GRAB	DRY	59.8	7471A	8.7		10	1.8
SO-ECCU55-03	10/15/2015	0-3	SOIL	GRAB	DRY	35.6	7471A	34.2		20	5.7
SO-ECCU55-06	10/15/2015	3-6	SOIL	GRAB	DRY	49.6	7471A	63.4		50	11.6

Appendix 3B-2. Analytical Results for Mercury in Soils in the ECC Overbank Areas and the 100-Year Floodplain Area

Sample ID	Sampling Date	Depth (inches)	Sample Matrix	Sample Type	Sample Basis	Percent Solids	Analysis Method	Total Mercury (mg/Kg)	Lab Flag	Dilution Factor	Reporting Limit (mg/Kg)
SO-ECCU56-03	10/15/2015	0-3	SOIL	GRAB	DRY	35.6	7471A	6.6		5	1.2
SO-ECCU56-06	10/15/2015	3-6	SOIL	GRAB	DRY	30.5	7471A	67.9		50	17.9
SO-ECCU57-03	10/15/2015	0-3	SOIL	GRAB	DRY	81.5	7471A	3.8		5	0.58
SO-ECCU57-03-DUP	10/15/2015	0-3	SOIL	GRAB	DRY	83.1	7471A	3.1		5	0.72
SO-ECCU57-06	10/15/2015	3-6	SOIL	GRAB	DRY	88.9	7471A	2.4		10	1.2
SO-ECCU58-03	10/15/2015	0-3	SOIL	GRAB	DRY	38.6	7471A	169		100	26.8
SO-ECCU58-06	10/15/2015	3-6	SOIL	GRAB	DRY	39.2	7471A	290		100	28.3
SO-ECCU59-03	10/15/2015	0-3	SOIL	GRAB	DRY	79.4	7471A	0.47		1	0.12
SO-ECCU60-03	10/15/2015	0-3	SOIL	GRAB	DRY	68.2	7471A	7		5	0.81
SO-ECCU60-06	10/15/2015	3-6	SOIL	GRAB	DRY	72.9	7471A	5.1		10	1.5
SO-ECCU61-03	10/15/2015	0-3	SOIL	GRAB	DRY	93.6	7471A	355		500	50.9
SO-ECCU61-06	10/15/2015	3-6	SOIL	GRAB	DRY	80.8	7471A	139		100	12.6
SO-ECCU62-03	10/15/2015	0-3	SOIL	GRAB	DRY	86.1	7471A	0.24		1	0.11
SO-ECCU63-03	10/15/2015	0-3	SOIL	GRAB	DRY	74.5	7471A	0.35		1	0.15

Notes:

Laboratory Data Qualifiers:

J – Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

F1 – MS and/or MSD recovery is outside acceptance limits.

Sample Basis - samples that are not air-dried prior to analysis are presumed to have a certain moisture content and are reported on a dry or wet basis with a percent solids measured by the laboratory and reported. Samples that are air-dried are presumed to have no moisture content and therefore no percent solids reported.

ISM Sample - Incremental sampling methodology (ISM) is a structured composite sampling and processing protocol having specific elements designed to reduce data variability and increase sample representativeness for a specified volume of soil under investigation.

Grab Sample - A grab sample is a sampling technique which is a single sample or measurement taken at a specific time or over as short a period, as feasible.

Lab - Laboratory
mg/kg - milligrams/kilogram

APPENDIX 3B-3

Analytical Results for Metals and Explosives in Soils in the Test Range Sub-areas and Soil UCL Exceedance Areas

Appendix 3B-3. Analytical Results for
Metals and Explosives in Soilsin the Test Range Subareas and Soil UCL Exceedance Areas

Method	Analyte	CAS	Unit	Basis	SO-SFRF-03-PM		SO-SFRF-03-RM1		SO-SFRF-03-RM2		SO-SHSP-03-PM		SO-SHSP-03-RM1		SO-SHSP-03-RM2		SO-SNRF-03-PM	
					10/13/2015		10/13/2015		10/13/2015		10/14/2015		10/14/2015		10/14/2015		10/13/2015	
					ISM		ISM		ISM		ISM		ISM		ISM		ISM	
					SOIL		SOIL		SOIL		SOIL		SOIL		SOIL		SOIL	
					0-3		0-3		0-3		0-3		0-3		0-3		0-3	
6010	Aluminum	7429-90-5	mg/Kg	WET	5650	F1	5880		6320		2380		2120		2240		5460	F1
6010	Antimony	7440-36-0	mg/Kg	WET	0.52	U ^	0.5	U ^	0.51	U ^	0.68	^	0.8	^	0.75	^	3.8	^ F2 F1
6010	Arsenic	7440-38-2	mg/Kg	WET	3.6		3.7		4.2		1.7		1.8		1.7		2.7	
6010	Barium	7440-39-3	mg/Kg	WET	93.7	F1	83.6		129		114		117		112		131	
6010	Beryllium	7440-41-7	mg/Kg	WET	0.55		0.45		0.59		0.14	J	0.12	J	0.14	J	0.3	
6010	Cadmium	7440-43-9	mg/Kg	WET	0.36		0.33		0.51		0.42		0.35		0.44		1.2	
6010	Calcium	7440-70-2	mg/Kg	WET	2710	B	2480	B	3570	B	6370		6600		6310		1560	B
6010	Chromium	7440-47-3	mg/Kg	WET	7.7		149		9.5		2.5		117		54.9		62.8	
6010	Cobalt	7440-48-4	mg/Kg	WET	3.3		3.8		4.3		1.1		1.6		1.2		2.9	
6010	Copper	7440-50-8	mg/Kg	WET	15.5		15.6		20.9		162		184		180		205	
6010	Iron	7439-89-6	mg/Kg	WET	8830	B	9930	B	13500	B	3710		5140		3810		9920	
6010	Lead	7439-92-1	mg/Kg	WET	38.7		39.4		50.8		63.7		63.9		75.9		317	F2
6010	Magnesium	7439-95-4	mg/Kg	WET	1450		1640		1610		1140		1250		1160		1360	
6010	Manganese	7439-96-5	mg/Kg	WET	239	B	236	B	328	B	47.5	B	49.9	B	54	B	170	B
6010	Nickel	7440-02-0	mg/Kg	WET	8.3		9.8		10.8		6.8		6.3		6.3		9.6	
6010	Potassium	7440-09-7	mg/Kg	WET	585	F1	795		901		369	B	690	B	526	B	719	
6010	Selenium	7782-49-2	mg/Kg	WET	0.55		0.4	J	0.69		0.74		0.91		0.72		0.55	
6010	Silver	7440-22-4	mg/Kg	WET	0.52	U	0.5	U	0.22	J	0.5	U	0.48	U	0.5	U	0.27	J
6010	Sodium	7440-23-5	mg/Kg	WET	150		206		254		977	B	1090	B	975	B	122	J
6010	Thallium	7440-28-0	mg/Kg	WET	1	U	0.99	U	1	U	0.99	U	0.95	U	1	U	1	U
6010	Vanadium	7440-62-2	mg/Kg	WET	15.2		15.6		18.2		14.7		11.7		13.7		15.5	
6010	Zinc	7440-66-6	mg/Kg	WET	77.9		70.1		107		340		178		221		154	F1
7471A	Mercury	7439-97-6	mg/Kg	WET	0.15		0.15		0.27		0.15		0.16		0.2		0.31	
6850	Perchlorate	14797-73-0	ug/Kg	WET	0.71	B	0.86	B	1.5	B	1.54	U *	0.31	J * B	0.47	J * B	0.85	B
8330B	1,3,5-Trinitrobenzene	99-35-4	ug/Kg	WET	93.3	U	93.9	U	97.8	U	49.7	J p	277	p	68.5	J p	95.1	U
8330B	1,3-Dinitrobenzene	99-65-0	ug/Kg	WET	93.3	U	93.9	U	97.8	U	197	U	222		197	p	95.1	U
8330B	2,4,6-Trinitrotoluene	118-96-7	ug/Kg	WET	93.3	U	93.9	U	97.8	U	197	U	193	U	196	U	95.1	U
8330B	2,4-diamino-6-nitrotoluene	6629-29-4	ug/Kg	WET	93.3	U	93.9	U	97.8	U	197	U	193	U	196	U	95.1	U F1
8330B	2,4-Dinitrotoluene	121-14-2	ug/Kg	WET	106		174		231		197	U	193	U	196	U	95.1	U
8330B	2,6-diamino-4-nitrotoluene	59229-75-3	ug/Kg	WET	93.3	U	93.9	U	97.8	U	197	U	193	U	196	U	95.1	U F1
8330B	2,6-Dinitrotoluene	606-20-2	ug/Kg	WET	20.8	J p	68.2	J p	52.2	J	197	U	193	U	196	U	95.1	U
8330B	2-Amino-4,6-dinitrotoluene	35572-78-2	ug/Kg	WET	93.3	U	93.9	U	97.8	U	197	U	193	U	196	U	30.2	J
8330B	2-Nitrotoluene	88-72-2	ug/Kg	WET	93.3	U	93.9	U	97.8	U	191	J	141	J	146	J	95.1	U
8330B	3-Nitrotoluene	99-08-1	ug/Kg	WET	93.3	U	93.9	U	97.8	U	197	U	193	U	196	U	95.1	U
8330B	4-Amino-2,6-dinitrotoluene	19406-51-0	ug/Kg	WET	93.3	U	93.9	U	97.8	U	197	U	193	U	196	U	95.1	U
8330B	4-Nitrotoluene	99-99-0	ug/Kg	WET	93.3	U	93.9	U	97.8	U	197	U	193	U	196	U	48	J p
8330B	HMX	2691-41-0	ug/Kg	WET	93.3	U	93.9	U	97.8	U	197	U	193	U	196	U	95.1	U
8330B	Nitrobenzene	98-95-3	ug/Kg	WET	93.3	U	93.9	U	97.8	U	197	U	193	U	196	U	27.8	J
8330B	Nitroglycerin	55-63-0	ug/Kg	WET	1870	U	1880	U	1960	U	6780	p	30000		19700	p	8780	
8330B	PETN	78-11-5	ug/Kg	WET	4660	U	4690	U	4890	U	9860	U	9650	U	9780	U	4750	U
8330B	Picric acid	88-89-1	ug/Kg	WET	93.3	U F1	93.9	U	80.2	J p	380	p	295	p	196	U	279	p
8330B	RDX	121-82-4	ug/Kg	WET	93.3	U	93.9	U	97.8	U	197	U	193	U	196	U	95.1	U
8330B	Tetryl	479-45-8	ug/Kg	WET	93.3	U	93.9	U	97.8	U	197	U	94.3	J p	123	J p	95.1	U

Appendix 3B-3. Analytical Results for
Metals and Explosives in Soilsin the Test Range Subareas and Soil UCL Exceedance Areas

Method	Analyte	CAS	Unit	Basis	SO-SNRF-03-RM1		SO-SNRF-03-RM2		SO-STRB1-06-PM		SO-STRB1-06-RM1		SO-STRB1-06-RM2		SO-STRB1-12-PM		SO-STRB1-12-RM1	
					10/13/2015		10/13/2015		10/13/2015		10/13/2015		10/13/2015		10/13/2015		10/13/2015	
					ISM		ISM		ISM		ISM		ISM		ISM		ISM	
					SOIL		SOIL		SOIL		SOIL		SOIL		SOIL		SOIL	
					0-3		0-3		3-6		3-6		3-6		6-12		6-12	
6010	Aluminum	7429-90-5	mg/Kg	WET	5830	^	6500	^	6220	^	6090	^	6110	^	6420	^	7020	^
6010	Antimony	7440-36-0	mg/Kg	WET	4.3	^	5	^	1.4	^	1.4	^	1.1	^	1.8	^	2.8	^
6010	Arsenic	7440-38-2	mg/Kg	WET	3.3		4		2.5		2.6		2.6		2.7		3	
6010	Barium	7440-39-3	mg/Kg	WET	129		158		32.1		31.4		28.9		33		35.7	
6010	Beryllium	7440-41-7	mg/Kg	WET	0.29		0.3		0.34		0.32		0.31		0.32		0.34	
6010	Cadmium	7440-43-9	mg/Kg	WET	1.3		1.3		0.19	J	0.16	J	0.15	J	0.2		0.28	
6010	Calcium	7440-70-2	mg/Kg	WET	1680	B	1900	B	1230	B	1090	B	1060	B	1010	B	911	B
6010	Chromium	7440-47-3	mg/Kg	WET	368		625		333		312		274		302		165	
6010	Cobalt	7440-48-4	mg/Kg	WET	3.9		4.9		3.7		3.5		3.4		3.6		3.2	
6010	Copper	7440-50-8	mg/Kg	WET	136		217		18.2		12.8		13		16.4		26.7	
6010	Iron	7439-89-6	mg/Kg	WET	13100	B	15300	B	10900	B	10400	B	10000	B	10600	B	10300	B
6010	Lead	7439-92-1	mg/Kg	WET	332		262		240		327		232		309		685	
6010	Magnesium	7439-95-4	mg/Kg	WET	1410		1450		1490		1440		1420		1410		1510	
6010	Manganese	7439-96-5	mg/Kg	WET	186	B	201	B	171	B	162	B	163	B	155	B	162	B
6010	Nickel	7440-02-0	mg/Kg	WET	11.1		14.8		9		7.9		8		7.8		8.3	
6010	Potassium	7440-09-7	mg/Kg	WET	990		1220		1130		1100		1040		1110		1050	
6010	Selenium	7782-49-2	mg/Kg	WET	0.64		0.92		0.5		0.73		0.51	U	0.48	U	0.52	U
6010	Silver	7440-22-4	mg/Kg	WET	0.37	J	0.5		0.5	U	0.47	U	0.51	U	0.48	U	0.52	U
6010	Sodium	7440-23-5	mg/Kg	WET	224		308		229		232		210		248		235	
6010	Thallium	7440-28-0	mg/Kg	WET	1	U	0.95	U	1	U	0.95	U	1	U	0.96	U	1	U
6010	Vanadium	7440-62-2	mg/Kg	WET	15		16.7		13.6		12.6		12.9		13.2		13.8	
6010	Zinc	7440-66-6	mg/Kg	WET	130		161		22.8		32.5		20.4		23.7		32.3	
7471A	Mercury	7439-97-6	mg/Kg	WET	0.32		0.33		0.029		0.032		0.045		0.048		0.059	
6850	Perchlorate	14797-73-0	ug/Kg	WET	1.69	B	2.3	B	0.55	J B	0.48	J B	0.53	J B	0.84	B	0.48	J B
8330B	1,3,5-Trinitrobenzene	99-35-4	ug/Kg	WET	98.3	U	98.4	U	93.7	U	93.4	U H	98.3	U	98.1	U	94.6	U
8330B	1,3-Dinitrobenzene	99-65-0	ug/Kg	WET	98.3	U	98.4	U	93.7	U	99.1	U	98.3	U	98.1	U	94.6	U
8330B	2,4,6-Trinitrotoluene	118-96-7	ug/Kg	WET	98.3	U	98.4	U	93.7	U	93.4	U H	98.3	U	98.1	U	94.6	U
8330B	2,4-diamino-6-nitrotoluene	6629-29-4	ug/Kg	WET	98.3	U	98.4	U	93.7	U	99.1	U	98.3	U	98.1	U	94.6	U
8330B	2,4-Dinitrotoluene	121-14-2	ug/Kg	WET	288	p	98.4	U	93.7	U	99.1	U	98.3	U	98.1	U	94.6	U
8330B	2,6-diamino-4-nitrotoluene	59229-75-3	ug/Kg	WET	98.3	U	98.4	U	93.7	U	99.1	U	98.3	U	98.1	U	94.6	U
8330B	2,6-Dinitrotoluene	606-20-2	ug/Kg	WET	23.6	J	98.4	U	93.7	U	99.1	U	98.3	U	98.1	U	94.6	U
8330B	2-Amino-4,6-dinitrotoluene	35572-78-2	ug/Kg	WET	98.3	U	98.4	U	93.7	U	99.1	U	98.3	U	98.1	U	94.6	U
8330B	2-Nitrotoluene	88-72-2	ug/Kg	WET	98.3	U	98.4	U	93.7	U	99.1	U	98.3	U	98.1	U	94.6	U
8330B	3-Nitrotoluene	99-08-1	ug/Kg	WET	98.3	U	98.4	U	93.7	U	99.1	U	98.3	U	98.1	U	94.6	U
8330B	4-Amino-2,6-dinitrotoluene	19406-51-0	ug/Kg	WET	98.3	U	98.4	U	93.7	U	99.1	U	98.3	U	98.1	U	94.6	U
8330B	4-Nitrotoluene	99-99-0	ug/Kg	WET	98.3	U	98.4	U	93.7	U	99.1	U	98.3	U	98.1	U	94.6	U
8330B	HMX	2691-41-0	ug/Kg	WET	98.3	U	98.4	U	93.7	U	99.1	U	98.3	U	98.1	U	94.6	U
8330B	Nitrobenzene	98-95-3	ug/Kg	WET	98.3	U	98.4	U	93.7	U	99.1	U	98.3	U	98.1	U	94.6	U
8330B	Nitroglycerin	55-63-0	ug/Kg	WET	14100		13900	p	1870	U	1980	U	1970	U	1960	U	1890	U
8330B	PETN	78-11-5	ug/Kg	WET	4920	U	4920	U	4690	U	4960	U	4920	U	4910	U	4730	U
8330B	Picric acid	88-89-1	ug/Kg	WET	215	p	117	p	93.7	U	99.1	U	98.3	U	98.1	U	94.6	U
8330B	RDX	121-82-4	ug/Kg	WET	98.3	U	98.4	U	93.7	U	93.4	U H	98.3	U	98.1	U	94.6	U
8330B	Tetryl	479-45-8	ug/Kg	WET	73	J p	254	p	93.7	U	93.4	U H	98.3	U	98.1	U	94.6	U

Appendix 3B-3. Analytical Results for
Metals and Explosives in Soilsin the Test Range Subareas and Soil UCL Exceedance Areas

Method	Analyte	CAS	Unit	Basis	SO-STRB1-12-RM2		SO-STRB2-06-PM		SO-STRB2-06-RM1		SO-STRB2-06-RM2		SO-STRB2-12-PM		SO-STRB2-12-RM1		SO-STRB2-12-RM2	
					10/13/2015		10/13/2015		10/13/2015		10/13/2015		10/13/2015		10/13/2015		10/13/2015	
					ISM		ISM		ISM		ISM		ISM		ISM		ISM	
					SOIL		SOIL		SOIL		SOIL		SOIL		SOIL		SOIL	
					6-12		3-6		3-6		3-6		6-12		6-12		6-12	
6010	Aluminum	7429-90-5	mg/Kg	WET	6540	^	6320	^	5720	^	6370	^	6390	^	6870	^	7190	^
6010	Antimony	7440-36-0	mg/Kg	WET	0.97	^	1.4	^	3.8	^	0.65	^	0.89	^	0.49	U ^	0.92	^
6010	Arsenic	7440-38-2	mg/Kg	WET	2.3		3.2		2.7		2.2		2.9		2		3	
6010	Barium	7440-39-3	mg/Kg	WET	30.4		33.4		32.7		31.6		42.6		43.2		54.4	
6010	Beryllium	7440-41-7	mg/Kg	WET	0.33		0.31		0.31		0.31		0.32		0.33		0.32	
6010	Cadmium	7440-43-9	mg/Kg	WET	0.18	J	0.2		0.17	J	0.18	J	0.28		0.27		0.37	
6010	Calcium	7440-70-2	mg/Kg	WET	927	B	1070	B	1200	B	1050	B	1070	B	1110	B	1090	B
6010	Chromium	7440-47-3	mg/Kg	WET	7.1		467		413		190		455		8.4		436	
6010	Cobalt	7440-48-4	mg/Kg	WET	2.8		3.9		3.9		2.9		4.1		2.8		3.9	
6010	Copper	7440-50-8	mg/Kg	WET	13.6		16.5		17.2		11.2		17		24.7		123	
6010	Iron	7439-89-6	mg/Kg	WET	10900	B	11800	B	11200	B	9740	B	11800	B	12500	B	12300	B
6010	Lead	7439-92-1	mg/Kg	WET	264		215		302		127		152		102		109	
6010	Magnesium	7439-95-4	mg/Kg	WET	1450		1330		1310		1280		1360		1340		1400	
6010	Manganese	7439-96-5	mg/Kg	WET	170	B	166	B	161	B	143	B	166	B	184	B	176	B
6010	Nickel	7440-02-0	mg/Kg	WET	5.8		10.7		8.7		8.3		10.6		6.2		9.5	
6010	Potassium	7440-09-7	mg/Kg	WET	1030		1080		1120		1000		1150		1130		1180	
6010	Selenium	7782-49-2	mg/Kg	WET	0.52	U	0.5	U	0.41	J	0.39	J	0.57		0.49	U	0.52	
6010	Silver	7440-22-4	mg/Kg	WET	0.52	U	0.5	U	0.5	U	0.48	U	0.48	U	0.49	U	0.52	U
6010	Sodium	7440-23-5	mg/Kg	WET	249		265		288		255		303		275		269	
6010	Thallium	7440-28-0	mg/Kg	WET	1	U	1	U	1	U	0.97	U	0.97	U	0.98	U	1	U
6010	Vanadium	7440-62-2	mg/Kg	WET	13.4		15.8		14.4		14.4		15.3		16.1		16.7	
6010	Zinc	7440-66-6	mg/Kg	WET	23.8		20.2		18		18.8		20.6		20.9		59.5	
7471A	Mercury	7439-97-6	mg/Kg	WET	0.047		0.25		0.22		0.19		0.28		0.34		0.47	
6850	Perchlorate	14797-73-0	ug/Kg	WET	0.73	B	0.86	B	0.66	J B	0.64	J B	0.79	B	0.83	B	0.81	B
8330B	1,3,5-Trinitrobenzene	99-35-4	ug/Kg	WET	94.1	U	97.2	U	93.7	U	97.3	U	93.4	U	96.9	U	92.9	U
8330B	1,3-Dinitrobenzene	99-65-0	ug/Kg	WET	94.1	U	97.2	U	93.7	U	97.3	U	93.4	U	96.9	U	92.9	U
8330B	2,4,6-Trinitrotoluene	118-96-7	ug/Kg	WET	94.1	U	97.2	U	93.7	U	97.3	U	93.4	U	96.9	U	92.9	U
8330B	2,4-diamino-6-nitrotoluene	6629-29-4	ug/Kg	WET	94.1	U	97.2	U	93.7	U	97.3	U	93.4	U	96.9	U	92.9	U
8330B	2,4-Dinitrotoluene	121-14-2	ug/Kg	WET	94.1	U	97.2	U	93.7	U	97.3	U	93.4	U	96.9	U	92.9	U
8330B	2,6-diamino-4-nitrotoluene	59229-75-3	ug/Kg	WET	94.1	U	97.2	U	93.7	U	97.3	U	93.4	U	96.9	U	92.9	U
8330B	2,6-Dinitrotoluene	606-20-2	ug/Kg	WET	94.1	U	97.2	U	93.7	U	97.3	U	93.4	U	96.9	U	92.9	U
8330B	2-Amino-4,6-dinitrotoluene	35572-78-2	ug/Kg	WET	94.1	U	97.2	U	93.7	U	97.3	U	93.4	U	96.9	U	92.9	U
8330B	2-Nitrotoluene	88-72-2	ug/Kg	WET	94.1	U	97.2	U	93.7	U	97.3	U	93.4	U	96.9	U	92.9	U
8330B	3-Nitrotoluene	99-08-1	ug/Kg	WET	94.1	U	97.2	U	93.7	U	97.3	U	93.4	U	96.9	U	92.9	U
8330B	4-Amino-2,6-dinitrotoluene	19406-51-0	ug/Kg	WET	94.1	U	97.2	U	93.7	U	97.3	U	93.4	U	96.9	U	92.9	U
8330B	4-Nitrotoluene	99-99-0	ug/Kg	WET	94.1	U	97.2	U	93.7	U	97.3	U	93.4	U	96.9	U	92.9	U
8330B	HMX	2691-41-0	ug/Kg	WET	94.1	U	97.2	U	93.7	U	97.3	U	93.4	U	96.9	U	92.9	U
8330B	Nitrobenzene	98-95-3	ug/Kg	WET	94.1	U	97.2	U	93.7	U	97.3	U	93.4	U	96.9	U	92.9	U
8330B	Nitroglycerin	55-63-0	ug/Kg	WET	1880	U	1940	U	1870	U	1950	U	1870	U	1940	U	1860	U
8330B	PETN	78-11-5	ug/Kg	WET	4700	U	4860	U	4690	U	4860	U	4670	U	4840	U	4640	U
8330B	Picric acid	88-89-1	ug/Kg	WET	94.1	U	97.2	U	93.7	U	97.3	U	93.4	U	96.9	U	92.9	U
8330B	RDX	121-82-4	ug/Kg	WET	94.1	U	97.2	U	93.7	U	97.3	U	93.4	U	96.9	U	92.9	U
8330B	Tetryl	479-45-8	ug/Kg	WET	94.1	U	97.2	U	93.7	U	97.3	U	93.4	U	96.9	U	92.9	U

Appendix 3B-3. Analytical Results for
Metals and Explosives in Soilsin the Test Range Subareas and Soil UCL Exceedance Areas

Method	Analyte	CAS	Unit	Basis	SO-STRB3-06-PM		SO-STRB3-06-RM1		SO-STRB3-06-RM2		SO-STRB3-12-PM		SO-STRB3-12-RM1		SO-STRB3-12-RM2		SO-STRB4-06-PM	
					10/13/2015		10/13/2015		10/13/2015		10/13/2015		10/13/2015		10/13/2015		10/13/2015	
					ISM		ISM		ISM		ISM		ISM		ISM		ISM	
					SOIL		SOIL		SOIL		SOIL		SOIL		SOIL		SOIL	
					3-6		3-6		3-6		6-12		6-12		6-12		3-6	
6010	Aluminum	7429-90-5	mg/Kg	WET	7720	^	7900	^	8540	^	7160	^	7680	^	7180	^	7050	^
6010	Antimony	7440-36-0	mg/Kg	WET	0.93	^	0.89	^	2.4	^	2.6	^	0.48	U ^	15.7	^	1	^
6010	Arsenic	7440-38-2	mg/Kg	WET	2.8		3		2.5		3.6		2.2		9		2.8	
6010	Barium	7440-39-3	mg/Kg	WET	33.1		33		37.6		33		34.3		31.6		37.3	
6010	Beryllium	7440-41-7	mg/Kg	WET	0.33		0.34		0.36		0.35		0.36		0.34		0.3	
6010	Cadmium	7440-43-9	mg/Kg	WET	0.2		0.2	J	0.21		0.18	J	0.16	J	0.24		0.24	
6010	Calcium	7440-70-2	mg/Kg	WET	912	B	954	B	1120	B	1080	B	1040	B	1030	B	1100	B
6010	Chromium	7440-47-3	mg/Kg	WET	199		356		9.4		302		8.5		284		263	
6010	Cobalt	7440-48-4	mg/Kg	WET	3.1		3.7		3.1		3.9		3.3		3.9		3.1	
6010	Copper	7440-50-8	mg/Kg	WET	11.5		12.7		12.9		10.6		7.9		11.5		102	
6010	Iron	7439-89-6	mg/Kg	WET	10600		11700		14700		11200		12800		10900		10800	
6010	Lead	7439-92-1	mg/Kg	WET	278		185		483		209		46.1		843		271	
6010	Magnesium	7439-95-4	mg/Kg	WET	1420		1400		1480		1540		1530		1540		1290	
6010	Manganese	7439-96-5	mg/Kg	WET	155	B	162	B	211	B	168	B	191	B	168	B	144	B
6010	Nickel	7440-02-0	mg/Kg	WET	8.5		8.5		6.8		8.4		6.5		8.7		9.7	
6010	Potassium	7440-09-7	mg/Kg	WET	1030		1080		1260		1160		1180		1130		1110	
6010	Selenium	7782-49-2	mg/Kg	WET	0.4	J	0.55		0.52	U	0.55		0.73		0.41	J	0.67	
6010	Silver	7440-22-4	mg/Kg	WET	0.49	U	0.51	U	0.52	U	0.47	U	0.48	U	0.47	U	0.49	U
6010	Sodium	7440-23-5	mg/Kg	WET	235		238		294		245		256		222		301	
6010	Thallium	7440-28-0	mg/Kg	WET	0.98	U	1	U	1	U	0.94	U	0.97	U	0.95	U	0.98	U
6010	Vanadium	7440-62-2	mg/Kg	WET	14.8		15.4		17.3		14.5		15.4		14.2		17.9	
6010	Zinc	7440-66-6	mg/Kg	WET	21.7		21.3		22.8		20		20.8		20.6		31.7	
7471A	Mercury	7439-97-6	mg/Kg	WET	0.051		0.042		0.046		0.025		0.032		0.03		0.53	
6850	Perchlorate	14797-73-0	ug/Kg	WET	0.59	J * B	0.68	J * B	0.63	J * B	0.48	J * B	0.6	J * B	1.17	* B	1.11	* B
8330B	1,3,5-Trinitrobenzene	99-35-4	ug/Kg	WET	89.5	U	90.7	U	98.9	U	98.3	U	98	U	98.3	U	96.5	U
8330B	1,3-Dinitrobenzene	99-65-0	ug/Kg	WET	89.5	U	90.7	U	98.9	U	98.3	U	98	U	98.3	U	96.5	U
8330B	2,4,6-Trinitrotoluene	118-96-7	ug/Kg	WET	89.5	U	90.7	U	98.9	U	98.3	U	98	U	98.3	U	96.5	U
8330B	2,4-diamino-6-nitrotoluene	6629-29-4	ug/Kg	WET	89.5	U	90.7	U	98.9	U	98.3	U	98	U	98.3	U	96.5	U
8330B	2,4-Dinitrotoluene	121-14-2	ug/Kg	WET	89.5	U	90.7	U	98.9	U	98.3	U	98	U	98.3	U	96.5	U
8330B	2,6-diamino-4-nitrotoluene	59229-75-3	ug/Kg	WET	89.5	U	90.7	U	98.9	U	98.3	U	98	U	98.3	U	96.5	U
8330B	2,6-Dinitrotoluene	606-20-2	ug/Kg	WET	89.5	U	90.7	U	98.9	U	98.3	U	98	U	98.3	U	96.5	U
8330B	2-Amino-4,6-dinitrotoluene	35572-78-2	ug/Kg	WET	89.5	U	90.7	U	98.9	U	98.3	U	98	U	98.3	U	96.5	U
8330B	2-Nitrotoluene	88-72-2	ug/Kg	WET	89.5	U	90.7	U	98.9	U	98.3	U	98	U	98.3	U	23.7	J p
8330B	3-Nitrotoluene	99-08-1	ug/Kg	WET	89.5	U	90.7	U	98.9	U	98.3	U	98	U	98.3	U	96.5	U
8330B	4-Amino-2,6-dinitrotoluene	19406-51-0	ug/Kg	WET	89.5	U	90.7	U	98.9	U	98.3	U	98	U	98.3	U	96.5	U
8330B	4-Nitrotoluene	99-99-0	ug/Kg	WET	89.5	U	90.7	U	98.9	U	98.3	U	98	U	98.3	U	96.5	U
8330B	HMX	2691-41-0	ug/Kg	WET	89.5	U	90.7	U	98.9	U	98.3	U	98	U	98.3	U	96.5	U
8330B	Nitrobenzene	98-95-3	ug/Kg	WET	89.5	U	90.7	U	98.9	U	98.3	U	98	U	98.3	U	96.5	U
8330B	Nitroglycerin	55-63-0	ug/Kg	WET	1790	U	1810	U	1980	U	1970	U	1960	U	1970	U	1930	U
8330B	PETN	78-11-5	ug/Kg	WET	4480	U	4530	U	4950	U	4920	U	4900	U	4920	U	4830	U
8330B	Picric acid	88-89-1	ug/Kg	WET	16	J	16.2	J	30	J	98.3	U	98	U	98.3	U	96.5	U
8330B	RDX	121-82-4	ug/Kg	WET	89.5	U	90.7	U	98.9	U	98.3	U	98	U	98.3	U	96.5	U
8330B	Tetryl	479-45-8	ug/Kg	WET	89.5	U	90.7	U	98.9	U	98.3	U	98	U	98.3	U	96.5	U

Appendix 3B-3. Analytical Results for
Metals and Explosives in Soilsin the Test Range Subareas and Soil UCL Exceedance Areas

Method	Analyte	CAS	Unit	Basis	SO-STRB4-06-RM1		SO-STRB4-06-RM2		SO-STRB4-12-PM		SO-STRB4-12-RM1		SO-STRB4-12-RM2		SO-STRD-03-PM		SO-STRD-03-RM1	
					10/13/2015		10/13/2015		10/13/2015		10/13/2015		10/13/2015		10/13/2015		10/13/2015	
					ISM		ISM		ISM		ISM		ISM		ISM		ISM	
					SOIL		SOIL		SOIL		SOIL		SOIL		SOIL		SOIL	
					3-6		3-6		6-12		6-12		6-12		0-3		0-3	
6010	Aluminum	7429-90-5	mg/Kg	WET	7680	^	7000	^	7170	F1	7840	^	7390		8170	^	7700	^
6010	Antimony	7440-36-0	mg/Kg	WET	1.8	^	1.4	^	0.84	^ F1	1.6	^	0.38	J ^	28.3	^	11	^
6010	Arsenic	7440-38-2	mg/Kg	WET	3.7		3.7		2		3.2		2.5		13.5		7.5	
6010	Barium	7440-39-3	mg/Kg	WET	41.7		36.7		31.2	F1	37.3		33		86.5		71	
6010	Beryllium	7440-41-7	mg/Kg	WET	0.32		0.3		0.31		0.34		0.34		0.24		0.24	
6010	Cadmium	7440-43-9	mg/Kg	WET	0.26		0.24		0.2		0.22		0.21		0.69		0.51	
6010	Calcium	7440-70-2	mg/Kg	WET	1110	B	915	B	841	F1	971	B	865		836	B	806	B
6010	Chromium	7440-47-3	mg/Kg	WET	561		562		136	F1	413		186		328		779	
6010	Cobalt	7440-48-4	mg/Kg	WET	4.2		4.2		2.8		4		3.1		2.3		3.9	
6010	Copper	7440-50-8	mg/Kg	WET	25.4		72.5		13.7		27.1		35.4		99.1		71.6	
6010	Iron	7439-89-6	mg/Kg	WET	13300		13300		9470		12300		10400		11400		14000	
6010	Lead	7439-92-1	mg/Kg	WET	274		304		147	F1	180		140		1990		1290	
6010	Magnesium	7439-95-4	mg/Kg	WET	1270		1260		1300		1360		1340		883		898	
6010	Manganese	7439-96-5	mg/Kg	WET	164	B	157	B	135	F1 B	164	B	144	B	105	B	129	B
6010	Nickel	7440-02-0	mg/Kg	WET	12.2		10.9		7.2		9.2		8.4		11.9		14.5	
6010	Potassium	7440-09-7	mg/Kg	WET	1100		1010		798	F1 B	1030		889	B	1150		1110	
6010	Selenium	7782-49-2	mg/Kg	WET	1		1		0.45	J	0.61		0.56		1.1		0.72	
6010	Silver	7440-22-4	mg/Kg	WET	0.52	U	0.51	U	0.5	U	0.49	U	0.47	U	0.31	J	0.22	J
6010	Sodium	7440-23-5	mg/Kg	WET	317		277		167	B	249		213	B	334		311	
6010	Thallium	7440-28-0	mg/Kg	WET	1	U	1	U	1	U	0.98	U	0.94	U	0.95	U	0.99	U
6010	Vanadium	7440-62-2	mg/Kg	WET	19.7		18.9		15.4		17.7		15.9		33.1		27.6	
6010	Zinc	7440-66-6	mg/Kg	WET	23.8		32.8		20.6		22.6		24.9		38.5		32.1	
7471A	Mercury	7439-97-6	mg/Kg	WET	0.63		0.62		0.57		0.58		0.45		8.4		5.7	
6850	Perchlorate	14797-73-0	ug/Kg	WET	0.94	* B	0.87	* B	0.63	J * B	0.64	J * B	0.81	* B	3.6	* B	2.17	* B
8330B	1,3,5-Trinitrobenzene	99-35-4	ug/Kg	WET	97.2	U	98.8	U	99.1	U	98.3	U	97.4	U	98.3	U	98.5	U
8330B	1,3-Dinitrobenzene	99-65-0	ug/Kg	WET	97.2	U	98.8	U	99.1	U	98.3	U	97.4	U	98.3	U	98.5	U
8330B	2,4,6-Trinitrotoluene	118-96-7	ug/Kg	WET	97.2	U	98.8	U	99.1	U	98.3	U	97.4	U	98.3	U	98.5	U
8330B	2,4-diamino-6-nitrotoluene	6629-29-4	ug/Kg	WET	97.2	U	98.8	U	99.1	U	98.3	U	97.4	U	98.3	U	98.5	U
8330B	2,4-Dinitrotoluene	121-14-2	ug/Kg	WET	97.2	U	98.8	U	99.1	U	98.3	U	97.4	U	98.3	U	98.5	U
8330B	2,6-diamino-4-nitrotoluene	59229-75-3	ug/Kg	WET	97.2	U	98.8	U	99.1	U	98.3	U	97.4	U	98.3	U	98.5	U
8330B	2,6-Dinitrotoluene	606-20-2	ug/Kg	WET	97.2	U	98.8	U	99.1	U	98.3	U	97.4	U	98.3	U	98.5	U
8330B	2-Amino-4,6-dinitrotoluene	35572-78-2	ug/Kg	WET	97.2	U	98.8	U	99.1	U	98.3	U	97.4	U	98.3	U	15.3	J p
8330B	2-Nitrotoluene	88-72-2	ug/Kg	WET	97.2	U	98.8	U	99.1	U	98.3	U	97.4	U	98.3	U	98.5	U
8330B	3-Nitrotoluene	99-08-1	ug/Kg	WET	97.2	U	98.8	U	99.1	U	98.3	U	97.4	U	98.3	U	98.5	U
8330B	4-Amino-2,6-dinitrotoluene	19406-51-0	ug/Kg	WET	97.2	U	98.8	U	99.1	U	98.3	U	97.4	U	98.3	U	98.5	U
8330B	4-Nitrotoluene	99-99-0	ug/Kg	WET	97.2	U	98.8	U	99.1	U	98.3	U	97.4	U	128		236	
8330B	HMX	2691-41-0	ug/Kg	WET	97.2	U	98.8	U	99.1	U	98.3	U	97.4	U	98.3	U	98.5	U
8330B	Nitrobenzene	98-95-3	ug/Kg	WET	97.2	U	98.8	U	99.1	U	98.3	U	97.4	U	98.3	U	98.5	U
8330B	Nitroglycerin	55-63-0	ug/Kg	WET	1940	U	1980	U	1980	U	1970	U	1950	U	1210	J p	3670	
8330B	PETN	78-11-5	ug/Kg	WET	4860	U	4940	U	4960	U	4920	U	4870	U	4920	U	4930	U
8330B	Picric acid	88-89-1	ug/Kg	WET	11.3	J p	23.1	J	99.1	U F1	98.3	U	97.4	U	75.5	J p	31.9	J
8330B	RDX	121-82-4	ug/Kg	WET	97.2	U	98.8	U	99.1	U	98.3	U	97.4	U	98.3	U	98.5	U
8330B	Tetryl	479-45-8	ug/Kg	WET	97.2	U	98.8	U	99.1	U	98.3	U	97.4	U	98.3	U	98.5	U

Appendix 3B-3. Analytical Results for
Metals and Explosives in Soilsin the Test Range Subareas and Soil UCL Exceedance Areas

Method	Analyte	CAS	Unit	Basis	SO-STRD-03-RM2		SO-STRF-03-PM		SO-STRF-03-RM1		SO-STRF-03-RM2		SO-SPZE1-06		SO-SPZE2-06		SO-SPZE3-06	
					10/13/2015		10/13/2015		10/13/2015		10/13/2015		10/23/2015		10/23/2015		10/23/2015	
					ISM		ISM		ISM		ISM		ISM		ISM		ISM	
					SOIL		SOIL		SOIL		SOIL		SOIL		SOIL		SOIL	
					0-3		0-3		0-3		0-3		3-6		3-6		3-6	
6010	Aluminum	7429-90-5	mg/Kg	WET	6440	^	10600	^	10000	^	10500	^	9720		10600		9440	
6010	Antimony	7440-36-0	mg/Kg	WET	10.1	^	0.5	U ^	0.67	^	0.89	^	0.5	U	0.5	U	0.5	U
6010	Arsenic	7440-38-2	mg/Kg	WET	4.4		6.1		6.9		8		3.9		3.1		4	
6010	Barium	7440-39-3	mg/Kg	WET	71		41.9		37.6		43		835		1910		671	
6010	Beryllium	7440-41-7	mg/Kg	WET	0.2		0.42		0.4		0.41		0.57		0.57		0.54	
6010	Cadmium	7440-43-9	mg/Kg	WET	0.54		0.25		0.32		0.36		2.2		2.1		1.3	
6010	Calcium	7440-70-2	mg/Kg	WET	734	B	934	B	941	B	1060	B	1700	B	1700	B	1640	B
6010	Chromium	7440-47-3	mg/Kg	WET	11.4		13.1		167		521		289		15		143	
6010	Cobalt	7440-48-4	mg/Kg	WET	2		3.7		3.5		5		9.4		7.7		6.8	
6010	Copper	7440-50-8	mg/Kg	WET	140		9.4		10.8		17.2		138		56.9		45.7	
6010	Iron	7439-89-6	mg/Kg	WET	16700		17800		13300		16900		14900		16300		13700	
6010	Lead	7439-92-1	mg/Kg	WET	2600		171		203		239		566		557		402	
6010	Magnesium	7439-95-4	mg/Kg	WET	783		1750		1640		1690		3920		4530		3220	
6010	Manganese	7439-96-5	mg/Kg	WET	170	B	244	B	179	B	224	B	651	B	650	B	503	B
6010	Nickel	7440-02-0	mg/Kg	WET	8.4		10.3		11.1		14.1		23.7		24.4		21.8	
6010	Potassium	7440-09-7	mg/Kg	WET	1010		1360		1210		1290		1200		1320		1250	
6010	Selenium	7782-49-2	mg/Kg	WET	1.3		1		0.83		0.51	U	0.84		0.62		0.91	
6010	Silver	7440-22-4	mg/Kg	WET	0.28	J	0.5	U	0.23	J	0.43	J	0.46	J	0.51		0.24	J
6010	Sodium	7440-23-5	mg/Kg	WET	310		294		273		269		326		320		271	
6010	Thallium	7440-28-0	mg/Kg	WET	1	U	0.99	U	0.99	U	1	U	0.99	U	1	U	1	U
6010	Vanadium	7440-62-2	mg/Kg	WET	28.1		26.6		23.7		26.1		19.4		20.5		19.4	
6010	Zinc	7440-66-6	mg/Kg	WET	36.1		26.6		24.5		28.3		94.8		101		69	
7471A	Mercury	7439-97-6	mg/Kg	WET	6		0.14		0.14		0.17		0.039		0.076		0.03	
6850	Perchlorate	14797-73-0	ug/Kg	WET	3.33	* B	1	B	0.95	B	0.77	J * B	NA		NA		NA	
8330B	1,3,5-Trinitrobenzene	99-35-4	ug/Kg	WET	47.3	J p	96.2	U	94.8	U	98.9	U	94.3	U	99.9	U	96.7	U
8330B	1,3-Dinitrobenzene	99-65-0	ug/Kg	WET	94.6	U	96.2	U	94.8	U	98.9	U	27.2	J p	15.8	J	185	p
8330B	2,4,6-Trinitrotoluene	118-96-7	ug/Kg	WET	94.6	U	125	p	94.8	U	98.9	U	94.3	U	99.9	U	96.7	U
8330B	2,4-diamino-6-nitrotoluene	6629-29-4	ug/Kg	WET	94.6	U	96.2	U	94.8	U	98.9	U	94.3	U	99.9	U	96.7	U
8330B	2,4-Dinitrotoluene	121-14-2	ug/Kg	WET	94.6	U	96.2	U	94.8	U	98.9	U	94.3	U	99.9	U	96.7	U
8330B	2,6-diamino-4-nitrotoluene	59229-75-3	ug/Kg	WET	94.6	U	96.2	U	94.8	U	98.9	U	94.3	U	99.9	U	96.7	U
8330B	2,6-Dinitrotoluene	606-20-2	ug/Kg	WET	94.6	U	96.2	U	94.8	U	98.9	U	94.3	U	99.9	U	96.7	U
8330B	2-Amino-4,6-dinitrotoluene	35572-78-2	ug/Kg	WET	15.2	J p	96.2	U	94.8	U	98.9	U	94.3	U	99.9	U	17.9	J
8330B	2-Nitrotoluene	88-72-2	ug/Kg	WET	94.6	U	96.2	U	94.8	U	98.9	U	94.3	U	99.9	U	96.7	U
8330B	3-Nitrotoluene	99-08-1	ug/Kg	WET	94.6	U	96.2	U	94.8	U	98.9	U	60.7	J p	99.9	U	96.7	U
8330B	4-Amino-2,6-dinitrotoluene	19406-51-0	ug/Kg	WET	94.6	U	96.2	U	19.4	J p	98.9	U	94.3	U	99.9	U	96.7	U
8330B	4-Nitrotoluene	99-99-0	ug/Kg	WET	445	p	96.2	U	94.8	U	98.9	U	94.3	U	99.9	U	96.7	U
8330B	HMX	2691-41-0	ug/Kg	WET	94.6	U	96.2	U	94.8	U	98.9	U	15.5	J p	14	J p	9.01	J p
8330B	Nitrobenzene	98-95-3	ug/Kg	WET	34.8	J	96.2	U	94.8	U	98.9	U	94.3	U	99.9	U	96.7	U
8330B	Nitroglycerin	55-63-0	ug/Kg	WET	1890	U	1920	U	1900	U	1980	U	1890	U	2000	U	1930	U
8330B	PETN	78-11-5	ug/Kg	WET	4730	U	4810	U	4740	U	4950	U	4720	U	5000	U	4840	U
8330B	Picric acid	88-89-1	ug/Kg	WET	49.5	J p	26.1	J p	31.4	J p	98.9	U	94.3	U	99.9	U	96.7	U
8330B	RDX	121-82-4	ug/Kg	WET	94.6	U	96.2	U	94.8	U	98.9	U	27.8	J	25.1	J	96.7	U
8330B	Tetryl	479-45-8	ug/Kg	WET	94.6	U	350		68.4	J p	98.9	U	94.3	U	99.9	U	44.6	J p

Appendix 3B-3. Analytical Results for
Metals and Explosives in Soilsin the Test Range Subareas and Soil UCL Exceedance Areas

Method	Analyte	CAS	Unit	Basis	SO-SSDA1-06		SO-SSDA2-06		SO-SSDA3-06	
					10/23/2015		10/23/2015		10/23/2015	
					ISM		ISM		ISM	
					SOIL		SOIL		SOIL	
					3-6		3-6		3-6	
6010	Aluminum	7429-90-5	mg/Kg	WET	8760		8690		9000	
6010	Antimony	7440-36-0	mg/Kg	WET	48.9		42.9		61.3	
6010	Arsenic	7440-38-2	mg/Kg	WET	12.4		10.2		11	
6010	Barium	7440-39-3	mg/Kg	WET	1660		1910		1680	
6010	Beryllium	7440-41-7	mg/Kg	WET	0.5		0.48		0.48	
6010	Cadmium	7440-43-9	mg/Kg	WET	11.5		11.2		10.9	
6010	Calcium	7440-70-2	mg/Kg	WET	3150	B	2760	B	3490	B
6010	Chromium	7440-47-3	mg/Kg	WET	458		419		267	
6010	Cobalt	7440-48-4	mg/Kg	WET	8.9		7.7		8	
6010	Copper	7440-50-8	mg/Kg	WET	877		507		778	
6010	Iron	7439-89-6	mg/Kg	WET	44100		35000		44500	
6010	Lead	7439-92-1	mg/Kg	WET	1960		1810		2320	
6010	Magnesium	7439-95-4	mg/Kg	WET	3750		3550		3690	
6010	Manganese	7439-96-5	mg/Kg	WET	521	B	500	B	566	B
6010	Nickel	7440-02-0	mg/Kg	WET	90.8		73.7		106	
6010	Potassium	7440-09-7	mg/Kg	WET	1190		1160		1130	
6010	Selenium	7782-49-2	mg/Kg	WET	5.4		3.5		5	
6010	Silver	7440-22-4	mg/Kg	WET	1.4		1.4		1.4	
6010	Sodium	7440-23-5	mg/Kg	WET	286		269		255	
6010	Thallium	7440-28-0	mg/Kg	WET	1	U	1	U	5	U
6010	Vanadium	7440-62-2	mg/Kg	WET	21.9		21.2		21	
6010	Zinc	7440-66-6	mg/Kg	WET	2290		2320		1610	
7471A	Mercury	7439-97-6	mg/Kg	WET	1.4		1.2		1.2	
6850	Perchlorate	14797-73-0	ug/Kg	WET	NA		NA		NA	
8330B	1,3,5-Trinitrobenzene	99-35-4	ug/Kg	WET	99.6	U	28.5	J p	99.2	U
8330B	1,3-Dinitrobenzene	99-65-0	ug/Kg	WET	39.9	J	20.5	J p	27.5	J p
8330B	2,4,6-Trinitrotoluene	118-96-7	ug/Kg	WET	1080	p	1150		1240	p
8330B	2,4-diamino-6-nitrotoluene	6629-29-4	ug/Kg	WET	99.6	U	98.4	U	99.2	U
8330B	2,4-Dinitrotoluene	121-14-2	ug/Kg	WET	250	p	128	p	160	p
8330B	2,6-diamino-4-nitrotoluene	59229-75-3	ug/Kg	WET	99.6	U	98.4	U	99.2	U
8330B	2,6-Dinitrotoluene	606-20-2	ug/Kg	WET	43.4	J	40.2	J	57.2	J
8330B	2-Amino-4,6-dinitrotoluene	35572-78-2	ug/Kg	WET	314		605		325	
8330B	2-Nitrotoluene	88-72-2	ug/Kg	WET	99.6	U	98.4	U	99.2	U
8330B	3-Nitrotoluene	99-08-1	ug/Kg	WET	99.6	U	98.4	U	99.2	U
8330B	4-Amino-2,6-dinitrotoluene	19406-51-0	ug/Kg	WET	277		501		300	
8330B	4-Nitrotoluene	99-99-0	ug/Kg	WET	69.6	J p	93.2	J	96.9	J p
8330B	HMX	2691-41-0	ug/Kg	WET	20.8	J p	18.3	J p	14.3	J p
8330B	Nitrobenzene	98-95-3	ug/Kg	WET	99.6	U	231	p	195	p
8330B	Nitroglycerin	55-63-0	ug/Kg	WET	1990	U	1970	U	1980	U
8330B	PETN	78-11-5	ug/Kg	WET	4980	U	4920	U	4960	U
8330B	Picric acid	88-89-1	ug/Kg	WET	99.6	U	35.9	J	57.5	J p
8330B	RDX	121-82-4	ug/Kg	WET	21.4	J	17.6	J p	29.6	J p
8330B	Tetryl	479-45-8	ug/Kg	WET	99.6	U	98.4	U	99.2	U

Notes:

Laboratory Data Qualifiers:

- U – Indicates the analyte was analyzed for but not detected.
- J – Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.
- B – Compound was found in the blank and sample.
- H – Sample was prepped or analyzed beyond the specified holding time.
- F1 – MS and/or MSD recovery is outside acceptance limits.
- F2 – MS/MSD RPD exceeds control limits.
- p – The % RPD between the primary and confirmation column/detector is > 40%. The lower value has been reported.
- *- Interference check standard or LCS/LCSD is outside acceptance limits.
- ^ - Instrument QC is outside acceptance limits.

Sample Basis - samples that are not air-dried prior to analysis are presumed to have a certain moisture content and are reported on a dry or wet basis with a percent solids measured by the laboratory and reported. Samples that are air-dried are presumed to have no moisture content and therefore no percent solids reported.

ISM Sample - Incremental sampling methodology (ISM) is a structured composite sampling and processing protocol having specific elements designed to reduce data variability and increase sample representativeness for a specified volume of soil under investigation.

mg/kg - milligrams/kilogram

ug/kg - micrograms/kilogram

APPENDIX 3B-4

Analytical Results for Metals in Soils in the Marsh Upland Area

Appendix 3B-4. Analytical Results for Metals
in Soils in the Marsh Upland Area

Method	Analyte	CAS	Unit	Basis	SO-MUAU1-12		SO-MUAU1-24		SO-MUAU1-24-DUP		SO-MUAU1-36		SO-MUAU1-48		SO-MUAU2-12	
					10/28/2015		10/28/2015		10/28/2015		10/28/2015		10/28/2015		10/29/2015	
					GRAB		GRAB		GRAB		GRAB		GRAB		GRAB	
					SOIL		SOIL		SOIL		SOIL		SOIL		SOIL	
					6-12		12-24		12-24		24-36		36-48		6-12	
6010	Aluminum	7429-90-5	mg/Kg	DRY	6430		8790		7410		12200		9290		8720	
6010	Antimony	7440-36-0	mg/Kg	DRY	6		1.8		6.8		0.8	J F1	1.8	U	0.52	U
6010	Arsenic	7440-38-2	mg/Kg	DRY	2.9		1.9		2.7		1.9		2.4		2.2	
6010	Barium	7440-39-3	mg/Kg	DRY	20.5		39.2		43.9		38.4		25.2		32.8	
6010	Beryllium	7440-41-7	mg/Kg	DRY	0.29		0.26		0.26		0.28	J	0.29	J	0.33	
6010	Cadmium	7440-43-9	mg/Kg	DRY	0.086	J	0.098	J	0.12	J	0.084	J	0.069	J	0.21	U
6010	Calcium	7440-70-2	mg/Kg	DRY	592	B	360	B	445	B	189	J	195	J	707	B
6010	Chromium	7440-47-3	mg/Kg	DRY	13.2	B	5.7	B	7.4	B	8.7	B	11.3	B	6.3	B
6010	Cobalt	7440-48-4	mg/Kg	DRY	1.8		0.94		1.6		1.4		2.7		2.6	
6010	Copper	7440-50-8	mg/Kg	DRY	150		67.9		166		6.6		5.2		32.5	
6010	Iron	7439-89-6	mg/Kg	DRY	7740	^	8210	^	7760	^	8500	B	11100	B	10900	^
6010	Lead	7439-92-1	mg/Kg	DRY	882		71.9		303		17.4		8		33.6	
6010	Magnesium	7439-95-4	mg/Kg	DRY	1070		594		923		607		1650		1530	F1
6010	Manganese	7439-96-5	mg/Kg	DRY	90.4	B	56.1	B	83	B	38.8		114		180	B
6010	Nickel	7440-02-0	mg/Kg	DRY	11.9		4.2		6.5		5.8		6.8		5.3	
6010	Potassium	7440-09-7	mg/Kg	DRY	443		294		370		155	J	224	J	421	
6010	Selenium	7782-49-2	mg/Kg	DRY	0.58	U	0.58	U	1.7		0.66	J	1.8	U	0.52	U
6010	Silver	7440-22-4	mg/Kg	DRY	0.58	U	0.58	U	0.56	U	1.1	U	0.91	U	0.52	U
6010	Sodium	7440-23-5	mg/Kg	DRY	67.5	J B	49.1	J B	47.4	J B	25.6	J	31.8	J	44.4	J B
6010	Thallium	7440-28-0	mg/Kg	DRY	1.2	U	1.2	U	1.1	U	2.2	U	1.8	U	1	U
6010	Vanadium	7440-62-2	mg/Kg	DRY	15.4		13.9		13.3		14.4		16.6		16.5	
6010	Zinc	7440-66-6	mg/Kg	DRY	15.7		29.6		24.6		22	B	23.3	B	27	
7471A	Mercury	7439-97-6	mg/Kg	DRY	27.1		24.2		92.3		0.8	F1 F2	0.11		1.2	F1

Appendix 3B-4. Analytical Results for Metals in Soils in the Marsh Upland Area

Method	Analyte	CAS	Unit	Basis	SO-MUAU2-24		SO-MUAU3-12		SO-MUAU3-24		SO-MUAU3-36		SO-MUAU3-48		SO-MUAU4-12	
					10/29/2015		10/29/2015		10/29/2015		10/29/2015		10/29/2015		10/29/2015	
					GRAB		GRAB		GRAB		GRAB		GRAB		GRAB	
					SOIL		SOIL		SOIL		SOIL		SOIL		SOIL	
					12-24		6-12		12-24		24-36		36-48		6-12	
6010	Aluminum	7429-90-5	mg/Kg	DRY	8970		6120		7310		3120		4410		5410	
6010	Antimony	7440-36-0	mg/Kg	DRY	0.57	U	4		6.5		1.7	U	3.1		10	
6010	Arsenic	7440-38-2	mg/Kg	DRY	2.9		2.9		3.1		1.3		1.3	J	2.5	
6010	Barium	7440-39-3	mg/Kg	DRY	30.1		18.5		20.3		9.6	J	13.5	J	14.5	
6010	Beryllium	7440-41-7	mg/Kg	DRY	0.3		0.3		0.31		0.14	J	0.18	J	0.25	
6010	Cadmium	7440-43-9	mg/Kg	DRY	0.049	J	0.1	J	0.093	J	2.3		0.16	J	0.097	J
6010	Calcium	7440-70-2	mg/Kg	DRY	409	B	799	B	679	B	352	J	420	J	667	B
6010	Chromium	7440-47-3	mg/Kg	DRY	7.9	B	7.4	B	9.7	B	4.3	B	6.3	B	8.4	B
6010	Cobalt	7440-48-4	mg/Kg	DRY	2.7		2.6		2.5		3.1		1.7		2.7	
6010	Copper	7440-50-8	mg/Kg	DRY	70.4		139		148		59.3		243		144	
6010	Iron	7439-89-6	mg/Kg	DRY	9190	^	7720	^	9830	^	4060	B	5900	B	9120	^
6010	Lead	7439-92-1	mg/Kg	DRY	4.9		444		351		677		305		436	
6010	Magnesium	7439-95-4	mg/Kg	DRY	1170		1240		1400		876		1150		1240	
6010	Manganese	7439-96-5	mg/Kg	DRY	107	B	136	B	121	B	63.4		83.1		147	B
6010	Nickel	7440-02-0	mg/Kg	DRY	12.7		14.4		8		5.8		7		43.6	
6010	Potassium	7440-09-7	mg/Kg	DRY	485		647		521		204	J	284	J	578	
6010	Selenium	7782-49-2	mg/Kg	DRY	0.57	U	0.55	U	0.55	U	1.7	U	2.4	U	0.57	U
6010	Silver	7440-22-4	mg/Kg	DRY	0.57	U	0.55	U	0.55	U	0.84	U	1.2	U	0.57	U
6010	Sodium	7440-23-5	mg/Kg	DRY	46.2	J B	59.9	J B	51.8	J B	20.8	J	27	J	50.9	J B
6010	Thallium	7440-28-0	mg/Kg	DRY	1.1	U	1.1	U	1.1	U	1.7	U	2.4	U	1.1	U
6010	Vanadium	7440-62-2	mg/Kg	DRY	13.7		10.5		14		7.7		8.6		10.1	
6010	Zinc	7440-66-6	mg/Kg	DRY	31.7		30.7		26.9		127	B	32.2	B	24.7	
7471A	Mercury	7439-97-6	mg/Kg	DRY	0.067		28.2		105		48.7		146		18.4	

Appendix 3B-4. Analytical Results for Metals in Soils in the Marsh Upland Area

Method	Analyte	CAS	Unit	Basis	SO-MUAU4-24		SO-MUAU4-24-DUP		SO-MUAU4-36		SO-MUAU4-48		SO-MUAU4-60		SO-MUAU4-72	
					10/29/2015		10/29/2015		10/29/2015		10/29/2015		10/29/2015		10/29/2015	
					GRAB		GRAB		GRAB		GRAB		GRAB		GRAB	
					SOIL		SOIL		SOIL		SOIL		SOIL		SOIL	
					12-24		12-24		24-36		36-48		48-60		60-72	
6010	Aluminum	7429-90-5	mg/Kg	DRY	6470		6670		5270		2420		2600		2820	
6010	Antimony	7440-36-0	mg/Kg	DRY	10.6		11.3		3.5		1.7	U	1.8	U	2	U
6010	Arsenic	7440-38-2	mg/Kg	DRY	2.3		2.3		2.1		1.6		1.6		1.7	
6010	Barium	7440-39-3	mg/Kg	DRY	16.9		16.3		34		7.9	J	7.3	J	18	J
6010	Beryllium	7440-41-7	mg/Kg	DRY	0.28		0.27		0.2	J	0.16	J	0.16	J	0.18	J
6010	Cadmium	7440-43-9	mg/Kg	DRY	0.1	J	0.12	J	0.53		0.03	J	0.049	J	0.15	J
6010	Calcium	7440-70-2	mg/Kg	DRY	561	B	746	B	307	J	368	J	468		620	
6010	Chromium	7440-47-3	mg/Kg	DRY	8.1	B	7.6	B	9	B	3.6	B	7.4	B	4.9	B
6010	Cobalt	7440-48-4	mg/Kg	DRY	2.7		3		2.5		2.3		1.9		2.3	
6010	Copper	7440-50-8	mg/Kg	DRY	258		243		118		3.8		7.7		6.5	
6010	Iron	7439-89-6	mg/Kg	DRY	8430	^	8270		7740	B	5330	B	5640	B	6340	B
6010	Lead	7439-92-1	mg/Kg	DRY	477		516		377		3.3		11.1		5.2	
6010	Magnesium	7439-95-4	mg/Kg	DRY	1160		1250		1170		954		959		1050	
6010	Manganese	7439-96-5	mg/Kg	DRY	131	B	135	B	111		105		88.2		100	
6010	Nickel	7440-02-0	mg/Kg	DRY	16.2		17.1		168		3.8		6.1		5.2	
6010	Potassium	7440-09-7	mg/Kg	DRY	505		526		235	J	264	J	254	J	282	J
6010	Selenium	7782-49-2	mg/Kg	DRY	0.53	U	0.56	U	0.33	J	1.7	U	1.8	U	2	U
6010	Silver	7440-22-4	mg/Kg	DRY	0.53	U	0.56	U	0.93	U	0.85	U	0.9	U	0.99	U
6010	Sodium	7440-23-5	mg/Kg	DRY	48.7	J B	47.1	J B	22.5	J	17.3	J	19.5	J	22.2	J
6010	Thallium	7440-28-0	mg/Kg	DRY	1.1	U	1.1	U	1.9	U	1.7	U	1.8	U	2	U
6010	Vanadium	7440-62-2	mg/Kg	DRY	11.3		11.5		9.6		6.5		7.4		8.8	
6010	Zinc	7440-66-6	mg/Kg	DRY	33.8		28		62.1	B	16.1	B	25.1	B	55.9	B
7471A	Mercury	7439-97-6	mg/Kg	DRY	38.7		32.2		40.2		2.8		1.9		0.37	

Appendix 3B-4. Analytical Results for Metals in Soils in the Marsh Upland Area

Method	Analyte	CAS	Unit	Basis	SO-MUAU5-12		SO-MUAU5-24		SO-MUAU5-36		SO-MUAU5-48		SO-MUAU5-60		SO-MUAU6-12	
					10/29/2015		10/29/2015		10/29/2015		10/29/2015		10/29/2015		10/29/2015	
					GRAB		GRAB		GRAB		GRAB		GRAB		GRAB	
					SOIL		SOIL		SOIL		SOIL		SOIL		SOIL	
					6-12		12-24		24-36		36-48		48-60		6-12	
6010	Aluminum	7429-90-5	mg/Kg	DRY	10200		9720	B	5530		4460		4930		6620	B
6010	Antimony	7440-36-0	mg/Kg	DRY	0.48	J	0.55	U ^	1.9	U	2	U	1.9	U	1.9	^
6010	Arsenic	7440-38-2	mg/Kg	DRY	3		3.1		2.1		2.2		2.6		2	
6010	Barium	7440-39-3	mg/Kg	DRY	26.2	F2 F1	25.8		11.9	J	8.9	J	11.8	J	21.1	
6010	Beryllium	7440-41-7	mg/Kg	DRY	0.35		0.33		0.23	J	0.22	J	0.23	J	0.3	
6010	Cadmium	7440-43-9	mg/Kg	DRY	0.094	J	0.2	J B	0.056	J	0.06	J	0.069	J	0.18	J B
6010	Calcium	7440-70-2	mg/Kg	DRY	669	B	524	B	217	J	190	J	227	J	2260	B
6010	Chromium	7440-47-3	mg/Kg	DRY	8	B	9.5		6.7	B	6.5	B	9.6	B	6	
6010	Cobalt	7440-48-4	mg/Kg	DRY	2.7		2.5		3.7		3.4		4.4		4.3	
6010	Copper	7440-50-8	mg/Kg	DRY	62.5	F1	53.6		6.1		5.5		6		48.7	
6010	Iron	7439-89-6	mg/Kg	DRY	10700		10100		7660	B	7070	B	8020	B	11200	
6010	Lead	7439-92-1	mg/Kg	DRY	26.7	F1	58.9		6.4		6.6		5		112	
6010	Magnesium	7439-95-4	mg/Kg	DRY	1350		1380		1330		1280		1840		2240	
6010	Manganese	7439-96-5	mg/Kg	DRY	130	F1 B	123	B	127		148		226		172	B
6010	Nickel	7440-02-0	mg/Kg	DRY	7.7	F1	8.1		5.5		5.7		9.7		9.1	
6010	Potassium	7440-09-7	mg/Kg	DRY	375	F1	453		310	J	265	J	376	J	791	
6010	Selenium	7782-49-2	mg/Kg	DRY	0.52	U	0.76		1.9	U	2	U	1.9	U	0.51	J
6010	Silver	7440-22-4	mg/Kg	DRY	0.52	U	0.55	U	0.93	U	1	U	0.95	U	0.53	U
6010	Sodium	7440-23-5	mg/Kg	DRY	41.5	J B	33.1	J	20.6	J	19.8	J	19.4	J	265	
6010	Thallium	7440-28-0	mg/Kg	DRY	1	U	1.1	U	1.9	U	2	U	1.9	U	1.1	U
6010	Vanadium	7440-62-2	mg/Kg	DRY	14		15.1		9.3		8		9		22.7	
6010	Zinc	7440-66-6	mg/Kg	DRY	22		21.2		16.6	B	14.2	B	15.8	B	30	
7471A	Mercury	7439-97-6	mg/Kg	DRY	18.8		22		0.57		0.82		0.34		11.8	

Appendix 3B-4. Analytical Results for Metals in Soils in the Marsh Upland Area

Method	Analyte	CAS	Unit	Basis	SO-MUAU6-24		SO-MUAU6-24-DUP		SO-MUAU6-36		SO-MUAU6-48		SO-MUAU7-12		SO-MUAU7-24	
					10/29/2015		10/29/2015		10/29/2015		10/29/2015		10/29/2015		10/29/2015	
					GRAB		GRAB		GRAB		GRAB		GRAB		GRAB	
					SOIL		SOIL		SOIL		SOIL		SOIL		SOIL	
					12-24		12-24		24-36		36-48		6-12		12-24	
6010	Aluminum	7429-90-5	mg/Kg	DRY	3880	B	5240	B	5440		7370		4830	B F1	4110	^
6010	Antimony	7440-36-0	mg/Kg	DRY	1.5	^	1.1	^	0.47	J	2.5	U	1.6	^	2.4	
6010	Arsenic	7440-38-2	mg/Kg	DRY	2.4		2.2		1.4		2		1.7		2.3	
6010	Barium	7440-39-3	mg/Kg	DRY	17.5		18.9		17.3	J	21.4	J	44.4	F1	18.4	
6010	Beryllium	7440-41-7	mg/Kg	DRY	0.2		0.26		0.2	J	0.25	J	0.24		0.27	
6010	Cadmium	7440-43-9	mg/Kg	DRY	0.14	J B	0.2	J B	0.12	J	0.065	J	0.49	B	0.58	
6010	Calcium	7440-70-2	mg/Kg	DRY	587	B	565	B	290	J	221	J	788	B F1	778	B
6010	Chromium	7440-47-3	mg/Kg	DRY	5.3		6.1		5.9	B	8.1	B	7		6	
6010	Cobalt	7440-48-4	mg/Kg	DRY	2		2.6		1.7		2.3		3.4		2.1	
6010	Copper	7440-50-8	mg/Kg	DRY	25		40.2		23.3		4.4		107	F1	191	
6010	Iron	7439-89-6	mg/Kg	DRY	6310		7110		6880	B	9450	B	19900		7590	^
6010	Lead	7439-92-1	mg/Kg	DRY	73.1		94.9		46.5		7.5		118	F1	137	
6010	Magnesium	7439-95-4	mg/Kg	DRY	1210		1230		888		1000		1040		1210	B
6010	Manganese	7439-96-5	mg/Kg	DRY	115	B	123	B	97.3		87.7		168	B	112	B
6010	Nickel	7440-02-0	mg/Kg	DRY	4.7		4.9		4.6		4.8	J	7.8		6.7	
6010	Potassium	7440-09-7	mg/Kg	DRY	395		441		174	J	152	J	519		600	
6010	Selenium	7782-49-2	mg/Kg	DRY	0.52		0.74		1.8	U	2.5	U	0.75		0.54	U
6010	Silver	7440-22-4	mg/Kg	DRY	0.48	U	0.63	U	0.88	U	1.2	U	0.27	J	0.54	U
6010	Sodium	7440-23-5	mg/Kg	DRY	26.7	J	33.5	J	25.5	J	29.1	J	74.7	J	40.5	J
6010	Thallium	7440-28-0	mg/Kg	DRY	0.97	U	1.3	U	1.8	U	2.5	U	1.1	U	1.1	U
6010	Vanadium	7440-62-2	mg/Kg	DRY	7.8		10.7		8.6		13.8		9.1		9.6	
6010	Zinc	7440-66-6	mg/Kg	DRY	18.9		21.3		21.6	B	15.2	B	25.5		30.4	
7471A	Mercury	7439-97-6	mg/Kg	DRY	10.4		13.5		6.1		0.45		109	F2	360	

Appendix 3B-4. Analytical Results for Metals in Soils in the Marsh Upland Area

Method	Analyte	CAS	Unit	Basis	SO-MUAU7-36		SO-MUAU7-48		SO-MUAU8-12		SO-MUAU8-12-DUP		SO-MUAU8-24		SO-MUAU8-36	
					10/29/2015		10/29/2015		10/29/2015		10/29/2015		10/29/2015		10/29/2015	
					GRAB		GRAB		GRAB		GRAB		GRAB		GRAB	
					SOIL		SOIL		SOIL		SOIL		SOIL		SOIL	
					24-36		36-48		6-12		6-12		12-24		24-36	
6010	Aluminum	7429-90-5	mg/Kg	DRY	3130		4020		5470	^	5910	^	4660	^	3900	
6010	Antimony	7440-36-0	mg/Kg	DRY	1.4	J	2.2		4.7		7.4		0.69		1.5	U
6010	Arsenic	7440-38-2	mg/Kg	DRY	1.7		2		3.1		2.9		2.1		1.8	
6010	Barium	7440-39-3	mg/Kg	DRY	22.1	J	13.5	J	17.2		15.3		18.4		11.4	J
6010	Beryllium	7440-41-7	mg/Kg	DRY	0.15	J	0.19	J	0.44		0.28		0.23		0.17	J
6010	Cadmium	7440-43-9	mg/Kg	DRY	0.84		0.54	J	0.64		0.65		0.079	J	0.23	J
6010	Calcium	7440-70-2	mg/Kg	DRY	374	J	456	J	638	B	523	B	547	B	422	
6010	Chromium	7440-47-3	mg/Kg	DRY	4.7	B	6.6	B	10.7		7.5		4.9		8.5	B
6010	Cobalt	7440-48-4	mg/Kg	DRY	2.7		2.6		2.5		2.4		1.9		2.7	
6010	Copper	7440-50-8	mg/Kg	DRY	153		178		131		109		40.9		32.6	
6010	Iron	7439-89-6	mg/Kg	DRY	5900	B	8560	B	12500	^	7590	^	6900	^	6870	B
6010	Lead	7439-92-1	mg/Kg	DRY	106		157		419		331		23.1		29.7	
6010	Magnesium	7439-95-4	mg/Kg	DRY	1060		1370		1350	B	1210	B	1160	B	1180	
6010	Manganese	7439-96-5	mg/Kg	DRY	197		122		139	B	144	B	110	B	105	
6010	Nickel	7440-02-0	mg/Kg	DRY	5.1		7.2		11.6		9.2		5		7.2	
6010	Potassium	7440-09-7	mg/Kg	DRY	240	J	302	J	618		605		580		270	J
6010	Selenium	7782-49-2	mg/Kg	DRY	2.3	U	2.2	U	0.55	U	0.57	U	0.53	U	1.5	U
6010	Silver	7440-22-4	mg/Kg	DRY	1.1	U	1.1	U	0.55	U	0.57	U	0.53	U	0.77	U
6010	Sodium	7440-23-5	mg/Kg	DRY	28.5	J	29.8	J	34.4	J	32.9	J	31.6	J	18.3	J
6010	Thallium	7440-28-0	mg/Kg	DRY	2.3	U	2.2	U	1.1	U	1.1	U	1.1	U	1.5	U
6010	Vanadium	7440-62-2	mg/Kg	DRY	6.6		8.7		10.2		8.3		7.8		8.1	
6010	Zinc	7440-66-6	mg/Kg	DRY	37.1	B	32.9	B	31.9		27.7		19.4		20.6	B
7471A	Mercury	7439-97-6	mg/Kg	DRY	138		182		89.9		62.3		90.4		267	

Appendix 3B-4. Analytical Results for Metals in Soils in the Marsh Upland Area

Method	Analyte	CAS	Unit	Basis	SO-MUAU8-48		SO-MUAU9-12		SO-MUAU9-24		SO-MUAU10-12		SO-MUAU10-24		SO-MUAU11-12	
					10/29/2015		10/29/2015		10/29/2015		10/29/2015		10/29/2015		10/29/2015	
					GRAB		GRAB		GRAB		GRAB		GRAB		GRAB	
					SOIL		SOIL		SOIL		SOIL		SOIL		SOIL	
					36-48		6-12		12-24		6-12		12-24		6-12	
6010	Aluminum	7429-90-5	mg/Kg	DRY	7060		5270	^	5370	^ F1	15600		15700		4130	
6010	Antimony	7440-36-0	mg/Kg	DRY	3		0.52	U	0.55	U	0.63	U	0.58	U	0.86	
6010	Arsenic	7440-38-2	mg/Kg	DRY	2		2.5		2.7		2.7		3.2		2.1	
6010	Barium	7440-39-3	mg/Kg	DRY	14.5	J	15.9		25		50.2		54.1		13.8	
6010	Beryllium	7440-41-7	mg/Kg	DRY	0.23	J	0.29		0.33		0.43		0.46		0.24	
6010	Cadmium	7440-43-9	mg/Kg	DRY	0.28	J	0.045	J	0.057	J	0.18	J	0.054	J	0.085	J
6010	Calcium	7440-70-2	mg/Kg	DRY	288	J	740	B	1100	B F1	439	B	397	B	712	B
6010	Chromium	7440-47-3	mg/Kg	DRY	11.5	B	11.2		11		10.4		15.2		5.2	
6010	Cobalt	7440-48-4	mg/Kg	DRY	2.2		3.9		3		1.6		3.9		2.1	
6010	Copper	7440-50-8	mg/Kg	DRY	329		11.6		7.8		14.6		4.1		56.4	
6010	Iron	7439-89-6	mg/Kg	DRY	7590	B	8960	^	9800	^	13900	^	14500	^	7030	^
6010	Lead	7439-92-1	mg/Kg	DRY	201		24.4		7.2		27.7		8.3		89.7	
6010	Magnesium	7439-95-4	mg/Kg	DRY	1010		1960	B	1990	F1 B	893	B	2060	B	1170	B
6010	Manganese	7439-96-5	mg/Kg	DRY	97.9		172	B	158	F1 B	86.8	B	137	B	113	B
6010	Nickel	7440-02-0	mg/Kg	DRY	8.2		8.2		7.2		5.1		9.2		5	
6010	Potassium	7440-09-7	mg/Kg	DRY	230	J	676		650		357		490		587	
6010	Selenium	7782-49-2	mg/Kg	DRY	2.2	U	0.52	U	0.55	U	0.63	U	0.58	U	0.49	U
6010	Silver	7440-22-4	mg/Kg	DRY	1.1	U	0.52	U	0.55	U	0.63	U	0.58	U	0.49	U
6010	Sodium	7440-23-5	mg/Kg	DRY	555	U	37.6	J	41.7	J	44.1	J	51.1	J	33.6	J
6010	Thallium	7440-28-0	mg/Kg	DRY	2.2	U	1	U	1.1	U	1.3	U	1.2	U	0.98	U
6010	Vanadium	7440-62-2	mg/Kg	DRY	9		12.4		13.8		24.9		25.6		8.9	
6010	Zinc	7440-66-6	mg/Kg	DRY	25.1	B	21.5		19.7		28.8		28.6		18.7	
7471A	Mercury	7439-97-6	mg/Kg	DRY	278		1.5		0.27	F1	0.52		0.15		93.3	

Appendix 3B-4. Analytical Results for Metals in Soils in the Marsh Upland Area

Method	Analyte	CAS	Unit	Basis	SO-MUAU11-24		SO-MUAU11-36		SO-MUAU11-48		SO-MUAU12-12	
					10/29/2015		10/29/2015		10/29/2015		10/29/2015	
					GRAB		GRAB		GRAB		GRAB	
					SOIL		SOIL		SOIL		SOIL	
					12-24		24-36		36-48		6-12	
6010	Aluminum	7429-90-5	mg/Kg	DRY	3590		2690		2450		16000	
6010	Antimony	7440-36-0	mg/Kg	DRY	0.52	U	1.7	U	1.7	U	0.56	U
6010	Arsenic	7440-38-2	mg/Kg	DRY	2		1.6		1.7		2.4	
6010	Barium	7440-39-3	mg/Kg	DRY	14.8		9.6	J	8.7	J	27.9	
6010	Beryllium	7440-41-7	mg/Kg	DRY	0.26		0.18	J	0.15	J	0.36	
6010	Cadmium	7440-43-9	mg/Kg	DRY	0.084	J	0.1	J	0.02	J	0.093	J
6010	Calcium	7440-70-2	mg/Kg	DRY	914	B	440		563		299	B
6010	Chromium	7440-47-3	mg/Kg	DRY	4.8		3.7	B	3.6	B	8.6	
6010	Cobalt	7440-48-4	mg/Kg	DRY	2.7		2		1.9		1.3	
6010	Copper	7440-50-8	mg/Kg	DRY	29.2		8.1		3.9		53	
6010	Iron	7439-89-6	mg/Kg	DRY	7210	^	5620	B	5890	B	11700	^
6010	Lead	7439-92-1	mg/Kg	DRY	8.9		3.3		3.5		14.1	
6010	Magnesium	7439-95-4	mg/Kg	DRY	1090	B	980		1030		551	B
6010	Manganese	7439-96-5	mg/Kg	DRY	116	B	95.4		102		66.5	B
6010	Nickel	7440-02-0	mg/Kg	DRY	5.2		4.1		3.7		4.5	
6010	Potassium	7440-09-7	mg/Kg	DRY	638		294	J	322	J	255	
6010	Selenium	7782-49-2	mg/Kg	DRY	0.52	U	1.7	U	1.7	U	0.56	U
6010	Silver	7440-22-4	mg/Kg	DRY	0.52	U	0.83	U	0.85	U	0.56	U
6010	Sodium	7440-23-5	mg/Kg	DRY	36.1	J	18.8	J	21.6	J	28.7	J
6010	Thallium	7440-28-0	mg/Kg	DRY	1	U	1.7	U	1.7	U	1.1	U
6010	Vanadium	7440-62-2	mg/Kg	DRY	10.7		6.3		6.2		18.4	
6010	Zinc	7440-66-6	mg/Kg	DRY	17.1		19.8	B	12.9	B	18.7	
7471A	Mercury	7439-97-6	mg/Kg	DRY	20		0.53		0.13		5.9	

Appendix 3B-4. Analytical Results for Metals in Soils in the Marsh Upland Area

Method	Analyte	CAS	Unit	Basis	SO-MUAU12-24	
					10/29/2015	
					GRAB	
					SOIL	
					12-24	
6010	Aluminum	7429-90-5	mg/Kg	DRY	15800	
6010	Antimony	7440-36-0	mg/Kg	DRY	0.51	U
6010	Arsenic	7440-38-2	mg/Kg	DRY	3	
6010	Barium	7440-39-3	mg/Kg	DRY	39.3	
6010	Beryllium	7440-41-7	mg/Kg	DRY	0.38	
6010	Cadmium	7440-43-9	mg/Kg	DRY	0.081	J
6010	Calcium	7440-70-2	mg/Kg	DRY	413	B
6010	Chromium	7440-47-3	mg/Kg	DRY	11.4	
6010	Cobalt	7440-48-4	mg/Kg	DRY	1.9	
6010	Copper	7440-50-8	mg/Kg	DRY	4	
6010	Iron	7439-89-6	mg/Kg	DRY	12400	^
6010	Lead	7439-92-1	mg/Kg	DRY	8.8	
6010	Magnesium	7439-95-4	mg/Kg	DRY	1010	B
6010	Manganese	7439-96-5	mg/Kg	DRY	79.8	B
6010	Nickel	7440-02-0	mg/Kg	DRY	6.2	
6010	Potassium	7440-09-7	mg/Kg	DRY	401	
6010	Selenium	7782-49-2	mg/Kg	DRY	0.6	
6010	Silver	7440-22-4	mg/Kg	DRY	0.51	U
6010	Sodium	7440-23-5	mg/Kg	DRY	35.5	J
6010	Thallium	7440-28-0	mg/Kg	DRY	1	U
6010	Vanadium	7440-62-2	mg/Kg	DRY	22.3	
6010	Zinc	7440-66-6	mg/Kg	DRY	24.1	
7471A	Mercury	7439-97-6	mg/Kg	DRY	2.6	

Notes:

Laboratory Data Qualifiers:

U – Indicates the analyte was analyzed for but not detected.

J – Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

B – Compound was found in the blank and sample.

F1 – MS and/or MSD recovery is outside acceptance limits.

F2 – MS/MSD RPD exceeds control limits.

^ - Instrument QC is outside acceptance limits.

Sample Basis - samples that are not air-dried prior to analysis are presumed to have a certain moisture content and are reported on a dry or wet basis with a percent solids measured by the laboratory and reported. Samples that are air-dried are presumed to have no moisture content and therefore no percent solids reported.

Grab Sample - A grab sample is a sampling technique which is a single sample or measurement taken at a specific time or over as short a period, as feasible.

mg/kg - milligrams/kilogram

APPENDIX 3B-5

Analytical Results for Lead and Mercury in Groundwater in the Southern Conservation Commission Area

Appendix 3B-5. Analytical Results for Lead and Mercury in Groundwater in the Southern Commission Conservation Area

Method	Analyte	CAS	Unit	GW-DP-MW1		GW-DP-MW1-DUP		GW-MW-B4		GW-MW-B4-DUP	
				10/22/2015		10/22/2015		10/23/2015		10/23/2015	
				GRAB		GRAB		GRAB		GRAB	
				Groundwater		Groundwater		Groundwater		Groundwater	
6010	Total Lead	7439-92-1	ug/L	NA		NA		2.8	J	1.9	J
7470A	Total Mercury	7439-97-6	ug/L	1170		1230		NA		NA	

Notes:

Laboratory Data Qualifiers:

J – Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

Grab Sample - A grab sample is a sampling technique which is a single sample or measurement taken at a specific time or over as short a period, as feasible.

ug/L - micrograms/Liter

APPENDIX 3C

CAM Protocol Certificates

Appendix 3C. CAM Certificates

MassDEP Analytical Protocol Certification Form

Laboratory Name: TestAmerica laboratories, Inc.

Project #: 106-4383

Project Location: Hanover, MA

RTN: 4-0000090

This Form provides certifications for the following data set: list Laboratory Sample ID Number(s):
Samples. 200-30181-1 through 200-30181-11

Matrices: Groundwater/Surface Water x Soil/Sediment Drinking Water Air Other:

CAM Protocol (check all that apply below):

8260 VOC CAM II A	7470/7471 Hg CAM III B x	MassDEP VPH CAM IV A	8081 Pesticides CAM V B	7196 Hex Cr CAM VI B	MassDEP APH CAM IX A
8270 SVOC CAM II B	7010 Metals CAM III C	MassDEP EPH CAM IV B	8151 Herbicides CAM V C	8330 Explosives CAM VIII A	TO-15 VOC CAM IX B
6010 Metals CAM III A	6020 Metals CAM III D	8082 PCB CAM V A	9014 Total Cyanide/PAC CAM VI A	6860 Perchlorate CAM VIII B	

Affirmative Responses to Questions A through F are required for "Presumptive Certainty" status

A	Were all samples received in a condition consistent with those described on the Chain-of-Custody, properly preserved (including temperature) in the field or laboratory, and prepared/analyzed within method holding times?	X Yes No
B	Were the analytical method(s) and all associated QC requirements specified in the selected CAM protocol(s) followed?	X Yes No
C	Were all required corrective actions and analytical response actions specified in the selected CAM protocol(s) implemented for all identified performance standard non-conformances?	X Yes No
D	Does the laboratory report comply with all the reporting requirements specified in CAM VII A, "Quality Assurance and Quality Control Guidelines for the Acquisition and Reporting of Analytical Data"?	X Yes No
E	VPH, EPH, APH, and TO-15 only: a. VPH, EPH, and APH Methods only: Was each method conducted without significant modification(s)? (Refer to the individual method(s) for a list of significant modifications). b. APH and TO-15 Methods only: Was the complete analyte list reported for each method?	Yes No Yes No
F	Were all applicable CAM protocol QC and performance standard non-conformances identified and evaluated in a laboratory narrative (including all "No" responses to Questions A through E)?	X Yes No

Responses to Questions G, H and I below are required for "Presumptive Certainty" status

G	Were the reporting limits at or below all CAM reporting limits specified in the selected CAM protocol(s)?	X Yes No[1]

__Data User Note__: Data that achieve "Presumptive Certainty" status may not necessarily meet the data usability and representativeness requirements described in 310 CMR 40. 1056 (2)(k) and WSC-07-350.

H	Were **all** QC performance standards specified in the CAM protocol(s) achieved?	X Yes No[1]
I	Were results reported for the complete analyte list specified in the selected CAM protocol(s)?	X Yes No[1]

[1] *All negative responses must be addressed in an attached laboratory narrative.*

I, the undersigned, attest under the pains and penalties of perjury that, based upon my personal inquiry of those responsible for obtaining the information, the material contained in this analytical report is, to the best of my knowledge and belief, accurate and complete.

Signature:

Position: Project Manager

Printed Name: Jim Madison

Date: 10/22/2015

MassDEP Analytical Protocol Certification Form

Laboratory Name: TestAmerica laboratories, Inc. Project #: 106-4383

Project Location: Hanover, MA RTN: 4-0000090

This Form provides certifications for the following data set: list Laboratory Sample ID Number(s):
Samples. 200-30182-1 through 200-30182-30

Matrices: Groundwater/Surface Water x Soil/Sediment Drinking Water Air Other:

CAM Protocol (check all that apply below):

8260 VOC CAM II A	7470/7471 Hg CAM III B x	MassDEP VPH CAM IV A	8081 Pesticides CAM V B	7196 Hex Cr CAM VI B	MassDEP APH CAM IX A
8270 SVOC CAM II B	7010 Metals CAM III C	MassDEP EPH CAM IV B	8151 Herbicides CAM V C	8330 Explosives CAM VIII A	TO-15 VOC CAM IX B
6010 Metals CAM III A	6020 Metals CAM III D	8082 PCB CAM V A	9014 Total Cyanide/PAC CAM VI A x	6860 Perchlorate CAM VIII B	

Affirmative Responses to Questions A through F are required for "Presumptive Certainty" status

A	Were all samples received in a condition consistent with those described on the Chain-of-Custody, properly preserved (including temperature) in the field or laboratory, and prepared/analyzed within method holding times?	X Yes No
B	Were the analytical method(s) and all associated QC requirements specified in the selected CAM protocol(s) followed?	X Yes No
C	Were all required corrective actions and analytical response actions specified in the selected CAM protocol(s) implemented for all identified performance standard non-conformances?	X Yes No
D	Does the laboratory report comply with all the reporting requirements specified in CAM VII A, "Quality Assurance and Quality Control Guidelines for the Acquisition and Reporting of Analytical Data"?	X Yes No
E	VPH, EPH, APH, and TO-15 only: a. VPH, EPH, and APH Methods only: Was each method conducted without significant modification(s)? (Refer to the individual method(s) for a list of significant modifications). b. APH and TO-15 Methods only: Was the complete analyte list reported for each method?	Yes No Yes No
F	Were all applicable CAM protocol QC and performance standard non-conformances identified and evaluated in a laboratory narrative (including all "No" responses to Questions A through E)?	X Yes No

Responses to Questions G, H and I below are required for "Presumptive Certainty" status

G	Were the reporting limits at or below all CAM reporting limits specified in the selected CAM protocol(s)?	X Yes No[1]

<u>Data User Note</u>: Data that achieve "Presumptive Certainty" status may not necessarily meet the data usability and representativeness requirements described in 310 CMR 40. 1056 (2)(k) and WSC-07-350.

H	Were **all** QC performance standards specified in the CAM protocol(s) achieved?	X Yes No[1]
I	Were results reported for the complete analyte list specified in the selected CAM protocol(s)?	X Yes No[1]

[1] *All negative responses must be addressed in an attached laboratory narrative.*

I, the undersigned, attest under the pains and penalties of perjury that, based upon my personal inquiry of those responsible for obtaining the information, the material contained in this analytical report is, to the best of my knowledge and belief, accurate and complete.

Signature: **Position:** Project Manager

Printed Name: Jim Madison **Date:** 10\22\2015

MassDEP Analytical Protocol Certification Form

Laboratory Name: TestAmerica laboratories, Inc. Project #: 106-4383

Project Location: Hanover, MA RTN: 4-0000090

This Form provides certifications for the following data set: list Laboratory Sample ID Number(s):
Samples. 200-30182-13, -19, -25, 200-30212-5, -19, -23

Matrices: Groundwater/Surface Water **x** Soil/Sediment Drinking Water Air Other:

CAM Protocol (check all that apply below):

8260 VOC CAM II A	7470/7471 Hg CAM III B **x**	MassDEP VPH CAM IV A	8081 Pesticides CAM V B	7196 Hex Cr CAM VI B	MassDEP APH CAM IX A
8270 SVOC CAM II B	7010 Metals CAM III C	MassDEP EPH CAM IV B	8151 Herbicides CAM V C	8330 Explosives CAM VIII A	TO-15 VOC CAM IX B
6010 Metals CAM III A	6020 Metals CAM III D	8082 PCB CAM V A	9014 Total Cyanide/PAC CAM VI A	6860 Perchlorate CAM VIII B	

Affirmative Responses to Questions A through F are required for "Presumptive Certainty" status

A	Were all samples received in a condition consistent with those described on the Chain-of-Custody, properly preserved (including temperature) in the field or laboratory, and prepared/analyzed within method holding times?	**X** Yes No
B	Were the analytical method(s) and all associated QC requirements specified in the selected CAM protocol(s) followed?	**X** Yes No
C	Were all required corrective actions and analytical response actions specified in the selected CAM protocol(s) implemented for all identified performance standard non-conformances?	**X** Yes No
D	Does the laboratory report comply with all the reporting requirements specified in CAM VII A, "Quality Assurance and Quality Control Guidelines for the Acquisition and Reporting of Analytical Data"?	**X** Yes No
E	VPH, EPH, APH, and TO-15 only: a. VPH, EPH, and APH Methods only: Was each method conducted without significant modification(s)? (Refer to the individual method(s) for a list of significant modifications). b. APH and TO-15 Methods only: Was the complete analyte list reported for each method?	Yes No Yes No
F	Were all applicable CAM protocol QC and performance standard non-conformances identified and evaluated in a laboratory narrative (including all "No" responses to Questions A through E)?	**X** Yes No

Responses to Questions G, H and I below are required for "Presumptive Certainty" status

G	Were the reporting limits at or below all CAM reporting limits specified in the selected CAM protocol(s)?	**X** Yes No[1]

<u>Data User Note</u>: Data that achieve "Presumptive Certainty" status may not necessarily meet the data usability and representativeness requirements described in 310 CMR 40. 1056 (2)(k) and WSC-07-350.

H	Were **all** QC performance standards specified in the CAM protocol(s) achieved?	**X** Yes No[1]
I	Were results reported for the complete analyte list specified in the selected CAM protocol(s)?	**X** Yes No[1]

[1] All negative responses must be addressed in an attached laboratory narrative.

I, the undersigned, attest under the pains and penalties of perjury that, based upon my personal inquiry of those responsible for obtaining the information, the material contained in this analytical report is, to the best of my knowledge and belief, accurate and complete.

Signature: **Position:** Project Manager

Printed Name: Jim Madison **Date:** 11/6/2015

MassDEP Analytical Protocol Certification Form

Laboratory Name: TestAmerica laboratories, Inc. Project #: 106-4383

Project Location: Hanover, MA RTN: 4-0000090

This Form provides certifications for the following data set: list Laboratory Sample ID Number(s):
Samples. 200-30184-3, 6-11, 13-17, 21, 25-26 and 200-30213-4, 7-8, 10-12

Matrices: Groundwater/Surface Water x Soil/Sediment Drinking Water Air Other:

CAM Protocol (check all that apply below):

8260 VOC CAM II A	7470/7471 Hg CAM III B x	MassDEP VPH CAM IV A	8081 Pesticides CAM V B	7196 Hex Cr CAM VI B	MassDEP APH CAM IX A
8270 SVOC CAM II B	7010 Metals CAM III C	MassDEP EPH CAM IV B	8151 Herbicides CAM V C	8330 Explosives CAM VIII A	TO-15 VOC CAM IX B
6010 Metals CAM III A	6020 Metals CAM III D	8082 PCB CAM V A	9014 Total Cyanide/PAC CAM VI A	6860 Perchlorate CAM VIII B	

Affirmative Responses to Questions A through F are required for "Presumptive Certainty" status

A	Were all samples received in a condition consistent with those described on the Chain-of-Custody, properly preserved (including temperature) in the field or laboratory, and prepared/analyzed within method holding times?	**X** Yes No
B	Were the analytical method(s) and all associated QC requirements specified in the selected CAM protocol(s) followed?	**X** Yes No
C	Were all required corrective actions and analytical response actions specified in the selected CAM protocol(s) implemented for all identified performance standard non-conformances?	**X** Yes No
D	Does the laboratory report comply with all the reporting requirements specified in CAM VII A, "Quality Assurance and Quality Control Guidelines for the Acquisition and Reporting of Analytical Data"?	**X** Yes No
E	VPH, EPH, APH, and TO-15 only: a. VPH, EPH, and APH Methods only: Was each method conducted without significant modification(s)? (Refer to the individual method(s) for a list of significant modifications). b. APH and TO-15 Methods only: Was the complete analyte list reported for each method?	Yes No Yes No
F	Were all applicable CAM protocol QC and performance standard non-conformances identified and evaluated in a laboratory narrative (including all "No" responses to Questions A through E)?	**X** Yes No

Responses to Questions G, H and I below are required for "Presumptive Certainty" status

G	Were the reporting limits at or below all CAM reporting limits specified in the selected CAM protocol(s)?	**X** Yes No[1]

<u>Data User Note</u>: Data that achieve "Presumptive Certainty" status may not necessarily meet the data usability and representativeness requirements described in 310 CMR 40. 1056 (2)(k) and WSC-07-350.

H	Were **all** QC performance standards specified in the CAM protocol(s) achieved?	**X** Yes No[1]
I	Were results reported for the complete analyte list specified in the selected CAM protocol(s)?	**X** Yes No[1]

[1] *All negative responses must be addressed in an attached laboratory narrative.*

I, the undersigned, attest under the pains and penalties of perjury that, based upon my personal inquiry of those responsible for obtaining the information, the material contained in this analytical report is, to the best of my knowledge and belief, accurate and complete.

Signature: **Position:** Project Manager

Printed Name: Jim Madison **Date:** 11/3/2015

MassDEP Analytical Protocol Certification Form

Laboratory Name: TestAmerica laboratories, Inc. Project #: 106-4383

Project Location: Hanover, MA RTN: 4-0000090

This Form provides certifications for the following data set: list Laboratory Sample ID Number(s):
Samples. 200-30211-1 through 200-30211-15

Matrices: Groundwater/Surface Water **x** Soil/Sediment Drinking Water Air Other:

CAM Protocol (check all that apply below):

8260 VOC CAM II A	7470/7471 Hg CAM III B **x**	MassDEP VPH CAM IV A	8081 Pesticides CAM V B	7196 Hex Cr CAM VI B	MassDEP APH CAM IX A
8270 SVOC CAM II B	7010 Metals CAM III C	MassDEP EPH CAM IV B	8151 Herbicides CAM V C	8330 Explosives CAM VIII A	TO-15 VOC CAM IX B
6010 Metals CAM III A	6020 Metals CAM III D	8082 PCB CAM V A	9014 Total Cyanide/PAC CAM VI A	6860 Perchlorate CAM VIII B	

Affirmative Responses to Questions A through F are required for "Presumptive Certainty" status

A	Were all samples received in a condition consistent with those described on the Chain-of-Custody, properly preserved (including temperature) in the field or laboratory, and prepared/analyzed within method holding times?	**X** Yes No
B	Were the analytical method(s) and all associated QC requirements specified in the selected CAM protocol(s) followed?	**X** Yes No
C	Were all required corrective actions and analytical response actions specified in the selected CAM protocol(s) implemented for all identified performance standard non-conformances?	**X** Yes No
D	Does the laboratory report comply with all the reporting requirements specified in CAM VII A, "Quality Assurance and Quality Control Guidelines for the Acquisition and Reporting of Analytical Data"?	**X** Yes No
E	VPH, EPH, APH, and TO-15 only: a. VPH, EPH, and APH Methods only: Was each method conducted without significant modification(s)? (Refer to the individual method(s) for a list of significant modifications). b. APH and TO-15 Methods only: Was the complete analyte list reported for each method?	Yes No Yes No
F	Were all applicable CAM protocol QC and performance standard non-conformances identified and evaluated in a laboratory narrative (including all "No" responses to Questions A through E)?	**X** Yes No

Responses to Questions G, H and I below are required for "Presumptive Certainty" status

G	Were the reporting limits at or below all CAM reporting limits specified in the selected CAM protocol(s)?	**X** Yes No[1]

***Data User Note:** Data that achieve "Presumptive Certainty" status may not necessarily meet the data usability and representativeness requirements described in 310 CMR 40. 1056 (2)(k) and WSC-07-350.*

H	Were **all** QC performance standards specified in the CAM protocol(s) achieved?	**X** Yes No[1]
I	Were results reported for the complete analyte list specified in the selected CAM protocol(s)?	**X** Yes No[1]

[1] *All negative responses must be addressed in an attached laboratory narrative.*

I, the undersigned, attest under the pains and penalties of perjury that, based upon my personal inquiry of those responsible for obtaining the information, the material contained in this analytical report is, to the best of my knowledge and belief, accurate and complete.

Signature:____________________ **Position:** Project Manager

Printed Name: Jim Madison **Date:**____________________

MassDEP Analytical Protocol Certification Form

Laboratory Name: TestAmerica laboratories, Inc. Project #: 106-4383

Project Location: Hanover, MA RTN: 4-0000090

This Form provides certifications for the following data set: list Laboratory Sample ID Number(s):
Samples. 200-30182-13, -19, -25, 200-30212-5, -19, -23

Matrices: Groundwater/Surface Water **x** Soil/Sediment Drinking Water Air Other:

CAM Protocol (check all that apply below):

8260 VOC CAM II A	7470/7471 Hg CAM III B x	MassDEP VPH CAM IV A	8081 Pesticides CAM V B	7196 Hex Cr CAM VI B	MassDEP APH CAM IX A
8270 SVOC CAM II B	7010 Metals CAM III C	MassDEP EPH CAM IV B	8151 Herbicides CAM V C	8330 Explosives CAM VIII A	TO-15 VOC CAM IX B
6010 Metals CAM III A	6020 Metals CAM III D	8082 PCB CAM V A	9014 Total Cyanide/PAC CAM VI A	6860 Perchlorate CAM VIII B	

Affirmative Responses to Questions A through F are required for "Presumptive Certainty" status

A	Were all samples received in a condition consistent with those described on the Chain-of-Custody, properly preserved (including temperature) in the field or laboratory, and prepared/analyzed within method holding times?	**X** Yes No
B	Were the analytical method(s) and all associated QC requirements specified in the selected CAM protocol(s) followed?	**X** Yes No
C	Were all required corrective actions and analytical response actions specified in the selected CAM protocol(s) implemented for all identified performance standard non-conformances?	**X** Yes No
D	Does the laboratory report comply with all the reporting requirements specified in CAM VII A, "Quality Assurance and Quality Control Guidelines for the Acquisition and Reporting of Analytical Data"?	**X** Yes No
E	VPH, EPH, APH, and TO-15 only: a. VPH, EPH, and APH Methods only: Was each method conducted without significant modification(s)? (Refer to the individual method(s) for a list of significant modifications). b. APH and TO-15 Methods only: Was the complete analyte list reported for each method?	Yes No Yes No
F	Were all applicable CAM protocol QC and performance standard non-conformances identified and evaluated in a laboratory narrative (including all "No" responses to Questions A through E)?	**X** Yes No

Responses to Questions G, H and I below are required for "Presumptive Certainty" status

G	Were the reporting limits at or below all CAM reporting limits specified in the selected CAM protocol(s)?	**X** Yes No[1]

<u>Data User Note</u>: Data that achieve "Presumptive Certainty" status may not necessarily meet the data usability and representativeness requirements described in 310 CMR 40. 1056 (2)(k) and WSC-07-350.

H	Were **all** QC performance standards specified in the CAM protocol(s) achieved?	**X** Yes No[1]
I	Were results reported for the complete analyte list specified in the selected CAM protocol(s)?	**X** Yes No[1]

[1] *All negative responses must be addressed in an attached laboratory narrative.*

I, the undersigned, attest under the pains and penalties of perjury that, based upon my personal inquiry of those responsible for obtaining the information, the material contained in this analytical report is, to the best of my knowledge and belief, accurate and complete.

Signature: **Position:** Project Manager

Printed Name: Jim Madison **Date:** 11/6/2015

MassDEP Analytical Protocol Certification Form

Laboratory Name: TestAmerica laboratories, Inc. Project #: 106-4383

Project Location: Hanover, MA RTN: 4-0000090

This Form provides certifications for the following data set: list Laboratory Sample ID Number(s):
Samples. 200-30213-2, -3, -5, -6

Matrices: Groundwater/Surface Water x Soil/Sediment Drinking Water Air Other:

CAM Protocol (check all that apply below):

8260 VOC CAM II A	7470/7471 Hg CAM III B x	MassDEP VPH CAM IV A	8081 Pesticides CAM V B	7196 Hex Cr CAM VI B	MassDEP APH CAM IX A
8270 SVOC CAM II B	7010 Metals CAM III C	MassDEP EPH CAM IV B	8151 Herbicides CAM V C	8330 Explosives CAM VIII A	TO-15 VOC CAM IX B
6010 Metals CAM III A	6020 Metals CAM III D	8082 PCB CAM V A	9014 Total Cyanide/PAC CAM VI A	6860 Perchlorate CAM VIII B	

Affirmative Responses to Questions A through F are required for "Presumptive Certainty" status

A	Were all samples received in a condition consistent with those described on the Chain-of-Custody, properly preserved (including temperature) in the field or laboratory, and prepared/analyzed within method holding times?	X Yes No
B	Were the analytical method(s) and all associated QC requirements specified in the selected CAM protocol(s) followed?	X Yes No
C	Were all required corrective actions and analytical response actions specified in the selected CAM protocol(s) implemented for all identified performance standard non-conformances?	X Yes No
D	Does the laboratory report comply with all the reporting requirements specified in CAM VII A, "Quality Assurance and Quality Control Guidelines for the Acquisition and Reporting of Analytical Data"?	X Yes No
E	VPH, EPH, APH, and TO-15 only: a. VPH, EPH, and APH Methods only: Was each method conducted without significant modification(s)? (Refer to the individual method(s) for a list of significant modifications). b. APH and TO-15 Methods only: Was the complete analyte list reported for each method?	Yes No Yes No
F	Were all applicable CAM protocol QC and performance standard non-conformances identified and evaluated in a laboratory narrative (including all "No" responses to Questions A through E)?	X Yes No

Responses to Questions G, H and I below are required for "Presumptive Certainty" status

G	Were the reporting limits at or below all CAM reporting limits specified in the selected CAM protocol(s)?	X Yes No[1]

<u>Data User Note</u>: Data that achieve "Presumptive Certainty" status may not necessarily meet the data usability and representativeness requirements described in 310 CMR 40. 1056 (2)(k) and WSC-07-350.

H	Were **all** QC performance standards specified in the CAM protocol(s) achieved?	X Yes No[1]
I	Were results reported for the complete analyte list specified in the selected CAM protocol(s)?	X Yes No[1]

[1] *All negative responses must be addressed in an attached laboratory narrative.*

I, the undersigned, attest under the pains and penalties of perjury that, based upon my personal inquiry of those responsible for obtaining the information, the material contained in this analytical report is, to the best of my knowledge and belief, accurate and complete.

Signature: **Position:** Project Manager

Printed Name: Jim Madison **Date:** 11/9/2015

MassDEP Analytical Protocol Certification Form

Laboratory Name: TestAmerica laboratories, Inc. Project #: 106-4383

Project Location: Hanover, MA RTN: 4-0000090

This Form provides certifications for the following data set: list Laboratory Sample ID Number(s):
Samples. 200-30309-1 through 200-30309-39

Matrices: Groundwater/Surface Water x Soil/Sediment Drinking Water Air Other:

CAM Protocol (check all that apply below):

8260 VOC CAM II A	7470/7471 Hg CAM III B x	MassDEP VPH CAM IV A	8081 Pesticides CAM V B	7196 Hex Cr CAM VI B	MassDEP APH CAM IX A
8270 SVOC CAM II B	7010 Metals CAM III C	MassDEP EPH CAM IV B	8151 Herbicides CAM V C	8330 Explosives CAM VIII A x	TO-15 VOC CAM IX B
6010 Metals CAM III A x	6020 Metals CAM III D	8082 PCB CAM V A	9014 Total Cyanide/PAC CAM VI A	6860 Perchlorate CAM VIII B x	

Affirmative Responses to Questions A through F are required for "Presumptive Certainty" status

A	Were all samples received in a condition consistent with those described on the Chain-of-Custody, properly preserved (including temperature) in the field or laboratory, and prepared/analyzed within method holding times?	X Yes No
B	Were the analytical method(s) and all associated QC requirements specified in the selected CAM protocol(s) followed?	X Yes No
C	Were all required corrective actions and analytical response actions specified in the selected CAM protocol(s) implemented for all identified performance standard non-conformances?	X Yes No
D	Does the laboratory report comply with all the reporting requirements specified in CAM VII A, "Quality Assurance and Quality Control Guidelines for the Acquisition and Reporting of Analytical Data"?	X Yes No
E	VPH, EPH, APH, and TO-15 only: a. VPH, EPH, and APH Methods only: Was each method conducted without significant modification(s)? (Refer to the individual method(s) for a list of significant modifications). b. APH and TO-15 Methods only: Was the complete analyte list reported for each method?	Yes No Yes No
F	Were all applicable CAM protocol QC and performance standard non-conformances identified and evaluated in a laboratory narrative (including all "No" responses to Questions A through E)?	X Yes No

Responses to Questions G, H and I below are required for "Presumptive Certainty" status

G	Were the reporting limits at or below all CAM reporting limits specified in the selected CAM protocol(s)?	X Yes No[1]

<u>Data User Note</u>: Data that achieve "Presumptive Certainty" status may not necessarily meet the data usability and representativeness requirements described in 310 CMR 40. 1056 (2)(k) and WSC-07-350.

H	Were **all** QC performance standards specified in the CAM protocol(s) achieved?	X Yes No[1]
I	Were results reported for the complete analyte list specified in the selected CAM protocol(s)?	X Yes No[1]

[1] *All negative responses must be addressed in an attached laboratory narrative.*

I, the undersigned, attest under the pains and penalties of perjury that, based upon my personal inquiry of those responsible for obtaining the information, the material contained in this analytical report is, to the best of my knowledge and belief, accurate and complete.

Signature:______________ **Position:** Project Manager

Printed Name: Jim Madison **Date:** 11/13/2015

MassDEP Analytical Protocol Certification Form

Laboratory Name: TestAmerica laboratories, Inc. Project #: 106-4383

Project Location: Hanover, MA RTN: 4-0000090

This Form provides certifications for the following data set: list Laboratory Sample ID Number(s):
Samples. 200-30313-4-10, -12-13, -16-18, -20-28.

Matrices: Groundwater/Surface Water **x** Soil/Sediment Drinking Water Air Other:

CAM Protocol (check all that apply below):

8260 VOC CAM II A	7470/7471 Hg CAM III B **x**	MassDEP VPH CAM IV A	8081 Pesticides CAM V B	7196 Hex Cr CAM VI B	MassDEP APH CAM IX A
8270 SVOC CAM II B	7010 Metals CAM III C	MassDEP EPH CAM IV B	8151 Herbicides CAM V C	8330 Explosives CAM VIII A	TO-15 VOC CAM IX B
6010 Metals CAM III A	6020 Metals CAM III D	8082 PCB CAM V A	9014 Total Cyanide/PAC CAM VI A	6860 Perchlorate CAM VIII B	

Affirmative Responses to Questions A through F are required for "Presumptive Certainty" status

A	Were all samples received in a condition consistent with those described on the Chain-of-Custody, properly preserved (including temperature) in the field or laboratory, and prepared/analyzed within method holding times?	**X** Yes No
B	Were the analytical method(s) and all associated QC requirements specified in the selected CAM protocol(s) followed?	**X** Yes No
C	Were all required corrective actions and analytical response actions specified in the selected CAM protocol(s) implemented for all identified performance standard non-conformances?	**X** Yes No
D	Does the laboratory report comply with all the reporting requirements specified in CAM VII A, "Quality Assurance and Quality Control Guidelines for the Acquisition and Reporting of Analytical Data"?	**X** Yes No
E	VPH, EPH, APH, and TO-15 only: a. VPH, EPH, and APH Methods only: Was each method conducted without significant modification(s)? (Refer to the individual method(s) for a list of significant modifications). b. APH and TO-15 Methods only: Was the complete analyte list reported for each method?	Yes No Yes No
F	Were all applicable CAM protocol QC and performance standard non-conformances identified and evaluated in a laboratory narrative (including all "No" responses to Questions A through E)?	**X** Yes No

Responses to Questions G, H and I below are required for "Presumptive Certainty" status

G	Were the reporting limits at or below all CAM reporting limits specified in the selected CAM protocol(s)?	**X** Yes No[1]

***Data User Note:** Data that achieve "Presumptive Certainty" status may not necessarily meet the data usability and representativeness requirements described in 310 CMR 40. 1056 (2)(k) and WSC-07-350.*

H	Were **all** QC performance standards specified in the CAM protocol(s) achieved?	**X** Yes No[1]
I	Were results reported for the complete analyte list specified in the selected CAM protocol(s)?	**X** Yes No[1]

[1] *All negative responses must be addressed in an attached laboratory narrative.*

I, the undersigned, attest under the pains and penalties of perjury that, based upon my personal inquiry of those responsible for obtaining the information, the material contained in this analytical report is, to the best of my knowledge and belief, accurate and complete.

Signature: **Position:** Project Manager

Printed Name: Jim Madison **Date:** 11\16\2015

MassDEP Analytical Protocol Certification Form

Laboratory Name: TestAmerica laboratories, Inc. Project #: 106-4383

Project Location: Hanover, MA RTN: 4-0000090

This Form provides certifications for the following data set: list Laboratory Sample ID Number(s):
Samples. 200-30315-1 through 200-30315-4

Matrices: Groundwater/Surface Water **x** Soil/Sediment Drinking Water Air Other:

CAM Protocol (check all that apply below):

8260 VOC CAM II A	7470/7471 Hg CAM III B **x**	MassDEP VPH CAM IV A	8081 Pesticides CAM V B	7196 Hex Cr CAM VI B	MassDEP APH CAM IX A
8270 SVOC CAM II B	7010 Metals CAM III C	MassDEP EPH CAM IV B	8151 Herbicides CAM V C	8330 Explosives CAM VIII A	TO-15 VOC CAM IX B
6010 Metals CAM III A	6020 Metals CAM III D	8082 PCB CAM V A	9014 Total Cyanide/PAC CAM VI A	6860 Perchlorate CAM VIII B	

Affirmative Responses to Questions A through F are required for "Presumptive Certainty" status

A	Were all samples received in a condition consistent with those described on the Chain-of-Custody, properly preserved (including temperature) in the field or laboratory, and prepared/analyzed within method holding times?	**X** Yes No
B	Were the analytical method(s) and all associated QC requirements specified in the selected CAM protocol(s) followed?	**X** Yes No
C	Were all required corrective actions and analytical response actions specified in the selected CAM protocol(s) implemented for all identified performance standard non-conformances?	**X** Yes No
D	Does the laboratory report comply with all the reporting requirements specified in CAM VII A, "Quality Assurance and Quality Control Guidelines for the Acquisition and Reporting of Analytical Data"?	**X** Yes No
E	VPH, EPH, APH, and TO-15 only: a. VPH, EPH, and APH Methods only: Was each method conducted without significant modification(s)? (Refer to the individual method(s) for a list of significant modifications). b. APH and TO-15 Methods only: Was the complete analyte list reported for each method?	Yes No Yes No
F	Were all applicable CAM protocol QC and performance standard non-conformances identified and evaluated in a laboratory narrative (including all "No" responses to Questions A through E)?	**X** Yes No

Responses to Questions G, H and I below are required for "Presumptive Certainty" status

G	Were the reporting limits at or below all CAM reporting limits specified in the selected CAM protocol(s)?	**X** Yes No[1]

***Data User Note:** Data that achieve "Presumptive Certainty" status may not necessarily meet the data usability and representativeness requirements described in 310 CMR 40. 1056 (2)(k) and WSC-07-350.*

H	Were **all** QC performance standards specified in the CAM protocol(s) achieved?	**X** Yes No[1]
I	Were results reported for the complete analyte list specified in the selected CAM protocol(s)?	**X** Yes No[1]

[1] *All negative responses must be addressed in an attached laboratory narrative.*

I, the undersigned, attest under the pains and penalties of perjury that, based upon my personal inquiry of those responsible for obtaining the information, the material contained in this analytical report is, to the best of my knowledge and belief, accurate and complete.

Signature:______________________ **Position:** Project Manager

Printed Name: Jim Madison **Date:** 11/11/2015

MassDEP Analytical Protocol Certification Form

Laboratory Name: TestAmerica laboratories, Inc. Project #: 106-4383

Project Location: Hanover, MA RTN: 4-0000090

This Form provides certifications for the following data set: list Laboratory Sample ID Number(s):
Samples. 200-30316-1 through 200-30316-6

Matrices: Groundwater/Surface Water x Soil/Sediment Drinking Water Air Other:

CAM Protocol (check all that apply below):

8260 VOC CAM II A	7470/7471 Hg CAM III B x	MassDEP VPH CAM IV A	8081 Pesticides CAM V B	7196 Hex Cr CAM VI B	MassDEP APH CAM IX A
8270 SVOC CAM II B	7010 Metals CAM III C	MassDEP EPH CAM IV B	8151 Herbicides CAM V C	8330 Explosives CAM VIII A	TO-15 VOC CAM IX B
6010 Metals CAM III A	6020 Metals CAM III D	8082 PCB CAM V A	9014 Total Cyanide/PAC CAM VI A x	6860 Perchlorate CAM VIII B	

Affirmative Responses to Questions A through F are required for "Presumptive Certainty" status

A	Were all samples received in a condition consistent with those described on the Chain-of-Custody, properly preserved (including temperature) in the field or laboratory, and prepared/analyzed within method holding times?	X Yes No
B	Were the analytical method(s) and all associated QC requirements specified in the selected CAM protocol(s) followed?	X Yes No
C	Were all required corrective actions and analytical response actions specified in the selected CAM protocol(s) implemented for all identified performance standard non-conformances?	X Yes No
D	Does the laboratory report comply with all the reporting requirements specified in CAM VII A, "Quality Assurance and Quality Control Guidelines for the Acquisition and Reporting of Analytical Data"?	X Yes No
E	VPH, EPH, APH, and TO-15 only: a. VPH, EPH, and APH Methods only: Was each method conducted without significant modification(s)? (Refer to the individual method(s) for a list of significant modifications). b. APH and TO-15 Methods only: Was the complete analyte list reported for each method?	Yes No Yes No
F	Were all applicable CAM protocol QC and performance standard non-conformances identified and evaluated in a laboratory narrative (including all "No" responses to Questions A through E)?	X Yes No

Responses to Questions G, H and I below are required for "Presumptive Certainty" status

G	Were the reporting limits at or below all CAM reporting limits specified in the selected CAM protocol(s)?	X Yes No[1]

***Data User Note:* Data that achieve "Presumptive Certainty" status may not necessarily meet the data usability and representativeness requirements described in 310 CMR 40. 1056 (2)(k) and WSC-07-350.**

H	Were **all** QC performance standards specified in the CAM protocol(s) achieved?	X Yes No[1]
I	Were results reported for the complete analyte list specified in the selected CAM protocol(s)?	X Yes No[1]

[1] *All negative responses must be addressed in an attached laboratory narrative.*

I, the undersigned, attest under the pains and penalties of perjury that, based upon my personal inquiry of those responsible for obtaining the information, the material contained in this analytical report is, to the best of my knowledge and belief, accurate and complete.

Signature: **Position:** Project Manager

Printed Name: Jim Madison **Date:** 10/29/205

MassDEP Analytical Protocol Certification Form

Laboratory Name: TestAmerica laboratories, Inc. Project #: 106-4383

Project Location: Hanover, MA RTN: 4-0000090

This Form provides certifications for the following data set: list Laboratory Sample ID Number(s):
Samples. 200-30318-1 through 200-30318-48

Matrices: Groundwater/Surface Water x Soil/Sediment Drinking Water Air Other:

CAM Protocol (check all that apply below):

8260 VOC CAM II A	7470/7471 Hg CAM III B x	MassDEP VPH CAM IV A	8081 Pesticides CAM V B	7196 Hex Cr CAM VI B	MassDEP APH CAM IX A
8270 SVOC CAM II B	7010 Metals CAM III C	MassDEP EPH CAM IV B	8151 Herbicides CAM V C	8330 Explosives CAM VIII A	TO-15 VOC CAM IX B
6010 Metals CAM III A	6020 Metals CAM III D	8082 PCB CAM V A	9014 Total Cyanide/PAC CAM VI A	6860 Perchlorate CAM VIII B	

Affirmative Responses to Questions A through F are required for "Presumptive Certainty" status

A	Were all samples received in a condition consistent with those described on the Chain-of-Custody, properly preserved (including temperature) in the field or laboratory, and prepared/analyzed within method holding times?	**X** Yes No
B	Were the analytical method(s) and all associated QC requirements specified in the selected CAM protocol(s) followed?	**X** Yes No
C	Were all required corrective actions and analytical response actions specified in the selected CAM protocol(s) implemented for all identified performance standard non-conformances?	**X** Yes No
D	Does the laboratory report comply with all the reporting requirements specified in CAM VII A, "Quality Assurance and Quality Control Guidelines for the Acquisition and Reporting of Analytical Data"?	**X** Yes No
E	VPH, EPH, APH, and TO-15 only: a. VPH, EPH, and APH Methods only: Was each method conducted without significant modification(s)? (Refer to the individual method(s) for a list of significant modifications). b. APH and TO-15 Methods only: Was the complete analyte list reported for each method?	Yes No Yes No
F	Were all applicable CAM protocol QC and performance standard non-conformances identified and evaluated in a laboratory narrative (including all "No" responses to Questions A through E)?	**X** Yes No

Responses to Questions G, H and I below are required for "Presumptive Certainty" status

G	Were the reporting limits at or below all CAM reporting limits specified in the selected CAM protocol(s)?	**X** Yes No[1]

<u>Data User Note</u>: Data that achieve "Presumptive Certainty" status may not necessarily meet the data usability and representativeness requirements described in 310 CMR 40. 1056 (2)(k) and WSC-07-350.

H	Were **all** QC performance standards specified in the CAM protocol(s) achieved?	**X** Yes No[1]
I	Were results reported for the complete analyte list specified in the selected CAM protocol(s)?	**X** Yes No[1]

[1] *All negative responses must be addressed in an attached laboratory narrative.*

I, the undersigned, attest under the pains and penalties of perjury that, based upon my personal inquiry of those responsible for obtaining the information, the material contained in this analytical report is, to the best of my knowledge and belief, accurate and complete.

Signature:__________ **Position:** Project Manager

Printed Name: Jim Madison **Date:** 11\11\15

MassDEP Analytical Protocol Certification Form

Laboratory Name: TestAmerica laboratories, Inc. Project #: 106-4383

Project Location: Hanover, MA RTN: 4-0000090

This Form provides certifications for the following data set: list Laboratory Sample ID Number(s):
Samples. 200-30340-1 through 200-30340-15

Matrices: Groundwater/Surface Water x Soil/Sediment Drinking Water Air Other:

CAM Protocol (check all that apply below):

8260 VOC CAM II A	7470/7471 Hg CAM III B x	MassDEP VPH CAM IV A	8081 Pesticides CAM V B	7196 Hex Cr CAM VI B	MassDEP APH CAM IX A
8270 SVOC CAM II B	7010 Metals CAM III C	MassDEP EPH CAM IV B	8151 Herbicides CAM V C	8330 Explosives CAM VIII A	TO-15 VOC CAM IX B
6010 Metals CAM III A x	6020 Metals CAM III D	8082 PCB CAM V A	9014 Total Cyanide/PAC CAM VI A	6860 Perchlorate CAM VIII B	

Affirmative Responses to Questions A through F are required for "Presumptive Certainty" status

A	Were all samples received in a condition consistent with those described on the Chain-of-Custody, properly preserved (including temperature) in the field or laboratory, and prepared/analyzed within method holding times?	**X** Yes No
B	Were the analytical method(s) and all associated QC requirements specified in the selected CAM protocol(s) followed?	Yes **X** No
C	Were all required corrective actions and analytical response actions specified in the selected CAM protocol(s) implemented for all identified performance standard non-conformances?	**X** Yes No
D	Does the laboratory report comply with all the reporting requirements specified in CAM VII A, "Quality Assurance and Quality Control Guidelines for the Acquisition and Reporting of Analytical Data"?	**X** Yes No
E	VPH, EPH, APH, and TO-15 only: a. VPH, EPH, and APH Methods only: Was each method conducted without significant modification(s)? (Refer to the individual method(s) for a list of significant modifications). b. APH and TO-15 Methods only: Was the complete analyte list reported for each method?	Yes No Yes No
F	Were all applicable CAM protocol QC and performance standard non-conformances identified and evaluated in a laboratory narrative (including all "No" responses to Questions A through E)?	**X** Yes No

Responses to Questions G, H and I below are required for "Presumptive Certainty" status

G	Were the reporting limits at or below all CAM reporting limits specified in the selected CAM protocol(s)?	**X** Yes No[1]

<u>Data User Note</u>: Data that achieve "Presumptive Certainty" status may not necessarily meet the data usability and representativeness requirements described in 310 CMR 40. 1056 (2)(k) and WSC-07-350.

H	Were **all** QC performance standards specified in the CAM protocol(s) achieved?	**X** Yes No[1]
I	Were results reported for the complete analyte list specified in the selected CAM protocol(s)?	**X** Yes No[1]

[1] *All negative responses must be addressed in an attached laboratory narrative.*

I, the undersigned, attest under the pains and penalties of perjury that, based upon my personal inquiry of those responsible for obtaining the information, the material contained in this analytical report is, to the best of my knowledge and belief, accurate and complete.

Signature:

Position: Project Manager

Printed Name: Jim Madison

Date: 11/18/15

MassDEP Analytical Protocol Certification Form

Laboratory Name: TestAmerica laboratories, Inc.　　Project #: 106-4383

Project Location: Hanover, MA　　RTN: 4-0000090

This Form provides certifications for the following data set: list Laboratory Sample ID Number(s):
Samples. 200-30341-4, -6, -7, -8

Matrices: Groundwater/Surface Water x Soil/Sediment Drinking Water Air Other:

CAM Protocol (check all that apply below):

8260 VOC CAM II A	7470/7471 Hg CAM III B x	MassDEP VPH CAM IV A	8081 Pesticides CAM V B	7196 Hex Cr CAM VI B	MassDEP APH CAM IX A
8270 SVOC CAM II B	7010 Metals CAM III C	MassDEP EPH CAM IV B	8151 Herbicides CAM V C	8330 Explosives CAM VIII A	TO-15 VOC CAM IX B
6010 Metals CAM III A	6020 Metals CAM III D	8082 PCB CAM V A	9014 Total Cyanide/PAC CAM VI A	6860 Perchlorate CAM VIII B	

Affirmative Responses to Questions A through F are required for "Presumptive Certainty" status

A	Were all samples received in a condition consistent with those described on the Chain-of-Custody, properly preserved (including temperature) in the field or laboratory, and prepared/analyzed within method holding times?	**X** Yes No
B	Were the analytical method(s) and all associated QC requirements specified in the selected CAM protocol(s) followed?	**X** Yes No
C	Were all required corrective actions and analytical response actions specified in the selected CAM protocol(s) implemented for all identified performance standard non-conformances?	**X** Yes No
D	Does the laboratory report comply with all the reporting requirements specified in CAM VII A, "Quality Assurance and Quality Control Guidelines for the Acquisition and Reporting of Analytical Data"?	**X** Yes No
E	VPH, EPH, APH, and TO-15 only: a. VPH, EPH, and APH Methods only: Was each method conducted without significant modification(s)? (Refer to the individual method(s) for a list of significant modifications). b. APH and TO-15 Methods only: Was the complete analyte list reported for each method?	Yes No Yes No
F	Were all applicable CAM protocol QC and performance standard non-conformances identified and evaluated in a laboratory narrative (including all "No" responses to Questions A through E)?	**X** Yes No

Responses to Questions G, H and I below are required for "Presumptive Certainty" status

G	Were the reporting limits at or below all CAM reporting limits specified in the selected CAM protocol(s)?	**X** Yes No[1]

<u>Data User Note</u>: Data that achieve "Presumptive Certainty" status may not necessarily meet the data usability and representativeness requirements described in 310 CMR 40. 1056 (2)(k) and WSC-07-350.

H	Were **all** QC performance standards specified in the CAM protocol(s) achieved?	**X** Yes No[1]
I	Were results reported for the complete analyte list specified in the selected CAM protocol(s)?	**X** Yes No[1]

[1] *All negative responses must be addressed in an attached laboratory narrative.*

I, the undersigned, attest under the pains and penalties of perjury that, based upon my personal inquiry of those responsible for obtaining the information, the material contained in this analytical report is, to the best of my knowledge and belief, accurate and complete.

Signature:　　**Position:** Project Manager

Printed Name: Jim Madison　　**Date:** 11/16/2015

MassDEP Analytical Protocol Certification Form

Laboratory Name: TestAmerica laboratories, Inc. Project #: 106-4383

Project Location: Hanover, MA RTN: 4-0000090

This Form provides certifications for the following data set: list Laboratory Sample ID Number(s):
Samples. 200-30342-1 through 200-30342-14

Matrices: Groundwater/Surface Water x Soil/Sediment Drinking Water Air Other:

CAM Protocol (check all that apply below):

8260 VOC CAM II A	7470/7471 Hg CAM III B x	MassDEP VPH CAM IV A	8081 Pesticides CAM V B	7196 Hex Cr CAM VI B	MassDEP APH CAM IX A
8270 SVOC CAM II B	7010 Metals CAM III C	MassDEP EPH CAM IV B	8151 Herbicides CAM V C	8330 Explosives CAM VIII A	TO-15 VOC CAM IX B
6010 Metals CAM III A	6020 Metals CAM III D	8082 PCB CAM V A	9014 Total Cyanide/PAC CAM VI A x	6860 Perchlorate CAM VIII B	

Affirmative Responses to Questions A through F are required for "Presumptive Certainty" status

A	Were all samples received in a condition consistent with those described on the Chain-of-Custody, properly preserved (including temperature) in the field or laboratory, and prepared/analyzed within method holding times?	X Yes No
B	Were the analytical method(s) and all associated QC requirements specified in the selected CAM protocol(s) followed?	X Yes No
C	Were all required corrective actions and analytical response actions specified in the selected CAM protocol(s) implemented for all identified performance standard non-conformances?	X Yes No
D	Does the laboratory report comply with all the reporting requirements specified in CAM VII A, "Quality Assurance and Quality Control Guidelines for the Acquisition and Reporting of Analytical Data"?	X Yes No
E	VPH, EPH, APH, and TO-15 only: a. VPH, EPH, and APH Methods only: Was each method conducted without significant modification(s)? (Refer to the individual method(s) for a list of significant modifications). b. APH and TO-15 Methods only: Was the complete analyte list reported for each method?	Yes No Yes No
F	Were all applicable CAM protocol QC and performance standard non-conformances identified and evaluated in a laboratory narrative (including all "No" responses to Questions A through E)?	X Yes No

Responses to Questions G, H and I below are required for "Presumptive Certainty" status

G	Were the reporting limits at or below all CAM reporting limits specified in the selected CAM protocol(s)?	X Yes No[1]

<u>Data User Note</u>: Data that achieve "Presumptive Certainty" status may not necessarily meet the data usability and representativeness requirements described in 310 CMR 40. 1056 (2)(k) and WSC-07-350.

H	Were **all** QC performance standards specified in the CAM protocol(s) achieved?	X Yes No[1]
I	Were results reported for the complete analyte list specified in the selected CAM protocol(s)?	X Yes No[1]

[1] *All negative responses must be addressed in an attached laboratory narrative.*

I, the undersigned, attest under the pains and penalties of perjury that, based upon my personal inquiry of those responsible for obtaining the information, the material contained in this analytical report is, to the best of my knowledge and belief, accurate and complete.

Signature: **Position:** Project Manager

Printed Name: Jim Madison **Date:** 11/5/2015

MassDEP Analytical Protocol Certification Form

Laboratory Name: TestAmerica laboratories, Inc. Project #: 106-4383

Project Location: Hanover, MA RTN: 4-0000090

This Form provides certifications for the following data set: list Laboratory Sample ID Number(s):
Samples. 200-30378-1 through 200-30378-11

Matrices: Groundwater/Surface Water x Soil/Sediment Drinking Water Air Other:

CAM Protocol (check all that apply below):

8260 VOC CAM II A	7470/7471 Hg CAM III B x	MassDEP VPH CAM IV A	8081 Pesticides CAM V B	7196 Hex Cr CAM VI B	MassDEP APH CAM IX A
8270 SVOC CAM II B	7010 Metals CAM III C	MassDEP EPH CAM IV B	8151 Herbicides CAM V C	8330 Explosives CAM VIII A	TO-15 VOC CAM IX B
6010 Metals CAM III A x	6020 Metals CAM III D	8082 PCB CAM V A	9014 Total Cyanide/PAC CAM VI A	6860 Perchlorate CAM VIII B	

Affirmative Responses to Questions A through F are required for "Presumptive Certainty" status

A	Were all samples received in a condition consistent with those described on the Chain-of-Custody, properly preserved (including temperature) in the field or laboratory, and prepared/analyzed within method holding times?	X Yes No
B	Were the analytical method(s) and all associated QC requirements specified in the selected CAM protocol(s) followed?	Yes X No
C	Were all required corrective actions and analytical response actions specified in the selected CAM protocol(s) implemented for all identified performance standard non-conformances?	X Yes No
D	Does the laboratory report comply with all the reporting requirements specified in CAM VII A, "Quality Assurance and Quality Control Guidelines for the Acquisition and Reporting of Analytical Data"?	X Yes No
E	VPH, EPH, APH, and TO-15 only: a. VPH, EPH, and APH Methods only: Was each method conducted without significant modification(s)? (Refer to the individual method(s) for a list of significant modifications). b. APH and TO-15 Methods only: Was the complete analyte list reported for each method?	Yes No Yes No
F	Were all applicable CAM protocol QC and performance standard non-conformances identified and evaluated in a laboratory narrative (including all "No" responses to Questions A through E)?	X Yes No

Responses to Questions G, H and I below are required for "Presumptive Certainty" status

G	Were the reporting limits at or below all CAM reporting limits specified in the selected CAM protocol(s)?	X Yes No[1]

<u>Data User Note</u>: Data that achieve "Presumptive Certainty" status may not necessarily meet the data usability and representativeness requirements described in 310 CMR 40. 1056 (2)(k) and WSC-07-350.

H	Were **all** QC performance standards specified in the CAM protocol(s) achieved?	X Yes No[1]
I	Were results reported for the complete analyte list specified in the selected CAM protocol(s)?	X Yes No[1]

[1] *All negative responses must be addressed in an attached laboratory narrative.*

I, the undersigned, attest under the pains and penalties of perjury that, based upon my personal inquiry of those responsible for obtaining the information, the material contained in this analytical report is, to the best of my knowledge and belief, accurate and complete.

Signature: **Position:** Project Manager

Printed Name: Jim Madison **Date:** 11\19\2015

MassDEP Analytical Protocol Certification Form

Laboratory Name: TestAmerica laboratories, Inc. Project #: 106-4383

Project Location: Hanover, MA RTN: 4-0000090

This Form provides certifications for the following data set: list Laboratory Sample ID Number(s):
Samples. 200-30379-3, -8 through -11, -17, -20, -22, -25, -27, -28, -30 through -35.

Matrices: Groundwater/Surface Water **x** Soil/Sediment Drinking Water Air Other:

CAM Protocol (check all that apply below):

8260 VOC CAM II A	7470/7471 Hg CAM III B x	MassDEP VPH CAM IV A	8081 Pesticides CAM V B	7196 Hex Cr CAM VI B	MassDEP APH CAM IX A
8270 SVOC CAM II B	7010 Metals CAM III C	MassDEP EPH CAM IV B	8151 Herbicides CAM V C	8330 Explosives CAM VIII A	TO-15 VOC CAM IX B
6010 Metals CAM III A	6020 Metals CAM III D	8082 PCB CAM V A	9014 Total Cyanide/PAC CAM VI A	6860 Perchlorate CAM VIII B	

Affirmative Responses to Questions A through F are required for "Presumptive Certainty" status

A	Were all samples received in a condition consistent with those described on the Chain-of-Custody, properly preserved (including temperature) in the field or laboratory, and prepared/analyzed within method holding times?	**X** Yes No
B	Were the analytical method(s) and all associated QC requirements specified in the selected CAM protocol(s) followed?	**X** Yes No
C	Were all required corrective actions and analytical response actions specified in the selected CAM protocol(s) implemented for all identified performance standard non-conformances?	**X** Yes No
D	Does the laboratory report comply with all the reporting requirements specified in CAM VII A, "Quality Assurance and Quality Control Guidelines for the Acquisition and Reporting of Analytical Data"?	**X** Yes No
E	VPH, EPH, APH, and TO-15 only: a. VPH, EPH, and APH Methods only: Was each method conducted without significant modification(s)? (Refer to the individual method(s) for a list of significant modifications). b. APH and TO-15 Methods only: Was the complete analyte list reported for each method?	Yes No Yes No
F	Were all applicable CAM protocol QC and performance standard non-conformances identified and evaluated in a laboratory narrative (including all "No" responses to Questions A through E)?	**X** Yes No

Responses to Questions G, H and I below are required for "Presumptive Certainty" status

G	Were the reporting limits at or below all CAM reporting limits specified in the selected CAM protocol(s)?	**X** Yes No[1]

<u>Data User Note</u>: Data that achieve "Presumptive Certainty" status may not necessarily meet the data usability and representativeness requirements described in 310 CMR 40. 1056 (2)(k) and WSC-07-350.

H	Were **all** QC performance standards specified in the CAM protocol(s) achieved?	**X** Yes No[1]
I	Were results reported for the complete analyte list specified in the selected CAM protocol(s)?	**X** Yes No[1]

[1] *All negative responses must be addressed in an attached laboratory narrative.*

I, the undersigned, attest under the pains and penalties of perjury that, based upon my personal inquiry of those responsible for obtaining the information, the material contained in this analytical report is, to the best of my knowledge and belief, accurate and complete.

Signature: **Position:** Project Manager

Printed Name: Jim Madison **Date:** 11/17/15

MassDEP Analytical Protocol Certification Form

Laboratory Name: TestAmerica laboratories, Inc. Project #: 106-4383

Project Location: Hanover, MA RTN: 4-0000090

This Form provides certifications for the following data set: list Laboratory Sample ID Number(s):
Samples. 200-30379-1, -2, -6, -7, -15

Matrices: Groundwater/Surface Water x Soil/Sediment Drinking Water Air Other:

CAM Protocol (check all that apply below):

8260 VOC CAM II A	7470/7471 Hg CAM III B x	MassDEP VPH CAM IV A	8081 Pesticides CAM V B	7196 Hex Cr CAM VI B	MassDEP APH CAM IX A
8270 SVOC CAM II B	7010 Metals CAM III C	MassDEP EPH CAM IV B	8151 Herbicides CAM V C	8330 Explosives CAM VIII A	TO-15 VOC CAM IX B
6010 Metals CAM III A	6020 Metals CAM III D	8082 PCB CAM V A	9014 Total Cyanide/PAC CAM VI A	6860 Perchlorate CAM VIII B	

Affirmative Responses to Questions A through F are required for "Presumptive Certainty" status

A	Were all samples received in a condition consistent with those described on the Chain-of-Custody, properly preserved (including temperature) in the field or laboratory, and prepared/analyzed within method holding times?	**X** Yes No
B	Were the analytical method(s) and all associated QC requirements specified in the selected CAM protocol(s) followed?	**X** Yes No
C	Were all required corrective actions and analytical response actions specified in the selected CAM protocol(s) implemented for all identified performance standard non-conformances?	**X** Yes No
D	Does the laboratory report comply with all the reporting requirements specified in CAM VII A, "Quality Assurance and Quality Control Guidelines for the Acquisition and Reporting of Analytical Data"?	**X** Yes No
E	VPH, EPH, APH, and TO-15 only: a. VPH, EPH, and APH Methods only: Was each method conducted without significant modification(s)? (Refer to the individual method(s) for a list of significant modifications). b. APH and TO-15 Methods only: Was the complete analyte list reported for each method?	Yes No Yes No
F	Were all applicable CAM protocol QC and performance standard non-conformances identified and evaluated in a laboratory narrative (including all "No" responses to Questions A through E)?	**X** Yes No

Responses to Questions G, H and I below are required for "Presumptive Certainty" status

G	Were the reporting limits at or below all CAM reporting limits specified in the selected CAM protocol(s)?	**X** Yes No[1]

<u>Data User Note</u>: Data that achieve "Presumptive Certainty" status may not necessarily meet the data usability and representativeness requirements described in 310 CMR 40. 1056 (2)(k) and WSC-07-350.

H	Were **all** QC performance standards specified in the CAM protocol(s) achieved?	**X** Yes No[1]
I	Were results reported for the complete analyte list specified in the selected CAM protocol(s)?	**X** Yes No[1]

[1] *All negative responses must be addressed in an attached laboratory narrative.*

I, the undersigned, attest under the pains and penalties of perjury that, based upon my personal inquiry of those responsible for obtaining the information, the material contained in this analytical report is, to the best of my knowledge and belief, accurate and complete.

Signature:

Position: Project Manager

Printed Name: Jim Madison

Date: 11/17/15

MassDEP Analytical Protocol Certification Form

Laboratory Name: TestAmerica laboratories, Inc. Project #: 106-4383

Project Location: Hanover, MA RTN: 4-0000090

This Form provides certifications for the following data set: list Laboratory Sample ID Number(s):
Samples. 200-30382-1 through 200-30382-49

Matrices: Groundwater/Surface Water x Soil/Sediment Drinking Water Air Other:

CAM Protocol (check all that apply below):

8260 VOC CAM II A	7470/7471 Hg CAM III B x	MassDEP VPH CAM IV A	8081 Pesticides CAM V B	7196 Hex Cr CAM VI B	MassDEP APH CAM IX A
8270 SVOC CAM II B	7010 Metals CAM III C	MassDEP EPH CAM IV B	8151 Herbicides CAM V C	8330 Explosives CAM VIII A	TO-15 VOC CAM IX B
6010 Metals CAM III A	6020 Metals CAM III D	8082 PCB CAM V A	9014 Total Cyanide/PAC CAM VI A	6860 Perchlorate CAM VIII B	

Affirmative Responses to Questions A through F are required for "Presumptive Certainty" status

A	Were all samples received in a condition consistent with those described on the Chain-of-Custody, properly preserved (including temperature) in the field or laboratory, and prepared/analyzed within method holding times?	X Yes No
B	Were the analytical method(s) and all associated QC requirements specified in the selected CAM protocol(s) followed?	X Yes No
C	Were all required corrective actions and analytical response actions specified in the selected CAM protocol(s) implemented for all identified performance standard non-conformances?	X Yes No
D	Does the laboratory report comply with all the reporting requirements specified in CAM VII A, "Quality Assurance and Quality Control Guidelines for the Acquisition and Reporting of Analytical Data"?	X Yes No
E	VPH, EPH, APH, and TO-15 only: a. VPH, EPH, and APH Methods only: Was each method conducted without significant modification(s)? (Refer to the individual method(s) for a list of significant modifications). b. APH and TO-15 Methods only: Was the complete analyte list reported for each method?	Yes No Yes No
F	Were all applicable CAM protocol QC and performance standard non-conformances identified and evaluated in a laboratory narrative (including all "No" responses to Questions A through E)?	X Yes No

Responses to Questions G, H and I below are required for "Presumptive Certainty" status

G	Were the reporting limits at or below all CAM reporting limits specified in the selected CAM protocol(s)?	X Yes No[1]

***Data User Note**: Data that achieve "Presumptive Certainty" status may not necessarily meet the data usability and representativeness requirements described in 310 CMR 40. 1056 (2)(k) and WSC-07-350.*

H	Were **all** QC performance standards specified in the CAM protocol(s) achieved?	X Yes No[1]
I	Were results reported for the complete analyte list specified in the selected CAM protocol(s)?	X Yes No[1]

[1] *All negative responses must be addressed in an attached laboratory narrative.*

I, the undersigned, attest under the pains and penalties of perjury that, based upon my personal inquiry of those responsible for obtaining the information, the material contained in this analytical report is, to the best of my knowledge and belief, accurate and complete.

Signature: **Position:** Project Manager

Printed Name: Jim Madison **Date:** 11/5/2015

MassDEP Analytical Protocol Certification Form

Laboratory Name: TestAmerica laboratories, Inc. Project #: 106-4383

Project Location: Hanover, MA RTN: 4-0000090

This Form provides certifications for the following data set: list Laboratory Sample ID Number(s):
Samples. 200-30385-1 through 200-30385-5

Matrices: Groundwater/Surface Water x Soil/Sediment Drinking Water Air Other:

CAM Protocol (check all that apply below):

8260 VOC CAM II A	7470/7471 Hg CAM III B x	MassDEP VPH CAM IV A	8081 Pesticides CAM V B	7196 Hex Cr CAM VI B	MassDEP APH CAM IX A
8270 SVOC CAM II B	7010 Metals CAM III C	MassDEP EPH CAM IV B	8151 Herbicides CAM V C	8330 Explosives CAM VIII A	TO-15 VOC CAM IX B
6010 Metals CAM III A	6020 Metals CAM III D	8082 PCB CAM V A	9014 Total Cyanide/PAC CAM VI A x	6860 Perchlorate CAM VIII B	

Affirmative Responses to Questions A through F are required for "Presumptive Certainty" status

A	Were all samples received in a condition consistent with those described on the Chain-of-Custody, properly preserved (including temperature) in the field or laboratory, and prepared/analyzed within method holding times?	X Yes No
B	Were the analytical method(s) and all associated QC requirements specified in the selected CAM protocol(s) followed?	X Yes No
C	Were all required corrective actions and analytical response actions specified in the selected CAM protocol(s) implemented for all identified performance standard non-conformances?	X Yes No
D	Does the laboratory report comply with all the reporting requirements specified in CAM VII A, "Quality Assurance and Quality Control Guidelines for the Acquisition and Reporting of Analytical Data"?	X Yes No
E	VPH, EPH, APH, and TO-15 only: a. VPH, EPH, and APH Methods only: Was each method conducted without significant modification(s)? (Refer to the individual method(s) for a list of significant modifications). b. APH and TO-15 Methods only: Was the complete analyte list reported for each method?	Yes No Yes No
F	Were all applicable CAM protocol QC and performance standard non-conformances identified and evaluated in a laboratory narrative (including all "No" responses to Questions A through E)?	X Yes No

Responses to Questions G, H and I below are required for "Presumptive Certainty" status

G	Were the reporting limits at or below all CAM reporting limits specified in the selected CAM protocol(s)?	X Yes No[1]

<u>Data User Note</u>: Data that achieve "Presumptive Certainty" status may not necessarily meet the data usability and representativeness requirements described in 310 CMR 40. 1056 (2)(k) and WSC-07-350.

H	Were **all** QC performance standards specified in the CAM protocol(s) achieved?	X Yes No[1]
I	Were results reported for the complete analyte list specified in the selected CAM protocol(s)?	X Yes No[1]

[1] *All negative responses must be addressed in an attached laboratory narrative.*

I, the undersigned, attest under the pains and penalties of perjury that, based upon my personal inquiry of those responsible for obtaining the information, the material contained in this analytical report is, to the best of my knowledge and belief, accurate and complete.

Signature: **Position:** Project Manager

Printed Name: Jim Madison **Date:** 11/9/15

MassDEP Analytical Protocol Certification Form

Laboratory Name: TestAmerica laboratories, Inc. Project #: 106-4383

Project Location: Hanover, MA RTN: 4-0000090

This Form provides certifications for the following data set: list Laboratory Sample ID Number(s):
Samples. 200-30407-1 through 200-30407-22

Matrices: Groundwater/Surface Water x Soil/Sediment Drinking Water Air Other:

CAM Protocol (check all that apply below):

8260 VOC CAM II A	7470/7471 Hg CAM III B x	MassDEP VPH CAM IV A	8081 Pesticides CAM V B	7196 Hex Cr CAM VI B	MassDEP APH CAM IX A
8270 SVOC CAM II B	7010 Metals CAM III C	MassDEP EPH CAM IV B.	8151 Herbicides CAM V C	8330 Explosives CAM VIII A	TO-15 VOC CAM IX B
6010 Metals CAM III A	6020 Metals CAM III D	8082 PCB CAM V A	9014 Total Cyanide/PAC CAM VI A	6860 Perchlorate CAM VIII B	

Affirmative Responses to Questions A through F are required for "Presumptive Certainty" status

A	Were all samples received in a condition consistent with those described on the Chain-of-Custody, properly preserved (including temperature) in the field or laboratory, and prepared/analyzed within method holding times?	**X** Yes No
B	Were the analytical method(s) and all associated QC requirements specified in the selected CAM protocol(s) followed?	**X** Yes No
C	Were all required corrective actions and analytical response actions specified in the selected CAM protocol(s) implemented for all identified performance standard non-conformances?	**X** Yes No
D	Does the laboratory report comply with all the reporting requirements specified in CAM VII A, "Quality Assurance and Quality Control Guidelines for the Acquisition and Reporting of Analytical Data"?	**X** Yes No
E	VPH, EPH, APH, and TO-15 only: a. VPH, EPH, and APH Methods only: Was each method conducted without significant modification(s)? (Refer to the individual method(s) for a list of significant modifications). b. APH and TO-15 Methods only: Was the complete analyte list reported for each method?	Yes No Yes No
F	Were all applicable CAM protocol QC and performance standard non-conformances identified and evaluated in a laboratory narrative (including all "No" responses to Questions A through E)?	**X** Yes No

Responses to Questions G, H and I below are required for "Presumptive Certainty" status

G	Were the reporting limits at or below all CAM reporting limits specified in the selected CAM protocol(s)?	**X** Yes No[1]

<u>Data User Note</u>: Data that achieve "Presumptive Certainty" status may not necessarily meet the data usability and representativeness requirements described in 310 CMR 40. 1056 (2)(k) and WSC-07-350.

H	Were **all** QC performance standards specified in the CAM protocol(s) achieved?	Yes **X** No[1]
I	Were results reported for the complete analyte list specified in the selected CAM protocol(s)?	**X** Yes No[1]

[1] *All negative responses must be addressed in an attached laboratory narrative.*

I, the undersigned, attest under the pains and penalties of perjury that, based upon my personal inquiry of those responsible for obtaining the information, the material contained in this analytical report is, to the best of my knowledge and belief, accurate and complete.

Signature: **Position:** Project Manager

Printed Name: Don Dawicki **Date:** 11/25/15

MassDEP Analytical Protocol Certification Form

Laboratory Name: TestAmerica laboratories, Inc. Project #: 106-4383

Project Location: Hanover, MA RTN: 4-0000090

This Form provides certifications for the following data set: list Laboratory Sample ID Number(s):
Samples. 200-30408-1 through 200-30408-6

Matrices: Groundwater/Surface Water x Soil/Sediment Drinking Water Air Other:

CAM Protocol (check all that apply below):

8260 VOC CAM II A	7470/7471 Hg CAM III B x	MassDEP VPH CAM IV A	8081 Pesticides CAM V B	7196 Hex Cr CAM VI B	MassDEP APH CAM IX A
8270 SVOC CAM II B	7010 Metals CAM III C	MassDEP EPH CAM IV B	8151 Herbicides CAM V C	8330 Explosives CAM VIII A	TO-15 VOC CAM IX B
6010 Metals CAM III A x	6020 Metals CAM III D	8082 PCB CAM V A	9014 Total Cyanide/PAC CAM VI A	6860 Perchlorate CAM VIII B	

Affirmative Responses to Questions A through F are required for "Presumptive Certainty" status

A	Were all samples received in a condition consistent with those described on the Chain-of-Custody, properly preserved (including temperature) in the field or laboratory, and prepared/analyzed within method holding times?	**X** Yes No
B	Were the analytical method(s) and all associated QC requirements specified in the selected CAM protocol(s) followed?	**X** Yes No
C	Were all required corrective actions and analytical response actions specified in the selected CAM protocol(s) implemented for all identified performance standard non-conformances?	**X** Yes No
D	Does the laboratory report comply with all the reporting requirements specified in CAM VII A, "Quality Assurance and Quality Control Guidelines for the Acquisition and Reporting of Analytical Data"?	**X** Yes No
E	VPH, EPH, APH, and TO-15 only: a. VPH, EPH, and APH Methods only: Was each method conducted without significant modification(s)? (Refer to the individual method(s) for a list of significant modifications). b. APH and TO-15 Methods only: Was the complete analyte list reported for each method?	Yes No Yes No
F	Were all applicable CAM protocol QC and performance standard non-conformances identified and evaluated in a laboratory narrative (including all "No" responses to Questions A through E)?	**X** Yes No

Responses to Questions G, H and I below are required for "Presumptive Certainty" status

G	Were the reporting limits at or below all CAM reporting limits specified in the selected CAM protocol(s)?	**X** Yes No[1]

<u>Data User Note</u>: Data that achieve "Presumptive Certainty" status may not necessarily meet the data usability and representativeness requirements described in 310 CMR 40. 1056 (2)(k) and WSC-07-350.

H	Were **all** QC performance standards specified in the CAM protocol(s) achieved?	**X** Yes No[1]
I	Were results reported for the complete analyte list specified in the selected CAM protocol(s)?	**X** Yes No[1]

[1] *All negative responses must be addressed in an attached laboratory narrative.*

I, the undersigned, attest under the pains and penalties of perjury that, based upon my personal inquiry of those responsible for obtaining the information, the material contained in this analytical report is, to the best of my knowledge and belief, accurate and complete.

Signature: **Position:** Project Manager

Printed Name: Jim Madison **Date:** 11/19/2015

MassDEP Analytical Protocol Certification Form

Laboratory Name: TestAmerica laboratories, Inc. Project #: 106-4383

Project Location: Hanover, MA RTN: 4-0000090

This Form provides certifications for the following data set: list Laboratory Sample ID Number(s):
Samples. 200-30409-1 through 200-30409-21

Matrices: Groundwater/Surface Water x Soil/Sediment Drinking Water Air Other:

CAM Protocol (check all that apply below):

8260 VOC CAM II A	7470/7471 Hg CAM III B x	MassDEP VPH CAM IV A	8081 Pesticides CAM V B	7196 Hex Cr CAM VI B	MassDEP APH CAM IX A
8270 SVOC CAM II B	7010 Metals CAM III C	MassDEP EPH CAM IV B	8151 Herbicides CAM V C	8330 Explosives CAM VIII A	TO-15 VOC CAM IX B
6010 Metals CAM III A x	6020 Metals CAM III D	8082 PCB CAM V A	9014 Total Cyanide/PAC CAM VI A	6860 Perchlorate CAM VIII B	

Affirmative Responses to Questions A through F are required for "Presumptive Certainty" status

A	Were all samples received in a condition consistent with those described on the Chain-of-Custody, properly preserved (including temperature) in the field or laboratory, and prepared/analyzed within method holding times?	X Yes No
B	Were the analytical method(s) and all associated QC requirements specified in the selected CAM protocol(s) followed?	X Yes No
C	Were all required corrective actions and analytical response actions specified in the selected CAM protocol(s) implemented for all identified performance standard non-conformances?	X Yes No
D	Does the laboratory report comply with all the reporting requirements specified in CAM VII A, "Quality Assurance and Quality Control Guidelines for the Acquisition and Reporting of Analytical Data"?	X Yes No
E	VPH, EPH, APH, and TO-15 only: a. VPH, EPH, and APH Methods only: Was each method conducted without significant modification(s)? (Refer to the individual method(s) for a list of significant modifications). b. APH and TO-15 Methods only: Was the complete analyte list reported for each method?	Yes No Yes No
F	Were all applicable CAM protocol QC and performance standard non-conformances identified and evaluated in a laboratory narrative (including all "No" responses to Questions A through E)?	X Yes No

Responses to Questions G, H and I below are required for "Presumptive Certainty" status

G	Were the reporting limits at or below all CAM reporting limits specified in the selected CAM protocol(s)?	X Yes No[1]

<u>Data User Note</u>: Data that achieve "Presumptive Certainty" status may not necessarily meet the data usability and representativeness requirements described in 310 CMR 40. 1056 (2)(k) and WSC-07-350.

H	Were **all** QC performance standards specified in the CAM protocol(s) achieved?	X Yes No[1]
I	Were results reported for the complete analyte list specified in the selected CAM protocol(s)?	X Yes No[1]

[1] *All negative responses must be addressed in an attached laboratory narrative.*

I, the undersigned, attest under the pains and penalties of perjury that, based upon my personal inquiry of those responsible for obtaining the information, the material contained in this analytical report is, to the best of my knowledge and belief, accurate and complete.

Signature: ______________ **Position:** Project Manager

Printed Name: Jim Madison **Date:** 11\17/2015

MassDEP Analytical Protocol Certification Form

Laboratory Name: TestAmerica laboratories, Inc.

Project #: 106-4383

Project Location: Hanover, MA

RTN: 4-0000090

This Form provides certifications for the following data set: list Laboratory Sample ID Number(s):
Samples. 200-30410-1 through 200-30410-6

Matrices: Groundwater/Surface Water **x** Soil/Sediment Drinking Water Air Other:

CAM Protocol (check all that apply below):

8260 VOC CAM II A	7470/7471 Hg CAM III B **x**	MassDEP VPH CAM IV A	8081 Pesticides CAM V B	7196 Hex Cr CAM VI B	MassDEP APH CAM IX A
8270 SVOC CAM II B	7010 Metals CAM III C	MassDEP EPH CAM IV B	8151 Herbicides CAM V C	8330 Explosives CAM VIII A	TO-15 VOC CAM IX B
6010 Metals CAM III A **x**	6020 Metals CAM III D	8082 PCB CAM V A	9014 Total Cyanide/PAC CAM VI A	6860 Perchlorate CAM VIII B	

Affirmative Responses to Questions A through F are required for "Presumptive Certainty" status

A	Were all samples received in a condition consistent with those described on the Chain-of-Custody, properly preserved (including temperature) in the field or laboratory, and prepared/analyzed within method holding times?	**X** Yes No
B	Were the analytical method(s) and all associated QC requirements specified in the selected CAM protocol(s) followed?	**X** Yes No
C	Were all required corrective actions and analytical response actions specified in the selected CAM protocol(s) implemented for all identified performance standard non-conformances?	**X** Yes No
D	Does the laboratory report comply with all the reporting requirements specified in CAM VII A, "Quality Assurance and Quality Control Guidelines for the Acquisition and Reporting of Analytical Data"?	**X** Yes No
E	VPH, EPH, APH, and TO-15 only: a. VPH, EPH, and APH Methods only: Was each method conducted without significant modification(s)? (Refer to the individual method(s) for a list of significant modifications). b. APH and TO-15 Methods only: Was the complete analyte list reported for each method?	Yes No Yes No
F	Were all applicable CAM protocol QC and performance standard non-conformances identified and evaluated in a laboratory narrative (including all "No" responses to Questions A through E)?	**X** Yes No

Responses to Questions G, H and I below are required for "Presumptive Certainty" status

G	Were the reporting limits at or below all CAM reporting limits specified in the selected CAM protocol(s)?	**X** Yes No[1]

<u>Data User Note</u>: Data that achieve "Presumptive Certainty" status may not necessarily meet the data usability and representativeness requirements described in 310 CMR 40. 1056 (2)(k) and WSC-07-350.

H	Were **all** QC performance standards specified in the CAM protocol(s) achieved?	**X** Yes No[1]
I	Were results reported for the complete analyte list specified in the selected CAM protocol(s)?	**X** Yes No[1]

[1] *All negative responses must be addressed in an attached laboratory narrative.*

I, the undersigned, attest under the pains and penalties of perjury that, based upon my personal inquiry of those responsible for obtaining the information, the material contained in this analytical report is, to the best of my knowledge and belief, accurate and complete.

Signature:

Position: Project Manager

Printed Name: Jim Madison

Date: 11/19/2015

MassDEP Analytical Protocol Certification Form

Laboratory Name: TestAmerica laboratories, Inc. Project #: 106-4383

Project Location: Hanover, MA RTN: 4-0000090

This Form provides certifications for the following data set: list Laboratory Sample ID Number(s):
Samples. 200-30480-1 through 200-30480-26

Matrices: Groundwater/Surface Water **x** Soil/Sediment Drinking Water Air Other:

CAM Protocol (check all that apply below):

8260 VOC CAM II A	7470/7471 Hg CAM III B **x**	MassDEP VPH CAM IV A	8081 Pesticides CAM V B	7196 Hex Cr CAM VI B	MassDEP APH CAM IX A
8270 SVOC CAM II B	7010 Metals CAM III C	MassDEP EPH CAM IV B	8151 Herbicides CAM V C	8330 Explosives CAM VIII A	TO-15 VOC CAM IX B
6010 Metals CAM III A	6020 Metals CAM III D	8082 PCB CAM V A	9014 Total Cyanide/PAC CAM VI A	6860 Perchlorate CAM VIII B	

Affirmative Responses to Questions A through F are required for "Presumptive Certainty" status

A	Were all samples received in a condition consistent with those described on the Chain-of-Custody, properly preserved (including temperature) in the field or laboratory, and prepared/analyzed within method holding times?	**X** Yes No
B	Were the analytical method(s) and all associated QC requirements specified in the selected CAM protocol(s) followed?	**X** Yes No
C	Were all required corrective actions and analytical response actions specified in the selected CAM protocol(s) implemented for all identified performance standard non-conformances?	**X** Yes No
D	Does the laboratory report comply with all the reporting requirements specified in CAM VII A, "Quality Assurance and Quality Control Guidelines for the Acquisition and Reporting of Analytical Data"?	**X** Yes No
E	VPH, EPH, APH, and TO-15 only: a. VPH, EPH, and APH Methods only: Was each method conducted without significant modification(s)? (Refer to the individual method(s) for a list of significant modifications). b. APH and TO-15 Methods only: Was the complete analyte list reported for each method?	Yes No Yes No
F	Were all applicable CAM protocol QC and performance standard non-conformances identified and evaluated in a laboratory narrative (including all "No" responses to Questions A through E)?	**X** Yes No

Responses to Questions G, H and I below are required for "Presumptive Certainty" status

G	Were the reporting limits at or below all CAM reporting limits specified in the selected CAM protocol(s)?	**X** Yes No[1]

<u>Data User Note</u>: Data that achieve "Presumptive Certainty" status may not necessarily meet the data usability and representativeness requirements described in 310 CMR 40. 1056 (2)(k) and WSC-07-350.

H	Were **all** QC performance standards specified in the CAM protocol(s) achieved?	**X** Yes No[1]
I	Were results reported for the complete analyte list specified in the selected CAM protocol(s)?	**X** Yes No[1]

[1] *All negative responses must be addressed in an attached laboratory narrative.*

I, the undersigned, attest under the pains and penalties of perjury that, based upon my personal inquiry of those responsible for obtaining the information, the material contained in this analytical report is, to the best of my knowledge and belief, accurate and complete.

Signature: **Position:** Project Manager

Printed Name: Don Dawicki **Date:** 11/25/15

MassDEP Analytical Protocol Certification Form

Laboratory Name: TestAmerica laboratories, Inc. Project #: 106-4383

Project Location: Hanover, MA RTN: 4-0000090

This Form provides certifications for the following data set: list Laboratory Sample ID Number(s):
Samples. 200-30482-1 through 200-30482-8

Matrices: Groundwater/Surface Water x Soil/Sediment Drinking Water Air Other:

CAM Protocol (check all that apply below):

8260 VOC CAM II A	7470/7471 Hg CAM III B x	MassDEP VPH CAM IV A	8081 Pesticides CAM V B	7196 Hex Cr CAM VI B	MassDEP APH CAM IX A
8270 SVOC CAM II B	7010 Metals CAM III C	MassDEP EPH CAM IV B	8151 Herbicides CAM V C	8330 Explosives CAM VIII A	TO-15 VOC CAM IX B
6010 Metals CAM III A x	6020 Metals CAM III D	8082 PCB CAM V A	9014 Total Cyanide/PAC CAM VI A x	6860 Perchlorate CAM VIII B	

Affirmative Responses to Questions A through F are required for "Presumptive Certainty" status

A	Were all samples received in a condition consistent with those described on the Chain-of-Custody, properly preserved (including temperature) in the field or laboratory, and prepared/analyzed within method holding times?	**X** Yes No
B	Were the analytical method(s) and all associated QC requirements specified in the selected CAM protocol(s) followed?	**X** Yes No
C	Were all required corrective actions and analytical response actions specified in the selected CAM protocol(s) implemented for all identified performance standard non-conformances?	**X** Yes No
D	Does the laboratory report comply with all the reporting requirements specified in CAM VII A, "Quality Assurance and Quality Control Guidelines for the Acquisition and Reporting of Analytical Data"?	**X** Yes No
E	VPH, EPH, APH, and TO-15 only: a. VPH, EPH, and APH Methods only: Was each method conducted without significant modification(s)? (Refer to the individual method(s) for a list of significant modifications). b. APH and TO-15 Methods only: Was the complete analyte list reported for each method?	Yes No Yes No
F	Were all applicable CAM protocol QC and performance standard non-conformances identified and evaluated in a laboratory narrative (including all "No" responses to Questions A through E)?	**X** Yes No

Responses to Questions G, H and I below are required for "Presumptive Certainty" status

G	Were the reporting limits at or below all CAM reporting limits specified in the selected CAM protocol(s)?	**X** Yes No[1]

Data User Note: Data that achieve "Presumptive Certainty" status may not necessarily meet the data usability and representativeness requirements described in 310 CMR 40. 1056 (2)(k) and WSC-07-350.

H	Were **all** QC performance standards specified in the CAM protocol(s) achieved?	**X** Yes No[1]
I	Were results reported for the complete analyte list specified in the selected CAM protocol(s)?	**X** Yes No[1]

[1] *All negative responses must be addressed in an attached laboratory narrative.*

I, the undersigned, attest under the pains and penalties of perjury that, based upon my personal inquiry of those responsible for obtaining the information, the material contained in this analytical report is, to the best of my knowledge and belief, accurate and complete.

Signature:

Position: Project Manager

Printed Name: Don Dawicki

Date: 11/25/15

MassDEP Analytical Protocol Certification Form

Laboratory Name: TestAmerica laboratories, Inc. Project #: 106-4383

Project Location: Hanover, MA RTN: 4-0000090

This Form provides certifications for the following data set: list Laboratory Sample ID Number(s):
Samples. 200-30499-3, 4, 13-16, 19-21, 23-25 and 28-34

Matrices: Groundwater/Surface Water x Soil/Sediment Drinking Water Air Other:

CAM Protocol (check all that apply below):

8260 VOC CAM II A	7470/7471 Hg CAM III B x	MassDEP VPH CAM IV A	8081 Pesticides CAM V B	7196 Hex Cr CAM VI B	MassDEP APH CAM IX A
8270 SVOC CAM II B	7010 Metals CAM III C	MassDEP EPH CAM IV B	8151 Herbicides CAM V C	8330 Explosives CAM VIII A	TO-15 VOC CAM IX B
6010 Metals CAM III A	6020 Metals CAM III D	8082 PCB CAM V A	9014 Total Cyanide/PAC CAM VI A	6860 Perchlorate CAM VIII B	

Affirmative Responses to Questions A through F are required for "Presumptive Certainty" status

A	Were all samples received in a condition consistent with those described on the Chain-of-Custody, properly preserved (including temperature) in the field or laboratory, and prepared/analyzed within method holding times?	**X** Yes No
B	Were the analytical method(s) and all associated QC requirements specified in the selected CAM protocol(s) followed?	**X** Yes No
C	Were all required corrective actions and analytical response actions specified in the selected CAM protocol(s) implemented for all identified performance standard non-conformances?	**X** Yes No
D	Does the laboratory report comply with all the reporting requirements specified in CAM VII A, "Quality Assurance and Quality Control Guidelines for the Acquisition and Reporting of Analytical Data"?	**X** Yes No
E	VPH, EPH, APH, and TO-15 only: a. VPH, EPH, and APH Methods only: Was each method conducted without significant modification(s)? (Refer to the individual method(s) for a list of significant modifications). b. APH and TO-15 Methods only: Was the complete analyte list reported for each method?	Yes No Yes No
F	Were all applicable CAM protocol QC and performance standard non-conformances identified and evaluated in a laboratory narrative (including all "No" responses to Questions A through E)?	**X** Yes No

Responses to Questions G, H and I below are required for "Presumptive Certainty" status

G	Were the reporting limits at or below all CAM reporting limits specified in the selected CAM protocol(s)?	**X** Yes No[1]

<u>Data User Note</u>: Data that achieve "Presumptive Certainty" status may not necessarily meet the data usability and representativeness requirements described in 310 CMR 40. 1056 (2)(k) and WSC-07-350.

H	Were **all** QC performance standards specified in the CAM protocol(s) achieved?	**X** Yes No[1]
I	Were results reported for the complete analyte list specified in the selected CAM protocol(s)?	**X** Yes No[1]

[1] *All negative responses must be addressed in an attached laboratory narrative.*

I, the undersigned, attest under the pains and penalties of perjury that, based upon my personal inquiry of those responsible for obtaining the information, the material contained in this analytical report is, to the best of my knowledge and belief, accurate and complete.

Signature: **Position:** Project Manager

Printed Name: Jim Madison **Date:** 11/13/15

MassDEP Analytical Protocol Certification Form

Laboratory Name: TestAmerica laboratories, Inc. Project #: 106-4383

Project Location: Hanover, MA RTN: 4-0000090

This Form provides certifications for the following data set: list Laboratory Sample ID Number(s):
Samples. 200-30499-1, -2, -5 through -12, -17, -18, -22, -26, -27.

Matrices: Groundwater/Surface Water x Soil/Sediment Drinking Water Air Other:

CAM Protocol (check all that apply below):

8260 VOC CAM II A	7470/7471 Hg CAM III B x	MassDEP VPH CAM IV A	8081 Pesticides CAM V B	7196 Hex Cr CAM VI B	MassDEP APH CAM IX A
8270 SVOC CAM II B	7010 Metals CAM III C	MassDEP EPH CAM IV B	8151 Herbicides CAM V C	8330 Explosives CAM VIII A	TO-15 VOC CAM IX B
6010 Metals CAM III A	6020 Metals CAM III D	8082 PCB CAM V A	9014 Total Cyanide/PAC CAM VI A	6860 Perchlorate CAM VIII B	

Affirmative Responses to Questions A through F are required for "Presumptive Certainty" status

A	Were all samples received in a condition consistent with those described on the Chain-of-Custody, properly preserved (including temperature) in the field or laboratory, and prepared/analyzed within method holding times?	**X** Yes No
B	Were the analytical method(s) and all associated QC requirements specified in the selected CAM protocol(s) followed?	**X** Yes No
C	Were all required corrective actions and analytical response actions specified in the selected CAM protocol(s) implemented for all identified performance standard non-conformances?	**X** Yes No
D	Does the laboratory report comply with all the reporting requirements specified in CAM VII A, "Quality Assurance and Quality Control Guidelines for the Acquisition and Reporting of Analytical Data"?	**X** Yes No
E	VPH, EPH, APH, and TO-15 only: a. VPH, EPH, and APH Methods only: Was each method conducted without significant modification(s)? (Refer to the individual method(s) for a list of significant modifications). b. APH and TO-15 Methods only: Was the complete analyte list reported for each method?	Yes No Yes No
F	Were all applicable CAM protocol QC and performance standard non-conformances identified and evaluated in a laboratory narrative (including all "No" responses to Questions A through E)?	**X** Yes No

Responses to Questions G, H and I below are required for "Presumptive Certainty" status

G	Were the reporting limits at or below all CAM reporting limits specified in the selected CAM protocol(s)?	**X** Yes No[1]

***Data User Note**: Data that achieve "Presumptive Certainty" status may not necessarily meet the data usability and representativeness requirements described in 310 CMR 40. 1056 (2)(k) and WSC-07-350.*

H	Were **all** QC performance standards specified in the CAM protocol(s) achieved?	**X** Yes No[1]
I	Were results reported for the complete analyte list specified in the selected CAM protocol(s)?	**X** Yes No[1]

[1] *All negative responses must be addressed in an attached laboratory narrative.*

I, the undersigned, attest under the pains and penalties of perjury that, based upon my personal inquiry of those responsible for obtaining the information, the material contained in this analytical report is, to the best of my knowledge and belief, accurate and complete.

Signature:______________________ **Position:** Project Manager

Printed Name: Jim Madison **Date:** 11\16\2015

MassDEP Analytical Protocol Certification Form

Laboratory Name: TestAmerica laboratories, Inc. Project #: 106-4383

Project Location: Hanover, MA RTN: 4-0000090

This Form provides certifications for the following data set: list Laboratory Sample ID Number(s):
Samples. 200-30500-1 through 200-30500-4

Matrices: Groundwater/Surface Water x Soil/Sediment Drinking Water Air Other:

CAM Protocol (check all that apply below):

8260 VOC CAM II A	7470/7471 Hg CAM III B x	MassDEP VPH CAM IV A	8081 Pesticides CAM V B	7196 Hex Cr CAM VI B	MassDEP APH CAM IX A
8270 SVOC CAM II B	7010 Metals CAM III C	MassDEP EPH CAM IV B	8151 Herbicides CAM V C	8330 Explosives CAM VIII A	TO-15 VOC CAM IX B
6010 Metals CAM III A x	6020 Metals CAM III D	8082 PCB CAM V A	9014 Total Cyanide/PAC CAM VI A x	6860 Perchlorate CAM VIII B	

Affirmative Responses to Questions A through F are required for "Presumptive Certainty" status

A	Were all samples received in a condition consistent with those described on the Chain-of-Custody, properly preserved (including temperature) in the field or laboratory, and prepared/analyzed within method holding times?	**X** Yes No
B	Were the analytical method(s) and all associated QC requirements specified in the selected CAM protocol(s) followed?	**X** Yes No
C	Were all required corrective actions and analytical response actions specified in the selected CAM protocol(s) implemented for all identified performance standard non-conformances?	**X** Yes No
D	Does the laboratory report comply with all the reporting requirements specified in CAM VII A, "Quality Assurance and Quality Control Guidelines for the Acquisition and Reporting of Analytical Data"?	**X** Yes No
E	VPH, EPH, APH, and TO-15 only: a. VPH, EPH, and APH Methods only: Was each method conducted without significant modification(s)? (Refer to the individual method(s) for a list of significant modifications). b. APH and TO-15 Methods only: Was the complete analyte list reported for each method?	Yes No Yes No
F	Were all applicable CAM protocol QC and performance standard non-conformances identified and evaluated in a laboratory narrative (including all "No" responses to Questions A through E)?	**X** Yes No

Responses to Questions G, H and I below are required for "Presumptive Certainty" status

G	Were the reporting limits at or below all CAM reporting limits specified in the selected CAM protocol(s)?	**X** Yes No[1]

<u>Data User Note</u>: Data that achieve "Presumptive Certainty" status may not necessarily meet the data usability and representativeness requirements described in 310 CMR 40. 1056 (2)(k) and WSC-07-350.

H	Were **all** QC performance standards specified in the CAM protocol(s) achieved?	**X** Yes No[1]
I	Were results reported for the complete analyte list specified in the selected CAM protocol(s)?	**X** Yes No[1]

[1] *All negative responses must be addressed in an attached laboratory narrative.*

I, the undersigned, attest under the pains and penalties of perjury that, based upon my personal inquiry of those responsible for obtaining the information, the material contained in this analytical report is, to the best of my knowledge and belief, accurate and complete.

Signature:

Position: Project Manager

Printed Name: Jim Madison

Date: 11/13/2015

MassDEP Analytical Protocol Certification Form

Laboratory Name: TestAmerica laboratories, Inc. Project #: 106-4383

Project Location: Hanover, MA RTN: 4-0000090

This Form provides certifications for the following data set: list Laboratory Sample ID Number(s):
Samples. 200-30503-1 through 200-30503-28

Matrices: Groundwater/Surface Water x Soil/Sediment Drinking Water Air Other:

CAM Protocol (check all that apply below):

8260 VOC CAM II A	7470/7471 Hg CAM III B x	MassDEP VPH CAM IV A	8081 Pesticides CAM V B	7196 Hex Cr CAM VI B	MassDEP APH CAM IX A
8270 SVOC CAM II B	7010 Metals CAM III C	MassDEP EPH CAM IV B	8151 Herbicides CAM V C	8330 Explosives CAM VIII A	TO-15 VOC CAM IX B
6010 Metals CAM III A x	6020 Metals CAM III D	8082 PCB CAM V A	9014 Total Cyanide/PAC CAM VI A	6860 Perchlorate CAM VIII B	

Affirmative Responses to Questions A through F are required for "Presumptive Certainty" status

A	Were all samples received in a condition consistent with those described on the Chain-of-Custody, properly preserved (including temperature) in the field or laboratory, and prepared/analyzed within method holding times?	X Yes No
B	Were the analytical method(s) and all associated QC requirements specified in the selected CAM protocol(s) followed?	X Yes No
C	Were all required corrective actions and analytical response actions specified in the selected CAM protocol(s) implemented for all identified performance standard non-conformances?	X Yes No
D	Does the laboratory report comply with all the reporting requirements specified in CAM VII A, "Quality Assurance and Quality Control Guidelines for the Acquisition and Reporting of Analytical Data"?	X Yes No
E	VPH, EPH, APH, and TO-15 only: a. VPH, EPH, and APH Methods only: Was each method conducted without significant modification(s)? (Refer to the individual method(s) for a list of significant modifications). b. APH and TO-15 Methods only: Was the complete analyte list reported for each method?	Yes No Yes No
F	Were all applicable CAM protocol QC and performance standard non-conformances identified and evaluated in a laboratory narrative (including all "No" responses to Questions A through E)?	X Yes No

Responses to Questions G, H and I below are required for "Presumptive Certainty" status

G	Were the reporting limits at or below all CAM reporting limits specified in the selected CAM protocol(s)?	X Yes No[1]

<u>Data User Note</u>: Data that achieve "Presumptive Certainty" status may not necessarily meet the data usability and representativeness requirements described in 310 CMR 40. 1056 (2)(k) and WSC-07-350.

H	Were **all** QC performance standards specified in the CAM protocol(s) achieved?	X Yes No[1]
I	Were results reported for the complete analyte list specified in the selected CAM protocol(s)?	X Yes No[1]

[1] *All negative responses must be addressed in an attached laboratory narrative.*

I, the undersigned, attest under the pains and penalties of perjury that, based upon my personal inquiry of those responsible for obtaining the information, the material contained in this analytical report is, to the best of my knowledge and belief, accurate and complete.

Signature:

Position: Project Manager

Printed Name: Jim Madison

Date: 11\13\2015

MassDEP Analytical Protocol Certification Form

Laboratory Name: TestAmerica laboratories, Inc. Project #: 106-4383

Project Location: Hanover, MA RTN: 4-0000090

This Form provides certifications for the following data set: list Laboratory Sample ID Number(s):
Samples. 200-30505-1, -2, -5 through –19, -24 and -25

Matrices: Groundwater/Surface Water **x** Soil/Sediment Drinking Water Air Other:

CAM Protocol (check all that apply below):

8260 VOC CAM II A	7470/7471 Hg CAM III B x	MassDEP VPH CAM IV A	8081 Pesticides CAM V B	7196 Hex Cr CAM VI B	MassDEP APH CAM IX A
8270 SVOC CAM II B	7010 Metals CAM III C	MassDEP EPH CAM IV B	8151 Herbicides CAM V C	8330 Explosives CAM VIII A	TO-15 VOC CAM IX B
6010 Metals CAM III A x	6020 Metals CAM III D	8082 PCB CAM V A	9014 Total Cyanide/PAC CAM VI A	6860 Perchlorate CAM VIII B	

Affirmative Responses to Questions A through F are required for "Presumptive Certainty" status

A	Were all samples received in a condition consistent with those described on the Chain-of-Custody, properly preserved (including temperature) in the field or laboratory, and prepared/analyzed within method holding times?	**X** Yes No
B	Were the analytical method(s) and all associated QC requirements specified in the selected CAM protocol(s) followed?	Yes **X** No
C	Were all required corrective actions and analytical response actions specified in the selected CAM protocol(s) implemented for all identified performance standard non-conformances?	**X** Yes No
D	Does the laboratory report comply with all the reporting requirements specified in CAM VII A, "Quality Assurance and Quality Control Guidelines for the Acquisition and Reporting of Analytical Data"?	**X** Yes No
E	VPH, EPH, APH, and TO-15 only: a. VPH, EPH, and APH Methods only: Was each method conducted without significant modification(s)? (Refer to the individual method(s) for a list of significant modifications). b. APH and TO-15 Methods only: Was the complete analyte list reported for each method?	Yes No Yes No
F	Were all applicable CAM protocol QC and performance standard non-conformances identified and evaluated in a laboratory narrative (including all "No" responses to Questions A through E)?	**X** Yes No

Responses to Questions G, H and I below are required for "Presumptive Certainty" status

G	Were the reporting limits at or below all CAM reporting limits specified in the selected CAM protocol(s)?	**X** Yes No[1]

***Data User Note:** Data that achieve "Presumptive Certainty" status may not necessarily meet the data usability and representativeness requirements described in 310 CMR 40. 1056 (2)(k) and WSC-07-350.*

H	Were **all** QC performance standards specified in the CAM protocol(s) achieved?	**X** Yes No[1]
I	Were results reported for the complete analyte list specified in the selected CAM protocol(s)?	**X** Yes No[1]

[1] *All negative responses must be addressed in an attached laboratory narrative.*

I, the undersigned, attest under the pains and penalties of perjury that, based upon my personal inquiry of those responsible for obtaining the information, the material contained in this analytical report is, to the best of my knowledge and belief, accurate and complete.

Signature: **Position:** Project Manager

Printed Name: Jim Madison **Date:** Project Manager

APPENDIX 3D

Proposed Surficial Sediment Mercury Preliminary Remedial Goal for the Fireworks Site

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ATTACHMENTS

ACRONYMS AND ABBREVIATIONS

BAF	Bioaccumulation Factor
BERA	Baseline Ecological Risk Assessment
BFPD	Below Factory Pond Dam
BSAF	biota sediment accumulation factor
cm	centimeter
CMR	Code of Massachusetts Regulations
CUG	cleanup goal
DO	dissolved oxygen
DOC	dissolved organic carbon
dwt	dry weight
ECC	Eastern Channel Corridor
FP	Forge Pond
Ha	hectare
HHRA	Human Health Risk Assessment
IQR	inter-quartile range
kg	kilogram
LDR	Lower Drinkwater River
LMB	largemouth bass
LUFP	Lily Pond and Upper Factory Pond
MA	Massachusetts
MassDEP	Massachusetts Department of Environmental Protection
MCP	Massachusetts Contingency Plan
MeHg	methylmercury
mg	milligram
MLFP	Middle and Lower Factory Pond
mm	millimeters
NDR	Northern Drinkwater River
NSR	No Significant Risk
ODEQ	Oregon Department of Environmental Quality
PDF	probability density function
PRG	preliminary remediation goal
PSS	Permanent Solution Statement
Site	Fireworks Site
THg	total mercury
TOC	total organic carbon
TXR	Transfer Factor
US	United States
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
wwt	wet weight

1. CONCEPTUAL DESIGN OF THE MERCURY SEDIMENT PRELIMINARY REMEDIATION GOAL

A project-specific preliminary remediation goal (PRG) (sometimes referred to as a cleanup goal (CUG)) for mercury in sediment at the Fireworks Site (Site) was developed with the objective of reducing the surficial sediment mercury concentrations in the ponds and streams at the Site such that the resident largemouth bass (LMB) fillet tissue mercury concentrations would decline to the point where they would be at or below the Massachusetts statewide background LMB fillet tissue mercury concentration. A site-specific relationship between the sediment mercury concentration and the LMB fillet tissue mercury concentration was established in consideration of multiple watershed-specific and species-specific factors. The uncertainty associated with making this connection of sediment concentration and fish tissue concentration of a bio-accumulating contaminant in a fish species at the top of the food chain was explicitly considered. This approach to establishing the mercury sediment PRG was selected to allow for the achievement of a permanent solution under the Massachusetts Contingency Plan (MCP), since it would entail reducing an environmental medium to its background level which, by definition under the MCP, would achieve a level of “No Significant Risk” (NSR).

Application of a mercury sediment PRG developed in this way in a revised Phase III evaluation would:

> “result in: (a) the identification and evaluation of remedial action alternatives which are reasonably likely to achieve a level of No Significant Risk considering the oil and hazardous material present, media contaminated, and site characteristics; and (b) the recommendation of a remedial action alternative that is a Permanent or Temporary Solution, where a Permanent Solution includes measures that reduce, to the extent feasible, the concentrations of oil and hazardous material in the environment to levels that achieve or approach background…Where feasible, implementation of a Permanent Solution shall include a measure or measures designed to reduce to the extent possible the level of oil and/or hazardous materials in the environment to background.” (310 CMR 40.0853)

For a sediment mercury PRG to be technically defensible, it must be demonstrated with sufficient confidence that the target statewide background LMB fillet tissue mercury concentration would be attained in the water bodies at the Site if the sediment PRG is achieved in those water bodies. In accordance with MCP risk characterization guidance, if all chemicals reported in a particular medium are present at background levels, then exposure to that medium does not require a risk characterization. If all chemicals in all media at the site are present at background concentrations or if they have been reduced to background levels through some response action, then a risk characterization is not required as a level of NSR is deemed to exist (MassDEP 1995). LMB were selected as the species of interest as it is a higher trophic level fish species that would be expected to bio-concentrate the most mercury via the food chain. The fillet tissue of the LMB was the exposure medium of most concern because of the importance of the fish ingestion exposure pathway for recreational fishermen and their families if the current consumption prohibition were to be lifted at the Site.

The technical development of a site-specific mercury sediment PRG is described in the remainder of this response. The development approach included three main steps:

1. Developing an understanding of mercury movement in a water body from sediment into fish tissue and the factors indicated to affect this movement;
2. Identifying an appropriate measure of the statewide background LMB fillet tissue mercury concentration; and
3. Identifying an average surficial sediment total mercury (THg) PRG that would provide sufficient confidence that achieving that average surficial sediment mercury concentration in a water body at the Site would result in the achievement of the statewide background LMB fillet tissue mercury concentration in the fish living within that water body by applying a robust uptake and food chain bio-concentration relationship.

The development of the PRG also should take into consideration that mercury levels in sediments and fish tissues may be reduced over the time frame of the remedial activities as a result of ongoing state and federal initiatives designed specifically for that outcome.

Each of these steps is described in the sections that follow.

2. FACTORS AFFECTING MERCURY UPTAKE AND BIO-CONCENTRATION IN A FRESHWATER HABITAT

Identifying an appropriate measure of the statewide background LMB fillet tissue mercury concentration requires the examination and analysis of a broad range of data and descriptive information about the fresh water habitat, its environs, LMB, and processes of the environmental fate and transport of mercury. More specifically, a critical examination must be made of the following parameters (among others):

- paired fish tissue and surficial sediment quality data for THg and methylmercury (MeHg);
- surface water quality parameters;
- watershed characteristics;
- the sources and chemical forms of the mercury present in the water bodies and biotic tissue; and
- biological parameters associated with mercury uptake through the food chain.

These parameters and characteristics have been shown to directly or indirectly affect or be correlated with the levels of mercury measured in fish in Massachusetts or influence the uptake of mercury from the sediment into LMB fillet tissue.

Several alternate approaches can be used to estimate the average surficial sediment THg concentration needed to achieve a LMB fillet tissue mercury concentration. These approaches range from simple empirical approaches (e.g., observational evaluation and regression approaches) to more mechanistic approaches involving a biota sediment accumulation factor (BSAF) or mercury partitioning considerations. Application of each different approach requires a different methodology and the use of different sampling or characterization data to evaluate. The relevant factors affecting mercury uptake and bio-accumulation in fish are summarized below.

Multiple environmental factors are known to correlate with the mercury concentration in the muscle (i.e., fillet tissue) of LMB, including: fish age; fish length; fish weight; the foraging range of LMB; water chemistry parameters; sediment chemistry parameters; watershed characteristics; and fishery makeup. The correlation of fish age and fish size has received significant study in the literature as both are directly linked to exposure duration and MeHg passage up through the sequential trophic levels of aquatic food chains. Surface water pH also has been found to be significantly correlated with mercury uptake due to its influence on methylation rates and mercury bioavailabilty. Other factors such as the non-pH related water quality parameters (e.g., alkalinity, chloride, hardness) are less well understood relative to their effect on mercury uptake and mercury bioaccumulation in fish tissues. These factors, and the available data pertinent to each, are discussed in this section to provide context and justification for the analyses and PRG design decisions that were made.

2.1. LMB Age-Length Characteristics in Massachusetts Fish

The most comprehensive database for age and total length of LMB for freshwaters in Massachusetts was the Massachusetts Department of Environmental Protection (MassDEP) Fish Mercury Research Data Portal Database for Massachusetts Lakes (http://www.mass.gov /eea/agencies/massdep/toxics/sources/fish-mercury-research-data-portal.html). Only the LMB tissue data with corresponding age/length and surficial sediment THg concentrations were selected for use in the age-length analysis performed to support the PRG development process. This subset of the MassDEP Fish Mercury Research Data Portal Database was used to develop an age-length relationship for the LMB collected from lakes and ponds located across Massachusetts that were indicated to not have been affected by any known industrial point sources of mercury. Based on an analysis of these data, as presented in Figure 2-1 and Table 2-1, LMB would attain the minimum creelable size of 30.5 centimeters (cm) (http://www.eregulations.com/Massachusetts/ huntingandfishing/fishing-seasons/) by 3 years of age. A “creelable” fish is large enough to be legally taken and consumed. A small fraction of 2 year old LMB (i.e., 2 of 30 individuals in the extracted data set) also attained the minimum creelable size. Conversely, a small fraction of 3-year-old LMB (i.e., 2 of 36 in the extracted data set) had not yet reached the minimum creelable size before being sampled.

2.2. LMB Age-Size Class Distribution in Massachusetts Fish

Multiple studies relating to LMB size have identified both age and length as good predictors of LMB fillet tissue body burden levels of bioaccumulating contaminants such as mercury. The compiled data set was used to characterize the age of LMB by size class based on size distribution characteristics. Age-based size classes were assigned as mean total lengths bounded by one standard deviation of the data set for each age class. The age and mean total length, standard deviation, and minimum and maximum lengths by age class are summarized in Table 2-1.

As can be seen, there is a relatively broad range of fish sizes observed for each age class of LMB. This variability of fish size for each fish age was assumed to be caused by differences in factors such as lake-specific growth rates, gender, and dietary quality. The LMB total length data exhibit a non-normal distribution, and so were log-transformed for further statistical evaluation. An analysis of variance for this data revealed no statistical difference in the log transformed total length ranges for LMB in age classes 5-6 years and 6-7 years. This would suggest, based on these data, the age of a LMB would be difficult to predict on the basis of total fish length after years of age. As such, the age-length relationship developed using the data extracted from the MassDEP Fish Mercury Research Data Portal Database is necessarily more uncertain for age classes greater than five years. Based on this analysis, the total length of LMB was judged to be the best metric for predicting body burden levels of mercury in LMB fillet tissue. This finding was used as the rationale for size standardizing the LMB fillet mercury concentration data prior to conducting further analyses. If size standardization is not performed first, the dependencies or correlations of LMB fillet tissue mercury concentrations with other factors may be masked and not identified.

2.3. LMB Home Range

The home range of a resident species will significantly affect the spatial trends in exposure to localized surficial sediment contamination. Home range studies of LMB have largely been based on telemetry studies (Ahrenstorff, et al. 2009; Harris, 2013; Thompson, et al., 2005). No studies on home range characteristics specifically for Massachusetts LMB populations could be found in the primary scientific literature or the published MassDEP data. Therefore, studies on LMB populations from other U.S. aquatic habitats were reviewed to develop a better understanding of the home range characteristics of LMB. The factors that have been identified as influencing the size of the home range for LMB include: water body size; population densities; preferred habitat; and seasonality (Harris, 2013). Spawning LMB individuals have been shown to have very strong site fidelity based on observed spawning and nesting behaviors. Seasonal movements in LMB have been shown to occur in response to water temperature, such that LMB move to shallower waters in the spring and summer and to deeper waters in the fall and winter when feeding during the winter months becomes very limited (Scott and Crossman, 1973). LMB home range also appears to be influenced by water body size (especially the surface area of the water body) (Sammons, et al., 2003), fish age, and habitat structure (Ahrenstorff, et al., 2009). Larger home ranges (on the average of 8-19 hectares (Ha) or 20 to 50 acres) were associated with larger (10,000 Ha or 24,700 acres) riverine impoundments in the Mid-Central U.S. (Sammons, et al., 2003; Harris, 2013). These waterbodies were somewhat larger than the overall Factory Pond/Lily Pond water body at the Site, which is approximately 15 acres, and the surface area of the Drinkwater River watershed, which is approximately 13,300 acres (see Figure 2-2). Additionally, home range was found to be inversely related to fish size (i.e., total length) and population density, such that larger fish occupied smaller home ranges and rarely schooled (Harris, 2013). Smaller LMB home ranges were associated with smaller water bodies. Studies on water bodies and watersheds larger than those of the Fireworks Site were not judged to be applicable to the current evaluation and were not used to project the LMB home range for the Site.

Table 2-2 summarizes the available studies identified for the comparably-sized water bodies that were known to support populations of LMB. The mean home range from the studies identified in Table 2-2 (± 1 standard deviation) is 1.9 ± 1.1 Ha (4.7 acres ± 2.7 acres) within an overall range of home range estimates of 0.40 to 3.04 Ha (0.98 to 7.5 acres). The impoundments of Lily Pond/Upper Factory Pond and Middle/Lower Factory Pond are joined by a narrow (approximately 10 - 20 feet) channel that allows for downstream flow from the upper to the lower water bodies. This constriction in flow geometry allows for surface water flow to occur, but may act to limit the migration of fish between these two water bodies. This assessment of LMB home range supports the position that largely independent LMB populations may exist within Lily Pond/Upper Factory Pond and Middle/Lower Factory Pond. This would suggest that a mercury sediment PRG should be applied separately to these two portions of the overall impoundment.

2.4. Surface Water Chemistry

Among the most influential water quality parameters identified by Rose, et al., (1999) relative to mercury uptake in fish in the freshwater bodies of Massachusetts was the surface water pH. Negative correlations between fish tissue mercury concentration and water body pH are well established (Hanten, et al., 1998; Grieb, et al., 1990; Hrabik and Watras, 2002 as cited in Furl (2007)). The increased accumulation of mercury in low-pH systems is attributed to increased microbial methylation in acidic waters (Xun, et al., 1987). The inverse relationship between surface water alkalinity and mercury levels in fish tissue is likely related to a water body's inability to neutralize fluxes of acidic waters when the alkalinity buffering capacity is very low.

2.5. Watershed Characteristics

The relative fraction of an overall watershed that is wetlands also has been found to affect the methylation process within the included water bodies and the uptake of mercury by resident fish (Rose et al., 1999). Higher proportions of wetlands have been correlated with greater methylation and greater uptake by fish. There are approximately 2,900 acres of wetlands within the Drinkwater River watershed. This represents approximately 22% of the overall watershed (see Figure 2-2). Many subareas of the Site in and adjacent to Lily Pond and the Lower Drinkwater River are wetlands.

2.6. Distribution of Fish Species

A fishery transect survey was performed as part of the Phase IID investigation at the Site. Fish were collected and catalogued using a combination of electroshocking, gill netting and hoop netting techniques. The results of that survey are summarized in Table 2-3. This table shows that the distribution of fish species is similar across the various reaches at the Site.

3. COMPILATION AND EVALUATION OF THE AVAILABLE PERTINENT DATA

Establishing a defensible mercury sediment PRG required the identification of an appropriate measure and value of the statewide background LMB fillet tissue mercury concentration and identifying a robust relationship for mercury uptake from sediment and bioaccumulation through the various trophic levels of the LMB food chain. A broad range of potentially relevant site characterization data and descriptive information was compiled and reviewed toward this end, including (but not limited to): fish tissue and surficial sediment chemistry data; surface water quality parameters; watershed characteristics; the chemical form of the mercury present; and biological parameters associated with mercury uptake through the food chain. Because the list of potentially pertinent data is long, it was quickly recognized that all of this information is rarely, if ever, collected at most sites with aquatic habitats on a routine basis. Most of this information is not needed for the routine monitoring of fish tissue mercury levels which is the most common reason for sampling at water bodies in the state. In addition, sampling that has been performed historically has typically focused only on THg (and not MeHg) and has not documented most of the other surface water or watershed parameters that would allow a more complete evaluation of the data relative to causation or correlation.

At a minimum, data for both LMB fillet tissue and co-located or proximate surficial sediment mercury concentrations is needed to begin to evaluate the linkage between sediment and fish tissue. Given the inherent complexity and variability in the sediment-to-fish tissue mercury uptake process, the other factors (e.g., surface water chemistry, watershed characteristics) also should be considered to establish not just what the sediment-to-fish tissue relationship is now, but what it may be following a significant sediment removal response that would result in lower future average surficial sediment mercury concentrations.

3.1. Sources of Pertinent Data

Two partially overlapping data sets were compiled to support the PRG development process:

1. A critically reviewed data set of relatively recently measured LMB fillet tissue mercury concentrations at lakes and ponds from across Massachusetts that may be considered "background" in the sense that they are not indicated to have been affected by nearby sources of mercury released from stacks or discharges. The minimally required data pairs that were identified, reviewed and compiled were LMB fillet tissue mercury concentrations (in units of milligrams (mg) per kilogram (Kg) wet weight (wwt)) and the proximately co-located surficial sediment THg concentration (reported as mg/Kg dry weight (dwt)). This data set was used to establish an appropriate concentration to represent the statewide background LMB fillet tissue mercury concentration.

2. A compilation of the available characterization parameters for water bodies or particular reaches of aquatic habitats at sites across Massachusetts that had the minimally requisite

paired LMB fillet tissue and surficial sediment THg sampling results and, when available, any of the other pertinent descriptive characteristics (e.g., pH, other surface water parameters, watershed characteristics). This data set was used to develop an estimate of the projected site-specific linkage between mercury in the surficial sediment and mercury in the LMB fillet tissue.

Each of these is discussed below.

3.1.1. Database Used to Establish the Statewide Background LMB Fillet Tissue Mercury Concentration

State-specific data published by MassDEP was obtained from the online repository (http://www.mass.gov/eea/agencies/massdep/toxics/sources/fish-mercury-research-data-portal.html).In addition, a data request was made to MassDEP on September 20, 2013 asking for any other relevant data that may have been collected or compiled by MassDEP but not yet published. The additional data provided in response included:

- Data validated sampling results for fish tissue concentrations that were collected more recently than what had been published online (e.g., adding data for Newfield Pond and Long Pond and validated 2012 data from the MassDEP Fish Toxics Monitoring Program to the earlier data for the years 2007-2011) and a limited amount of data for mercury in the surficial sediments collected at approximately the same locations where the fish tissue samples were collected.
- LMB fillet tissue sampling results and, in a few instances, results for smallmouth bass for THg and MeHg.

Only 19 Massachusetts lakes and ponds had data for both LMB fillet tissue concentrations and surficial sediment mercury measurements. Typically, only a single surficial sediment mercury sampling result was available to characterize the THg concentration in the surficial sediments of the water body. Most of these water bodies had data for multiple years of sampling, with each typically sampled on a rotating basis two or three different times during the period 2007-2012.

The combined data were evaluated for their potential usability for the task of identifying the statewide background LMB fillet tissue mercury concentration. The vetted data became the primary database used to estimate a statewide background LMB fillet tissue mercury concentration consistent with the Massachusetts Contingency Plan (MCP, 310 Code of Massachusetts Regulations [CMR] 40.0006). The regulatory definition of “background” under the MCP makes it clear that application of the term “background” is not limited only to locations with "pristine" conditions, and that the MCP recognizes that historic human activities have resulted in the ubiquitous presence of some chemicals in the environment. As such, the presence of mercury in the surficial sediment or LMB fish tissue associated with a water body in Massachusetts due to the deposition of atmospheric mercury that has been transported long distances from other states does not preclude that water body from being considered a "background" site, so long as there are no known nearby point sources of mercury release into the water body.

The pH of the Drinkwater River system, as measured during the Phase IIC and IID investigations, was within the range of 5.5 to 7.5. The compiled data was reviewed with respect to the pH of the surface water from which the samples were collected. The data for water bodies with a characteristic pH outside the range of 5.5 to 7.5 were removed from the database to be used for the analyses of mercury transfer from sediment to fish tissue. This was because, as was noted above, the pH of the surface water has been demonstrated to have an effect on the uptake of mercury by fish. As a result, the data provided for Stevens Pond, Johnson's Pond, Lake Buel, and Lake Wampanoag were removed from the database used to estimate a statewide background LMB fillet tissue mercury concentration.

A number of water bodies in northeastern Massachusetts have historically been associated with elevated mercury concentrations in LMB fillet tissue samples (Hutchenson, et al. 2008). The descriptive data for these water bodies and the circumstances and mercury loadings at these water bodies were judged by MassDEP to not be consistent with the MCP definition of "background". As such, the data for these water bodies (i.e., Baldpate Pond, Chadwicks Pond, Cochichewick, Haggetts Pond, Lake Saltonstall, Lowe Pond, Millvale Reservoir, Pentucket Pond, Pomps Pond, and Rock Pond) were not included in the database used to evaluate the statewide background LMB fillet tissue mercury concentration.

Upon review of the remaining data, certain subsets of the raw LMB fillet tissue mercury concentrations (i.e., the direct analytical results) did not correlate well with fish length. Such a correlation typically exists and was expected based on multiple studies in the published literature. Specifically, the 2009 data collected from several water bodies located in the central portion of the state (i.e., Quabbin Reservoir, Wickabog Pond, Upper Naukeag Lake, Lake Massapoag Dunstable, Massapoag Sharon, and North Watuppa Pond) displayed poor correlation relationships between the concentrations of mercury in LMB fish tissues and the lengths of the sampled fish. Similar data from other years in these same water bodies showed the typically high levels of correlation between LMB fillet tissue mercury concentration and fish length. However, this observed difference between the 2009 data and the data for the other years in the overall time period evaluated (i.e., 2007-2012) was shown not to be statistically significant. Consequently, the data for these water bodies for this particular year were not removed from the data set used to evaluate the statewide background LMB fillet tissue mercury concentration.

The list of water bodies for which their data was retained for use in identifying the statewide background LMB fillet tissue mercury concentration is presented in the left column of Table 3-1, and that data is summarized by year in Table 3-2.

3.1.2. Database Used to Establish an Appropriate Site-Specific Mercury Uptake Relationship

Initially, a large number of local, state and national sources of information and sampling data were considered relative to providing the minimally required co-located surficial sediment and LMB fillet tissue mercury concentration data needed to estimate potential mercury uptake and bioaccumulation. Many of these sources were reviewed and evaluated relative to their suitability for use in estimating a representative mercury uptake relationship or BSAF for the Site. It was quickly recognized that, while somewhat limited in quantity, the data associated with water bodies in Massachusetts or the site-specific information collected during the Phase I, Phases IIC & IID, and the Supplemental Phase III investigations were more likely to be representative of conditions at the Site than the sometimes more detailed or voluminous data collected at sites and watersheds in other parts of the U.S. (e.g., the Chesapeake Bay, Great Lakes, Florida Everglades). The National Study of Chemical Residues in Lake Fish Tissue: Years 1 through 4 (USEPA, 2004; USEPA, 2005), while comprehensive for fish tissue sampling results, lacked corresponding surficial sediment chemistry data to allow for the estimation of mercury uptake or the calculation of an effective BSAF. As such, these incomplete data sets were not included in the database compiled for the analysis of mercury uptake into fish.

The following reports and sources of potentially pertinent data were critically evaluated with a focus on mercury uptake and bioaccumulation:

<u>Fireworks Site-Specific Data:</u>

- Phase IIC Site Investigation Data Report for the Fireworks I (Former Fireworks Facility) Site, Hanover, MA, Tier 1 Permit #100223, October 2002;
- Stage II Environmental Risk Characterization for the Fireworks I (Former Fireworks Facility) Site, Hanover, MA, Tier 1 Permit #100223, November 2003;
- Phase IID Site Investigation Data Report for the Fireworks I (Former Fireworks Facility) Site, Hanover, MA, Tier 1 Permit #100223, March 2004;
- Comprehensive Site Assessment Report for the Fireworks I (Former Fireworks Facility) Site, Hanover, MA, Tier 1 Permit #100223, November 2005; and
- Supplemental Phase III Site Investigation Data Report for the Fireworks I (Former Fireworks Facility) Site, Hanover, MA, Tier 1 Permit #100223, March 2009.

<u>Nyanza Superfund Site Data:</u>

- Human Health Risk Assessment, Nyanza Superfund Site Operable Unit IV, Sudbury River Mercury Contamination, Prepared for USEPA, May 2006; and
- Baseline Ecological Risk Assessment, Nyanza Superfund Site Operable Unit IV, Sudbury River Mercury Contamination, Prepared for USEPA, May 2007.

<u>Data for Other Massachusetts Water Bodies:</u>

- MassDEP Fish Mercury Research Data Portal Database for Massachusetts Lakes (http://www.mass.gov/eea/agencies/massdep/toxics/sources/fish-mercury-research-data-portal.html) for those lakes with co-located and contemporaneous surficial sediment and fish tissue mercury sampling data as identified in Rose, et al. (1999) and Hutchenson, et al. (2008); and
- Data provided in response to the September 2013 Data Request to MassDEP, including previously unpublished sediment and LMB fillet tissue monitoring data for the Years 2007-2012 for select Massachusetts lakes and ponds (discussed previously above).

Each of the above data sources contained some pertinent information for river and lake ecosystems within Massachusetts that: (1) were or are currently being researched or are under regulatory investigation; and (2) provided the minimally required paired surficial sediment and LMB fillet tissue mercury concentration measurements. The usability of the data compiled from these sources for the current analysis was assessed relative to the data quality control and validation procedures that were conducted at the program or site investigation level at the time of the project-specific sampling. No data from these sources were rejected for use in the current analyses if they had been found to be of acceptable quality for the original project. The complete list of candidate water bodies assembled from the various sources for the analysis of mercury uptake into fish tissue is presented in the center column of Table 3-1.

3.2. Preliminary Analysis of the Available Data

The data provided in response to the September 2013 Data Request to MassDEP were the most complete with respect to individual fish length and fish weight, surface water chemistry parameters, and surficial sediment chemistry parameters. Preliminary multiple step-wise regression analyses were performed using the resulting "Reference" database to evaluate the potential effect of various surface water and sediment chemistry parameters on the LMB fillet tissue mercury concentration. The surface water chemistry parameters that were available included: pH, alkalinity, calcium, dissolved organic carbon (DOC) content, dissolved oxygen (DO) content, iron, manganese, and nitrate + nitrite. The surface water pH was the most available of the water quality parameters for all data sets. The only consistently available surficial sediment chemistry parameter was the THg concentration. Based on these preliminary regression evaluations, the most important predictors of LMB fillet tissue mercury concentration were (in decreasing order of indicated importance): fish length, surface water alkalinity, surficial sediment THg concentration, and surface water pH. Consequently, the raw LMB fillet tissue mercury concentration data (i.e., the direct recorded measurements) were then size standardized (as discussed below) and data for only the water bodies with a pH in the range of 5.5 to 7.5 to be consistent with the Fireworks Site were retained for the current analyses.

3.3. Vetting the Compiled Mercury Uptake/BSAF Database

The compiled database of paired LMB fillet tissue and surficial sediment mercury concentration measurements was screened for suitability for use in assessing mercury uptake and developing an appropriate BSAF for the Site. This screening focused on whether the data were associated with a water body and/or aquatic setting similar to what exists currently in Drinkwater River/Factory Pond and the Drinkwater Basin or what may exist following a significant sediment removal action.

3.3.1. Assessment of Water Body pH

The pH of the Drinkwater River system, as measured during the Phase IIC and IID investigations, was between 5.5 to 7.5. The compiled database was reviewed and the data for water bodies with a pH outside of the range of 5.5 to 7.5 were removed from the database to be used for the analyses of mercury transfer from sediment to fish tissue. This was because the pH of the surface water has been identified as having a demonstrated effect on the uptake of mercury by fish. As a result, the data provided for Stevens Pond, Johnson's Pond, Lake Buel, and Lake Wampanoag were removed from the database used to establish an appropriate mercury uptake relationship for the Site. The Massachusetts lakes from the MassDEP Fish Mercury Research Data Portal had a surface water pH between 5.1 to 10.5, a much broader range than that measured for the Drinkwater River/Factory Pond system. Rose, et al. (1999) had determined that pH had a significant influence on mercury update in lakes in remote regions of Massachusetts without apparent point source contributions of mercury. The source of mercury input to these aquatic systems would almost exclusively be atmospheric deposition of mercury transported from emission sources in other regions of the U.S. The pH for the Sudbury River watershed where the Nyanza Superfund Site is located measured at the United States Geological Survey (USGS) gaging station in Saxonville, MA on the Sudbury River (USGS station 01098530) over the period 1994-1995 and for 2013 ranged from 6.8 to 7.5 and was comparable to the range observed for the Drinkwater River, Factory Pond, and Luddam's Ford. As such, the Nyanza Site data for the Sudbury River, Charles River and Sudbury Reservoir were retained. The list of water bodies retained for the analyses of mercury transfer from sediment to fish tissue are listed in the right most column of Table 3-1.

3.3.2. Assessment of Other Characteristics of the Water Bodies

The strengths and weaknesses of the pH 5.5 to 7.5 database were then assessed to identify data gaps or data limitations that may contribute uncertainty into the mercury uptake analyses and BSAF estimates. This review was performed on the Fireworks site-specific sampling data, the pertinent sampling results for the Nyanza Site, and the pH 5.5 to 7.5 data from the MassDEP Fish Mercury Research Data Portal and the data provided by MassDEP in response to the September 2013 Data Request. The assessment resulted in some general observations that applied to each of the data sources, and other observations that were specific to only one or more of the individual data sources.

The general observations (presented below) related to the completeness and consistency of the descriptive characteristics reported for each water body and the basic data quality parameters:

- At a minimum, water bodies had to have both LMB fillet tissue and surficial sediment mercury concentration data, with the corresponding sampling location, sampling date, collection methodology, tissue type (i.e., whole body fillet or fillet) and representative fish size measurements to be most suitable for inclusion in the database.

- Redundant data for the same water body obtained from different sources were identified and eliminated to ensure that all data in the database were unique.
- The available data were attributed and referenced to the appropriate published reports, online databases or the agencies that developed them.
- The LMB fillet tissue and surficial sediment mercury concentration data were checked to ensure that they had been subjected to USEPA validation or MassDEP-equivalent procedures for both quality control and quality assurance purposes and had been deemed usable for their original purposes.
- Sampling results that were qualified as estimated (i.e., assigned a "J" during the data validation process) were judged to be usable for the current analyses.
- Non-detect analytical results (i.e., qualified as U or UJ) were taken to be at a concentration equal to one half the sample-specific mercury reporting limit in that medium if a discrete mercury concentration value was needed for a quantitative calculation or analysis.
- The LMB fillet tissue mercury data were converted to be expressed in units of milligrams of THg/Kg wet weight of fish tissue (mg/Kg wwt) using the associated database information for the samples.
- The surficial sediment mercury concentration data were converted to be expressed in units of milligrams of THg/Kg dry weight of sediment (mg/Kg dwt).
- The paired LMB fillet and the surficial sediment mercury concentration data, along with their supporting morphometric parameters, were then classified into two distinct groups:
  1. "Reference" Data Set – Comprised of water bodies not known or suspected of having been impacted by nearby industrial sources or direct discharges of mercury; and
  2. "Non-Reference" Data Set – Comprised of water bodies known to be impacted by major industrial sources or direct discharges of mercury (Note: This group included the data from the Fireworks Site and from the Nyanza Superfund Site).

Sources of "Reference" data included upstream locations identified and sampled as part of the Fireworks Site and the Nyanza Superfund Site investigations, as well as data obtained from MassDEP sources. Much of the MassDEP data were associated with lakes and ponds that were sampled to characterize locations that had not been impacted by point sources of mercury release.

The observed data source-specific characteristics that posed limitations or introduced significant uncertainty into the mercury uptake and BSAF analyses are summarized in Table 3-3 and are summarized below by individual data source.

Fireworks Site: Data Reported in the 1995 MassDEP Toxics in Fish Monitoring Program Technical Memorandum Submittal for the Water Body Monitoring Request for Luddams Ford

- This MassDEP Memorandum presented sampling results for one composite LMB fillet tissue sample from Luddam's Ford (located far downstream of the Site) and another for Forge Pond (located immediately upstream of the Site). Each composite was created from up to three individual LMB.
- The surface water pH values for each of these water bodies were assumed to be within the range of 5.5 to 7.5 based on the data collected some time later during the Phase IID investigation. As such, no data for either water body from this Memorandum were excluded from the current analysis based on this criterion.
- The LMB fillet tissue data were reported as skin-on THg concentrations on a wet weight basis.
- The lengths and weights of the individual LMB from which the fillets were collected were available for comparison purposes and for size standardization.
- The surficial sediment samples were collected from three locations in Forge Pond and from a single location at Luddam's Ford. The BSAFs were constructed using the single surficial sediment concentration from Luddam's Ford and the mean surficial sediment concentration for the samples from Forge Pond.
- The water quality parameters collected during the Phase IID investigation for both water bodies (i.e., Forge Pond and Luddam's Ford) were included in the database even though not all parameters were collected contemporaneously.
- Forge Pond was identified as the site-specific "reference" pond location for the Fireworks Site and was identified here as a "Reference" water body. Luddam's Ford is located downstream of the Factory Pond Dam and was classified as a "Non-Reference" sampling location.

Fireworks Site: Data Collected During the Phase IIC/IID and Supplemental Phase III Investigations

- LMB fillet tissue and surficial sediment data were collected from the individual ponds and river and stream reaches of the Drinkwater River System.
- Composite LMB fillet tissue samples were created from three individual LMB from each reach or pond.
- The LMB tissue THg and MeHg concentrations were for skin-on fillet samples.

- The site-specific "Reference" mercury concentration data for LMB fillet tissue and surficial sediment were associated with the Northern Drinkwater River (NDR) and Forge Pond (FP). The sampling results for the Eastern Channel Corridor (ECC), Lower Drinkwater River (LDR), Lily Pond and Upper Factory Pond (LUFP), Middle and Lower Factory Pond (MLFP), and from Below Factory Pond Dam (BFPD) were classified as "Non-Reference" data.
- Surface water pH values for the individual riverine reaches and ponds were available from the respective investigation reports. Despite the noted pH range database filtering, some sampling results for Middle/Lower Factory Pond that had an atypical pH in the range of 5.3-6.62 were not excluded from the analysis.
- The LMB fillet tissue sampling data that were collected as part of Phase IID investigation for Luddam's Ford were limited to a single composite LMB tissue sample and included no new surficial sediment data. As such, the BSAF calculations performed for this location combined the single composite LMB fillet tissue mercury concentration result with the surficial sediment mercury concentration from the earlier 1995 MassDEP Memorandum.

<u>Fireworks Site:</u> Data Reported in the 2005 MassDEP Toxics in Fish Monitoring Program Technical Request for Special Sampling for Identified Water Body

- This data resulted from an internal request for fish tissue sampling submitted by MassDEP to the fish monitoring program and approved for inclusion during the 2004/2005 sampling year.
- Only a single composite LMB fillet tissue sample (comprised of three fillets) was collected at Luddam's Ford.
- No corresponding surficial sediment or surface water body parameters were collected during this sampling event.
- The LMB fillet tissue data were reported as skin-on THg concentrations on a wet weight basis.
- The 1995 and 2005 LMB fillet tissue mercury concentration results were comparable and indicated that there had been no significant reduction in overall LMB tissue mercury concentrations between the two sampling events. As such, it was then assumed that the single 1995 surficial sediment mercury concentration for Luddam's Ford also would be largely unchanged, so it was used in combination with the newer LMB tissue concentration data in the BSAF calculations.
- The Luddam's Ford results were classified as "Non-Reference" data.

<u>Nyanza Superfund Site: Data for the Sudbury River Reaches, the Sudbury Reservoir, and the Charles River</u>

- LMB fillet tissue mercury concentrations for individual fish samples were not readily available for the Nyanza Site. Only the statistical summaries of the fish tissue concentrations by reach that were presented in the Nyanza Site Human Health Risk Assessment (HHRA) (USEPA, 2006) and the Baseline Ecological Risk Assessment (BERA) (USEPA, 2008) could be obtained.

- All LMB fillet tissue samples were reported as skin on fillet samples.

- Only the skin on fillet data for LMB greater than 30.5 cm in length (i.e., the legally creelable fish size for LMB in Massachusetts [http://www.mass.gov/eea/agencies/dfg/dfw/laws-regulations/]) were retained for the current analysis and were included in the "Reference" or the "Non-Reference" databases for the mercury uptake/BSAF analyses, as appropriate for the location where they were collected in relation to the Nyanza Site.

- Minimum and maximum LMB fillet tissue mercury concentrations were extracted from Tables 2-5, 2-7, 2-9, 2-11, 2-13, 2-15, 2-17, 2-19, 2-21, 2-23, 2-25 and 2-27 of the Nyanza Site HHRA (USEPA, 2006) and were interpreted as THg concentrations for skin on fillets (mg/Kg wwt) in the current database.

- The mean LMB fillet tissue mercury concentrations were extracted from Tables 4-2, 4-4, 4-6, 4-8, 4-10, 4-12, 4-14 and 4-16 of the Nyanza Site HHRA (USEPA, 2006) and were expressed as THg concentrations (mg/Kg wwt) in the current database.

- Data on the lengths of the individual fish sampled also were not available from the accessible sources during the initial evaluation process. The only fish length information that was available were the minimum, mean and maximum measurements and the fact that all of the LMB sampled were greater than 30.5 cm in total length. Since the initial evaluation, the supplemental individual fish length data for the LMB sampled from the Nyanza Site were obtained. These results and their potential effect on the outcome of the PRG proposal are presented in Attachment A.

- The pH levels for the Sudbury River were reported by the USGS gaging station on the Sudbury River at Saxonville, MA to be between 6.6 and 7.5 for the water years 1994, 1995 and 2003.

- The Nyanza-specific "Reference" data were identified as being that associated with Sudbury River Reach 1, the Sudbury Reservoir, and the Charles River. These locations were identified as not having been impacted by the Nyanza Superfund Site and were classified as "Reference" in the current database. All other sampling points were located downstream of the Nyanza Superfund Site and could have been impacted by its releases. As such, the data associated with these reaches were classified as "Non-Reference" data for the current analyses.

Other Massachusetts Water Bodies: Data from the MassDEP Fish Mercury Research Data Portal

- These data were accessed from the MassDEP Fish Mercury Research Data Portal Site (http://public.dep.state.ma.us/fish/fish.aspx).
- The data for only the water bodies that reported paired LMB fillet tissue and surficial sediment mercury concentrations were downloaded from the website.
- All LMB fillet data were reported as THg concentrations for skin off fillet samples.
- For all water bodies from this data source, only a single surficial sediment sampling result for mercury was reported for each water body. Accordingly, the BSAF calculations had to be performed using this single surficial sediment concentration in combination with the individual LMB fillet tissue mercury concentration for the water body for a particular year and/or the grand mean LMB fillet tissue mercury concentration.
- The associated water quality parameters were reported for the individual water bodies and were used to assess whether the pH of each lake and pond considered was similar to the pH range of the Fireworks Site. The data for water bodies with a pH outside of the range of 5.5 to 7.5 were not retained in the database used for the mercury uptake and BSAF analyses.
- The water bodies retained from this data source were classified as “Reference” water bodies given the circumstances and programs under which these water bodies were sampled.

4. SIZE STANDARDIZATION OF LMB FILLET TISSUE MERCURY DATA

Because fish tissue mercury concentration in many fish species is known to be strongly correlated with the size of the fish (e.g., with the total fish length or weight of the fish), these factors must be explicitly controlled in any assessment of mercury uptake or the evaluation will be too confounded and it will be difficult or impossible to recognize the influence of any other variables (such as surficial sediment mercury concentrations, temporal trends in fish tissue mercury concentration over time, or smaller differences between the mercury uptake at different water bodies) (Sonesten, 2003). As the preliminary step-wise regressions and statistical correlation analyses identified LMB total length as the better predictor of LMB fillet tissue mercury concentration than LMB weight for the compiled and vetted database, a linear relationship between the LMB fillet tissue mercury concentration and the LMB total fish length was developed. This relationship was then used to "size standardize" the LMB monitoring results to allow for the further assessment of other factors potentially influencing LMB fillet tissue mercury concentrations.

The form of the relationship between LMB fillet tissue mercury concentration (mg/Kg) and the total length of the LMB fish sampled (in mm) is well known (see Johnson, 1987 for example), and is of the form:

$$\mathrm{Log}_{10}[\text{LMB Fillet Tissue Mercury Conc.}] = a + b(\mathrm{Log}_{10}[\text{LMB Total Length}]) \quad \text{(Equation 1)}$$

The parameters "a" and "b" are the calculated intercept and slope, respectively, of the linear regression relationship. Size data are typically $\log_{10}$ transformed because the growth of fish (irrespective of age, weight, or length) is generally curvilinear, and not linear. The standard size selected for this size standardization was 30.5 cm (approximately 12 inches) total length. This length represents the minimum length for "creelable" fish in Massachusetts (i.e., 12 inches is the minimum length of LMB for Massachusetts that can be legally taken and consumed).

Data on fish length from the various sources included in the database for the mercury uptake and BSAF analyses were in part inconsistent, unspecific, or lacking altogether, which introduced uncertainty into the resulting size standardization relationships associated with these water bodies. Some of the available LMB length information was in the form of metrics associated with the overall fish size distribution (e.g., quartiles or specified percentiles), some were a single measure of the central tendency of the full set of total lengths of the sampled LMB (i.e., mean total length), and some were associated with one or more individual fish of a known but unspecific size (e.g., "all were greater than 30.5 cm in total length"). In the last case, the LMB fillet tissue mercury concentrations were treated as if they were associated with a single size grouping defined as being $\geq$ 30.5 cm total length and which were conservatively all assumed to be of a total length of exactly 30.5 cm.

Size standardization relationships for LMB fillet tissue concentration were developed for each water body using the pooled data from all sampling years. Where there were data gaps associated with the total length of the LMB sampled, the assumptions described above were applied to ascribe an appropriate total length to the fish associated with the LMB fillet tissue mercury concentration. The intercept (i.e., “a” in the regression relationship above) and slope (i.e., “b” in the regression relationship above) were calculated for each “Reference” and “Non-Reference” water body. The size standardization relationships and the corresponding standard size LMB fillet tissue mercury concentration for each “Reference” water body are presented in Table 4-1. Similarly, the size standardization relationships and the corresponding standard size LMB fillet tissue mercury concentration for each “Non-Reference” water body are presented in Table 4-2.

For the 15 reference locations in the 2007 – 2012 MassDEP Data Request data sets and for 9 of the 10 water bodies downloaded from the MassDEP Fish Mercury Research Data Portal (see Table 4-1), there were sufficient pairs of LMB fillet tissue mercury concentration and total length data to identify the regression relationship described above. The single LMB sample result obtained from the MassDEP Fish Mercury Research Data Portal for the Upper Naukeag was for a 29.5 cm fish, which was too small to be creelable and was not included in the standard size database.

For the 12 sampling locations reported for the Nyanza Superfund Site (i.e., Charles River, Sudbury River Reach 1, Sudbury Reservoir in Table 4-1 and Sudbury River Reaches 2-10 in Table 4-2), no individual fish lengths were reported during the initial evaluation process. However, it was noted that only fish greater than 30.48 cm were included in the BERA. Therefore, the Nyanza Site data could not be explicitly size standardized using the noted regression process. Consequently, the reported LMB fillet tissue THg concentrations for each Nyanza reach or water body were assumed to be associated with a standard size LMB of total length 30.5 cm. In actuality, this LMB fillet tissue mercury concentration is almost certainly an over-estimate of the actual standard size LMB fillet tissue mercury concentration, as LMB tend to continue to bioaccumulate mercury as they grow longer than the minimum creelable size, albeit at a rate slower than that observed earlier in their life cycle. Multiple studies relating to LMB have identified both age and length as good predictors of LMB fillet tissue body burden levels of bioaccumulative contaminants such as mercury. Consequently, values of the BSAF developed using the Nyanza Site data that were not size standardized and were developed assuming the LMB sampling results were associated with fish of the minimum creelable size will overestimate actual uptake. Higher numerical BSAFs would be estimated using the non-standard size Nyanza Site data than would have been generated had the LMB fillet tissue THg concentrations been able to be size standardized. After the initial evaluation of the Nyanza data set, the supplemental individual fish length data for the LMB sampled from the Nyanza Site were acquired. The potential effect of using non-standard size data was evaluated in Attachment A.

For 7 of the 8 reaches associated with the Fireworks Site Phase IIC/IID sampling (see Tables 4-1 and 4-2), individual fish lengths were reported, but sets of three individual fish of the same species were composited for analysis. Therefore, the reported THg concentration represents an average for the three fish included in the composite sample. For five of the sampled reaches (FP, NDR, LUFP, LDR, and MLFP), the average length of the LMB taken was at least 30.5 cm. Only one LMB was sampled from the ECC, and that fish was 39 cm long. Therefore, for these six reaches, the LMB fillet tissue mercury concentrations were assumed to be associated with the standard size fish. As with the Nyanza Superfund Site data, this approximation is likely to result in an over-estimate of the actual standard size LMB fillet mercury concentration.

In summary, size standardization was performed to acknowledge and explicitly eliminate this factor from the subsequent evaluations of the LMB fillet tissue mercury concentration data so that other potential influencing or correlated factors could be identified and further investigated. Limitations associated with the available data required that the Fireworks Site data and Nyanza Superfund Site data be assumed to be associated with a standard size LMB for purposes of the mercury uptake and BSAF analyses. This approximation is likely to over-estimate the actual standard-sized LMB fillet tissue mercury concentrations and the corresponding BSAFs for these two sites. The LMB fillet tissue data from the MassDEP Fish Mercury Research Data Portal and the data provided in response to the September 2013 MassDEP Data Request were size standardized using the methodology presented above to produce equivalent LMB fillet tissue mercury concentrations for a fish 30.5 cm in length for each water body. Tables 4-1 and 4-2 present the resulting standard sized LMB fillet tissue mercury concentrations for the “Reference” and “Non-Reference” water bodies whose data were used in the mercury uptake and BSAF analyses, respectively. Figure 4-1 shows box and whisker diagrams for the distributions of the standard size LMB fillet tissue data for the “Reference” and “Non-Reference” water bodies and reaches. The median (i.e., the 50th percentile) for each dataset is indicated by the center of the box, and the first and third quartiles are the lower and upper edges of the box, respectively. This range between the 25th and 75th percentiles is known as the inter-quartile range (IQR). The extreme values (within 1.5 times the inter-quartile range from the upper or lower quartile) are the ends of the lines extending from the IQR. Points at a greater distance from the median than 1.5 times the IQR are plotted individually as dots. These points represent potential outliers.

5. ESTIMATION OF THE STATEWIDE BACKGROUND LMB FILLET TISSUE MERCURY CONCENTRATION

5.1. Definition of "Background"

The regulatory definition of background under the MCP (310 CMR 40.0006) is:

> "Background means those levels of oil and hazardous material that would exist in the absence of the disposal site of concern which are: (a) ubiquitous and consistently present in the environment at and in the vicinity of the disposal site of concern; and (b) attributable to geologic or ecologic conditions, atmospheric deposition of industrial process or engine emissions, fill materials containing wood or coal ash, releases to groundwater from a public water supply system, and/or petroleum residues that are incidental to the normal operation of motor vehicles."

It is clear from this definition that the term "background" is not applicable only to "pristine" conditions, and that historic human activities have resulted in the presence of some chemicals in the environment at "background" locations. The MCP definition was used in the development of the set of Massachusetts water bodies considered to reflect background conditions.

5.2. Preliminary Evaluation of the Data

A preliminary evaluation was conducted of time trends in the LMB fillet tissue mercury concentration at various "background" water bodies located across Massachusetts where no nearby point sources of mercury have been identified (see the blue bars on the left side of Figure 5-1). The plotted LMB fillet tissue mercury concentrations for the period 2007 to 2012 (including data from Long Pond and Newfield Pond) indicated a very slight upward linear trend with time, but the slope was determined to not be statistically significantly different from zero (MassDEP, 2013b). The preliminary evaluation indicated that the annual mean standard size LMB fillet tissue mercury concentrations in these Massachusetts water bodies for the years 2007-2012 ranged from 0.48 to 0.66 mg THg/Kg wet weight during this six-year period. The overall range of standard size measurements was between 0.021 and 1.53 mg THg/Kg wet weight, but concentrations as high as 2.34 mg THg/Kg wet weight were reported in 2009.

Considerable year-to-year variability is evident in the background LMB fillet tissue mercury concentrations for this time period, even after the raw data was size standardized to correct for the length/age of the fish and a suitable set of "background" water bodies was identified. Different groups of background water bodies were sampled in each year (with a particular water body being re-sampled on a roughly 3-year rotation). This sampling rotation appears to be one source of year-to-year variability seen in Figure 5-1.

Because this evaluation was performed using the "common-slope" method of size standardization, a further evaluation of the statewide background database was performed to:

- Incorporate the additional background water body LMB fillet tissue mercury concentration data obtained from MassDEP;
- Size standardize all of the background LMB fillet tissue mercury concentration data for each water body using the identified protocol with water body-specific LMB fillet tissue vs. LMB total length relationships;
- Determine if there is a decreasing or increasing time trend in the standard size statewide background LMB fillet tissue mercury concentration for the period 2007 to 2012;
- Estimate the statewide background LMB fillet tissue mercury concentration consistent with the MCP concept of "background" that should be used as the basis of specifying an average surficial sediment THg PRG; and
- Estimate the statewide background LMB fillet tissue mercury concentration consistent with the MCP concept of "background" that could later be used for sample-to-sample compliance testing.

The vetted, standard size LMB fillet tissue mercury concentration data for the statewide background water bodies were used for these analyses.

5.3. Time Trend Analysis of the LMB Fillet Tissue Mercury Monitoring Results for the Statewide "Background" Lakes

The preliminary evaluations performed on the statewide background LMB fillet tissue data showed that the background concentration of mercury in LMB fillet tissue has not changed significantly over the last six years. As the average life span of LMB is in the range of 10 to 16 years, the six-year period of the sampling results that were evaluated is approximately one half the life span of a typical individual LMB. This initial evaluation provided information using a "pooled" size standardization based on all of the fish from all of the water bodies for all of the specified monitoring years. However, further evaluation of the possible changes in LMB fillet tissue mercury concentration over this same time period for individual water bodies was deemed to be warranted. A water body-specific evaluation involved developing a water body specific size standardization relationship and allowed other potentially influential factors associated with the water bodies to be identified that might not have been discernable in the evaluation of the "pooled" data.

The vetted, standard size LMB fillet tissue mercury concentration statewide background database included data for 26 MassDEP-identified water bodies. Of these, 13 water bodies had at least three years of sampling data and more than two data points per sampling year (i.e., the very minimum requirements for developing a linear regression relationship and performing the water body-specific size standardization). It should be noted that the sampling programs that generated the vast majority of the data contained in this MassDEP background database resulted in each of the 26 water bodies being sampled on a rotational basis approximately once every three years. There were a few exceptions where a particular lake was sampled more frequently for a short interval of time to support the examination of a particular issue, and where sampling at other water bodies became less frequent because there were no observed changes for a number of sampling events or budgets for routine monitoring were limited. For each of the background water bodies with at least three years of sampling data and more than two individual sampling results for each year, $\log_{10}$ – $\log_{10}$ size standardization regression relationships were developed for each water body. These relationships were then used to estimate the standard size (i.e., 30.5 cm) LMB fillet tissue mercury concentration for each water body for each year with sampling results. These relationships are presented in Table 5-1. The resulting standard size LMB fillet tissue mercury concentrations by water body and sampling year are presented in Table 5-1 for the water bodies considered in the statewide background analysis. The water body-specific standard size LMB fillet tissue concentrations calculated using the data for all sampling years are presented in Table 5-2.

Graphical analyses and statistical tests for trend also were performed using the background data to see if mercury concentrations in LMB fillet tissues across Massachusetts have been increasing or decreasing over time. Figure 5-2 plots the data presented in the right-most column of Table 5-1. As can be seen, no consistent trend in LMB fillet tissue mercury concentrations over this period of time is apparent for these water bodies. Therefore, based on these data, the overall trend for the statewide background LMB fillet tissue mercury concentration was non-trending with respect to either an increase or decrease over time.

Statistical testing also was performed on the LMB fillet tissue mercury concentration data for the 13 individual water bodies that had at least three years of sampling data to further consider the slight upward or downward variability displayed in Figure 5-2. Two different statistical tests were performed for this purpose: (1) the Mann-Kendall Test for trend; and (2) the Theil-Sen Test for trend. The results of this testing are presented in Table 5-3, and are summarized as follows:

- None of the water bodies showed a statistically significant trend (either increasing or decreasing) based on the Mann-Kendall Test in consideration of the available background monitoring data.
- Using the Theil-Sen Test, three of the 13 water bodies showed a slight but statistically significant decreasing trend over time (i.e., Bare Hill Pond, Kenzoa, and Massapoag Dunstable); one water body showed a slight but statistically significant increasing trend over this period (i.e., Onota); and the other nine water bodies showed insufficient evidence of a trend in either direction in consideration of the available background monitoring data.

Based upon the preliminary evaluations performed by MassDEP and this supplemental analysis of the additional available background monitoring data, it is concluded that there has not been any statistically significant change in the Massachusetts statewide background LMB fillet tissue mercury concentration since at least 2007.

5.4. Analysis of the LMB Fillet Tissue Mercury Monitoring Results for the Statewide "Background" Lakes by Region

To determine whether the Site (which is located in the southeastern part of the State) would be expected to have a background LMB fillet tissue mercury concentration distribution different from the rest of the State, the available LMB fish tissue monitoring data from the "Reference" dataset were disaggregated and evaluated by region. These background water bodies were grouped by Western, Central and Southeastern regions of the State consistent with the established MassDEP ecological sub-regions. For this evaluation (as with the time-trend analysis in Section 5.3), the LMB fillet tissue mercury concentrations were used to develop water body-specific relationships to calculate a standard size average LMB fillet tissue mercury concentration for each background water body. A total of 26 "Reference" or background water bodies were grouped by their ecological regions within the State:

- Western Region (6 water bodies);
- Central Region (10 water bodies); and
- Southeastern Region (10 water bodies).

Note that the Northeastern Region water bodies were excluded from this analysis because local mercury sources are known to have impacted these water bodies such that they are not representative of "background" conditions as defined in the MCP.

The pink section of Figure 5-1 presents the following summary statistics for the Western, Central and Southeastern Regions of the State. The overall range of individual non-standard size (i.e., raw) LMB fillet tissue mercury concentrations from each region is represented by the large white bar for that region. The concentrations associated with the highest and lowest measured concentrations in this range are indicated. There is greater variability in the overall range of the non-standard size LMB fillet tissue mercury concentrations as one goes from the Western to the Central to the Southeastern Regions. This apparent difference may be explained, in part, by there being more background water bodies reflected in the Southeastern and Central Regions than in the Western Region (with their associated greater diversity and variability). The range of non-standard size annual average LMB fillet tissue mercury concentrations for the background water bodies in each Region is represented by the shorter pink bar on the left within the large white bar. The concentrations associated with the highest and lowest calculated water body-specific average concentrations for each Region are indicated. The range of calculated water body-specific standard size average LMB fillet tissue mercury concentrations for the water bodies in each region is represented by the shorter maroon bar on the right within the large white bar. The concentrations associated with the highest and lowest calculated water body-specific average concentrations for each Region are indicated.

Continuing to the right across Figure 5-1, the four available site-specific "Reference" location LMB fillet tissue mercury measurements for Forge Pond and the Northern Drinkwater River are shown on the vertical scale with enumerated black circles. These point measurements are presented next to the distribution of LMB fillet tissue mercury concentrations for the water bodies in the Southeastern Region (i.e., the Region where the Site is located) to facilitate comparison. As seen in the text box note, all four of these sampling results were associated with creelable sized fish (i.e., for LMB > 30.5 cm in length) and all the results are within the overall range of non-standard size concentrations measured in the Southeastern Region (i.e., the large white bar). In addition, two of the measurements are within the range of the non-standard size water body-specific calculated annual average concentrations and the range of water body-specific standard size average concentrations (i.e., the pink and maroon bars, respectively). As such, the site-specific "Reference" location LMB fillet tissue mercury data is not inconsistent with the data for the Southeastern Region.

The final set of white, pink, and maroon distribution bars shows:

- the overall range of individual non-standard size background water body LMB fillet tissue mercury sampling results for all Regions of the State;
- the range of the non-standard size water body-specific calculated annual average concentrations for all Regions of the State; and
- the range of calculated standard size water body average concentrations for the 26 state-wide background water bodies.

The central tendencies and spreads of the raw and standard size background LMB fillet tissue mercury concentration distributions for the Southeastern Region and the State overall are seen to be essentially the same.

5.5. Anticipated Reduction in Mercury Levels in LMB Fillet Tissue Over the Remediation Time Horizon for the Statewide "Background" Lakes

The MCP requires a demonstration that site conditions are consistent with background at the time the Permanent Solution Statement (PSS) is filed. However, there are a number of State and Federal initiatives designed to further reduce mercury levels in the environment and in fish in Massachusetts. Some beneficial effect of these initiatives is expected to be observed in the background LMB fillet tissue mercury concentration by the time the PSS is filed for the Site. It is estimated that the PSS for the Site will be filed approximately five years from now, to account for the time needed to revise the Phase III Report, develop the remedial design and associated plans, and perform the sediment removal.

Based on the results of the Theil-Sen Test for trend (see Section 5.3), there were three water bodies with a statistically significant reduction over the 5-year period from 2007 to 2012. For these three water bodies, the average identified reductions in the LMB fillet tissue mercury concentrations were roughly 20% over this period (see Table 5-3). There were no statistically significant reductions for this period for the other background water bodies with suitable time series data. Therefore, a further reduction of 5% in the overall state-wide background LMB fillet tissue mercury concentration over the next five years may be expected given the current information. The overall white bar and the internal green bar in the green section of Figure 5-1 reflect the anticipated 5% reduction over this 5-year period due to these ongoing initiatives. The concentrations associated with the overall highest and lowest non-standard size state-wide background LMB fillet tissue measurements and the range of calculated standard size water body-specific average concentrations reflecting this expected reduction are indicated on Figure 5-1. This anticipated standard size LMB fillet tissue concentration distribution represents the target standard size state-wide background LMB fillet tissue mercury concentration distribution to be achieved by the sediment removal action.

5.6. Establishing a Target Statewide Background LMB Fillet Tissue Mercury Concentration Distribution for Use in Developing a Surficial Sediment Mercury PRG

For a sediment mercury PRG to be a technically viable option for the Site, it must be demonstrated with sufficient confidence that the target background LMB fillet tissue mercury concentration will be attained if this sediment PRG is achieved within a reach. One approach for assessing the attainability of the PRG is to perform a side-by-side comparison of the full distribution of projected post-remediation standard size LMB fillet tissue mercury concentrations for a particular sediment PRG scenario to the target standard size background LMB fillet tissue mercury concentration at the anticipated PSS filing time. As specified in the MCP Risk Characterization guidance, the two distributions will be consistent with one another if they are similar and overlap relative to their central tendencies and the spread or range of their extreme values. Projected distributions of post-remediation standard size LMB fillet tissue mercury concentrations are presented in Figure 5-1 and discussed above in Section 5.5 followed by a discussion detailing the estimation of mercury uptake from surficial sediment to fish tissue. By estimating mercury uptake using BSAFs (as described below), distributions of fish tissue mercury levels based on specific sediment mercury concentrations can be extrapolated and compared to the distribution of target standard size background LMB fillet tissue mercury concentrations at the anticipated PSS filing time (i.e., the green distribution in Figure 5-1).

6. ESTIMATING MERCURY UPTAKE FROM SURFICIAL SEDIMENT TO FISH TISSUE

6.1. Introduction

The MCP defines a “permanent solution” as a remedial response that results in a condition of NSR or one that results in conditions in the environmental media at a site that are “consistent with background”. The behavior and effect of mercury in the environment, especially in fish tissue, are complex because past and ongoing atmospheric deposition of mercury and ongoing complex watershed biological and methylation conversion processes have impacted and continue to impact the amount and form of mercury in many freshwater ecosystems even though there are no nearby industrial point sources or releases associated with these sites.

A practical and effective remedial response for the Site will very likely involve the selective removal of surficial sediment from the ponds and streams with elevated mercury concentrations. One objective of this removal will be to reduce the risk associated with potential direct contact exposure to the sediments by people and ecological species. Another equally important objective will be to reduce the amount of mercury in the surficial sediments so that the biological uptake of mercury into species in the aquatic food chain will be reduced and the levels of mercury in the higher trophic levels of the food chain (such as in LMB) also will be reduced and eventually become “consistent with background” as defined under the MCP. The process for establishing the statewide background standard size LMB fillet tissue mercury concentration was described in Section 5.6.

Achieving this second remedial objective requires that a sufficiently robust linkage be made between the background concentration of mercury in standard size LMB fillet tissue and the concentration of mercury in the surficial sediment of the water body or reach in which the LMB lives. This linkage must be quantitative to allow a specified LMB fillet tissue mercury concentration to be used to establish a quantitative surficial sediment mercury PRG. In addition, the amount of variability and predictive uncertainty associated with the quantitative linkage also must be assessed so that the level of confidence can be gauged that reducing the mercury concentration in the surficial sediment to a particular PRG concentration will ultimately result in the standard size LMB fillet tissue mercury concentration being reduced to the concentration that has been determined to be “consistent with background”.

The uptake of mercury from sediment to fish tissue involves a complex series of steps and is subject to many influences. Three of the factors influencing LMB fillet tissue concentrations the most were already discussed in the context of developing the estimate of the statewide background LMB fillet tissue mercury concentration (i.e., the total length of the LMB, the concentration of THg in the surficial sediment, and the pH of the water body in which the LMB lives). These same factors also influence the uptake of mercury from the surficial sediment into and through the components of the aquatic food chain. Explicit modeling of these uptake and bioaccumulation/bioconcentration processes requires a great deal of site-specific information which does not currently exist for the Site, and would require model calibration and verification over a number of seasons/years. This option was not practical or feasible for this Site relative to establishing a PRG. Detailed modeling of this type also is not guaranteed to produce results and predictions that are universally "better" than those achieved through other approaches.

As an alternative, the compiled and vetted data described above were critically evaluated along with much of the characterization data collected at the Site during the Phase I, Phases IIA-IID, and Supplemental Phase III investigations to develop estimates of the apparent linkage between mercury in the surficial sediment and mercury in the local LMB fillet tissue. Given the limitations associated with the available data, developing these estimates using one approach or another required assumptions to be made. Depending on the approach used and the specific data gap that had to be filled with an assumption to allow that approach to be used, the implication of the data gap or uncertainty of the predicted linkage was either minor or more significant. As different approaches to estimating this linkage required different data with different associated limitations, it was decided to estimate the quantitative linkage between mercury in the surficial sediment and LMB fillet tissue using a number of different technically defensible approaches so that a particular data gap or high degree of variability in a particular input parameter would not unduly influence the level of confidence that could be placed on the overall predictive results.

The linkage between mercury in the surficial sediment and mercury in LMB fillet tissue was quantitatively estimated in four different ways. It was believed that if the different approaches produced comparable quantitative estimates of the linkage between surficial sediment and fish tissue mercury concentrations (and the corresponding calculated surficial sediment mercury concentration needed to achieve the target statewide background standard size LMB fillet mercury concentration), a greater level of confidence could be justifiably placed in the PRG-setting process and results. Alternatively, if the different approaches produced widely different results, the level of confidence that could be associated with the PRG-setting process would have to be lower. The remainder of this section presents the different approaches used to estimate the linkage between the surficial sediment and LMB fillet tissue mercury concentrations and identifying a surficial sediment THg PRG to cause site LMB fillet tissue mercury concentrations to become consistent with the statewide background standard size LMB fillet tissue mercury concentration.

In applying these different estimation approaches, multiple lines of evidence were considered in answering some common questions:

1. What range of surficial sediment THg concentrations have been observed to be associated with water bodies in Massachusetts where the standard size LMB fillet tissue mercury concentration has been measured to be consistent with the identified statewide background concentration distribution?
2. What is the indicated empirical relationship between the standard size LMB fillet tissue mercury concentration and the surficial sediment THg concentration and (given the inherent uncertainties) how confident can one be that achieving a specific average surficial

sediment THg concentration in a water body or reach will produce a specific LMB fillet tissue mercury concentration?

3. Given the indicated empirical relationship associated with #2 above, do the point estimates of the mercury uptake calculated using the site-specific characterization data make sense?
4. Do approaches that estimate the linkage between mercury in the surficial sediment and mercury in LMB fillet tissue on an empirical basis match the estimates from more mechanistic approaches?

6.2. Different Measures of Mercury Uptake from Surficial Sediment to LMB Fillet Tissue

This section presents the different approaches used to estimate the linkage between the surficial sediment and LMB fillet tissue mercury concentrations.

6.2.1. Simplest Empirical Measure of Mercury Uptake (BSAF1)

Biota sediment accumulation factors have long been used to characterize the linkage between a contaminant like mercury in surface sediment and that same contaminant in the tissues of aquatic organisms living in contact with that sediment. For this analysis of LMB, the BSAF is most simply calculated as the ratio of the mercury concentration in the LMB fillet tissue to the THg concentration in the surficial sediment (indicated as BSAF1):

BSAF1 (unitless) $= C_{LMB}/C_{Sediment}$ (Equation 2)

Where:

C_{LMB} = Mercury concentration in the LMB fillet tissue (mg Mercury/Kg fish fillet tissue wwt.)

$C_{Sediment}$ = Mercury concentration in the surficial sediment (mg THg/Kg sediment dwt.)

As essentially all mercury in fish tissue is in the form of MeHg (this is generally true and also has been verified by the fish tissue analyses for the sampling at the Fireworks Site), the BSAF1 for this analysis was constructed using the THg concentrations for both the LMB fillet tissue and the surficial sediment. There was very limited available data on the concentration of MeHg in the surficial sediment other than what was collected during the Phase II investigation at the Site. The BSAF1 factor empirically captures the net effect of the many chemical, thermodynamic, and biological processes that take place between the surficial sediment and the upper trophic level LMB. BSAF1s should be calculated with pairs of surficial sediment and LMB fillet tissue THg sampling results that were co-located (i.e., taken from the same water body/reach) and collected at the same time. BSAF1s of this type were calculated using paired individual LMB fillet tissue and point estimate surficial sediment mercury concentrations or using paired central tendency measures (i.e., mean concentrations) of associated LMB fillet tissue and surficial sediment mercury concentrations. This analysis developed a number of BSAF1s for "Reference" water bodies/reaches from across Massachusetts and for "Non-Reference" water bodies/reaches associated with the Fireworks Site and the Nyanza Site.

In the calculation of the BSAF1s for a particular location or setting, no correction factor was applied for normalization of skin on vs. skin off fillet data. This was because the necessary descriptions of the sample preparation and processing procedures were typically not available from the sources used to develop the database used for the mercury uptake analyses. Differences between skin on and skin off fillet tissue mercury concentrations for LMB are expected to be small (i.e., in the range of 0% - 10% difference). Other factors such as seasonal and temporal influences also are indicated to have a minor effect on the LMB fillet tissue mercury concentration (Dellinger, et al., 1995). Because mercury primarily accumulates via binding with sulfhydryl groups of protein rich tissues such as skeletal and smooth muscle tissue (Beyer, et al., 1996) and almost no lipids content data were available for these samples, lipid normalization also was not performed on the LMB fillet tissue data. Numerous studies have documented significant relationships between Total Organic Carbon (TOC)-normalized sediment mercury levels and fish tissue mercury levels, although the geochemical processes underlying these relationships have not been clearly defined nor quantified (Furl, 2007; USEPA, 1997; Taylor, et al., 2012). For this reason, and in recognition of the fact that very little TOC data was available for the surficial sediments reflected in the vetted database, no organic carbon normalization was performed.

6.2.2. More Mechanistic Measure of Mercury Uptake (BSAF2)

As was noted, the mercury transport and uptake captured by the empirical BSAF1 factor actually includes a number of sequential steps from surficial sediment into the surface water and surface water into the biota of the food chain at multiple levels until the mercury makes it into the LMB at the fourth trophic level (i.e., fish-eating or piscivorous fish). A slightly more mechanistic approach to characterizing this overall uptake is to consider the overall process as occurring in two major steps:

1. the transfer of mercury from the surficial sediment into the surface water; and
2. the transfer of mercury from the surface water directly into the LMB tissues and into the food that the LMB eats.

The first step would be characterized by a sediment-to-surface water Transfer Factor ($TXR_{sed\text{-}sw}$), and would be calculated using paired values of the concentration of THg in the surficial sediment and the concentration of MeHg in the surface water at that location. The second step would be characterized by a surface water-to-LMB fillet tissue transfer factor that incorporates both direct absorption of mercury by the LMB in the surface water and the intake and bioaccumulation of mercury in the prey items of the LMB diet. This transfer factor is often referred to as the Bioaccumulation Factor ($BAF_{sw\text{-}LMB}$) and is calculated using paired values of the concentration of MeHg in the surface water and the concentration of THg in the LMB fillet tissue (which, as was noted, essentially equals the concentration of MeHg in the LMB fillet tissue) associated with that location.

$$\text{BSAF2 (unitless)} = \text{BAF}_{\text{sw-LMB}}/\text{TXR}_{\text{sed-sw}} \quad \text{(Equation 3)}$$

Where:

$\text{BAF}_{\text{sw-LMB}}$ = Mercury bioaccumulation factor between surface water and LMB fillet tissue (mg THg/Kg fish fillet tissue wwt. / mg MeHg/L_{sw})

$\text{TXR}_{\text{sed-sw}}$ = Mercury transfer factor between surficial sediment and surface water (mg MeHg/L_{sw} / mg THg/Kg sediment dwt.)

While producing a BSAF2 that ultimately relates the surficial sediment mercury concentration to the LMB fillet tissue mercury concentration, the construction of a BSAF2 using these two intermediate factors draws on the data for samples from different environmental media than are used to calculate the BSAF1 parameter (i.e., including the surface water), samples from slightly different locations within the water body/reaches, and sampling results for MeHg (not just THg). As such, the BSAF2 formulation provides a different (and somewhat independent) estimate of mercury uptake from the BSAF1 formulation. For the analyses described below, BSAF1 values were developed for a number of "Reference" and "Non-Reference" water bodies/reaches (including the Fireworks Site) and BSAF2 values were developed using only the Fireworks Site-specific characterization data.

6.3. Developing Estimates of Mercury Uptake and Corresponding Surficial Sediment PRGs for Achieving the Statewide Background LMB Fillet Tissue Mercury Concentration

The following sections present the results of a series of analyses performed to project the relationship between mercury in surficial sediments and LMB fish fillet tissue and to estimate the average surficial sediment THg PRG that would be needed to reduce the LMB fillet mercury concentration to be "consistent with background". As each analysis below uses a somewhat different approach and specific input data, each represents a separate line of evidence relative to establishing the surficial sediment THg PRG.

6.3.1. Line of Evidence 1: Applicable Data Selection

Perhaps the simplest and most direct approach for identifying a surficial sediment THg concentration that corresponds to a target LMB fillet tissue mercury concentration is to identify the surficial sediment THg concentrations associated with the Massachusetts water bodies that have been recently monitored and found to have LMB fillet tissue mercury concentrations consistent with the statewide background LMB fillet tissue mercury concentration distribution. Table 6-1 presents the data for the water bodies with observed average LMB fillet tissue mercury concentrations within the central range of the distribution of the background LMB fillet tissue concentration distribution shown in Figure 5-1.

This simple evaluation suggests that surficial sediment THg concentrations as high as 15 mg/kg do not necessarily result in LMB fillet tissue mercury concentrations that are inconsistent with background in some environments. The lowest eight surficial sediment concentrations listed in Table 6-1 are lower than the measured Fireworks Site background sediment concentration (i.e., 0.62 mg/Kg). It should also be noted that the 2003 Phase IID sampling results for Luddam's Ford indicated a standard size LMB fillet tissue mercury concentration of 0.57 mg/Kg (i.e., a concentration below the identified statewide background concentration) in association with a relatively high point estimate of the surficial sediment concentration of 33 mg THg/Kg.

6.3.2. Line of Evidence 2: Regression of LMB Fillet Tissue Mercury Concentration on Surficial Sediment Total Mercury Concentration

USEPA guidance (USEPA, 2009) indicates that there are two methods for determining the BSAF from paired observations of fish tissue and sediment concentrations:

1. a regression approach, whereby the BSAF is estimated by determining the slope and intercept of the fish tissue concentration versus sediment concentration linear relationship; and
2. an averaging approach, whereby the BSAF is estimated by averaging the BSAFs from the paired fish tissue concentration-sediment concentration observations.

Both approaches use the same basic data. Line of Evidence 2 is developed using the first of these two USEPA-recommended methods.

A linear regression analysis was performed on the $\log_{10}$ transformed standard size LMB fillet tissue mercury concentration and the $\log_{10}$ transformed surficial sediment THg concentration. The form of this regression relationship was given by:

Log_{10} (LMB Fillet Tissue Mercury Conc.) = A + [B *Log_{10} (Surficial Sediment THg Conc.)] (Equation 4)

Where:

Log_{10} (LMB Fillet Tissue Mercury Conc.)

= Logarithm (Base 10) of the wet weight mercury concentration in the LMB fillet tissue for a standard size LMB (i.e., 30.5 cm) (mg THg/Kg fish fillet tissue wwt.);

A = Intercept of the best fit linear regression relationship (unitless);

B = Slope of the best fit linear regression relationship (unitless); and

Log_{10} (Surficial Sediment THg Conc.)

= Logarithm (Base 10) of the dry weight THg concentration in the surficial sediment (mg THg/Kg sediment dwt.)

This specific form of the regression was selected based on a preliminary graphical and statistical evaluation of the associated parameter distributions. The compiled data for all 45 “Reference” and “Non-Reference” water bodies/reaches were originally used in this regression. The data point representing the ECC was indicated to have a large influence based on the original regression results (due to it exhibiting among the highest THg sediment concentrations). Consequently, the regression was re-run without this particular data point. However, it was seen that the estimates of the slope and intercept that were obtained in the analysis that excluded the ECC data point were nearly identical to those from the original regression analysis (i.e., slopes of 0.259 vs. 0.263 and intercepts of -0.254 vs. -0.253 (without the ECC vs. with the ECC data point, respectively)). This very small difference in slope and intercept suggests the original model is fairly robust. Table 6-2 shows the regression output from the original analysis with all 45 of the data points included. Both the slope (i.e., 0.263) and intercept (i.e., -0.253) terms in the regression model were statistically significant ($p < 0.001$). Residual plots, shown in Figure 6-1, were examined to further evaluate the regression model. The residuals appear to be normally distributed and random (i.e., they indicate that the model would not consistently under or over-predict the LMB fillet tissue mercury concentration over the full range of surficial sediment THg concentration).

This regression relationship and the estimates of the standard error associated with the regression parameters were used to develop a probabilistic model for the BSAF (in the form of BSAF1 above). Table 6-3 presents this simple algebraic model for calculating the BSAF using the regression relationship. The model uses the Monte Carlo simulation tool CrystalBall to incorporate the estimated variability for the LMB fillet tissue mercury concentrations for a range of surficial sediment mercury concentrations (i.e., from 0.10 to 42 mg/Kg Sediment) into calculated BSAFs. The uncertainty associated with the regression results was modeled as normally distributed for a given surficial sediment concentration, with a surficial sediment concentration mean and standard deviation taken from the Table 6-4 outputs. The probabilistic estimate of the LMB fillet tissue mercury concentration was then divided by the scenario-defining surficial sediment average THg concentration to form a BSAF distribution. This BSAF was then multiplied by the scenario-defining surficial sediment THg concentration to calculate a distribution of LMB fillet tissue mercury concentration linked to that specific surficial sediment THg concentration (see Table 6-3). Attachment B presents the Crystal Ball Report for this modeling. Table 6-5 provides a summary of the results relative to the objective of calculating an appropriately conservative surficial sediment THg PRG for achieving the statewide background standard size LMB fillet tissue mercury concentration. The last pages of the Crystal Ball Report in Attachment B show the green probability density function (PDF) input distributions for each of the 23 scenario-defining surficial sediment THg concentrations shown in the first column of Table 6-3. The output PDFs for the projected average LMB fillet tissue mercury concentration are presented in the initial pages of the

Report, one for each of the 23 scenario-defining surficial sediment concentrations. Typically, the graphical plots of these PDFs have a blue portion (on the left side of the plot) and a pink portion (on the right side of the plot). The dividing line is at the average statewide background LMB fillet tissue concentration of 0.85 mg/Kg fish fillet tissue wwt (used here as a benchmark for illustration purposes). The percentage of the probability that was projected to be less than this value is shown in the callout box. The series of these resulting values for each of the 23 scenario-defining surficial sediment concentrations was tabulated in Table 6-5. The results show that removal of sediment in a water body or reach to achieve an average surficial sediment THg concentration of 4.8 mg/Kg would have approximately a 50% chance of reducing the LMB fillet tissue mercury concentration to below the benchmark LMB fillet tissue concentration. Removal of sediment to achieve an average surficial sediment THg concentration of about 3.3 mg/Kg is indicated to be needed to achieve a 90% probability of achieving the benchmark background LMB fish fillet tissue mercury concentration.

6.3.3. Line of Evidence 3: Analysis of BSAF1 Estimates Developed from Paired LMB Fillet Tissue and Surficial Sediment Measurements

Line of Evidence 3 was developed using the second of the two USEPA-recommended methods identified in Section 6.3.2. In general, the recommended approach relies upon water body-specific paired fish tissue and surficial-sediment mercury concentration measurements. Because the anticipated post-remediation conditions at the Site may be different than the current conditions with respect to mercury uptake, the combined “Reference” and “Non-Reference” data were used for this analysis. BSAF1s were calculated as the ratio of the mean LMB fillet tissue mercury concentration to the mean or single sample surficial sediment THg concentration. The standard size LMB fillet tissue mercury concentrations were used to develop these BSAF1s for the various “Reference” and “Non-Reference” water bodies. Table 6-6 displays the calculation of these BSAF1 estimates, and Table 6-7 presents the resulting BSAF1 estimates grouped by the water body/reach classification. Summary statistics for the distributions of the “Reference” and “Non-Reference” water bodies are presented separately in Table 6-7.

Figure 6-2 presents these BSAF1 estimates ordered from the smallest (on the left) to the largest (on the right). The BSAF1 estimates calculated for the “Reference” water bodies are displayed in blue. The BSAF1 estimates calculated for the “Non-Reference” water bodies (i.e., primarily the Fireworks Site and the Nyanza Site) are displayed in pink. It is evident from the distribution of point estimates plotted in Figure 6-2 that the BSAF1s for the “Non-Reference” areas (i.e., those impacted by known non-atmospheric sources of mercury) are generally much lower than those calculated for the “Reference” water bodies not known or suspected of having been impacted by nearby industrial sources or direct discharges of mercury. For example, the calculated BSAF1s for the five impacted reaches of the Fireworks Site range from 0.008 to 0.064, whereas the calculated BSAF1s for the 15 “reference” water bodies included in the MassDEP Data Request set of water bodies range from 0.31 to 5.17. As a general observation, as the surficial sediment THg concentration increases, the LMB fillet tissue mercury concentration also increases but not as dramatically. As such, the BSAF1 ratio of these two quantities gets smaller as the degree of mercury contamination in the surficial sediment increases (i.e., the denominator of the BSAF1 gets bigger faster than the numerator). Other factors also contribute to this general observation. “Reference” water bodies that are impacted primarily by the atmospheric deposition of mercury tend to convert that mercury into biologically available MeHg quickly. The transfer of mercury to fish and other biota in the watershed is then limited only by the amount of mercury deposited into the water body or associated watershed. At water bodies containing larger quantities of mercury from past releases or discharges (i.e., “legacy” mercury sites) there is always sufficient mercury available for conversion to MeHg. The actual conversion is then limited by the rate of the local chemical and biological conversion reactions, and the process is “rate limited”. That is one of the main reasons why the LMB fillet tissue mercury concentrations do not typically increase dramatically in areas with relatively higher surficial sediment THg concentrations.

Table 6-8 represents the “Non-Reference” portion of Table 6-7, but with an additional column that indicates how these point estimates of the BSAF1 parameter compare to the probabilistic BSAF distributions projected in the analysis for Line of Evidence 2. The surficial sediment THg concentration associated with each BSAF1 point estimate developed for Line of Evidence 3 was identified along with the probabilistic BSAF for that surficial sediment concentration developed as part of the analysis under Line of Evidence 2. A low percentage in the highlighted right-most column of Table 5-8 (e.g., 16.8% for the BSAF estimate for Luddam’s Ford developed from the 1995 sampling results) indicates that the calculated standard size BSAF1 was consistent with the lower end of the projected probabilistic BSAF distribution for a surficial sediment concentration of 33 mg THg/Kg sediment. A high percentage in the highlighted right-most column of Table 6-8 (e.g., 95.0% for the BSAF estimate for Middle/Lower Factory Pond developed from the Phase IID sampling results) indicates that the calculated standard size BSAF1 was consistent with the higher end of the projected probabilistic BSAF distribution for a surficial sediment concentration of 42.3 mg THg/Kg sediment. While a few of the point BSAF1 estimates did not fall within the ranges of the probabilistic BSAF distributions for their respective surficial sediment THg concentrations, the degree of overlap that is observed increases the level of confidence that the two approaches for estimating BSAFs lead to comparable results.

The summary statistics presented in Table 6-7 can be used to calculate some point estimates of the surficial sediment THg concentration associated with meeting any specific measure of the statewide background LMB fillet tissue mercury concentration. This is accomplished by dividing that identified LMB fillet tissue concentration by the particular BSAF estimate. The results are shown in Table 6-9.

Because the average surficial sediment mercury concentration in a number of reaches of the Fireworks Site will be lower following a removal-based remedial response, the effective Fireworks Site mercury BSAFs at that time (i.e., post-removal) will likely not be the same as they are now. That is why the other tabulated BSAFs and associated surficial sediment THg concentrations must also be considered when evaluating the future conditions that may exist within the water bodies and reaches of the Site.

6.3.4. Line of Evidence 4: Analysis of Fireworks Site-Specific BSAF Estimates

BSAF2 was defined in Equation 3 as the mercury bioaccumulation factor between surface water and LMB fillet tissue (i.e., the $BAF_{sw\text{-}LMB}$) divided by the mercury transfer factor between surficial sediment and the surface water (i.e., $TXR_{sed\text{-}sw}$). Table 6-10 presents the calculation of $TXR_{sed\text{-}sw}$ values for the various stream and pond sampling locations at the Fireworks Site using the Phase IIC and Phase IID sampling results. The minimum, average and maximum calculated $TXR_{sed\text{-}sw}$ values for the streams and ponds also are presented in Table 6-10. Table 6-11 presents the calculation of $BAF_{sw\text{-}LMB}$ values for the various stream and pond sampling locations at the Fireworks Site using the 1995 MassDEP Technical Memorandum data and the Phase IIC and Phase IID sampling results. Since LMB fillet tissue was only sampled during Phase IID, site-specific BAF estimates were calculated for many of the reaches by combining the same Phase IID fish tissue concentrations with both the Phase IIC and Phase IID surface water MeHg concentrations. This difference in the sample collection times introduced some uncertainty to the resulting $BAF_{sw\text{-}LMB}$ estimates. Other $BAF_{sw\text{-}LMB}$ values also are presented in Table 6-11 for purposes of comparison. These other estimates are:

- The mercury BAF assumed for LMB for the Nyanza Superfund Site (site-wide);
- Estimates of the mercury BAF published by USEPA for LMB or other trophic level 4 fish species (i.e., fish-eating fish) for both ponds and streams; and
- Distributions of the mercury BAF calculated by the Oregon Department of Environmental Quality (ODEQ) for the Willamette Basin using detailed food web modeling. [These estimates are provided to give an indication of the magnitude of the potential uncertainty and variability that may be associated with mechanistically modeled BAF values.]

The Nyanza, USEPA, and ODEQ BAF values presented in Table 6-11 are comparable in magnitude to the $BAF_{sw\text{-}LMB}$ values calculated using the Fireworks Site sampling data.

The calculated values for $TXR_{sed\text{-}sw}$ from Table 6-10 were plotted to determine what type of distribution they represent. A histogram plot indicated that these values did not appear to be normally distributed. Plotting a histogram of the $\log_{10}$ transformation of the data showed that the $TXR_{sed\text{-}sw}$ factor more closely follows a lognormal distribution. Given that only a small number of site-specific values for this factor could be developed, this determination was somewhat subjective. The statistical measures of the mean and standard deviation of the logarithm-transformed $TXR_{sed\text{-}sw}$ values were used to define a probabilistic representation for this factor in a second Crystal Ball model for calculating BSAF2 and the resulting LMB fillet tissue mercury concentration for various possible surficial sediment THg PRGs. All of the calculated site-specific $TXR_{sed\text{-}sw}$ values were used in the quantitative specification of the variability and uncertainty in this factor.

The calculated values for $BAF_{sw\text{-}LMB}$ from Table 6-11 also were plotted to determine what type of distribution they most likely fit. A histogram plot indicated that these values also did not appear to be normally distributed. Plotting a histogram of the log_{10} transformation of the data showed that the $BAF_{sw\text{-}LMB}$ factor also more closely follows a lognormal distribution. Given that only a small number of site-specific values for this factor could be developed, this determination also was somewhat subjective. The statistical measures of the mean and standard deviation of the logarithm-transformed $BAF_{sw\text{-}LMB}$ values were used to define a probabilistic representation for this factor in the Crystal Ball BSAF2 model. All of the calculated Site-specific $BAF_{sw\text{-}LMB}$ values except those where the surface water MeHg concentration was reported to be below detection limits (i.e., indicated in Table 6-11 with a "> ##,###" value) were used in the quantitative specification of the variability and uncertainty associated with this factor.

The BSAF2 parameter (which, again, was calculated as the ratio of the $BAF_{sw\text{-}LMB}$ / $TXR_{sed\text{-}sw}$ factors) was then multiplied by the surficial sediment average THg concentration for each scenario to calculate a probabilistic LMB fillet tissue mercury concentration associated with that specific surficial sediment THg concentration (see Table 6-12). Attachment C presents the Crystal Ball Report for this BSAF2 modeling. Table 6-13 provides a summary of the results relative to the objective of calculating an appropriately conservative sediment mercury PRG for achieving the statewide background standard size LMB fillet tissue mercury concentration. The last page of the Crystal Ball Report in Attachment C shows the green PDF input distributions for the $BAF_{sw\text{-}LMB}$ and $TXR_{sed\text{-}sw}$ factors that were used for each of the 16 surficial sediment concentration scenarios shown in the first column of Table 6-12. The output PDFs for the projected average LMB fillet tissue mercury concentration are presented in the initial pages at the front of the Report, one for each of the 16 evaluated surficial sediment concentrations. Again, the graphical plots of these PDFs typically have a blue portion (on the left side of the plot) and a pink portion (on the right side of the plot). The dividing line is again at the benchmark statewide background LMB fillet tissue concentration. The percentage of the projected probability that was less than this value is shown in the callout box. The resulting values for the series of 16 evaluated surficial sediment concentrations were tabulated in Table 6-13. The results show that removal of sediment in a water body or reach to achieve an average surficial sediment THg concentration of approximately 19.5 mg THg/Kg sediment would have about a 50% chance of reducing the LMB fillet tissue mercury concentration to below the benchmark fish fillet tissue concentration. Removal of sediment to achieve an average surficial sediment THg concentration of about 2.2 mg THg/Kg sediment would be needed to achieve a 90% probability of achieving the benchmark statewide background LMB fish fillet tissue mercury concentration.

6.3.5. Summary of the Four Lines of Evidence

The results of the analyses conducted to produce the four Lines of Evidence relative to identifying a surficial sediment THg PRG projected to establish a LMB fillet tissue mercury concentration at the Site that is consistent with the target statewide LMB fish tissue mercury concentration distribution are presented in Table 6-14.

6.4. Side-By-Side Comparison of Projected Standard Size LMB Fillet Tissue Mercury Concentration Distributions to the Target Statewide Background LMB Fillet Tissue Mercury Concentration Distribution

The standard size LMB fillet tissue mercury concentration distributions associated with three alternative sediment PRG scenarios are presented in the gray section of Figure 5-1. These scenarios reflect a PRG of 5.0 mg THg/Kg (on the far right), and sequentially lower PRGs of 4.5 and 4.0 mg THg/Kg (continuing to the left on Figure 5-1). A wider range of potential sediment PRGs also was evaluated (see Table 6-15). For each sediment PRG scenario evaluated, two different distributions of standard size LMB fillet tissue mercury concentrations are shown in Figure 5-1:

- A distribution based on probabilistic modeling using scenario-specific BSAFs identified from regression analyses performed on the combined “Reference” and “Non-Reference” water body database (the distribution on the right within each pair of distributions) and
- A distribution based on probabilistic modeling using scenario-specific BSAFs identified from regression analyses performed on only the “Reference” water body database (the distribution on the left within each pair of distributions).

The distribution on the right in each scenario pair uses the Line of Evidence 2 approach and the probabilistic BSAF input parameter distributions as stated above. The distribution on the left in each scenario pair uses the same approach but with a new probabilistic BSAF input parameter developed from only the “Reference” water body data.

Each distribution in the pairs is depicted using a modified “box and whisker” plot that identifies:

- the median (50th percentile value for the projected standard size LMB fish fillet tissue mercury concentration);
- the concentrations defining the central 50% of the projected LMB fish fillet tissue mercury concentration probability (between the projected 25th percentile and 75th percentile concentration values);
- the concentrations defining the central 95% of the projected LMB fillet tissue mercury concentration probability (between the projected 2.5th percentile and 97.5th percentile concentration values); and
- the highest and lowest projected standard size LMB fillet tissue mercury concentration for the scenario.

The probabilistic modeling results associated with each BSAF set and sediment PRG scenario are presented in Table 6-15. Table 6-15 contains the results for sediment PRG scenarios both higher and lower than those depicted on Figure 5-1.

- The projected distributions on the right within each pair made use of the BSAF data for the combined "Reference" and "Non-Reference" water body and project slightly higher central tendency LMB fish fillet tissue concentrations than the simulations performed using only the BSAF data for the "Reference" water bodies. However, the projected variability in the distributions on the left within each pair is much broader than for the corresponding distribution on the right. This is primarily because the sediment PRG scenarios being evaluated (i.e., 4.0 to 5.0 mg THg/Kg) are within the range of sediment concentrations explicitly represented in the combined "Reference" and "Non-Reference" water body data base. As such, they are within the central portion of the dataset and the associated regression relationship for this BSAF. The standard error of a regression relationship is lowest in the central range of the independent variable and increases at both higher and lower values of the independent variable. Alternatively, the sediment PRG scenarios shown in Figure 5-1 are associated with sediment THg concentrations that are generally above the range of sediment concentrations represented in the "Reference" only water body database. Accordingly, they are outside of the central portion of the regression relationship for this new BSAF. As such, the standard error associated with this relationship is substantially larger and leads to more extreme high and low projected LMB fillet tissue concentrations.

- An examination of either the left or the right distributions of the pair for each sediment PRG scenario indicates that, at these sediment PRGs, there is relatively little additional return associated with further sediment PRG reductions. This is even more apparent by looking at the progression of distribution values presented in Table 6-15. There is also relatively little change in the projected distributions of standard size LMB fillet tissue concentration in terms of central tendency values or the spread of the distributions as one goes from a sediment PRG scenario of 5.0 mg THg/Kg down to 4.5 and further to 4.0 mg THg/Kg. This is especially evident for the central 50% and 95% of the probability distribution of projected LMB fillet tissue THg concentration.

7. IDENTIFICATION OF A SURFICIAL SEDIMENT TOTAL MERCURY PRG

The four lines of evidence presented above indicated that a sediment PRG between 3.0 and 7.0 mg THg/Kg would be technically defensible and provide confidence that the target background LMB fish fillet tissue mercury concentration would be achieved. Performing a direct comparison of the projected post-remediation average LMB fillet tissue mercury concentration distribution to the background LMB fillet tissue mercury concentration distribution also exhibited significant overlap and consistency in this range. The fundamental requirements for the sediment mercury PRG of "consistency with background", being "appropriately conservative", and the projected effectiveness of further reductions to mercury concentrations in the sediment in reducing the LMB fish fillet tissue mercury concentration further are examined below.

7.1. Consistency with Background – Central Tendency and Spread

The values reflected in the green bar shown in Figure 5-1 and the post-remediation LMB fillet tissue concentrations both represent standard size water body average LMB fillet tissue mercury concentrations. As such, they are suitable for direct comparison to one another. All of the values contained in the light green bar define the central tendency of the target background distribution. The best graphical representation of the central tendency of the post-remediation projections is the 25th percentile to the 75th percentile from the box and whisker plot for that scenario. These are depicted by the light gray or dark gray bar ranges shown on Figure 5-1. If the gray bar range for a scenario falls within the extent of the light green bar of the target background distribution, the central tendencies of the two distributions can be considered to be consistent.

A check of consistency of spread is of greatest interest at the higher end of the LMB fillet tissue mercury concentration distributions. The most robust graphical representation of the spread of the post-remediation projections is the central 95% range from the box and whisker plot for the scenario. These ranges are depicted by the white bars outlined in a solid black line extending above and below the 25th percentile to 75th percentile gray bar ranges shown on Figure 5-1. If the central 95% range of projections for a scenario also falls within the overall extent of the light green bar of the target background distribution, the spreads of the two distributions can be considered to be consistent. However, if the central 95% range of projections for a scenario falls within the range of values reflected in the white bar shown for the target LMB fillet tissue distribution in the green section of Figure 5-1, this also would reflect that the spreads of the two distributions are consistent. However, comparison of projections to the white bar range of concentrations in the green section may be confounded somewhat by the fact that the extreme concentrations shown are background LMB fillet tissue mercury concentrations that have not been size standardized and, therefore, they may be biased high by a few large fish. Cases where the upper extremes of the two distributions are very similar would be considered to be marginally consistent because of this difference.

Table 6-16 presents the key findings relative to consistency of the projected LMB fish tissue concentration distribution with the target statewide background distribution. Sediment PRGs between 4.0 and 5.0 mg THg/Kg had post-remediation projections of LMB fillet tissue mercury concentrations that would be considered consistent with background in terms of both central tendency and spread for the probabilistic modeling using the BSAFs identified through the regression analysis of the combined "Reference" and "Non-Reference" water body database. Sediment PRGs in this range also had post-remediation projections of LMB fillet tissue mercury concentrations that would be considered consistent with background in terms of central tendency, but not spread, for the probabilistic modeling using the BSAFs identified through the regression analysis of only the "Reference" water body database. As was noted previously, in the range of sediment concentrations associated with these alternative sediment PRGs this BSAF approach has larger uncertainty in the regression model (because the PRGs are on the upper end of sediment THg concentrations in the "Reference" water body database), which leads to LMB fillet tissue mercury concentration projections that exceed the target distribution. However, these exceedances are a likely result of the limited data used in the BSAF regressions and not a physical possibility since these extreme LMB concentrations have not been observed in any monitoring since 2007.

7.2. Effectiveness of Sediment Mercury Concentration Reductions on Decreasing the Average LMB Fillet Tissue Mercury Concentrations

Considering the 50th percentile projection results presented in Table 6-15, Table 6-16 presents the key findings relative to the marginal benefits of further reductions in the sediment mercury concentration on LMB fillet tissue mercury concentrations. The probabilistic modeling using the BSAFs identified through the regression analysis of only the "Reference" water body database showed diminishing marginal reductions in fish tissue concentration for Sediment PRGs below approximately 6.0 mg THg/Kg (see the lower portion of Table 6-15). The probabilistic modeling using the BSAFs identified through the regression analysis of the combined "Reference" and "Non-Reference" water body database showed a reduction in effectiveness for Sediment PRGs between 3.0 and 5.0 mg THg/Kg.

7.3. Surficial Sediment Total Mercury PRG

Based on these comparisons, the projected post-remediation standard size average LMB fillet tissue concentrations for the sediment PRG scenario of 4.0 mg THg/Kg are very consistent with the target statewide background standard size LMB fillet tissue distribution that reflects a 5% reduction over the 5-year PSS time horizon relative to both central tendency and spread. A lower sediment PRG would have a relatively low incremental benefit in terms of further reducing the LMB fish fillet tissue mercury concentration. As such, a sediment PRG of 4.0 mg THg/Kg is technically defensible and suitably conservative. A site-specific surficial sediment THg PRG of 4.0 mg THg/Kg is, therefore, recommended for application at the Fireworks Site.

In the application of this sediment mercury PRG, the following additional assumptions will be made:

1. Because there has not been a statistically significant change in the Massachusetts statewide background LMB fillet tissue mercury concentration over at least the last six years, the Massachusetts statewide background LMB fillet tissue mercury concentration will be an unchanging or fixed value for purposes of the sediment remediation for this project in relation to the MCP.
2. This surficial sediment mercury PRG should be applied on a reach-specific basis at the Fireworks Site in the Lower Drinkwater River, the ECC, Lily Pond, and Factory Pond. This is justified based on the home range of LMB, the relative sizes of the Site's pond and stream reaches, that these were the reaches where the majority of the LMB were found at the Site during the Phase IID fishery survey, and that LMB cannot move freely between the reaches.

8. CITED REFERENCES AND REVIEWED SOURCES

Adams. 2011. “Bioaccumulation of Metal Substances by Aquatic Organisms: Part 1”, Organisation for Economic Co-operation and Development (OECD) Meeting, Paris, September 7-8.

Ahrenstorff, T.D., G.G. Sass and M.R. Helmus. 2009. The influence of littoral zone coarse woody habitat on home range size, spatial distribution and feeding ecology of largemouth bass (Micropterus salmoides). Hydrobiologia. 623:223-233.

Allison, J.D. and T.L. Allison. 2005. Partition Coefficients for Metals in Surface Water, Soil and Waste, USEPA, EPA/600/R-05/074, July.

Beyer, W.N., G.H. Heinz and A.W. Redmon-Norwood. 1996. Environmental Contaminants in Wildlife: Interpreting Tissue Concentrations. Lewis Publishers, New York, New York.

CEE. Bioconcentration factors (BCFs) for aquatic organisms. CEE-PUBH 5730-6730, Lecture 9.

Chalmers, A.T. et al. 2011. Mercury trends in fish from rivers and lakes in the United States, 1969-2005. Environmental Monitoring Assessment (2011) 175: 175-191.

Dellinger J, Kmiecik N, Gerstenberger S, Ngu H. 1995. Mercury contamination of fish in the Ojibway diet. 1. Walleye fillets and skin-on versus skin-off sampling. Water Air Soil Pollut 80: 69–76.

Foster Wheeler Environmental Corporation. 2002. Phase IIC Site Investigation Data Report for the Fireworks I (Former Fireworks Facility), Hanover, MA, Tier 1 Permit #100223, October 2002.

Foster Wheeler Environmental Corporation. 2003. Stage II Environmental Risk Characterization for the Fireworks I (Former Fireworks Facility), Hanover, MA, Tier 1 Permit #100223, November 2003.

Foster Wheeler Environmental Corporation. 2004. Phase IID Site Investigation Data Report for the Fireworks I (Former Fireworks Facility), Hanover, MA, Tier 1 Permit #100223, March 2004.

Foster Wheeler Environmental Corporation. 2005. Comprehensive Site Assessment for the Fireworks I (Former Fireworks Facility), Hanover, MA, Tier 1 Permit #100223, November 2005.

Furl, C., 2007. Measuring Mercury Trends in Freshwater Fish in Washington State: 2006 Sampling Results. Washington State Department of Ecology, Olympia, WA. Publication No. 07-03-043. www.ecy.wa.gov/biblio/0703043.html

Harris, J.M. 2013. Habitat Selection, Movement, and Home Range of Largemouth Bass (Micropterus salmoides) following a habitat enhancement project in Table Rock Lake, Missouri. Master’s Degree Thesis to the University of Missouri.

Hollweg, T.A. et al. 2009. Methylmercury production in sediments in Chesapeake Bay and the mid-Atlantic continental margin. Marine Chemistry 114 (2009) 86-101.

Hutchenson, M.S., C.M. Smith, G.T. Wallace, J. Rose, B. Eddy, J. Sullivan, and O. Pancorbo. 2008. Freshwater Fish Mercury Concentrations in a Regionally High Mercury Deposition Area. Water Air Soil Pollut. V. 191, p. 15-31

Johnson, M.G., 1987. Trace Element Loadings to Sediments of Fourteen Ontario Lakes and Correlations with Mercury Concentrations in Fish. Can. J. Fisheries. Aquatic Sciences, v. 43, p. 3-13

Johnson, N.W. 2009. Mercury Methylation Beneath an In-Situ Sediment Cap. PhD Dissertation, University of Texas at Austin, August.

Lewis, W.M. and S. Flickinger, 1967. Home range tendency of the largemouth bass (Micropterus salmoides). Ecology 48(6):1020-1023.

Mason, R.P., 2003. Mercury and Methylmercury Concentrations in Water and Largemouth Bass in Maryland Reservoirs. Final Report, Submitted to Maryland Department of Natural Resources, October.

MassDEP. 1993. 1993 Public Request Fish Toxics Monitoring Surveys. R.J. Marietta.

MassDEP. 1995. Guidance for Disposal Site Risk Characterization in Support of the Massachusetts Contingency Plan. Interim Final Policy #WSC/ORS-95-141.

MassDEP. 2002. Technical Update: Background Levels of Polycyclic Aromatic Hydrocarbons and Metals in Soil, MassDEP, Office of Research and Standards, May.

MassDEP. 2013. Fish Mercury Research Data Portal Database for Massachusetts Lake. http://www.mass.gov/eea/agencies/massdep/toxics/sources/fish-mercury-research-data-portal.html.

MassDEP. 2013a. Email correspondence form Michael Hutcheson, MADEP to Ronald Marnicio, TetraTech, regarding MassDEP Fish Tissue Monitoring Data. March 7.

MassDEP. 2013b. Email correspondence form Michael Hutcheson, MADEP to Ronald Marnicio, TetraTech, regarding Massachusetts Fish Mercury Data Clarifications. April 22.

Mesing, C.L. and A.M. Wicker. 1986. Home range, spawning migrations, and homing of radio-tagged Florida largemouth bass in two central Florida lakes. Trans. Am. Fish. Soc. 115: 286-295.

NYSDEC. Procedures for Derivation of Bioaccumulation Factors. Memorandum from John Zambrano to the Regional Water Engineers, Bureau Directors and Section Chiefs, New York State Department of Environmental Conservation.

ODEQ. 2006. Willamette Basin Total Maximum Daily Load (TMDL) Appendix B: Mercury, Oregon Department of Environmental Quality, September.

Pancorbo. 1995. Release of Fish Toxics Metals Data. Memorandum to the Massachusetts Department of Health, Fish Tissue Analyses for the Drinkwater River and Indian Head Impoundment, September 11.

Rose, J., S. Hutcheson, C.R. West, O. Pancorbo, K. Hulme, A. Cooperman, G. DeCesare, R. Isaac, and A. Screpetis. 1999. Fish Mercury Distribution in Massachusetts, USA Lakes. Environmental Toxicology and Chemistry, Vol. 18, No. 7, pp. 1370-1379.

Sammons, S.M., M.J. Maceina, and D. Partridge. 2003. Changes in behavior, movement, and home ranges of largemouth bass following large-scale Hydrilla removal in lake Seminole, Georgia. J. Aquatic Plant Manage. 41:31-38.

Sanborn, J.R. and R.K. Brodberg. 2006. Evaluation of Bioaccumulation Factors and Translators for methylmercury, California EPA, OEHHA, Pesticide and Environmental Toxicology Section, March.

Scott, W.B. and E.J. Crossman. 1973. The Freshwater Fishes of Canada. Bull. Fish. Res. Board Can. 184:1-966.

Sheppard, S. et al. 2011. Solid/liquid partition coefficients (Kd) and plant/soil concentration ratios (CR) for selected soils, tills and sediments at Forsmark, R-11-24, Svensk Karnbranstehantering AB, Stockholm, November.

Sonesten. L. 2003. Fish mercury levels in lakes – adjusting for Hg and fish-size covariation. Environmental Pollution 125 (2003) 255-265.

Taylor, D.L.. Linehan, J.C., Murray, D.W. and W.L. Prell. “Indicators of sediment and biotic mercury contamination in a southern New England estuary”, Marine Pollution Bulletin: 64(4) 807-819.

Tetra Tech FW, Inc., 2004. Phase IID Site Investigation Data Report.

Thompson, T.M., C.E. Cichra, W.J. Lingberg, J.A. Hale and J.E. Hill. 2005. Movement and Habitat Selection of Largemouth Bass in a Florida Steep-sided Quarry Lake. 2005 Proc. Annual Conf. SEAFWA.

USEPA. 1997. Mercury Study Report to Congress. EPA-4522/R-97-003, http://www.epa.gov/hg/report.htm.

USEPA. 2004. National Study of Chemical Residues in Lake Fish Tissue: Year 1 and Year 2 Data. December 2004 Update. Office of Water and Office of Science & Technology.

USEPA. 2005. Quality Assurance Report for the National Study of Chemical Residues in Lake Fish Tissue: Analytical Data Years 1 - 4. USEPA Office of Water, Office of Science and Technology, Washington, D.C. EPA-823-R-05-005.

USEPA. 2005b. National Study of Chemical Residues in Lake Fish Tissue: Year 3 and Year 4 Data. October 2005 Update. Office of Water and Office of Science & Technology.

USEPA. 2006. Human Health Risk Assessment, Nyanza Superfund Site Operable Unit IV, Sudbury River Mercury Contamination, Prepared for USEPA, May 2006.

USEPA. 2006b. Final Human Health Risk Assessment. Nyanza Superfund Site. Operable Unit IV Sudbury River Mercury Contamination. US Environmental Protection Agency, Region 1. May 2006.

USEPA. 2007. Baseline Ecological Risk Assessment, Nyanza Superfund Site Operable Unit IV, Sudbury River Mercury Contamination, Prepared for USEPA, May 2007.

USEPA. 2008. Final Supplemental Baseline Ecological Risk Assessment. Volume 1 Sections 1-5. Nyanza OU4 Chemical Waste Dump Superfund Site. Operable Unit 4 – Sudbury River, Ashland Massachusetts. RI/FS Remedial Action Contract No. EP-S1-06-03. US Environmental Protection Agency. December 2008.

USEPA. 2009. Estimation of Biota Sediment Accumulation Factor (BSAF) from Paired Observations of Chemical Concentration in Biota and Sediment. EPA/600/R-06/047 Office of Research and Development, National Health and Environmental Effects Research Laboratory, Duluth, MN, February.

USEPA. 2010. ProUCL Version 4.00.05 Technical Guide. EPA/600/R-07/041 Office of Research and Development, Washington, DC.

USGS. 2008. Total Mercury, Methylmercury, Methylmercury Production Potential, and Ancillary Streambed-Sediment and Pore-Water Data for Selected Streams in Oregon, Wisconsin and Florida, 2003-04. U.S. Geological Survey, National Water Quality Assessment Program, Data Series 375.

USGS. 2008b. Mercury and Methylmercury Processes in North San Francisco Bay Tidal Wetland Ecosystems, Oakland, CA. CalFed ERP02D-P62, Final Report, U.S. Geological Survey, Submitted to the California Bay-Delta Authority Ecosystem Restoration Program, May.

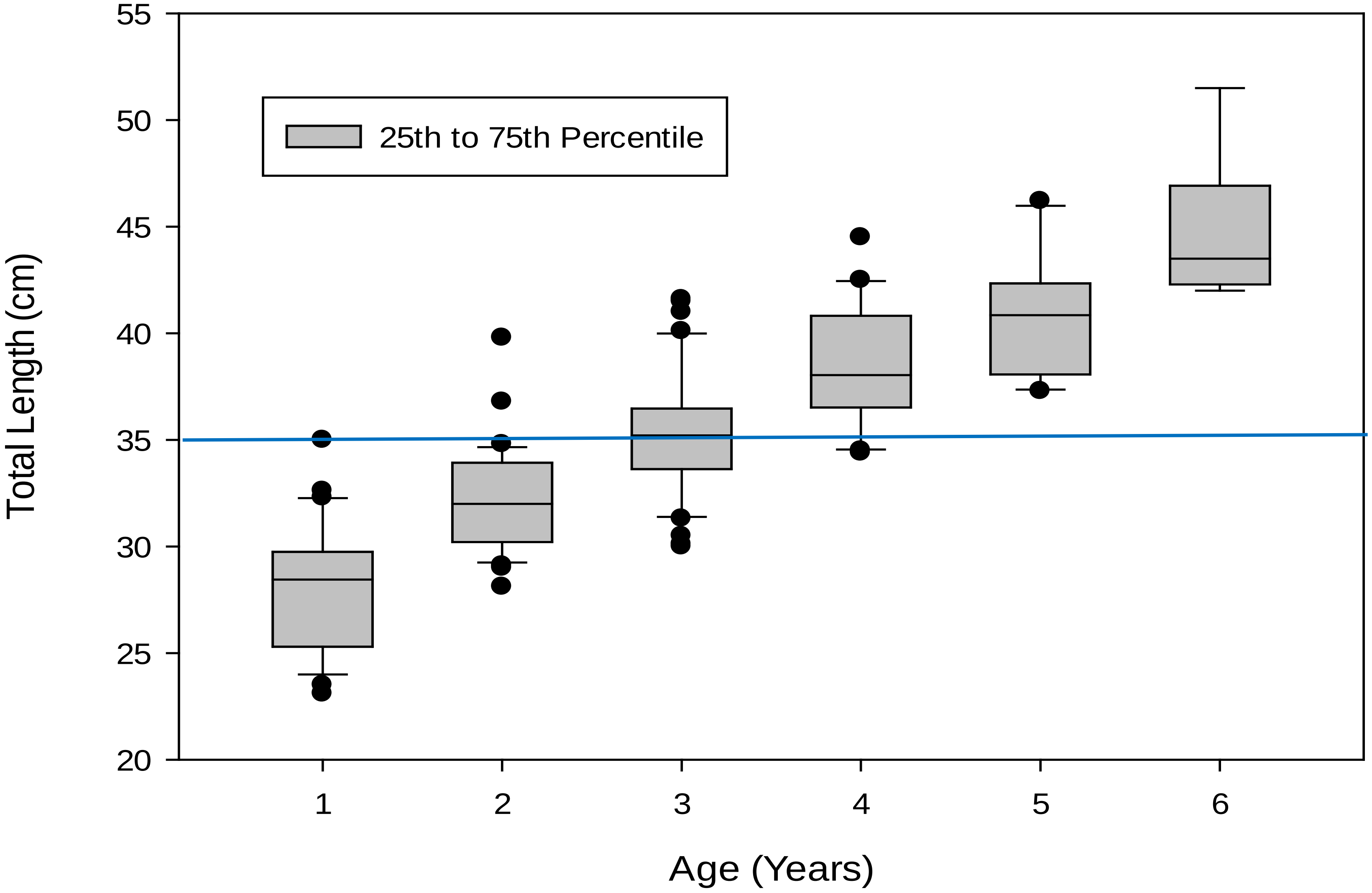
USGS. 2009. Mercury in Fish, Bed Sediment, and Water from Streams Across the United States, 1998-2005. U.S. Geological Survey, Scientific Investigations Report 2009-5109.

USGS. 2009b. Mercury, Methylmercury and Other Constituents in Sediments and Water from Seasonal and Permanent Wetlands in the Cache Creek Settling Basin and Yolo Bypass, Yolo County, CA, 2005-06. U.S. Geological Survey, Open File Report 2009-1182.

Xun, L., N. E. R. Campbell, and J. W. M. Rudd, 1987. Measurements of Specific Rates of Net Methyl Mercury Production in the Water Column and Surface Sediments of Acidified and Circumneutral Lakes. Canadian Journ. Fish. Aquat. Sci. 44: 750-757

FIGURES

Figure 2-1. Total Length-to-Age Relationship for Largemouth Bass (LMB) in Massachusetts Water Bodies



Notes:

- The Massachusetts Fish and Wildlife minimum creelable LMB length of 30.5 cm is depicted by the horizontal blue line.
- Outliers of the 10th and 90th percentile of the designated age class distribution are shown as black dots.
- The central tendency measure of the distribution for each age class is expressed as the 50th percentile value of the distribution.

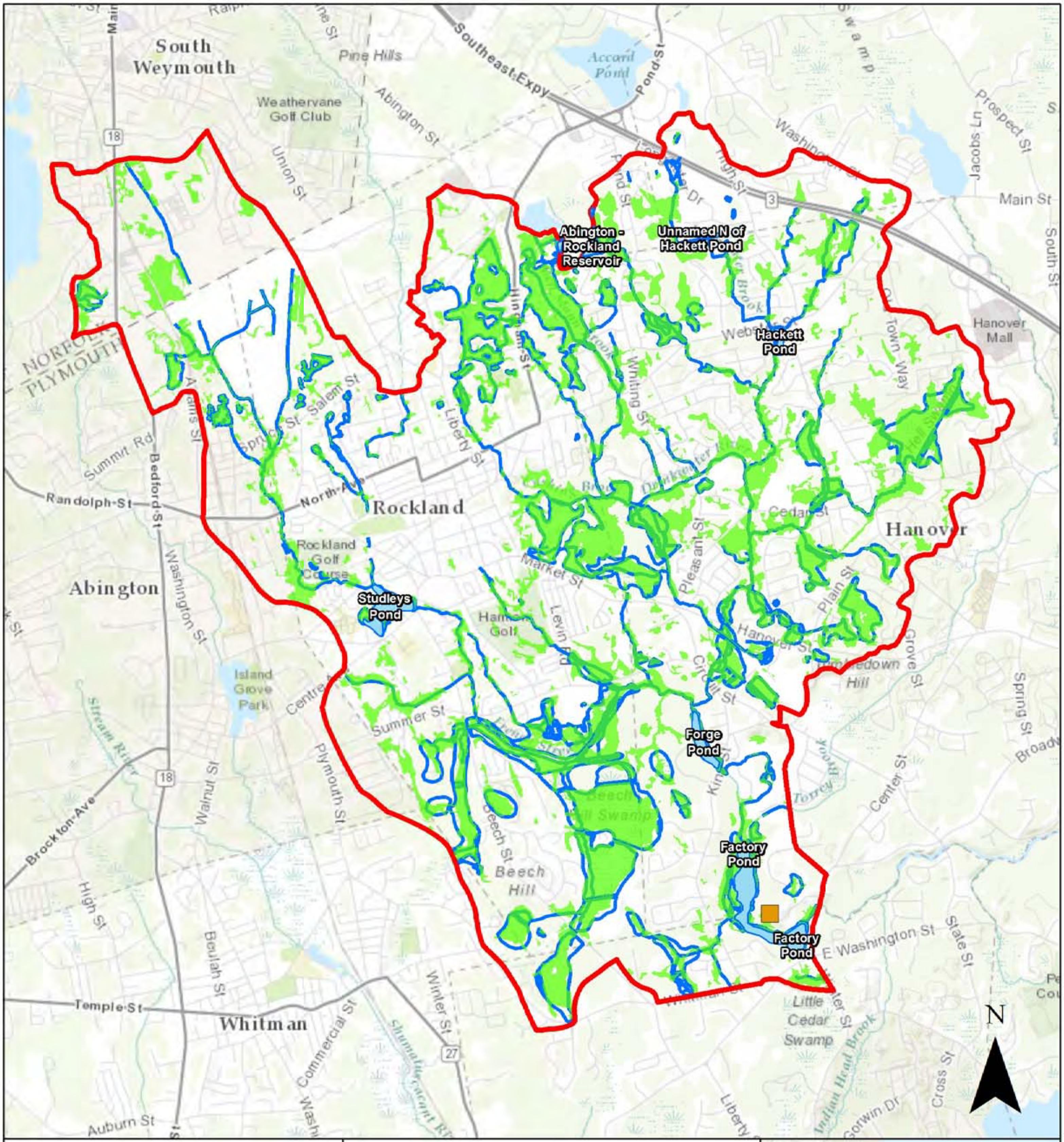
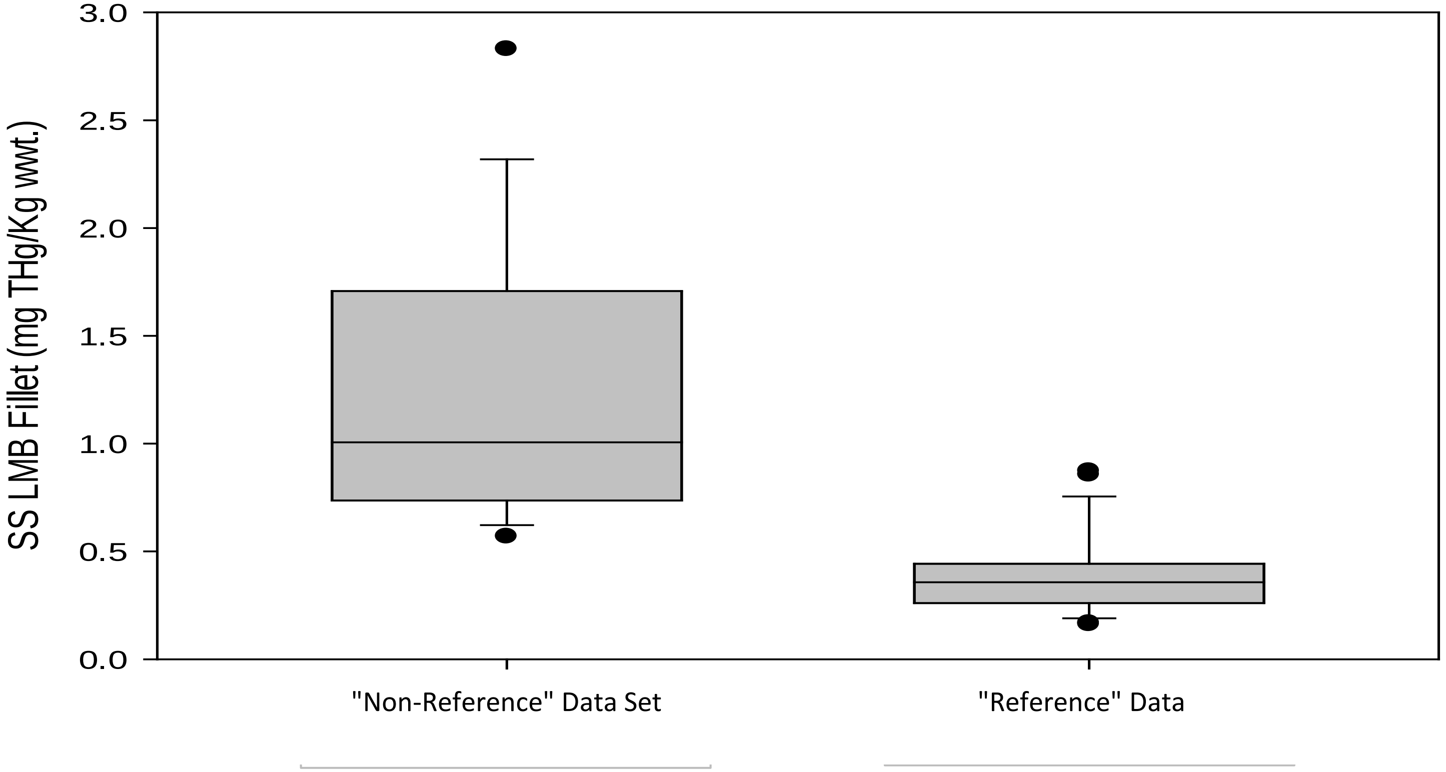


Figure 2-2
Drinkwater River Watershed and Features

Figure 4-1. Box and Whisker Diagrams Depicting the 25th, 50th, 75th Percentile Values of the Distributions of the Standard Size Largemouth Bass (LMB) Fillet Tissue Mercury Concentrations in the "Reference" and "Non-Reference" Massachusetts Water Bodies/Reaches

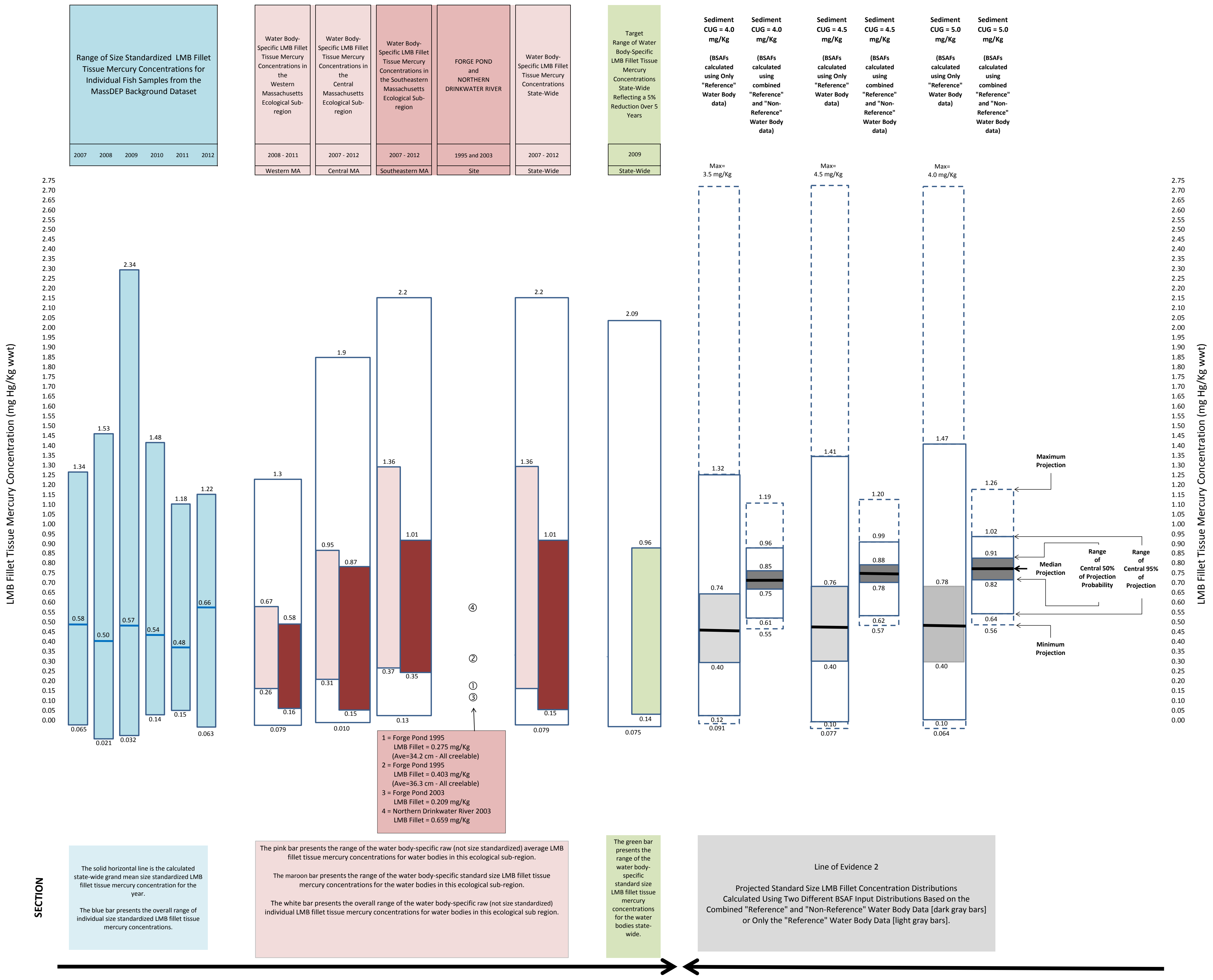
(Points at a greater distance from the median than 1.5 times the Inter-Quartile Range are plotted individually as dots)



Abbreviations:

SS	Standar Size
LMB	largemouth bass
THg	Total Mercury
mg	milligram
Kg	kilogram
wwt	wet weight

Figure 5-1. Comparison of the State-Wide Background Largemouth Bass Fillet Tissue Mercury Concentrations over Time to the Post-Remediation Standard Sized LMB Fillet Tissue Mercury Concentration Distributions Projected for Various Sediment Total Mercury Clean-Up Goals



1 = Forge Pond 1995
LMB Fillet = 0.275 mg/Kg
(Ave=34.2 cm - All creelable)
2 = Forge Pond 1995
LMB Fillet = 0.403 mg/Kg
(Ave=36.3 cm - All creelable)
3 = Forge Pond 2003
LMB Fillet = 0.209 mg/Kg
4 = Northern Drinkwater River 2003
LMB Fillet = 0.659 mg/Kg

The solid horizontal line is the calculated state-wide grand mean size standardized LMB fillet tissue mercury concentration for the year.

The blue bar presents the overall range of individual size standardized LMB fillet tissue mercury concentrations.

The pink bar presents the range of the water body-specific raw (not size standardized) average LMB fillet tissue mercury concentrations for water bodies in this ecological sub-region.

The maroon bar presents the range of the water body-specific standard size LMB fillet tissue mercury concentrations for the water bodies in this ecological sub-region.

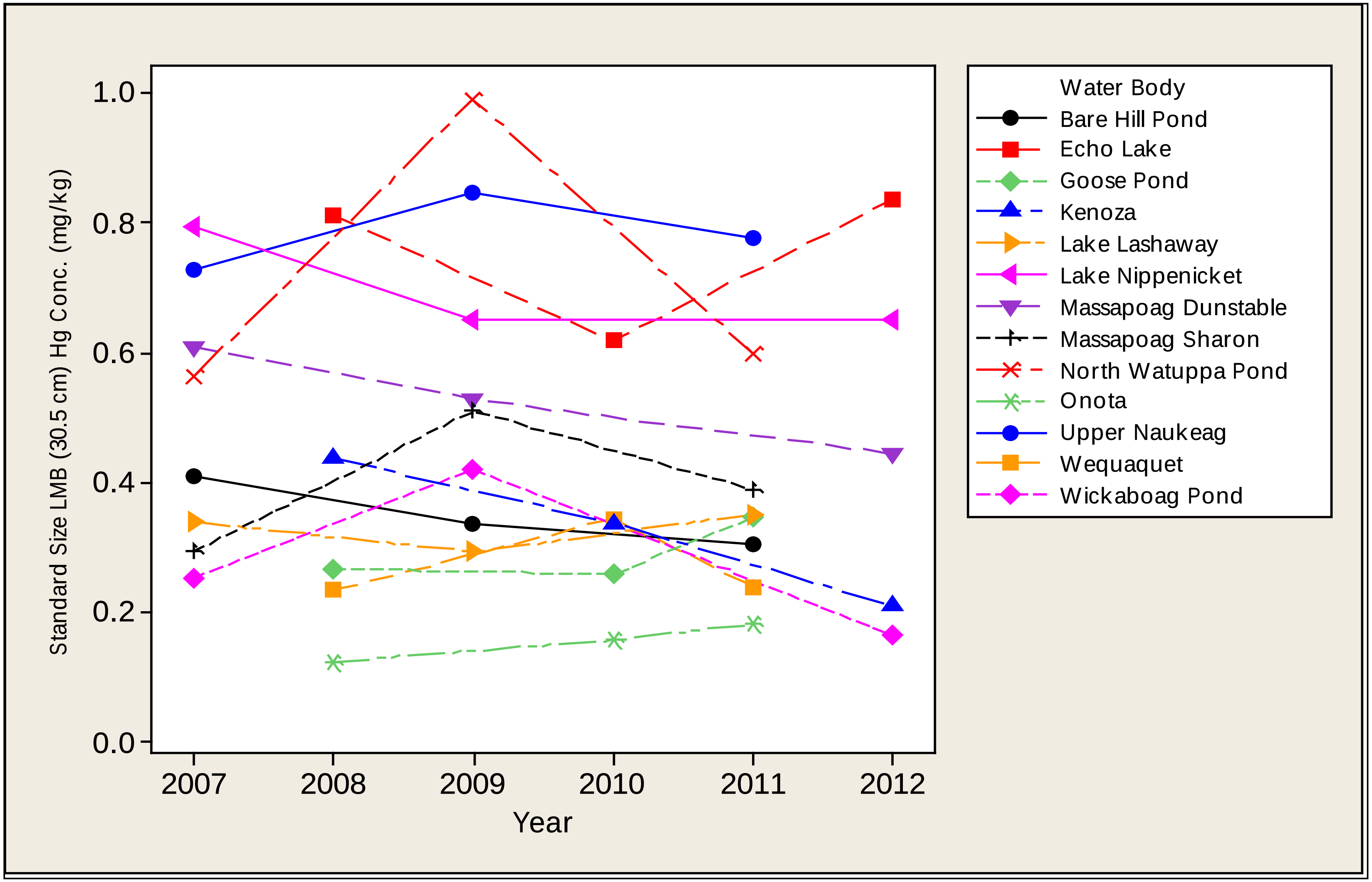
The white bar presents the overall range of the water body-specific raw (not size standardized) individual LMB fillet tissue mercury concentrations for water bodies in this ecological sub region.

The green bar presents the range of the water body-specific standard size LMB fillet tissue mercury concentrations for the water bodies state-wide.

Line of Evidence 2

Projected Standard Size LMB Fillet Concentration Distributions Calculated Using Two Different BSAF Input Distributions Based on the Combined "Reference" and "Non-Reference" Water Body Data [dark gray bars] or Only the "Reference" Water Body Data [light gray bars].

Figure 5-2. Time Series Plots of the Standard Size Largemouth Bass (LMB) Fillet Tissue Mercury Concentration in the Water Bodies with at Least Three Years of Sampling Data



NOTE:
Data source 2007 - 2012 MassDEP Formal Data Request

Figure 6-1. Results of the Regression Analysis of the Standard Size Largemouth Bass (LMB) Fillet Tissue Mercury Concentration on the Average Surficial Sediment Total Mercury Concentration [Log10 - Log10 Transform]

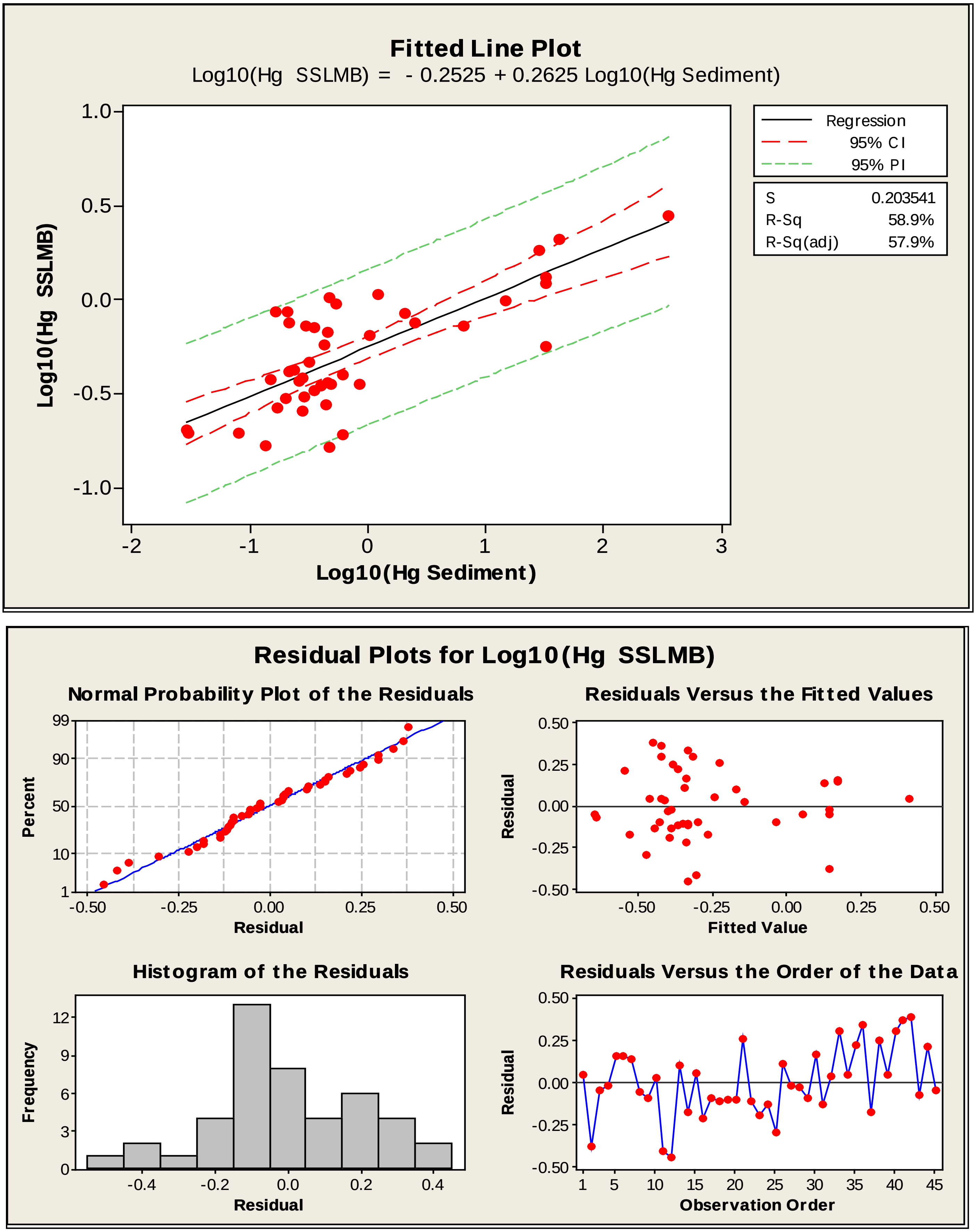
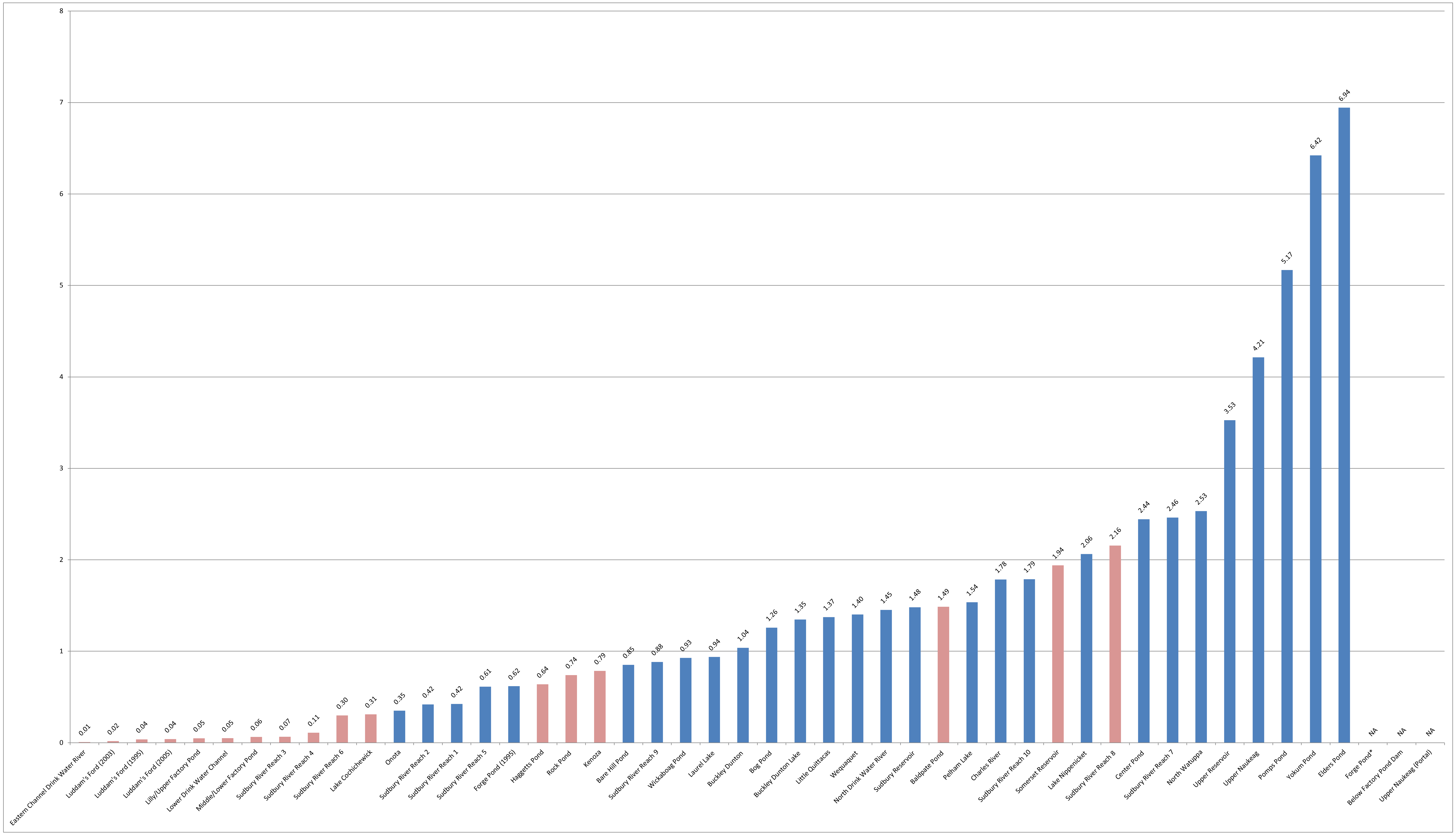


Figure 6-2. Distribution of Point Estimates of the Biota Sediment Accumulation Factors (BSAF1s) for Largemouth Bass (LMB) Fillet Tissue From "Reference" (Blue) and "Non-Reference" (Pink) Massachusetts Water Bodies



NA = A standard size LMB fillet tissue mercury concentration could not be estimated as only the average length of the sampled LMB was reported and the reported average was less than 30.5 cm long. Therefore a water body-specific BSAF could not be calculated.

TABLES

Table 2-1. Statistical Summary of the Total Lengths of the Largemouth Bass (LMB) Samples Reflected in the Data Obtained from the MassDEP Fish Mercury Research Data Portal Database for Massachusetts Lakes

LMB Age Class	Number of Sampled Individuals	Mean of Total Length Within the Age Class	Standard Deviation of Total Length Within the Age Class	Minimum Total Length Within the Age Class	Maximum Total Length Within the Age Class
(years)	(#)	(cm)	(cm)	(cm)	(cm)
1	9	21.7	2.7	20.1	28.7
2	30	28.5	3.0	23.1	35.0
3	36	32.0	2.4	28.1	39.8
4	40	35.2	2.9	30.0	41.6
5	20	38.1	2.8	34.4	44.5
6	10	40.9	2.7	37.3	46.2
7	6	43.5	3.5	42.0	51.5

Table 2-2. Home Range Estimates for Largemouth Bass (LMB) Populations from Various Sources

Study	Water Body, State	Water Body Size	Minimum Home Range Size	Maximum Home Range Size	Median Home Range Size	Notes
		(Ha) [acres]	(Ha) [acres]	(Ha) [acres]	(Ha) [acres]	
Thompson, et al., 2005	Kirkpatrick Lake, FL	7 [17.3]	0.56 [1.4]	4.84 [12.0]	3.04 [7.5]	Very clear, oligotrophic lake
Lewis and Flickinger, 1967	Third Sister Lake, MI	3.4 [8.6]	0.073 [0.18	0.66 [1.6]	0.4 [0.99]	High LMB population density in small farm pond
Mesing and Wicker, 1986	Unnamed lakes Central FL	NA	0.01 [0.025]	5.86 [14.5]	2.9 [7.2]	Warm water habitat
Ahrenstrorff, et al., 2009	Little Rock Lake, WI	19.1 [47.2]	0.69 [1.7]	1.57 [3.9]	1.1 [2.7]	Range across high and low coarse woody debris (CWD) habitats
Ahrenstrorff, et al., 2009	Camp Lake, WI	26.1 [64.5]	1.03 [2.5]	3.13 [7.7]	2.1 [5.2]	Range across high and low CWD habitats

Table 2-3. Distribution of Fish Species Collected During the Phase IID Investigation at the Fireworks Site by Species, Reach and Capture Method [Reproduced from Table B-1-4 of the Phase IID Investigation Report]

Capture Method	Species	Catch Rate (fish per hour)								
		Fireworks Site Survey Water Body or Reach								
		Northern Drinkwater River	Forge Pond	Eastern Channel Corridor	Upper Drinkwater River	Lower Drinkwater River	Lily / Upper Factory Pond	Middle / Lower Factory Pond	Below Factory Pond Dam	Luddams Ford
Electroshocking										
	largemouth bass	9.5	8.1	0.6	*	**10.2**	**9.1**	**7.1**	0	7.1
	bluegill	7.1	21.2	2.6	*	5.6	2.3	18.2	2.6	22.2
	pumpkinseed	4.8	7.1	2.3	*	8.3	4.5	7.1	0.9	13.1
	yellow perch	0	2.0	0.6	*	5.8	18.9	16.2	0	0
	chain pickerel	0	7.1	0	*	0	1.5	1.0	0	2.0
	brown bullhead	0	0	0	*	0	1.5	0	0	0
	golden shiner	0	0	0	*	0	2.3	2.0	0	2.0
	black crappie	0	0	0	*	0	0.8	2.0	0	2.0
	white sucker	0	0	0	*	0	0	0	6.6	0
	white perch	0	0	0	*	0	0	0	4.0	1.0
	American eel	9.5	7.1	0.6	*	4.2	0.8	1.0	2.6	5.1
Gill net										
	largemouth bass	*	0.3	*	*	*****	**0**	**0**	*	0.9
	yellow perch	*	0.3	*	*	*	0.4	2.0	*	0
	chain pickerel	*	0.3	*	*	*	0.4	0	*	0
	brown bullhead	*	0.7	*	*	*	0	0	*	0
	golden shiner	*	0.3	*	*	*	0.4	1.0	*	0
	white perch	*	0	*	*	*	0	0	*	0.4
Hoop Net										
	largemouth bass	*	*	*	*	,,,, ,,	**1.1**	*****	*	*
	bluegill	*	*	*	*	*	2.8	*	*	*
	yellow perch	*	*	*	*	*	0.6	*	*	*
	chain pickerel	*	*	*	*	*	0.6	*	*	*
	golden shiner	*	*	*	*	*	0.6	*	*	*
	black crappie	*	*	*	*	*	0.6	*	*	*

Note:
* Sampling method not used for this water body or reach.

Table 3-1. Identification of Which Massachusetts Water Body Data were Used in the Two Primary Types of Analysis Performed in Support of the Cleanup Goal Package

Water Bodies Whose Data Were Used in the Evaluation of the Statewide Background LMB Fillet Tissue Mercury Concentration	Listing of the Massachusetts Water Bodies with Available Pertinent Data	Water Bodies Whose Data Were Used in the Evaluation of the Uptake of Mercury from the Surficial Sediment into LMB Fillet Tissue
Ashfield Pond	Ashfield Pond	Baldpate Pond
Bare Hill Pond	Baldpate Pond	Bare Hill Pond
Buckley Dunton Lake	Bare Hill Pond	Below Factory Pond Dam
Chebacco	Below Factory Pond Dam	Bog Pond
Crystal Lake	Bog Pond	Buckley Dunton Lake (Portal)
Echo Lake	Buckley Dunton Lake (Portal)	Buckley Dunton Lake (Request)
Goose Pond	Buckley Dunton Lake (Request)	Center Pond
Horseleech Pond	Center Pond	Charles River
Kenoza	Charles River	Cochichewick
Lake Lashaway	Cochichewick	Eastern Channel Drink Water River
Lake Nippenicket	Eastern Channel Drink Water River	Elders Pond
Laurel Lake	Elders Pond	Forge Pond (1995)
Long Pond	Forge Pond (1995)	Forge Pond (FWX-PH2D)
Massapoag Dunstable	Forge Pond (FWX-PH2D)	Kenoza
Massapoag Sharon	Haggetts Pond	Lake Nippenicket
Newfield Pond	Heard Pond Reach 7	Laurel Lake
North Watuppa	Johnsons Pond	Lilly/Upper Factory Pond
Onota	Kenoza	Little Quittacas
Pelham Lake	Lake Buel	Lower Drink Water Channel
Quabbin Reservoir	Lake Nippenicket	Luddam's Ford
Round Pond (East)	Laurel Lake	Middle/Lower Factory Pond
Somerset Reservoir	Lilly/Upper Factory Pond	North Drink Water River
Upper Naukeag	Little Quittacas	North Watuppa
Upper Reservoir	Lower Drink Water Channel	Onota
Wequaquet	Luddam's Ford	Pelham Lake
Wickaboag Pond	Luddam's Ford(1995)	Pomps Pond
	Middle Pond	Rock Pond
	Middle/Lower Factory Pond	Somerset Reservoir
	North Drink Water River	Sudbury Reservoir
	North Watuppa	Sudbury River Reach 1
	Onota	Sudbury River Reach 2
	Pelham Lake	Sudbury River Reach 3
	Plainfield Pond	Sudbury River Reach 4
	Pomps Pond	Sudbury River Reach 5
	Prospect Pond	Sudbury River Reach 6
	Rock Pond	Sudbury River Reach 7
	Somerset Reservoir	Sudbury River Reach 8
	Stevens Pond	Sudbury River Reach 9
	Sudbury Reservoir	Sudbury River Reach 10
	Sudbury River Reach 1	Upper Naukeag (Portal)
	Sudbury River Reach 2	Upper Reservoir (Request)
	Sudbury River Reach 3	Wequaquet
	Sudbury River Reach 4	Wickaboag Pond
	Sudbury River Reach 5	Yokum Pond
	Sudbury River Reach 6	
	Sudbury River Reach 7	
	Sudbury River Reach 8	
	Sudbury River Reach 9	
	Sudbury River Reach 10	
	Upper Naukeag (Portal)	
	Upper Naukeag (Request)	
	Upper Reservoir (Portal)	
	Upper Reservoir (Request)	
	Wampanoag (Portal)	
	Wampanoag (Request)	
	Watson Pond	
	Wequaquet	
	West Meadow Pond	
	Wickaboag Pond	
	Yokum Pond	

Data sources:
Nyanza = Nyanza BERA
Portal = MassDEP Fish Mercury Research Data Portal
1995 MADEP = 1995 MassDEP Toxics in Fish Monitoring Program
FWX-PH2D = Fireworks Site Phase IIC/IID
Request = 2007 - 2012 MassDEP Formal Data Request
2005 MADEP = MassDEP 2005 Toxics in Fish Monitoring Program Technical Request for Special Sampling for Identified Waterbody

Table 3-2. Summary of the Fish Tissue Sampling Data Used to Evaluate the Statewide Background Largemouth Bass (LMB) Fillet Tissue Mercury Concentration by Water Body

Water Body	Sampling Year	# LMB Fillet Tissue Samples	# Samples with Length Data	LMB Length		LMB Fillet Tissue Mercury Concentration	
				Average	Range	Average	Range
		(#)	(#)	(mm)		(mg/Kg wwt.)	
Ashfield Pond	2009	15	15	363.3	136 - 483	0.549	0.12 - 1.3
Bare Hill Pond	2007	15	15	379.1	228 - 498	0.685	0.31 - 1.3
	2009	15	15	365.1	186 - 476	0.507	0.21 - 1.1
	2011	15	15	349.1	225 - 522	0.547	0.19 - 1.8
Buckley Dunton Lake	2008	3	3	264.3	153 - 434	0.543	0.25 - 1.1
	2010	3	3	380.3	320 - 444	0.803	0.41 - 1.3
Chebacco	2008	15	15	446.7	228 - 572	0.801	0.16 - 1.5
	2010	15	15	375.6	238 - 525	0.615	0.22 - 1.2
Crystal Lake	2007	15	15	258.1	184 - 362	0.344	0.22 - 0.59
	2011	12	12	337.6	264 - 444	0.388	0.24 - 0.67
Echo Lake	2008	11	11	257.8	205 - 376	0.577	0.23 - 1.2
	2010	12	12	327.2	266 - 420	0.683	0.46 - 1.1
	2012	14	14	308.9	212 - 397	0.863	0.39 - 1.4
Goose Pond	2008	11	11	229.6	167 - 362	0.196	0.082 - 0.39
	2010	5	5	213.8	160 - 305	0.178	0.1 - 0.24
	2011	14	14	311.3	235 - 433	0.379	0.18 - 0.73
Horseleech Pond	2008	15	15	359.2	301 - 426	0.669	0.25 - 1.1
	2010	15	15	357.8	282 - 461	0.713	0.51 - 1.4
Kenoza	2008	15	15	363.7	245 - 489	0.679	0.3 - 1.8
	2010	15	15	400.0	225 - 485	0.778	0.21 - 1.3
	2012	15	15	421.0	315 - 472	0.700	0.25 - 1.2
Lake Lashaway	2007	15	15	364.8	240 - 510	0.572	0.26 - 1.7
	2009	14	14	315.1	233 - 459	0.345	0.19 - 0.79
	2011	12	12	354.3	280 - 421	0.611	0.26 - 1.2
Lake Nippenicket	2007	15	15	390.7	265 - 495	1.101	0.75 - 1.8
	2009	15	15	363.1	236 - 438	0.967	0.41 - 1.8
	2012	15	15	415.3	325 - 521	1.115	0.57 - 1.9
Laurel Lake	2009	15	15	278.5	136 - 348	0.345	0.12 - 0.58
Long Pond	2009	15	15	353.7	264 - 510	0.280	0.1 - 0.96
Massapoag Dunstable	2007	15	15	324.4	193 - 508	0.653	0.42 - 1.2
	2009	15	15	306.4	122 - 506	0.579	0.27 - 1.3
	2012	15	15	353.5	232 - 459	0.576	0.34 - 1
Massapoag Sharon	2007	15	15	382.1	318 - 456	0.542	0.3 - 1.2
	2009	15	15	189.3	165 - 241	0.499	0.13 - 0.89
	2011	15	15	347.4	235 - 450	0.571	0.22 - 1.2
Newfield Pond	2009	15	15	154.5	124 - 252	0.388	0.17 - 1.1
	2012	15	15	361.3	257 - 527	0.516	0.26 - 1.4
North Watuppa Pond	2007	15	15	391.2	285 - 447	0.924	0.55 - 1.4
	2009	15	15	313.3	214 - 459	1.060	0.22 - 1.4
	2011	24	24	350.3	254 - 459	0.953	0.48 - 1.5
Onota	2008	12	12	286.2	184 - 441	0.124	0.079 - 0.36
	2010	10	10	346.5	259 - 480	0.275	0.08 - 0.73
	2011	12	12	366.8	208 - 483	0.381	0.065 - 0.9
Pelham Lake	2008	7	7	242.7	197 - 309	0.113	0.085 - 0.14
	2011	10	10	359.0	276 - 408	0.486	0.3 - 0.78
Plainfield Pond	2010	1	1	180.0	180 - 180	0.240	0.24 - 0.24
Quabbin Reservoir	2009	13	12	298.7	165 - 438	0.394	0.18 - 0.74
Round Pond (East)	2008	15	15	405.4	246 - 508	1.497	0.66 - 2.2
	2010	14	14	395.1	296 - 549	1.226	0.76 - 1.5
Somerset Reservoir	2009	15	15	337.9	188 - 510	0.997	0.31 - 1.7
	2012	15	15	386.1	362 - 432	1.447	1.1 - 2
Upper Naukeag	2007	12	12	364.8	245 - 454	0.977	0.44 - 1.8
	2009	7	7	178.9	153 - 192	0.746	0.47 - 1.5
	2011	16	16	352.2	182 - 476	1.040	0.39 - 1.9
Upper Reservoir	2007	2	2	444.0	441 - 447	1.350	1.3 - 1.4
	2009	2	2	181.0	177 - 185	0.510	0.44 - 0.58
	2012	5	5	410.0	285 - 488	1.000	0.45 - 1.9
Wequaquet	2008	15	15	439.3	363 - 502	0.821	0.28 - 1.1
	2010	12	12	354.6	157 - 511	0.468	0.15 - 0.88
	2011	14	14	433.4	328 - 516	0.799	0.26 - 1.4
Wickaboag Pond	2007	15	15	366.1	260 - 522	0.361	0.13 - 0.98
	2009	14	14	223.4	174 - 292	0.493	0.17 - 1.1
	2012	15	15	365.6	268 - 492	0.352	0.1 - 0.78

Table 3-3. Uncertainties and Limitation Associated with the Data Assembled for Use in Developing the Cleanup Goal Package

Data Set	Uncertainty	Significance	Implication
General (All)	Data for total mercury applied in analysis and trends	The primary form of mercury in fillet is methy mercury (>95-98% typically) and inorganic mercury forms dominate in sediments	Addressed all mercury as total mercury in fillet and sediments with no differentiation between methyl mercury and inorganic forms. Toxicological characteristics not considered in evaluation
Nyanza Superfund Site	Descriptive data summaries were only valuable for reaches or waterbodies and individual fish data were not available	Loss of understanding if variation within reaches is limited. Variation on a reach wide basis is the basis for comparison	Some loss of understanding in individual variation in LMB mercury concentrations
	Fish size data limited to a size class of >30.5 cm only	Lack of individual length data results in inability to do regression analysis between fish length and mercury concentrations	Regression analysis not able to be conducted with individual reaches or waterbodies
	Skin-on fillet used	Concentration of mercury slightly underestimated due to potential dilutive effects of skin presence	Dellinger et al. (1995) reported no effect to slight underestimate on mercury concentration data compared to skin off data for same species. No corrective factor was applied to data
MassDEP Fish Mercury Research Data Portal	Lakes were sampled for LMB but were limited to subset with both LMB and sediment data	Only subset of data had co-located LMB fillet and sediment data .	Reduced list of lakes with useable data for BSAF determination but still provided a comprehensive data set
	Skin-off fillet used	Fillet data based on muscle tissue without skin present	Concentration data based on muscle tissue exclusively, may be higher value than if skin left on
1995 MassDEP Toxics in Fish Monitoring Program	Sampling data was limited to only a single LMB fillet sample and single sediment sample from Luddams's Ford and Forge Pond	Limited data for two waterbodies within the Drinkwater River sub-basin. One LMB	Data are limited to a single event, with limited sediment data collected
	Skin-on fillet used	Concentration of mercury slightly underestimated due to dilutive effects of skin	Minimal impact on data. Dellinger et al. (1995) reported no effect to slight underestimate on mercury concentration data compared to skin off data in a freshwater fish species
Fireworks Site Phase IIC/IID	Composite samples of LMB fillet collected along a reach gradient	Clear gradient in mercury body burden defined but individual variation within reaches is undefined	Regression analysis not able to be conducted with individual reaches or waterbodies
	Skin-on fillet used	Concentration of mercury slightly underestimated due to dilutive effects of skin	Minimal impact on data. Dellinger et al. (1995) reported no effect to slight underestimation of mercury concentration data compared to skin off data in a freshwater fish species
2007 - 2012 MassDEP Formal Data Request	Database with most recent data for Fish Toxics Program. Not all lakes listed had corresponding LMB fillet (skin off) and sediment data	19 lakes had LMB and sediment data with total mercury and methyl mercury data	Reduced list of lakes with useable data for BSAF determination but still a comprehensive data set
	Skin-off fillet used	Fillet data based on muscle tissue without skin present	Concentration data based on muscle tissue exclusively, may be higher value than if skin left on
MassDEP 2005 Toxics in Fish Monitoring Program Technical Request for Special Sampling for Identified Waterbody	Sampling data was limited to only a single LMB fillet sample and sediment sample from Luddams's Ford and Forge Pond	Limited data for two waterbodies, Forge Pond and Luddams Ford, within the Drinkwater River sub-basin.	Data are limited to a single event, with limited sediment data collected

Table 4-1. Calculated Standard Size Largemouth Bass (LMB) Fillet Tissue Mercury Concentrations for the "Reference" Massachusetts Water Bodies Evaluated for the Mercury Uptake Analyses

Water Body (data source)	Notes / Regression Equation	Coefficient of Determination (R^2)	Standard Size (30.5 cm) LMB Fillet Tissue Mercury Concentration
		(percent)	(mg/Kg wwt)
Baldpate Pond (Request)	Log10(total Hg wet wt) = - 3.58 + 1.37 Log10(total length, mm)	62.2%	0.666
Bare Hill Pond (Request)	Log10(total Hg wet wt) = - 6.25 + 2.33 Log10(total length, mm)	78.3%	0.345
Bog Pond (Portal)	Log10(total Hg wet wt) = - 7.96 + 4.84 Log10(total length, cm)	81.7%	0.167
Buckley Dunton Lake (Portal)	Log10(total Hg wet wt) = - 4.87 + 2.93 Log10(total length, cm)	84.8%	0.301
Buckley Dunton Lake (Request)	Log10(total Hg wet wt) = - 3.89 + 1.47 Log10(total length, mm)	78.6%	0.578
Center Pond (Portal)	Log10(total Hg wet wt) = - 4.85 + 2.79 Log10(total length, cm)	48.1%	0.196
Charles River (Nyanza)	Fish length reported as > 30.48 cm	-	0.423
Elders Pond (Portal)	Log10(total Hg wet wt) = - 4.57 + 2.61 Log10(total length, cm)	85.3%	0.201
Forge Pond (MADEP1995)	Average fish length 34.1 cm	-	0.275
Forge Pond (FWX-PH2D)	Fish length 28 cm	-	*
Haggetts Pond (Request)	Log10(total Hg wet wt) = - 6.86 + 2.60 Log10(total length, mm)	92.1%	0.397
Kenoza (Request)	Log10(total Hg wet wt) = - 6.18 + 2.31 Log10(total length, mm)	71.0%	0.362
Lake Cochichewick (Request)	Log10(total Hg wet wt) = - 8.20 + 3.01 Log10(total length, mm)	74.0%	0.190
Lake Nippenicket (Request)	Log10(total Hg wet wt) = - 4.12 + 1.60 Log10(total length, mm)	68.9%	0.716
Laurel Lake (Portal)	Log10(total Hg wet wt) = - 4.39 + 2.56 Log10(total length, cm)	28.6%	0.257
Little Quittacas (Portal)	Log10(total Hg wet wt) = - 3.83 + 2.30 Log10(total length, cm)	47.5%	0.384
North Drink Water River	Average fish length 39.3 cm	-	0.462
North Watuppa (Portal)	Log10(total Hg wet wt) = - 3.57 + 2.12 Log10(total length, cm)	79.5%	0.377
Onota (Request)	Log10(total Hg wet wt) = - 7.10 + 2.54 Log10(total length, mm)	73.1%	0.162
Pelham Lake (Request)	Log10(total Hg wet wt) = - 7.04 + 2.60 Log10(total length, mm)	73.3%	0.263
Pomps Pond (Request)	Log10(total Hg wet wt) = - 2.47 + 0.813 Log10(total length, mm)	31.2%	0.355
Rock Pond (Request)	Log10(total Hg wet wt) = - 2.06 + 0.802 Log10(total length, mm)	52.5%	0.856
Somerset Reservoir (Portal)	Log10(total Hg wet wt) = - 4.15 + 2.54 Log10(total length, cm)	90.9%	0.417
Sudbury Reservoir (Nyanza)	Fish length reported as > 30.48 cm	-	0.295
Sudbury River Reach 1 (Nyanza)	Fish length reported as > 30.48 cm	-	0.357
Upper Naukeag (Request)	Log10(total Hg wet wt) = - 2.32 + 0.910 Log10(total length, mm)	52.9%	0.872
Upper Naukeag (Portal)	Fish length 29.5 cm	-	*
Upper Reservoir (Request)	Log10(total Hg wet wt) = - 2.83 + 1.09 Log10(total length, mm)	60.8%	0.755
Wequaquet (Request)	Log10(total Hg wet wt) = - 5.18 + 1.91 Log10(total length, mm)	75.2%	0.367
Wickaboag Pond (Request)	Log10(total Hg wet wt) = - 1.16 + 0.273 Log10(total length, mm)	0.0%	0.330
Yokum Pond (Portal)	Log10(total Hg wet wt) = - 5.94 + 3.52 Log10(total length, cm)	70.5%	0.193

NOTE:

* = Reported only average fish length which was less than 30.5 cm.

Data sources:

Nyanza = Nyanza BERA
Portal = MassDEP Fish Mercury Research Data Portal
1995 MADEP = 1995 MassDEP Toxics in Fish Monitoring Program
FWX-PH2D = Fireworks Site Phase IIC/IID
Request = 2007 - 2012 MassDEP Formal Data Request
2005 MADEP = MassDEP 2005 Toxics in Fish Monitoring Program Technical Request for Special Sampling for Identified Waterbody

Table 4-2. Calculated Standard Size Largemouth Bass (LMB) Fillet Tissue Mercury Concentrations for the "Non-Reference" Massachusetts Water Bodies Evaluated for the Mercury Uptake Analyses

Water Body	Notes / Regression Equation	Coefficient of Determination (R^2)	Standard Size (30.5 cm) LMB Fillet Tissue Mercury Concentration
		(percent)	(mg/Kg wwt)
Below Factory Pond Dam (FWX-PH2D)	Average fish length 20.6 cm		*
Eastern Channel Drink Water River (FWX-PH2D)	Single fish length 39 cm		2.83
Lilly/Upper Factory Pond (FWX-PH2D)	Average fish length 40.3 cm		2.1
Lower Drink Water Channel (FWX-PH2D)	Average fish length 34.6 cm		2.09
Middle/Lower Factory Pond (FWX-PH2D)	Average fish length 31.5 cm		1.84
Luddam's Ford (MassDEP 1995)	Average fish length 36 cm		1.23
Luddam's Ford (FWX-PH2D)	Average fish length 31 cm		0.569
Luddam's Ford (MassDEP 2005)	Log10(total Hg wet wt) = - 1.11 + 0.827 Log10(total length, cm)	89.4%	1.31
Sudbury River Reach 2 (Nyanza)	Fish length reported as > 30.48 cm		0.853
Sudbury River Reach 3 (Nyanza)	Fish length reported as > 30.48 cm		0.991
Sudbury River Reach 4 (Nyanza)	Fish length reported as > 30.48 cm		0.728
Sudbury River Reach 5 (Nyanza)	Fish length reported as > 30.48 cm		0.645
Sudbury River Reach 6 (Nyanza)	Fish length reported as > 30.48 cm		0.755
Sudbury River Reach 7 (Nyanza)	Fish length reported as > 30.48 cm		0.729
Sudbury River Reach 8 (Nyanza)	Fish length reported as > 30.48 cm		1.02
Sudbury River Reach 9 (Nyanza)	Fish length reported as > 30.48 cm		1.07
Sudbury River Reach 10 (Nyanza)	Fish length reported as > 30.48 cm		0.955

NOTE:

* = Reported only average fish length which was less than 30.5 cm

Data sources:

Nyanza = Nyanza BERA
Portal = MassDEP Fish Mercury Research Data Portal
1995 MADEP = 1995 MassDEP Toxics in Fish Monitoring Program
FWX-PH2D = Fireworks Site Phase IIC/IID
Request = 2007 - 2012 MassDEP Formal Data Request
2005 MADEP = MassDEP 2005 Toxics in Fish Monitoring Program Technical Request for Special Sampling for Identified Waterbody

Table 5-1. Size Standardization Regression Relationships for the Largemouth Bass (LMB) Fillet Tissue Mercury Concentration Data By Water Body and Sampling Year

Water Body	Sampling Year	Notes / Regression Equation	Coefficient of Determination (R^2)	Standard Size (30.5 cm) LMB Fillet Tissue Mercury Concentration
			(percent)	(mg/Kg wwt)
Ashfield Pond	2009	Less than 3 years of data	-	-
Bare Hill Pond	2007	Log10(total Hg wet wt) = - 5.73 + 2.15 Log10(total length, mm)	77.3%	0.409
Bare Hill Pond	2009	Log10(total Hg wet wt) = - 4.77 + 1.73 Log10(total length, mm)	68.8%	0.337
Bare Hill Pond	2011	Log10(total Hg wet wt) = - 7.40 + 2.77 Log10(total length, mm)	87.0%	0.303
Buckley Dunton Lake	2008	Less than 3 years of data	-	-
Buckley Dunton Lake	2010	Less than 3 years of data	-	-
Chebacco	2008	Less than 3 years of data	-	-
Chebacco	2010	Less than 3 years of data	-	-
Crystal Lake	2007	Less than 3 years of data	-	-
Crystal Lake	2011	Less than 3 years of data	-	-
Echo Lake	2008	Log10(total Hg wet wt) = - 6.45 + 2.56 Log10(total length, mm)	76.4%	0.812
Echo Lake	2010	Log10(total Hg wet wt) = - 4.01 + 1.53 Log10(total length, mm)	58.0%	0.618
Echo Lake	2012	Log10(total Hg wet wt) = - 3.73 + 1.47 Log10(total length, mm)	61.5%	0.835
Goose Pond	2008	Log10(total Hg wet wt) = - 3.58 + 1.21 Log10(total length, mm)	50.4%	0.267
Goose Pond	2010	Log10(total Hg wet wt) = - 3.37 + 1.12 Log10(total length, mm)	63.7%	0.258
Goose Pond	2011	Log10(total Hg wet wt) = - 5.28 + 1.94 Log10(total length, mm)	60.0%	0.346
Horseleech Pond	2008	Less than 3 years of data	-	-
Horseleech Pond	2010	Less than 3 years of data	-	-
Kenoza	2008	Log10(total Hg wet wt) = - 5.70 + 2.15 Log10(total length, mm)	79.3%	0.438
Kenoza	2010	Log10(total Hg wet wt) = - 7.13 + 2.68 Log10(total length, mm)	71.1%	0.337
Kenoza	2012	Log10(total Hg wet wt) = - 9.25 + 3.45 Log10(total length, mm)	88.3%	0.209
Lake Lashaway	2007	Log10(total Hg wet wt) = - 6.06 + 2.25 Log10(total length, mm)	65.8%	0.339
Lake Lashaway	2009	Log10(total Hg wet wt) = - 4.98 + 1.79 Log10(total length, mm)	78.3%	0.293
Lake Lashaway	2011	Log10(total Hg wet wt) = - 8.38 + 3.19 Log10(total length, mm)	71.1%	0.351
Lake Nippenicket	2007	Log10(total Hg wet wt) = - 3.13 + 1.22 Log10(total length, mm)	54.2%	0.796
Lake Nippenicket	2009	Log10(total Hg wet wt) = - 5.28 + 2.05 Log10(total length, mm)	85.5%	0.650
Lake Nippenicket	2012	Log10(total Hg wet wt) = - 4.31 + 1.66 Log10(total length, mm)	56.7%	0.652
Laurel Lake	2009	Less than 3 years of data	-	-
Long Pond	2009	Less than 3 years of data	-	-
Massapoag Dunstable	2007	Log10(total Hg wet wt) = - 2.51 + 0.924 Log10(total length, mm)	68.4%	0.610
Massapoag Dunstable	2009	Log10(total Hg wet wt) = - 0.809 + 0.214 Log10(total length, mm)	0.0%	0.528
Massapoag Dunstable	2012	Log10(total Hg wet wt) = - 3.78 + 1.38 Log10(total length, mm)	59.3%	0.445
Massapoag Sharon	2007	Log10(total Hg wet wt) = - 6.62 + 2.45 Log10(total length, mm)	45.9%	0.293

Water Body	Sampling Year	Notes / Regression Equation	Coefficient of Determination (R^2)	Standard Size (30.5 cm) LMB Fillet Tissue Mercury Concentration
			(percent)	(mg/Kg wwt)
Massapoag Sharon	2009	Log10(total Hg wet wt) = - 1.41 + 0.45 Log10(total length, mm)	0.0%	0.510
Massapoag Sharon	2011	Log10(total Hg wet wt) = - 5.95 + 2.23 Log10(total length, mm)	83.3%	0.389
Newfield Pond	2009	Less than 3 years of data	-	-
Newfield Pond	2012	Less than 3 years of data	-	-
North Watuppa Pond	2007	Log10(total Hg wet wt) = - 4.87 + 1.86 Log10(total length, mm)	52.7%	0.563
North Watuppa Pond	2009	Log10(total Hg wet wt) = - 1.01 + 0.405 Log10(total length, mm)	0.0%	0.991
North Watuppa Pond	2011	Log10(total Hg wet wt) = - 4.62 + 1.77 Log10(total length, mm)	72.5%	0.599
Onota	2008	Log10(total Hg wet wt) = - 3.64 + 1.10 Log10(total length, mm)	41.4%	0.124
Onota	2010	Log10(total Hg wet wt) = - 8.78 + 3.21 Log10(total length, mm)	79.6%	0.157
Onota	2011	Log10(total Hg wet wt) = - 7.97 + 2.91 Log10(total length, mm)	85.2%	0.182
Pelham Lake	2008	Less than 3 years of data	-	-
Pelham Lake	2011	Less than 3 years of data	-	-
Plainfield Pond	2010	Less than 3 years of data	-	-
Quabbin Reservoir	2009	Less than 3 years of data	-	-
Round Pond (East)	2008	Less than 3 years of data	-	-
Round Pond (East)	2010	Less than 3 years of data	-	-
Somerset Reservoir	2009	Less than 3 years of data	-	-
Somerset Reservoir	2012	Less than 3 years of data	-	-
Upper Naukeag	2007	Log10(total Hg wet wt) = - 3.79 + 1.47 Log10(total length, mm)	81.2%	0.728
Upper Naukeag	2009	Log10(total Hg wet wt) = - 1.09 + 0.41 Log10(total length, mm)	0.0%	0.848
Upper Naukeag	2011	Log10(total Hg wet wt) = - 3.91 + 1.53 Log10(total length, mm)	82.8%	0.778
Upper Reservoir	2007	Only 2 data points	-	-
Upper Reservoir	2009	Only 2 data points	-	-
Upper Reservoir	2012	Less than 3 years of sufficient data	-	-
Wequaquet	2008	Log10(total Hg wet wt) = - 8.93 + 3.34 Log10(total length, mm)	47.1%	0.233
Wequaquet	2010	Log10(total Hg wet wt) = - 4.09 + 1.46 Log10(total length, mm)	84.6%	0.344
Wequaquet	2011	Log10(total Hg wet wt) = - 8.52 + 3.18 Log10(total length, mm)	83.1%	0.240
Wickaboag Pond	2007	Log10(total Hg wet wt) = - 3.95 + 1.35 Log10(total length, mm)	20.5%	0.253
Wickaboag Pond	2009	Log10(total Hg wet wt) = - 0.05 - 0.131 Log10(total length, mm)	0.0%	0.421
Wickaboag Pond	2012	Log10(total Hg wet wt) = - 8.81 + 3.23 Log10(total length, mm)	87.5%	0.164

NOTE:
Data source 2007 - 2012 MassDEP Formal Data Request

Table 5-2. Calculated Standard Size Largemouth Bass (LMB) Fillet Tissue Mercury Concentrations for the Massachusetts Water Bodies Evaluated for the Statewide Background Mercury Concentration Analysis

Water Body	Notes / Regression Equation	Coefficient of Determination (R^2)	Standard Size (30.5 cm) LMB Fillet Tissue Mercury Concentration
		(percent)	(mg/Kg wwt)
Ashfield Pond	Log10(total Hg wet wt) = - 5.33 + 1.96 Log10(total length, mm)	77.0%	0.346
Bare Hill Pond	Log10(total Hg wet wt) = - 6.25 + 2.33 Log10(total length, mm)	78.3%	0.345
Buckley Dunton Lake	Log10(total Hg wet wt) = - 3.89 + 1.47 Log10(total length, mm)	78.6%	0.578
Chebacco	Log10(total Hg wet wt) = - 5.63 + 2.08 Log10(total length, mm)	85.1%	0.345
Crystal Lake	Log10(total Hg wet wt) = - 3.03 + 1.05 Log10(total length, mm)	60.4%	0.379
Echo Lake	Log10(total Hg wet wt) = - 4.36 + 1.69 Log10(total length, mm)	62.1%	0.689
Goose Pond	Log10(total Hg wet wt) = - 4.48 + 1.60 Log10(total length, mm)	72.0%	0.313
Horseleech Pond	Log10(total Hg wet wt) = - 6.45 + 2.45 Log10(total length, mm)	65.2%	0.433
Kenoza	Log10(total Hg wet wt) = - 6.18 + 2.31 Log10(total length, mm)	71.0%	0.362
Lake Lashaway	Log10(total Hg wet wt) = - 6.17 + 2.29 Log10(total length, mm)	71.3%	0.330
Lake Nippenicket	Log10(total Hg wet wt) = - 4.12 + 1.60 Log10(total length, mm)	68.9%	0.716
Laurel Lake	Log10(total Hg wet wt) = - 4.25 + 1.54 Log10(total length, mm)	90.4%	0.377
Long Pond	Log10(total Hg wet wt) = - 8.02 + 2.90 Log10(total length, mm)	69.5%	0.153
Massapoag Dunstable	Log10(total Hg wet wt) = - 1.33 + 0.434 Log10(total length, mm)	14.7%	0.560
Massapoag Sharon	Log10(total Hg wet wt) = - 1.87 + 0.625 Log10(total length, mm)	12.8%	0.482
Newfield Pond	Log10(total Hg wet wt) = - 1.43 + 0.438 Log10(total length, mm)	14.8%	0.455
North Watuppa	Log10(total Hg wet wt) = - 1.27 + 0.487 Log10(total length, mm)	6.2%	0.871
Onota	Log10(total Hg wet wt) = - 7.10 + 2.54 Log10(total length, mm)	73.1%	0.162
Pelham Lake	Log10(total Hg wet wt) = - 7.04 + 2.60 Log10(total length, mm)	73.3%	0.263
Quabbin Reservoir	Log10(total Hg wet wt) = 0.384 - 0.338 Log10(total length, mm)	0.0%	0.350
Round Pond (East)	Log10(total Hg wet wt) = - 2.68 + 1.08 Log10(total length, mm)	52.0%	1.007
Somerset Reservoir	Log10(total Hg wet wt) = - 4.58 + 1.81 Log10(total length, mm)	49.3%	0.825
Upper Naukeag	Log10(total Hg wet wt) = - 2.32 + 0.910 Log10(total length, mm)	52.9%	0.872
Upper Reservoir	Log10(total Hg wet wt) = - 2.83 + 1.09 Log10(total length, mm)	60.8%	0.755
Wequaquet	Log10(total Hg wet wt) = - 5.18 + 1.91 Log10(total length, mm)	75.2%	0.367
Wickaboag Pond	Log10(total Hg wet wt) = - 1.16 + 0.273 Log10(total length, mm)	0.0%	0.330

NOTE:
Data source 2007 - 2012 MassDEP Formal Data Request

Table 5-3. Water Body-Specific Statistical Testing of the Possible Change with Time of the Statewide Background Largemouth Bass (LMB) Fillet Tissue Mercury Concentration

Water Body	Mann-Kendall Test for Time Trend	Theil-Sen Test for Time Trend		
	Notes / Results	Notes / Results	Theil-Sen Slope	Theil-Sen Intercept
Ashfield Pond	Only sampled in 2009			
Bare Hill Pond	Insufficient evidence to identify a significant trend at the specified level of significance (0.05)	Statistically signficant evidence of decreasing trend at the specified level of significance (0.05)	-0.0264	53.3256
Buckley Dunton Lake	Only sampled in 2008, 2010			
Chebacco	Only sampled in 2008, 2010			
Crystal Lake	Only sampled in 2007, 2011			
Echo Lake	Insufficient evidence to identify a significant trend at the specified level of significance (0.05)	Insufficient evidence to identify a significant trend at the specified level of significance (0.05)	0.0057	-10.7350
Goose Pond	Insufficient evidence to identify a significant trend at the specified level of significance (0.05)	Insufficient evidence to identify a significant trend at the specified level of significance (0.05)	0.0266	-53.1213
Horseleech Pond	Only sampled in 2008, 2010			
Kenoza	Insufficient evidence to identify a significant trend at the specified level of significance (0.05)	Statistically signficant evidence of decreasing trend at the specified level of significance (0.05)	-0.0571	115.1269
Lake Lashaway	Insufficient evidence to identify a significant trend at the specified level of significance (0.05)	Insufficient evidence to identify a significant trend at the specified level of significance (0.05)	0.0030	-5.73560
Lake Nippenicket	Insufficient evidence to identify a significant trend at the specified level of significance (0.05)	Insufficient evidence to identify a significant trend at the specified level of significance (0.05)	-0.0265	54.0368
Laurel Lake	Only sampled in 2009			
Long Pond	Only sampled in 2009			
Massapoag Dunstable	Insufficient evidence to identify a significant trend at the specified level of significance (0.05)	Statistically signficant evidence of decreasing trend at the specified level of significance (0.05)	-0.0331	66.9279
Massapoag Sharon	Insufficient evidence to identify a significant trend at the specified level of significance (0.05)	Insufficient evidence to identify a significant trend at the specified level of significance (0.05)	0.0241	-47.9573
Newfield Pond	Only sampled in 2009, 2012			
North Watuppa	Insufficient evidence to identify a significant trend at the specified level of significance (0.05)	Insufficient evidence to identify a significant trend at the specified level of significance (0.05)	0.0088	-17.0252
Onota	Insufficient evidence to identify a significant trend at the specified level of significance (0.05)	Statistically signficant evidence of increasing trend at the specified level of significance (0.05)	0.0193	-38.6228
Pelham Lake	Only sampled in 2008, 2011			
Quabbin Reservoir	Only sampled in 2009			
Round Pond (East)	Only sampled in 2008, 2010			
Somerset Reservoir	Only sampled in 2009, 2012			
Upper Naukeag	Insufficient evidence to identify a significant trend at the specified level of significance (0.05)	Insufficient evidence to identify a significant trend at the specified level of significance (0.05)	0.0126	-24.511
Upper Reservoir	Only 2 data points available for 2007 and 2009			
Wequaquet	Insufficient evidence to identify a significant trend at the specified level of significance (0.05)	Insufficient evidence to identify a significant trend at the specified level of significance (0.05)	0.0023	-4.3250
Wickaboag Pond	Insufficient evidence to identify a significant trend at the specified level of significance (0.05)	Insufficient evidence to identify a significant trend at the specified level of significance (0.05)	-0.0179	36.2581

NOTE:
Data source 2007 - 2012 MassDEP Formal Data Request

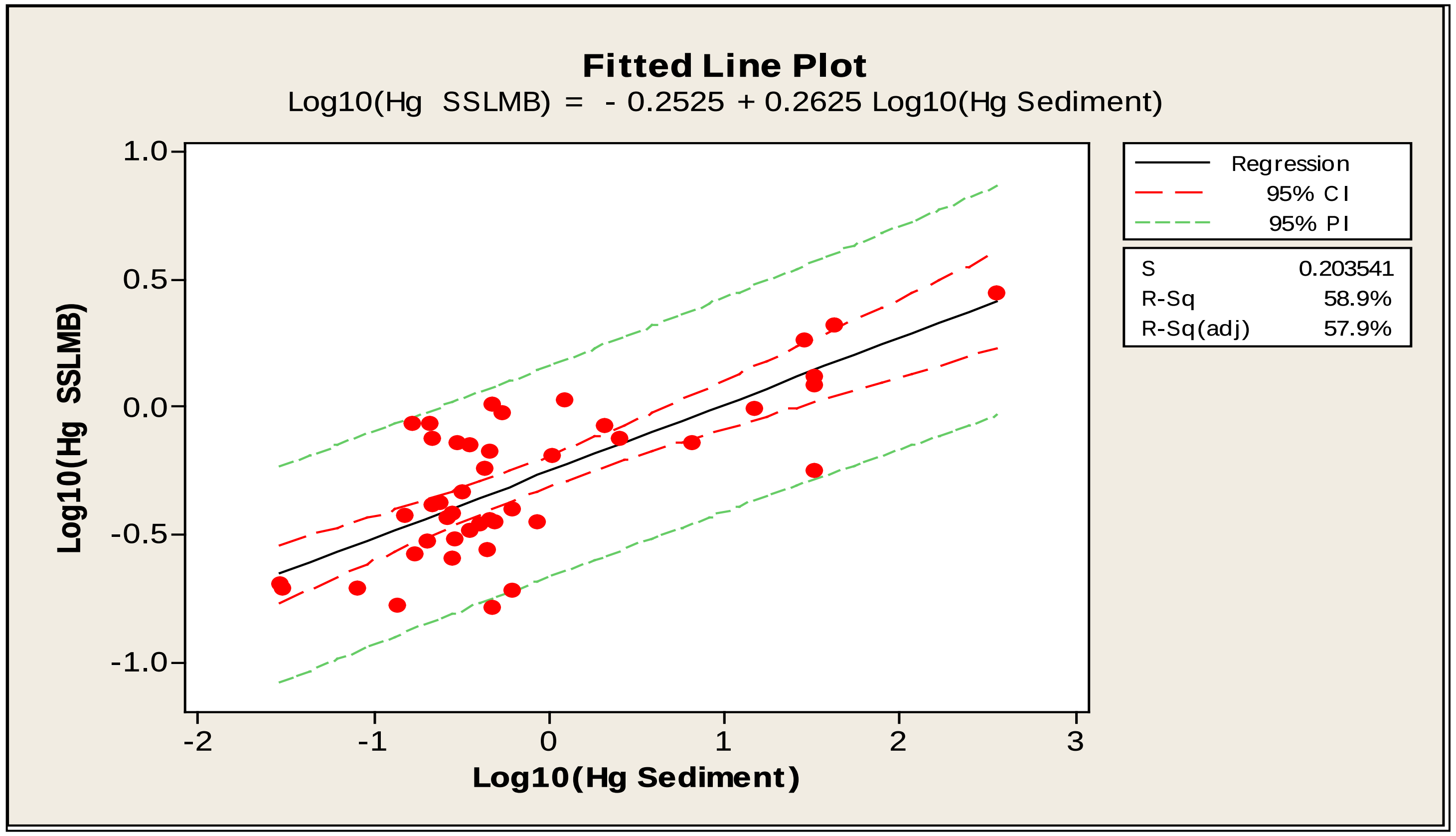
Table 6-1. Background Massachusetts Water Bodies / Reaches with Largemouth Bass (LMB) Fillet Tissue Mercury Concentrations Approximately Equal to the Identified Statewide Background Concentration

Water Body / Reach	Data Source	Surface Water pH	Average Standard Size (30.5 cm) LMB Fillet Tissue Mercury Concentration [1]	Average Surficial Sediment Total Mercury Concentration
		(pH units)	(mg/Kg wwt)	(mg/Kg dwt)
Baldpate Pond	MassDEP Data Request	7.0	0.666	0.448
Lake Nippenicket	MassDEP Data Request	6.2	0.716	0.347
Pomps Pond	MassDEP Data Request	7.28	0.355	0.166
Sudbury River Reach 2	NYANZA BERA	7.0-7.04	0.853	2.03
Sudbury River Reach 3	NYANZA BERA	7.0-7.04	0.991	15.0
Sudbury River Reach 4	NYANZA BERA	7.0-7.04	0.728	6.59
Sudbury River Reach 5	NYANZA BERA	7.0-7.04	0.645	1.05
Sudbury River Reach 6	NYANZA BERA	7.0-7.04	0.755	2.53
Sudbury River Reach 7	NYANZA BERA	7.0-7.04	0.729	0.296
Sudbury River Reach 8	NYANZA BERA	7.0-7.04	1.02	0.473
Sudbury River Reach 9	NYANZA BERA	7.0-7.04	1.07	1.21
Sudbury River Reach 10	NYANZA BERA	7.0-7.04	0.955	0.534
Upper Naukeag	MassDEP Data Request	5.6	0.872	0.207
Upper Reservoir	MassDEP Data Request	5.6	0.755	0.214

NOTES:

1. Water bodies / reaches with LMB Tissue (fillet) mercury concentrations within the central range of the statewide background LMB fillet tissue concentration distribution shown in Figure 5-1.

Table 6-2. Regression of the Standard Size Largemouth Bass (LMB) Fillet Tissue Mercury Concentration on the Average Surficial Sediment Total Mercury Concentration Using a Log10 - Log10 Transformation



The regression equation is
Log10(Hg SSLMB) = - 0.252 + 0.263 Log10(Hg Sediment)

```
Predictor              Coef  SE Coef      T      P
Constant           -0.25247  0.03048  -8.28  0.000
Log10(Hg Sediment)  0.26252  0.03347   7.84  0.000
```

S = 0.203541   R-Sq = 58.9%   R-Sq(adj) = 57.9%

```
Analysis of Variance

Source          DF      SS      MS      F      P
Regression       1  2.5491  2.5491  61.53  0.000
Residual Error  43  1.7814  0.0414
Total           44  4.3306
```

Unusual Observations

```
     Log10(Hg  Log10(Hg
Obs  Sediment)    SSLMB)     Fit  SE Fit  Residual  St Resid
  1       2.56    0.4518  0.4183  0.0934    0.0334     0.18 X    Eastern Channel Drink Water River
  2       1.52   -0.2449  0.1462  0.0617   -0.3911    -2.02R     Luddam's Ford (2003)
 11      -0.22   -0.7223 -0.3090  0.0307   -0.4132    -2.05R     Lake Cochichewick
 12      -0.33   -0.7899 -0.3400  0.0315   -0.4499    -2.24R     Onota

R denotes an observation with a large standardized residual.
X denotes an observation whose X value gives it large influence.
```

Table 6-3. Probabilistic Projections of the Average Largemouth Bass (LMB) Fillet Tissue Mercury Concentration as a Function of the Average Surficial Sediment Total Mercury Concentration

Average Surficial Sediment Total Mercury Concentration	Log10 Average Surficial Sediment Total Mercury Concentration	Regression Slope Term	Regression Intercept Term	Log10 Standard Size LMB Fillet Tissue Mercury Concentration	Log10 Standard Size LMB Fillet Tissue Mercury Concentration Standard Error		Log10 Standard Size LMB Fillet Tissue Mercury Concentration (Crystal Ball)	Standard Size LMB Fillet Tissue Mercury Concentration	Apparent BSAF	Apparent BSAF (Crystal Ball)		Projected Average LMB Fillet Tissue Mercury Concentration (Crystal Ball)
(mg/kg dwt)	(---)	(---)	(---)	(---)			(---)	(mg/kg)	(unitless)	(unitless)		(mg/kg wwt)
0.10	-1.00	0.2625	-0.2525	-0.5150	0.0431		-0.5150	0.30549	3.0549	3.0549		0.305
0.30	-0.52	0.2625	-0.2525	-0.3898	0.0337		-0.3898	0.40757	1.3586	1.3586		0.408
0.50	-0.30	0.2625	-0.2525	-0.3315	0.0312		-0.3315	0.46612	0.9322	0.9322		0.466
1.0	0.00	0.2625	-0.2525	-0.2525	0.0305		-0.2525	0.55911	0.5591	0.5591		0.559
1.5	0.1761	0.2625	-0.2525	-0.2063	0.0316		-0.2063	0.62187	0.4146	0.4146		0.622
2.0	0.3010	0.2625	-0.2525	-0.1735	0.0330		-0.1735	0.67066	0.3353	0.3353		0.671
2.5	0.3979	0.2625	-0.2525	-0.1480	0.0344		-0.1480	0.71121	0.2845	0.2845		0.711
3.0	0.4771	0.2625	-0.2525	-0.1273	0.0357		-0.1273	0.74593	0.2486	0.2486		0.746
3.07	0.4871	0.2625	-0.2525	-0.1246	0.0359		-0.1246	0.75059	0.2445	0.2445		0.751
3.16	0.4997	0.2625	-0.2525	-0.1213	0.0361		-0.1213	0.75631	0.2393	0.2393		0.756
3.5	0.5441	0.2625	-0.2525	-0.1097	0.0369		-0.1097	0.77678	0.2219	0.2219		0.777
4.0	0.6021	0.2625	-0.2525	-0.0945	0.0381		-0.0945	0.80445	0.2011	0.2011		0.804
4.5	0.6532	0.2625	-0.2525	-0.0810	0.0391		-0.0810	0.82985	0.1844	0.1844		0.830
5.0	0.6990	0.2625	-0.2525	-0.0690	0.0401		-0.0690	0.85310	0.1706	0.1706		0.853
6.0	0.7782	0.2625	-0.2525	-0.0482	0.0419		-0.0482	0.89495	0.1492	0.1492		0.895
7.0	0.8451	0.2625	-0.2525	-0.0307	0.0435		-0.0307	0.93175	0.1331	0.1331		0.932
8.0	0.9031	0.2625	-0.2525	-0.0154	0.0449		-0.0154	0.96516	0.1206	0.1206		0.965
9.0	0.9542	0.2625	-0.2525	-0.0020	0.0462		-0.0020	0.99541	0.1106	0.1106		0.995
10	1.00	0.2625	-0.2525	0.0100	0.0473		0.0100	1.02329	0.1023	0.1023		1.023
15	1.18	0.2625	-0.2525	0.0562	0.0520		0.0562	1.13815	0.0759	0.0759		1.138
20	1.30	0.2625	-0.2525	0.0890	0.0554		0.0890	1.22744	0.0614	0.0614		1.227
33	1.52	0.2625	-0.2525	0.1461	0.0617		0.1461	1.39991	0.0424	0.0424		1.400
42	1.62	0.2625	-0.2525	0.1736	0.0647		0.1736	1.49142	0.0355	0.0355		1.491

Table 6-4. MINITAB Output of the Predicted Mean and Standard Error Values from the Regression Relationship Between the Log10 Standard Size Largemouth Bass (LMB) Fillet Tissue Mercury Concentration and the Log10 Surficial Sediment Total Mercury Concentration

```
Regression Analysis: Log10(Hg  SSLMB) versus Log10(Hg Sediment)

The regression equation is
Log10(Hg  SSLMB) = - 0.252 + 0.263 Log10(Hg Sediment)

Predictor               Coef  SE Coef      T      P
Constant            -0.25247  0.03048  -8.28  0.000
Log10(Hg Sediment)   0.26252  0.03347   7.84  0.000

S = 0.203541   R-Sq = 58.9%   R-Sq(adj) = 57.9%

Analysis of Variance

Source          DF      SS      MS      F      P
Regression       1  2.5491  2.5491  61.53  0.000
Residual Error  43  1.7814  0.0414
Total           44  4.3306

Predicted Values for New Observations

New
Obs      Fit  SE Fit        95% CI              95% PI
  1  -0.5150  0.0431  (-0.6019, -0.4281)  (-0.9346, -0.0954)


Values of Predictors for New Observations

New   Log10(Hg
Obs  Sediment)
  1      -1.00


Predicted Values for New Observations

New
Obs      Fit  SE Fit        95% CI              95% PI
  1  -0.2525  0.0305  (-0.3139, -0.1910)  (-0.6675, 0.1626)


Values of Predictors for New Observations

New   Log10(Hg
Obs  Sediment)
  1   0.000000


Predicted Values for New Observations

New
Obs     Fit  SE Fit        95% CI             95% PI
  1  0.0101  0.0473  (-0.0854, 0.1055)  (-0.4114, 0.4315)


Values of Predictors for New Observations
```

```
New   Log10(Hg
Obs  Sediment)
  1       1.00
```

Predicted Values for New Observations

```
New
Obs     Fit  SE Fit        95% CI             95% PI
  1  0.0563  0.0520  (-0.0486, 0.1611)  (-0.3674, 0.4799)
```

Values of Predictors for New Observations

```
New   Log10(Hg
Obs  Sediment)
  1       1.18
```

Predicted Values for New Observations

```
New
Obs     Fit  SE Fit        95% CI             95% PI
  1  0.0891  0.0554  (-0.0227, 0.2009)  (-0.3364, 0.5145)
```

Values of Predictors for New Observations

```
New   Log10(Hg
Obs  Sediment)
  1       1.30
```

Predicted Values for New Observations

```
New
Obs      Fit  SE Fit        95% CI              95% PI
  1  -0.3897  0.0337  (-0.4577, -0.3218)  (-0.8058, 0.0263)
```

Values of Predictors for New Observations

```
New   Log10(Hg
Obs  Sediment)
  1     -0.523
```

Predicted Values for New Observations

```
New
Obs      Fit  SE Fit        95% CI              95% PI
  1  -0.3315  0.0312  (-0.3944, -0.2686)  (-0.7468, 0.0838)
```

Values of Predictors for New Observations

```
New   Log10(Hg
```

```
Obs  Sediment)
  1     -0.301


Predicted Values for New Observations

New
Obs     Fit  SE Fit       95% CI             95% PI
  1  0.1462  0.0617  (0.0218, 0.2705)  (-0.2827, 0.5751)


Values of Predictors for New Observations

New   Log10(Hg
Obs  Sediment)
  1       1.52


Predicted Values for New Observations

New
Obs     Fit  SE Fit       95% CI             95% PI
  1  0.1737  0.0647  (0.0431, 0.3042)  (-0.2571, 0.6044)


Values of Predictors for New Observations

New   Log10(Hg
Obs  Sediment)
  1       1.62

Predicted Values for New Observations

New
Obs      Fit  SE Fit        95% CI              95% PI
  1  -0.2062  0.0316  (-0.2699, -0.1426)  (-0.6216, 0.2092)


Values of Predictors for New Observations

New   Log10(Hg
Obs  Sediment)
  1      0.176


Predicted Values for New Observations

New
Obs      Fit  SE Fit        95% CI              95% PI
  1  -0.1734  0.0330  (-0.2400, -0.1069)  (-0.5893, 0.2424)


Values of Predictors for New Observations

New   Log10(Hg
Obs  Sediment)
  1      0.301

```

Predicted Values for New Observations

```
New
Obs      Fit  SE Fit        95% CI              95% PI
  1  -0.1480  0.0344  (-0.2173, -0.0787)  (-0.5643, 0.2683)
```

Values of Predictors for New Observations

```
New   Log10(Hg
Obs  Sediment)
  1      0.398
```

Predicted Values for New Observations

```
New
Obs      Fit  SE Fit        95% CI              95% PI
  1  -0.1272  0.0357  (-0.1992, -0.0552)  (-0.5440, 0.2895)
```

Values of Predictors for New Observations

```
New   Log10(Hg
Obs  Sediment)
  1      0.477
```

Predicted Values for New Observations

```
New
Obs      Fit  SE Fit        95% CI              95% PI
  1  -0.1213  0.0361  (-0.1941, -0.0485)  (-0.5382, 0.2956)
```

Values of Predictors for New Observations

```
New   Log10(Hg
Obs  Sediment)
  1      0.500
```

Predicted Values for New Observations

```
New
Obs      Fit  SE Fit        95% CI              95% PI
  1  -0.1246  0.0359  (-0.1970, -0.0522)  (-0.5414, 0.2922)
```

Values of Predictors for New Observations

```
New   Log10(Hg
Obs  Sediment)
  1      0.487
```

Predicted Values for New Observations

```
New
Obs      Fit  SE Fit        95% CI             95% PI
  1  -0.1096  0.0369  (-0.1841, -0.0351)  (-0.5268, 0.3076)
```

Values of Predictors for New Observations

```
New   Log10(Hg
Obs  Sediment)
  1      0.544
```

Predicted Values for New Observations

```
New
Obs      Fit  SE Fit        95% CI             95% PI
  1  -0.0944  0.0381  (-0.1712, -0.0176)  (-0.5120, 0.3232)
```

Values of Predictors for New Observations

```
New   Log10(Hg
Obs  Sediment)
  1      0.602
```

Predicted Values for New Observations

```
New
Obs      Fit  SE Fit        95% CI             95% PI
  1  -0.0810  0.0391  (-0.1599, -0.0021)  (-0.4990, 0.3370)
```

Values of Predictors for New Observations

```
New   Log10(Hg
Obs  Sediment)
  1      0.653
```

Predicted Values for New Observations

```
New
Obs      Fit  SE Fit        95% CI            95% PI
  1  -0.0690  0.0401  (-0.1499, 0.0119)  (-0.4873, 0.3494)
```

Values of Predictors for New Observations

```
New   Log10(Hg
Obs  Sediment)
  1      0.699
```

Predicted Values for New Observations

```
New
```

```
Obs      Fit  SE Fit        95% CI             95% PI
  1  -0.0482  0.0419  (-0.1327, 0.0363)  (-0.4673, 0.3709)


Values of Predictors for New Observations

New   Log10(Hg
Obs  Sediment)
  1      0.778


Predicted Values for New Observations

New
Obs      Fit  SE Fit        95% CI             95% PI
  1  -0.0306  0.0435  (-0.1183, 0.0571)  (-0.4503, 0.3891)


Values of Predictors for New Observations

New   Log10(Hg
Obs  Sediment)
  1      0.845


Predicted Values for New Observations

New
Obs      Fit  SE Fit        95% CI             95% PI
  1  -0.0154  0.0449  (-0.1059, 0.0751)  (-0.4357, 0.4050)


Values of Predictors for New Observations

New   Log10(Hg
Obs  Sediment)
  1      0.903


Predicted Values for New Observations

New
Obs      Fit  SE Fit        95% CI             95% PI
  1  -0.0020  0.0462  (-0.0951, 0.0911)  (-0.4229, 0.4189)


Values of Predictors for New Observations

New   Log10(Hg
Obs  Sediment)
  1      0.954

```

Table 6-5. Projected Probability that a Specified Average Surficial Sediment Total Mercury Cleanup Goal will Result in an Average Largemouth Bass (LMB) Fillet Tissue Mercury Concentration Less Than the Benchmark Statewide Background Concentration Using the Regression Relationship-Based Model

Average Surficial Sediment Total Mercury Concentration (mg/Kg dwt)	Probability that the Post-Remediation Average LMB Fillet Mercury Concentration Will be Less than the Benchmark Statewide Background Concentration of 0.85 mg/Kg wwt (%)
0.10	100
0.30	100
0.50	100
1.0	100
1.5	100
2.0	99.9
2.5	98.6
3.0	94.1
3.1	93.1
3.2	91.4
3.5	84.9
4.0	72.1
4.5	59.5
5.0	47.4
6.0	28.7
7.0	17.3
8.0	10.5
9.0	6.8
10	4.0
15	0.68
20	0.16
33	0.040
42	0.007

Table 6-6. Calculated Standard Size and Non-Standard Size Biota Sediment Accumulation Factors (BSAFs) for the Massachusetts Water Bodies with Paired Surficial Sediment and Largemouth Bass (LMB) Fillet Tissue Mercury Measurements

Water Body	Water Body Group	Data Source	pH of Water Body	Average Surficial Sediment Total Mercury Concentration	Standard Size LMB Fillet Tissue Mercury Concentration	Non-Standard Size LMB Fillet Tissue Mercury Concentration	Length of LMB Sampled (notes)	Calculated Non-Standard Size BSAF	Calculated Standard Size BSAF
			(pH units)	(mg/Kg dwt)	(mg/Kg wwt)	(mg/Kg wwt)	(cm)	(unitless)	(unitless)
Eastern Channel Drink Water River	Non-Reference	FWX-PH2D	6.47	359	2.83	2.83	39	0.00788	0.00788
Luddam's Ford (2003)	Non-Reference	FWX-PH2D	7-7.04	33	0.569	0.569	Ave = 31	0.0172	0.0172
Luddam's Ford (1995)	Non-Reference	1995 MADEP	7-7.04	33	1.23	1.23	Ave = 36	0.0373	0.0373
Luddam's Ford (2005)	Non-Reference	2005 MADEP	7-7.04	33	1.31	1.63	Ave = 40	0.0492	0.0397
Lilly/Upper Factory Pond	Non-Reference	FWX-PH2D	5.79-6.31	42.9	2.10	2.1	Ave = 40.3	0.0490	0.0490
Lower Drink Water Channel	Non-Reference	FWX-PH2D	6.46-6.7	42.3	2.09	2.09	Ave = 34.6	0.0494	0.0494
Middle/Lower Factory Pond	Non-Reference	FWX-PH2D	5.3-6.62	28.9	1.84	1.84	Ave = 31.5	0.0637	0.0637
Sudbury River Reach 3	Non-Reference	NYANZA BERA	7-7.04	15	0.991	0.991	≥30.48*	0.0661	0.0661
Sudbury River Reach 4	Non-Reference	NYANZA BERA	7-7.04	6.59	0.728	0.728	≥30.48*	0.110	0.110
Sudbury River Reach 6	Non-Reference	NYANZA BERA	7-7.04	2.53	0.755	0.755	≥30.48*	0.298	0.298
Lake Cochichewick	Reference	MADEP Request	6.33	0.609	0.190	0.282	Standard-sized 30.5 cm	0.463	0.311
Onota	Reference	MADEP Request	7.32	0.464	0.162	0.259	Standard-sized 30.5 cm	0.559	0.350
Sudbury River Reach 2	Non-Reference	NYANZA BERA	7-7.04	2.03	0.853	0.853	≥30.48*	0.420	0.420
Sudbury River Reach 1	Reference	NYANZA BERA	7-7.04	0.843	0.357	0.357	≥30.48*	0.423	0.423
Sudbury River Reach 5	Non-Reference	NYANZA BERA	7-7.04	1.05	0.645	0.645	≥30.48*	0.614	0.614
Forge Pond (1995)	Reference	1995 MADEP	6.61-6.85	0.445	0.275	0.275	Ave = 34.1	0.618	0.618
Haggetts Pond	Reference	MADEP Request	7.3	0.622	0.397	0.642	Standard-sized 30.5 cm	1.03	0.639
Kenoza	Reference	MADEP Request	7	0.461	0.362	0.728	Standard-sized 30.5 cm	1.58	0.785
Bare Hill Pond	Reference	MADEP Request	6.45	0.405	0.345	0.580	Standard-sized 30.5 cm	1.43	0.853
Sudbury River Reach 9	Non-Reference	NYANZA BERA	7-7.04	1.21	1.07	1.07	≥30.48*	0.88	0.884
Wickaboag Pond	Reference	MADEP Request	6.5	0.355	0.330	0.400	Standard-sized 30.5 cm	1.13	0.929
Laurel Lake	Reference	MADEP Mercury Portal	6.40	0.274	0.257	0.381	Standard-sized 30.5 cm	1.39	0.938
Buckley Dunton	Reference	MADEP Mercury Portal	5.70	0.29	0.301	0.427	Standard-sized 30.5 cm	1.47	1.04
Bog Pond	Reference	MADEP Mercury Portal	6.45	0.133	0.167	0.413	Standard-sized 30.5 cm	3.11	1.26
Buckley Dunton Lake	Reference	MADEP Request	6.65	0.429	0.578	0.673	Standard-sized 30.5 cm	1.57	1.35
Little Quittacas	Reference	MADEP Mercury Portal	7.14	0.279	0.384	0.280	Standard-sized 30.5 cm	1.00	1.37
Wequaquet	Reference	MADEP Request	5.88	0.262	0.367	0.545	Standard-sized 30.5 cm	2.08	1.40
North Drink Water River	Reference	FWX-PH2D	6.80	0.3180	0.462	0.462	Ave = 39.3	1.45	1.45
Sudbury Reservoir	Reference	NYANZA BERA	7-7.04	0.199	0.295	0.295	≥30.48*	1.48	1.48
Baldpate Pond	Reference	MADEP Request	7	0.448	0.666	0.648	Standard-sized 30.5 cm	1.45	1.49
Pelham Lake	Reference	MADEP Request	6.02	0.171	0.263	0.332	Standard-sized 30.5 cm	1.94	1.54
Charles River	Reference	NYANZA BERA	7-7.04	0.237	0.423	0.423	≥30.48*	1.78	1.78
Rock Pond	Reference	MADEP Request	5.72	0.479	0.856	0.948	Standard-sized 30.5 cm	1.98	1.787
Sudbury River Reach 10	Non-Reference	NYANZA BERA	7-7.04	0.534	0.955	0.955	≥30.48*	1.79	1.79
Somerset Reservoir	Reference	MADEP Mercury Portal	7.29	0.215	0.417	0.637	Standard-sized 30.5 cm	2.96	1.94
Lake Nippenicket	Reference	MADEP Request	6.2	0.347	0.716	1.06	Standard-sized 30.5 cm	3.06	2.06
Pomps Pond	Reference	MADEP Request	7.28	0.166	0.355	0.333	Standard-sized 30.5 cm	2.01	2.14
Sudbury River Reach 8	Non-Reference	NYANZA BERA	7-7.04	0.473	1.02	1.02	≥30.48*	2.16	2.16
Center Pond	Reference	MADEP Mercury Portal	7.48	0.08	0.196	0.323	Standard-sized 30.5 cm	4.04	2.44
Sudbury River Reach 7	Non-Reference	NYANZA BERA	7-7.04	0.296	0.729	0.729	≥30.48*	2.46	2.46
North Watuppa	Reference	MADEP Mercury Portal	6.08	0.149	0.377	0.723	Standard-sized 30.5 cm	4.85	2.53
Upper Reservoir	Reference	MADEP Request	5.6	0.214	0.755	0.969	Standard-sized 30.5 cm	4.53	3.53
Upper Naukeag	Reference	MADEP Request	5.6	0.207	0.872	1.23	Standard-sized 30.5 cm	5.95	4.21
Yokum Pond	Reference	MADEP Mercury Portal	7.17	0.03	0.193	0.188	Standard-sized 30.5 cm	6.28	6.42
Elders Pond	Reference	MADEP Mercury Portal	7.13	0.029	0.201	0.251	Standard-sized 30.5 cm	8.66	6.94
Forge Pond	Reference	FWX-PH2D		0.37	*	0.204	Ave = 28 (too small)	0.551	No value
Below Factory Pond Dam	Non-Reference	FWX-PH2D	5.99	0.992	*	0.598	Ave = 20.6 (too small)	0.603	No value
Upper Naukeag (Portal)	Reference	MADEP Mercury Portal	5.63	0.148	*	0.37	29.5 (too small)	2.50	No value

Data sources:

Nyanza = Nyanza BERA
Portal = MassDEP Fish Mercury Research Data Portal
1995 MADEP = 1995 MassDEP Toxics in Fish Monitoring Program
FWX-PH2D = Fireworks Site Phase IIC/IID
Request = 2007 - 2012 MassDEP Formal Data Request
2005 MADEP = MassDEP 2005 Toxics in Fish Monitoring

Table 6-7. Calculated Standard Size Biota Sediment Accumulation Factors (BSAFs) for the "Reference" and "Non-Reference" Massachusetts Water Bodies

Water Body	Water Body Group	Data Source	pH of Water Body	Standard Size LMB Fillet Tissue Mercury Concentration	Average Surficial Sediment Total Mercury Concentration	Calculated Standard Size BSAF
			(pH units)	(mg/Kg wwt)	(mg/Kg dwt)	(unitless)
Sudbury Reservoir	Reference	NYANZA BERA	7-7.04	0.295	0.199	1.48
Sudbury River Reach 1	Reference	NYANZA BERA	7-7.04	0.357	0.843	0.42
Forge Pond (1995)	Reference	1995MADEP	6.61-6.85	0.275	0.445	0.62
Laurel Lake	Reference	MADEP Mercury Portal	6.40	0.257	0.274	0.94
Buckley Dunton	Reference	MADEP Mercury Portal	5.70	0.301	0.290	1.04
Bog Pond	Reference	MADEP Mercury Portal	6.45	0.167	0.133	1.26
Little Quittacas	Reference	MADEP Mercury Portal	7.14	0.384	0.279	1.37
Charles River	Reference	NYANZA BERA	7-7.04	0.423	0.237	1.78
Somerset Reservoir	Reference	MADEP Mercury Portal	7.29	0.417	0.215	1.94
Center Pond	Reference	MADEP Mercury Portal	7.48	0.196	0.080	2.44
North Watuppa	Reference	MADEP Mercury Portal	6.08	0.377	0.149	2.53
Yokum Pond	Reference	MADEP Mercury Portal	7.17	0.193	0.030	6.42
North Drink Water River	Reference	FWX-PH2D	6.80	0.462	0.0686	6.73
Elders Pond	Reference	MADEP Mercury Portal	7.13	0.201	0.029	6.94
Lake Cochichewick	Reference	MADEP Request	6.33	0.190	0.609	0.31
Onota	Reference	MADEP Request	7.32	0.162	0.464	0.35
Haggetts Pond	Reference	MADEP Request	7.30	0.397	0.622	0.64
Rock Pond	Reference	MADEP Request	5.72	0.856	0.479	1.79
Kenoza	Reference	MADEP Request	7.00	0.362	0.461	0.79
Bare Hill Pond	Reference	MADEP Request	6.45	0.345	0.405	0.85
Wickaboag Pond	Reference	MADEP Request	6.50	0.330	0.355	0.93
Buckley Dunton Lake	Reference	MADEP Request	6.65	0.578	0.429	1.35
Wequaquet	Reference	MADEP Request	5.88	0.367	0.262	1.40
Baldpate Pond	Reference	MADEP Request	7.00	0.666	0.448	1.49
Pelham Lake	Reference	MADEP Request	6.02	0.263	0.171	1.54
Lake Nippenicket	Reference	MADEP Request	6.20	0.716	0.347	2.06
Upper Reservoir	Reference	MADEP Request	5.60	0.755	0.214	3.53
Upper Naukeag	Reference	MADEP Request	5.60	0.872	0.207	4.21
Pomps Pond	Reference	MADEP Request	7.28	0.355	0.166	2.14
				All "Reference"	**Mimimum**	**0.311**
					Average	**2.045**
					Maximum	**6.944**
					Median	**1.482**
					Standard Deviation	**1.837**
Water Body	**Water Body Group**	**Data Source**	**pH of Water Body**	**Standard Size LMB Fillet Tissue Mercury Concentration**	**Average Surficial Sediment Total Mercury Concentration**	**Calculated Standard Size BSAF**
			(pH units)	**(mg/Kg wwt)**	**(mg/Kg dwt)**	**(unitless)**
Eastern Channel Drink Water River	Non-Reference	FWX-PH2D	6.47	2.83	359	0.0079
Luddam's Ford (2003)	Non-Reference	FWX-PH2D	7-7.04	0.569	33.0	0.017
Luddam's Ford (1995)	Non-Reference	1995MADEP	7-7.04	1.23	33.0	0.037
Luddam's Ford (2005)	Non-Reference	2005MADEP	7-7.04	1.31	33.0	0.040
Lilly/Upper Factory Pond	Non-Reference	FWX-PH2D	5.79-6.31	2.10	42.9	0.049
Lower Drink Water Channel	Non-Reference	FWX-PH2D	6.46-6.7	2.09	42.3	0.049
Middle/Lower Factory Pond	Non-Reference	FWX-PH2D	5.3-6.62	1.84	28.9	0.064
Sudbury River Reach 3	Non-Reference	NYANZA BERA	7-7.04	0.991	15.0	0.066
Sudbury River Reach 4	Non-Reference	NYANZA BERA	7-7.04	0.728	6.59	0.11
Sudbury River Reach 6	Non-Reference	NYANZA BERA	7-7.04	0.755	2.53	0.30
Sudbury River Reach 2	Non-Reference	NYANZA BERA	7-7.04	0.853	2.03	0.42
Sudbury River Reach 5	Non-Reference	NYANZA BERA	7-7.04	0.645	1.05	0.61
Sudbury River Reach 9	Non-Reference	NYANZA BERA	7-7.04	1.07	1.21	0.88
Sudbury River Reach 10	Non-Reference	NYANZA BERA	7-7.04	0.955	0.534	1.79
Sudbury River Reach 8	Non-Reference	NYANZA BERA	7-7.04	1.02	0.473	2.16
Sudbury River Reach 7	Non-Reference	NYANZA BERA	7-7.04	0.729	0.296	2.46
				All "Non-Reference"	**Mimimum**	**0.008**
					Average	**0.567**
					Maximum	**2.463**
					Median	**0.088**
					Standard Deviation	**0.826**
				Fireworks Site Only	**Mimimum**	**0.008**
					Average	**0.038**
					Maximum	**0.064**
					Median	**0.040**
					Standard Deviation	**0.019**

Table 6-8. Comparisons of the Calculated Standard Size Largemouth Bass (LMB) Biota Sediment Accumulation Factors (BSAFs) for the "Non-Reference" Massachusetts Water Bodies to the Projected Probabilistic Standard Size BSAF for the Same Average Surficial Sediment Total Mercury Concentration

Water Body	Water Body Group	Data Source	pH of Water Body	Standard Size LMB Fillet Tissue Mercury Concentration	Average Surficial Sediment Total Mercury Concentration	Calculated Standard Size BSAF	Approximate Percentile of the Probabilistic BSAF Distribution that is Less Than the Calculated Standard Size BSAF [1,2]
			(pH units)	(mg/Kg wwt)	(mg/Kg dwt)	(unitless)	(%)
Eastern Channel Drink Water River	Non-Reference	FWX-PH2D	6.47	2.83	359	0.0079	0.0%
Luddam's Ford (2003)	Non-Reference	FWX-PH2D	7-7.04	0.569	33.0	0.017	0.0%
Luddam's Ford (1995)	Non-Reference	1995MADEP	7-7.04	1.23	33.0	0.037	16.8%
Luddam's Ford (2005)	Non-Reference	2005MADEP	7-7.04	1.31	33.0	0.040	34.6%
Lilly/Upper Factory Pond	Non-Reference	FWX-PH2D	5.79-6.31	2.10	42.9	0.049	98.4%
Lower Drink Water Channel	Non-Reference	FWX-PH2D	6.46-6.7	2.09	42.3	0.049	98.4%
Middle/Lower Factory Pond	Non-Reference	FWX-PH2D	5.3-6.62	1.84	28.9	0.064	95.0%
Sudbury River Reach 3	Non-Reference	NYANZA BERA	7-7.04	0.991	15.0	0.066	12.0%
Sudbury River Reach 4	Non-Reference	NYANZA BERA	7-7.04	0.728	6.59	0.11	2.9%
Sudbury River Reach 6	Non-Reference	NYANZA BERA	7-7.04	0.755	2.53	0.30	74.7%
Sudbury River Reach 2	Non-Reference	NYANZA BERA	7-7.04	0.853	2.03	0.42	100%
Sudbury River Reach 5	Non-Reference	NYANZA BERA	7-7.04	0.645	1.05	0.61	89.4%
Sudbury River Reach 9	Non-Reference	NYANZA BERA	7-7.04	1.07	1.21	0.88	100%
Sudbury River Reach 10	Non-Reference	NYANZA BERA	7-7.04	0.955	0.534	1.79	100%
Sudbury River Reach 8	Non-Reference	NYANZA BERA	7-7.04	1.02	0.473	2.16	100%
Sudbury River Reach 7	Non-Reference	NYANZA BERA	7-7.04	0.729	0.296	2.46	100%
			All "Non-Reference"		**Mimimum**	**0.008**	
					Average	**0.567**	
					Maximum	**2.463**	
					Median	**0.088**	
					Standard Deviation	**0.826**	
			Fireworks Site Only		**Mimimum**	**0.008**	
					Average	**0.038**	
					Maximum	**0.064**	
					Median	**0.040**	
					Standard Deviation	**0.019**	

NOTES:

1 A low percentage in this column indicates that the calculated standard size BSAF was toward the lower end or smaller than the projected probabilistic BSAF distribution for that sediment total mercury concentration

2 A high percentage in this column indicates that the calculated standard size BSAF was toward the higher end or greater than than the projected probabilistic BSAF distribution for that sediment total mercury concentration

Table 6-9. Average Surficial Sediment Total Mercury Concentrations Associated with Achieving the Benchmark Statewide Background Largemouth Bass (LMB) Fillet Tissue Mercury Concentration Assuming Various Point Estimates of the Biota Sediment Accumulation Factor (BSAF)

Water Body Class / Identification	**BSAF1**	**Average Surficial Sediment Total mercury Concentration required to Produce the Statewide Background LMB Fillet Tissue Mercury Concentration**
	(unitless)	**(mg/Kg dwt)**
Fireworks Site Average BSAF1	0.038	22.3
Fireworks Site Median BSAF1	0.04	21.2
Fireworks Site Maximum BSAF1	0.064	13.2
All "Non-Background" Median BSAF1	0.088	9.6

Table 6-10. Calculated Fireworks Site-Specific Surficial Sediment (Total Mercury) to Surface Water (Methylmercury) Transfer Factors

FIREWORKS SITE	Sediment		Porewater		Surface Water					
Reach / Sample ID	Total Mercury Conc.	Methyl-mercury Conc.	Total Mercury Conc.	Methyl-mercury Conc.	Total Mercury Conc.	Investigation	Methyl-mercury Conc.	Investigation	Methyl-mercury Conc.	Sediment-to-Surface Water Transfer Factor
	(mg/Kg dwt)	(mg/Kg dwt)	(ug/L)	(ug/L)	(ug/L)	Phase	(ug/L)	Phase	(mg/L)	(L/Kg)
Reference Reach										
NDWRTRA	0.343	0.00147	0.0567	0.000542	0.007390	Phase IID	0.008570	Phase IID	0.000008570	40,023
Stream Reaches										
ECCTRA10	29.7	0.0279	3510	1.78	0.025000	Phase IIC	0.000386	Phase IIC	0.000000386	76,943,005
					0.043400	Phase IID	0.001150	Phase IID	0.000001150	25,826,087
ECCTRA11	99	0.0452	1480	1.78	0.025000	Phase IIC	0.000386	Phase IIC	0.000000386	256,476,684
					0.043400	Phase IID	0.001150	Phase IID	0.000001150	86,086,957
ECCTRA12	2.62	0.00356	1.87	0.0189	0.025000	Phase IIC	0.000386	Phase IIC	0.000000386	6,787,565
					0.043400	Phase IID	0.001150	Phase IID	0.000001150	2,278,261
LDCTRA10	245	0.0308	1490	0.416	0.017900	Phase IIC	0.000185	Phase IIC	0.000000185	1,324,324,324
					0.047800	Phase IID	0.001470	Phase IID	0.000001470	166,666,667
LDCTRA11	38.8	0.0563	299	0.351	0.017900	Phase IIC	0.000185	Phase IIC	0.000000185	209,729,730
					0.047800	Phase IID	0.001470	Phase IID	0.000001470	26,394,558
									Streams Minimum	**2,278,261**
									Streams Average	**218,151,384**
									Streams Maximum	**1,324,324,324**
Ponds										
LUFPTRA10	38.2	0.0101	4.34	0.00604	0.014700	Phase IIC	0.00115	Phase IIC	0.000001150	33,217,391
					0.026900	Phase IID	0.00257	Phase IID	0.000002570	14,863,813
LUFPTRA11	46.3	0.0121	4.45	0.00822	0.014700	Phase IIC	0.00115	Phase IIC	0.000001150	40,260,870
					0.026900	Phase IID	0.00257	Phase IID	0.000002570	18,015,564
MLFPTRA10	27.4	0.0095	3.33	0.00466	0.029400	Phase IIC	0.000446	Phase IIC	0.000000446	61,503,928
					0.028200	Phase IID	0.002690	Phase IID	0.000002690	10,185,874
MLFPTRA11	40.3	0.0105	7.67	0.0473	0.029400	Phase IIC	0.000446	Phase IIC	0.000000446	90,460,157
					0.028200	Phase IID	0.002690	Phase IID	0.000002690	14,981,413
MLFPTRA12	16.9	0.018	5.38	0.0106	0.029400	Phase IIC	0.000446	Phase IIC	0.000000446	37,934,905
					0.028200	Phase IID	0.002690	Phase IID	0.000002690	6,282,528
									Ponds Minimum	**6,282,528**
									Ponds Average	**32,770,644**
									Ponds Maximum	**90,460,157**

Table 6-11. Calculated Fireworks Site-Specific Largemouth Bass (LMB) Mercury Bioccumulation Factors (BAFs) and Other Published LMB and Trophic Level 4 BAFs

SITE Reach	Sampling Year	Water Body Type	Sampled Fish Trophic Level	Fish Species	Fillet Tissue Methylmercury Concentration	Data Source	Fillet Tissue Methylmercury Concentration	Surface Water Methylmercury Concentration	Data Source	Surface Water Methylmercury Concentration	BAF
					(ng MeHg/g)		(mg MeHg/Kg)	(ug MeHg/L)		(mg MeHg/L)	(L/Kg)
FIREWORKS SITE											
Forge Pond	1995	Pond	4	LMB [2]	282	1995 MassDEP Memo [1,4]	0.282	0.0154	1995 MassDEP Memo [1,5]	0.00001540	> 18,286
Forge Pond	2003	Pond	4	LMB	209	Phase IID	0.209	0.00128500	Phase IID	0.000001285	162,646
Upper Drinkwater River	2003	Stream	4	LMB	659	Phase IID [3]	0.659	0.00017900	Phase IIC [6]	0.000000179	*3,681,564*
Upper Drinkwater River	2003	Stream	4	LMB	659	Phase IID [3]	0.659	0.00083800	Phase IID [7]	0.000000838	*786,396*
Eastern Channel Corridor	2003	Stream	4	LMB	2295	Phase IID	2.295	0.00038600	Phase IIC	0.000000386	5,945,596
Eastern Channel Corridor	2003	Stream	4	LMB	2295	Phase IID	2.295	0.00115000	Phase IID	0.000001150	1,995,652
Lower Drinkwater River	2003	Stream	4	LMB	2150	Phase IID	2.150	0.00018500	Phase IIC	0.000000185	11,621,622
Lower Drinkwater River	2003	Stream	4	LMB	2150	Phase IID	2.150	0.00147000	Phase IID	0.000001470	1,462,585
Lily Pond/Upper Factory Pond	2003	Pond	4	LMB	1750	Phase IID	1.750	0.00115000	Phase IIC	0.000001150	1,521,739
Lily Pond/Upper Factory Pond	2003	Pond	4	LMB	1750	Phase IID	1.750	0.00257500	Phase IID	0.000002575	679,612
Middle/Lower Factory Pond	2003	Pond	4	LMB	1660	Phase IIC	1.660	0.00044550	Phase IIC	0.000000446	3,726,150
Middle/Lower Factory Pond	2003	Pond	4	LMB	1660	Phase IID	1.660	0.00269000	Phase IID	0.000002690	617,100
Below Factory Pond Dam (Luddam's Ford)	1995	Pond	4	LMB	1513	1995 MassDEP Memo [1,4]	1.513	0.0154	1995 MassDEP Memo [1,5]	0.00001540	> 98,240
Below Factory Pond Dam	2003	Stream	4	LMB	717	Phase IID	0.717	0.0007815	Phase IID	0.000000782	917,466
NYANZA CHEMICAL WASTE DUMP SUPERFUND SITE (Operable Unit 4 - Sudbury River, MA)											
Reach 3 (Used Site-Wide)	2007-2008	Stream	4	LMB	-	Nyanza ROD [8]	-	-	-	-	7,800,000
U.S. EPA ESTIMATES FOR LENTIC AND LOTIC ENVIRONMENTS FOR TROPHIC LEVEL 4											
National - Lentic / Direct	2006	Pond	4	LMB	-	OEHHA [9]	-	-	-	-	8,060,000
National - Lentic / Direct (GM)	2006	Pond	4	Multiple TL4 Species	-	OEHHA [9]	-	-	-	-	6,800,000
National - Lentic / Combined	2006	Pond	4	Multiple TL4 Species	-	OEHHA [9]	-	-	-	-	5,740,000
National - Lotic / Direct	2006	River/Stream	4	LMB - Everglades	-	OEHHA [9]	-	-	-	-	985,915
National - Lotic / Direct	2006	River/Stream	4	LMB - So. FL Canals	-	OEHHA [9]	-	-	-	-	6,464,028
National - Lotic / Converted	2006	River/Stream	4	LMB	-	OEHHA [9]	-	-	-	-	10,401,681
National - Lotic / Combined	2006	River/Stream	4	Multiple TL4 Species	-	OEHHA [9]	-	-	-	-	1,240,000
ODEQ FOOD WEB MODELING - Willamette Basin, OR [Indication of variability]											
Site-Specific Modeling											
5th %-ile	2006	Stream	4	LMB	-	ODEQ [10]	-	-	-	-	1,600,000
50th %-ile	2006	Stream	4	LMB	-	ODEQ [10]	-	-	-	-	7,700,000
Mean	2006	Stream	4	LMB	-	ODEQ [10]	-	-	-	-	13,900,000
95th %-ile	2006	Stream	4	LMB	-	ODEQ [10]	-	-	-	-	43,400,000
U.S. EPA Direct Estimate BAF for Trophic Level 4 Species											
5th %-ile	2006	Stream	4	Multiple TL4 Species	-	ODEQ [10]	-	-	-	-	326,000
50th %-ile	2006	Stream	4	Multiple TL4 Species	-	ODEQ [10]	-	-	-	-	6,810,000
Mean	2006	Stream	4	Multiple TL4 Species	-	ODEQ [10]	-	-	-	-	11,100,000
95th %-ile	2006	Stream	4	Multiple TL4 Species	-	ODEQ [10]	-	-	-	-	14,200,000

NOTES AND REFERENCES:

[1] The measured total mercury surface water concentrations was non-detect at 0.0002 mg THg/L. The total mercury concentration was conservatively assumed to be 1/2 this detection limit. This adds some uncertainty to the BAF estimate in that the calculated value is the lowest value the measurements would suggest.

[2] The fish tissue and surface water sampling results were only for total mercury. The values shown are for methyl mercury and were calculated using the reach-specific MeHg-to-THg ratios for LMB fish tissue and surface water that were observed in the later Phase IID sampling results.

[3] No LMB were caught in the Upper Drinkwater River during Phase IID. The LMB fish tissue concentrations shown are from the Northern Drinkwater River reference station just upstream. This approximation adds some uncertainty to

[4] Reference: Massachusetts Department of Environmental Protection (MassDEP), 1995. Memorandum: Release of Fish Toxics Metal Data. September.

[5] Reference: Massachusetts Department of Environmental Protection (MassDEP), 1995. Memorandum: Hanover, Factory Pond Results. March.

[6] Reference: Foster Wheeler Environmental Corporation (FWENC), 2002. Draft Phase IIC Site Investigation Data Report: Fireworks I (Former Fireworks Facility), Hanover, MA Tier 1A Permit #100233 RTN: 4-0090. September.

[7] Reference: Foster Wheeler Environmental Corporation (FWENC), 2004. Draft Phase IID Site Investigation Data Report: Fireworks I (Former Fireworks Facility), Hanover, MA Tier 1A Permit #100233 RTN: 4-0090. April.

[8] Reference: USEPA, 2010. EPA New England Region 1 Record of Decision, Nyanza Chemical Waste Dump Superfund Site, Operable Unit 4 (Sudbury River). September.

[9] Reference: California Environmental Protection Agency Office of Environmental Health Hazard Assessment (CalEPA/OEHHA), 2006. Evaluation of Bioaccumulation Factors and Translators for Methylmercury, Tables 6 and 7. March.

[10] Reference: State of Oregon Department of Environmental Quality, 2006. Williamette Basin Total Maximum Daily Load (TMDL). Appendix B: Mercury. Table 8. September.

Table 6-12. Probabilistic Projections of the Average Largemouth Bass (LMB) Fillet Tissue Mercury Concentration as a Function of the Average Surficial Sediment Total Mercury Concentration Using a Fireworks Site-Specific Mercury Bioaccumulation Factor (BAF) and a Fireworks Site-Specific Mercury Sediment-to-Surface Water Mercury Transfer Factor

Average Surficial Sediment Total Mercury Concentration (mg/Kg dwt)	Median of the Calculated Log10 of the Fireworks Site BAFs (---)	Standard Deviation of the Calculated Log10 of the Fireworks Site BAFs (---)	Median of the Calculated Log10 of the Fireworks Site BAFs (Crystal Ball) (---)	Calculated Fireworks Site BAFs (Crystal Ball) (Lsw/Kg Fish)	Median of the Calculated Log10 of the Fireworks Site Sediment-to-Surface Water Mercury Transfer Factors (---)	Standard Deviation of the Calculated Log10 of the Fireworks Site Sediment-to-Surface Water Mercury Transfer Factors (---)	Median of the Calculated Log10 of the Fireworks Site Sediment-to-Surface Water Mercury Transfer Factors (---)	Calculated Fireworks Site Sediment-to-Surface Water Mercury Transfer Factor (Crystal Ball) (Lsw/Kg Sed)		Projected Average LMB Fillet Tissue Mercury Concentration (Crystal Ball) (mg/Kg wwt)
1	6.174	0.504	6.1740	1,492,794	7.521	0.550	7.5210	33,189,446		0.0450
2										0.0900
3										0.1349
4										0.1799
5										0.2249
6										0.2699
7										0.3148
8										0.3598
10										0.4498
12										0.5397
14										0.6297
16										0.7196
18										0.8096
20										0.8996
30										1.3493
40										1.7991

Table 6-13. Projected Probability that a Specified Average Surficial Sediment Total Mercury Cleanup Goal will Result in an Average Largemouth Bass (LMB) Fillet Tissue Mercury Concentration Less Than the Benchmark Statewide Background Concentration Using the BSAF2 Approach Model

Average Surficial Sediment Total Mercury Concentration	Probability that the Post-Remediation Average LMB Fillet Mercury Concentration Will be Less than the Benchmark Statewide Background Concentration
(mg/Kg dwt)	**(%)**
1.0	95.7
2.0	90.5
3.0	85.9
4.0	81.8
5.0	78.2
6.0	74.9
7.0	71.8
8.0	69.2
10	64.5
12	60.4
14	56.8
16	53.7
18	51.0
20	48.6
30	39.2
40	33.1

Table 6-14. Summary of the Findings From the Four Lines of Evidence Relative to Establishing an Appropriately Conservative Average Surficial Sediment Total Mercury Cleanup Goal to Establsih a Largemouth Bass (LMB) Fillet Tissue Mercury Concentration Distribution Consistent with the Statewide Background Distribution

Line of Evidence	Findings	Confidence	Notes
1: Direct Empirical Approach	→Surficial sediment total mercury concentrations as high as 15 mg/kg are currently associated with the statewide background LMB fillet tissue mercury concentration →Most probably < 6.6 mg/kg	Low to Moderate	No direct linkage to conditions at the Fireworks Site
2: Regression of LMB Fillet Tissue Mercury Concentration on Average Surficial Sediment Total Mercury Concentration	→A surficial sediment concentration of 4.8 mg/kg is associated with a 50% probability of meeting the benchmark statewide background LMB fillet tissue concentration →A surficial sediment concentration of 3.3 mg/kg is associated with a 90% probability of meeting the benchmark statewide background LMB fillet tissue concentration	Moderate to High	Relatively large data set
3: Analysis of BSAF1 Estimates Developed from Paired LMB Fillet Tissue and Surficial Sediment Mercury Measurements	→BSAF1 values for the Fireworks Site were lower than for the other Non-Reference sites →BSAF1 values for the Reference sites were larger than for the Non-Reference sites →Sites with different sources and forms of mercury input to water bodies exhibit different BSAF1 values	Moderate	The observed comparability of the calculated BSAF1 values and the probabilistic BSAF distributions from Line of Evidence 1 increases the level of confidence that the two approaches are producing consistent results
4: Fireworks Site-Specific BSAF Estimates Developed Using the BSAF2 Formulation	→Fireworks-specific $BAF_{sw\text{-}LMB\ /}$ values were not inconsistent with other published estimated for similar circumstances →A surficial sediment concentration of 19.5 mg/kg is associated with a 50% probability of meeting the benchmar statewide background LMB fillet concentration →A surficial sediment concentration of 2.2 mg/kg is associated with a 90% probability of meeting the benchmark statewide background LMB fillet concentration	Low to Moderate	Limited Fireworks Site-specific data set

Table 6-15.
Projected Standard Sized LMB Fillet Tissue Mercury Concentration Distributions Resulting from Probabilistic Modeling Using BSAF Distributions Developed from Two Different Water Body Datasets
(Combined "Reference" and "Non-Reference" Water Bodies and Only the "Reference" Water Bodies)

Probabilistic Modeling Results Using BSAFs Developed from the Combined "Reference" and "Non-Reference" Water Body Data

Sediemnt CUG (mg THg/Kg)	Minimum Projected Value (mg/Kg wt wt)	2.5th Percentile Projection (mg/Kg wt wt)	25th Percentile Projection (mg/Kg wt wt)	50th Percentile Projection (mg/Kg wt wt)	75th Percentile Projection (mg/Kg wt wt)	97.5th Percentile Projection (mg/Kg wt wt)	Maximum Projected Value (mg/Kg wt wt)
1.0	0.42	0.45	0.53	0.56	0.59	0.64	0.75
2.0	0.49	0.53	0.64	0.67	0.71	0.78	0.92
3.0	0.51	0.58	0.71	0.75	0.79	0.88	1.09
3.5	0.54	0.59	0.73	0.78	0.82	0.92	1.07
4.0	0.55	0.61	0.75	0.81	0.85	0.96	1.12
4.5	0.57	0.62	0.78	0.83	0.88	0.99	1.20
5.0	0.56	0.64	0.80	0.85	0.91	1.02	1.26
6.0	0.75	0.82	1.05	1.12	1.19	1.35	1.65
7.0	0.60	0.67	0.87	0.93	1.00	1.14	1.48
10.0	0.65	0.72	0.95	1.02	1.10	1.27	1.64

Probabilistic Modeling Results Using BSAFs Developed from Only the "Reference" Water Body Data

Sediemnt CUG (mg THg/Kg)	Minimum Projected Value (mg/Kg wt wt)	2.5th Percentile Projection (mg/Kg wt wt)	25th Percentile Projection (mg/Kg wt wt)	50th Percentile Projection (mg/Kg wt wt)	75th Percentile Projection (mg/Kg wt wt)	97.5th Percentile Projection (mg/Kg wt wt)	Maximum Projected Value (mg/Kg wt wt)
1.0	0.17	0.20	0.38	0.44	0.52	0.69	1.06
2.0	0.11	0.15	0.39	0.49	0.62	0.96	2.30
3.0	0.10	0.13	0.40	0.52	0.69	1.16	2.80
3.5	0.78	0.12	0.40	0.53	0.72	1.25	3.26
4.0	0.09	0.12	0.40	0.55	0.74	1.33	3.50
4.5	0.08	0.10	0.40	0.55	0.76	1.41	4.48
5.0	0.06	0.10	0.40	0.56	0.78	1.48	3.96
6.0	0.07	0.09	0.41	0.58	0.82	1.61	6.95
7.0	0.06	0.06	0.41	0.59	0.86	1.74	6.34
10.0	0.05	0.06	0.41	0.62	0.94	2.06	8.30

Abbreviations:

BSAF	Biota Sediment Accumulation Factor
Kg	kilogram
LMB	largemouth bass
mg	milligram
THg	Total Mercury
wt wt	wet weight

Table 6-16.
Examination of Alternative Sediment CUG Scenario Post-Remediation LMB Fillet Tissue Average Mercury Concentrations Relative to Consistency with the Target Staewide Background LMB Fillet Tissue Mercury Concentration Distribution and the Marginal Benefit of Further Reductions in the Sediment Mercury Concentration on the LBM Fillet Tissue Mercury Concentration (Refer to Figure 5-1)

	Probabilistic Modeling Using BSAFs Identified from the Combined "Reference" and "Non-Reference" Water Body Database	**Probabilistic Modeling Using BSAFs Identified from Only the "Reference" Water Body Database**
Central Tendency		
Overlap of the Central 50% Projected Post-Remediation Probability Range with the Green Bar of the Target Distribution	Occurs up to a Sediment CUG of 5.0 mg THg/Kg	Occurs up to a Sediment CUG of 10.0 mg THg/Kg
Overlap of the Central 95% Projected Post-Remediation Probability Range with the Green Bar of the Target Distribution	Occurs up to a Sediment CUG of 4.0 mg THg/Kg	Occurs up to a Sediment CUG of 8.0 mg THg/Kg
Spread		
Overlap of the Projected Post-Remediation Probability Range with the Green Bar of the Target Distribution	Occurs up to a Sediment CUG of 4.0 mg THg/Kg	Occurs up to a Sediment CUG of 2.0 mg THg/Kg
Overlap of the Projected Post-Remediation Probability Range with the White Bar of the Target Distribution	Occurs for Sediment CUGs > 10.0 mg THg/Kg	Occurs for Sediment CUGs > 10.0 mg THg/Kg
Decreased Marginal Return in Terms of Reduced Average LMB Fillet Tissue Mercury Concentrations	Range of Limited Change Between Sediment CUGs of 3.0 and 5.0 mg THg/Kg	Begins for Sediment CUGs < ~6.0 mg THg/Kg

Abbreviations:

BSAF	Biota Sediment Accumulation Factor
Kg	kilogram
mg	milligram
THg	Total Mercury

ATTACHMENT A EVALUATION OF NYANZA INDIVIDUAL FISH LENGTH DATA

Appendix 3D - ATTACHMENT A

EVALUATION OF NYANZA INDIVIDUAL FISH LENGTH DATA

Sensitivity Analysis on the Effect of Properly Size Standardizing the LMB Fillet Tissue Sampling Results Prior to Analysis

A quantitative estimate of the effect of not having information on the individual sample fish lengths associated with the Nyanza Site fish tissue total mercury (THg) concentrations was developed to allow the monitoring results for largemouth bass (LMB) to be size standardized.

As was previously described, only fish greater than 30.5 cm (i.e., the minimum creelable size) were included in the Baseline Ecological Risk Assessment (BERA) that was prepared for the Nyanza Site. No individual sample fish lengths were reported for the 12 Nyanza River reaches or sampling locations. Therefore, the Nyanza Site data could not be size standardized using the same regression process that was used for the Reference water bodies. As a result, the average observed LMB fillet tissue THg concentration for each Nyanza reach was conservatively assumed to be associated with a standard size LMB that was 30.5 cm in length. The fish that were sampled were likely to have been longer than the minimum creelable size and, as such, the LMB fillet tissue THg concentration is almost certainly an over-estimate of the actual standard size LMB fillet tissue THg concentration for the respective reaches. This is because LMB continue to bioaccumulate mercury as they grow older and longer than the minimum creelable size, albeit at a rate of growth slower than that observed earlier in their life cycle. Multiple studies relating to LMB have identified both age and length as good predictors of LMB fillet tissue body burden levels of bioaccumulative contaminants such as mercury. Consequently, values of the Biota Sediment Accumulation Factor (BSAF) developed using the Nyanza Site data that were not size standardized and were developed assuming the LMB sampling results were associated with fish of the minimum creelable size will overestimate actual uptake. Higher numerical BSAFs would be estimated using the non-size standardized Nyanza Site data than would have been generated had the LMB fillet tissue THg concentrations been able to be size standardized. The lack of individual sample fish length information for the Nyanza Site data set is especially significant if BSAFs calculated using this data (i.e., Non-Standard Size [Non-SS] BSAFs) are compared to BSAFs calculated using appropriately size standardized LMB fillet tissue THg concentration data (i.e., Standard Size [SS] BSAFs). If a BSAF is ultimately used in combination with a post-remediation target LMB fillet tissue THg concentration to identify a sediment THg concentration PRG, a Non-SS BSAF would require a lower sediment PRG than would an SS-BSAF based on the same target LMB fillet tissue THg concentration. As such, it is important to understand how much of an effect the inability to size standardize the Nyanza Site data, or any data set, has on the LMB fillet tissue THg concentrations and the resulting BSAFs.

An estimate of the magnitude of the conservatism associated with not being able to size standardize the Nyanza Site LMB fillet tissue THg concentration data prior to calculating BSAFs was made using the "MassDEP Request" data set, as it was the only available data set with the supplementary information needed to properly estimate the THg concentration in a standard size LMB on a water body specific basis. The estimate was developed by answering the question: “If the data set provided by MassDEP had been subject to the same information limitations as the Nyanza Site data set, how would the resulting estimated Non-SS BSAF values calculated using non-size standardized LMB fillet tissue THg concentrations compare to the estimated SS BSAFs calculated using size standardized LMB THg concentrations?” This question was answered through a 2-step analysis:

Step 1: Estimate water body-specific average fillet tissue THg concentrations for LMB greater than or equal to 30.5 cm using the “MassDEP Request” data.

- Start with the MassDEP provided dataset (Reference water body) fish tissue data (total N = 4032 fish sampling results)
- Eliminate all fish less than 30.5 cm in length (leaving 989 fish of creelable size)
- Eliminate all non-LMB fish sampling results (leaving 819 creelable LMB results)
- Calculate average fish lengths and fillet tissue THg concentrations for these creelable LMB for each of the 15 water bodies that were quantitatively evaluated in the Original PRG Package

Step 2: Calculate water-body specific Non- SS BSAF values as the ratio of the not size standardized mean creelable LMB fillet tissue THg concentration / mean water body sediment THg concentration.

The results are tabulated in Table A-1.

Table A-1

Water Body	**Mean Length of Sampled LMB > 30.5 cm**	**Mean Creelable LMB Fillet Tissue THg Conc. for the Water Body**	**Standard Size Creelable LMB Fillet Tissue THg Conc. for the Water Body**	**Mean Sediment THg Conc. for the Water Body**	**Non-SS BSAF [Using Mean Creelable LMB Fillet Tissue THg Conc.]**	**SS BSAF [Using Standard Size LMB Fillet Tissue THg Conc.]**	**Ratio of Non-SS BSAF to SS BSAF**	**Multiplicative Correction Factor[1]**
	(cm)	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	(-)	(-)	**(%)**	(-)
Baldpate Pond	38.023	1.01	0.666	0.448	2.25	1.49	152%	0.66
Bare Hill Pond	39.662	0.68	0.345	0.405	1.69	0.85	198%	0.51
Buckley Dunton Lake	39.375	0.88	0.578	0.429	2.05	1.35	152%	0.66
Cochichewick	38.503	0.41	0.190	0.609	0.67	0.31	216%	0.46
Haggetts Pond	41.584	0.94	0.397	0.622	1.52	0.64	238%	0.42
Kenoza Lake	41.569	0.78	0.362	0.461	1.69	0.79	216%	0.46
Lake Nippenicket	40.480	1.11	0.716	0.347	3.21	2.06	156%	0.64
Onota	37.409	0.34	0.162	0.464	0.72	0.35	207%	0.48
Pelham Lake	37.067	0.46	0.263	0.171	2.71	1.54	176%	0.57
Pomps Pond	34.383	0.43	0.355	0.166	2.58	2.14	121%	0.83
Rock Pond	42.283	1.22	0.856	0.479	2.54	1.79	142%	0.70
Upper Naukeag	40.090	1.18	0.872	0.207	5.69	4.21	135%	0.74
Upper Reservoir	44.217	1.21	0.755	0.214	5.65	3.53	160%	0.62
Wequaquet	43.797	0.78	0.367	0.262	2.98	1.40	213%	0.47
Wickaboag Pond	40.138	0.44	0.330	0.355	1.23	0.93	133%	0.75
Average							**174%**	**0.60**

NOTE: [1] Multiplicative correction factor to apply the Non-SS BSAF for LMB >30.5 cm to approximate the SS BSAF for LMB >30.5 cm

Based on this analysis, the estimated Non-SS BSAF for Reference water bodies would have been on average 1.74 times larger than the corresponding SS BSAF if those water bodies had been subject to the same information limitations as the Nyanza Site data set. The consequences of the lack of sufficient supplemental sample fish length information are discussed further in the material provided below.

This “what if?” analysis performed for the Reference water bodies was repeated using the Nyanza Site data in a follow up analysis. The comparable results are presented in Table A-2.

Table A-2

Water Body	**Mean Length of Sampled LMB > 30.5 cm**	**Mean Creelable LMB Fillet Tissue THg Conc. for the Water Body**	**Standard Size Creelable LMB Fillet Tissue THg Conc. for the Water Body**	**Mean Sediment THg Conc. for the Water Body**	**Non-SS BSAF [Using Mean Creelable LMB Fillet Tissue THg Conc.]**	**SS BSAF [Using Standard Size LMB Fillet Tissue THg Conc.]**	**Ratio of Non-SS BSAF to SS BSAF**	**Multiplicative Correction Factor[1]**
	(cm)	**(mg/kg)**	**(mg/kg)**	**(mg/kg)**	(-)	(-)	**(%)**	(-)
Charles River	36.8	0.423	0.300	0.237	1.78	1.27	141%	0.71
Sudbury Reservoir	37.0	0.295	0.133	0.199	1.48	0.67	222%	0.45
Sudbury River Reach 1	33.5	0.357	0.338	0.843	0.42	0.40	106%	0.95
Sudbury River Reach 10	39.5	0.955	0.413	0.534	1.79	0.77	231%	0.43
Sudbury River Reach 2	39.5	0.853	0.492	2.03	0.42	0.24	173%	0.58
Sudbury River Reach 3	37.1	0.991	0.551	15	0.07	0.04	180%	0.56
Sudbury River Reach 4	33.6	0.728	0.607	6.59	0.11	0.09	120%	0.83
Sudbury River Reach 5	38.2	0.645	0.478	1.05	0.61	0.46	135%	0.74
Sudbury River Reach 6	38.3	0.755	0.451	2.53	0.30	0.18	167%	0.60
Sudbury River Reach 7	38.8	0.729	0.330	0.296	2.46	1.11	221%	0.45
Sudbury River Reach 8	39.4	1.02	0.634	0.473	2.16	1.34	161%	0.62
Sudbury River Reach 9	37.8	1.07	0.682	1.21	0.88	0.56	157%	0.64
Average							**168%**	**63%**

NOTE: [1] Multiplicative correction factor to apply the Non-SS LMB fillet tissue THg concentration for LMB >30.5 cm to approximate SS LMB fillet tissue THg concentration for LMB >30.5 cm

The results indicate that the Non-SS LMB fillet tissue THg concentrations for the 12 Nyanza Site reaches and sampling locations were on average 1.68 times larger than the SS LMB fillet tissue THg concentrations that were calculated using the recently obtained individual fish length data. This consistency with the prior result for the Reference water body sites is believed to reflect that the length of the LMB that tend to be caught and sampled from both Reference and Non-Reference water bodies are similarly larger than the minimum creelable size of 30.5 cm.

Data Plots and Interpretation of the LMB Fillet Tissue THg Concentration and BSAF vs. Sediment THg Concentration Relationships

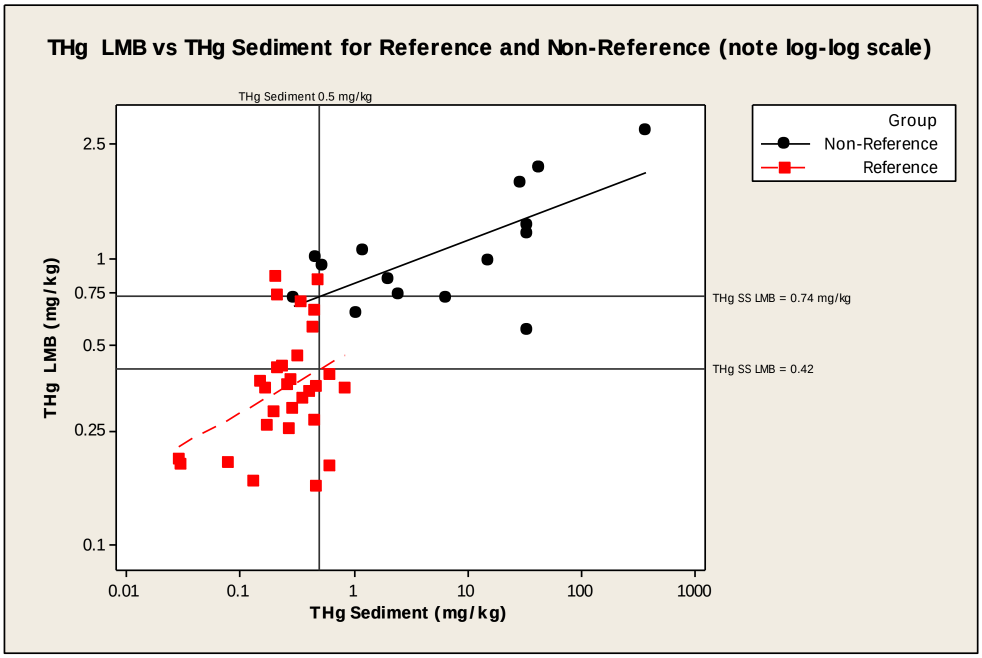
The following information is provided to supplement and clarify the discussion regarding the relationship between the LMB fillet tissue THg concentration and the BSAF to the sediment THg concentration. Additional explanation is provided for the counterintuitive result that the post-remediation LMB fillet tissue THg concentration projected based on the regression results using only the Reference water body data were LOWER that the post-remediation LMB fillet tissue THg concentration projected based on the regression results using the combined Reference and Non-Reference water body data. Results of the follow up analysis which used Nyanza individual dish length data also are presented and discussed.

The two underlying reasons believed to be contributing to the counterintuitive results are:

1) the overestimation resulting from having to use the non-standard sized LMB fillet tissue THg concentration data for the Nyanza Site and the Fireworks Site (as was discussed above and is further discussed below); and
2) the statistical uncertainty that results from projecting estimates using regression results for values of the independent variable that are outside of or beyond the range of the observed data used to develop the regression.

Relative to the first posited reason, Figure A-1 presents the logarithm base 10 standard sized LMB fillet tissue THg concentrations versus the logarithm base 10 of the associated sediment THg concentrations. In this log-log plot, the Reference water body data are plotted in red symbols and the Non-Reference water body data are plotted in black symbols. It should be noted that the displayed linear trend lines are not necessarily statistically significant (especially for the Reference data), but were not deleted from the computer generated plot and Figure A-1 to facilitate this discussion.

FIGURE A-1



It is believed that had sufficient information been available to calculate standard size LMB fillet tissue THg concentrations for the LMB samples from the Nyanza Site and the Fireworks Site reaches (i.e., the data represented by the black symbols in Figure A-1), there would very likely only be one relationship for the combined Reference and Non-Reference data over the whole range of noted sediment THg concentrations and it would be characterized by a single slope and y-intercept. The quantitative effect of there appearing to be different relationships for the Reference and Non-Reference water bodies can be evaluated by considering the estimated standard size LMB THg concentration at a specified sediment concentration. As shown visually by the horizontal reference lines above:

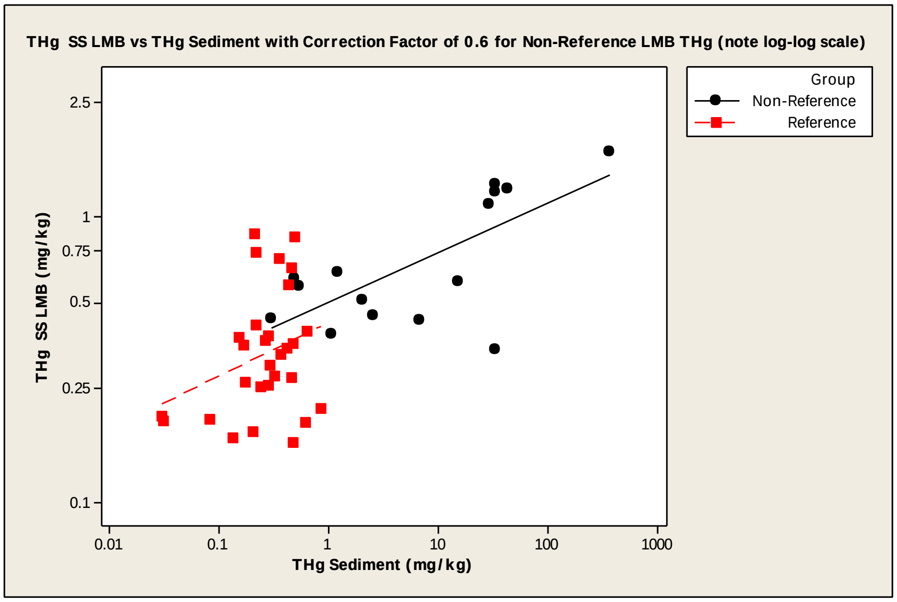
- If only the red Reference data points and linear relationship are used, the corresponding standard size LMB fillet tissue THg concentration would be 0.42 mg/kg for a sediment THg concentration of 0.5 mg/kg.
- If only the black Non-Reference data points and linear relationship are used, the corresponding standard size LMB THg concentration would be 0.74 mg/kg for a sediment concentration of 0.5 mg/kg.
- If, instead, the regression model based on the combined Reference and Non-Reference data set is used (i.e., the regression model presented in the Original PRG Package), the standard size LMB fillet tissue THg concentration would be 0.47 mg/kg for a sediment concentration of 0.5 mg/kg using the regression equation:

  Log10(Standard Size LMB THg Conc.) = -0.2525 + 0.2625 x Log10(Sediment THg Conc.)

  This relationship would plot between the red and the black lines on the above graph, and be roughly parallel to those lines.

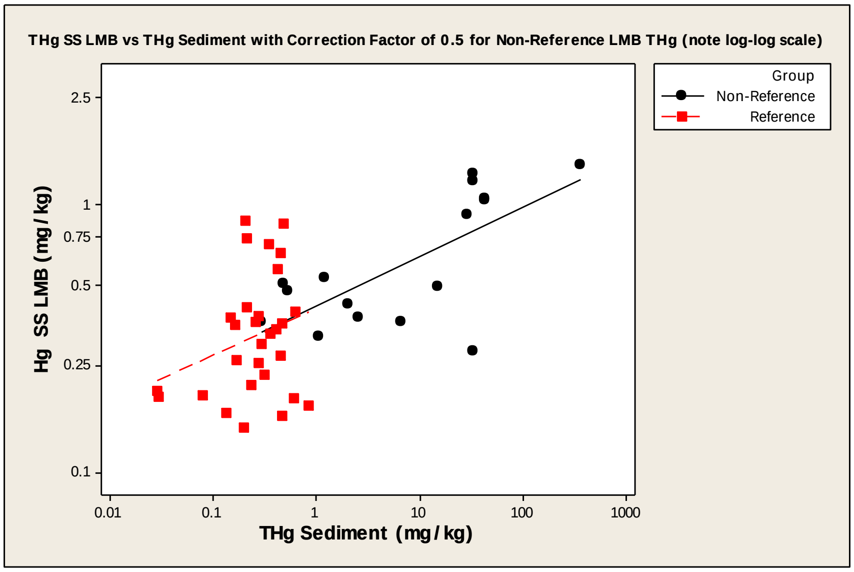
For example, the combined data set regression model would predict a standard size LMB fillet tissue THg concentration for a sediment THg concentration of 0.5 mg/kg approximately 12% (i.e., [0.47 – 0.42]/0.42) higher than would the Reference only data set regression model. If the average multiplicative correction factor identified in Table A-1 (i.e., 0.60) is applied to the Nyanza Site and Fireworks Site data, the graph would appear as shown in Figure A-2.

FIGURE A-2



Visually, the multiplicative correction factor of 0.60 does not fully eliminate the difference in the y-intercepts associated with the black and red linear trend lines. However, application of this average correction factor does substantially reduce the apparent difference between the red and the black regression lines. A multiplicative correction factor of 0.50 applied to the Nyanza Site and Fireworks Site observed LMB fillet tissue THg concentrations results in a near perfect visual alignment of the Reference and Non-Reference regression lines, as shown in Figure A-3.

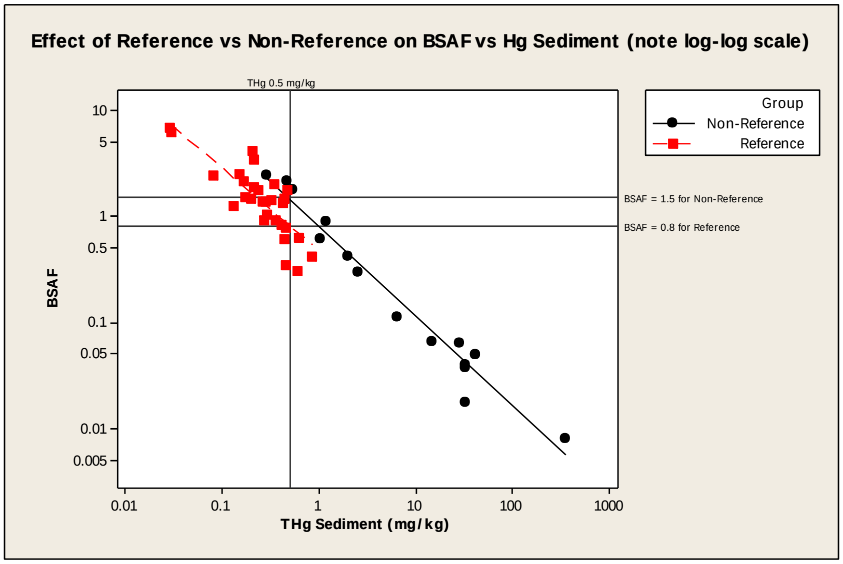
FIGURE A-3



These results do not include the fish length data for the Nyanza Site. However, the inclusion of this data is believed to improve this estimate of the degree of over-estimation inherent in the Non-Reference standard size LMB fillet tissue THg concentrations and corresponding BSAFs by a re-analysis of the properly standard sized data.

To better illustrate how this artificial data limitation difference in the y-intercept caused by the lack of information to properly size standardize the Non-Reference water body LMB fillet tissue THg concentration data can affect an estimated BSAF for a particular sediment THg concentration, Figure A-4 is a plot of the calculated BSAF (which is the ratio of the estimated standard size LMB fillet tissue THg concentration divided by the paired sediment THg concentration) as a function of sediment THg concentration using the combined Reference and uncorrected Non-Reference data set (i.e., without application of the multiplicative correction factor).

FIGURE A-4



When presented in terms of BSAF, it becomes evident how a regression model based on the combined Reference data and Non-Reference data (which are primarily the Nyanza Site and Fireworks Site data) would give higher estimates of BSAF for a specific sediment THg concentration than would a regression model based only on the Reference data. Again, this plot reflects the assumption that there are actually two separate relationships for the Reference and Non-Reference data sets and they are both statistically significant. As shown in Figure A-4 for a sediment THg concentration of 0.5 mg/kg, the BSAF projected using the black line Non-Reference data (which could not be properly size standardized) is approximately 1.5 while the BSAF projected using the red line Reference data is a much lower 0.8. This illustrates the basis of the counter-intuitive result since lower BSAFs are typically seen at impacted sites with higher sediment THg concentrations and higher BSAFs are typically seen at background locations with lower sediment THg concentrations. However, as noted above, we believe that there is actually only one relationship between LMB fillet tissue THg concentration or BSAF and sediment THg concentration over the range of reference and Non-Reference sediment THg concentrations shown in Figure A-4 and that this relationship would be statistically significant if the Reference and Non-Reference LMB fillet tissue THg concentration data could all be properly size standardized. We believe that the counter-intuitive result is explained through the following:

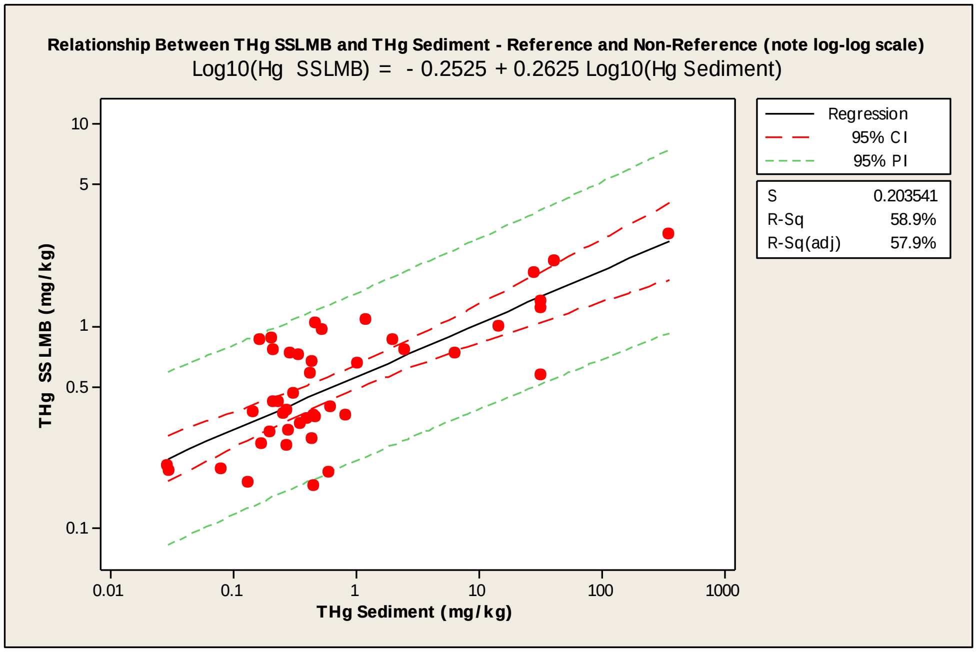
- Higher LMB fillet tissue THg concentrations generally occur at higher sediment THg concentrations (i.e., the LMB fillet tissue THg concentration is an "increasing" function of sediment THg concentration).
- Higher sediment BSAFs generally occur at lower sediment THg concentrations (i.e., THg BSAFs are a "decreasing" function of sediment THg concentration).
- The different decreasing functional relationships between BSAF and sediment THg concentration for the Reference data set (i.e., the red-line in Figure 2B-4) and for the Non-Reference data set (i.e., the black line in Figure 2B-4) are not real, but are a result of the

individual sample fish length data limitations associated with the Non-Reference water body data set.

- The data limitations associated with the black line Non-Reference water body data set (and, by extension, the combined Reference and Non-Reference water body data set) are causing the resulting regression relationship to be higher than it should be. Estimates of the degree of over-estimation of the black line BSAFs would suggest that the “corrected” BSAFs for the Non-Reference water bodies are much lower and closer to what would have been predicted using the red line Reference water body relationship.
- It is not that the Monte Carlo modeling results shown in Figure 1 of the Revised PRG Proposal for the “Reference Only” case were in fact counter-intuitive because they predicted lower LMB fillet tissue THg concentrations than the earlier combined “Reference + Non-Reference” case. In consideration of the above analyses, it would appear that this result was because the original “Reference + Non-Reference” LMB fillet tissue THg concentration results were “artificially” conservatively high because there was insufficient information available to estimate standard size LMB fillet tissue THg concentrations for the Nyanza Site and Fireworks Site reaches. It is believed that obtaining the supplemental individual sample fish length data for the Nyanza Site and properly size standardizing that data prior to analysis (or lacking that, applying the identified multiplicative correction factor to the non-size standardized LMB fillet tissue THg concentration data for the Nyanza Site and Fireworks Site data prior to analyses) would produce a single statistically significant regression relationship that leads to intuitive results relative to LMB fillet tissue THg concentrations and BSAFs as a function of sediment THg concentration.

Relative to the second posited reason for the counter-intuitive results, Figure A-5 illustrates the confidence interval (CI - red dashed lines) and prediction interval bands (PI - green dashed lines) for the regression model based on the combined data sets for both the Reference and Non-Reference water bodies (i.e., the relationship presented in the initial evaluation and reflected in the right side of the paired LMB fillet tissue THg concentration comparisons presented under Line of Evidence 2 in Figure 6-15).

FIGURE A-5



Note that the CI bands for the combined data set relationship are relatively narrow over a fairly broad range of sediment THg concentrations (i.e., 0.08 to 10 mg/kg).

Figure A-6 shows the relationship between the BSAF calculated using the size standardized LMB fillet tissue THg concentration and the associated sediment THg concentration in a log-log transformation.

FIGURE A-6

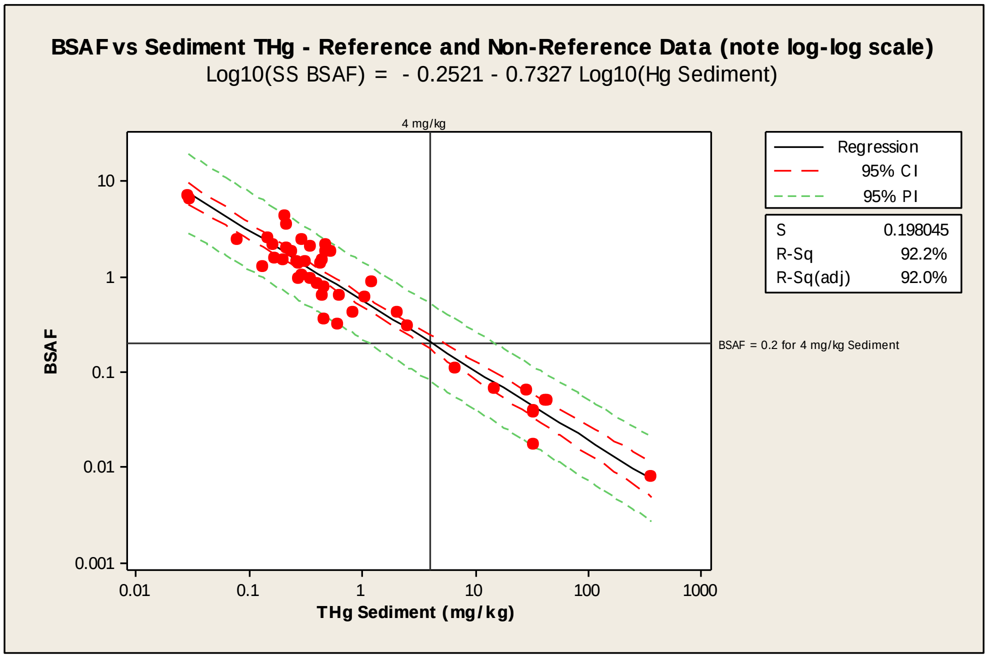
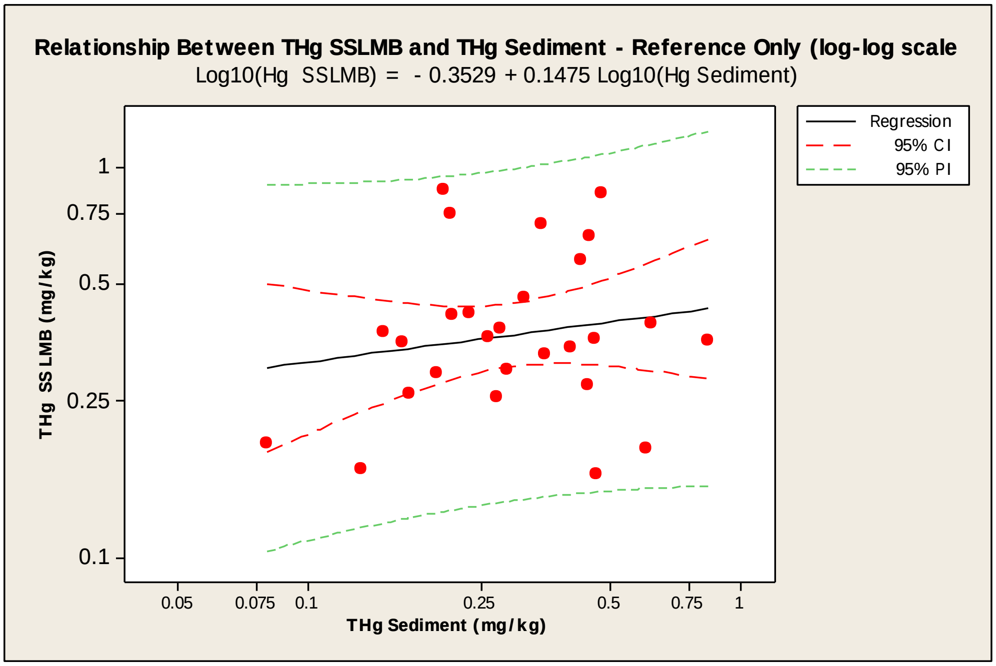


Figure A-7 illustrates the effect on the CI and PI of hypothetically using only the Reference data set for the regression analysis (as shown on the left-side of the paired LMB fillet tissue THg concentration comparisons presented under Line of Evidence 2 in Figure 1 of the Revised PRG Proposal).

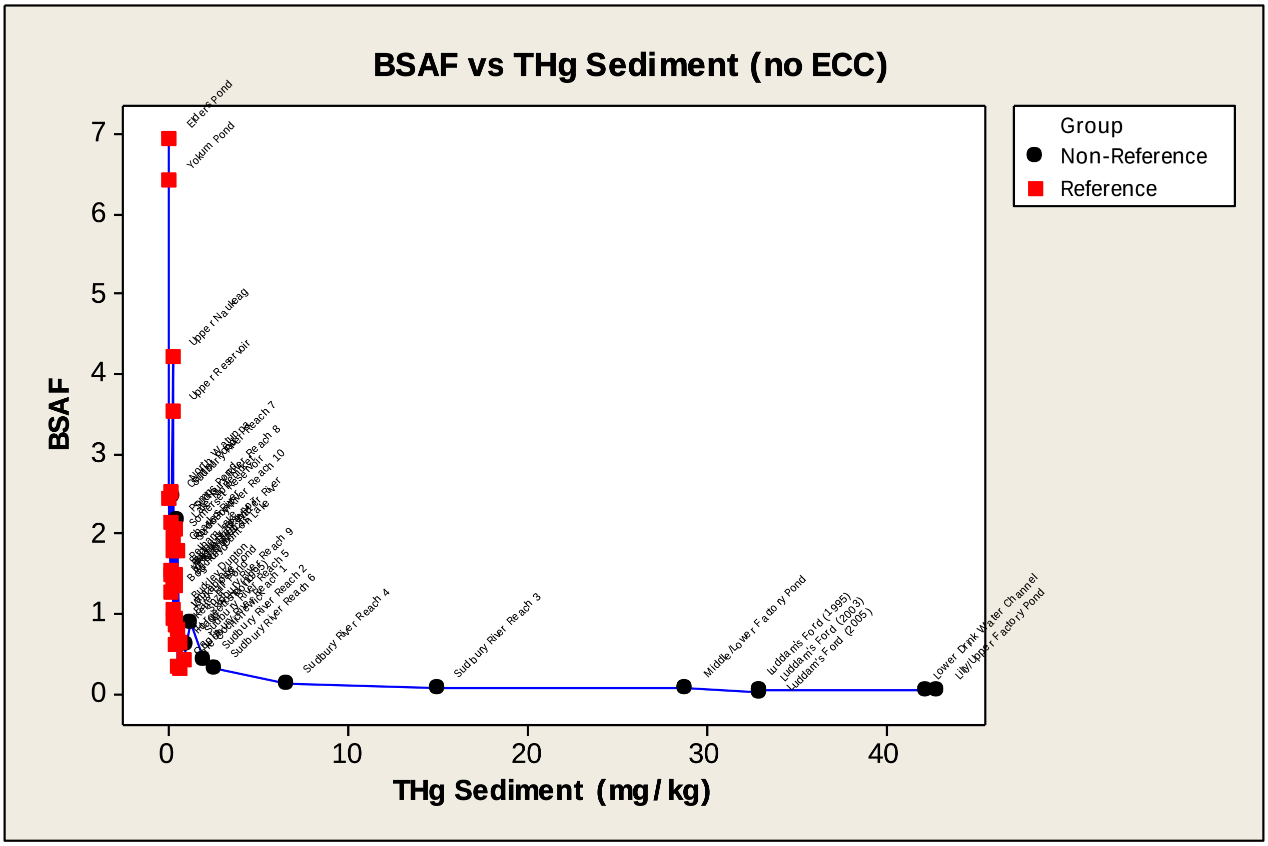
FIGURE A-7



It is evident that if the CI lines (red dashed lines) and PI lines (green dashed lines) are projected further out from the central range of the respective sediment THg concentrations (i.e., 0.1 to 0.5 mg/kg) to a sediment THg concentration in the range of 1 to 10 mg/kg, the resulting uncertainty quickly becomes quite large because the CI bounds are hyperbolic. In any regression analysis, the CI and PI are narrowest in the middle of the range of the observed values of the independent variable. This was a primary reason why the regression analysis in the Original PRG Package was performed using the combined Reference and Non-Reference water body data set.

It should be noted that all of the basic data presentations have been in log-log space. This transformation was necessary to linearize the relationship between the LMB fillet tissue THg concentrations or the associated BSAFs and sediment THg concentrations to facilitate data evaluation and statistical analysis. Figure A-8 illustrates the relationship between BSAF and the sediment THg concentration using the uncorrected data without the log-log transformation.

FIGURE A-8



Note: The data for the Eastern Channel Corridor (ECC) at the Fireworks Site are not shown on this graph because the sediment THg concentration was 359 mg/kg and inclusion of this data point would have completely obscured the rest of the data.

Upon receiving the supplemental individual fish length data for the LMB sampled from the Nyanza Site they were used to properly size standardize the sampling results. Hereafter, the previous non-standard size LMB fillet tissue THg concentrations for the Nyanza Site reaches in the combined Reference and Non-Reference database used for the previous regression analyses are replaced with the properly size standardized LMB fillet tissue THg concentrations.

This updated database contained the LMB fillet tissue THg concentration and sediment THg concentration data for all water bodies for which the measured LMB fillet tissue THg concentration could be properly size standardized. This included: all of the data associated with the MassDEP Data Request (which consistently excluded data from the Northeastern Region as was defined by MassDEP and water bodies with pH concentrations outside the range 5.5 – 7.5); all of the Nyanza Site data; and the data for eight (8) water bodies from the MassDEP Fish Mercury Research Data Portal. The only compiled data not included in this database was the data collected at the Fireworks Site (including 1995 Memo data for Forge Pond and 1995 Memo and 2005 Phase II data for Luddams Ford) and the data collected for the Upper Naukeag from the MassDEP Fish Mercury Research Data Portal (since the 1995 sampling event at this water body consisted of only a single fish). The Fireworks Site and the Upper Naukeag data were not used for the update described in this Addendum because: (1) they were the only remaining compiled data that could not be size standardized; and (2) the data that could be size standardized now covered the full range of sediment THg concentrations of interest now that the Nyanza Site data was included.

Figures A-5 and A-6 show the regression results that were developed using these data. Figure A-5 shows the relationship between the size standardized LMB fillet tissue THg concentration and the associated sediment THg concentration in a log-log transformation. Plot A-6 shows the relationship between the BSAF calculated using the size standardized LMB fillet tissue THg concentration and the associated sediment THg concentration in a log-log transformation.

Figure A-9 and A-10 show the same two regression relationships developed using the updated database with only the standard size data.

FIGURE A-9

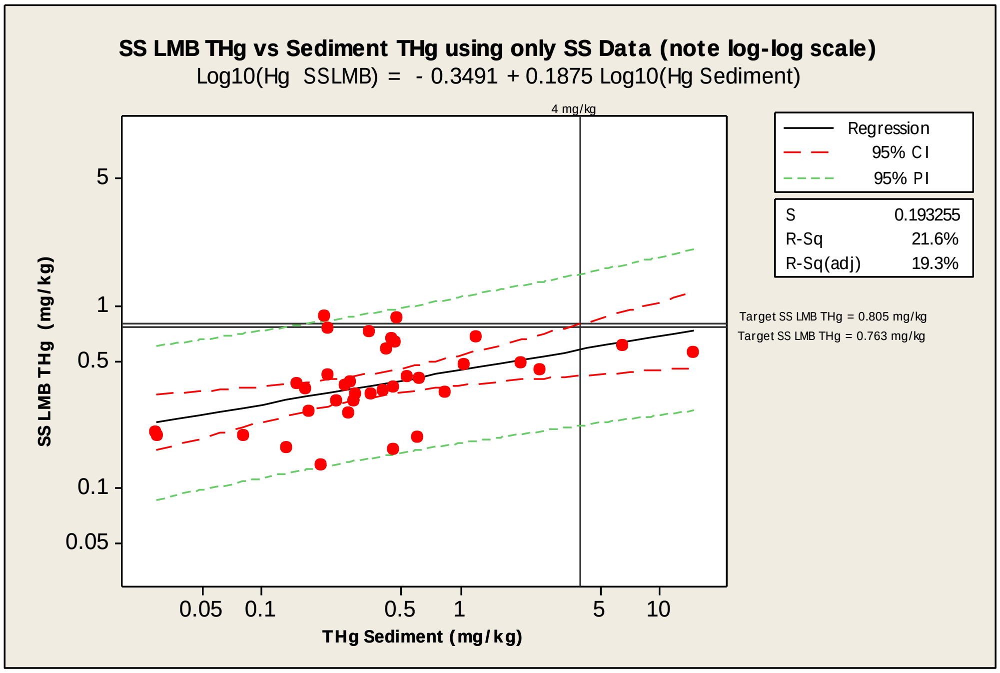
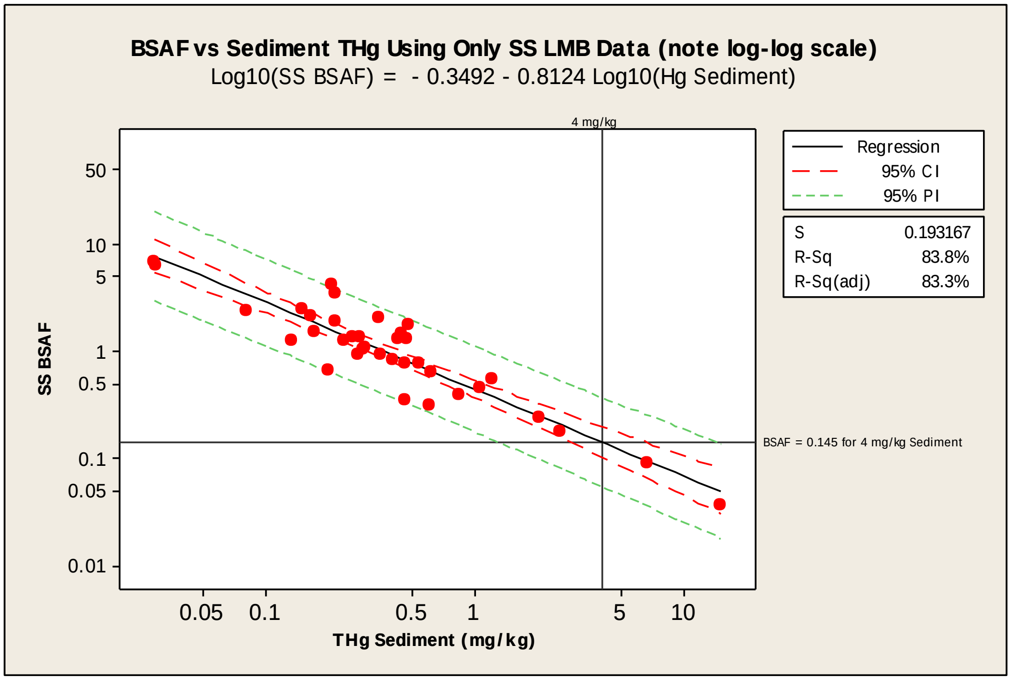


FIGURE A-10



The primary differences between the LMB Fillet Tissue THg Concentration vs. Sediment THg Concentration regression results shown in the Response (Figure A-5) and the updated regression results (Figure A-9) are:

- The updated regression slope term is lower in Figure A-9 than it was in Figure A-5. Less of the overall change in the LMB fillet tissue THg concentration is attributable to the sediment THg concentration (note the lower r-squared value). The implication is that a greater change in the sediment THg concentration is needed to effect a specific mercury concentration change in the LMB fillet tissue THg concentration.
- The regression intercept term is more negative in Figure A-9 than it was in Figure A-5. The implication is that a lower LMB fillet tissue THg concentration would be projected for a specific sediment THg concentration using the updated regression results than would have been indicated before.

The primary difference between the BSAF vs. Sediment THg Concentration regression results shown in the Response (Figure A-6) and the updated BSAF regression results (Figure A-10) is that a lower BSAF would be associated with a particular sediment THg concentration for the updated results than would have been indicated before (i.e., a best estimate BSAF of 0.145 for a sediment THg concentration of 4 mg/kg in Plot A-4 vs. a best estimate BSAF = 0.20 for a sediment THg concentration of 4 mg/kg in Figure A-6).

Effect of Incorporating the Size Standardized Nyanza Site Data on the Selection of a Sediment PRG

Figure A-9 shows that the proposed sediment THg PRG of 4.0 mg THg/kg intersects the regression-generated red dashed 95% Confidence Interval (CI) line at LMB fillet tissue THg concentrations in the range of the target LMB fillet tissue THg concentrations of most interest. To get a better estimate of the levels of confidence associated with achieving a specific target LMB fillet tissue THg concentration with a sediment THg PRG of 4.0 mg THg/kg, the distribution associated with the expected range of average LMB fillet tissue THg concentrations for a sediment THg concentration of 4.0 mg THg/kg was constructed. This distribution was estimated using the sediment THg concentration-specific estimated standard error for 4.0 mg/kg and then calculating the Student's t value associated with the specific target LMB fillet tissue THg concentration. The Student's t value was then used to determine the associated level of confidence in achieving a particular LMB fillet tissue THg concentration. An examination of this resulting distribution leads to the following projections relative to the sediment THg PRG:

- The PRG needed to achieve a target LMB fillet tissue THg concentration that is a **5% over 5 years reduction** from the current state-wide background average LMB fillet tissue THg concentration (i.e., 0.806 mg/kg) **<u>with 97.5% confidence</u>** is **4.0** mg THg/kg.

- A sediment PRG of **4.0** mg THg/kg is also expected to achieve a target LMB fillet tissue THg concentration that is a **10% over 5 years reduction** from the current state-wide background average LMB fillet tissue THg concentration (i.e., 0.763 mg/kg) with **94.6% confidence**.

- A sediment PRG of **4.0** mg THg/kg is the rounded value of **3.9** mg THg/kg, which is the best estimate of the sediment concentration needed to achieve the **upper 95% confidence limit of the grand <u>mean</u> state-wide background LMB fillet tissue THg concentration identified in the 3/7/13 M. Hutcheson email** (i.e., 0.577 mg/kg) (Figure A-9). The same email identified the central tendency grand mean itself to be 0.556 mg/kg. Looking at the regression results from the perspective of the BSAF, the best estimate BSAF for a sediment THg concentration of **4.0** mg THg/kg is **0.145** (Figure A-10). This BSAF multiplied by the sediment THg concentration results in a best estimate LMB fillet tissue THg concentration of **0.58 mg/kg**.

Summary

The initial regression results presented in the text, which were known to be conservative because the Nyanza Site and Fireworks Site data could not be properly size standardized, resulted in a best estimate projection that a sediment THg PRG of 4 mg THg/kg would be needed to achieve a target LMB fillet tissue THg concentration that is a 5% over 5 years reduction from current state-wide 90th percentile background water body-specific average SS LMB fillet tissue THg concentration (Figure A-5).

When much of the known conservatism in the regression relationship was addressed by incorporating the recently acquired Nyanza Site individual LMB fish length data into the analyses and only regressing data that could be properly size standardized, it was shown that a sediment THg PRG of 4 mg THg/kg would achieve a target LMB fillet tissue THg concentration that is a 5% over 5 years reduction from the current state-wide background average LMB fillet tissue THg concentration with 97.5% confidence (Plot Figure A-9).

Furthermore, a sediment THg PRG of 4 mg THg/kg is projected using the updated database to result in a best estimate LMB fillet tissue THg concentration that is essentially equal to the calculated <u>central value mean</u> state-wide background LMB fillet tissue THg concentration for all LMB in all background water bodies during 2007-2012 (i.e., 0.577 mg/kg) (See the relationship shown on Figure A-9).

The incorporation of the properly size standardized Nyanza Site data into the analysis has confirmed that the initial analysis presented in the body of the response resulted in conservative regression results for LMB fillet tissue THg concentration and BSAF on sediment THg concentration. This conservatism led to the identification of a conservative sediment THg PRG to achieve a specified target LMB fillet tissue THg concentration. The level of conservatism has been shown to be quantitatively influential relative to the sediment THg PRG presented in this Appendix.

In light of the extremely non-linear relationship seen in Figure A-8 between the untransformed BSAF (or standard size LMB fillet tissue THg concentration) and untransformed sediment THg concentration, a systematic multiplicative correction factor or any other type of adjustment cannot be applied defensibly to the untransformed sediment THg concentrations. In addition, both the log-log graph and the untransformed graph of BSAF vs. sediment THg concentration clearly illustrate that the BSAF is highly dependent upon the sediment THg concentration in the range of interest for the Fireworks Site sediment THg PRG. The application of a single BSAF value (e.g., an average across even a relatively narrow range of sediment THg concentration within this range) can mask the true nature of the dependency and skew the predicted LMB fillet tissue THg concentrations associated with those sediment THg concentrations.

As such, two simpler alternatives approaches (relative to the Monte Carlo-based demonstration of consistency with background) for justifying the selection of the sediment THg PRG have been shown:

1. Identifying a product of the sediment concentration-specific BSAF (from Figure A-10) and the candidate sediment THg PRG that produces a standard size LMB fillet tissue THg concentration that does not exceed the target state-wide background average LMB fillet tissue THg concentration; or
2. Identifying the sediment THg PRG associated with the target state-wide background average LMB fillet tissue THg concentration directly from the standard size LMB fillet tissue THg concentration vs. sediment THg concentration plot (Figure A-9).

Either of these could be used to provide the primary justification of a single value sediment THg PRG, with the Monte Carlo / projected LMB fillet tissue THg concentration distribution comparison potentially presented as supplemental information.

Therefore, the proposed sediment THg PRG of 4.0 mg/kg is projected to achieve a future target LMB fillet tissue THg concentration that reflects a reasonable reduction over the next 5 years.

In summary, a sediment THg PRG of 4 mg THg/kg is projected to achieve a future state-wide background LMB fillet tissue THg concentration with a very high level of confidence.

ATTACHMENT B CRYSTAL BALL REPORT FOR REGRESSION-SUPPORTED BSAF PROBABILISTIC MODELING

ATTACHMENT B
Crystal Ball Report for Regression-Supported BSAF Probabilistic Modeling

Crystal Ball Report - Custom

Simulation started on 12/17/2013 at 8:13 AM
Simulation stopped on 12/17/2013 at 8:13 AM

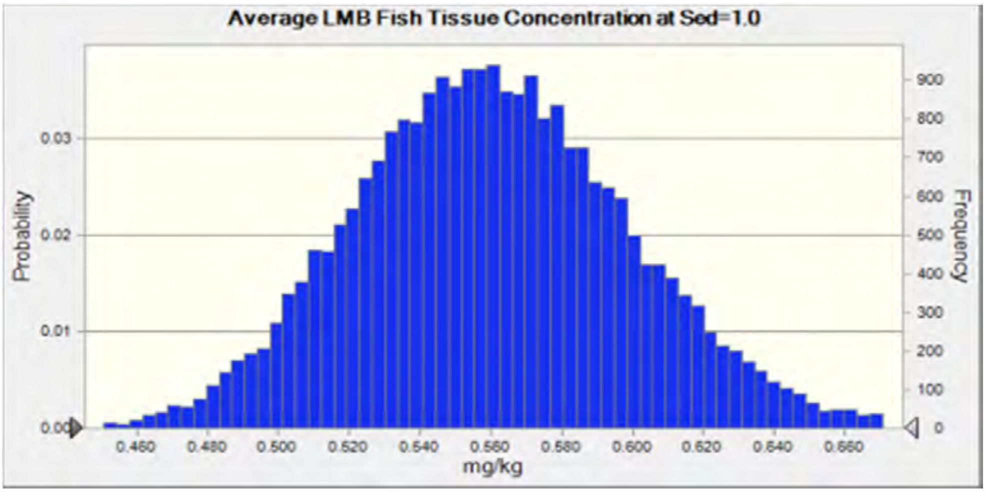
Run preferences:	
Number of trials run	25,000
Monte Carlo	
Random seed	
Precision control on	
Confidence level	95.00%
Run statistics:	
Total running time (sec)	17.35
Trials/second (average)	1,441
Random numbers per sec	33,146
Crystal Ball data:	
Assumptions	23
Correlations	0
Correlation matrices	0
Decision variables	0
Forecasts	46

Forecasts

Worksheet: [CB121713.xlsx]Sheet1

Forecast: Average LMB Fish Tissue Concentration at Sed=1.0 **Cell: N10**

Summary:
Entire range is from 0.417 to 0.765
Base case is 0.559
After 25,000 trials, the std. error of the mean is 0.000



Statistics:	Forecast values
Trials	25,000
Base Case	0.559
Mean	0.561
Median	0.559
Mode	---
Standard Deviation	0.039
Variance	0.002
Skewness	0.2232
Kurtosis	3.13
Coeff. of Variation	0.0699
Minimum	0.417
Maximum	0.765
Range Width	0.348
Mean Std. Error	0.000

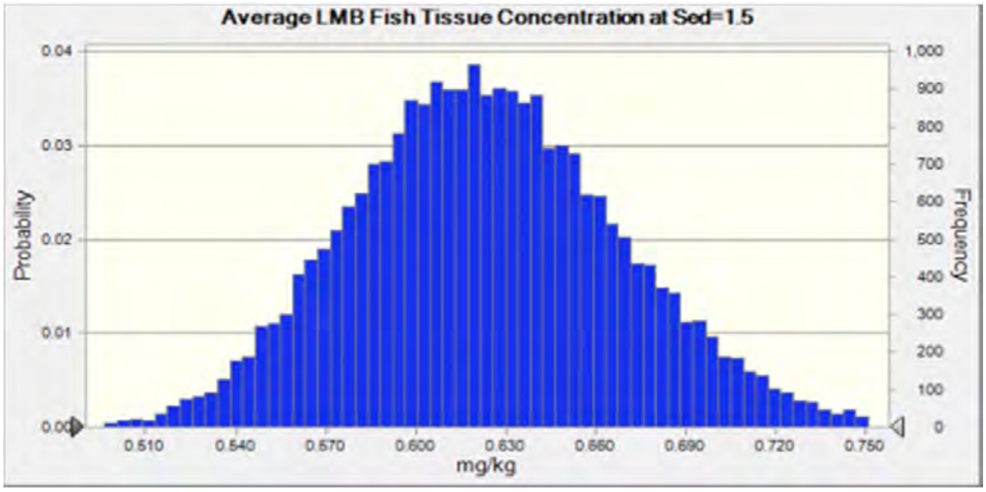
Forecast: Average LMB Fish Tissue Concentration at Sed=1.0 (cont'd) **Cell: N10**

Percentiles:	Forecast values
0%	0.417
10%	0.511
20%	0.527
30%	0.539
40%	0.549
50%	0.559
60%	0.569
70%	0.580
80%	0.593
90%	0.612
100%	0.765

ATTACHMENT B
Crystal Ball Report for Regression-Supported BSAF Probabilistic Modeling

Forecast: Average LMB Fish Tissue Concentration at Sed=1.5 **Cell: N11**

Summary:
Entire range is from 0.460 to 0.833
Base case is 0.622
After 25,000 trials, the std. error of the mean is 0.000



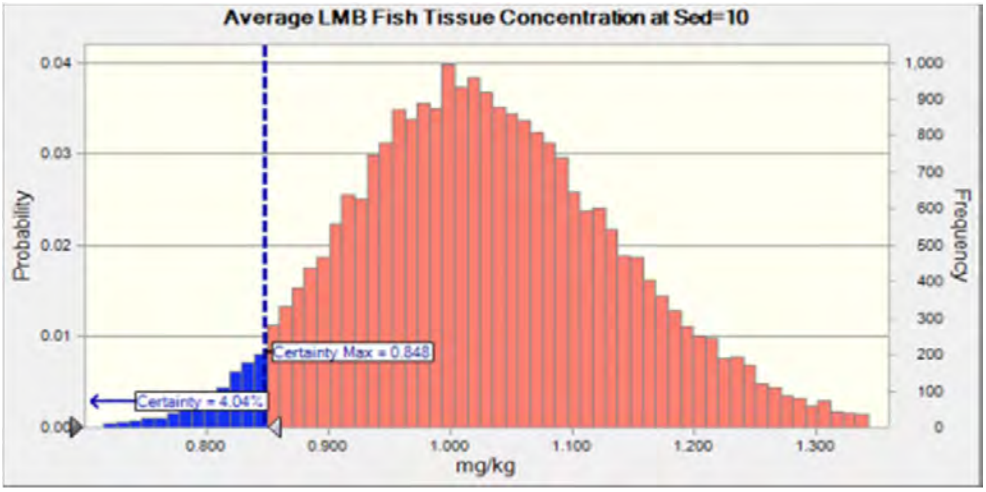
Statistics:	Forecast values
Trials	25,000
Base Case	0.622
Mean	0.624
Median	0.622
Mode	---
Standard Deviation	0.045
Variance	0.002
Skewness	0.2145
Kurtosis	3.07
Coeff. of Variation	0.0729
Minimum	0.460
Maximum	0.833
Range Width	0.373
Mean Std. Error	0.000

Forecast: Average LMB Fish Tissue Concentration at Sed=1.5 (cont'd) **Cell: N11**

Percentiles:	Forecast values
0%	0.460
10%	0.566
20%	0.585
30%	0.599
40%	0.611
50%	0.622
60%	0.633
70%	0.646
80%	0.661
90%	0.683
100%	0.833

Forecast: Average LMB Fish Tissue Concentration at Sed=10 **Cell: N25**

Summary:
Certainty level is 4.042%
Certainty range is from -Infinity to 0.848
Entire range is from 0.616 to 1.558
Base case is 1.023
After 25,000 trials, the std. error of the mean is 0.001



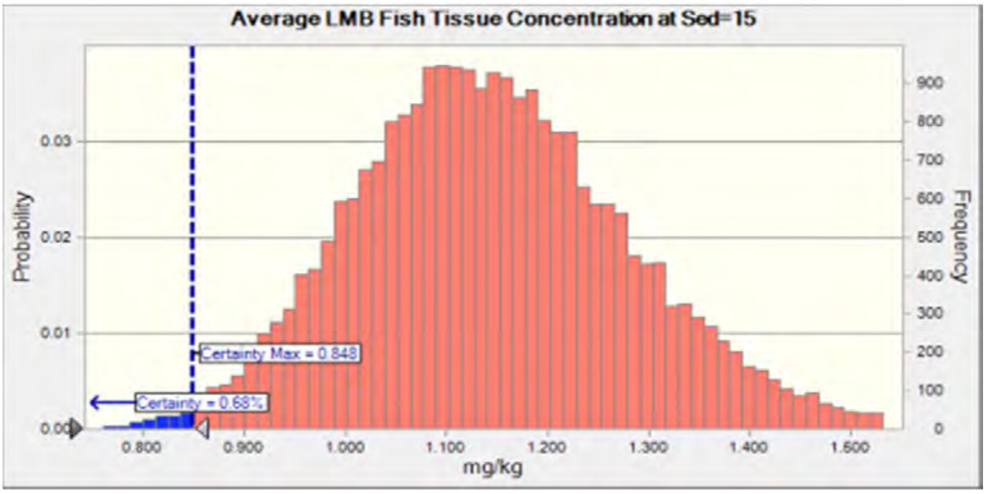
Statistics:	Forecast values
Trials	25,000
Base Case	1.023
Mean	1.030
Median	1.023
Mode	---
Standard Deviation	0.112
Variance	0.013
Skewness	0.3213
Kurtosis	3.20
Coeff. of Variation	0.1087
Minimum	0.616
Maximum	1.558
Range Width	0.942
Mean Std. Error	0.001

Forecast: Average LMB Fish Tissue Concentration at Sed=10 (cont'd) **Cell: N25**

Percentiles:	Forecast values
0%	0.616
10%	0.891
20%	0.935
30%	0.967
40%	0.996
50%	1.023
60%	1.052
70%	1.083
80%	1.122
90%	1.177
100%	1.558

Forecast: Average LMB Fish Tissue Concentration at Sed=15 **Cell: N26**

Summary:
- Certainty level is 0.678%
- Certainty range is from -Infinity to 0.848
- Entire range is from 0.679 to 1.828
- Base case is 1.138
- After 25,000 trials, the std. error of the mean is 0.001



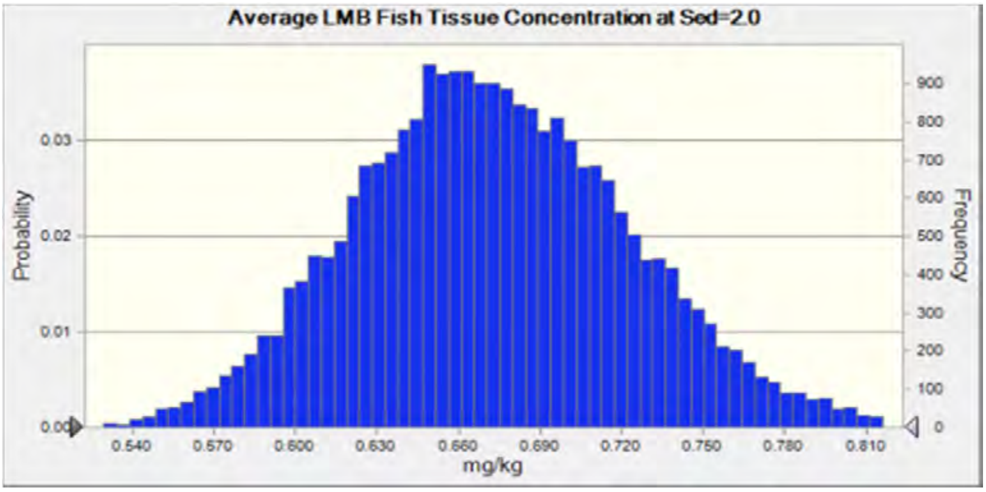
Statistics:	Forecast values
Trials	25,000
Base Case	1.138
Mean	1.146
Median	1.138
Mode	---
Standard Deviation	0.137
Variance	0.019
Skewness	0.3657
Kurtosis	3.28
Coeff. of Variation	0.1199
Minimum	0.679
Maximum	1.828
Range Width	1.149
Mean Std. Error	0.001

Forecast: Average LMB Fish Tissue Concentration at Sed=15 (cont'd) **Cell: N26**

Percentiles:	Forecast values
0%	0.679
10%	0.977
20%	1.030
30%	1.070
40%	1.104
50%	1.138
60%	1.173
70%	1.211
80%	1.258
90%	1.327
100%	1.828

Forecast: Average LMB Fish Tissue Concentration at Sed=2.0 **Cell: N12**

Summary:
- Certainty level is 99.892%
- Certainty range is from -Infinity to 0.848
- Entire range is from 0.478 to 0.894
- Base case is 0.671
- After 25,000 trials, the std. error of the mean is 0.000



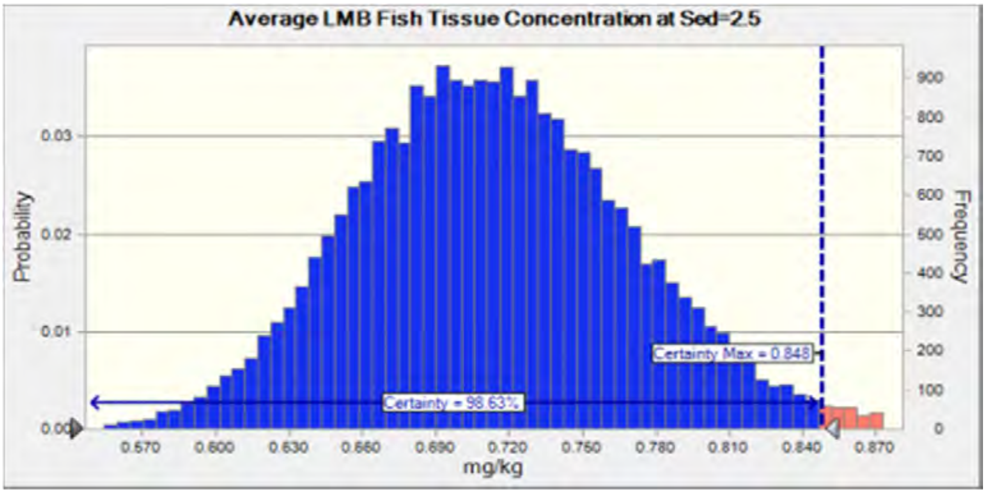
Statistics:	Forecast values
Trials	25,000
Base Case	0.671
Mean	0.673
Median	0.671
Mode	---
Standard Deviation	0.051
Variance	0.003
Skewness	0.2162
Kurtosis	3.08
Coeff. of Variation	0.0760
Minimum	0.478
Maximum	0.894
Range Width	0.416
Mean Std. Error	0.000

Forecast: Average LMB Fish Tissue Concentration at Sed=2.0 (cont'd) **Cell: N12**

Percentiles:	Forecast values
0%	0.478
10%	0.608
20%	0.629
30%	0.645
40%	0.658
50%	0.671
60%	0.684
70%	0.698
80%	0.715
90%	0.739
100%	0.894

Forecast: Average LMB Fish Tissue Concentration at Sed=2.5 **Cell: N13**

Summary:
Certainty level is 98.627%
Certainty range is from -Infinity to 0.848
Entire range is from 0.529 to 0.992
Base case is 0.711
After 25,000 trials, the std. error of the mean is 0.000



Statistics:	Forecast values
Trials	25,000
Base Case	0.711
Mean	0.714
Median	0.711
Mode	---
Standard Deviation	0.057
Variance	0.003
Skewness	0.2450
Kurtosis	3.10
Coeff. of Variation	0.0796
Minimum	0.529
Maximum	0.992
Range Width	0.463
Mean Std. Error	0.000

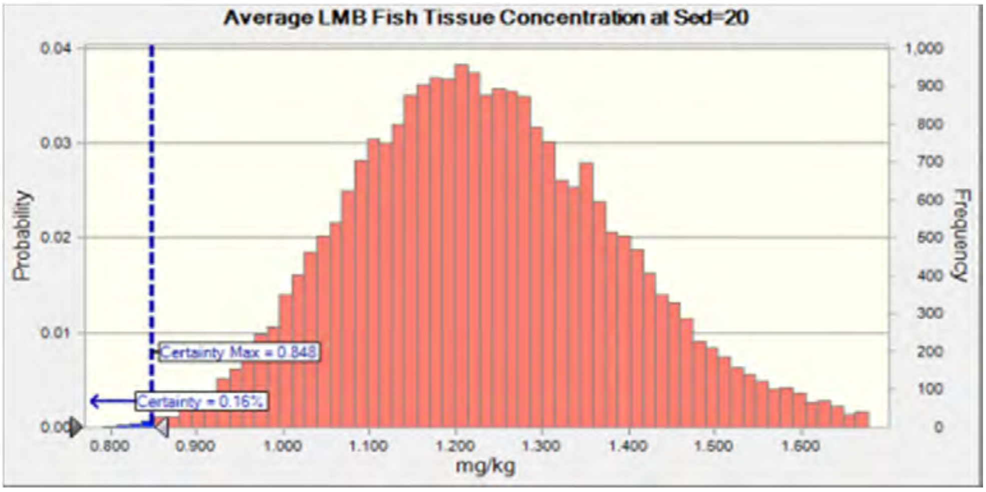
Forecast: Average LMB Fish Tissue Concentration at Sed=2.5 (cont'd) Cell: N13

Percentiles:	Forecast values
0%	0.529
10%	0.643
20%	0.665
30%	0.682
40%	0.697
50%	0.711
60%	0.726
70%	0.742
80%	0.760
90%	0.788
100%	0.992

ATTACHMENT B
Crystal Ball Report for Regression-Supported BSAF Probabilistic Modeling

Forecast: Average LMB Fish Tissue Concentration at Sed=20 **Cell: N27**

Summary:
Certainty level is 0.156%
Certainty range is from -Infinity to 0.848
Entire range is from 0.752 to 2.019
Base case is 1.227
After 25,000 trials, the std. error of the mean is 0.001



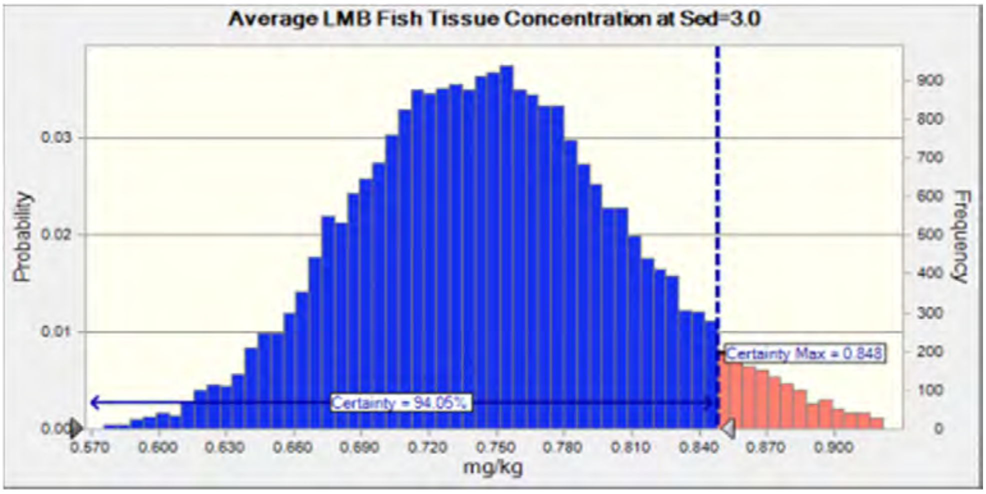
Statistics:	Forecast values
Trials	25,000
Base Case	1.227
Mean	1.235
Median	1.224
Mode	---
Standard Deviation	0.158
Variance	0.025
Skewness	0.3879
Kurtosis	3.23
Coeff. of Variation	0.1280
Minimum	0.752
Maximum	2.019
Range Width	1.267
Mean Std. Error	0.001

Forecast: Average LMB Fish Tissue Concentration at Sed=20 (cont'd) **Cell: N27**

Percentiles:	Forecast values
0%	0.752
10%	1.039
20%	1.099
30%	1.146
40%	1.186
50%	1.224
60%	1.265
70%	1.309
80%	1.364
90%	1.441
100%	2.019

Forecast: Average LMB Fish Tissue Concentration at Sed=3.0 **Cell: N14**

Summary:
Certainty level is 94.052%
Certainty range is from -Infinity to 0.848
Entire range is from 0.541 to 1.052
Base case is 0.746
After 25,000 trials, the std. error of the mean is 0.000



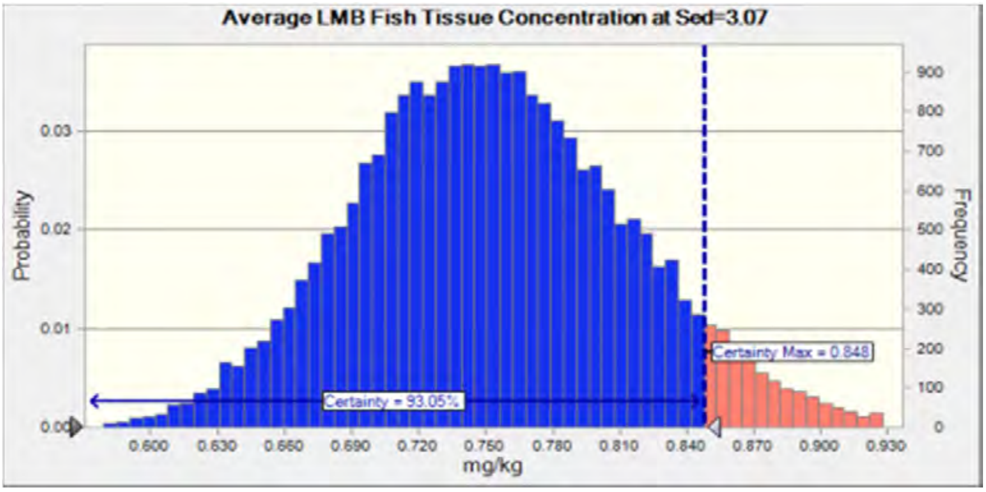
Statistics:	Forecast values
Trials	25,000
Base Case	0.746
Mean	0.749
Median	0.746
Mode	---
Standard Deviation	0.062
Variance	0.004
Skewness	0.2450
Kurtosis	3.10
Coeff. of Variation	0.0823
Minimum	0.541
Maximum	1.052
Range Width	0.510
Mean Std. Error	0.000

Forecast: Average LMB Fish Tissue Concentration at Sed=3.0 (cont'd) **Cell: N14**

Percentiles:	Forecast values
0%	0.541
10%	0.672
20%	0.696
30%	0.714
40%	0.730
50%	0.746
60%	0.762
70%	0.778
80%	0.799
90%	0.829
100%	1.052

Forecast: Average LMB Fish Tissue Concentration at Sed=3.07 **Cell: N15**

Summary:
- Certainty level is 93.051%
- Certainty range is from -Infinity to 0.848
- Entire range is from 0.528 to 1.113
- Base case is 0.751
- After 25,000 trials, the std. error of the mean is 0.000



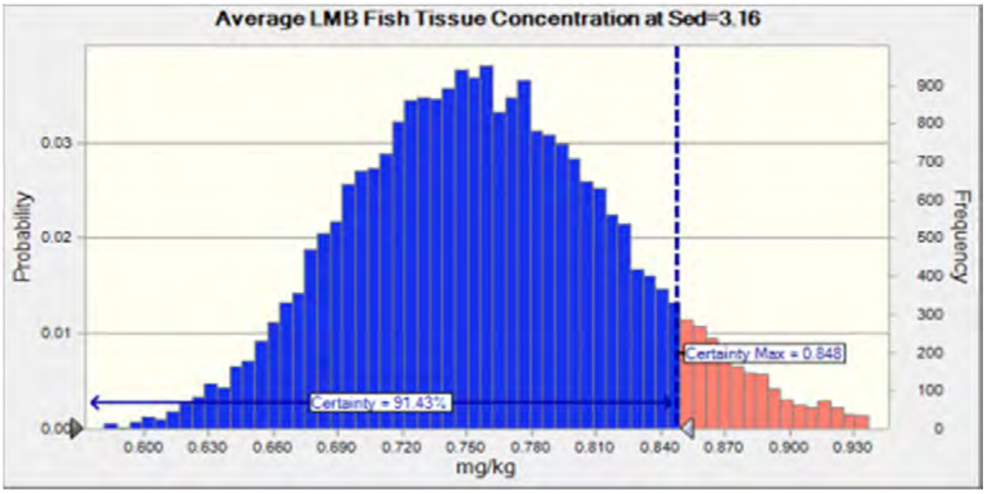
Statistics:	Forecast values
Trials	25,000
Base Case	0.751
Mean	0.753
Median	0.751
Mode	---
Standard Deviation	0.062
Variance	0.004
Skewness	0.2476
Kurtosis	3.16
Coeff. of Variation	0.0826
Minimum	0.528
Maximum	1.113
Range Width	0.585
Mean Std. Error	0.000

Forecast: Average LMB Fish Tissue Concentration at Sed=3.07 (cont'd) **Cell: N15**

Percentiles:	Forecast values
0%	0.528
10%	0.676
20%	0.701
30%	0.719
40%	0.735
50%	0.751
60%	0.766
70%	0.784
80%	0.805
90%	0.834
100%	1.113

Forecast: Average LMB Fish Tissue Concentration at Sed=3.16 **Cell: N16**

Summary:
- Certainty level is 91.431%
- Certainty range is from -Infinity to 0.848
- Entire range is from 0.542 to 1.065
- Base case is 0.756
- After 25,000 trials, the std. error of the mean is 0.000



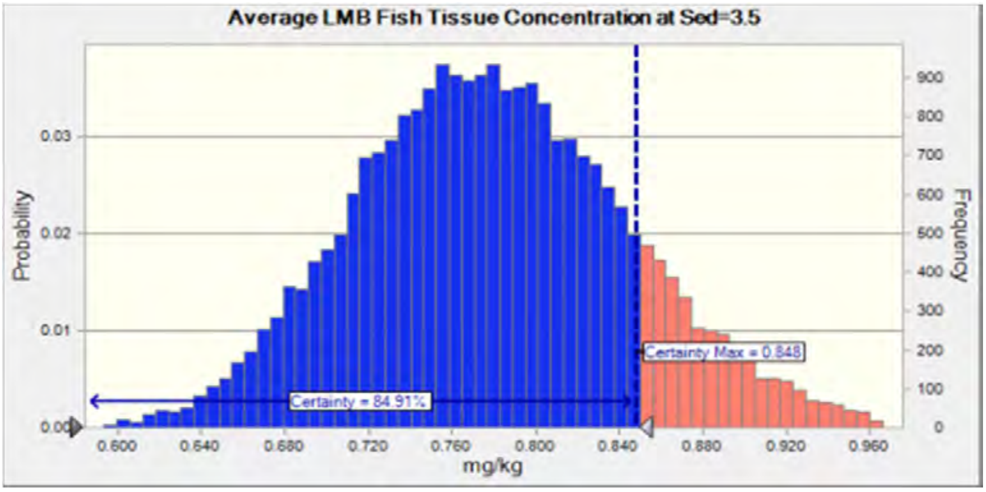
Statistics:	Forecast values
Trials	25,000
Base Case	0.756
Mean	0.759
Median	0.756
Mode	---
Standard Deviation	0.063
Variance	0.004
Skewness	0.2661
Kurtosis	3.11
Coeff. of Variation	0.0836
Minimum	0.542
Maximum	1.065
Range Width	0.523
Mean Std. Error	0.000

Forecast: Average LMB Fish Tissue Concentration at Sed=3.16 (cont'd) **Cell: N16**

Percentiles:	Forecast values
0%	0.542
10%	0.680
20%	0.704
30%	0.724
40%	0.740
50%	0.756
60%	0.773
70%	0.790
80%	0.811
90%	0.842
100%	1.065

Forecast: Average LMB Fish Tissue Concentration at Sed=3.5 **Cell: N17**

Summary:
Certainty level is 84.908%
Certainty range is from -Infinity to 0.848
Entire range is from 0.549 to 1.069
Base case is 0.777
After 25,000 trials, the std. error of the mean is 0.000



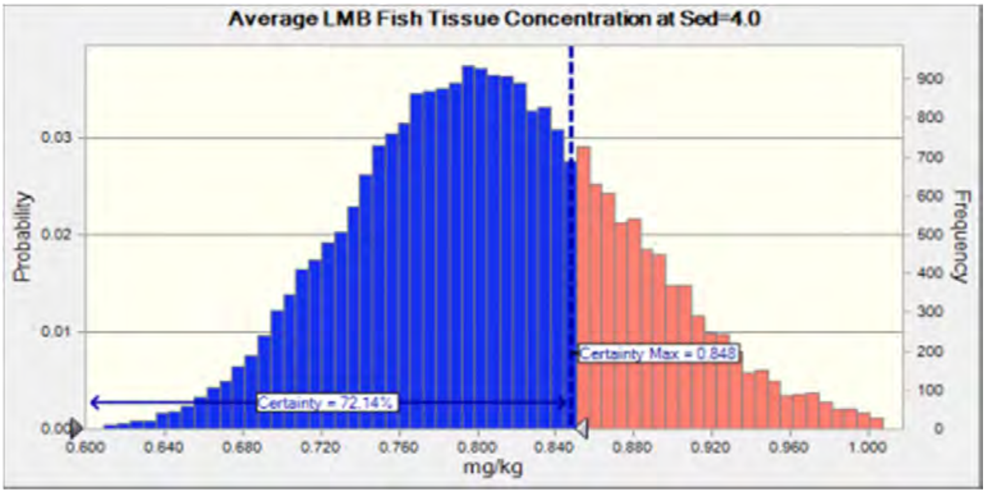
Statistics:	Forecast values
Trials	25,000
Base Case	0.777
Mean	0.780
Median	0.777
Mode	---
Standard Deviation	0.066
Variance	0.004
Skewness	0.2421
Kurtosis	3.09
Coeff. of Variation	0.0853
Minimum	0.549
Maximum	1.069
Range Width	0.520
Mean Std. Error	0.000

Forecast: Average LMB Fish Tissue Concentration at Sed=3.5 (cont'd) **Cell: N17**

Percentiles:	Forecast values
0%	0.549
10%	0.696
20%	0.723
30%	0.743
40%	0.760
50%	0.777
60%	0.794
70%	0.813
80%	0.835
90%	0.866
100%	1.069

Forecast: Average LMB Fish Tissue Concentration at Sed=4.0 **Cell: N18**

Summary:
Certainty level is 72.145%
Certainty range is from -Infinity to 0.848
Entire range is from 0.564 to 1.152
Base case is 0.804
After 25,000 trials, the std. error of the mean is 0.000



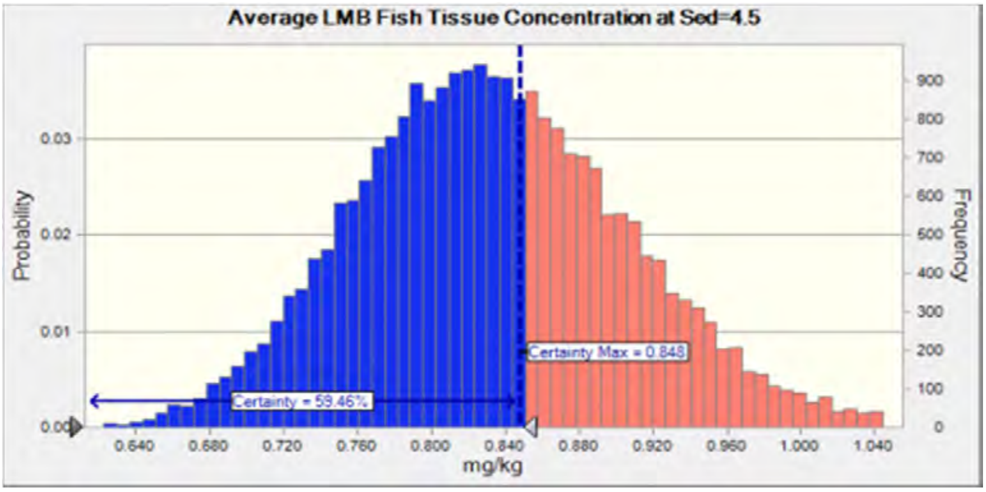
Statistics:	Forecast values
Trials	25,000
Base Case	0.804
Mean	0.808
Median	0.805
Mode	---
Standard Deviation	0.071
Variance	0.005
Skewness	0.2587
Kurtosis	3.08
Coeff. of Variation	0.0878
Minimum	0.564
Maximum	1.152
Range Width	0.588
Mean Std. Error	0.000

Forecast: Average LMB Fish Tissue Concentration at Sed=4.0 (cont'd) **Cell: N18**

Percentiles:	Forecast values
0%	0.564
10%	0.718
20%	0.748
30%	0.769
40%	0.787
50%	0.805
60%	0.823
70%	0.843
80%	0.867
90%	0.901
100%	1.152

Forecast: Average LMB Fish Tissue Concentration at Sed=4.5 **Cell: N19**

Summary:
Certainty level is 59.465%
Certainty range is from -Infinity to 0.848
Entire range is from 0.569 to 1.200
Base case is 0.830
After 25,000 trials, the std. error of the mean is 0.000



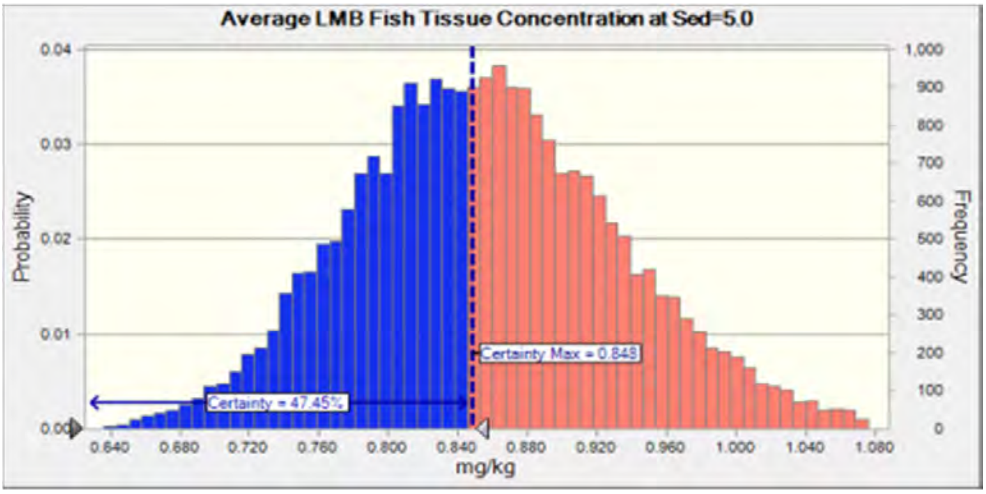
Statistics:	Forecast values
Trials	25,000
Base Case	0.830
Mean	0.833
Median	0.830
Mode	---
Standard Deviation	0.075
Variance	0.006
Skewness	0.2994
Kurtosis	3.20
Coeff. of Variation	0.0903
Minimum	0.569
Maximum	1.200
Range Width	0.631
Mean Std. Error	0.000

Forecast: Average LMB Fish Tissue Concentration at Sed=4.5 (cont'd) **Cell: N19**

Percentiles:	Forecast values
0%	0.569
10%	0.740
20%	0.770
30%	0.792
40%	0.811
50%	0.830
60%	0.849
70%	0.870
80%	0.895
90%	0.931
100%	1.200

Forecast: Average LMB Fish Tissue Concentration at Sed=5.0 **Cell: N20**

Summary:
Certainty level is 47.447%
Certainty range is from -Infinity to 0.848
Entire range is from 0.558 to 1.235
Base case is 0.853
After 25,000 trials, the std. error of the mean is 0.000



Statistics:	Forecast values
Trials	25,000
Base Case	0.853
Mean	0.856
Median	0.853
Mode	---
Standard Deviation	0.079
Variance	0.006
Skewness	0.2574
Kurtosis	3.11
Coeff. of Variation	0.0917
Minimum	0.558
Maximum	1.235
Range Width	0.677
Mean Std. Error	0.000

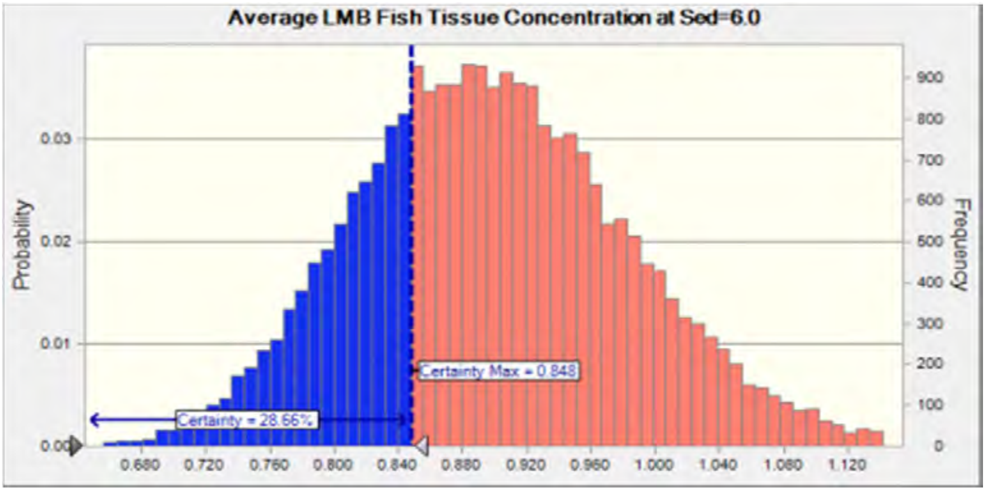
Forecast: Average LMB Fish Tissue Concentration at Sed=5.0 (cont'd)

Cell: N20

Percentiles:	Forecast values
0%	0.558
10%	0.758
20%	0.790
30%	0.813
40%	0.833
50%	0.853
60%	0.873
70%	0.894
80%	0.921
90%	0.960
100%	1.235

Forecast: Average LMB Fish Tissue Concentration at Sed=6.0 **Cell: N21**

Summary:
- Certainty level is 28.658%
- Certainty range is from -Infinity to 0.848
- Entire range is from 0.590 to 1.295
- Base case is 0.895
- After 25,000 trials, the std. error of the mean is 0.001



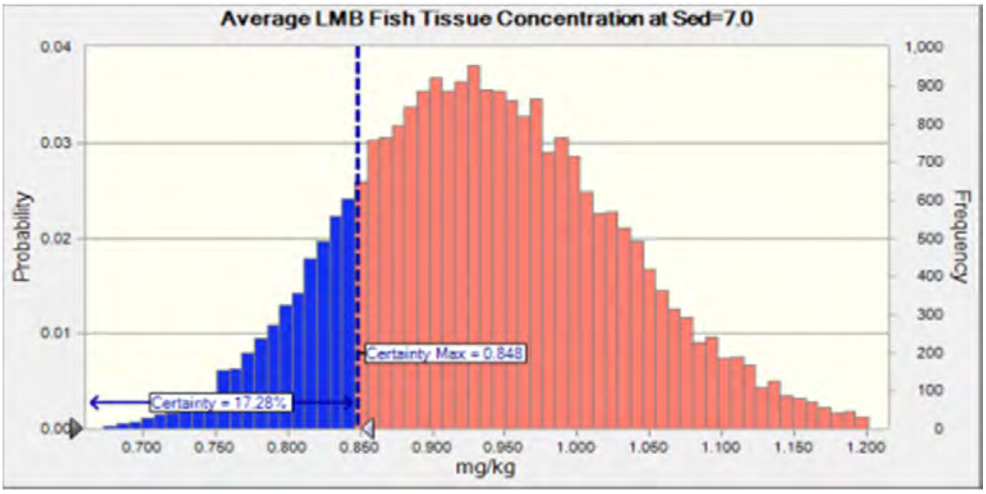
Statistics:	Forecast values
Trials	25,000
Base Case	0.895
Mean	0.899
Median	0.895
Mode	---
Standard Deviation	0.087
Variance	0.007
Skewness	0.2921
Kurtosis	3.17
Coeff. of Variation	0.0963
Minimum	0.590
Maximum	1.295
Range Width	0.705
Mean Std. Error	0.001

Forecast: Average LMB Fish Tissue Concentration at Sed=6.0 (cont'd) **Cell: N21**

Percentiles:	Forecast values
0%	0.590
10%	0.791
20%	0.826
30%	0.851
40%	0.873
50%	0.895
60%	0.917
70%	0.942
80%	0.970
90%	1.012
100%	1.295

Forecast: Average LMB Fish Tissue Concentration at Sed=7.0 **Cell: N22**

Summary:
Certainty level is 17.279%
Certainty range is from -Infinity to 0.848
Entire range is from 0.645 to 1.365
Base case is 0.932
After 25,000 trials, the std. error of the mean is 0.001



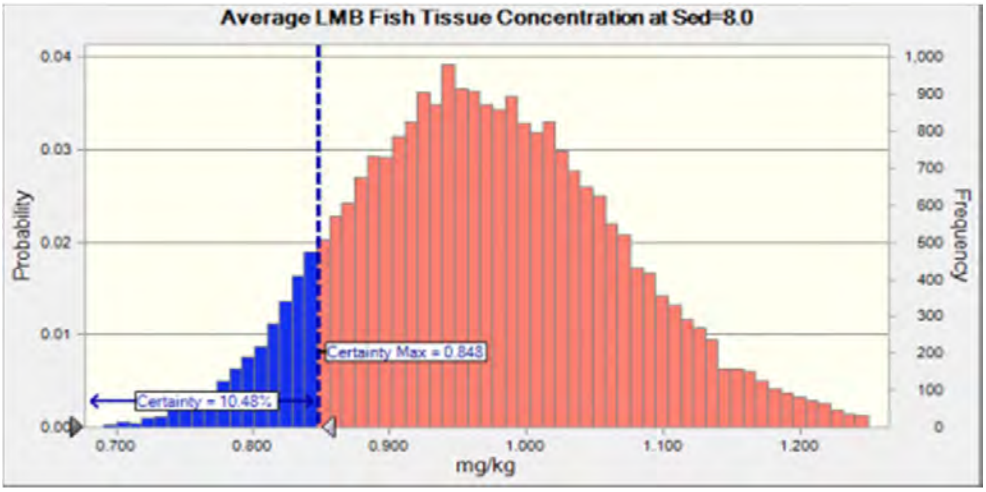
Statistics:	Forecast values
Trials	25,000
Base Case	0.932
Mean	0.937
Median	0.932
Mode	---
Standard Deviation	0.094
Variance	0.009
Skewness	0.2826
Kurtosis	3.11
Coeff. of Variation	0.1006
Minimum	0.645
Maximum	1.365
Range Width	0.720
Mean Std. Error	0.001

Forecast: Average LMB Fish Tissue Concentration at Sed=7.0 (cont'd) **Cell: N22**

Percentiles:	Forecast values
0%	0.645
10%	0.820
20%	0.857
30%	0.884
40%	0.909
50%	0.932
60%	0.957
70%	0.984
80%	1.015
90%	1.060
100%	1.365

Forecast: Average LMB Fish Tissue Concentration at Sed=8.0 **Cell: N23**

Summary:
Certainty level is 10.484%
Certainty range is from -Infinity to 0.848
Entire range is from 0.631 to 1.466
Base case is 0.965
After 25,000 trials, the std. error of the mean is 0.001



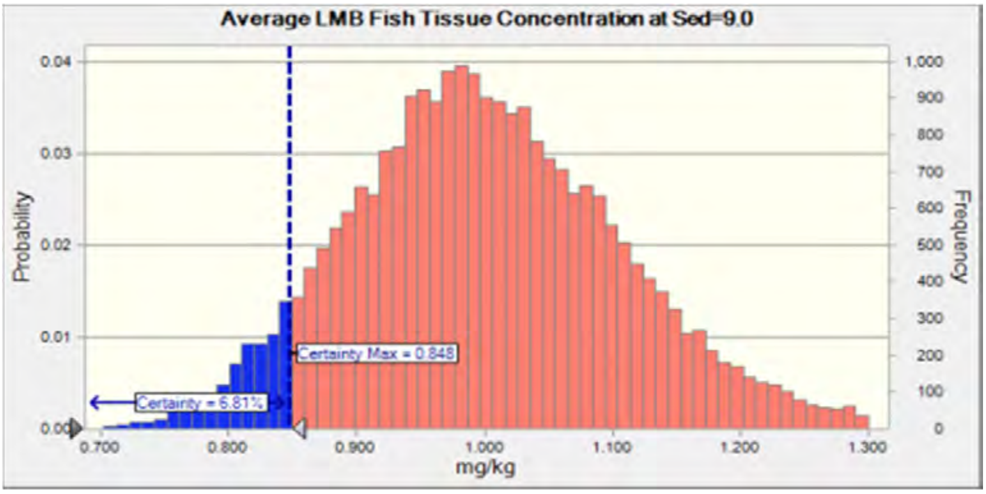
Statistics:	Forecast values
Trials	25,000
Base Case	0.965
Mean	0.970
Median	0.965
Mode	---
Standard Deviation	0.100
Variance	0.010
Skewness	0.3151
Kurtosis	3.17
Coeff. of Variation	0.1029
Minimum	0.631
Maximum	1.466
Range Width	0.835
Mean Std. Error	0.001

Forecast: Average LMB Fish Tissue Concentration at Sed=8.0 (cont'd) **Cell: N23**

Percentiles:	Forecast values
0%	0.631
10%	0.846
20%	0.885
30%	0.915
40%	0.940
50%	0.965
60%	0.991
70%	1.019
80%	1.053
90%	1.101
100%	1.466

Forecast: Average LMB Fish Tissue Concentration at Sed=9.0 **Cell: N24**

Summary:
- Certainty level is 6.813%
- Certainty range is from -Infinity to 0.848
- Entire range is from 0.634 to 1.497
- Base case is 0.995
- After 25,000 trials, the std. error of the mean is 0.001



Statistics:	Forecast values
Trials	25,000
Base Case	0.995
Mean	1.001
Median	0.995
Mode	---
Standard Deviation	0.107
Variance	0.011
Skewness	0.2924
Kurtosis	3.11
Coeff. of Variation	0.1065
Minimum	0.634
Maximum	1.497
Range Width	0.863
Mean Std. Error	0.001

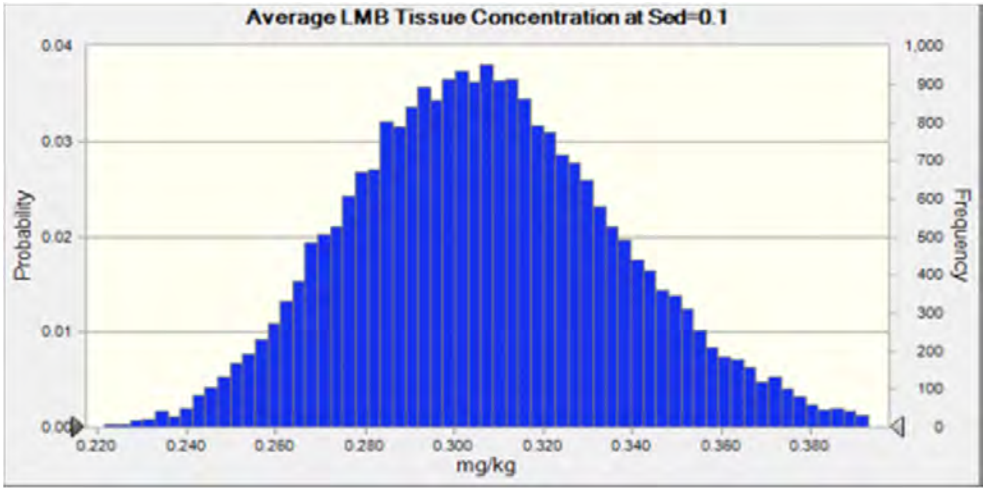
Forecast: Average LMB Fish Tissue Concentration at Sed=9.0 (cont'd)

Cell: N24

Percentiles:	Forecast values
0%	0.634
10%	0.868
20%	0.911
30%	0.943
40%	0.970
50%	0.995
60%	1.022
70%	1.052
80%	1.089
90%	1.140
100%	1.497

Forecast: Average LMB Tissue Concentration at Sed=0.1 **Cell: N7**

Summary:
Entire range is from 0.203 to 0.455
Base case is 0.305
After 25,000 trials, the std. error of the mean is 0.000



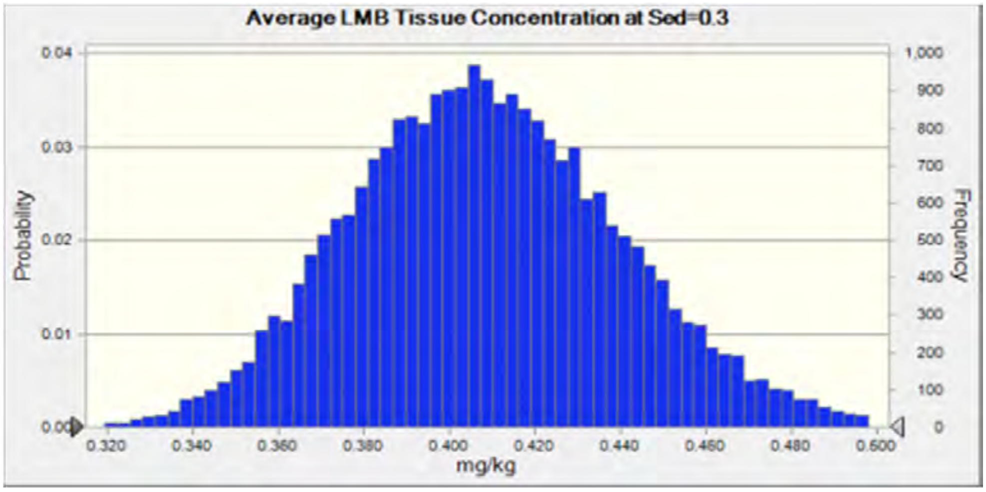
Statistics:	Forecast values
Trials	25,000
Base Case	0.305
Mean	0.307
Median	0.306
Mode	---
Standard Deviation	0.031
Variance	0.001
Skewness	0.3106
Kurtosis	3.16
Coeff. of Variation	0.0996
Minimum	0.203
Maximum	0.455
Range Width	0.251
Mean Std. Error	0.000

Forecast: Average LMB Tissue Concentration at Sed=0.1 (cont'd) **Cell: N7**

Percentiles:	Forecast values
0%	0.203
10%	0.269
20%	0.281
30%	0.290
40%	0.298
50%	0.306
60%	0.313
70%	0.322
80%	0.332
90%	0.348
100%	0.455

Forecast: Average LMB Tissue Concentration at Sed=0.3 **Cell: N8**

Summary:
Entire range is from 0.296 to 0.600
Base case is 0.408
After 25,000 trials, the std. error of the mean is 0.000



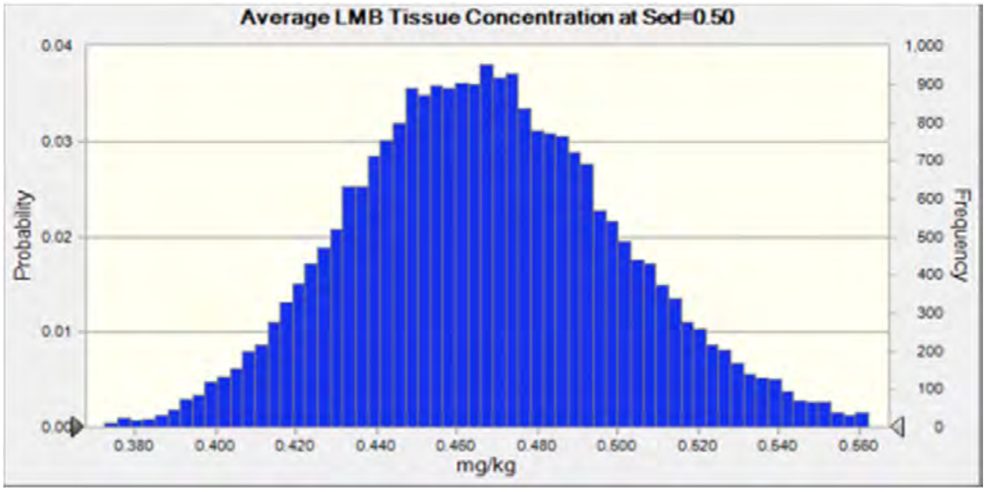
Statistics:	Forecast values
Trials	25,000
Base Case	0.408
Mean	0.409
Median	0.407
Mode	---
Standard Deviation	0.032
Variance	0.001
Skewness	0.2464
Kurtosis	3.14
Coeff. of Variation	0.0780
Minimum	0.296
Maximum	0.600
Range Width	0.304
Mean Std. Error	0.000

Forecast: Average LMB Tissue Concentration at Sed=0.3 (cont'd) **Cell: N8**

Percentiles:	Forecast values
0%	0.296
10%	0.369
20%	0.381
30%	0.391
40%	0.399
50%	0.407
60%	0.415
70%	0.424
80%	0.435
90%	0.450
100%	0.600

Forecast: Average LMB Tissue Concentration at Sed=0.50 **Cell: N9**

Summary:
Entire range is from 0.354 to 0.644
Base case is 0.466
After 25,000 trials, the std. error of the mean is 0.000



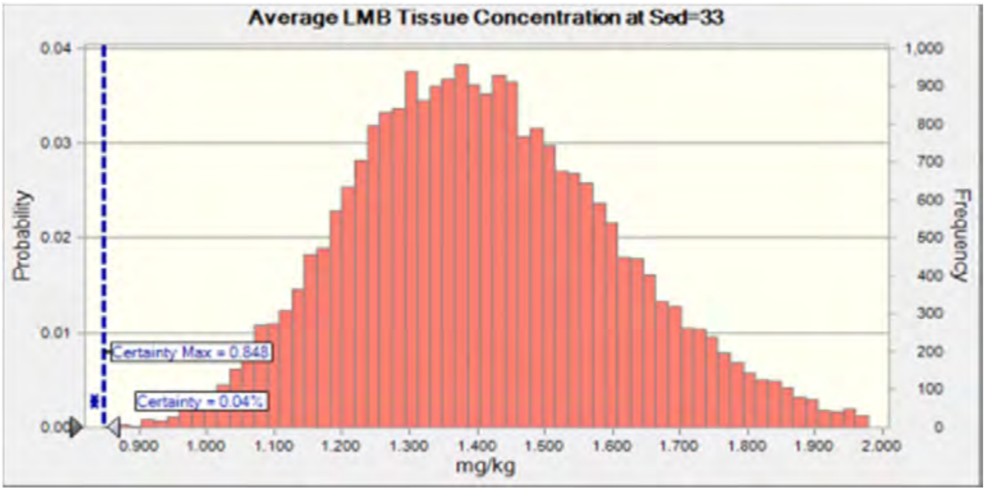
Statistics:	Forecast values
Trials	25,000
Base Case	0.466
Mean	0.467
Median	0.466
Mode	---
Standard Deviation	0.034
Variance	0.001
Skewness	0.2644
Kurtosis	3.15
Coeff. of Variation	0.0725
Minimum	0.354
Maximum	0.644
Range Width	0.290
Mean Std. Error	0.000

Forecast: Average LMB Tissue Concentration at Sed=0.50 (cont'd) **Cell: N9**

Percentiles:	Forecast values
0%	0.354
10%	0.425
20%	0.439
30%	0.449
40%	0.457
50%	0.466
60%	0.474
70%	0.484
80%	0.495
90%	0.511
100%	0.644

Forecast: Average LMB Tissue Concentration at Sed=33 **Cell: N28**

Summary:
- Certainty level is 0.040%
- Certainty range is from -Infinity to 0.848
- Entire range is from 0.802 to 2.397
- Base case is 1.400
- After 25,000 trials, the std. error of the mean is 0.001



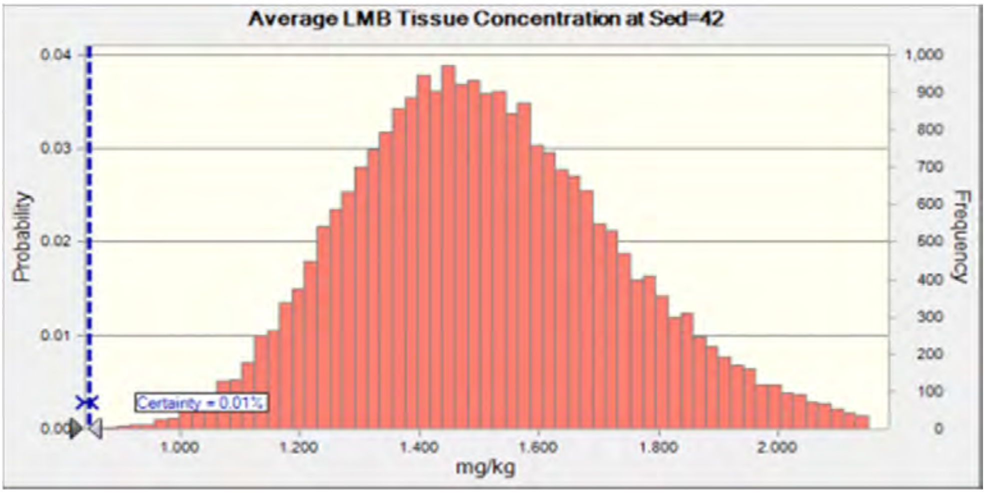
Statistics:	Forecast values
Trials	25,000
Base Case	1.400
Mean	1.413
Median	1.398
Mode	---
Standard Deviation	0.202
Variance	0.041
Skewness	0.4233
Kurtosis	3.28
Coeff. of Variation	0.1429
Minimum	0.802
Maximum	2.397
Range Width	1.595
Mean Std. Error	0.001

Forecast: Average LMB Tissue Concentration at Sed=33 (cont'd) **Cell: N28**

Percentiles:	Forecast values
0%	0.802
10%	1.166
20%	1.242
30%	1.297
40%	1.348
50%	1.398
60%	1.449
70%	1.508
80%	1.577
90%	1.678
100%	2.397

Forecast: Average LMB Tissue Concentration at Sed=42 **Cell: N29**

Summary:
- Certainty level is 0.007%
- Certainty range is from -Infinity to 0.848
- Entire range is from 0.816 to 2.616
- Base case is 1.491
- After 25,000 trials, the std. error of the mean is 0.001



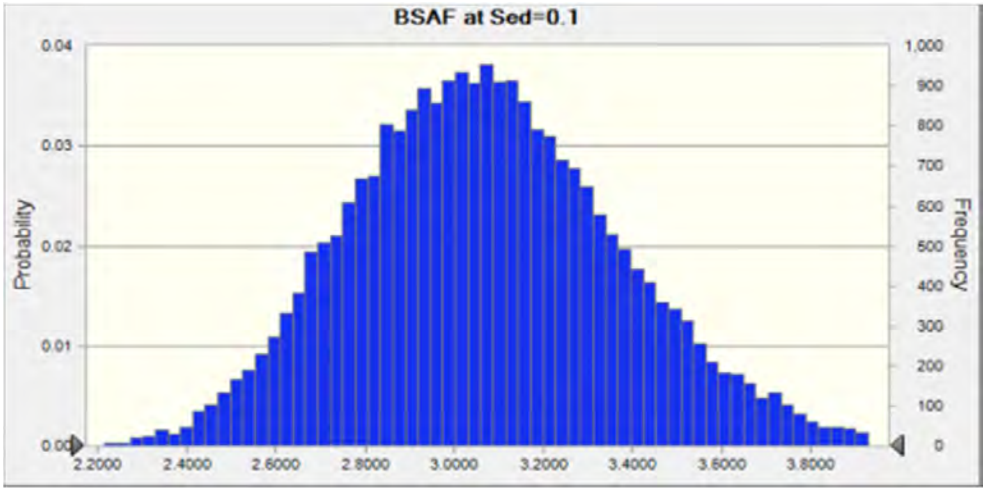
Statistics:	Forecast values
Trials	25,000
Base Case	1.491
Mean	1.511
Median	1.493
Mode	---
Standard Deviation	0.228
Variance	0.052
Skewness	0.4440
Kurtosis	3.30
Coeff. of Variation	0.1509
Minimum	0.816
Maximum	2.616
Range Width	1.799
Mean Std. Error	0.001

Forecast: Average LMB Tissue Concentration at Sed=42 (cont'd) **Cell: N29**

Percentiles:	Forecast values
0%	0.816
10%	1.232
20%	1.316
30%	1.381
40%	1.438
50%	1.493
60%	1.552
70%	1.616
80%	1.695
90%	1.812
100%	2.616

Forecast: BSAF at Sed=0.1 **Cell: L7**

Summary:
Entire range is from 2.0346 to 4.5472
Base case is 3.0549
After 25,000 trials, the std. error of the mean is 0.0019



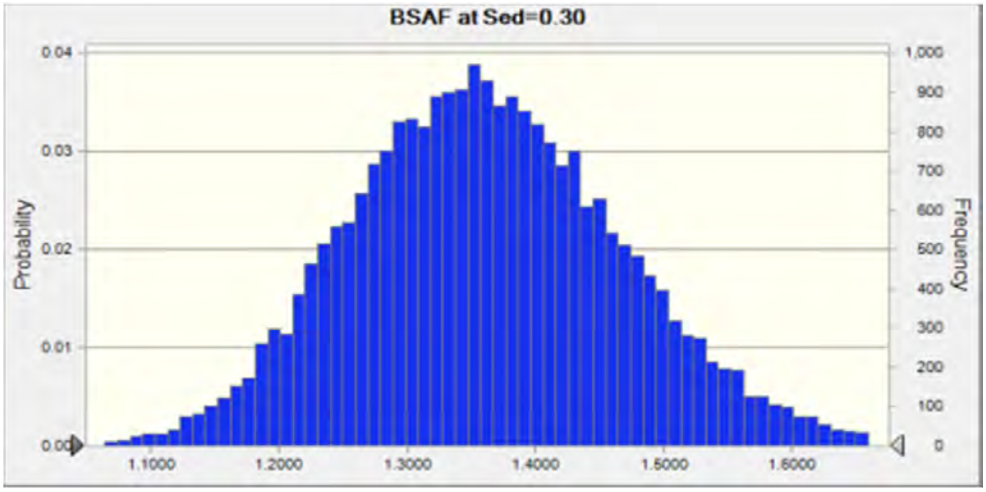
Statistics:	Forecast values
Trials	25,000
Base Case	3.0549
Mean	3.0727
Median	3.0589
Mode	---
Standard Deviation	0.3061
Variance	0.0937
Skewness	0.3106
Kurtosis	3.16
Coeff. of Variation	0.0996
Minimum	2.0346
Maximum	4.5472
Range Width	2.5126
Mean Std. Error	0.0019

Forecast: BSAF at Sed=0.1 (cont'd) **Cell: L7**

Percentiles:	Forecast values
0%	2.0346
10%	2.6899
20%	2.8112
30%	2.9026
40%	2.9821
50%	3.0589
60%	3.1347
70%	3.2201
80%	3.3238
90%	3.4762
100%	4.5472

Forecast: BSAF at Sed=0.30 **Cell: L8**

Summary:
Entire range is from 0.9872 to 1.9999
Base case is 1.3586
After 25,000 trials, the std. error of the mean is 0.0007



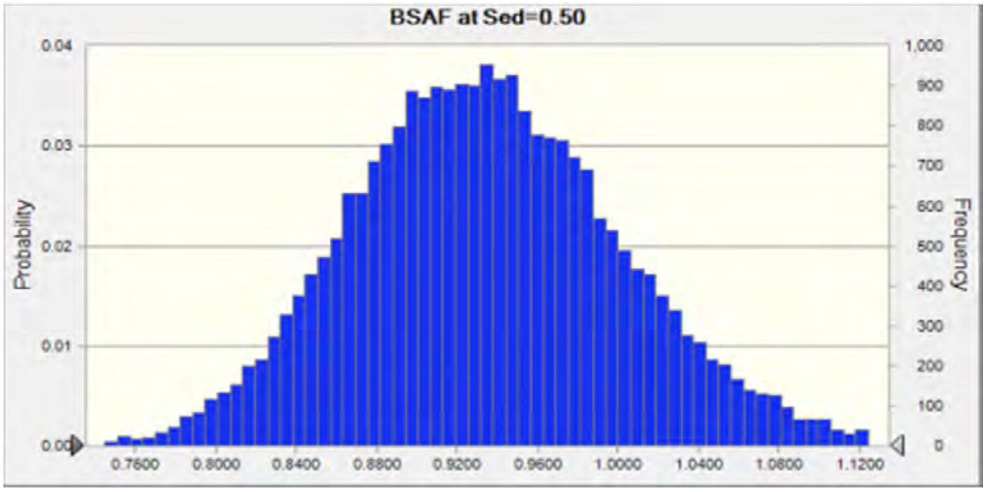
Statistics:	Forecast values
Trials	25,000
Base Case	1.3586
Mean	1.3620
Median	1.3575
Mode	---
Standard Deviation	0.1062
Variance	0.0113
Skewness	0.2464
Kurtosis	3.14
Coeff. of Variation	0.0780
Minimum	0.9872
Maximum	1.9999
Range Width	1.0127
Mean Std. Error	0.0007

Forecast: BSAF at Sed=0.30 (cont'd) **Cell: L8**

Percentiles:	Forecast values
0%	0.9872
10%	1.2290
20%	1.2714
30%	1.3028
40%	1.3315
50%	1.3575
60%	1.3847
70%	1.4147
80%	1.4501
90%	1.4998
100%	1.9999

Forecast: BSAF at Sed=0.50 **Cell: L9**

Summary:
Entire range is from 0.7088 to 1.2890
Base case is 0.9322
After 25,000 trials, the std. error of the mean is 0.0004



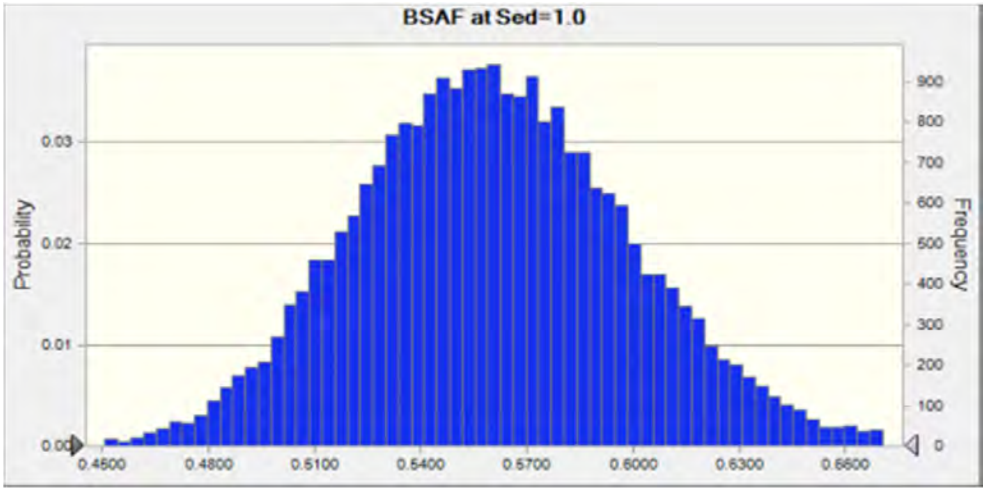
Statistics:	Forecast values
Trials	25,000
Base Case	0.9322
Mean	0.9347
Median	0.9321
Mode	---
Standard Deviation	0.0678
Variance	0.0046
Skewness	0.2644
Kurtosis	3.15
Coeff. of Variation	0.0725
Minimum	0.7088
Maximum	1.2890
Range Width	0.5802
Mean Std. Error	0.0004

Forecast: BSAF at Sed=0.50 (cont'd) **Cell: L9**

Percentiles:	Forecast values
0%	0.7088
10%	0.8500
20%	0.8773
30%	0.8972
40%	0.9147
50%	0.9321
60%	0.9488
70%	0.9682
80%	0.9900
90%	1.0228
100%	1.2890

Forecast: BSAF at Sed=1.0 **Cell: L10**

Summary:
Entire range is from 0.4168 to 0.7651
Base case is 0.5591
After 25,000 trials, the std. error of the mean is 0.0002



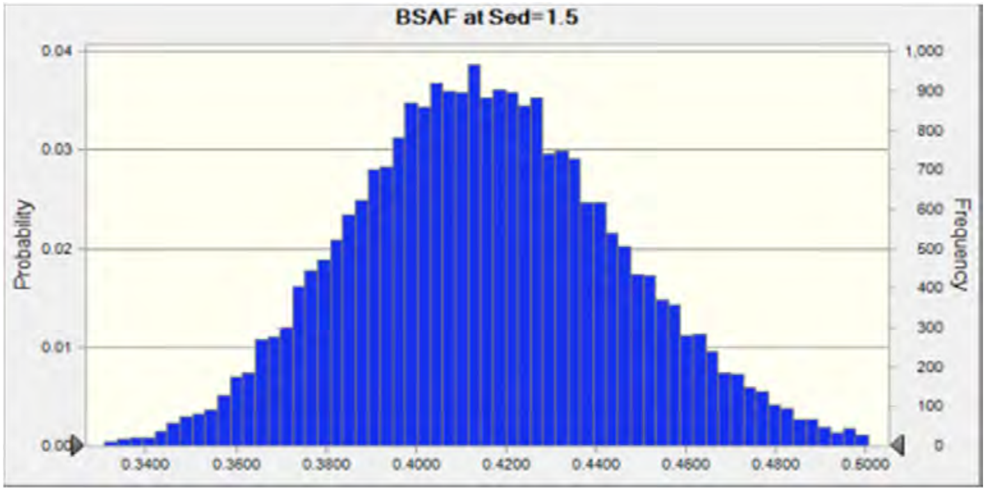
Statistics:	Forecast values
Trials	25,000
Base Case	0.5591
Mean	0.5606
Median	0.5593
Mode	---
Standard Deviation	0.0392
Variance	0.0015
Skewness	0.2232
Kurtosis	3.13
Coeff. of Variation	0.0699
Minimum	0.4168
Maximum	0.7651
Range Width	0.3483
Mean Std. Error	0.0002

Forecast: BSAF at Sed=1.0 (cont'd) **Cell: L10**

Percentiles:	Forecast values
0%	0.4168
10%	0.5111
20%	0.5273
30%	0.5392
40%	0.5495
50%	0.5593
60%	0.5694
70%	0.5800
80%	0.5930
90%	0.6115
100%	0.7651

Forecast: BSAF at Sed=1.5 **Cell: L11**

Summary:
Entire range is from 0.3064 to 0.5554
Base case is 0.4146
After 25,000 trials, the std. error of the mean is 0.0002



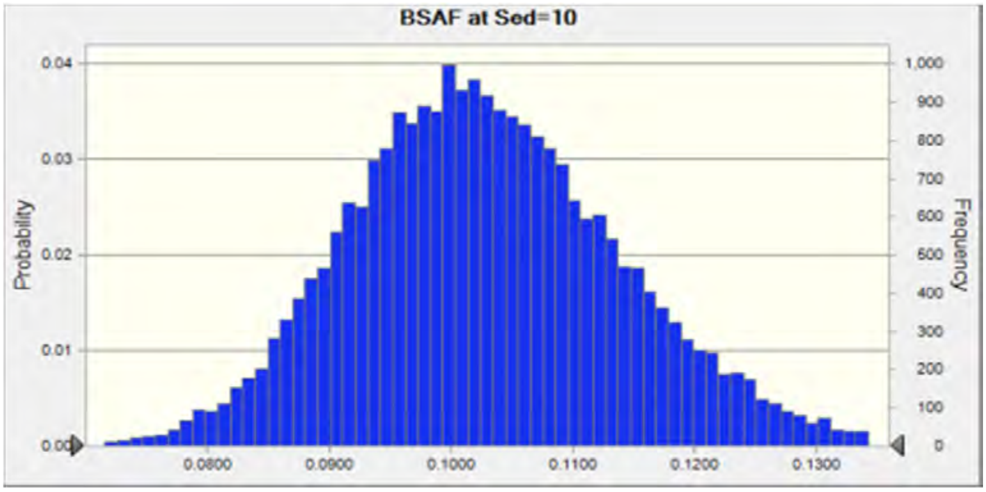
Statistics:	Forecast values
Trials	25,000
Base Case	0.4146
Mean	0.4157
Median	0.4145
Mode	---
Standard Deviation	0.0303
Variance	0.0009
Skewness	0.2145
Kurtosis	3.07
Coeff. of Variation	0.0729
Minimum	0.3064
Maximum	0.5554
Range Width	0.2490
Mean Std. Error	0.0002

Forecast: BSAF at Sed=1.5 (cont'd) **Cell: L11**

Percentiles:	Forecast values
0%	0.3064
10%	0.3775
20%	0.3899
30%	0.3992
40%	0.4070
50%	0.4145
60%	0.4223
70%	0.4306
80%	0.4407
90%	0.4554
100%	0.5554

Forecast: BSAF at Sed=10 **Cell: L25**

Summary:
Entire range is from 0.0616 to 0.1558
Base case is 0.1023
After 25,000 trials, the std. error of the mean is 0.0001



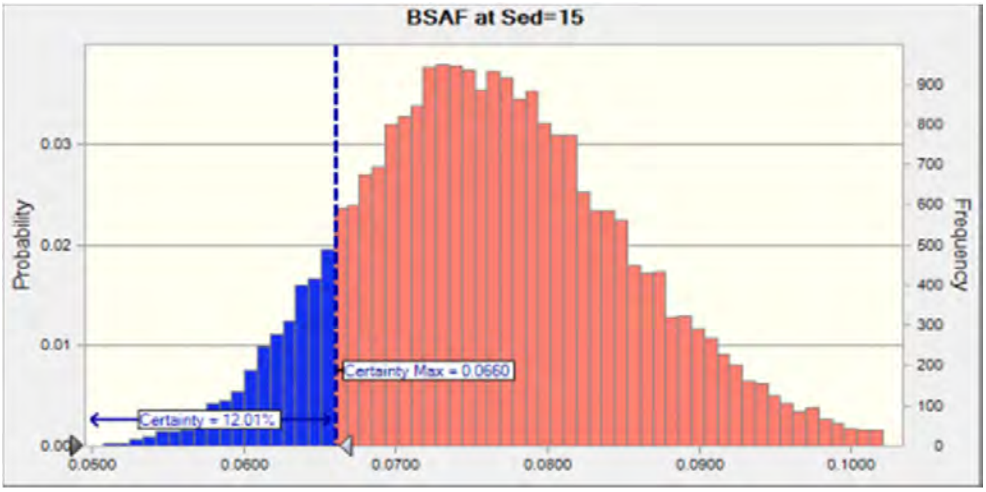
Statistics:	Forecast values
Trials	25,000
Base Case	0.1023
Mean	0.1030
Median	0.1023
Mode	---
Standard Deviation	0.0112
Variance	0.0001
Skewness	0.3213
Kurtosis	3.20
Coeff. of Variation	0.1087
Minimum	0.0616
Maximum	0.1558
Range Width	0.0942
Mean Std. Error	0.0001

Forecast: BSAF at Sed=10 (cont'd) **Cell: L25**

Percentiles:	Forecast values
0%	0.0616
10%	0.0891
20%	0.0935
30%	0.0967
40%	0.0996
50%	0.1023
60%	0.1052
70%	0.1083
80%	0.1122
90%	0.1177
100%	0.1558

Forecast: BSAF at Sed=15 **Cell: L26**

Summary:
Certainty level is 12.013%
Certainty range is from -Infinity to 0.0660
Entire range is from 0.0452 to 0.1218
Base case is 0.0759
After 25,000 trials, the std. error of the mean is 0.0001



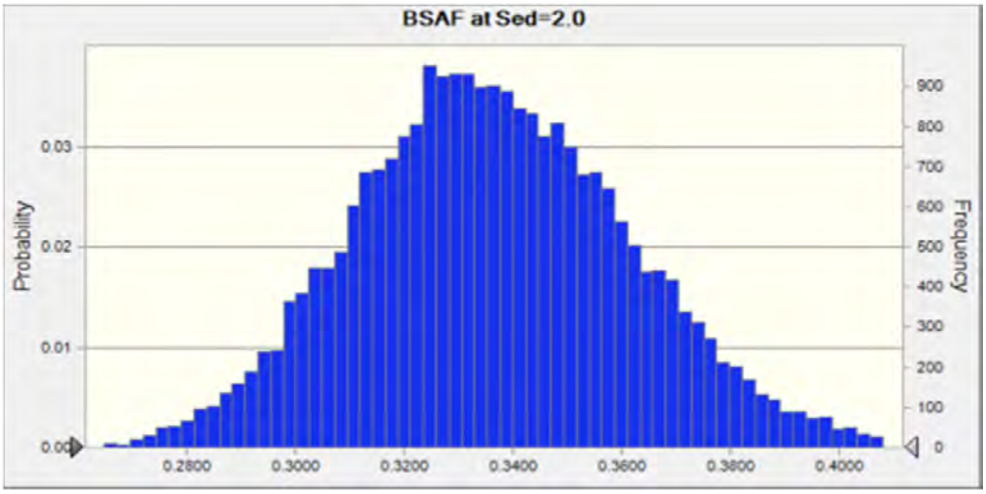
Statistics:	Forecast values
Trials	25,000
Base Case	0.0759
Mean	0.0764
Median	0.0759
Mode	---
Standard Deviation	0.0092
Variance	0.0001
Skewness	0.3657
Kurtosis	3.28
Coeff. of Variation	0.1199
Minimum	0.0452
Maximum	0.1218
Range Width	0.0766
Mean Std. Error	0.0001

Forecast: BSAF at Sed=15 (cont'd) **Cell: L26**

Percentiles:	Forecast values
0%	0.0452
10%	0.0651
20%	0.0686
30%	0.0713
40%	0.0736
50%	0.0759
60%	0.0782
70%	0.0807
80%	0.0839
90%	0.0884
100%	0.1218

Forecast: BSAF at Sed=2.0 **Cell: L12**

Summary:
Certainty level is 99.837%
Certainty range is from -Infinity to 0.4200
Entire range is from 0.2389 to 0.4471
Base case is 0.3353
After 25,000 trials, the std. error of the mean is 0.0002



Statistics:	Forecast values
Trials	25,000
Base Case	0.3353
Mean	0.3364
Median	0.3353
Mode	---
Standard Deviation	0.0256
Variance	0.0007
Skewness	0.2162
Kurtosis	3.08
Coeff. of Variation	0.0760
Minimum	0.2389
Maximum	0.4471
Range Width	0.2081
Mean Std. Error	0.0002

Forecast: BSAF at Sed=2.0 (cont'd)

Cell: L12

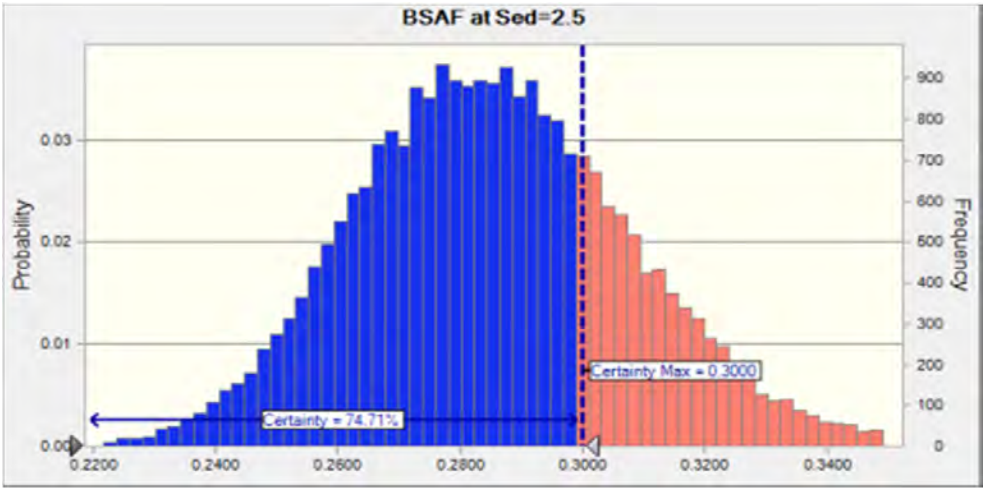
Percentiles:	Forecast values
0%	0.2389
10%	0.3040
20%	0.3147
30%	0.3225
40%	0.3289
50%	0.3353
60%	0.3420
70%	0.3492
80%	0.3576
90%	0.3697
100%	0.4471

ATTACHMENT B

Crystal Ball Report for Regression-Supported BSAF Probabilistic Modeling

Forecast: BSAF at Sed=2.5 **Cell: L13**

Summary:
- Certainty level is 74.707%
- Certainty range is from -Infinity to 0.3000
- Entire range is from 0.2116 to 0.3967
- Base case is 0.2845
- After 25,000 trials, the std. error of the mean is 0.0001



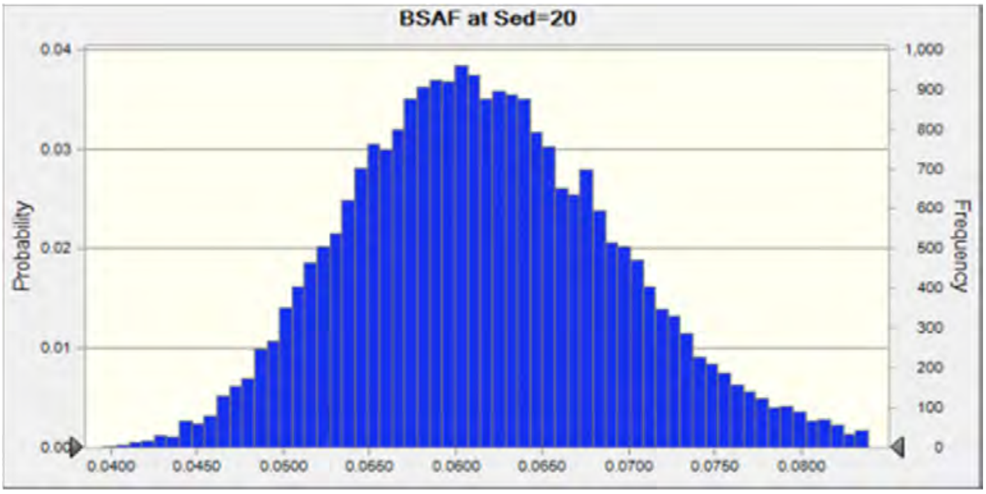
Statistics:	Forecast values
Trials	25,000
Base Case	0.2845
Mean	0.2854
Median	0.2845
Mode	---
Standard Deviation	0.0227
Variance	0.0005
Skewness	0.2450
Kurtosis	3.10
Coeff. of Variation	0.0796
Minimum	0.2116
Maximum	0.3967
Range Width	0.1852
Mean Std. Error	0.0001

Forecast: BSAF at Sed=2.5 (cont'd) **Cell: L13**

Percentiles:	Forecast values
0%	0.2116
10%	0.2571
20%	0.2661
30%	0.2728
40%	0.2787
50%	0.2845
60%	0.2904
70%	0.2966
80%	0.3042
90%	0.3151
100%	0.3967

Forecast: BSAF at Sed=20 **Cell: L27**

Summary:
Entire range is from 0.0376 to 0.1009
Base case is 0.0614
After 25,000 trials, the std. error of the mean is 0.0000



Statistics:	Forecast values
Trials	25,000
Base Case	0.0614
Mean	0.0617
Median	0.0612
Mode	---
Standard Deviation	0.0079
Variance	0.0001
Skewness	0.3879
Kurtosis	3.23
Coeff. of Variation	0.1280
Minimum	0.0376
Maximum	0.1009
Range Width	0.0634
Mean Std. Error	0.0000

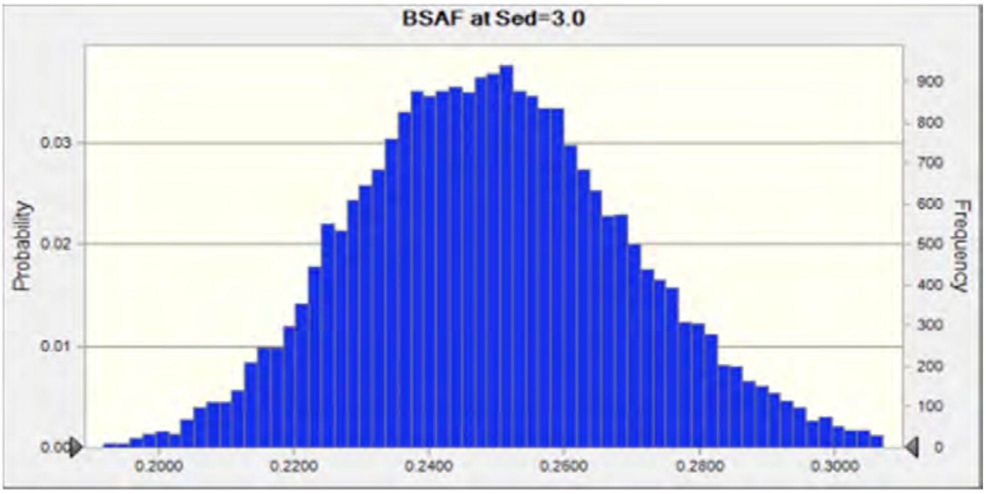
Forecast: BSAF at Sed=20 (cont'd) **Cell: L27**

Percentiles:	Forecast values
0%	0.0376
10%	0.0519
20%	0.0550
30%	0.0573
40%	0.0593
50%	0.0612
60%	0.0633
70%	0.0655
80%	0.0682
90%	0.0720
100%	0.1009

ATTACHMENT B
Crystal Ball Report for Regression-Supported BSAF Probabilistic Modeling

Forecast: BSAF at Sed=3.0 **Cell: L14**

Summary:
  Entire range is from 0.1804 to 0.3505
  Base case is 0.2486
  After 25,000 trials, the std. error of the mean is 0.0001



Statistics:	Forecast values
Trials	25,000
Base Case	0.2486
Mean	0.2495
Median	0.2488
Mode	---
Standard Deviation	0.0205
Variance	0.0004
Skewness	0.2450
Kurtosis	3.10
Coeff. of Variation	0.0823
Minimum	0.1804
Maximum	0.3505
Range Width	0.1701
Mean Std. Error	0.0001

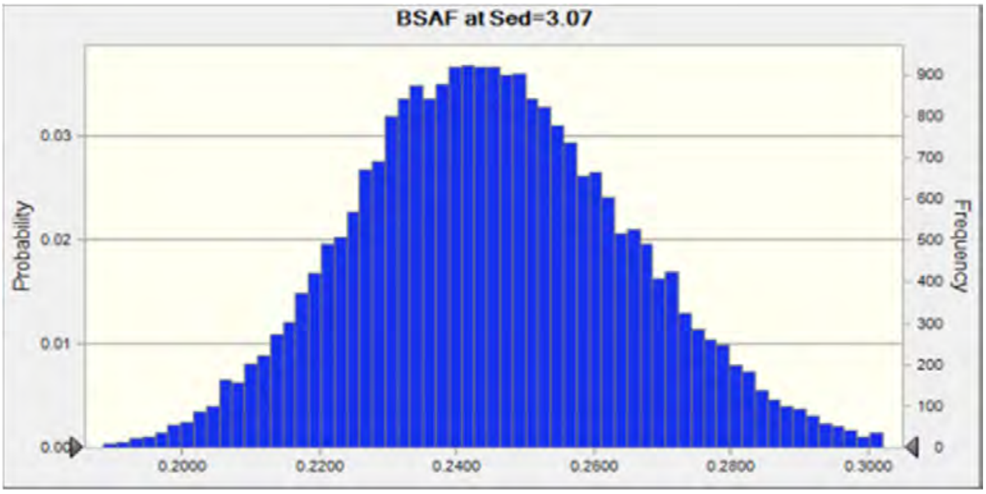
Forecast: BSAF at Sed=3.0 (cont'd) **Cell: L14**

Percentiles:	Forecast values
0%	0.1804
10%	0.2241
20%	0.2321
30%	0.2381
40%	0.2435
50%	0.2488
60%	0.2540
70%	0.2595
80%	0.2664
90%	0.2763
100%	0.3505

ATTACHMENT B
Crystal Ball Report for Regression-Supported BSAF Probabilistic Modeling

Forecast: BSAF at Sed=3.07 **Cell: L15**

Summary:
Entire range is from 0.1721 to 0.3625
Base case is 0.2445
After 25,000 trials, the std. error of the mean is 0.0001



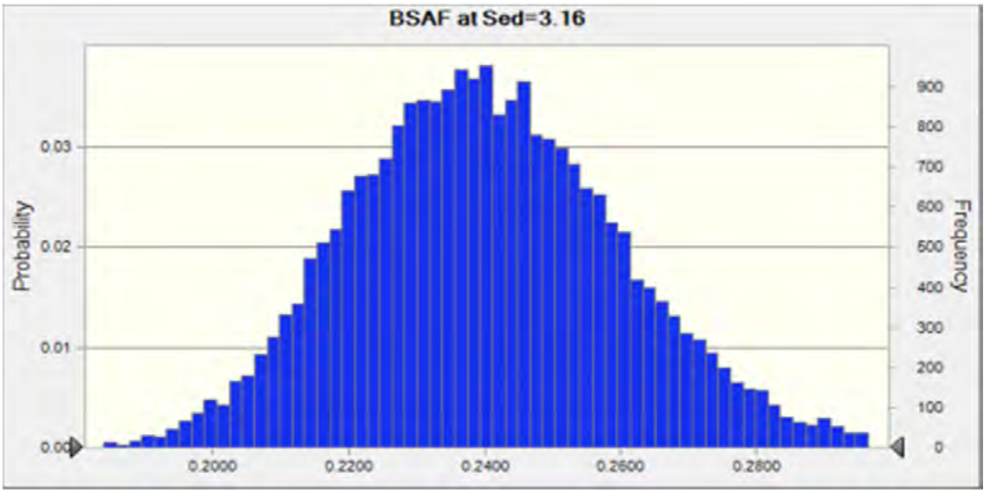
Statistics:	Forecast values
Trials	25,000
Base Case	0.2445
Mean	0.2454
Median	0.2446
Mode	---
Standard Deviation	0.0203
Variance	0.0004
Skewness	0.2476
Kurtosis	3.16
Coeff. of Variation	0.0826
Minimum	0.1721
Maximum	0.3625
Range Width	0.1905
Mean Std. Error	0.0001

Forecast: BSAF at Sed=3.07 (cont'd) **Cell: L15**

Percentiles:	Forecast values
0%	0.1721
10%	0.2201
20%	0.2283
30%	0.2341
40%	0.2395
50%	0.2445
60%	0.2497
70%	0.2553
80%	0.2622
90%	0.2718
100%	0.3625

Forecast: BSAF at Sed=3.16 **Cell: L16**

Summary:
Entire range is from 0.1715 to 0.3371
Base case is 0.2393
After 25,000 trials, the std. error of the mean is 0.0001



Statistics:	Forecast values
Trials	25,000
Base Case	0.2393
Mean	0.2402
Median	0.2393
Mode	---
Standard Deviation	0.0201
Variance	0.0004
Skewness	0.2661
Kurtosis	3.11
Coeff. of Variation	0.0836
Minimum	0.1715
Maximum	0.3371
Range Width	0.1656
Mean Std. Error	0.0001

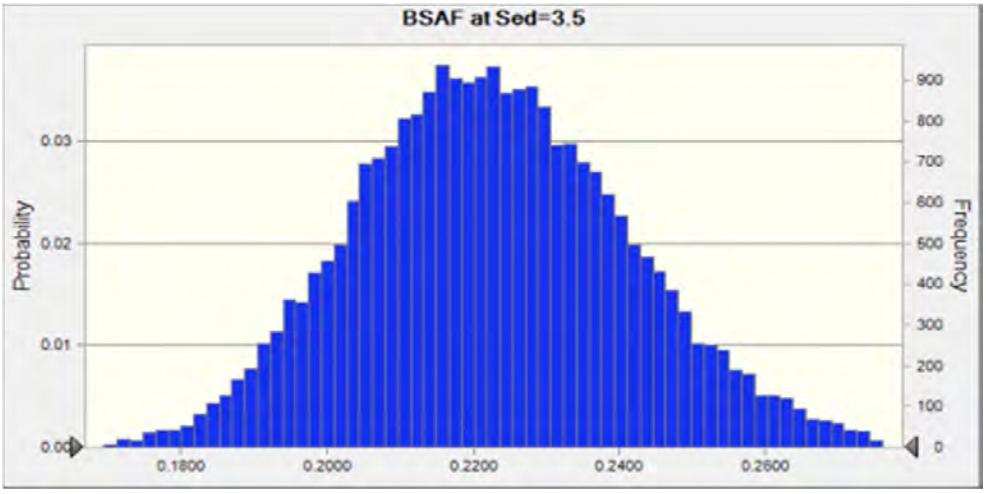
Forecast: BSAF at Sed=3.16 (cont'd) **Cell: L16**

Percentiles:	Forecast values
0%	0.1715
10%	0.2151
20%	0.2229
30%	0.2290
40%	0.2343
50%	0.2393
60%	0.2446
70%	0.2501
80%	0.2568
90%	0.2665
100%	0.3371

ATTACHMENT B
Crystal Ball Report for Regression-Supported BSAF Probabilistic Modeling

Forecast: BSAF at Sed=3.5 **Cell: L17**

Summary:
Entire range is from 0.1570 to 0.3055
Base case is 0.2219
After 25,000 trials, the std. error of the mean is 0.0001



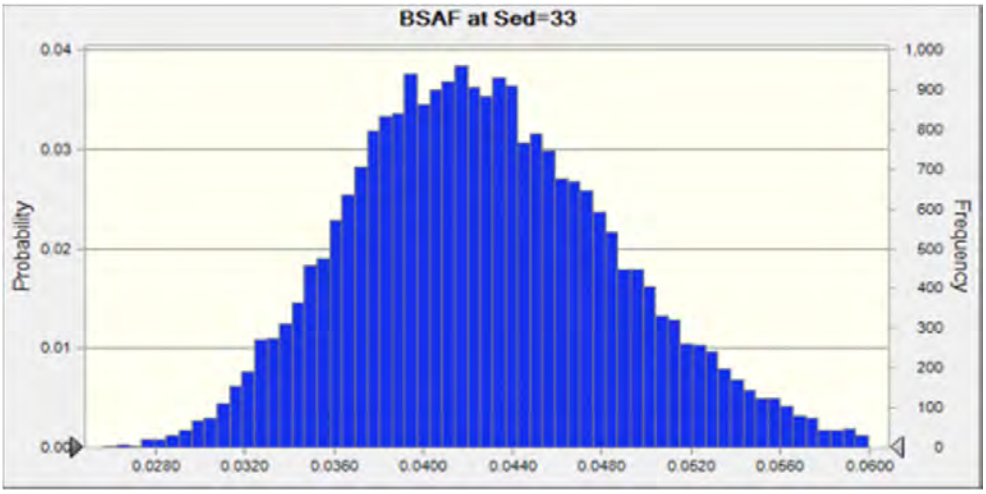
Statistics:	Forecast values
Trials	25,000
Base Case	0.2219
Mean	0.2227
Median	0.2220
Mode	---
Standard Deviation	0.0190
Variance	0.0004
Skewness	0.2421
Kurtosis	3.09
Coeff. of Variation	0.0853
Minimum	0.1570
Maximum	0.3055
Range Width	0.1485
Mean Std. Error	0.0001

Forecast: BSAF at Sed=3.5 (cont'd) **Cell: L17**

Percentiles:	Forecast values
0%	0.1570
10%	0.1989
20%	0.2066
30%	0.2123
40%	0.2172
50%	0.2220
60%	0.2269
70%	0.2322
80%	0.2385
90%	0.2474
100%	0.3055

Forecast: BSAF at Sed=33 **Cell: L28**

Summary:
Certainty level is 99.802%
Certainty range is from -Infinity to 0.0640
Entire range is from 0.0243 to 0.0726
Base case is 0.0424
After 25,000 trials, the std. error of the mean is 0.0000



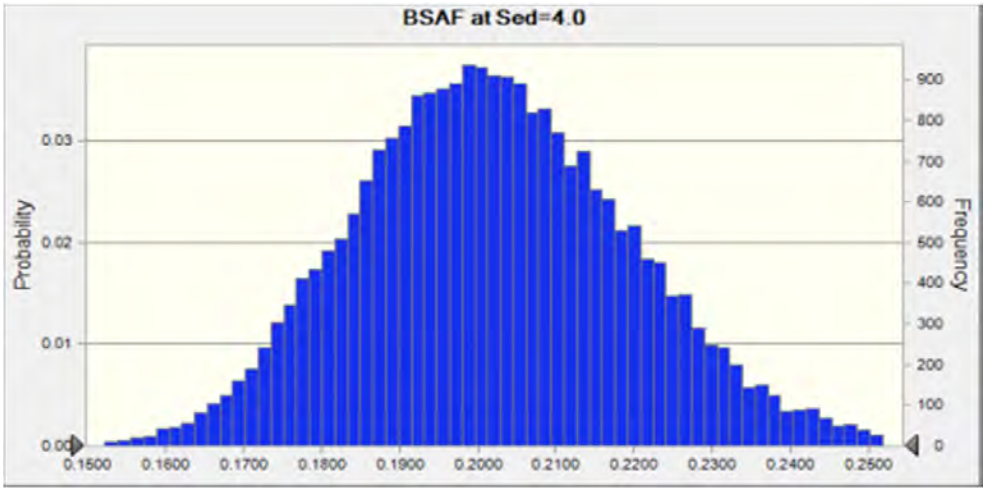
Statistics:	Forecast values
Trials	25,000
Base Case	0.0424
Mean	0.0428
Median	0.0424
Mode	---
Standard Deviation	0.0061
Variance	0.0000
Skewness	0.4233
Kurtosis	3.28
Coeff. of Variation	0.1429
Minimum	0.0243
Maximum	0.0726
Range Width	0.0483
Mean Std. Error	0.0000

Forecast: BSAF at Sed=33 (cont'd) **Cell: L28**

Percentiles:	Forecast values
0%	0.0243
10%	0.0353
20%	0.0376
30%	0.0393
40%	0.0409
50%	0.0424
60%	0.0439
70%	0.0457
80%	0.0478
90%	0.0508
100%	0.0726

Forecast: BSAF at Sed=4.0 **Cell: L18**

Summary:
Entire range is from 0.1410 to 0.2880
Base case is 0.2011
After 25,000 trials, the std. error of the mean is 0.0001



Statistics:	Forecast values
Trials	25,000
Base Case	0.2011
Mean	0.2020
Median	0.2013
Mode	---
Standard Deviation	0.0177
Variance	0.0003
Skewness	0.2587
Kurtosis	3.08
Coeff. of Variation	0.0878
Minimum	0.1410
Maximum	0.2880
Range Width	0.1470
Mean Std. Error	0.0001

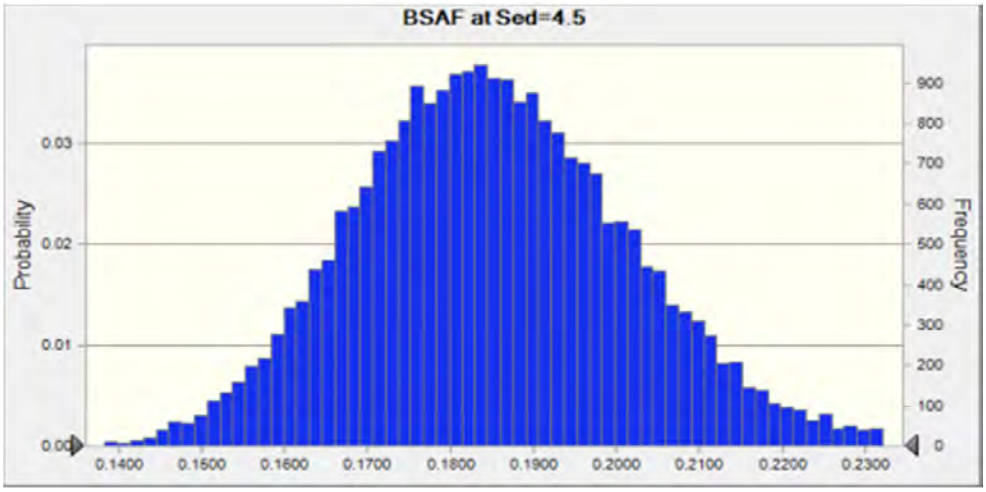
Forecast: BSAF at Sed=4.0 (cont'd) **Cell: L18**

Percentiles:	Forecast values
0%	0.1410
10%	0.1796
20%	0.1869
30%	0.1922
40%	0.1969
50%	0.2013
60%	0.2058
70%	0.2108
80%	0.2168
90%	0.2251
100%	0.2880

Forecast: BSAF at Sed=4.5 **Cell: L19**

Summary:

Entire range is from 0.1264 to 0.2666
Base case is 0.1844
After 25,000 trials, the std. error of the mean is 0.0001



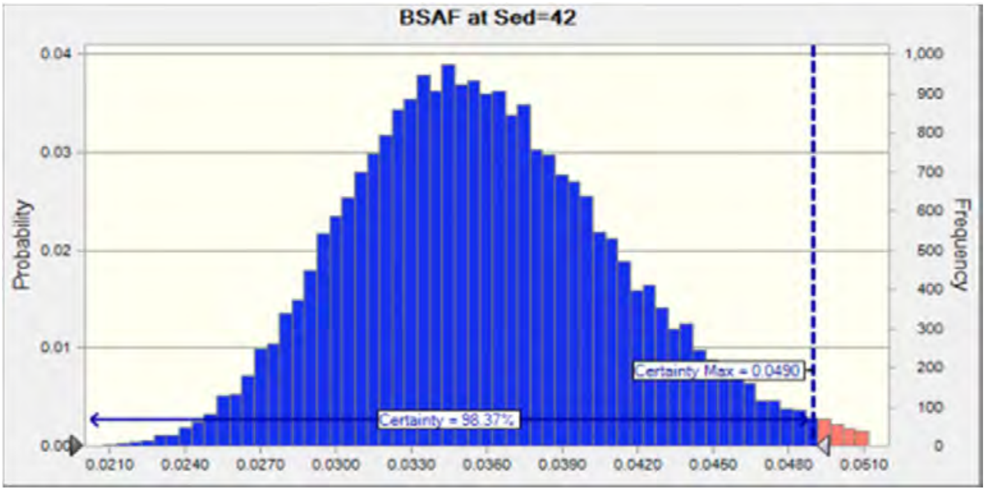
Statistics:	Forecast values
Trials	25,000
Base Case	0.1844
Mean	0.1852
Median	0.1844
Mode	---
Standard Deviation	0.0167
Variance	0.0003
Skewness	0.2994
Kurtosis	3.20
Coeff. of Variation	0.0903
Minimum	0.1264
Maximum	0.2666
Range Width	0.1402
Mean Std. Error	0.0001

Forecast: BSAF at Sed=4.5 (cont'd) **Cell: L19**

Percentiles:	Forecast values
0%	0.1264
10%	0.1644
20%	0.1710
30%	0.1759
40%	0.1803
50%	0.1844
60%	0.1887
70%	0.1933
80%	0.1989
90%	0.2069
100%	0.2666

Forecast: BSAF at Sed=42 **Cell: L29**

Summary:
- Certainty level is 98.372%
- Certainty range is from -Infinity to 0.0490
- Entire range is from 0.0194 to 0.0623
- Base case is 0.0355
- After 25,000 trials, the std. error of the mean is 0.0000



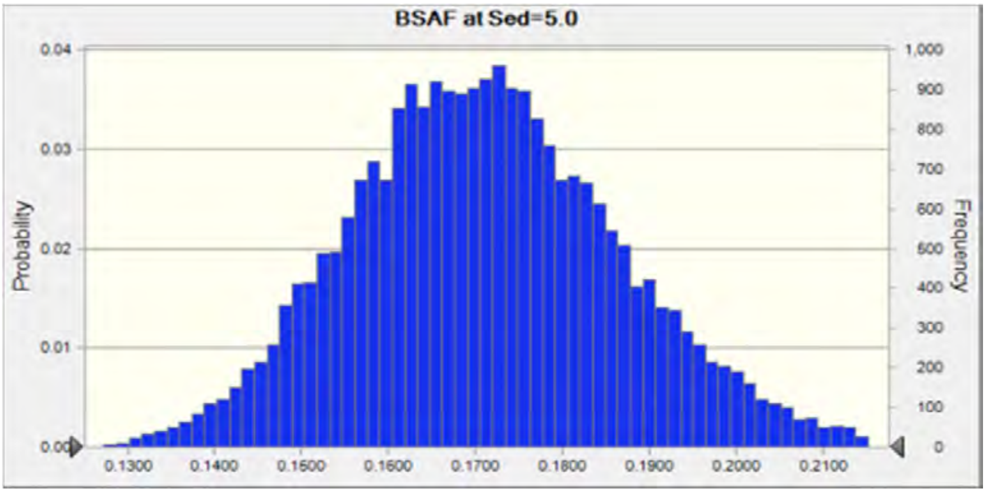
Statistics:	Forecast values
Trials	25,000
Base Case	0.0355
Mean	0.0360
Median	0.0355
Mode	---
Standard Deviation	0.0054
Variance	0.0000
Skewness	0.4440
Kurtosis	3.30
Coeff. of Variation	0.1509
Minimum	0.0194
Maximum	0.0623
Range Width	0.0428
Mean Std. Error	0.0000

Forecast: BSAF at Sed=42 (cont'd) **Cell: L29**

Percentiles:	Forecast values
0%	0.0194
10%	0.0293
20%	0.0313
30%	0.0329
40%	0.0342
50%	0.0355
60%	0.0370
70%	0.0385
80%	0.0404
90%	0.0432
100%	0.0623

Forecast: BSAF at Sed=5.0 **Cell: L20**

Summary:
Entire range is from 0.1116 to 0.2470
Base case is 0.1706
After 25,000 trials, the std. error of the mean is 0.0001



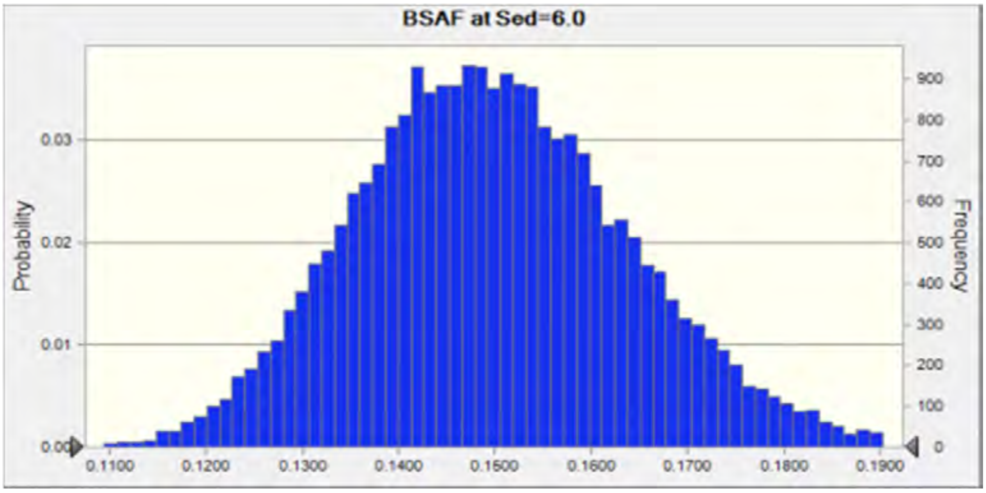
Statistics:	Forecast values
Trials	25,000
Base Case	0.1706
Mean	0.1712
Median	0.1706
Mode	---
Standard Deviation	0.0157
Variance	0.0002
Skewness	0.2574
Kurtosis	3.11
Coeff. of Variation	0.0917
Minimum	0.1116
Maximum	0.2470
Range Width	0.1354
Mean Std. Error	0.0001

Forecast: BSAF at Sed=5.0 (cont'd) **Cell: L20**

Percentiles:	Forecast values
0%	0.1116
10%	0.1515
20%	0.1579
30%	0.1626
40%	0.1666
50%	0.1706
60%	0.1745
70%	0.1788
80%	0.1842
90%	0.1919
100%	0.2470

Forecast: BSAF at Sed=6.0 **Cell: L21**

Summary:
Entire range is from 0.0983 to 0.2158
Base case is 0.1492
After 25,000 trials, the std. error of the mean is 0.0001



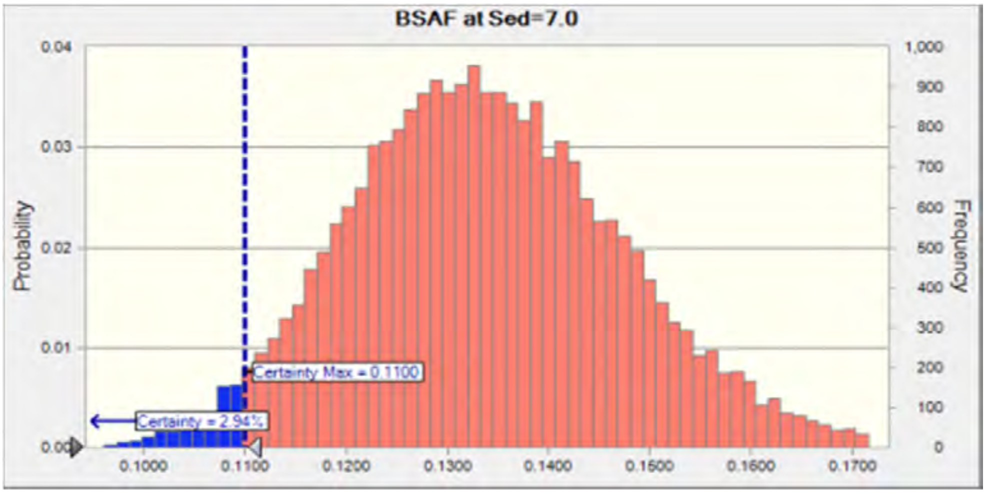
Statistics:	Forecast values
Trials	25,000
Base Case	0.1492
Mean	0.1499
Median	0.1491
Mode	---
Standard Deviation	0.0144
Variance	0.0002
Skewness	0.2921
Kurtosis	3.17
Coeff. of Variation	0.0963
Minimum	0.0983
Maximum	0.2158
Range Width	0.1175
Mean Std. Error	0.0001

Forecast: BSAF at Sed=6.0 (cont'd) **Cell: L21**

Percentiles:	Forecast values
0%	0.0983
10%	0.1319
20%	0.1376
30%	0.1418
40%	0.1456
50%	0.1491
60%	0.1528
70%	0.1569
80%	0.1617
90%	0.1686
100%	0.2158

Forecast: BSAF at Sed=7.0 **Cell: L22**

Summary:
- Certainty level is 2.940%
- Certainty range is from -Infinity to 0.1100
- Entire range is from 0.0921 to 0.1950
- Base case is 0.1331
- After 25,000 trials, the std. error of the mean is 0.0001



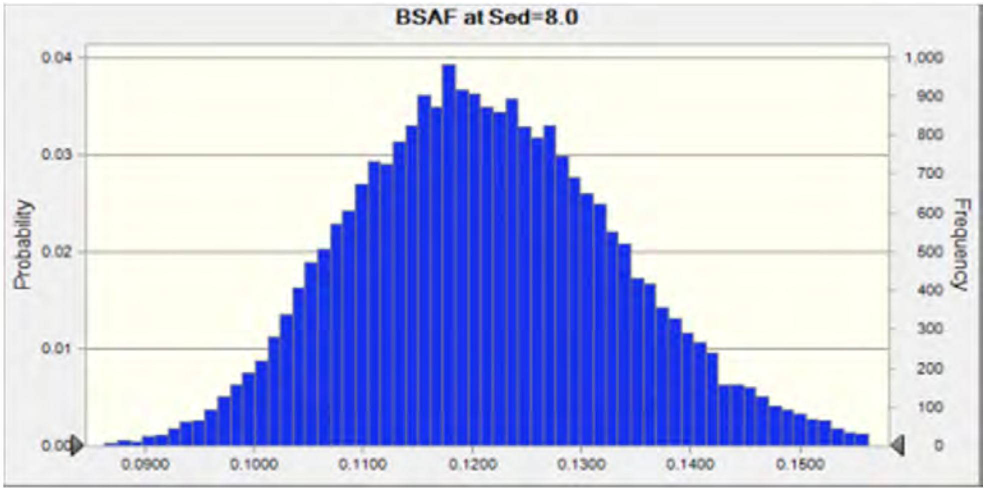
Statistics:	Forecast values
Trials	25,000
Base Case	0.1331
Mean	0.1339
Median	0.1332
Mode	---
Standard Deviation	0.0135
Variance	0.0002
Skewness	0.2826
Kurtosis	3.11
Coeff. of Variation	0.1006
Minimum	0.0921
Maximum	0.1950
Range Width	0.1029
Mean Std. Error	0.0001

Forecast: BSAF at Sed=7.0 (cont'd) **Cell: L22**

Percentiles:	Forecast values
0%	0.0921
10%	0.1171
20%	0.1224
30%	0.1263
40%	0.1298
50%	0.1332
60%	0.1367
70%	0.1405
80%	0.1450
90%	0.1514
100%	0.1950

Forecast: BSAF at Sed=8.0 **Cell: L23**

Summary:
Entire range is from 0.0788 to 0.1833
Base case is 0.1206
After 25,000 trials, the std. error of the mean is 0.0001



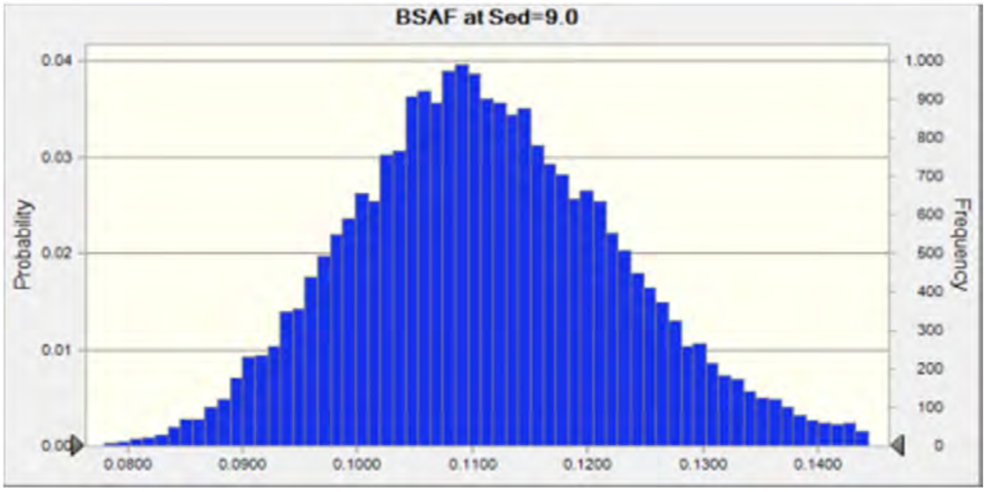
Statistics:	Forecast values
Trials	25,000
Base Case	0.1206
Mean	0.1213
Median	0.1206
Mode	---
Standard Deviation	0.0125
Variance	0.0002
Skewness	0.3151
Kurtosis	3.17
Coeff. of Variation	0.1029
Minimum	0.0788
Maximum	0.1833
Range Width	0.1044
Mean Std. Error	0.0001

Forecast: BSAF at Sed=8.0 (cont'd) **Cell: L23**

Percentiles:	Forecast values
0%	0.0788
10%	0.1057
20%	0.1106
30%	0.1143
40%	0.1176
50%	0.1206
60%	0.1239
70%	0.1274
80%	0.1316
90%	0.1376
100%	0.1833

Forecast: BSAF at Sed=9.0 **Cell: L24**

Summary:
Entire range is from 0.0704 to 0.1663
Base case is 0.1106
After 25,000 trials, the std. error of the mean is 0.0001



Statistics:	Forecast values
Trials	25,000
Base Case	0.1106
Mean	0.1112
Median	0.1105
Mode	---
Standard Deviation	0.0118
Variance	0.0001
Skewness	0.2924
Kurtosis	3.11
Coeff. of Variation	0.1065
Minimum	0.0704
Maximum	0.1663
Range Width	0.0959
Mean Std. Error	0.0001

Forecast: BSAF at Sed=9.0 (cont'd) **Cell: L24**

Percentiles:	Forecast values
0%	0.0704
10%	0.0964
20%	0.1012
30%	0.1048
40%	0.1077
50%	0.1105
60%	0.1136
70%	0.1169
80%	0.1210
90%	0.1267
100%	0.1663

End of Forecasts

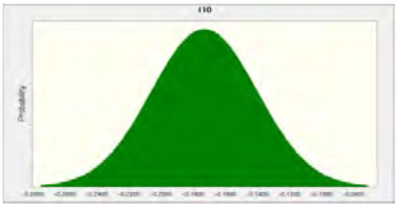
Assumptions

Worksheet: [CB121713.xlsx]Sheet1

Assumption: I10 **Cell: I12**

Normal distribution with parameters:

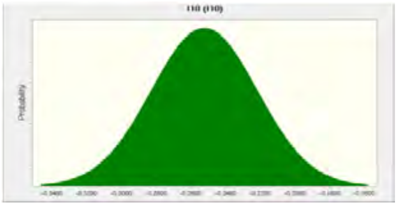
Mean	-0.1735
Std. Dev.	0.0330



Assumption: I10 (I10) **Cell: I10**

Normal distribution with parameters:

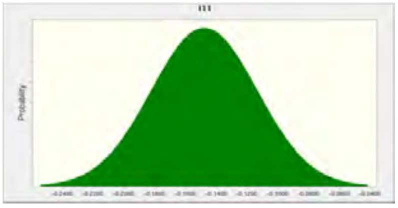
Mean	-0.2525
Std. Dev.	0.0305



Assumption: I11 **Cell: I13**

Normal distribution with parameters:

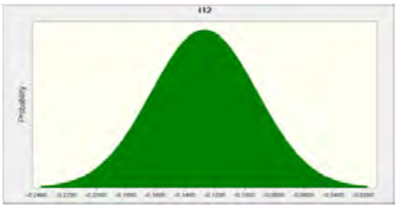
Mean	-0.1480
Std. Dev.	0.0344



Assumption: I12 **Cell: I14**

Normal distribution with parameters:

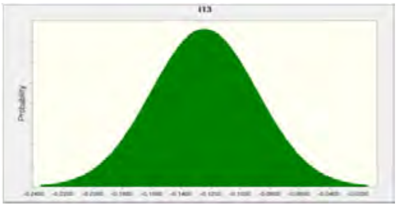
Mean	-0.1273
Std. Dev.	0.0357



Assumption: I13 **Cell: I15**

Normal distribution with parameters:

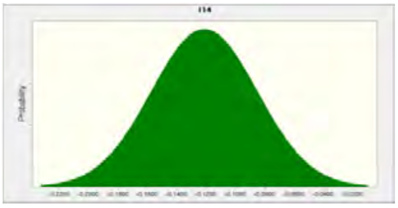
Mean	-0.1246
Std. Dev.	0.0359



Assumption: I14 **Cell: I16**

Normal distribution with parameters:

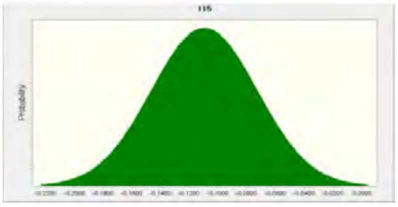
Mean	-0.1213
Std. Dev.	0.0361



Assumption: I15 **Cell: I17**

Normal distribution with parameters:

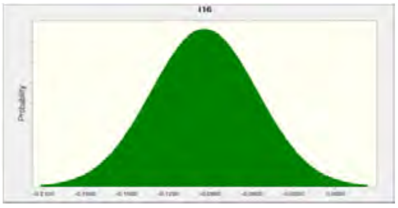
Mean	-0.1097
Std. Dev.	0.0369



Assumption: I16 **Cell: I18**

Normal distribution with parameters:

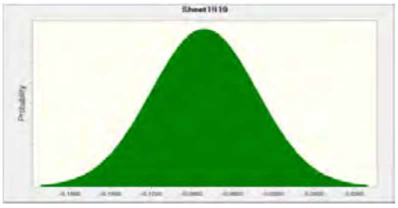
Mean	-0.0945
Std. Dev.	0.0381



Assumption: I19 **Cell: I19**

Normal distribution with parameters:

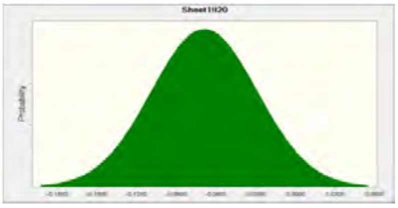
Mean	-0.0810
Std. Dev.	0.0391



Assumption: I20 **Cell: I20**

Normal distribution with parameters:

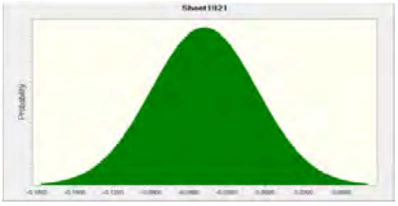
Mean	-0.0690
Std. Dev.	0.0401



Assumption: I21 **Cell: I21**

Normal distribution with parameters:

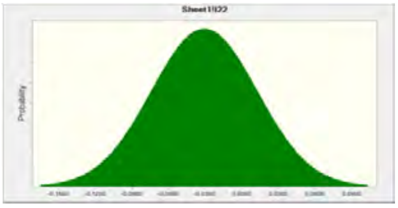
Mean	-0.0482
Std. Dev.	0.0419



Assumption: I22 **Cell: I22**

Normal distribution with parameters:

Mean	-0.0307
Std. Dev.	0.0435

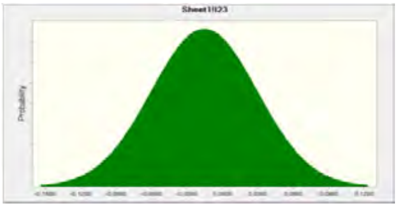


Assumption: I23

Cell: I23

Normal distribution with parameters:

Mean	-0.0154
Std. Dev.	0.0449

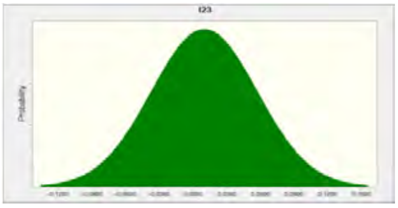


Assumption: I23

Cell: I25

Normal distribution with parameters:

Mean	0.0100
Std. Dev.	0.0473

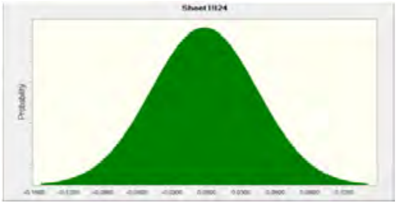


Assumption: I24

Cell: I24

Normal distribution with parameters:

Mean	-0.0020
Std. Dev.	0.0462

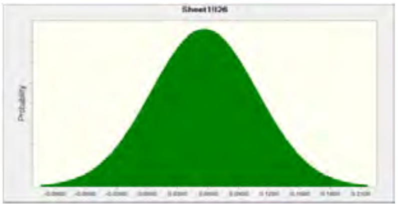


Assumption: I26

Cell: I26

Normal distribution with parameters:

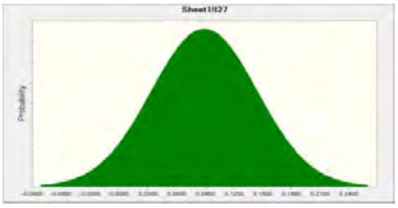
Mean	0.0562
Std. Dev.	0.0520



Assumption: I27 **Cell: I27**

Normal distribution with parameters:

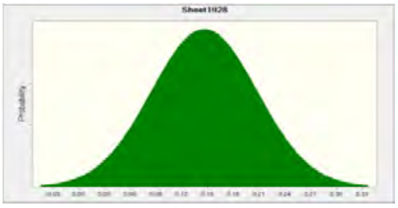
Mean	0.0890
Std. Dev.	0.0554



Assumption: I28 **Cell: I28**

Normal distribution with parameters:

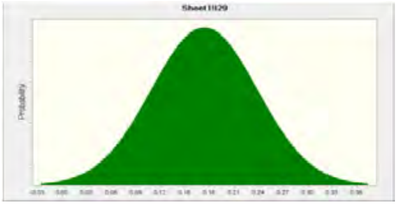
Mean	0.15
Std. Dev.	0.06



Assumption: I29 **Cell: I29**

Normal distribution with parameters:

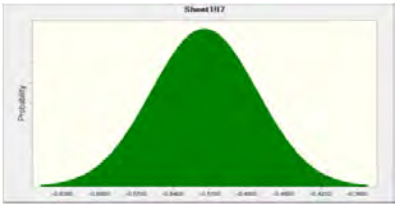
Mean	0.17
Std. Dev.	0.06



Assumption: I7 **Cell: I7**

Normal distribution with parameters:

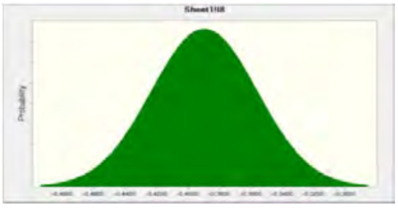
Mean	-0.5150
Std. Dev.	0.0431



Assumption: I8 **Cell: I8**

Normal distribution with parameters:

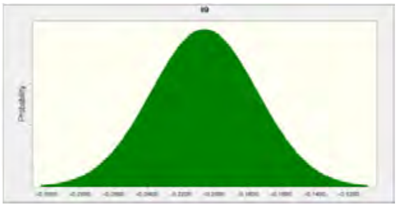
Mean	-0.3898
Std. Dev.	0.0337



Assumption: I9 **Cell: I11**

Normal distribution with parameters:

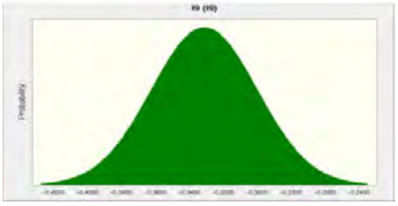
Mean	-0.2063
Std. Dev.	0.0316



Assumption: I9 (I9) **Cell: I9**

Normal distribution with parameters:

Mean	-0.3315
Std. Dev.	0.0312



End of Assumptions

ATTACHMENT C CRYSTAL BALL REPORT FOR BSAF2 PROBABILISTIC MODELING

ATTACHMENT C
Crystal Ball Report for BSAF2 Probabilistic Modeling

Crystal Ball Report - Full

Simulation started on 12/18/2013 at 8:56 PM
Simulation stopped on 12/18/2013 at 8:59 PM

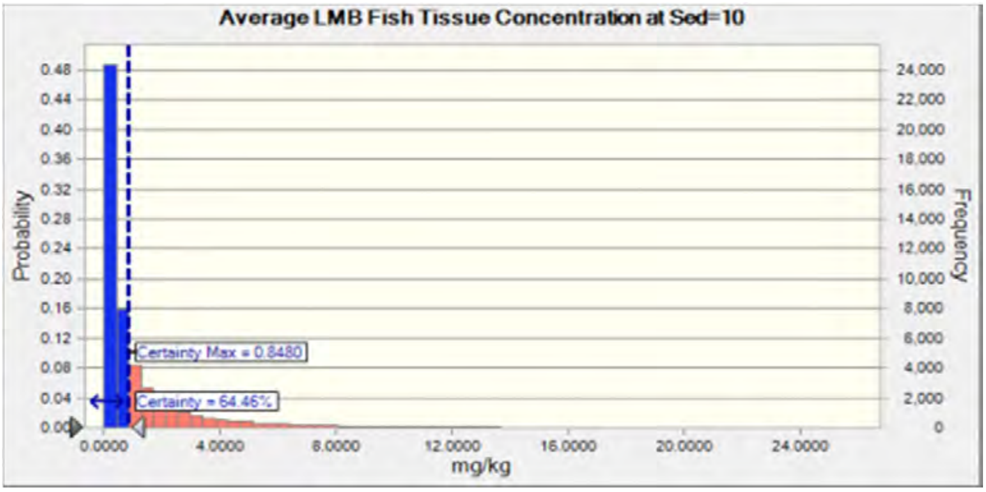
Run preferences:	
Number of trials run	50,000
Monte Carlo	
Random seed	
Precision control on	
Confidence level	95.00%
Run statistics:	
Total running time (sec)	21.91
Trials/second (average)	2,282
Random numbers per sec	4,565
Crystal Ball data:	
Assumptions	2
Correlations	0
Correlation matrices	0
Decision variables	0
Forecasts	18

Forecasts

Worksheet: [CB_BAF_TXF_121813.xlsx]Sheet1

Forecast: Average LMB Fish Tissue Concentration at Sed=10 **Cell: K15**

Summary:
Certainty level is 64.463%
Certainty range is from -Infinity to 0.8480
Entire range is from 0.0004 to 1,182.2181
Base case is 0.4498
After 50,000 trials, the std. error of the mean is 0.0385



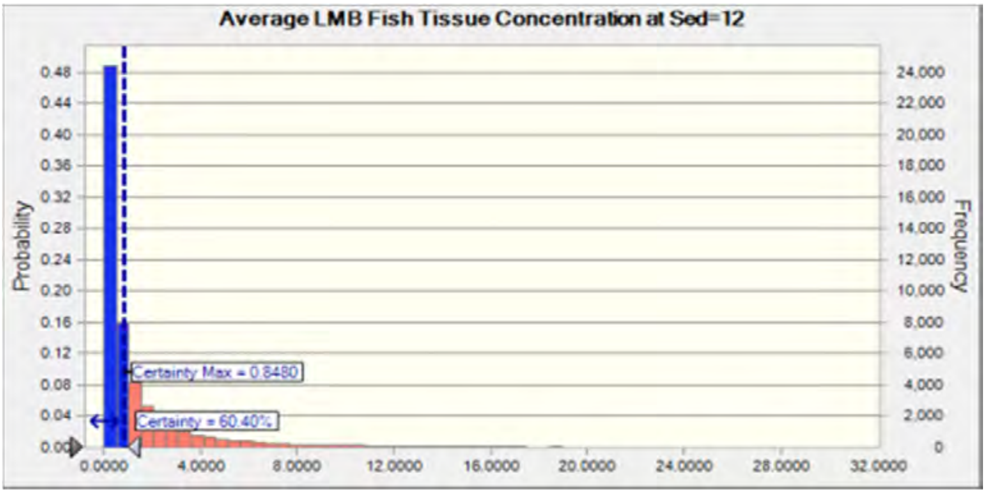
Statistics:	Forecast values
Trials	50,000
Base Case	0.4498
Mean	1.9417
Median	0.4504
Mode	---
Standard Deviation	8.6063
Variance	74.0691
Skewness	60.19
Kurtosis	7,278.01
Coeff. of Variation	4.43
Minimum	0.0004
Maximum	1,182.2181
Range Width	1,182.2177
Mean Std. Error	0.0385

Forecast: Average LMB Fish Tissue Concentration at Sed=10 (cont'd) **Cell: K15**

Percentiles:	Forecast values
0%	0.0004
10%	0.0500
20%	0.1052
30%	0.1831
40%	0.2933
50%	0.4504
60%	0.6952
70%	1.1022
80%	1.8935
90%	4.0142
100%	1,182.2181

Forecast: Average LMB Fish Tissue Concentration at Sed=12 **Cell: K16**

Summary:
Certainty level is 60.397%
Certainty range is from -Infinity to 0.8480
Entire range is from 0.0004 to 1,418.6617
Base case is 0.5397
After 50,000 trials, the std. error of the mean is 0.0462



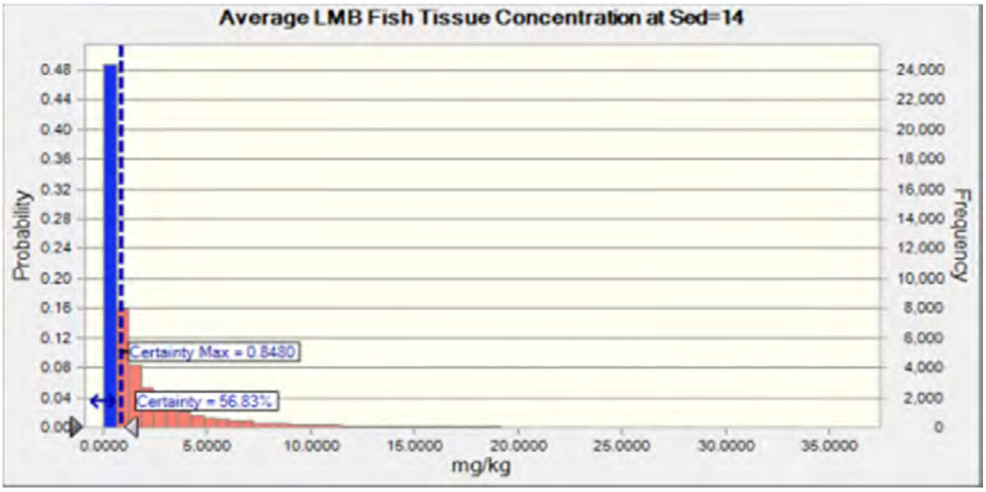
Statistics:	Forecast values
Trials	50,000
Base Case	0.5397
Mean	2.3300
Median	0.5405
Mode	---
Standard Deviation	10.3276
Variance	106.6595
Skewness	60.19
Kurtosis	7,278.01
Coeff. of Variation	4.43
Minimum	0.0004
Maximum	1,418.6617
Range Width	1,418.6612
Mean Std. Error	0.0462

Forecast: Average LMB Fish Tissue Concentration at Sed=12 (cont'd) **Cell: K16**

Percentiles:	Forecast values
0%	0.0004
10%	0.0600
20%	0.1262
30%	0.2197
40%	0.3520
50%	0.5405
60%	0.8343
70%	1.3227
80%	2.2723
90%	4.8170
100%	1,418.6617

Forecast: Average LMB Fish Tissue Concentration at Sed=14 **Cell: K17**

Summary:
Certainty level is 56.830%
Certainty range is from -Infinity to 0.8480
Entire range is from 0.0005 to 1,655.1053
Base case is 0.6297
After 50,000 trials, the std. error of the mean is 0.0539



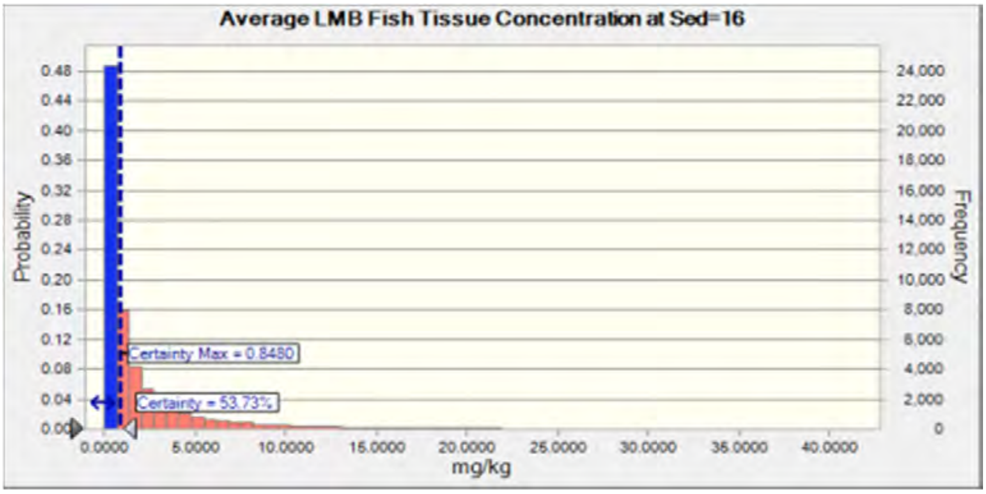
Statistics:	Forecast values
Trials	50,000
Base Case	0.6297
Mean	2.7184
Median	0.6306
Mode	---
Standard Deviation	12.0489
Variance	145.1755
Skewness	60.19
Kurtosis	7,278.01
Coeff. of Variation	4.43
Minimum	0.0005
Maximum	1,655.1053
Range Width	1,655.1048
Mean Std. Error	0.0539

Forecast: Average LMB Fish Tissue Concentration at Sed=14 (cont'd) **Cell: K17**

Percentiles:	Forecast values
0%	0.0005
10%	0.0700
20%	0.1472
30%	0.2563
40%	0.4107
50%	0.6306
60%	0.9733
70%	1.5431
80%	2.6510
90%	5.6199
100%	1,655.1053

Forecast: Average LMB Fish Tissue Concentration at Sed=16 **Cell: K18**

Summary:
Certainty level is 53.730%
Certainty range is from -Infinity to 0.8480
Entire range is from 0.0006 to 1,891.5489
Base case is 0.7196
After 50,000 trials, the std. error of the mean is 0.0616



Statistics:	Forecast values
Trials	50,000
Base Case	0.7196
Mean	3.1067
Median	0.7207
Mode	---
Standard Deviation	13.7701
Variance	189.6170
Skewness	60.19
Kurtosis	7,278.01
Coeff. of Variation	4.43
Minimum	0.0006
Maximum	1,891.5489
Range Width	1,891.5483
Mean Std. Error	0.0616

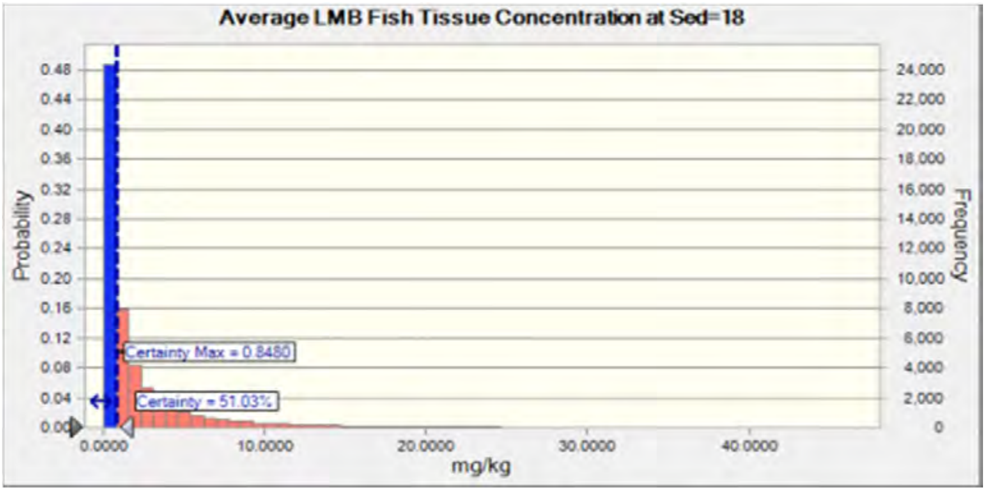
Forecast: Average LMB Fish Tissue Concentration at Sed=16 (cont'd)

Cell: K18

Percentiles:	Forecast values
0%	0.0006
10%	0.0800
20%	0.1683
30%	0.2929
40%	0.4693
50%	0.7207
60%	1.1124
70%	1.7635
80%	3.0297
90%	6.4227
100%	1,891.5489

Forecast: Average LMB Fish Tissue Concentration at Sed=18 **Cell: K19**

Summary:
Certainty level is 51.032%
Certainty range is from -Infinity to 0.8480
Entire range is from 0.0007 to 2,127.9925
Base case is 0.8096
After 50,000 trials, the std. error of the mean is 0.0693



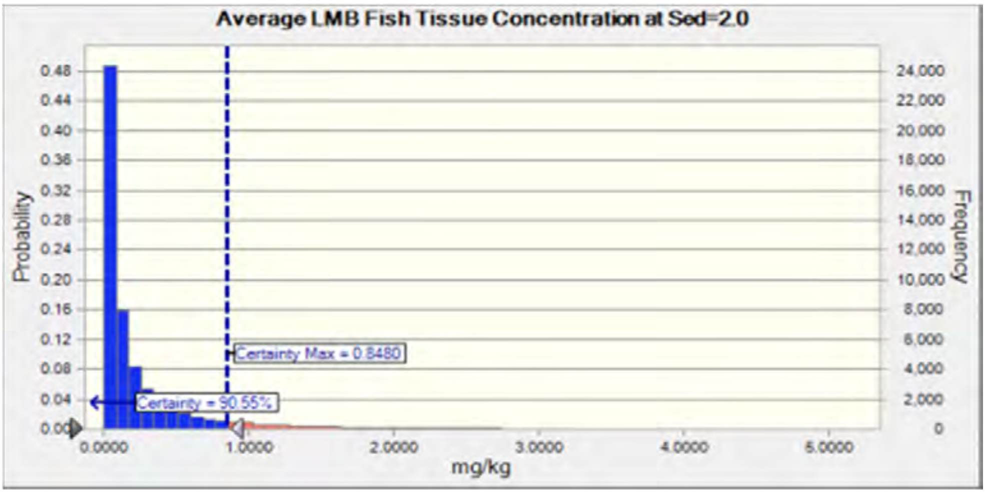
Statistics:	Forecast values
Trials	50,000
Base Case	0.8096
Mean	3.4950
Median	0.8108
Mode	---
Standard Deviation	15.4914
Variance	239.9840
Skewness	60.19
Kurtosis	7,278.01
Coeff. of Variation	4.43
Minimum	0.0007
Maximum	2,127.9925
Range Width	2,127.9918
Mean Std. Error	0.0693

Forecast: Average LMB Fish Tissue Concentration at Sed=18 (cont'd) **Cell: K19**

Percentiles:	Forecast values
0%	0.0007
10%	0.0900
20%	0.1893
30%	0.3295
40%	0.5280
50%	0.8107
60%	1.2514
70%	1.9840
80%	3.4084
90%	7.2255
100%	2,127.9925

Forecast: Average LMB Fish Tissue Concentration at Sed=2.0 **Cell: K8**

Summary:
Certainty level is 90.549%
Certainty range is from -Infinity to 0.8480
Entire range is from 0.0001 to 236.4436
Base case is 0.0900
After 50,000 trials, the std. error of the mean is 0.0077



Statistics:	Forecast values
Trials	50,000
Base Case	0.0900
Mean	0.3883
Median	0.0901
Mode	---
Standard Deviation	1.7213
Variance	2.9628
Skewness	60.19
Kurtosis	7,278.01
Coeff. of Variation	4.43
Minimum	0.0001
Maximum	236.4436
Range Width	236.4435
Mean Std. Error	0.0077

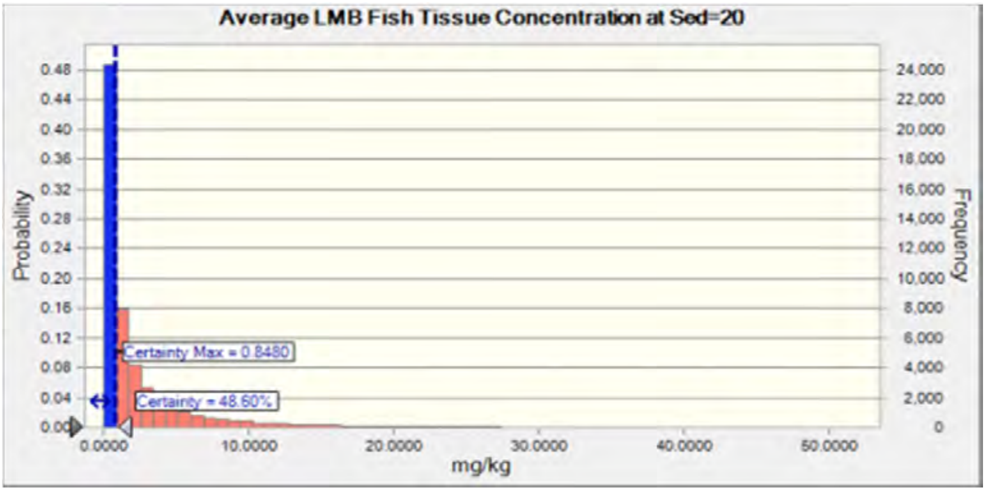
Forecast: Average LMB Fish Tissue Concentration at Sed=2.0 (cont'd) **Cell: K8**

Percentiles:	Forecast values
0%	0.0001
10%	0.0100
20%	0.0210
30%	0.0366
40%	0.0587
50%	0.0901
60%	0.1390
70%	0.2204
80%	0.3787
90%	0.8028
100%	236.4436

ATTACHMENT C
Crystal Ball Report for BSAF2 Probabilistic Modeling

Forecast: Average LMB Fish Tissue Concentration at Sed=20 **Cell: K20**

Summary:
Certainty level is 48.601%
Certainty range is from -Infinity to 0.8480
Entire range is from 0.0007 to 2,364.4361
Base case is 0.8996
After 50,000 trials, the std. error of the mean is 0.0770



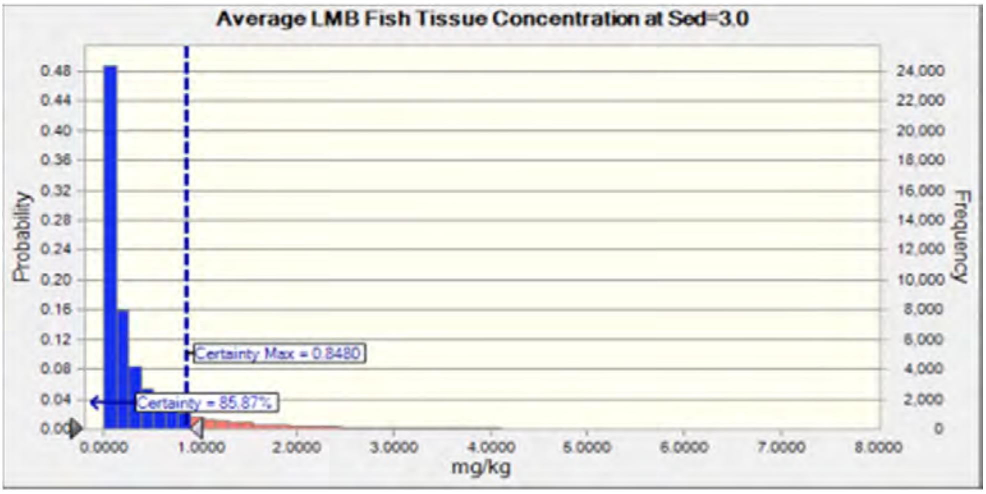
Statistics:	Forecast values
Trials	50,000
Base Case	0.8996
Mean	3.8834
Median	0.9008
Mode	---
Standard Deviation	17.2127
Variance	296.2765
Skewness	60.19
Kurtosis	7,278.01
Coeff. of Variation	4.43
Minimum	0.0007
Maximum	2,364.4361
Range Width	2,364.4354
Mean Std. Error	0.0770

Forecast: Average LMB Fish Tissue Concentration at Sed=20 (cont'd) **Cell: K20**

Percentiles:	Forecast values
0%	0.0007
10%	0.1000
20%	0.2104
30%	0.3661
40%	0.5866
50%	0.9008
60%	1.3905
70%	2.2044
80%	3.7871
90%	8.0284
100%	2,364.4361

Forecast: Average LMB Fish Tissue Concentration at Sed=3.0 **Cell: K9**

Summary:
Certainty level is 85.866%
Certainty range is from -Infinity to 0.8480
Entire range is from 0.0001 to 354.6654
Base case is 0.1349
After 50,000 trials, the std. error of the mean is 0.0115



Statistics:	Forecast values
Trials	50,000
Base Case	0.1349
Mean	0.5825
Median	0.1351
Mode	---
Standard Deviation	2.5819
Variance	6.6662
Skewness	60.19
Kurtosis	7,278.01
Coeff. of Variation	4.43
Minimum	0.0001
Maximum	354.6654
Range Width	354.6653
Mean Std. Error	0.0115

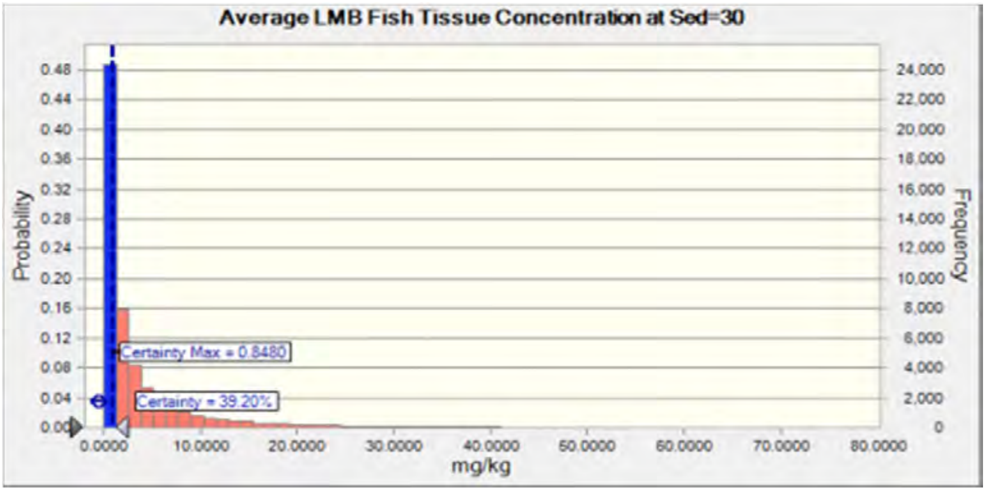
Forecast: Average LMB Fish Tissue Concentration at Sed=3.0 (cont'd)

Cell: K9

Percentiles:	Forecast values
0%	0.0001
10%	0.0150
20%	0.0316
30%	0.0549
40%	0.0880
50%	0.1351
60%	0.2086
70%	0.3307
80%	0.5681
90%	1.2043
100%	354.6654

Forecast: Average LMB Fish Tissue Concentration at Sed=30 **Cell: K21**

Summary:
- Certainty level is 39.200%
- Certainty range is from -Infinity to 0.8480
- Entire range is from 0.0011 to 3,546.6542
- Base case is 1.3493
- After 50,000 trials, the std. error of the mean is 0.1155



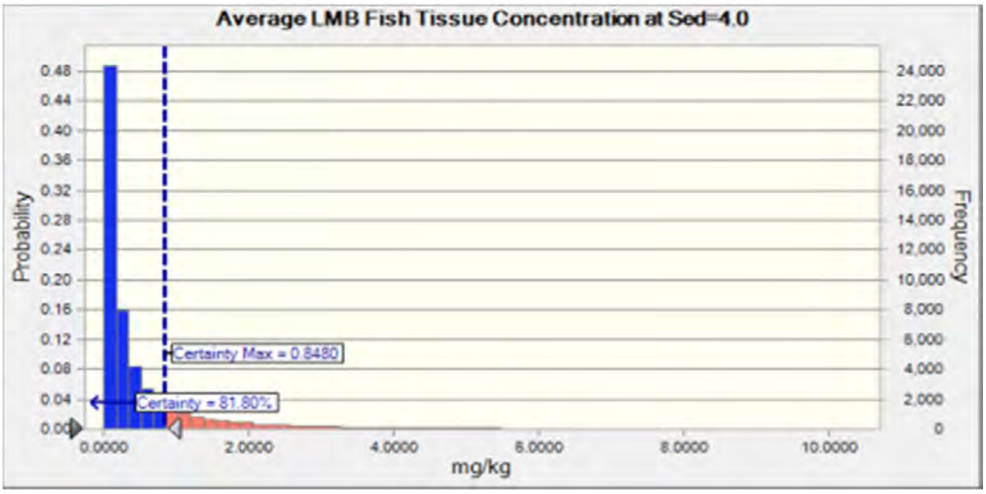
Statistics:	Forecast values
Trials	50,000
Base Case	1.3493
Mean	5.8250
Median	1.3513
Mode	---
Standard Deviation	25.8190
Variance	666.6221
Skewness	60.19
Kurtosis	7,278.01
Coeff. of Variation	4.43
Minimum	0.0011
Maximum	3,546.6542
Range Width	3,546.6530
Mean Std. Error	0.1155

Forecast: Average LMB Fish Tissue Concentration at Sed=30 (cont'd) **Cell: K21**

Percentiles:	Forecast values
0%	0.0011
10%	0.1500
20%	0.3155
30%	0.5492
40%	0.8800
50%	1.3512
60%	2.0857
70%	3.3067
80%	5.6806
90%	12.0425
100%	3,546.6542

Forecast: Average LMB Fish Tissue Concentration at Sed=4.0 **Cell: K10**

Summary:
Certainty level is 81.797%
Certainty range is from -Infinity to 0.8480
Entire range is from 0.0001 to 472.8872
Base case is 0.1799
After 50,000 trials, the std. error of the mean is 0.0154



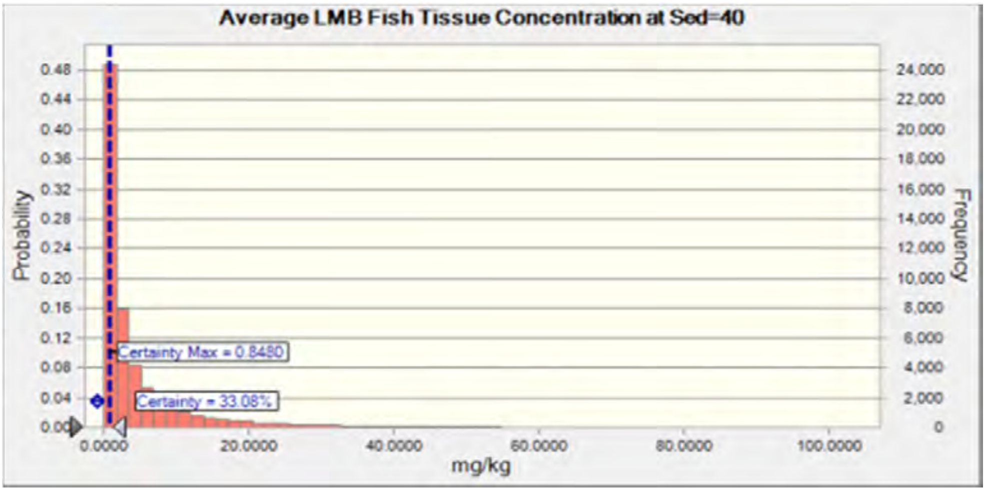
Statistics:	Forecast values
Trials	50,000
Base Case	0.1799
Mean	0.7767
Median	0.1802
Mode	---
Standard Deviation	3.4425
Variance	11.8511
Skewness	60.19
Kurtosis	7,278.01
Coeff. of Variation	4.43
Minimum	0.0001
Maximum	472.8872
Range Width	472.8871
Mean Std. Error	0.0154

Forecast: Average LMB Fish Tissue Concentration at Sed=4.0 (cont'd) **Cell: K10**

Percentiles:	Forecast values
0%	0.0001
10%	0.0200
20%	0.0421
30%	0.0732
40%	0.1173
50%	0.1802
60%	0.2781
70%	0.4409
80%	0.7574
90%	1.6057
100%	472.8872

Forecast: Average LMB Fish Tissue Concentration at Sed=40 **Cell: K22**

Summary:
Certainty level is 33.076%
Certainty range is from -Infinity to 0.8480
Entire range is from 0.0015 to 4,728.8722
Base case is 1.7991
After 50,000 trials, the std. error of the mean is 0.1540



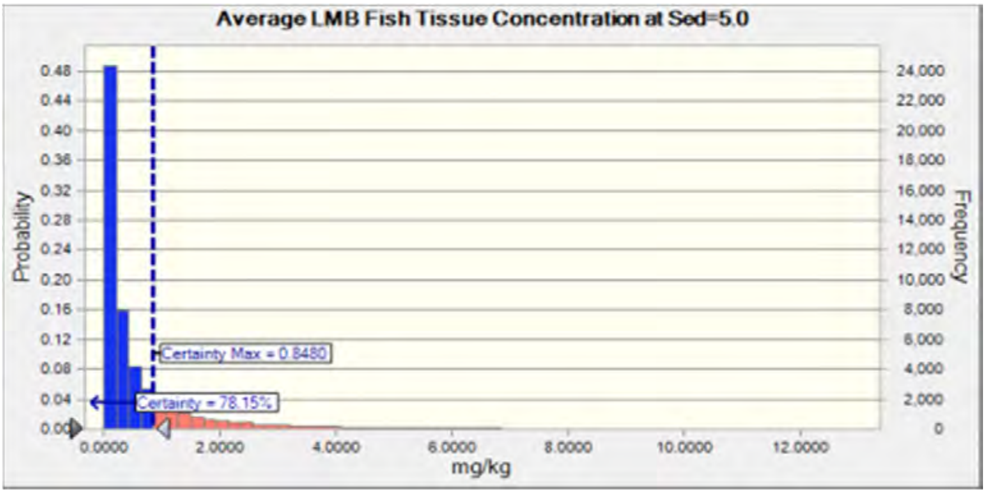
Statistics:	Forecast values
Trials	50,000
Base Case	1.7991
Mean	7.7667
Median	1.8017
Mode	---
Standard Deviation	34.4254
Variance	1,185.1059
Skewness	60.19
Kurtosis	7,278.01
Coeff. of Variation	4.43
Minimum	0.0015
Maximum	4,728.8722
Range Width	4,728.8707
Mean Std. Error	0.1540

Forecast: Average LMB Fish Tissue Concentration at Sed=40 (cont'd) **Cell: K22**

Percentiles:	Forecast values
0%	0.0015
10%	0.2000
20%	0.4207
30%	0.7322
40%	1.1733
50%	1.8017
60%	2.7809
70%	4.4089
80%	7.5742
90%	16.0567
100%	4,728.8722

Forecast: Average LMB Fish Tissue Concentration at Sed=5.0 **Cell: K11**

Summary:
Certainty level is 78.155%
Certainty range is from -Infinity to 0.8480
Entire range is from 0.0002 to 591.1090
Base case is 0.2249
After 50,000 trials, the std. error of the mean is 0.0192



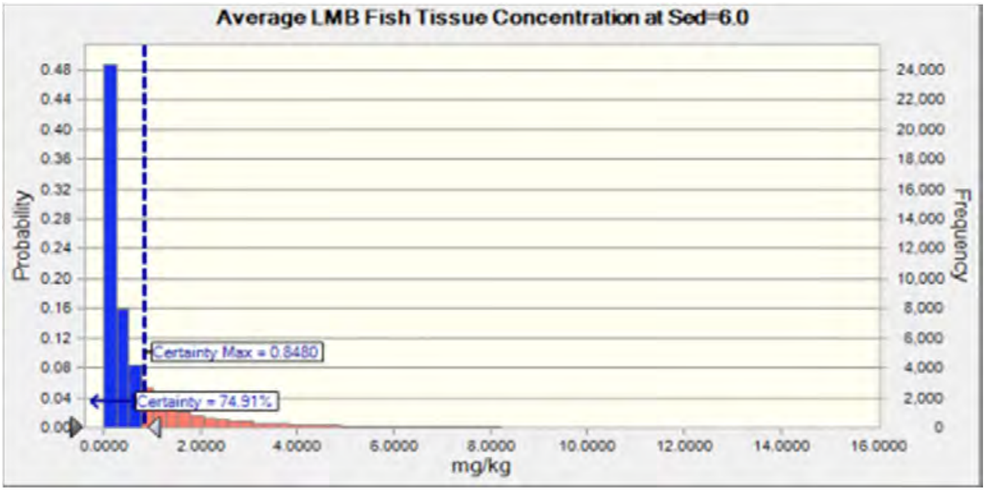
Statistics:	Forecast values
Trials	50,000
Base Case	0.2249
Mean	0.9708
Median	0.2252
Mode	---
Standard Deviation	4.3032
Variance	18.5173
Skewness	60.19
Kurtosis	7,278.01
Coeff. of Variation	4.43
Minimum	0.0002
Maximum	591.1090
Range Width	591.1088
Mean Std. Error	0.0192

Forecast: Average LMB Fish Tissue Concentration at Sed=5.0 (cont'd) **Cell: K11**

Percentiles:	Forecast values
0%	0.0002
10%	0.0250
20%	0.0526
30%	0.0915
40%	0.1467
50%	0.2252
60%	0.3476
70%	0.5511
80%	0.9468
90%	2.0071
100%	591.1090

Forecast: Average LMB Fish Tissue Concentration at Sed=6.0 **Cell: K12**

Summary:
Certainty level is 74.908%
Certainty range is from -Infinity to 0.8480
Entire range is from 0.0002 to 709.3308
Base case is 0.2699
After 50,000 trials, the std. error of the mean is 0.0231



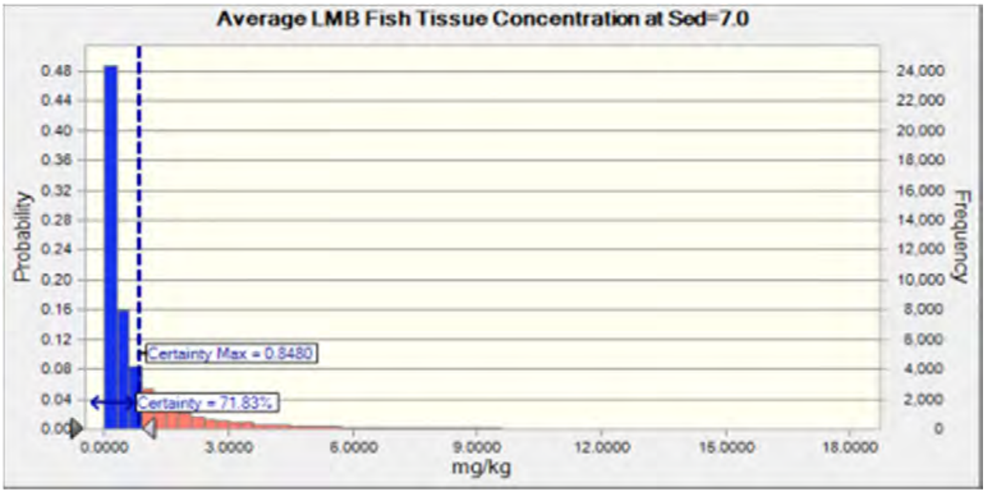
Statistics:	Forecast values
Trials	50,000
Base Case	0.2699
Mean	1.1650
Median	0.2703
Mode	---
Standard Deviation	5.1638
Variance	26.6649
Skewness	60.19
Kurtosis	7,278.01
Coeff. of Variation	4.43
Minimum	0.0002
Maximum	709.3308
Range Width	709.3306
Mean Std. Error	0.0231

Forecast: Average LMB Fish Tissue Concentration at Sed=6.0 (cont'd) **Cell: K12**

Percentiles:	Forecast values
0%	0.0002
10%	0.0300
20%	0.0631
30%	0.1098
40%	0.1760
50%	0.2702
60%	0.4171
70%	0.6613
80%	1.1361
90%	2.4085
100%	709.3308

Forecast: Average LMB Fish Tissue Concentration at Sed=7.0 **Cell: K13**

Summary:
- Certainty level is 71.832%
- Certainty range is from -Infinity to 0.8480
- Entire range is from 0.0003 to 827.5526
- Base case is 0.3148
- After 50,000 trials, the std. error of the mean is 0.0269



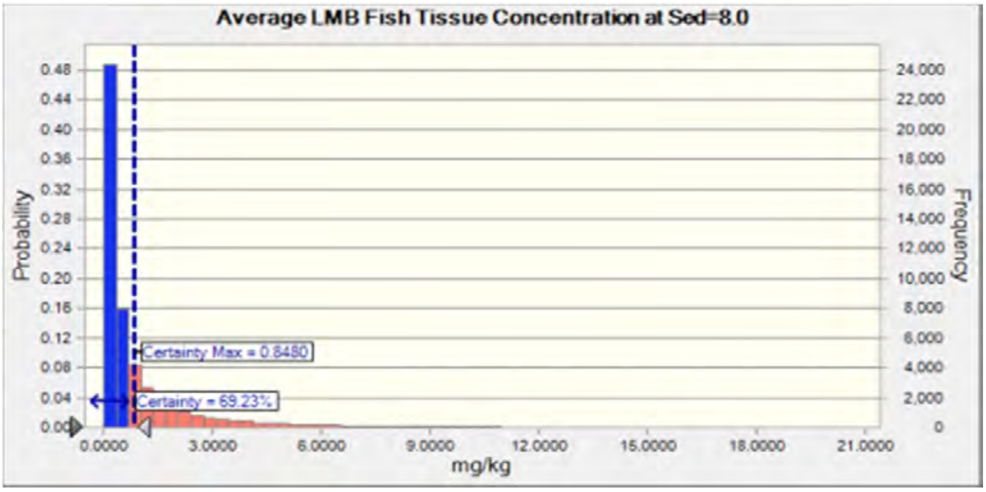
Statistics:	Forecast values
Trials	50,000
Base Case	0.3148
Mean	1.3592
Median	0.3153
Mode	---
Standard Deviation	6.0244
Variance	36.2939
Skewness	60.19
Kurtosis	7,278.01
Coeff. of Variation	4.43
Minimum	0.0003
Maximum	827.5526
Range Width	827.5524
Mean Std. Error	0.0269

Forecast: Average LMB Fish Tissue Concentration at Sed=7.0 (cont'd) **Cell: K13**

Percentiles:	Forecast values
0%	0.0003
10%	0.0350
20%	0.0736
30%	0.1281
40%	0.2053
50%	0.3153
60%	0.4867
70%	0.7716
80%	1.3255
90%	2.8099
100%	827.5526

Forecast: Average LMB Fish Tissue Concentration at Sed=8.0 **Cell: K14**

Summary:
Certainty level is 69.227%
Certainty range is from -Infinity to 0.8480
Entire range is from 0.0003 to 945.7744
Base case is 0.3598
After 50,000 trials, the std. error of the mean is 0.0308



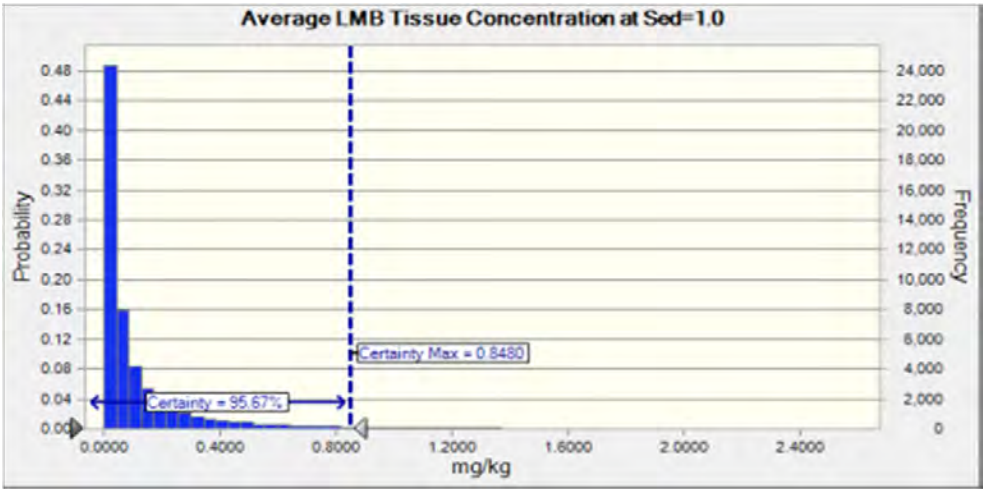
Statistics:	Forecast values
Trials	50,000
Base Case	0.3598
Mean	1.5533
Median	0.3603
Mode	---
Standard Deviation	6.8851
Variance	47.4042
Skewness	60.19
Kurtosis	7,278.01
Coeff. of Variation	4.43
Minimum	0.0003
Maximum	945.7744
Range Width	945.7741
Mean Std. Error	0.0308

Forecast: Average LMB Fish Tissue Concentration at Sed=8.0 (cont'd) **Cell: K14**

Percentiles:	Forecast values
0%	0.0003
10%	0.0400
20%	0.0841
30%	0.1464
40%	0.2347
50%	0.3603
60%	0.5562
70%	0.8818
80%	1.5148
90%	3.2113
100%	945.7744

Forecast: Average LMB Tissue Concentration at Sed=1.0 **Cell: K7**

Summary:
Certainty level is 95.673%
Certainty range is from -Infinity to 0.8480
Entire range is from 0.0000 to 118.2218
Base case is 0.0450
After 50,000 trials, the std. error of the mean is 0.0038



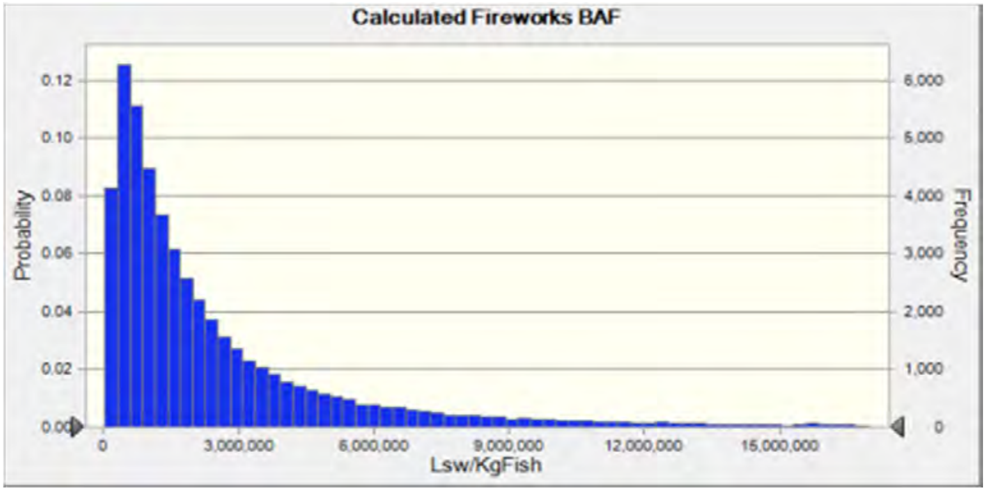
Statistics:	Forecast values
Trials	50,000
Base Case	0.0450
Mean	0.1942
Median	0.0450
Mode	---
Standard Deviation	0.8606
Variance	0.7407
Skewness	60.19
Kurtosis	7,278.01
Coeff. of Variation	4.43
Minimum	0.0000
Maximum	118.2218
Range Width	118.2218
Mean Std. Error	0.0038

Forecast: Average LMB Tissue Concentration at Sed=1.0 (cont'd) **Cell: K7**

Percentiles:	Forecast values
0%	0.0000
10%	0.0050
20%	0.0105
30%	0.0183
40%	0.0293
50%	0.0450
60%	0.0695
70%	0.1102
80%	0.1894
90%	0.4014
100%	118.2218

Forecast: Calculated Fireworks BAF **Cell: E7**

Summary:
Entire range is from 22,384 to 270,210,303
Base case is 1,492,794
After 50,000 trials, the std. error of the mean is 22,420



Statistics:	Forecast values
Trials	50,000
Base Case	1,492,794
Mean	2,933,525
Median	1,486,997
Mode	---
Standard Deviation	5,013,181
Variance	25,131,986,166,062
Skewness	10.79
Kurtosis	320.97
Coeff. of Variation	1.71
Minimum	22,384
Maximum	270,210,303
Range Width	270,187,919
Mean Std. Error	22,420

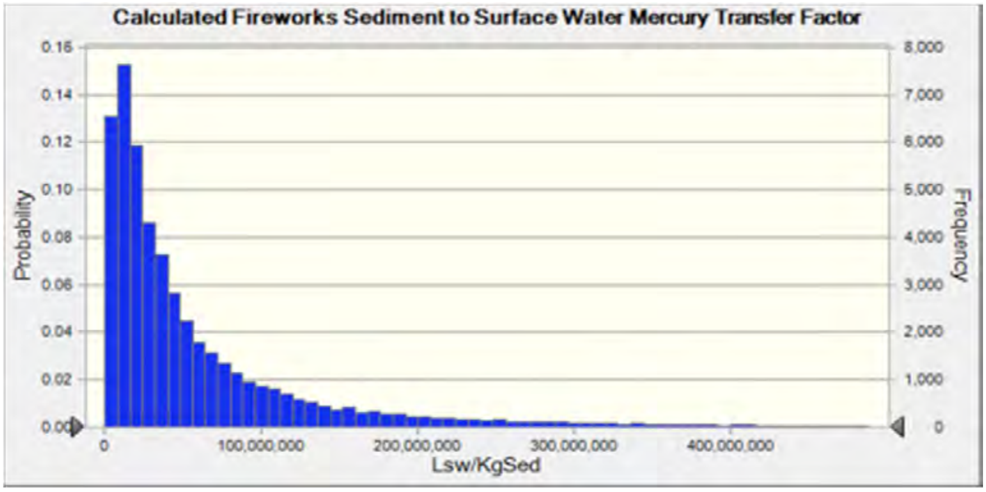
Forecast: Calculated Fireworks BAF (cont'd) **Cell: E7**

Percentiles:	Forecast values
0%	22,384
10%	337,179
20%	559,286
30%	802,902
40%	1,105,357
50%	1,486,971
60%	1,994,911
70%	2,727,008
80%	3,965,238
90%	6,662,714
100%	270,210,303

Forecast: Calculated Fireworks Sediment to Surface Water Mercury Transfer Factor **Cell: I7**

Summary:

Entire range is from 162,432 to 9,194,827,012
Base case is 33,189,446
After 50,000 trials, the std. error of the mean is 660,632



Statistics:	Forecast values
Trials	50,000
Base Case	33,189,446
Mean	73,870,801
Median	33,207,549
Mode	---
Standard Deviation	147,721,714
Variance	#################
Skewness	12.67
Kurtosis	424.02
Coeff. of Variation	2.00
Minimum	162,432
Maximum	9,194,827,012
Range Width	9,194,664,580
Mean Std. Error	660,632

Forecast: Calculated Fireworks Sediment to Surface Water Mercury Transfer Factor (cont'd) Cell: I7

Percentiles:	Forecast values
0%	162,432
10%	6,654,539
20%	11,575,234
30%	17,047,752
40%	23,948,746
50%	33,207,001
60%	45,464,537
70%	64,426,937
80%	96,690,171
90%	168,808,541
100%	9,194,827,012

End of Forecasts

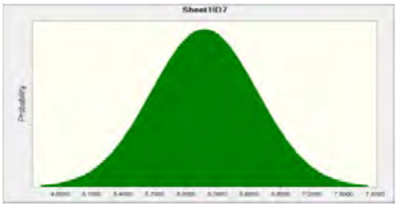
Assumptions

Worksheet: [CB_BAF_TXF_121813.xlsx]Sheet1

Assumption: D7 **Cell: D7**

Normal distribution with parameters:

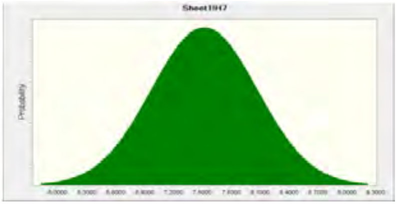
Mean	6.1740
Std. Dev.	0.5040



Assumption: H7 **Cell: H7**

Normal distribution with parameters:

Mean	7.5210
Std. Dev.	0.5500



End of Assumptions

APPENDIX 3E

Spatial Comparison of As-Received and Air-Dried Sediment Mercury Results – Implications for Sediment Remediation

1.0 PURPOSE

This appendix presents a detailed comparative evaluation of the concentrations and spatial distributions of mercury in sediments as determined by the re-baseline sampling at the Fireworks Site for both the as-received samples (i.e., the samples that were not air-dried prior to analysis) and the air-dried sediment samples. This evaluation was performed to provide a thorough assessment of any possible impacts of potential mercury loss during the re-baselining sample preparation on:

- future sediment remediation planning (particularly sediment removal design efforts); and
- future confirmatory sampling for verifying that the mercury sediment remediation goal has been met.

This evaluation also provides enhanced details on the overall spatial distribution of mercury concentrations in the sediments to assist in refinement of the remediation strategy.

2.0 SEDIMENT MERCURY CONCENTRATION DISTRIBUTION

Figures 3E-1 and 3E-2 present the mercury concentration distributions for the sediment samples that were analyzed both as-received and following air-drying. Of particular interest relative to the implications of possible mercury volatilization loss during laboratory air-drying are the samples reporting mercury concentrations near or just below the sediment mercury proposed preliminary remediation goal (PRG) of 4 mg/Kg. Figure 3E-1 displays the distribution of results for the sediment samples with mercury concentrations greater than or equal to 10 mg/Kg. As indicated in this Figure, the large majority of both the as-received and the air-dried samples reported mercury in the range of 10-100 mg/Kg. Relatively fewer sediment samples contained higher concentrations of mercury in the range of 100-1000 mg/Kg. The air-dried samples containing greater than 10 mg/Kg mercury are well above the proposed PRG. As such, any possible mercury loss from these samples during air-drying would have minimal impact on sediment remediation decision-making and there would be little uncertainty that the sample was impacted.

Figure 3E-2 presents the data for sediments containing mercury concentrations in the range of 0-10 mg/Kg. As is indicated, a large majority of these samples were as-received samples that were not air-dried prior to analysis. Of the sediment samples that were air-dried, only a relatively small number of samples had mercury concentrations of less than 4 mg/Kg. Of these, only five samples had concentrations in the 2-4 mg/Kg range immediately below the proposed PRG (i.e., in the concentration range that is the most sensitive with regard to the potential impact of the uncertainty of the mercury loss on sediment remediation decision-making).

3.0 SPATIAL DISTRIBUTION OF THE AIR-DRIED SAMPLES

The proportion of the re-baselining sediment samples requiring air-drying prior to analysis was not uniformly distributed throughout the different river/pond reaches of the Site. A total of 308 sediment samples were taken during the re-baselining sampling event, where 101 of those samples required air-drying.

- The largest number of air-dried samples were associated with Middle/Lower Factory Pond (i.e., 47 of the 101 air-dried samples) (see Table 3E-1). Table 3E-1 (last column) shows that these 47 air-dried samples were out of a total of 107 sediment samples that were collected from this area.
- The second highest number of air-dried samples was from Lily /Upper Factory Pond (i.e., 36 of the 101). Table 3E-1 (last column) shows that these 36 air-dried samples were out of a total of 135 sediment samples that were collected from this area.
- The third highest number of air-dried samples was from the Marsh Upland Area (i.e., 15 of the 101). These 15 air-dried samples were out of a total of 34 sediment samples that were collected from this area.

The sediments sampled from these ponds or standing water bodies were typically more fined grained and organic in composition than the sediments sampled from the stream and river channel reaches. Very few of the sediment samples from the stream reaches (e.g., the Eastern Channel Corridor and the Lower Drinkwater River Corridor) required air-drying prior to analysis.

- Only two out of the 101 air-dried samples were associated with the Eastern Channel Corridor. A total of 18 sediment samples were collected from this area.
- For the Lower Drinkwater River Corridor none of the six samples required air-drying. The Lower Drinkwater River Corridor sediments were coarser grained and less organic in composition.
- Only one out of the 101 air-dried samples were associated with the Indian Head River Corridor. A total of eight sediment samples were collected from this area.

In summary, Middle/Lower Factory Pond, the Marsh Upland Area and Lily/Upper Factory Pond exhibited the highest percentages of their samples requiring air-drying (i.e., 44%, 44% and 27%, respectively). Accordingly, the design of the sediment removals in these areas or the future specification of the confirmatory sampling approach for these areas will need to consider the possibility that the mercury concentrations in these particular areas may be somewhat higher than were reported in the re-baselining results due to possible volatilization losses during air-drying.

4.0 DEPTH DISTRIBUTION OF THE AIR-DRIED SAMPLES

Table 3E-1 also presents a breakdown of the sediment samples that were air-dried by depth of sample below the sediment surface for each area. For Middle/Lower Factory Pond, Lily/Upper Factory Pond, and the Marsh Upland Area, no sediment samples from a depth of 0”-3” below the sediment surface water interface required air-drying. For these three areas, the majority of the air-dried samples were collected from a depth of 3”-6” below the sediment surface.

- For Middle/Lower Factory Pond 47 out of a total of 107 sediment samples collected in this area required air-drying: 64% of the air-dried sediment samples (i.e., 30 of 47 samples) were from the 3”-6” depth interval and 28% of the air-dried samples (i.e., 13 of 47 samples) were collected from 6”-12”. Table 3E-1 provides the entire depth profile for the air-dried samples collected in this area.

- For Lily/Upper Factory Pond, 36 out of a total of 135 sediment samples collected in this area required air-drying: 86% of the air-dried sediment samples (i.e., 31 of 36 samples) were from the 3”-6” depth interval and 11% of the air-dried samples (i.e., 4 of 36 samples) were collected from 6”-12”.

- For the Marsh Upland Area, 15 out of a total of 34 sediment samples collected in this area required air-drying: 93% of the air-dried sediment samples (i.e., 14 of 15 samples) were from the 3”-6” depth interval and 7% of the air-dried samples (i.e., 1 of 15 samples) were collected from 6”-12”.

- In the Eastern Channel Corridor, 11% of the sediment samples collected required air-drying (i.e., 2 of 18). Of those air-dried samples, 100% were collected from a depth of 0”-3” since all samples collected from this area were surficial sediment samples.

- In the Indian Head River Corridor, 13% (i.e., 1 of 8) of the samples collected required air-drying. That air-dried sample was collected from a depth of 0”-3” since all samples collected from this area were surficial sediment samples.

These results may simply indicate that different portions of the ponds and the Marsh Upland Area naturally exhibit different sediment depositional behavior and/or that the high precipitation events that triggered the need for the re-baselining sampling effort may have deposited coarser grained or less organic sediments on top of the previously deposited siltier sediments with higher moisture contents.

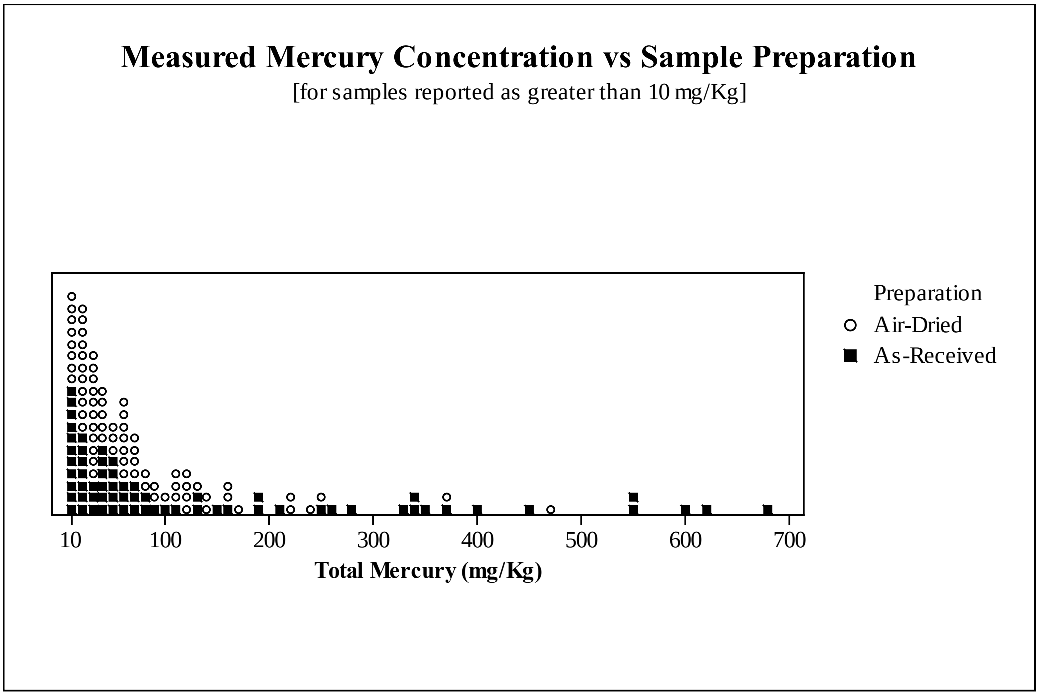


Figure 3E-1. Distribution of Sediment Samples that Exhibited a Mercury Concentration > 10 mg/Kg that were Analyzed As-Received vs. After Air-Drying

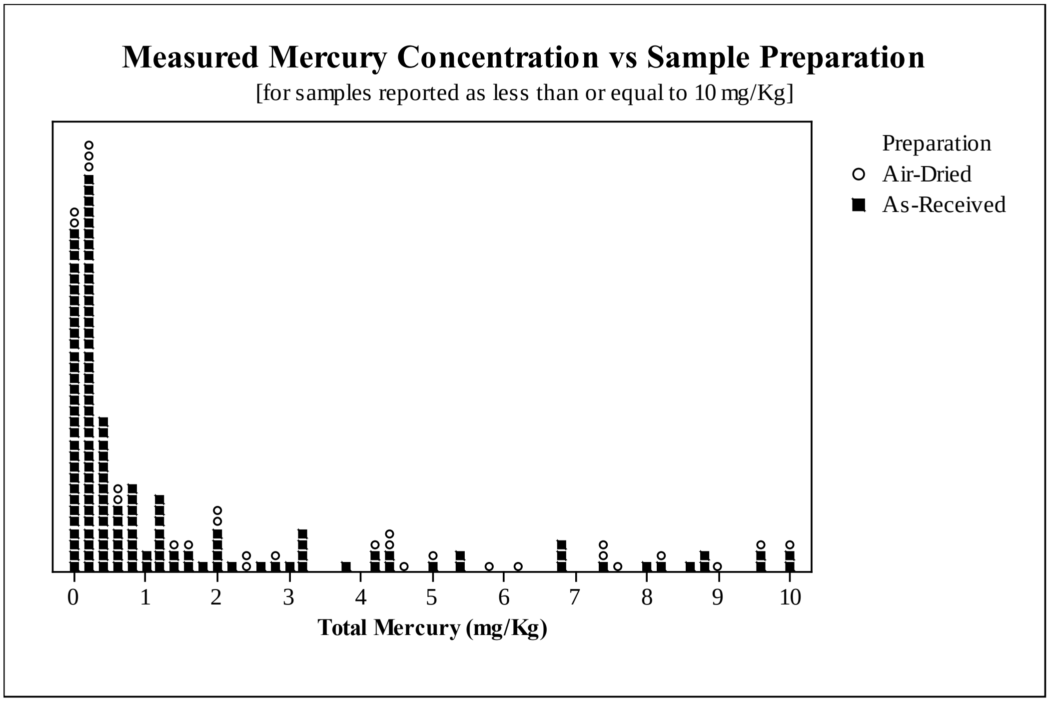


Figure 3E-2. Distribution of Sediment Samples that Exhibited a Mercury Concentration < 10 mg/Kg that were Analyzed As-Received vs. After Air-Drying

Table 3E-1. Spatial Distribution of the Air-Dried Sediment Samples

	Number of Sampling Locations (possible multiple samples per sample location)		Proportion of All Samples Collected that were Air-Dried Samples Within Each Depth Range							
Sediment Sampling Area	**Total # of Sampled Locations**	**# Sample Locations with at Least 1 Air-Dried Sample (%)**	**0”to 3”**	**3”to 6”**	**6“to 12”**	**12“to 18”**	**18”to 24”**	**24”to 30”**	**30”to 36”**	**All Depth Intervals (%)**
Eastern Channel Corridor	18	1 (6%)	2/18	0	0	0	0	0	0	2/18 (11%)
Lower Drinkwater River Corridor	3	0 (0%)	0	0/4	0/2	0	0	0	0	0/6 (0%)
Lily / Upper Factory Pond[1]	48	29 (60%)	0	31/57	4/45	1/16	0/12	0/3	0/2	36/135 (27%)
Middle / Lower Factory Pond	39	30 (77%)	0	30/42	13/40	3/15	0/6	0/2	1/2	47/107 (44%)
Marsh Upland Area (Sediments)	28	14 (50%)	0	14/26	1/7	0/1	0	0	0	15/34 (44%)
Indian Head River Corridor	8	1 (13%)	1/8	0	0	0	0	0	0	1/8 (13%)
Total	144	75 (52%)	3/26	75/129	18/94	4/32	0/18	0/5	1/4	101/308 (33%)

Note: Eight samples were tested for mercury twice: Once following conventional sample preparation (i.e., as-received and reported as “Dry” basis) and once after air-drying (i.e., reported as “Wet” basis).

5.0 LOCATIONS WHERE POSSIBLE MERCURY VOLATILIZATION LOSSES COULD CONCEIVABLY IMPACT REMEDIATION DECISIONS

To identify locations where possible mercury volatilization losses may impact remediation decisions, the sampling locations where air-dried samples exhibited concentrations less than 4 mg/Kg were identified along with the results for the other samples collected at the same sampling location at other depths. Each of these sampling locations was individually examined to determine what effect, if any, an air-dried analytical result reflecting possible mercury loss could have on future remediation decisions for that area. As discussed above, it was determined that air-dried samples reporting a mercury concentration less than 4 mg/Kg could potentially affect the sediment removal decision-making the most because of their possible effect on the reach-specific average residual mercury concentration.

Table 3E-2 presents the sediment mercury sampling results (for all samples that were analyzed as-received and after air-drying) for each sampling location where at least one air-dried sample was found to have a mercury concentration less than 4 mg/Kg. The air-dried samples at each sampling location with concentrations less than 4 mg/Kg are shown in bold for easier identification.

Of the 101 air-dried samples, only 14 were less than or equal to 4 mg/Kg. All 14 of these samples were from either Lily/Upper Factory Pond or Middle/Lower Factory Pond, and these 14 samples were collected from only nine different boring locations.

- At locations where an as-received sample that had a mercury concentration less than 4 mg/Kg that was collected from the same depth interval or from below the sample analyzed following air-drying, it was concluded that the air-dried sample would not influence the remediation decision-making at that location. With this sediment column concentration distribution, decisions could be made based on the results of the as-received sample and there would be no additional uncertainty due to air-drying about the extent of the mercury contamination less than 4 mg/Kg. This was the case at three of the nine locations (i.e., at SD-LUFP112, SD-LUFP82, and SD-MLFP37).

- At locations where an as-received sample with a concentration greater than 4 mg/Kg was collected at a depth beneath the air-dried sample with a concentration less than 4 mg/Kg, it was also concluded that potential mercury loss from the air-dried sample would not have an effect on the remediation decision-making at that location because removal of the sediment at the depth of the deeper sample that exceeded 4 mg/Kg would necessarily include removal of the overlying sediment where the air-dried sample was collected. This was the case at one of the nine locations (i.e., at SD-LUFP121).

- At locations where there was no as-received sample collected below the air-dried sample with a concentration less than 4 mg/Kg or where an as-received sediment sample collected below the air-dried sample also was found to have a mercury concentration less than 4 mg/Kg, it was determined that the extent of contamination and, therefore, the remediation decision-making could be uncertain if there was mercury loss during the air-drying of the sample prior to analysis. In these situations, a decision to remove or not remove the sediment at that location and depth would be made based on the air-dried result or the combination of air-dried and as-received results. Four locations described in more detail below were found to potentially be affected by the air-dried results (i.e., at SD-MLFP15, SD-MLFP19, SD-MLFP3, and SD-MLFP7).

1. Five sediment samples were collected at sampling location SD-MLFP15. Three samples from the depth intervals of 3”-6”, 6”-12”, and 12”-18”, respectively, were air-dried with each reporting a sediment mercury concentration less than 4 mg/Kg. Two samples were analyzed as-received at the lower depth intervals of 18”-24” and at 24”-30”, respectively, which also reported sediment mercury concentrations less than 4 mg/Kg.
2. Three sediment samples were collected at sampling location SD-MLFP19. Two samples from the depth interval of 3”-6” (one of which was a duplicate sample) were air-dried and had sediment mercury concentrations greater than 4 mg/Kg. One sample collected at the depth interval of 6”-12” was air-dried and reported a sediment mercury concentration less than 4 mg/Kg. No samples were collected at a depth below 12” at this location.
3. Two sediment samples were collected at sampling location SD-MLFP3. One air-dried sample from the depth interval of 3”-6” reported a sediment mercury concentration greater than 4 mg/Kg. The other air-dried sample was collected at the depth interval of 6”-12” and reported a sediment mercury concentration less than 4 mg/Kg. No samples were collected at a depth below 12” at this location.
4. Five sediment samples were collected at sampling location SD-MLFP7. One air-dried sample from the depth interval of 3”-6” reported a sediment mercury concentration greater than 4 mg/Kg. Four air-dried samples (including a duplicate sample at the depth interval 6”-12”) were collected at 6”-12”, 12”-18”, and 30”-36”. All of these samples had mercury concentrations less than 4 mg/Kg. No samples were collected between 18” and 30” or below a depth of 36” at this location.

- The last location (SD-MLFP24) had an air-dried sample collected from the 12”-18” interval with a reported mercury concentration less than 4 mg/Kg (0.16 mg/Kg). No samples were collected below that depth. However, a sample collected from the 6”-12” that was analyzed as-received had a mercury concentration of 0.31 mg/Kg. An as-received sample collected from the 3”-6” interval had a mercury concentration of 27.4 mg/Kg. Because the as-received sample from the 6”-12” depth interval immediately above the air-dried sample was found to be less than 4 mg/Kg, it is likely that the sediment from the 12”-18” interval also had a mercury concentration less than 4 mg/Kg. However, this could depend on the sediment movement at this location and layering over time.

While some uncertainty as to the depth of contamination exists at the specific sampled locations discussed above, the potential effect on the estimate of the depth of contamination (and the associated sediment removal volume from that location) would be limited to a single 6” depth interval.

Table 3E-2. Analysis of Sediment Sampling Results at Locations Where an Air-Dried Sample Had a Mercury Concentration < 4 mg/Kg

Sampled Area	Sample ID	Depth Interval (inches)	Sample Basis	Percent Solids	Total Mercury Concentration (mg/Kg)	Laboratory Data Qualifier	Details	Is the Remediation Decision-Making Sensitive to the Air-Dried Sample Result? (Yes/No)
Lily/Upper Factory Pond	SD-LUFP112-06	3-6	Air-dried		60.4		LUFP112: Air-dried sample at 12" and has an as-received sample result at same depth, both were less than 4 mg/Kg. This sample was one of the 6 samples with both an as-received and an air-dried result. Sample results below 12" were all less than 4 mg/Kg. Sample results above 12" were air-dried and greater than 4 mg/Kg.	No
	SD-LUFP112-12	6-12	As-received	22.6	1.6	F1 F2		
	SD-LUFP112-12	**6-12**	**Air-dried**	**22.5**	**2.4**			
	SD-LUFP112-18	12-18	As-received	36.4	0.050	J		
	SD-LUFP112-24	18-24	As-received	38.7	0.034	J		
	SD-LUFP121-06	**3-6**	**Air-dried**	**-**	**0.56**		LUFP121: Air-dried sample at 6" had a mercury concentration below 4 mg/Kg. Sample at 12" was analyzed as-received and was above 4 mg/Kg.	No
	SD-LUFP121-12	6-12	As-received	19.5	39.4			
	SD-LUFP82-06	3-6	Air-dried		155		LUFP82: Air-dried sample at 12" and has as-received sample at the same depth, both were less than 4 mg/Kg This sample was one of the 6 samples with both an as-received and an air-dried result. No sample was collected at a lower depth. As-Received sample at 6" is above 4 mg/Kg.	No
	SD-LUFP82-12	6-12	As-received	21.2	1.3			
	SD-LUFP82-12	**6-12**	**Air-dried**	**21.2**	**1.5**			

Middle/Lower Factory Pond	**SD-MLFP15-06**	**3-6**	**Air-dried**	**-**	**1.9**	*	MLFP15: Air-dried sample at 6”, 12”, and 18”, with mercury concentrations below 4 mg/Kg. As-Received samples collected at 24” and 30” were also below 4 mg/Kg.	Yes (Potentially)
	SD-MLFP15-12	**6-12**	**Air-dried**	**-**	**2.8**	*		
	SD-MLFP15-18	**12-18**	**Air-dried**	**-**	**0.14**	*** F1**		
	SD-MLFP15-24	18-24	As-received	13.3	0.32	J		
	SD-MLFP15-30	24-30	As-received	32.2	0.22	J		
	SD-MLFP19-06	3-6	Air-dried		112		MLFP19: Air-dried sample at 12” with a mercury concentration below 4 mg/Kg. No samples were collected below 12”. Two air-dried samples at 6” were above 4 mg/Kg.	Yes (Potentially)
	SD-MLFP19-06-DUP	3-6	Air-dried		63.8			
	SD-MLFP19-12	**6-12**	**Air-dried**	**-**	**2.3**			
	SD-MLFP24-06	3-6	As-received	18.6	27.4		MLFP24: Air-dried sample at 18” with a mercury concentration below 4 mg/Kg. No samples collected below 18”. As-received sample collected at 6” was above 4 mg/Kg. As-received sample collected at 12” was below 4 mg/Kg.	Probably No
	SD-MLFP24-12	6-12	As-received	18	0.31	J		
	SD-MLFP24-18	**12-18**	**Air-dried**	**-**	**0.16**			
	SD-MLFP3-06	3-6	Air-dried		39.9	H	MLFP3: Air-dried sample at 12” with a mercury concentration below 4 mg/Kg. No samples collected below 12”. Air-dried sample at 6” was above 4 mg/Kg.	Yes
	SD-MLFP3-12	**6-12**	**Air-dried**	**-**	**0.51**	**H**		
	SD-MLFP37-06	3-6	As-received	20.5	335		MLFP37: Air-dried sample at 12” with a mercury concentration below 4 mg/Kg. Duplicate as-received sample at 12” was also below 4 mg/Kg. As-received sample at 6” was above 4 mg/Kg.	No
	SD-MLFP37-12	**6-12**	**Air-dried**	**-**	**0.034**			
	SD-MLFP37-12-DUP	6-12	As-received	71.9	0.024	J		
	SD-MLFP7-06	3-6	Air-dried		44.7	H	MLFP7: Air-dried samples at 12”, 18”, and 36” were all below 4 mg/Kg. No samples collected below 36”. Air-dried sample at 6” had a mercury concentration above 4 mg/Kg.	Yes (Potentially)
	SD-MLFP7-12	**6-12**	**Air-dried**	**-**	**1.3**			
	SD-MLFP7-12-DUP	**6-12**	**Air-dried**	**-**	**1.9**			
	SD-MLFP7-18	**12-18**	**Air-dried**	**-**	**0.086**			
	SD-MLFP7-36	**30-36**	**Air-dried**	**-**	**0.2**			

Notes:

Laboratory Data Qualifiers:

J – Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value.

H – Sample was prepped or analyzed beyond the specified holding time.

F1 – MS and/or MSD recovery is outside acceptance limits.

F2 – MS/MSD RPD exceeds control limits.

*- Interference check standard or LCS/LCSD was outside acceptance limits.

Gray shaded samples are the samples that were analyzed as-received and also analyzed after air-drying.

Bolded samples are those air-dried samples that have a concentration below 4 mg/Kg

6.0 SUMMARY AND CONCLUSIONS

Approximately one-third of the sediment samples collected at the Fireworks Site during the re-baselining sampling were air-dried as a sample preparation step to allow the analytical method for mercury to be applied and information useful for the Phase III analysis to be generated. A potential concern was raised regarding the possible loss of mercury during the laboratory air-drying process, and whether some reported mercury concentrations could be biased low to the point that they could potentially impact future remediation decision-making. An analysis of the re-baselining sediment mercury data revealed the following information:

- Air-drying was required because of the high moisture content of the collected sediment samples primarily from Middle/Lower Factory Pond, Lily/Upper Factory Pond, and the Marsh Upland Area. The sediment in these pond and wetland areas was typically more organic and fine grained than in the streams on the Site. These three areas had the highest proportions of samples that required air-drying prior to analysis. Of the total number of air-dried samples at the Site (i.e., 101), 47 samples were collected from Middle/Lower Factory Pond, 36 were collected from Lily/Upper Factory Pond, and 15 were collected from the Marsh Upland Area.

- A majority of the sediment samples from Middle/Lower Factory Pond, Lily/Upper Factory Pond, and the Marsh Upland Area that required air-drying were collected from the 3”-6” depth interval. The remaining air-dried samples from these three areas were taken from depth intervals deeper than 6” below the sediment-surface water interface. All air-dried samples taken from the Eastern Channel Corridor and the Indian Head River Corridor were from the depth interval of 0”-3”.

- An analysis of sediment sampling results at locations where an air-dried sample was found to have a mercury concentration less than 4 mg/Kg was performed to assess whether future remediation decision-making may be sensitive to possible mercury losses from these samples prior to analysis. Of the 101 air-dried samples, only 14 had reported mercury concentrations less than or equal to 4 mg/Kg. All 14 samples were from either Lily/Upper Factory Pond or Middle/Lower Factory Pond and were collected from only nine different sampling locations. However, the remediation decision-making at only five of these nine sampling locations could be somewhat uncertain due to the air-drying and possible mercury losses.

- An assessment of the cases where a potential mercury loss during air-drying could have occurred indicated that such a loss, if it had occurred, would not have changed the location-specific mercury removal decision-making at many of the sampling locations because of the availability of as-received sample results collected from either the same depth interval or from intervals immediately above and below the air-dried samples. However, the possibility that limited mercury loss might have occurred in certain samples would be considered in any remediation planning for the pond areas or other areas with these sediment characteristics.

Some of the potential bias in the re-baselining sampling results at these few highlighted locations can be addressed specifically during remediation (removal) design and/or confirmation sampling by:

1. Using one approach, more sediment removal may be planned at these locations than would be indicated to be strictly necessary to meet the proposed remedial goal within that specific reach.
2. Another approach may be to lower the threshold for triggering further sediment removal to account for possible mercury losses during laboratory sample preparation and analysis of the confirmation samples.

A balance of these approaches along with other location specific considerations could be incorporated into the remedial design and confirmation sampling associated with the mercury-contaminated sediments at the Site, as may be deemed appropriate.

APPENDIX 3F

Source of Mercury in the Indian Head River Sediments

INTRODUCTION

Sediment sampling in the Indian Head River Corridor between Factory Pond Dam and Luddam's Ford Dam detected mercury at concentrations ranging from 0.084-0.78 mg/kg for samples 1-4 collected within 1,200 feet downstream of the Factory Pond Dam, 3.45 and 3.1 mg/kg for samples 5 and 7, respectively, collected between 1.0-1.6 miles downstream of the Factory Pond Dam, and 4.2 mg/kg at sampling station 8 located approximately 2.5 miles downstream of Factory Pond Dam and 1,000 feet upstream of Luddam's Ford Dam (see Figure 3-12 taken from the Final Supplemental Phase II Report). As stated in the Final Supplemental Phase II Report, the source of the mercury in the sediment between Factory Pond Dam and Luddam's Ford Dam is unclear given the currently available data, however, investigation indicates that the likely sources of contamination were historic manufacturing operations along the IHRC. While some mercury-contaminated sediment may have possibly migrated past/over the Factory Pond Dam during periods of very high flow and deposited in the river channel below the dam, given the low concentrations detected nearest to Factory Pond Dam, it is equally likely that atmospheric deposition of mercury into the watershed areas between the dams may have washed into the river channel and been deposited in the sediment.

Research into the historical activities that took place between the two dams was performed to determine whether it could be concluded if the mercury detected in these sediments was likely caused by the Fireworks Site (the Site). The following text presents the collected information regarding the types of historical activities that occurred downstream of the Site and, together with the technical and sampling data, provides a weight-of-evidence evaluation supporting our premise that the most likely source(s) of mercury in the sediment between Factory Pond Dam and Luddam's Ford Dam are not from the Site.

1.0 Prior Industrial Activity in this Portion of the Indian Head River

The local historical chronical "Focus on History" by Barbara Barker related the following about "Early Industries at Luddam's Ford in Hanover" (Barker 2006):

> *"As settlers moved into the area that was to become Hanover, they saw the (Indian Head) river as a source of water power for their future mills. Early on a dam was constructed here, on the Indian Head River at Luddam's Ford, by 1693 Joseph Curtis, Josiah Palmer, and others entered into an agreement "for erecting a saw mill on that part of the Indian Head River a little above the cartway (Elm Street).*
>
> *By 1704 an Iron Works had been constructed. Thomas Bardin, an immigrant from Wales, was an early pioneer in the industry of turning bog iron into utensils. Later names involved in this forge were Wanton, Randall, Barstow, and Josselyn. By 1720 Josselyn of "Old Forge" held a major portion of the shares until 1790.*
>
> *In 1791 the Curtis family, Lemuel, Ruben, and Consider became long time owners. Later George Curtis and Lemuel Dwelly took over. Curtis Iron Works, as it was known, made*

> *anchors ranging from 1000 to 10,000 pounds, and during the American Revolution it made many anchors for the Government. Later the anchors for the ship, Constitution, were forged here.*
>
> *A grist mill was operating here in 1791, and a saw mill was still in use in 1873. In 1839 a carding mill, which was built upstream at the junction of Rocky Run Brook, was moved to this site as well.*
>
> *In 1873 the Iron Forge property was sold to Mr. Eugene Clapp whose business was to grind products that contained rubber for reuse. He was a pioneer in the recycling industry. However, the waste was dumped in the riverside swamps and still remains today, somewhat overgrown, as an early trampoline. (an early polluter) The "old forge" building burned in 1881, and Mr. Clapp constructed a much larger mill and later built repeated additions and buildings on both sides of the river.*
>
> *The rubber mill was the last active business to operate here. At times over 400 men were employed. A terrible fire occurred in 1923, pictures of which are on file at the Historical Society. The business was rebuilt, but then the depression hit, and the company went into receivership. At the time of its closing it was the largest rubber reclaiming mill of its kind in the country and covered 18 acres along the Indian Head River."*

A further description of this area is presented in the Wikipedia entry for the Indian Head River (Indian Head River, 2016):

> *"The Indian Head River is located on the Hanover, Pembroke border in Massachusetts, United States, and covers about 8 acres (32,000 m^2). The river, 3.7 miles (6.0 km) long, is a tributary of the North River, which flows into Massachusetts Bay. The Indian Head River was probably a fishing and travel spot for Wampatuck Indians.*
>
> *History - The river runs through the Luddam's Ford Park, named after a guide, James Luddam, who in 1632 carried Governor Winthrop across the river to get to Weymouth. In November 1873, Eugene H. Clapp bought the Old Forge Property from George Curtis and built the Clapp Rubber Factory on the river.*
>
> *Habitat - The factory is no longer there, but the mercury pollution from the factory still clings to the rocks and fish making it unsafe to drink the water and eat the fish. There is a strip of rubber along the river on the Pembroke side which people may bounce on."*

In addition, Tetra Tech obtained and examined several Sanborn Maps of the Indian Head River Corridor between Factory Pond Dam and Luddam's Ford Dam from the years 1917 to 1931. These maps indicate the names and some other information about the buildings that were present along this stretch of the river. The Sanborn Maps labeled the various buildings according to the principal activities that took place within them (e.g., Mill Room, Vulcanization). From these maps it was ascertained that at least six historical factories or industrial operations once were active in this area. A number of these industrial operations were drawn to the location by the water power afforded by the Indian Head River. These operations were (starting at Luddam's Ford and working upstream):

1. E. H. Clapp Rubber Company located at Luddam's Ford (see Figures 1, 2, and 3);
2. Hanover Tack Company (formerly the R. C. Waterman Tack Factory at the same location) located on Water Street east of Graham Hill (Located 3,200 feet upstream of the Luddam's Ford Dam - see Figures 4 and 5);
3. E. Phillips & Sons Tack and Shoe Manufacturing (circa 1912) located where State Street crosses the Indian Head River (Located 7,125 feet upstream of the Luddam's Ford Dam - see Figure 6);
4. Diamond Tack and Nails Works located at Broadway and State Street (site of the former E. Phillips & Sons Tack and Shoe Manufacturing facility 7,125 feet upstream of the Luddam's Ford Dam - see Figure 7);
5. Joseph F. Corcoran Finishing Rubber Goods for E. H. Clapp Rubber Co. located at Broadway street north of Diamond Tack and Nails Works (see Figure 7); and
6. Hanover Rubber Company located on the north side of Forge Pond (see Figure 8).

The E. Phillips and Sons Tack and Nail Manufacturers (also identified on other maps as "E. Phillips & Sons Tack and Shoe Manufacturers") was located in South Hanover (David Williams Company 1908). The 1912 Sanborn Map (see Figure 6) shows this facility just downstream of the Cross Street / State Street bridge across the Indian Head River. The 1896 Sanborn Map (see Figure 4) shows the R.C. Waterman Tack Factory (later the Hanover Tack Company) on the bank of the Indian Head River along Water Street. In addition, according to the Sanborn Maps, the Hanover Rubber Co. located just northeast of Forge Pond upstream of the Site manufactured soles, heels, and welts for shoes. The presence of these factories focused on rubber and tacks/nails is evidence that the shoe manufacturing industry had a significant presence in Hanover (Baker 1998). Anecdotally, leather soles have been reported to have been found at several locations in the Indian Head River (stripersonline.com 2013). The presence of an unspecified "chemical company" also has been reported to have been located on Winter Street in Hanson, MA at the site of the current Country Ski & Sport Shop adjacent to Factory Pond Dam (Danubio, 2017). The Country Ski & Sport Shop building is believed to date back to the late 1800s.

1.1 E. Phillips & Sons Tack and Shoe Manufacturers

The E. Phillips & Sons Tack and Shoe Manufacturers appears to have been a mature operation at the time of the development of the 1912 Sanborn Map (see Figure 6). This facility was located just downstream of the Cross Street / State Street Bridge. There was a dam and two flumes that by-passed the dam at this location. The facility was coal-fired, with a coal pile shown on the map. Based on the Sanborn map labeling, operations at the tack and shoe factory included metal "bluing" since a "Blueing" building (spelled as labeled) was shown on the southern shoreline of the main river channel just downstream of the dam.

R.H. Angier, in his 1936 book "Firearms Blueing and Browning" (considered the "Bible" of metal coloring and finishing (R. Schreiber, 2018)) described blueing and browning as variations of the same basic process (Angier, 1936). There are many forms of metal blueing or browning, which are surface metal treatment operations to slow or prevent surface corrosion or rusting of steel or to change the color of the metal (e.g., "cold" bluing, "hot" bluing, "rust" bluing, "fume" bluing, "russeting", and "browning"). Metal was subjected to different bluing and browning processes to achieve the desired surface color and degree of protection from uncontrolled rusting and oxidation (Bluing [steel], 2018). Browning was an earlier form of bluing performed in the late 1800s and early 1900s (and as far back as the 16th century) that produced a reddish brown or reddish orange color on the metal (Shooters Forum, 2006). The browning and bluing formulas were comprised of corrosive solutions (typically involving nitric or hydrochloric acid) containing one or more metal salts. The exact solution composition and processing temperature and contact time were selected for a particular metal and to achieve the desired color and durability of the finish (Bluing [steel], 2018). Angier proposed a comprehensive browning solution classification scheme and documented the "recipes" and processes for 148 browning solutions of which 46 included the very soluble mercuric chloride or mercuric nitrate as the primary metallic salt (see table below):

Summary of Browning / Blueing Solutions for Metal Surface Treating and Finishing (Angier, 1936)

Angier Group	Solution Composition	Total Number of Documented Browning / Blueing Solutions	Number of Solutions Containing Mercuric Chloride or Mercuric Nitrate
Aa	Iron-Free, Containing 1 Metallic Salt	22	4
Ab	Iron-Free, Containing 2 Metallic Salts	11	6
Ac	Iron-Free, Containing 3 Metallic Salts	6	6
Ad	Iron-Free, Containing 4 Metallic Salts	3	2
B	Containing Iron, No Other Metallic Salt	13	0
C	Containing Iron, and 1 Metallic Salt	29	7
D	Containing Iron, and 2 Other Metallic Salts	19	14
E	Containing Iron, and 3 Other Metallic Salts	5	5
F	Combined Brownes	7	1
G	Collective Browning	20	1

H	Miscellaneous Browning and Blueing Methods	13	0
	TOTAL	**148**	**46**

Mercury chloride was a key component of the majority of these solutions, especially the most common ones used for treating common iron and steel products. The E. Phillips & Sons Tack and Shoe Manufacturers facility was operational during the time that blueing/browning was used in the industry. In addition, the 1912 Sanborn Map depiction of the facility shows a "Blueing" building. Accordingly, mercury associated with the blueing/browning process used on the tacks and shoe nails is likely to have been released into the environment and the river during that time. In addition, Figure 6 also identifies a "Lead Rolling & Tinning" building on the northern shore of the river just downstream of the dam, and a building labeled "Lead" is also seen right next to it. As lead and mercury have previously been used as indicators of Fireworks Site contaminants in early sediment sampling in the Indian Head River below Factory Pond Dam, the presence of other potential sources of lead to the sediments may confound interpretations of that data relative to the role of the Site in the presence of mercury and lead in river sediments.

1.2 R. C. Waterman Tack Factory

The 1896 Sanborn Map (see Figure 4) shows that the R.C. Waterman Tack Factory also had a "Blueing" operation right on the piece of land jutting out into the Indian Head River. This blueing operation also would likely have made use of a browning solution containing mercuric chloride as discussed above.

1.3 The E.H. Clapp Rubber Factory

The largest of the historical industrial operations was the E. H. Clapp Rubber Company (see Figure 9). In 1873, Mr. Clapp purchased the George Curtis Iron Works "Old Forge" property and converted the existing buildings to accommodate his rubber operations. The Iron Works had been in operation at this site on the Hanover side of the river since 1704. In 1881 a fire destroyed much of the rubber factory and Mr. Clapp rebuilt his factory, incorporating the most modern technology. The new factory was larger and spilled over from Hanover into Pembroke, MA on the other side of the river (Dwelley and Simmons 1910). The two sides of the factory were connected by a pipeline that ran over the Indian Head River (see Figure 10). The demand on the factory was such that operations took place both day and night (findagrave.com 2012). The principal operation of the rubber factory was the reclamation of used rubber. Mr. Clapp had invented an air-blast method to remove the fiber from the used rubber (Geer 1922). The used rubber was de-vulcanized and then re-vulcanized into new products such as soles and heels for shoes, rubber tubing, and wire insulation according to the Sanborn maps from this era (see Figure 11). Based on the Sanborn map labeling, operations at the rubber factory included de-vulcanizing, washing, drying, milling, grinding, cracking, mixing, acid processing, caustic tanks, rubber winding, rubber tubing, sole and heel cutting, moulding goods, sheeting, shipping and receiving, laboratory testing, storage, water wheels, and heat/steam production (see Figures 1 and

2). It is apparent from the maps that the factory was powered by both water wheel and steam from coal-fired boilers as was typical of late 1800s and early 1900s. Photographs obtained from the Stetson House Museum run by the Hanover Historical Society show that a second significant fire took place affecting the E. H. Clapp Rubber Company around the 1930s, possibly after the factory had been abandoned in 1937 (see Figures 10, 12, and 13).

No specific documentation has been found regarding the specific chemical processing at the E. H. Clapp Rubber Factory, as the processes used in the rubber making industry were closely guarded at the time (Geer 1922). However, investigation into the common rubber making processes employed during the operational time period of the E. H. Clapp Rubber Company showed that rubber makers were experimenting with different types of accelerators during the vulcanization and de-vulcanization processes. In the vulcanization process, natural rubber, which comes from the tree *Hevea braziliensis*, is typically strengthened by crosslinking their polymer chains with sulfur or sulfur donors. However, this crosslinking process took time to carry out. The addition of an accelerator sped up the process by acting as a catalyst in the vulcanization process (Boggs and Blake 1930). During the de-vulcanization process, the carbon-sulfur and sulfur-sulfur bonds are broken, leaving the basic polymer chain. Accelerators also were used to speed up the de-vulcanization process and were added in quantities up to 10 percent of the weight of rubber (Twiss and Thomas 1925).

One of the common accelerators used during the vulcanization and de-vulcanization process was mercuric iodide (Benko and Beers 2006; Geer and Bedford 1925; Heideman et al. 2005; The Gardner, Moffat Co. 1922). In 1891, mercuric iodide was discovered to be a rapid accelerator in the vulcanization process, more rapidly producing stronger bonds in comparison to other metal complex accelerators. In 1906, mercuric iodide was used in the vulcanization of tires. However, the rubber products produced using mercuric iodide as an accelerator were shown to not hold up well over time and the practice was phased out as other inorganic (e.g., containing zinc or lead) and organic accelerators producing better product results were identified (Geer and Bedford 1925). Mercuric oxide was also documented as having been used in this type of rubber processing as an accelerator during the 1920s (Twiss and Thomas 1925). Because the E. H. Clapp Rubber Company operated during this period of time, it is quite possible that mercuric iodide or mercuric oxide were used as accelerators at this factory. However, no production records have been found which confirm the use of a mercury-based accelerator at this particular plant.

There are two forms of mercury iodide; mercury (I) iodide (Hg_2I_2) and mercury (II) iodide (HgI_2). Mercury (I) iodide is photosensitive and readily decomposes into mercury and mercury (II) iodide. Because of this, it is thought that mercury (II) iodide was more generally used in the rubber making process. Mercury (II) iodide is a red powder that is insoluble in water and denser than water (NIH 2005). If mercury (II) iodide was used at the E. H. Clapp Rubber Company, it would most likely be associated with residual sludge and sediments given its physical and chemical properties. Mercury (II) iodide that may have been spilled or released into the environment could then find its way into the sediments of the Indian Head River. Mercuric oxide

(HgO), also known as mercury (II) oxide (i.e., a similar sounding but different compound from mercury (II) iodide), also is a red/orange powder that is very poorly soluble in water (NIH 2005).

Accelerators were not the only possible use of mercury in the rubber industry during this time period. Mercury also was used in several types of red and brown dyes in the rubber dying process. In the early 1900s vermilion (pigmented by mercuric sulfide), red chromate of mercury, sulfide of mercury, and iodide of mercury were used to dye rubber either red or brown. Chinese vermilion, considered the best dye for these colors, contains 89 percent of pure mercury and 11 percent sulfur (Pearson 1918; Twiss and Thomas 1925).

Any mercury compounds present during the dyeing or vulcanization/de-vulcanization processes could have found their way into the surrounding environment in at least two ways. The first is through a possible release of the liquids used to wash the rubber after the vulcanization process. This was done to make sure no caustic chemicals were left on the rubber products. In 1978, the United States Environmental Protection Agency (USEPA) released a source assessment document regarding rubber processing. This document states that, “Excess residues of coordination catalysts are detrimental to the aging stability of polymeric rubbers. Therefore, the undesirable residues are removed as soluble salts in a washing and decanting operation, sometimes using an alcohol or an alcohol/water solution.” Mercury compounds also may have been released through particulate emissions from the rubber factory’s grinding or materials handling operations. The USEPA states that hydrocarbons and particulates can be emitted during various operations of the rubber making process. Vulcanization and de-vulcanization occur at elevated temperatures making these processes the primary emission points for hydrocarbons in rubber reclaiming. Particulates can be emitted through the size reduction of scrap rubber (the grinding and milling processes) during rubber recycling (USEPA 1978). Particulates containing mercury could then be deposited onto the surrounding land and migrate into the river with precipitation run-off. These particulates would then either sink to the bottom of the river or travel downstream with the surface water flow.

Figure 3 presents a historical photograph of the E. H. Clapp Rubber Factory taken in 1924. The photograph shows visible black smoke emanating from the factory and dispersing in the up-stream direction of the Indian Head River. Given the apparent opacity of this plume, it would have had to have been dense with particulate matter from the coal fuel or the process material being heated. Mercury is a component of coal in different amounts depending on the type or rank of the coal and would largely become part of the bottom ash from the boilers or furnaces or exit through the stacks as part of the fly ash. Photographic evidence of such thick particulate-laden air emissions moving in the up-stream direction provides a demonstrated mechanism for mercury associated with the E. H. Clapp Rubber Factory to be transported up-stream to the areas where mercury was detected in the sediment by the sampling. Particulates deposited onto the soil of the watershed by gravity settling or precipitation washout could then be transported into the river via soil erosion or precipitation run-off. Once in the river, these mercury-laden particulates would settle and accumulate in the sediment. Over many years and decades, mercury levels in the sediment would increase. Because inorganic forms of mercury that are typical in sediment environments are conservative (i.e., they tend not to transform to other forms of mercury that may be liberated or dissolved and transported away) mercury levels in the sediment would continually increase so long as the depositional source continued. This photograph and the dispersion pathway it shows provides further support for the argument that mercury released from the factory could have been deposited up-stream in the Indian Head River Corridor sediment.

At this same time in history, mercury also was being used in rubber factories in mercury-vapor lamps. Mercury-vapor lamps are a gas discharge lamp in which electricity is sent through vaporized mercury to produce light. These lamps are surrounded by a double, hemi-cylindrical jacket of quartz. Due to the types of machinery used in rubber factories (e.g., open rubber rollers) and the fact that dark rubber absorbs the light from conventional fixtures, there was a need to develop a better type of lighting that would prevent eye strain and factory accidents. Additionally, fume hoods placed directly over the open rollers to draw off any fumes from the rubber made light placement more difficult. As a result, mercury-vapor lamps were placed inside the fume hood. These lamps diffused light so that there were no bouncing shadows and made the rubber itself easier to see (The Gardner, Moffat Co. 1920). Mercury could have been released into the environment if these lamps were broken or discarded in the surrounding areas.

Additionally, it would have been uncommon if the E. H. Clapp Rubber Company did not use mercury-filled manometers (pressure gauges) and thermometers to monitor and control conditions in the boilers that created the steam used during the vulcanization and de-vulcanization processes. Mercury thermometers were historically documented to be a better solution for identifying when boilers reached the correct temperature for vulcanization versus use of steam pressure gauges (The Gardner, Moffat Co. 1922). Mercury could have escaped from these manometers and thermometers via breaks and traveled into the environment.

Clear evidence of rubber plant residues is still present alongside the Indian Head River just downstream of the former E. H. Clapp Rubber Company plant. Four “rubber pits” were found on the Pembroke side of the river just downstream of the Luddam’s Ford Dam. These pits are well known to local residents and were observed by Tetra Tech on May 10, 2017. The pits contain an elastic residue which is firm but elastic in nature (see Figure 14). If mercury was used in any part of the rubber reclamation process. Given the close proximity of these pits to the river, they may be a continuing source of mercury release into the environment. This elastic material has not been characterized as to its chemical composition. Additionally, a local newspaper article (date unknown) reported the historical existence of debris from the E. H. Clapp Rubber Company as a source of pollution in the Indian Head River (see Figure 15).

For completeness, the potential presence of mercury in natural rubber, and subsequently recycled rubber, was researched. The research indicated that natural rubber is not known to contain detectable mercury (Dijkhuis 2017; Rubber Cal 2017; Sengupta 2017).

2.0 Potential Transport of Mercury in the Indian Head River

Based on the concentrations and locations of mercury detected in sediment in the Indian Head River corridor it is unlikely the mercury came from the Fireworks Site. For mercury from the Site to have gotten into the sediment in this Indian Head River corridor, it would have to have been transported on particles that were carried over or released through the control boards of the Factory Pond Dam. This is because prior sampling for mercury in the Site surface water showed very low concentrations of dissolved mercury (i.e., ranging from 0.1 to 48 parts per trillion during the Phase IIC).

The potential for high stream flow to transport sediment from the Site downstream past Factory Pond Dam was considered. An initial stream flow analysis of the flow data for the United States Geological Survey (USGS) Indian Head River stream gauging station was included in the 2009 Phase III Supplemental Sampling Data Report along with a figure plotting this flow over time. The USGS Indian Head River Stream Gauge (ID #01105730) is located approximately one-mile downstream of the Factory Pond Dam on the right bank at the downstream side of Elm Street. Discharge (flow) has been measured daily at this location since July of 1966. Currently, the gauge is a water-stage recorder with satellite telemetry. The drainage area identified at this location is 30.3 square miles, of which approximately 21 square miles is above the Factory Pond Dam with only two small unnamed streams and limited storm water run-off entering from the north and south between the Factory Pond Dam and the gauging station and contributing additional flow. Therefore, it can be assumed that flow rates at this gauging station are only slightly higher than they are at Factory Pond Dam at any given time, making the flow estimates conservative (i.e., probably higher) with respect to the overall flow from the Lower Drinkwater River through the Site.

Based on daily flow statistics from 1966 through 2017, the average flow at the stream gauge was 64 cubic feet per second (cfs). Peak flow occurred most often between January and May, with the average annual maximum occurring in March at 123 cfs. However, significant episodic flows over 200 cfs can be seen to occur at almost any time during the year, including the periods generally associated with low flow. Monthly statistics from 1966 to 2016 indicate that the low flow period occurs in July, August and September, with the average monthly discharge during this time being 23 cfs. Flow can be as low as approximately 2 cfs during periods of drought, however, such as were seen in September 2016. The highest flow ever recorded at this gauging station was on March 15, 2010 (during one of the storm events that necessitated the re-baselining sediment sampling) when the river peaked at 1,520 cfs. Before this major event, the highest measured flow during this period was on March 19, 1968 [1,206 cfs]. There were several other notable high flows, such as those recorded on October 21, 1996 [1,150 cfs] and on October 16, 2005 [1,160 cfs]. These were most likely due to fall hurricanes. It should be noted that flows above those recorded recently at the USGS gauging station must have occurred prior to the start of the recordings since historical flows or floods are known to have been high enough to destroy several smaller dams and factories between Factory Pond Dam and Luddam’s Ford Dam. Since both Factory Pond Dam and the Luddam’s Ford Dam existed during the period when these other dams were washed out, they have been an effective control feature to water flow and potential sediment for many years.

In addition, there are no studies that correlate stream flow with sediment transport in this river system. High flow does not necessarily correlate with high sediment transport. Many factors affect contaminant transport, such as sediment particle size, shape and weight; sediment organic matter composition; adsorption strength of the contaminant (i.e., mercury); and flow hydraulics at and behind the dam. These factors have not been studied for the flow through the Site and at and below Factory Pond Dam. Because high surface water flow does not consistently or necessarily create high sediment transport (especially with a dam or dams in the system), high episodic sediment transport cannot be presumed relative to the Site and this reach of the Indian Head River.

The measured mercury concentrations in the seven sediment samples from this reach of the Indian Head River ranged from 0.084 to 4.3 mg/Kg. (One sample collected from sampling station 5 reportedly contained 4.3 mg/Kg of mercury; a duplicate paired sample from the same location reportedly contained 2.6 mg/Kg of mercury. The two results reflect inherent variability in solid matrix samples. The average of the two results is shown in the table.) The maximum detection (4.2 mg/Kg) was from sampling station 8 (see table below).

Sampling Results for Mercury in the Surficial Sediment Samples Collected Between Factory Pond Dam and the Luddam's Ford Dam (Refer also to Figure 3-12 included below)

Sample ID	Sample Depth (inches)	Sample Date	Total Mercury Concentration (mg/Kg)	Lab Flag/ Qualifier
SD-INRC1-03	0-3	10/26/2015	0.21	
SD-INRC2-03	0-3	10/26/2015	0.26	
SD-INRC3-03	0-3	10/26/2015	0.78	
SD-INRC4-03	0-3	10/26/2015	0.084	J
SD-INRC5-03	0-3	10/26/2015	3.45 (Ave of 4.3 and 2.6 paired samples)	
SD-INRC7-03	0-3	10/26/2015	3.1	
SD-INRC8-03	0-3	10/26/2015	4.2	

A few observations should be noted:

- Mercury concentrations detected in the first depositional areas encountered within 1200 feet of the Factory Pond Dam at sampling stations 1 through 4 were very low (i.e., 0.084 to 0.78 mg/Kg).
- Within the depositional locations within an intermediate reach of the Indian Head River between 1.0 and 1.6 miles downstream of the Factory Pond Dam (i.e., between sampling stations 5 and 7), the surficial sediment mercury concentrations ranged from 3.1 mg/Kg

(detected at sampling station 7) to 3.45 mg/Kg (the average mercury concentration of the original and duplicate sample collected at sampling station 5).

- Farther downstream at sampling station 8 (i.e., 2.5 miles below the Factory Pond Dam and approximately 1000 feet above Luddam's Ford Dam), the surficial sediment mercury concentration was 4.2 mg/Kg. Sampling station 8 is associated with the major impoundment of Luddam's Ford Dam and is a sediment deposition area.

As shown in the table of sampling results, above, the distribution of mercury concentrations in sediment reflects an increase in mercury concentrations with distance (2.5 miles) below Factory Pond Dam, which is not what would be expected if the Site was the source of the mercury released. In other words, the concentrations of mercury generally increased as the sampling stations got farther away from the Site.

The absolute magnitude of the mercury concentrations measured in these samples also was considered. The data for surface sediment mercury levels in the "Reference" or background Massachusetts water bodies was presented in Table 6-7 of Appendix 3D. Portions of this table are reproduced below. The range of the average mercury concentrations measured in sediments from these background water bodies was 0.029 to 0.843 mg/Kg, which shows significant overlap with the range of the data collected in the Indian Head River in this reach.

Extracted from Table 6-7 of Appendix 3D

Table 6-7. Calculated Standard Size Biota Sediment Accumulation Factors (BSAFs) for the "Reference" and "Non-Reference" Massachusetts Water Bodies

Water Body	**Water Body Group**	**Data Source**	**pH of Water Body**	**Average Surficial Sediment Total Mercury Concentration**
			(pH units)	**(mg/Kg dwt)**
Sudbury Reservoir	Reference	NYANZA BERA	7-7.04	0.199
Sudbury River Reach 1	Reference	NYANZA BERA	7-7.04	0.843
Forge Pond (1995)	Reference	1995MADEP	6.61-6.85	0.445
Laurel Lake	Reference	MADEP Mercury Portal	6.4	0.274
Buckley Dunton	Reference	MADEP Mercury Portal	5.7	0.29
Bog Pond	Reference	MADEP Mercury Portal	6.45	0.133
Little Quittacas	Reference	MADEP Mercury Portal	7.14	0.279
Charles River	Reference	NYANZA BERA	7-7.04	0.237
Somerset Reservoir	Reference	MADEP Mercury Portal	7.29	0.215
Center Pond	Reference	MADEP Mercury Portal	7.48	0.08
North Watuppa	Reference	MADEP Mercury Portal	6.08	0.149

Extracted from Table 6-7 of Appendix 3D

Table 6-7. Calculated Standard Size Biota Sediment Accumulation Factors (BSAFs) for the "Reference" and "Non-Reference" Massachusetts Water Bodies

Water Body	Water Body Group	Data Source	pH of Water Body	Average Surficial Sediment Total Mercury Concentration
			(pH units)	(mg/Kg dwt)
Yokum Pond	Reference	MADEP Mercury Portal	7.17	0.03
North Drink Water River	Reference	FWX-PH2D	6.8	0.0686
Elders Pond	Reference	MADEP Mercury Portal	7.13	0.029
Lake Cochichewick	Reference	MADEP Request	6.33	0.609
Onota	Reference	MADEP Request	7.32	0.464
Haggetts Pond	Reference	MADEP Request	7.3	0.622
Rock Pond	Reference	MADEP Request	5.72	0.479
Kenoza	Reference	MADEP Request	7	0.461
Bare Hill Pond	Reference	MADEP Request	6.45	0.405
Wickaboag Pond	Reference	MADEP Request	6.5	0.355
Buckley Dunton Lake	Reference	MADEP Request	6.65	0.429
Wequaquet	Reference	MADEP Request	5.88	0.262
Baldpate Pond	Reference	MADEP Request	7	0.448
Pelham Lake	Reference	MADEP Request	6.02	0.171
Lake Nippenicket	Reference	MADEP Request	6.2	0.347
Upper Reservoir	Reference	MADEP Request	5.6	0.214
Upper Naukeag	Reference	MADEP Request	5.6	0.207
Pomps Pond	Reference	MADEP Request	7.28	0.166
			Minimum	**0.029**
			Average	**0.307**
			Maximum	**0.843**
			Standard Deviation	**0.192**

Neither of these ranges (the collected Indian Head River samples or the “Reference” Massachusetts water body data) reflects an average reach concentration exceeding the sediment mercury PRG proposed for the Site based on site- and watershed-specific factors.

3.0 Summary

Historical maps provide information regarding the manufacturing operations that took place at the E. Phillips & Sons Tack and Shoe Manufacturers, and available technical information indicates that mercury salts (i.e., mercuric chloride and mercuric nitrate) and lead were commonly used in the manufacturing and bluing processes used to surface treat and finish nails and other steel up to the early 1900s. Historical maps also provide information regarding the manufacturing operations that took place at the E.H. Clapp Rubber Factory. Research shows that within the time in which the E.H. Clapp Rubber Factory was operational, mercury was likely to have been used in several ways at the plant, including: as a chemical reaction accelerator in de-vulcanization and re-vulcanization; as a dye; in lamps specifically noted to be used in rubber factories during this time frame; and in manometers and thermometers for monitoring steam boiler and process conditions. The releases of mercury from the plant likely included point source releases of mercury-containing liquid used to wash rubber, leaks from manometers and thermometers, and air emissions from the heating operations during vulcanization/de-vulcanization and as a result of the grinding of the rubber being recycled.

Other industrial activities that took place along this portion of the Indian Head River related to the shoe making industry. These industries also may have used mercury in their processing, although the linkage is less clear. For example, prior to shipment to manufacturing or assembly facilities, animal hides used for clothing and footwear were historically treated with a variety of disinfection agents, including mercury chloride (Baker 2017). Depending on the handling and disposal practices at the sites where this disinfection was performed, mercury chloride could have been discharged into nearby waterways or onto adjacent lands. Records are insufficient to confirm whether leather processing of this type was conducted in this area in connection with the confirmed local shoe making operations.

Based on the evidence, it is more likely the historical operations of the rubber factory or the tack and shoe manufacturing operations previously located in this reach of the Indian Head River introduced mercury into the river sediments. In addition, continuing atmospheric deposition of mercury associated with coal-fired power plant emissions regionally and from the Midwest (recognized to be impacting water bodies throughout Massachusetts for many years) contributes mercury to these sediments. Moreover, the concentrations and distribution of mercury in the river sediment do not support a conclusion that mercury in this reach of the Indian Head River was transported from the Site.

Additional sampling of sediment in the Indian Head River Corridor between Factory Pond Dam and Luddam’s Ford Dam is very unlikely to provide additional information that will allow a more definitive attribution to the source of the mercury now present in this reach. Certified laboratory analytical methods for mercury speciation relative to a broad range of mercury compounds are not commercially available, and speciation relative to a particular species or compound is accomplished typically at the bench-scale level for a specific compound of interest. No sediment contaminant (mercury or otherwise) that could not have been introduced into the sediments in this reach of the Indian Head River from other sources has been identified. In addition, the mercury does not appear to be widely distributed throughout this reach and the concentrations of mercury already measured in these sediments are not high enough to pose a significant risk to users of the river or the environment. As such, further sampling of the sediments in this reach for determining the nature and extent of contaminated sediment from the Former National Fireworks Facility is not warranted.

4.0 References

Angier (1936). “Firearm Blueing and Browning”, R.H. Angier, Stackpole Books, Copyright by Thomas G. Samworth, 1936.

Baker, D.B. (2017) *Encyclopedia of Occupational Health and Safety.* International Labour Office. Chapter 88 p. 5– Leather, Fur and Footwear, http://ilocis.org/documents/chpt88e.htm

Barker, B. (2006) Focus on History. http://www.hanover-ma.gov/sites/hanoverma/files/file/file/focus_on_history.pdf, May 18, 2006.

Barker, B. (1998) *Hanover - A Town that Made Shoes*. Focus on History. April 1998.

Benko, D.A. and Beers, R.N. (2006) *Rubber Devulcanization*. Encyclopedia of Chemical Processing. The Goodyear Tire & Rubber Company. Akron, Ohio. 2006; vol 5.

Bluing (2018). Wikipedia definition, httpS://en.wikipedia.org/wiki/Bluing_(steel), April 2018.

Boggs, C.R. and Blake, J.T. (1930) *IV-A Theory of Vulcanization of Rubber*. Industrial and Engineering Chemistry. July 1930; vol *22* (7), pp 748–755.

Danubio, J. *Fly Fishing for the American Shad, Indian Head River, Hanover and Pembroke Massachusetts*. http://www.nsrwa.org/wp-content/uploads/2017/03/Fly-Fishing-for-the-American-Shad-and-River-Conservation-at-the-Indian-Head-River.pdf, Viewed on May 10, 2017.

David Williams Company (1908) *The Iron Age Directory*. Twelfth Annual Edition. The Iron Age, The Metal Worker, and Carpentry and Building. New York. May 1908.

Dijkhuis, I.K. (2017) RE: Ask us a question. Elastomer Research Testing B.V. Message to Ron Marnicio May 30, 2017. Email.

Dwelley and Simmons (1910) *History of the Town of Hanover, Massachusetts, with Family Genealogies*. Town of Hanover. 1910.

Findagrave.com (2012) *Eugene H. Clapp*. Retrieved from: https://www.findagrave.com/cgi-bin/fg.cgi?page=gr&GRid=91304789. Viewed on March 9, 2017.

The Gardner, Moffat Co. (1920) *Illumination an Aid to Production*. The Rubber Age and Tire News. April 1920; vol 7 (1) p. 469.

The Gardner, Moffat Co. (1922) *The Rubber Age*. October 10, 1922. Vol 7 (1) pp. 166 & 214.

Geer, W.C. (1922) *The Reign of Rubber*. The Century Co. New York. 1922.

Geer, W.C. and Bedford, C. W (1925) *The History of Organic Accelerators in the Rubber Industry*. Industrial and Engineering Chemistry. April 1925; vol 17 (4), pp 393–396.

Heideman, G., Noordermeer, J.W.M., Datta, R.N., Van Baarle, B., Eindhoven (2005*) Effect of Metal Oxides as Activator for Sulphur Vulcanisation in Various Rubbers*. Kautschuk Gummi Kunststoffe. 2005; vol 58, pp 30-42.

Indian Head River Corridor (2016), Wikipedia entry. https://en.wikipedia.org/wiki/Indian_Head_River, Viewed on February 22, 2016.

NIH (2005) National Institute of Health. *Mercury Diiodide*. PubChem open chemistry database. Viewed on March 9, 2017.

NIH (2005) National Institute of Health. *Mercury Oxide*. PubChem open chemistry database. Viewed on June 7, 2017.

Pearson, H.C. (1918) *Crude Rubber and Compounding Ingredients, A Textbook of Rubber Manufacture*. The India Rubber Publishing Company. Third edition. New York. 1918.

Rubber Cal (2017) FW: Possible mercury in recycled rubber products. Message to Ron Marnicio May 31, 2017. Email.

Schreiber (2018). Personal email and telephone communications with Mr. Richard Schreiber, Principal of Laurel Mountain Forge, April 5-6, 2018.

Sengupta, K. (2017) RE: Ask TCB Inquiry. The Conference Board. Message to Ron Marnicio May 30, 2017. Email.

Shooters Forum, 2006. “Metal Browning”, Ribbonstone (Moderator), January 1, 2006, 7:38 AM.

Stripersonline.com (2013) *Historical Indian Head River Pictures*. Retrieved from: http://www.stripersonline.com/surftalk/topic/559108-historical-indian-head-river-pics/. Viewed on March 10, 2017.

Twiss, D.F., and Thomas, F. (1925) A Comparative Study of Some Vulcanisation Accelerators. Journal of the Society of Chemical Industry. March 6, 1925; pp.100-109.

USEPA (1978) United States Environmental Protection Agency. *Source Assessment: Rubber Processing, State of the Art*. Environmental Protection Technology Series. Industrial Environmental Research Laboratory. Cincinnati, OH. March 1978.

FIGURES

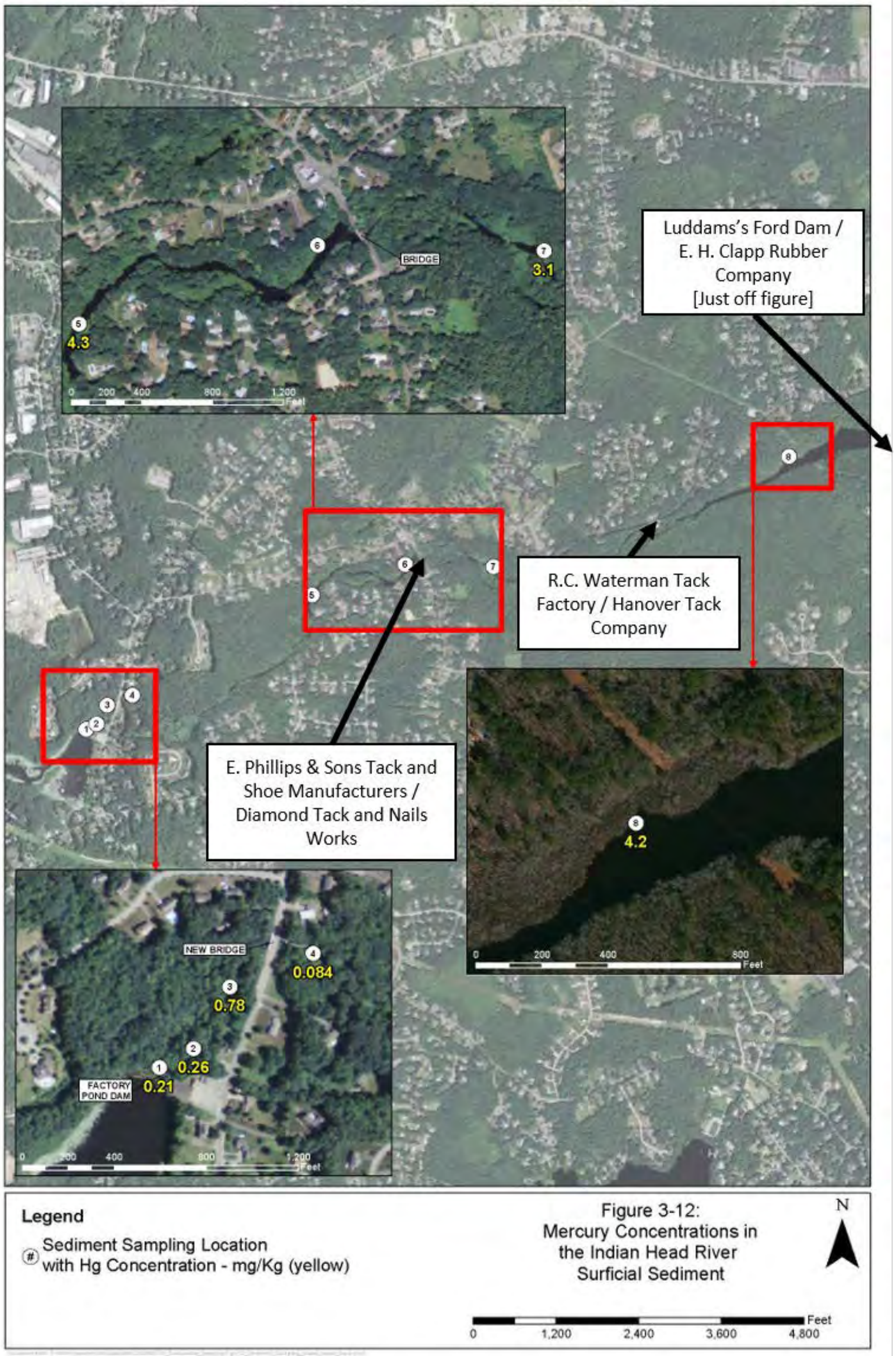


Figure 3-12. Mercury Concentrations in the Indian Head River Surficial Sediment Samples

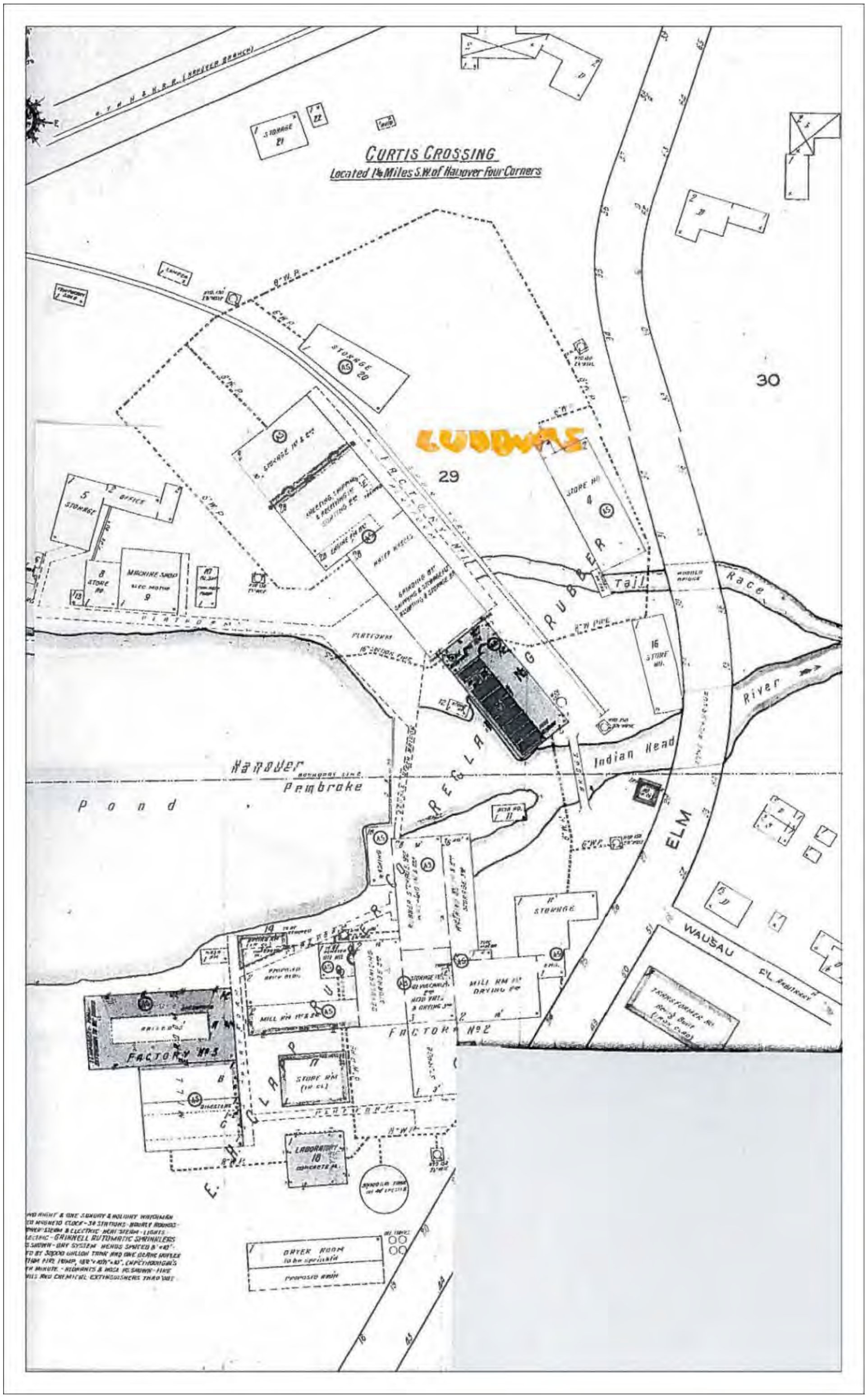


Figure 1. 1917 Sanborn Map of the E. H. Clapp Rubber Company

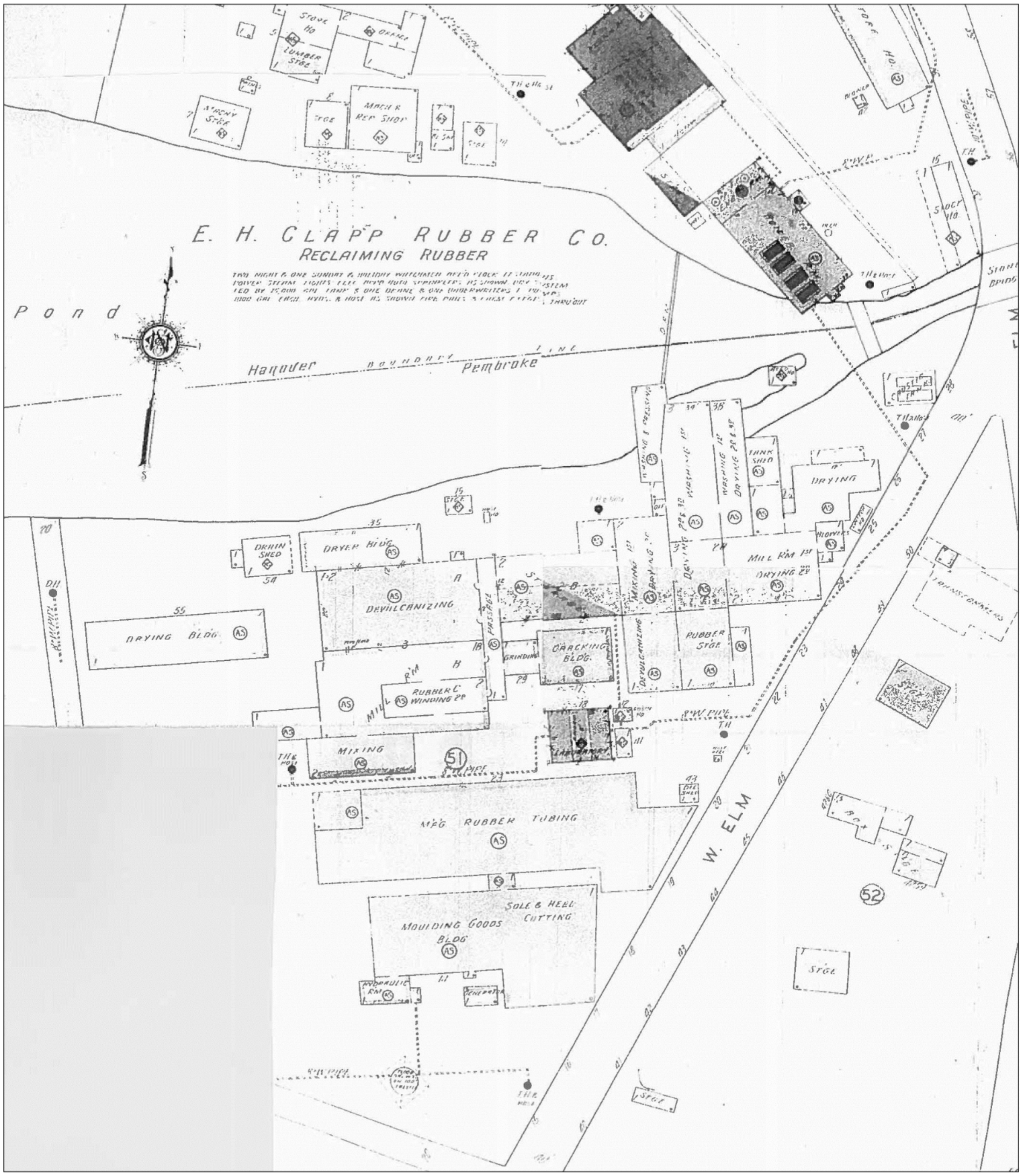


Figure 2. 1931 Sanborn Map of the E. H. Clapp Rubber Company

Figure 3. 1924 Historical Photograph of the E. H. Clapp Rubber Factory. Photograph courtesy: Barker, B. U. and Molyneaux, L.J (2004) Images of American, Hanover.

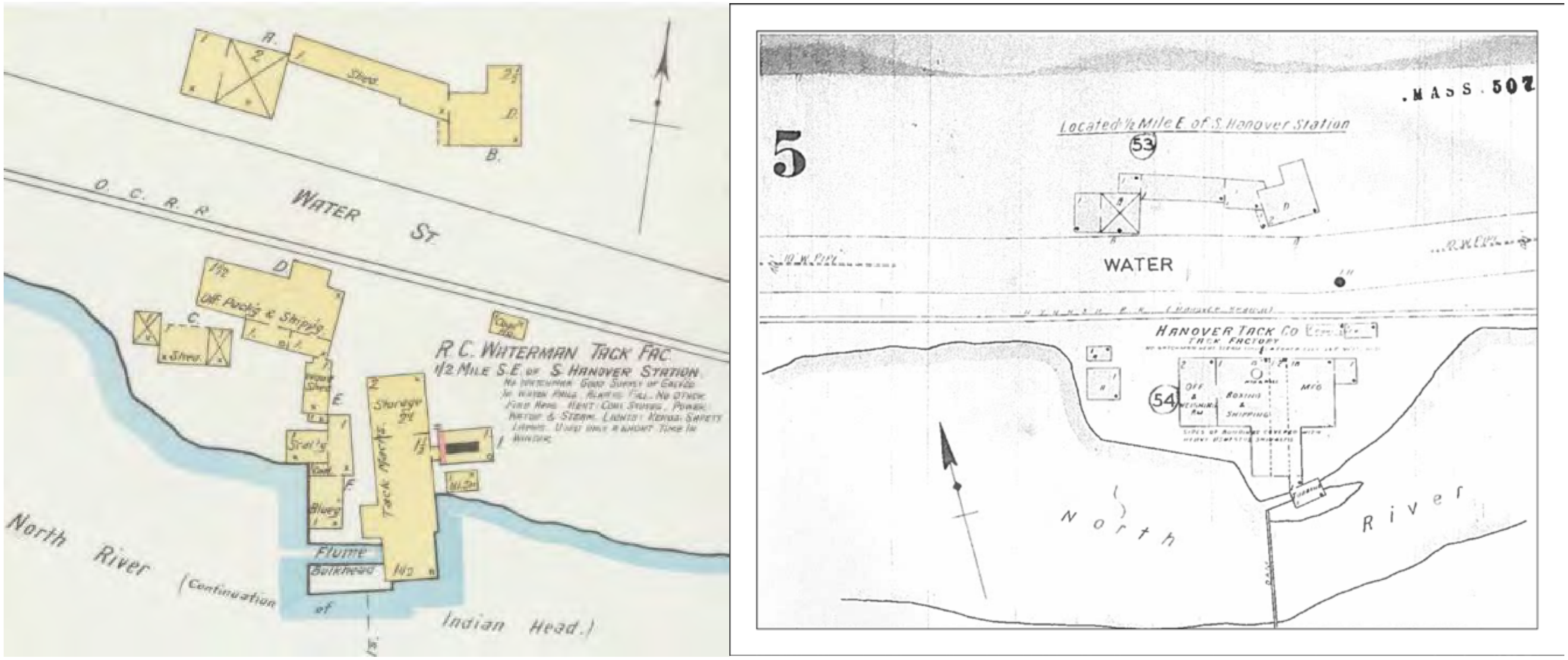


Figure 4. 1896 Sanborn Map of the R.C. Waterman Tack Factory and 1931 Sanborn Map of the Hanover Tack Company (Same Location)

Figure 5. Historical Photograph of the Hanover Tack Company (a.k.a the R. C. Waterman Tack Factory). Photograph Courtesy: Barker, B. U. and Molyneaux, L.J (2004) Images of American, Hanover.

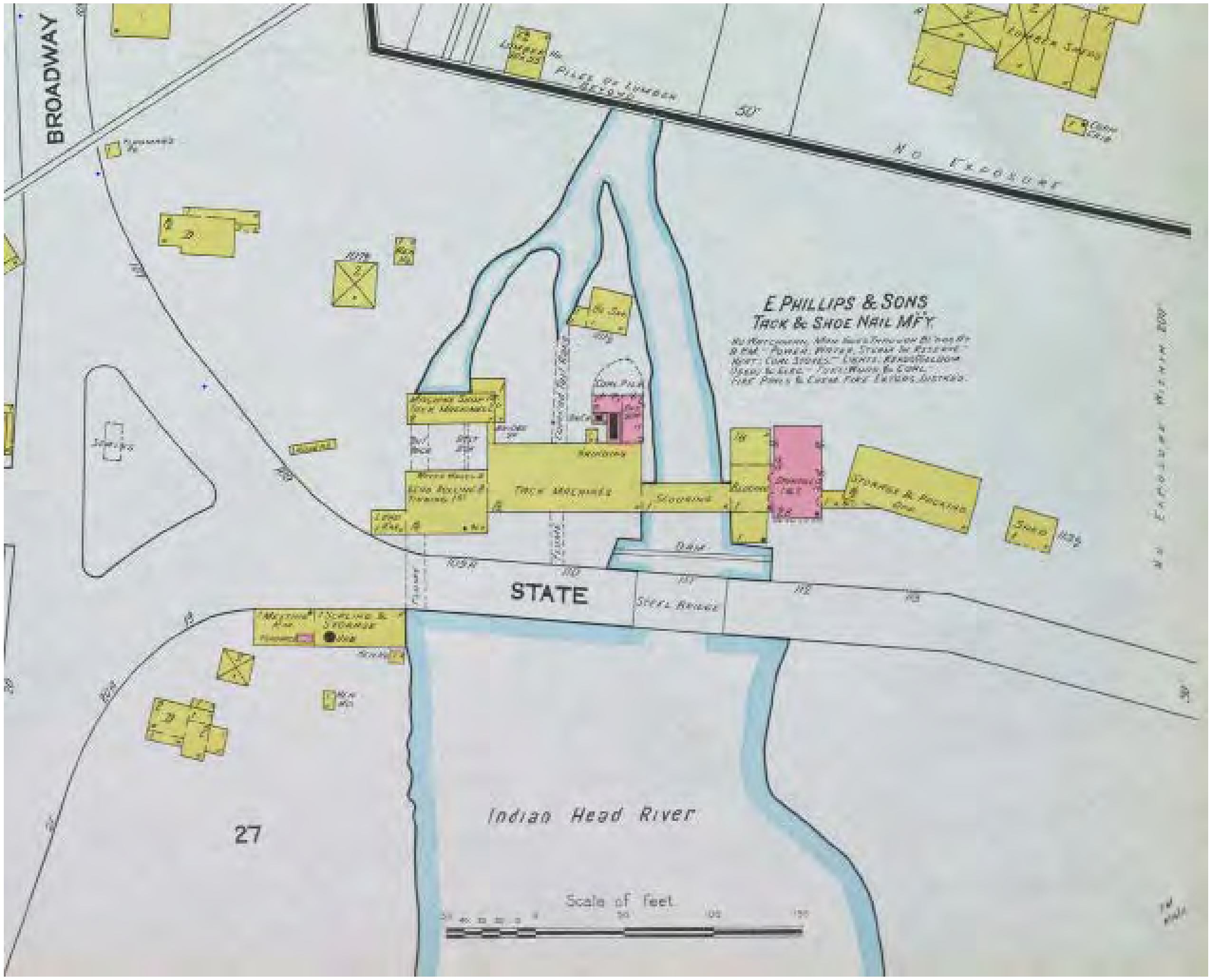


Figure 6. 1912 Sanborn Map of the E. Phillips & Sons Tack & Shoe Nail Manufacturers

Figure 7. 1931 Sanborn Map of the Joseph D. Corcoran Finishing Rubber Goods Building and the Diamond Tack and Nails Works

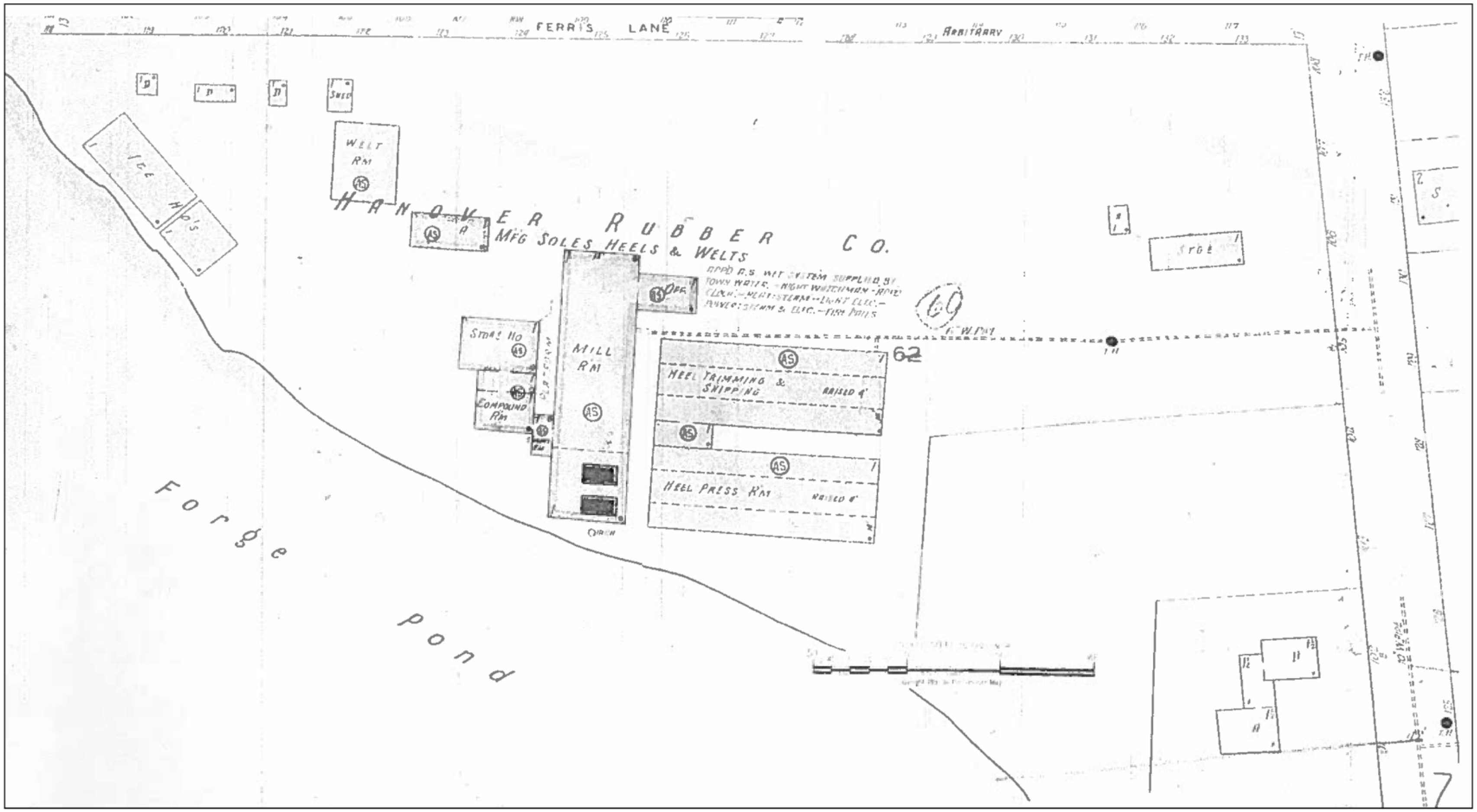


Figure 8. 1931 Sanborn Map of the Hanover Rubber Company

Figure 9. Historical Photograph of the E. H. Clapp Rubber Company. Photograph courtesy: Barker, B. U. and Molyneaux, L.J (2004) Images of American, Hanover. [Note: The Fireworks Site and upstream direction is to the right in this photograph.]

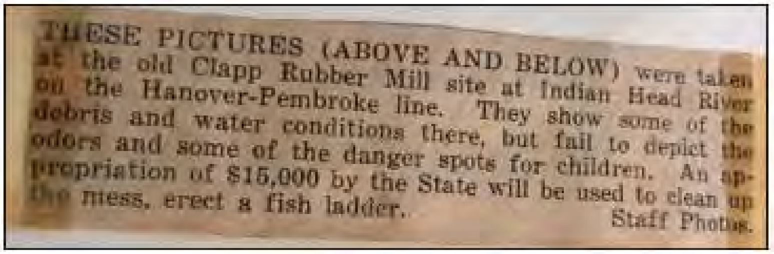
Figure 10. E. H. Clapp Pipeline. Photograph Courtesy: Hanover Historical Society.

Figure 11. The E. H. Clapp Rubber Company Float in a 1912 Parade. Photograph courtesy: Barker, B. U. and Molyneaux, L.J (2004) Images of American, Hanover.

Figure 12. Aftermath of Second Fire at the E. H. Clapp Rubber Factory. Photograph Courtesy: Hanover Historical Society.

Figure 13. Aftermath of Second Fire at the E. H. Clapp Rubber Factory Cont. Photograph Courtesy: Hanover Historical Society.

Figure 14. Apparent Rubber Pit Located Along the Indian Head River Just Downstream of the E. H. Clapp Rubber Factory.



THESE PICTURES (ABOVE AND BELOW) were taken at the old Clapp Rubber Mill site at Indian Head River on the Hanover-Pembroke line. They show some of the debris and water conditions there, but fail to depict the odors and some of the danger spots for children. An appropriation of $15,000 by the State will be used to clean up the mess, erect a fish ladder.

Staff Photos.

Figure 15. Newspaper Clipping Regarding Debris in the Indian Head River from the E. H. Clapp Rubber Company (date unknown). Photograph Courtesy: Hanover Historical Society.

APPENDIX 3G

Low-Flow Data Sheet for Monitoring Well DP-MW1

TETRA TECH

Low-Flow Data Sheet

Page 1 of 1

Project Name: Fireworks

Project No.: 106-4383

Well I.D.: DP-MW1

Date: 10/22/2015

Sample I.D.: DP-MW1 + DP-MW1-DUP

Well Depth (from T.I.C.) = 14.58 ft.

Well Diameter (in) = 2 in.

Sample Time: 1302

Static Water Level (from T.I.C) = 8.96 ft.

Pump Depth (ft) = approx. 12

TetraTech Samplers: T. Armes, A-Vall

Pump Start Time: 1220

Pump Type: perp.

		± 0.1	± 3%	± 10	±10	±10				
Time:	**Temp. (°~~F~~C)**	**pH (SU)**	**Spec. Conduct (mS/cm)**	**Turbidity (NTUs)**	**D.O. (mg/L)**	**ORP (mV)**	**Flow Rate (ml/min)**	**Static Water Level**	**Color**	**Comments**
1224	18.05	5.58	0.024	6.5	7.52	334	300	9.06	—	
1229	16.61	5.76	0.024	1.9	7.24	366		9.09	—	
1234	15.70	5.84	0.024	0.0	7.06	365	400	9.11	—	
1239	15.44	5.83	0.024	0.0	7.15	354		7.11	—	
1244	15.37	5.83	0.024	0.0	8.08	348		9.11		
1249	15.30	5.82	0.024	0.0	8.15	342		9.11		
1254	15.29	5.85	0.024	0.0	8.17	337		9.11		
1259	15.29	5.84	0.024	0.0	8.13	335		9.11		
	±10%	±0.1	±3%	±10%	±10%	±10mV				Total Volume Removed:

APPENDIX 3H

Low-Flow Data Sheet for Monitoring Well MW-B41

TETRA TECH

Low-Flow Data Sheet

Page ____ of ____

Project Name: Fireworks
Project No.: 106-4383
Well I.D.: MW-84
Date: 10/23/2015
Sample I.D.: GW-MW-84
Well Depth (from T.I.C.) = 23.39 ft.
Well Diameter (in) = 2"
Sample Time: 1100
Static Water Level (from T.I.C) = 5.49 ft.
Pump Depth (ft) = ~20' bgs.
TetraTech Samplers: A. Jay
Pump Start Time: 10.01
Pump Type: Peristaltic

		± 0.1	± 3%	± 10	±10	±10				
Time:	Temp. (°F)	pH (SU)	Spec. Conduct (mS/cm)	Turbidity (NTUs)	D.O. (mg/L)	ORP (mV)	Flow Rate (ml/min)	Static Water Level	Color	Comments
1002	12.25	6.40	0.554	107	8.46	65	250	~~[illegible]~~ 5.60	CLEAR	
1007	12.14	6.37	0.557	81.1	3.90	26	150	5.80	CLEAR.	
1012.	12.21	6.29	0.548	65.3	3.06	28	100	5.90	CLEAR	
1017	12.18	6.21	0.540	44.2	2.44	35	100	5.92	CLEAR.	
1022	12.11	6.17	0.536	31.2	2.16	37	100	5.94	" "	
1027	12.05	6.16	0.532	25.7	1.93	36	100	5.96	" "	
1032	12.00	6.13	0.529	21.8	1.50	36	100	5.98	CLEAR.	
1037	12.05	6.06	0.516	14.1	1.04	46	100	6.00	CLEAR	
1042	12.09	6.12	0.526	18.7	0.86	37	100	6.02	CLEAR.	
1047	12.05	6.09	0.518	8.9	0.78	40	100	6.04	CLEAR	
1052	12.05	6.08	0.516	5.7	0.75	40	100	6.06	CLEAR	
1057	12.06	6.07	0.516	5.4	0.76	40	100	6.08	CLEAR	
	±10%	±0.1	±3%	±10%	±10%	±10mV				Total Volume Removed: ______

APPENDIX 4A

Waste Characterization Results

ECC SOIL DRUM - COMPOSITE OF ECC UPPER BANK OVERFLOW AREA, MIDDLE BANK OVERFLOW AREA AND LOWER BANK OVERFLOW AREA

Sample A - ECC Upper Bank Overflow Area

Detections/Values

Area	Location	SampleID	Sample Date	Hold date	SampleType	Matrix	Dilution Factor	% Solids	Analyte	value	Unit	High Limit	Lab Job ID
Upper North Area	ECC Upper Bank Overflow Area	SO-ECCU-WD	10/15/2015	12-Nov-15	G	SO	1		Heptachlor epoxide	0.00020 U	mg/L	0.00020	200-30316-1
Upper North Area	ECC Upper Bank Overflow Area	SO-ECCU-WD	10/15/2015	12-Nov-15	G	SO	1		Pentachlorophenol	0.010 U	mg/L	0.010	200-30316-1
Upper North Area	ECC Upper Bank Overflow Area	SO-ECCU-WD	10/15/2015	12-Nov-15	G	SO	1		Pyridine	0.0030 J B	mg/L	0.025	200-30316-1
Upper North Area	ECC Upper Bank Overflow Area	SO-ECCU-WD	10/15/2015	12-Nov-15	G	SO	1	63.2	Cyanide, Total	0.96 J *	mg/Kg	1.4	200-30316-1
Upper North Area	ECC Upper Bank Overflow Area	SO-ECCU-WD	10/15/2015	12-Nov-15	G	SO	1		Sulfide, Reactive	10 U	mg/Kg	10	200-30316-1
Upper North Area	ECC Upper Bank Overflow Area	SO-ECCU-WD	10/15/2015	12-Nov-15	G	SO	1		pH	5.62 HF	SU	0.100	200-30316-1
Upper North Area	ECC Upper Bank Overflow Area	SO-ECCU-WD	10/15/2015	12-Nov-15	G	SO	1		Nitrobenzene	0.0050 U	mg/L	0.0050	200-30316-1
Upper North Area	ECC Upper Bank Overflow Area	SO-ECCU-WD	10/15/2015	12-Nov-15	G	SO	1		3-Methylphenol	0.010 U	mg/L	0.010	200-30316-1
Upper North Area	ECC Upper Bank Overflow Area	SO-ECCU-WD	10/15/2015	12-Nov-15	G	SO	1		Selenium	0.025 U	mg/L	0.025	200-30316-1
Upper North Area	ECC Upper Bank Overflow Area	SO-ECCU-WD	10/15/2015	12-Nov-15	G	SO	1		Arsenic	0.015 U	mg/L	0.015	200-30316-1
Upper North Area	ECC Upper Bank Overflow Area	SO-ECCU-WD	10/15/2015	12-Nov-15	G	SO	1		Barium	6.3	mg/L	1.0	200-30316-1
Upper North Area	ECC Upper Bank Overflow Area	SO-ECCU-WD	10/15/2015	12-Nov-15	G	SO	1		Free Liquid	pass	mL/100g		200-30316-1
Upper North Area	ECC Upper Bank Overflow Area	SO-ECCU-WD	10/15/2015	12-Nov-15	G	SO	1		Hexachloroethane	0.0050 U	mg/L	0.0050	200-30316-1
Upper North Area	ECC Upper Bank Overflow Area	SO-ECCU-WD	10/15/2015	12-Nov-15	G	SO	1		Cadmium	0.011	mg/L	0.0020	200-30316-1
Upper North Area	ECC Upper Bank Overflow Area	SO-ECCU-WD	10/15/2015	12-Nov-15	G	SO	10		Carbon tetrachloride	0.010 U	mg/L	0.010	200-30316-1
Upper North Area	ECC Upper Bank Overflow Area	SO-ECCU-WD	10/15/2015	12-Nov-15	G	SO	1		4-Methylphenol	0.010 U	mg/L	0.010	200-30316-1
Upper North Area	ECC Upper Bank Overflow Area	SO-ECCU-WD	10/15/2015	12-Nov-15	G	SO	1		2,4-Dinitrotoluene	0.0050 U	mg/L	0.0050	200-30316-1
Upper North Area	ECC Upper Bank Overflow Area	SO-ECCU-WD	10/15/2015	12-Nov-15	G	SO	1		2,4,6-Trichlorophenol	0.0050 U	mg/L	0.0050	200-30316-1
Upper North Area	ECC Upper Bank Overflow Area	SO-ECCU-WD	10/15/2015	12-Nov-15	G	SO	1		2,4,5-Trichlorophenol	0.0050 U	mg/L	0.0050	200-30316-1
Upper North Area	ECC Upper Bank Overflow Area	SO-ECCU-WD	10/15/2015	12-Nov-15	G	SO	1		1,4-Dichlorobenzene	0.010 U	mg/L	0.010	200-30316-1
Upper North Area	ECC Upper Bank Overflow Area	SO-ECCU-WD	10/15/2015	12-Nov-15	G	SO	10		Vinyl chloride	0.010 U	mg/L	0.010	200-30316-1
Upper North Area	ECC Upper Bank Overflow Area	SO-ECCU-WD	10/15/2015	12-Nov-15	G	SO	10		Trichloroethene	0.010 U	mg/L	0.010	200-30316-1
Upper North Area	ECC Upper Bank Overflow Area	SO-ECCU-WD	10/15/2015	12-Nov-15	G	SO	10		Tetrachloroethene	0.010 U	mg/L	0.010	200-30316-1
Upper North Area	ECC Upper Bank Overflow Area	SO-ECCU-WD	10/15/2015	12-Nov-15	G	SO	1		Hexachlorobenzene	0.0050 U	mg/L	0.0050	200-30316-1
Upper North Area	ECC Upper Bank Overflow Area	SO-ECCU-WD	10/15/2015	12-Nov-15	G	SO	1		Hexachlorobutadiene	0.0050 U	mg/L	0.0050	200-30316-1
Upper North Area	ECC Upper Bank Overflow Area	SO-ECCU-WD	10/15/2015	12-Nov-15	G	SO	1		Flashpoint	>176.0	Degrees F	50.0	200-30316-1
Upper North Area	ECC Upper Bank Overflow Area	SO-ECCU-WD	10/15/2015	12-Nov-15	G	SO	1		2-Methylphenol	0.0050 U	mg/L	0.0050	200-30316-1

Upper North Area	ECC Upper Bank Overflow Area	SO-ECCU-WD	10/15/2015	12-Nov-15	G	SO	1		Chromium	0.020 U	mg/L	0.020	200-30316-1
Upper North Area	ECC Upper Bank Overflow Area	SO-ECCU-WD	10/15/2015	12-Nov-15	G	SO	1		gamma-BHC (Lindane)	0.00020 U	mg/L	0.00020	200-30316-1
Upper North Area	ECC Upper Bank Overflow Area	SO-ECCU-WD	10/15/2015	12-Nov-15	G	SO	10		Benzene	0.010 U	mg/L	0.010	200-30316-1
Upper North Area	ECC Upper Bank Overflow Area	SO-ECCU-WD	10/15/2015	12-Nov-15	G	SO	10		2-Butanone (MEK)	0.050 U	mg/L	0.050	200-30316-1
Upper North Area	ECC Upper Bank Overflow Area	SO-ECCU-WD	10/15/2015	12-Nov-15	G	SO	10		1,2-Dichloroethane	0.010 U	mg/L	0.010	200-30316-1
Upper North Area	ECC Upper Bank Overflow Area	SO-ECCU-WD	10/15/2015	12-Nov-15	G	SO	10		1,1-Dichloroethene	0.010 U	mg/L	0.010	200-30316-1
Upper North Area	ECC Upper Bank Overflow Area	SO-ECCU-WD	10/15/2015	12-Nov-15	G	SO	1		Silvex (2,4,5-TP)	0.0020 U	mg/L	0.0020	200-30316-1
Upper North Area	ECC Upper Bank Overflow Area	SO-ECCU-WD	10/15/2015	12-Nov-15	G	SO	1		2,4-D	0.0020 U	mg/L	0.0020	200-30316-1
Upper North Area	ECC Upper Bank Overflow Area	SO-ECCU-WD	10/15/2015	12-Nov-15	G	SO	1		Silver	0.0060 U	mg/L	0.0060	200-30316-1
Upper North Area	ECC Upper Bank Overflow Area	SO-ECCU-WD	10/15/2015	12-Nov-15	G	SO	1		Methoxychlor	0.00020 U	mg/L	0.00020	200-30316-1
Upper North Area	ECC Upper Bank Overflow Area	SO-ECCU-WD	10/15/2015	12-Nov-15	G	SO	10		Chlorobenzene	0.010 U	mg/L	0.010	200-30316-1
Upper North Area	ECC Upper Bank Overflow Area	SO-ECCU-WD	10/15/2015	12-Nov-15	G	SO	1		Heptachlor	0.00020 U	mg/L	0.00020	200-30316-1
Upper North Area	ECC Upper Bank Overflow Area	SO-ECCU-WD	10/15/2015	12-Nov-15	G	SO	1		Lead	0.030	mg/L	0.020	200-30316-1
Upper North Area	ECC Upper Bank Overflow Area	SO-ECCU-WD	10/15/2015	12-Nov-15	G	SO	1		Toxaphene	0.0020 U	mg/L	0.0020	200-30316-1
Upper North Area	ECC Upper Bank Overflow Area	SO-ECCU-WD	10/15/2015	12-Nov-15	G	SO	10		Chloroform	0.010 U	mg/L	0.010	200-30316-1
Upper North Area	ECC Upper Bank Overflow Area	SO-ECCU-WD	10/15/2015	12-Nov-15	G	SO	1		Endrin	0.00020 U	mg/L	0.00020	200-30316-1
Upper North Area	ECC Upper Bank Overflow Area	SO-ECCU-WD	10/15/2015	12-Nov-15	G	SO	1		Chlordane (technical)	0.0020 U	mg/L	0.0020	200-30316-1
Upper North Area	ECC Upper Bank Overflow Area	SO-ECCU-WD	10/15/2015	12-Nov-15	G	SO	1		Mercury	0.00032	mg/L	0.00020	200-30316-1

Sample B - ECC Middle Bank Overflow Area

Detections/Values

Area	Location	SampleID	SampleDate	Hold date	SampleType	Matrix	Dilution Factor	% Solids	Analyte	value	Unit	High Limit	Lab Job ID
Upper North Area	ECC Middle Bank Overflow Area	SO-ECCM-WD	10/20/2015	17-Nov-15	G	SO	1		Pyridine	0.00070 J B	mg/L	0.025	200-30385-1
Upper North Area	ECC Middle Bank Overflow Area	SO-ECCM-WD	10/20/2015	17-Nov-15	G	SO	1		Hexachloroethane	0.0050 U	mg/L	0.0050	200-30385-1
Upper North Area	ECC Middle Bank Overflow Area	SO-ECCM-WD	10/20/2015	17-Nov-15	G	SO	1		Chromium	0.020 U	mg/L	0.020	200-30385-1
Upper North Area	ECC Middle Bank Overflow Area	SO-ECCM-WD	10/20/2015	17-Nov-15	G	SO	1		Pentachlorophenol	0.010 U	mg/L	0.010	200-30385-1
Upper North Area	ECC Middle Bank Overflow Area	SO-ECCM-WD	10/20/2015	17-Nov-15	G	SO	1	48.4	Cyanide, Total	1.9 U	mg/Kg	1.9	200-30385-1
Upper North Area	ECC Middle Bank Overflow Area	SO-ECCM-WD	10/20/2015	17-Nov-15	G	SO	1		pH	5.76 HF	SU	0.100	200-30385-1
Upper North Area	ECC Middle Bank Overflow Area	SO-ECCM-WD	10/20/2015	17-Nov-15	G	SO	1		Silvex (2,4,5-TP)	0.0020 U	mg/L	0.0020	200-30385-1
Upper North Area	ECC Middle Bank Overflow Area	SO-ECCM-WD	10/20/2015	17-Nov-15	G	SO	1		Methoxychlor	0.00020 U	mg/L	0.00020	200-30385-1
Upper North Area	ECC Middle Bank Overflow Area	SO-ECCM-WD	10/20/2015	17-Nov-15	G	SO	1		Barium	0.32 J	mg/L	1.0	200-30385-1

Upper North Area	ECC Middle Bank Overflow Area	SO-ECCM-WD	10/20/2015	17-Nov-15	G	SO	1	Heptachlor epoxide	0.00020 U	mg/L	0.00020	200-30385-1
Upper North Area	ECC Middle Bank Overflow Area	SO-ECCM-WD	10/20/2015	17-Nov-15	G	SO	1	Hexachlorobenzene	0.0050 U	mg/L	0.0050	200-30385-1
Upper North Area	ECC Middle Bank Overflow Area	SO-ECCM-WD	10/20/2015	17-Nov-15	G	SO	1	4-Methylphenol	0.010 U	mg/L	0.010	200-30385-1
Upper North Area	ECC Middle Bank Overflow Area	SO-ECCM-WD	10/20/2015	17-Nov-15	G	SO	1	3-Methylphenol	0.010 U	mg/L	0.010	200-30385-1
Upper North Area	ECC Middle Bank Overflow Area	SO-ECCM-WD	10/20/2015	17-Nov-15	G	SO	1	2-Methylphenol	0.0050 U	mg/L	0.0050	200-30385-1
Upper North Area	ECC Middle Bank Overflow Area	SO-ECCM-WD	10/20/2015	17-Nov-15	G	SO	1	2,4,6-Trichlorophenol	0.0050 U	mg/L	0.0050	200-30385-1
Upper North Area	ECC Middle Bank Overflow Area	SO-ECCM-WD	10/20/2015	17-Nov-15	G	SO	1	Nitrobenzene	0.0050 U	mg/L	0.0050	200-30385-1
Upper North Area	ECC Middle Bank Overflow Area	SO-ECCM-WD	10/20/2015	17-Nov-15	G	SO	1	2,4,5-Trichlorophenol	0.0050 U	mg/L	0.0050	200-30385-1
Upper North Area	ECC Middle Bank Overflow Area	SO-ECCM-WD	10/20/2015	17-Nov-15	G	SO	1	Endrin	0.00020 U	mg/L	0.00020	200-30385-1
Upper North Area	ECC Middle Bank Overflow Area	SO-ECCM-WD	10/20/2015	17-Nov-15	G	SO	1	1,4-Dichlorobenzene	0.010 U	mg/L	0.010	200-30385-1
Upper North Area	ECC Middle Bank Overflow Area	SO-ECCM-WD	10/20/2015	17-Nov-15	G	SO	1	Free Liquid	passed	mL/100g		200-30385-1
Upper North Area	ECC Middle Bank Overflow Area	SO-ECCM-WD	10/20/2015	17-Nov-15	G	SO	1	Toxaphene	0.0020 U	mg/L	0.0020	200-30385-1
Upper North Area	ECC Middle Bank Overflow Area	SO-ECCM-WD	10/20/2015	17-Nov-15	G	SO	1	2,4-Dinitrotoluene	0.0050 U	mg/L	0.0050	200-30385-1
Upper North Area	ECC Middle Bank Overflow Area	SO-ECCM-WD	10/20/2015	17-Nov-15	G	SO	10	Tetrachloroethene	0.010 U	mg/L	0.010	200-30385-1
Upper North Area	ECC Middle Bank Overflow Area	SO-ECCM-WD	10/20/2015	17-Nov-15	G	SO	1	Sulfide, Reactive	10 U	mg/Kg	10	200-30385-1
Upper North Area	ECC Middle Bank Overflow Area	SO-ECCM-WD	10/20/2015	17-Nov-15	G	SO	1	Hexachlorobutadiene	0.0050 U	mg/L	0.0050	200-30385-1
Upper North Area	ECC Middle Bank Overflow Area	SO-ECCM-WD	10/20/2015	17-Nov-15	G	SO	10	Benzene	0.010 U	mg/L	0.010	200-30385-1
Upper North Area	ECC Middle Bank Overflow Area	SO-ECCM-WD	10/20/2015	17-Nov-15	G	SO	10	Carbon tetrachloride	0.010 U	mg/L	0.010	200-30385-1
Upper North Area	ECC Middle Bank Overflow Area	SO-ECCM-WD	10/20/2015	17-Nov-15	G	SO	10	Chlorobenzene	0.010 U	mg/L	0.010	200-30385-1
Upper North Area	ECC Middle Bank Overflow Area	SO-ECCM-WD	10/20/2015	17-Nov-15	G	SO	1	Heptachlor	0.00020 U	mg/L	0.00020	200-30385-1
Upper North Area	ECC Middle Bank Overflow Area	SO-ECCM-WD	10/20/2015	17-Nov-15	G	SO	10	2-Butanone (MEK)	0.050 U	mg/L	0.050	200-30385-1
Upper North Area	ECC Middle Bank Overflow Area	SO-ECCM-WD	10/20/2015	17-Nov-15	G	SO	10	Vinyl chloride	0.010 U	mg/L	0.010	200-30385-1
Upper North Area	ECC Middle Bank Overflow Area	SO-ECCM-WD	10/20/2015	17-Nov-15	G	SO	1	Selenium	0.025 U	mg/L	0.025	200-30385-1
Upper North Area	ECC Middle Bank Overflow Area	SO-ECCM-WD	10/20/2015	17-Nov-15	G	SO	10	Trichloroethene	0.0076 J	mg/L	0.010	200-30385-1
Upper North Area	ECC Middle Bank Overflow Area	SO-ECCM-WD	10/20/2015	17-Nov-15	G	SO	10	1,2-Dichloroethane	0.010 U	mg/L	0.010	200-30385-1
Upper North Area	ECC Middle Bank Overflow Area	SO-ECCM-WD	10/20/2015	17-Nov-15	G	SO	1	Chlordane (technical)	0.0020 U	mg/L	0.0020	200-30385-1
Upper North Area	ECC Middle Bank Overflow Area	SO-ECCM-WD	10/20/2015	17-Nov-15	G	SO	1	gamma-BHC (Lindane)	0.00020 U	mg/L	0.00020	200-30385-1
Upper North Area	ECC Middle Bank Overflow Area	SO-ECCM-WD	10/20/2015	17-Nov-15	G	SO	1	Cadmium	0.0019 J	mg/L	0.0020	200-30385-1

Upper North Area	ECC Middle Bank Overflow Area	SO-ECCM-WD	10/20/2015	17-Nov-15	G	SO	1		Silver	0.0060 U	mg/L	0.0060	200-30385-1
Upper North Area	ECC Middle Bank Overflow Area	SO-ECCM-WD	10/20/2015	17-Nov-15	G	SO	1		Flashpoint	>176.0	Degrees F	50.0	200-30385-1
Upper North Area	ECC Middle Bank Overflow Area	SO-ECCM-WD	10/20/2015	17-Nov-15	G	SO	10		Chloroform	0.010 U	mg/L	0.010	200-30385-1
Upper North Area	ECC Middle Bank Overflow Area	SO-ECCM-WD	10/20/2015	17-Nov-15	G	SO	1		Mercury	0.00020 U	mg/L	0.00020	200-30385-1
Upper North Area	ECC Middle Bank Overflow Area	SO-ECCM-WD	10/20/2015	17-Nov-15	G	SO	10		1,1-Dichloroethene	0.010 U	mg/L	0.010	200-30385-1
Upper North Area	ECC Middle Bank Overflow Area	SO-ECCM-WD	10/20/2015	17-Nov-15	G	SO	1		Lead	0.020	mg/L	0.020	200-30385-1
Upper North Area	ECC Middle Bank Overflow Area	SO-ECCM-WD	10/20/2015	17-Nov-15	G	SO	1		Arsenic	0.015 U	mg/L	0.015	200-30385-1
Upper North Area	ECC Middle Bank Overflow Area	SO-ECCM-WD	10/20/2015	17-Nov-15	G	SO	1		2,4-D	0.0020 U	mg/L	0.0020	200-30385-1

Sample C - ECC Lower Bank Overflow Area

Detections/Values

Area	Location	SampleID	SampleDate	Hold date	SampleType	Matrix	Dilution Factor	% Solids	Analyte	value	Unit	High Limit	Lab Job ID
Upper North Area	ECC Lower Bank Overflow Area	SO-ECCL-WD	10/16/2015	13-Nov-15	G	SO	10		Vinyl chloride	0.010 U	mg/L	0.010	200-30316-1
Upper North Area	ECC Lower Bank Overflow Area	SO-ECCL-WD	10/16/2015	13-Nov-15	G	SO	1		Methoxychlor	0.00020 U	mg/L	0.00020	200-30316-1
Upper North Area	ECC Lower Bank Overflow Area	SO-ECCL-WD	10/16/2015	13-Nov-15	G	SO	1		pH	5.24 HF	SU	0.100	200-30316-1
Upper North Area	ECC Lower Bank Overflow Area	SO-ECCL-WD	10/16/2015	13-Nov-15	G	SO	1		Heptachlor epoxide	0.00020 U	mg/L	0.00020	200-30316-1
Upper North Area	ECC Lower Bank Overflow Area	SO-ECCL-WD	10/16/2015	13-Nov-15	G	SO	1		Heptachlor	0.00020 U	mg/L	0.00020	200-30316-1
Upper North Area	ECC Lower Bank Overflow Area	SO-ECCL-WD	10/16/2015	13-Nov-15	G	SO	1		Silver	0.0060 U	mg/L	0.0060	200-30316-1
Upper North Area	ECC Lower Bank Overflow Area	SO-ECCL-WD	10/16/2015	13-Nov-15	G	SO	1		Sulfide, Reactive	10 U	mg/Kg	10	200-30316-1
Upper North Area	ECC Lower Bank Overflow Area	SO-ECCL-WD	10/16/2015	13-Nov-15	G	SO	1		gamma-BHC (Lindane)	0.00020 U	mg/L	0.00020	200-30316-1
Upper North Area	ECC Lower Bank Overflow Area	SO-ECCL-WD	10/16/2015	13-Nov-15	G	SO	1		Endrin	0.00020 U	mg/L	0.00020	200-30316-1
Upper North Area	ECC Lower Bank Overflow Area	SO-ECCL-WD	10/16/2015	13-Nov-15	G	SO	1		Toxaphene	0.0020 U	mg/L	0.0020	200-30316-1
Upper North Area	ECC Lower Bank Overflow Area	SO-ECCL-WD	10/16/2015	13-Nov-15	G	SO	1		Pyridine	0.0017 J B	mg/L	0.025	200-30316-1
Upper North Area	ECC Lower Bank Overflow Area	SO-ECCL-WD	10/16/2015	13-Nov-15	G	SO	10		Tetrachloroethene	0.010 U	mg/L	0.010	200-30316-1
Upper North Area	ECC Lower Bank Overflow Area	SO-ECCL-WD	10/16/2015	13-Nov-15	G	SO	1		Arsenic	0.015 U	mg/L	0.015	200-30316-1
Upper North Area	ECC Lower Bank Overflow Area	SO-ECCL-WD	10/16/2015	13-Nov-15	G	SO	10		Chloroform	0.010 U	mg/L	0.010	200-30316-1
Upper North Area	ECC Lower Bank Overflow Area	SO-ECCL-WD	10/16/2015	13-Nov-15	G	SO	10		Chlorobenzene	0.010 U	mg/L	0.010	200-30316-1
Upper North Area	ECC Lower Bank Overflow Area	SO-ECCL-WD	10/16/2015	13-Nov-15	G	SO	1		Mercury	0.00030	mg/L	0.00020	200-30316-1
Upper North Area	ECC Lower Bank Overflow Area	SO-ECCL-WD	10/16/2015	13-Nov-15	G	SO	10		2-Butanone (MEK)	0.050 U	mg/L	0.050	200-30316-1
Upper North Area	ECC Lower Bank Overflow Area	SO-ECCL-WD	10/16/2015	13-Nov-15	G	SO	1		1,4-Dichlorobenzene	0.010 U	mg/L	0.010	200-30316-1
Upper North Area	ECC Lower Bank Overflow Area	SO-ECCL-WD	10/16/2015	13-Nov-15	G	SO	1		2,4,5-Trichlorophenol	0.0050 U	mg/L	0.0050	200-30316-1

Upper North Area	ECC Lower Bank Overflow Area	SO-ECCL-WD	10/16/2015	13-Nov-15	G	SO	1		Lead	0.023	mg/L	0.020	200-30316-1
Upper North Area	ECC Lower Bank Overflow Area	SO-ECCL-WD	10/16/2015	13-Nov-15	G	SO	1		Chromium	0.020 U	mg/L	0.020	200-30316-1
Upper North Area	ECC Lower Bank Overflow Area	SO-ECCL-WD	10/16/2015	13-Nov-15	G	SO	1		Cadmium	0.0039	mg/L	0.0020	200-30316-1
Upper North Area	ECC Lower Bank Overflow Area	SO-ECCL-WD	10/16/2015	13-Nov-15	G	SO	10		Trichloroethene	0.010 U	mg/L	0.010	200-30316-1
Upper North Area	ECC Lower Bank Overflow Area	SO-ECCL-WD	10/16/2015	13-Nov-15	G	SO	1		Flashpoint	>176.0	Degrees F	50.0	200-30316-1
Upper North Area	ECC Lower Bank Overflow Area	SO-ECCL-WD	10/16/2015	13-Nov-15	G	SO	1	44.7	Cyanide, Total	2.2 U *	mg/Kg	2.2	200-30316-1
Upper North Area	ECC Lower Bank Overflow Area	SO-ECCL-WD	10/16/2015	13-Nov-15	G	SO	1		Selenium	0.025 U	mg/L	0.025	200-30316-1
Upper North Area	ECC Lower Bank Overflow Area	SO-ECCL-WD	10/16/2015	13-Nov-15	G	SO	1		Pentachlorophenol	0.010 U	mg/L	0.010	200-30316-1
Upper North Area	ECC Lower Bank Overflow Area	SO-ECCL-WD	10/16/2015	13-Nov-15	G	SO	1		2-Methylphenol	0.0050 U	mg/L	0.0050	200-30316-1
Upper North Area	ECC Lower Bank Overflow Area	SO-ECCL-WD	10/16/2015	13-Nov-15	G	SO	1		2,4-Dinitrotoluene	0.0050 U	mg/L	0.0050	200-30316-1
Upper North Area	ECC Lower Bank Overflow Area	SO-ECCL-WD	10/16/2015	13-Nov-15	G	SO	1		Hexachloroethane	0.0050 U	mg/L	0.0050	200-30316-1
Upper North Area	ECC Lower Bank Overflow Area	SO-ECCL-WD	10/16/2015	13-Nov-15	G	SO	1		Hexachlorobutadiene	0.0050 U	mg/L	0.0050	200-30316-1
Upper North Area	ECC Lower Bank Overflow Area	SO-ECCL-WD	10/16/2015	13-Nov-15	G	SO	1		Chlordane (technical)	0.0020 U	mg/L	0.0020	200-30316-1
Upper North Area	ECC Lower Bank Overflow Area	SO-ECCL-WD	10/16/2015	13-Nov-15	G	SO	1		Nitrobenzene	0.0050 U	mg/L	0.0050	200-30316-1
Upper North Area	ECC Lower Bank Overflow Area	SO-ECCL-WD	10/16/2015	13-Nov-15	G	SO	1		2,4,6-Trichlorophenol	0.0050 U	mg/L	0.0050	200-30316-1
Upper North Area	ECC Lower Bank Overflow Area	SO-ECCL-WD	10/16/2015	13-Nov-15	G	SO	10		Carbon tetrachloride	0.010 U	mg/L	0.010	200-30316-1
Upper North Area	ECC Lower Bank Overflow Area	SO-ECCL-WD	10/16/2015	13-Nov-15	G	SO	1		Free Liquid	pass	mL/100g		200-30316-1
Upper North Area	ECC Lower Bank Overflow Area	SO-ECCL-WD	10/16/2015	13-Nov-15	G	SO	10		1,2-Dichloroethane	0.010 U	mg/L	0.010	200-30316-1
Upper North Area	ECC Lower Bank Overflow Area	SO-ECCL-WD	10/16/2015	13-Nov-15	G	SO	10		1,1-Dichloroethene	0.010 U	mg/L	0.010	200-30316-1
Upper North Area	ECC Lower Bank Overflow Area	SO-ECCL-WD	10/16/2015	13-Nov-15	G	SO	1		3-Methylphenol	0.010 U	mg/L	0.010	200-30316-1
Upper North Area	ECC Lower Bank Overflow Area	SO-ECCL-WD	10/16/2015	13-Nov-15	G	SO	1		4-Methylphenol	0.010 U	mg/L	0.010	200-30316-1
Upper North Area	ECC Lower Bank Overflow Area	SO-ECCL-WD	10/16/2015	13-Nov-15	G	SO	1		Hexachlorobenzene	0.0050 U	mg/L	0.0050	200-30316-1
Upper North Area	ECC Lower Bank Overflow Area	SO-ECCL-WD	10/16/2015	13-Nov-15	G	SO	1		Silvex (2,4,5-TP)	0.0020 U	mg/L	0.0020	200-30316-1
Upper North Area	ECC Lower Bank Overflow Area	SO-ECCL-WD	10/16/2015	13-Nov-15	G	SO	1		2,4-D	0.0020 U	mg/L	0.0020	200-30316-1
Upper North Area	ECC Lower Bank Overflow Area	SO-ECCL-WD	10/16/2015	13-Nov-15	G	SO	10		Benzene	0.010 U	mg/L	0.010	200-30316-1
Upper North Area	ECC Lower Bank Overflow Area	SO-ECCL-WD	10/16/2015	13-Nov-15	G	SO	1		Barium	0.64 J	mg/L	1.0	200-30316-1

POND SEDIMENT DRUM - COMPOSITE OF LILY/UPPER FACTORY POND AND MIDDLE/LOWER FACTORY POND SEDIMENTS

Sample D - Lily / Upper Factory Pond

Detections/Values

Area	Location	SampleID	Sample Date	Hold date	SampleType	Matrix	Dilution Factor	% Solids	Analyte	value	Unit	High Limit	Lab Job ID

Pond Area	Lily Upper Factory Pond	SD-LUFP-WD	10/8/2015	05-Nov-15	C	SD	10		Carbon tetrachloride	0.010 U	mg/L	0.010	200-30182-1
Pond Area	Lily Upper Factory Pond	SD-LUFP-WD	10/8/2015	05-Nov-15	C	SD	10		Chlorobenzene	0.010 U	mg/L	0.010	200-30182-1
Pond Area	Lily Upper Factory Pond	SD-LUFP-WD	10/8/2015	05-Nov-15	C	SD	10		Benzene	0.010 U	mg/L	0.010	200-30182-1
Pond Area	Lily Upper Factory Pond	SD-LUFP-WD	10/8/2015	05-Nov-15	C	SD	1		Sulfide, Reactive	10	mg/Kg	10	200-30182-1
Pond Area	Lily Upper Factory Pond	SD-LUFP-WD	10/8/2015	05-Nov-15	C	SD	1		pH	6.30 HF	SU	0.100	200-30182-1
Pond Area	Lily Upper Factory Pond	SD-LUFP-WD	10/8/2015	05-Nov-15	C	SD	1		Selenium	0.025 U	mg/L	0.025	200-30182-1
Pond Area	Lily Upper Factory Pond	SD-LUFP-WD	10/8/2015	05-Nov-15	C	SD	1		Lead	0.0044 J	mg/L	0.020	200-30182-1
Pond Area	Lily Upper Factory Pond	SD-LUFP-WD	10/8/2015	05-Nov-15	C	SD	1		Chromium	0.020 U	mg/L	0.020	200-30182-1
Pond Area	Lily Upper Factory Pond	SD-LUFP-WD	10/8/2015	05-Nov-15	C	SD	1		Free Liquid	pass	mL/100g		200-30182-1
Pond Area	Lily Upper Factory Pond	SD-LUFP-WD	10/8/2015	05-Nov-15	C	SD	10		1,2-Dichloroethane	0.010 U	mg/L	0.010	200-30182-1
Pond Area	Lily Upper Factory Pond	SD-LUFP-WD	10/8/2015	05-Nov-15	C	SD	10		2-Butanone (MEK)	0.050 U	mg/L	0.050	200-30182-1
Pond Area	Lily Upper Factory Pond	SD-LUFP-WD	10/8/2015	05-Nov-15	C	SD	10		Tetrachloroethene	0.010 U	mg/L	0.010	200-30182-1
Pond Area	Lily Upper Factory Pond	SD-LUFP-WD	10/8/2015	05-Nov-15	C	SD	1		Cadmium	0.0020 U	mg/L	0.0020	200-30182-1
Pond Area	Lily Upper Factory Pond	SD-LUFP-WD	10/8/2015	05-Nov-15	C	SD	1		Barium	0.21 J	mg/L	1.0	200-30182-1
Pond Area	Lily Upper Factory Pond	SD-LUFP-WD	10/8/2015	05-Nov-15	C	SD	1		Arsenic	0.015 U	mg/L	0.015	200-30182-1
Pond Area	Lily Upper Factory Pond	SD-LUFP-WD	10/8/2015	05-Nov-15	C	SD	1		Silver	0.0060 U	mg/L	0.0060	200-30182-1
Pond Area	Lily Upper Factory Pond	SD-LUFP-WD	10/8/2015	05-Nov-15	C	SD	1	49.1	Cyanide, Total	2.0 U *	mg/Kg	2.0	200-30182-1
Pond Area	Lily Upper Factory Pond	SD-LUFP-WD	10/8/2015	05-Nov-15	C	SD	1		Flashpoint	>176.0	Degrees F	50.0	200-30182-1
Pond Area	Lily Upper Factory Pond	SD-LUFP-WD	10/8/2015	05-Nov-15	C	SD	10		Chloroform	0.010 U	mg/L	0.010	200-30182-1
Pond Area	Lily Upper Factory Pond	SD-LUFP-WD	10/8/2015	05-Nov-15	C	SD	10		Trichloroethene	0.010 U	mg/L	0.010	200-30182-1
Pond Area	Lily Upper Factory Pond	SD-LUFP-WD	10/8/2015	05-Nov-15	C	SD	1		Mercury	0.00020 U	mg/L	0.00020	200-30182-1
Pond Area	Lily Upper Factory Pond	SD-LUFP-WD	10/8/2015	05-Nov-15	C	SD	10		Vinyl chloride	0.010 U	mg/L	0.010	200-30182-1
Pond Area	Lily Upper Factory Pond	SD-LUFP-WD	10/8/2015	05-Nov-15	C	SD	10		1,1-Dichloroethene	0.010 U	mg/L	0.010	200-30182-1

Sample E - Middle / Lower Factory Pond

Detections/Values

Pond Area	Middle Lower Factory Pond	SD-MLFP-WD	10/20/2015	SD-MLFP-WD	17-Nov-15	SD	1		2,4,6-Trichlorophenol	0.0050 U	mg/L	0.0050	200-30342-1
Pond Area	Middle Lower Factory Pond	SD-MLFP-WD	10/20/2015	SD-MLFP-WD	17-Nov-15	SD	1		2,4,5-Trichlorophenol	0.0050 U	mg/L	0.0050	200-30342-1
Pond Area	Middle Lower Factory Pond	SD-MLFP-WD	10/20/2015	SD-MLFP-WD	17-Nov-15	SD	1		1,4-Dichlorobenzene	0.010 U	mg/L	0.010	200-30342-1
Pond Area	Middle Lower Factory Pond	SD-MLFP-WD	10/20/2015	SD-MLFP-WD	17-Nov-15	SD	10		Benzene	0.010 U	mg/L	0.010	200-30342-1
Pond Area	Middle Lower Factory Pond	SD-MLFP-WD	10/20/2015	SD-MLFP-WD	17-Nov-15	SD	10		Trichloroethene	0.010 U	mg/L	0.010	200-30342-1

Pond Area	Middle Lower Factory Pond	SD-MLFP-WD	10/20/2015	SD-MLFP-WD	17-Nov-15	SD	1		Lead	0.0063 J	mg/L	0.020	200-30342-1
Pond Area	Middle Lower Factory Pond	SD-MLFP-WD	10/20/2015	SD-MLFP-WD	17-Nov-15	SD	1		4-Methylphenol	0.010 U	mg/L	0.010	200-30342-1
Pond Area	Middle Lower Factory Pond	SD-MLFP-WD	10/20/2015	SD-MLFP-WD	17-Nov-15	SD	1		2,4-Dinitrotoluene	0.0050 U	mg/L	0.0050	200-30342-1
Pond Area	Middle Lower Factory Pond	SD-MLFP-WD	10/20/2015	SD-MLFP-WD	17-Nov-15	SD	10		Chlorobenzene	0.010 U	mg/L	0.010	200-30342-1
Pond Area	Middle Lower Factory Pond	SD-MLFP-WD	10/20/2015	SD-MLFP-WD	17-Nov-15	SD	1		Flashpoint	>176.0	Degrees F	50.0	200-30342-1
Pond Area	Middle Lower Factory Pond	SD-MLFP-WD	10/20/2015	SD-MLFP-WD	17-Nov-15	SD	10		Chloroform	0.010 U	mg/L	0.010	200-30342-1
Pond Area	Middle Lower Factory Pond	SD-MLFP-WD	10/20/2015	SD-MLFP-WD	17-Nov-15	SD	1		3-Methylphenol	0.010 U	mg/L	0.010	200-30342-1
Pond Area	Middle Lower Factory Pond	SD-MLFP-WD	10/20/2015	SD-MLFP-WD	17-Nov-15	SD	10		Tetrachloroethene	0.010 U	mg/L	0.010	200-30342-1
Pond Area	Middle Lower Factory Pond	SD-MLFP-WD	10/20/2015	SD-MLFP-WD	17-Nov-15	SD	1		Arsenic	0.012 J	mg/L	0.015	200-30342-1
Pond Area	Middle Lower Factory Pond	SD-MLFP-WD	10/20/2015	SD-MLFP-WD	17-Nov-15	SD	1		Hexachlorobutadiene	0.0050 U	mg/L	0.0050	200-30342-1
Pond Area	Middle Lower Factory Pond	SD-MLFP-WD	10/20/2015	SD-MLFP-WD	17-Nov-15	SD	1		Barium	0.27 J	mg/L	1.0	200-30342-1
Pond Area	Middle Lower Factory Pond	SD-MLFP-WD	10/20/2015	SD-MLFP-WD	17-Nov-15	SD	1		Hexachloroethane	0.0050 U	mg/L	0.0050	200-30342-1
Pond Area	Middle Lower Factory Pond	SD-MLFP-WD	10/20/2015	SD-MLFP-WD	17-Nov-15	SD	1		Nitrobenzene	0.0050 U	mg/L	0.0050	200-30342-1
Pond Area	Middle Lower Factory Pond	SD-MLFP-WD	10/20/2015	SD-MLFP-WD	17-Nov-15	SD	1		Pentachlorophenol	0.010 U	mg/L	0.010	200-30342-1
Pond Area	Middle Lower Factory Pond	SD-MLFP-WD	10/20/2015	SD-MLFP-WD	17-Nov-15	SD	1		Pyridine	0.025 U	mg/L	0.025	200-30342-1
Pond Area	Middle Lower Factory Pond	SD-MLFP-WD	10/20/2015	SD-MLFP-WD	17-Nov-15	SD	1		Hexachlorobenzene	0.0050 U	mg/L	0.0050	200-30342-1
Pond Area	Middle Lower Factory Pond	SD-MLFP-WD	10/20/2015	SD-MLFP-WD	17-Nov-15	SD	1		Endrin	0.00020 U	mg/L	0.00020	200-30342-1
Pond Area	Middle Lower Factory Pond	SD-MLFP-WD	10/20/2015	SD-MLFP-WD	17-Nov-15	SD	1	39.5	Cyanide, Total	2.5 U	mg/Kg	2.5	200-30342-1
Pond Area	Middle Lower Factory Pond	SD-MLFP-WD	10/20/2015	SD-MLFP-WD	17-Nov-15	SD	1		2-Methylphenol	0.0050 U	mg/L	0.0050	200-30342-1
Pond Area	Middle Lower Factory Pond	SD-MLFP-WD	10/20/2015	SD-MLFP-WD	17-Nov-15	SD	1		Heptachlor epoxide	0.00020 U	mg/L	0.00020	200-30342-1
Pond Area	Middle Lower Factory Pond	SD-MLFP-WD	10/20/2015	SD-MLFP-WD	17-Nov-15	SD	1		Selenium	0.025 U	mg/L	0.025	200-30342-1
Pond Area	Middle Lower Factory Pond	SD-MLFP-WD	10/20/2015	SD-MLFP-WD	17-Nov-15	SD	1		Cadmium	0.0020 U	mg/L	0.0020	200-30342-1
Pond Area	Middle Lower Factory Pond	SD-MLFP-WD	10/20/2015	SD-MLFP-WD	17-Nov-15	SD	1		Chlordane (technical)	0.0020 U	mg/L	0.0020	200-30342-1
Pond Area	Middle Lower Factory Pond	SD-MLFP-WD	10/20/2015	SD-MLFP-WD	17-Nov-15	SD	1		Chromium	0.020 U	mg/L	0.020	200-30342-1
Pond Area	Middle Lower Factory Pond	SD-MLFP-WD	10/20/2015	SD-MLFP-WD	17-Nov-15	SD	10		Vinyl chloride	0.010 U	mg/L	0.010	200-30342-1
Pond Area	Middle Lower Factory Pond	SD-MLFP-WD	10/20/2015	SD-MLFP-WD	17-Nov-15	SD	1		Heptachlor	0.00020 U	mg/L	0.00020	200-30342-1
Pond Area	Middle Lower Factory Pond	SD-MLFP-WD	10/20/2015	SD-MLFP-WD	17-Nov-15	SD	1		Methoxychlor	0.00020 U	mg/L	0.00020	200-30342-1
Pond Area	Middle Lower Factory Pond	SD-MLFP-WD	10/20/2015	SD-MLFP-WD	17-Nov-15	SD	1		Toxaphene	0.0020 U	mg/L	0.0020	200-30342-1

Pond Area	Middle Lower Factory Pond	SD-MLFP-WD	10/20/2015	SD-MLFP-WD	17-Nov-15	SD	1		Free Liquid	passed	mL/100g		200-30342-1
Pond Area	Middle Lower Factory Pond	SD-MLFP-WD	10/20/2015	SD-MLFP-WD	17-Nov-15	SD	1		Silver	0.0060 U	mg/L	0.0060	200-30342-1
Pond Area	Middle Lower Factory Pond	SD-MLFP-WD	10/20/2015	SD-MLFP-WD	17-Nov-15	SD	1		2,4-D	0.0020 U	mg/L	0.0020	200-30342-1
Pond Area	Middle Lower Factory Pond	SD-MLFP-WD	10/20/2015	SD-MLFP-WD	17-Nov-15	SD	1		Sulfide, Reactive	10 U	mg/Kg	10	200-30342-1
Pond Area	Middle Lower Factory Pond	SD-MLFP-WD	10/20/2015	SD-MLFP-WD	17-Nov-15	SD	1		pH	6.14 HF	SU	0.100	200-30342-1
Pond Area	Middle Lower Factory Pond	SD-MLFP-WD	10/20/2015	SD-MLFP-WD	17-Nov-15	SD	10		1,1-Dichloroethene	0.010 U	mg/L	0.010	200-30342-1
Pond Area	Middle Lower Factory Pond	SD-MLFP-WD	10/20/2015	SD-MLFP-WD	17-Nov-15	SD	10		1,2-Dichloroethane	0.010 U	mg/L	0.010	200-30342-1
Pond Area	Middle Lower Factory Pond	SD-MLFP-WD	10/20/2015	SD-MLFP-WD	17-Nov-15	SD	1		Silvex (2,4,5-TP)	0.0020 U	mg/L	0.0020	200-30342-1
Pond Area	Middle Lower Factory Pond	SD-MLFP-WD	10/20/2015	SD-MLFP-WD	17-Nov-15	SD	10		Carbon tetrachloride	0.010 U	mg/L	0.010	200-30342-1
Pond Area	Middle Lower Factory Pond	SD-MLFP-WD	10/20/2015	SD-MLFP-WD	17-Nov-15	SD	1		gamma-BHC (Lindane)	0.00020 U	mg/L	0.00020	200-30342-1
Pond Area	Middle Lower Factory Pond	SD-MLFP-WD	10/20/2015	SD-MLFP-WD	17-Nov-15	SD	10		2-Butanone (MEK)	0.050 U	mg/L	0.050	200-30342-1

RANGE BERM SOIL DRUM

Sample F - Test Range Berm

Detections/Values

Area	Location	SampleID	Sample Date	Hold date	SampleType	Matrix	Dilution Factor	% Solids	Analyte	value	Unit	High Limit	Lab Job ID
Southern Conservation Commission Area	Test Range Berm	BERM-ISM-WD	10/13/2015	10-Nov-15	C	SO	1		2,4,6-Trichlorophenol	0.0050 U	mg/L	0.0050	200-30316-1
Southern Conservation Commission Area	Test Range Berm	BERM-ISM-WD	10/13/2015	10-Nov-15	C	SO	10		Trichloroethene	0.010 U	mg/L	0.010	200-30316-1
Southern Conservation Commission Area	Test Range Berm	BERM-ISM-WD	10/13/2015	10-Nov-15	C	SO	1		Hexachloroethane	0.0050 U	mg/L	0.0050	200-30316-1
Southern Conservation Commission Area	Test Range Berm	BERM-ISM-WD	10/13/2015	10-Nov-15	C	SO	1		Nitrobenzene	0.0050 U	mg/L	0.0050	200-30316-1
Southern Conservation Commission Area	Test Range Berm	BERM-ISM-WD	10/13/2015	10-Nov-15	C	SO	10		2-Butanone (MEK)	0.050 U	mg/L	0.050	200-30316-1
Southern Conservation Commission Area	Test Range Berm	BERM-ISM-WD	10/13/2015	10-Nov-15	C	SO	1		Pyridine	0.0012 J B	mg/L	0.025	200-30316-1
Southern Conservation Commission Area	Test Range Berm	BERM-ISM-WD	10/13/2015	10-Nov-15	C	SO	1		2,4,5-Trichlorophenol	0.0050 U	mg/L	0.0050	200-30316-1

Southern Conservation Commission Area	Test Range Berm	BERM-ISM-WD	10/13/2015	10-Nov-15	C	SO	1	Lead	2.2	mg/L	0.020	200-30316-1
Southern Conservation Commission Area	Test Range Berm	BERM-ISM-WD	10/13/2015	10-Nov-15	C	SO	10	Carbon tetrachloride	0.010 U	mg/L	0.010	200-30316-1
Southern Conservation Commission Area	Test Range Berm	BERM-ISM-WD	10/13/2015	10-Nov-15	C	SO	10	Chlorobenzene	0.010 U	mg/L	0.010	200-30316-1
Southern Conservation Commission Area	Test Range Berm	BERM-ISM-WD	10/13/2015	10-Nov-15	C	SO	10	Chloroform	0.010 U	mg/L	0.010	200-30316-1
Southern Conservation Commission Area	Test Range Berm	BERM-ISM-WD	10/13/2015	10-Nov-15	C	SO	1	Hexachlorobutadiene	0.0050 U	mg/L	0.0050	200-30316-1
Southern Conservation Commission Area	Test Range Berm	BERM-ISM-WD	10/13/2015	10-Nov-15	C	SO	10	Tetrachloroethene	0.010 U	mg/L	0.010	200-30316-1
Southern Conservation Commission Area	Test Range Berm	BERM-ISM-WD	10/13/2015	10-Nov-15	C	SO	1	2,4-D	0.0020 U	mg/L	0.0020	200-30316-1
Southern Conservation Commission Area	Test Range Berm	BERM-ISM-WD	10/13/2015	10-Nov-15	C	SO	1	Silver	0.0060 U	mg/L	0.0060	200-30316-1
Southern Conservation Commission Area	Test Range Berm	BERM-ISM-WD	10/13/2015	10-Nov-15	C	SO	10	Benzene	0.010 U	mg/L	0.010	200-30316-1
Southern Conservation Commission Area	Test Range Berm	BERM-ISM-WD	10/13/2015	10-Nov-15	C	SO	10	Vinyl chloride	0.010 U	mg/L	0.010	200-30316-1
Southern Conservation Commission Area	Test Range Berm	BERM-ISM-WD	10/13/2015	10-Nov-15	C	SO	1	Flashpoint	>176.0	Degrees F	50.0	200-30316-1
Southern Conservation Commission Area	Test Range Berm	BERM-ISM-WD	10/13/2015	10-Nov-15	C	SO	10	1,2-Dichloroethane	0.010 U	mg/L	0.010	200-30316-1
Southern Conservation Commission Area	Test Range Berm	BERM-ISM-WD	10/13/2015	10-Nov-15	C	SO	1	Arsenic	0.0087 J	mg/L	0.015	200-30316-1
Southern Conservation Commission Area	Test Range Berm	BERM-ISM-WD	10/13/2015	10-Nov-15	C	SO	1	Barium	0.39 J	mg/L	1.0	200-30316-1

Southern Conservation Commission Area	Test Range Berm	BERM-ISM-WD	10/13/2015	10-Nov-15	C	SO	1	Cadmium	0.0025	mg/L	0.0020	200-30316-1
Southern Conservation Commission Area	Test Range Berm	BERM-ISM-WD	10/13/2015	10-Nov-15	C	SO	1	1,4-Dichlorobenzene	0.010 U	mg/L	0.010	200-30316-1
Southern Conservation Commission Area	Test Range Berm	BERM-ISM-WD	10/13/2015	10-Nov-15	C	SO	1	Chromium	0.020 U	mg/L	0.020	200-30316-1
Southern Conservation Commission Area	Test Range Berm	BERM-ISM-WD	10/13/2015	10-Nov-15	C	SO	1	Heptachlor	0.00020 U	mg/L	0.00020	200-30316-1
Southern Conservation Commission Area	Test Range Berm	BERM-ISM-WD	10/13/2015	10-Nov-15	C	SO	1	gamma-BHC (Lindane)	0.00020 U	mg/L	0.00020	200-30316-1
Southern Conservation Commission Area	Test Range Berm	BERM-ISM-WD	10/13/2015	10-Nov-15	C	SO	1	Selenium	0.025 U	mg/L	0.025	200-30316-1
Southern Conservation Commission Area	Test Range Berm	BERM-ISM-WD	10/13/2015	10-Nov-15	C	SO	1	Silvex (2,4,5-TP)	0.0020 U	mg/L	0.0020	200-30316-1
Southern Conservation Commission Area	Test Range Berm	BERM-ISM-WD	10/13/2015	10-Nov-15	C	SO	1	Pentachlorophenol	0.010 U	mg/L	0.010	200-30316-1
Southern Conservation Commission Area	Test Range Berm	BERM-ISM-WD	10/13/2015	10-Nov-15	C	SO	1	2,4-Dinitrotoluene	0.0050 U	mg/L	0.0050	200-30316-1
Southern Conservation Commission Area	Test Range Berm	BERM-ISM-WD	10/13/2015	10-Nov-15	C	SO	1	Hexachlorobenzene	0.0050 U	mg/L	0.0050	200-30316-1
Southern Conservation Commission Area	Test Range Berm	BERM-ISM-WD	10/13/2015	10-Nov-15	C	SO	1	Free Liquid	pass	mL/100g		200-30316-1
Southern Conservation Commission Area	Test Range Berm	BERM-ISM-WD	10/13/2015	10-Nov-15	C	SO	1	Heptachlor epoxide	0.00020 U	mg/L	0.00020	200-30316-1
Southern Conservation Commission Area	Test Range Berm	BERM-ISM-WD	10/13/2015	10-Nov-15	C	SO	1	pH	5.56 HF	SU	0.100	200-30316-1
Southern Conservation Commission Area	Test Range Berm	BERM-ISM-WD	10/13/2015	10-Nov-15	C	SO	1	Methoxychlor	0.00020 U	mg/L	0.00020	200-30316-1

Southern Conservation Commission Area	Test Range Berm	BERM-ISM-WD	10/13/2015	10-Nov-15	C	SO	1		Toxaphene	0.0020 U	mg/L	0.0020	200-30316-1
Southern Conservation Commission Area	Test Range Berm	BERM-ISM-WD	10/13/2015	10-Nov-15	C	SO	1	71.5	Cyanide, Total	1.3 U *	mg/Kg	1.3	200-30316-1
Southern Conservation Commission Area	Test Range Berm	BERM-ISM-WD	10/13/2015	10-Nov-15	C	SO	1		Chlordane (technical)	0.0020 U	mg/L	0.0020	200-30316-1
Southern Conservation Commission Area	Test Range Berm	BERM-ISM-WD	10/13/2015	10-Nov-15	C	SO	10		1,1-Dichloroethene	0.010 U	mg/L	0.010	200-30316-1
Southern Conservation Commission Area	Test Range Berm	BERM-ISM-WD	10/13/2015	10-Nov-15	C	SO	1		Endrin	0.00020 U	mg/L	0.00020	200-30316-1
Southern Conservation Commission Area	Test Range Berm	BERM-ISM-WD	10/13/2015	10-Nov-15	C	SO	1		2-Methylphenol	0.0050 U	mg/L	0.0050	200-30316-1
Southern Conservation Commission Area	Test Range Berm	BERM-ISM-WD	10/13/2015	10-Nov-15	C	SO	1		Mercury	0.00020 U F1	mg/L	0.00020	200-30316-1
Southern Conservation Commission Area	Test Range Berm	BERM-ISM-WD	10/13/2015	10-Nov-15	C	SO	1		3-Methylphenol	0.010 U	mg/L	0.010	200-30316-1
Southern Conservation Commission Area	Test Range Berm	BERM-ISM-WD	10/13/2015	10-Nov-15	C	SO	1		4-Methylphenol	0.010 U	mg/L	0.010	200-30316-1
Southern Conservation Commission Area	Test Range Berm	BERM-ISM-WD	10/13/2015	10-Nov-15	C	SO	1		Sulfide, Reactive	10 U	mg/Kg	10	200-30316-1

APPENDIX 4B

Generator Waste Stream Profile Sheet

90155182 75678 1077635

Appendix 4A. Generator Waste Stream Profile Sheet

1. Generator's US EPA ID No.

Manifest Document No. 75678

2. Page 1 of 1

3. Generator's Name and Mailing Address
FIREWORKS JOINT DEFENSE
GROUP c/o PIERCE ATWOOD LLC 100 SUMMER STREET
Boston, MA 02110

4. Generator's Phone ((617) 488-8146

A.

B. State Gen. ID
351 WINTER STREET
HANOVER MA 02339

5. Transporter 1 Company Name: CLEAN VENTURE, INC.

6. US EPA ID Number: NJ00000271 93

C. State Trans. ID

7. Transporter 2 Company Name

8. US EPA ID Number

D. Transporter's Phone ( )

E. State Trans. ID

9. Designated Facility Name and Site Address
TRADEBE TREATMENT AND RECYCLING
NORTHEAST, LLC 410 SHATTUCK WAY
NEWINGTON, NH 03801

10. US EPA ID Number: NHD980521843

F. Transporter's Phone ( )

G. State Facility's ID NOT REQUIRED

H. Facility's Phone ((603) 431-2420

GENERATOR

11. US DOT Description *(Including Proper Shipping Name, Hazard Class and ID Number)*	12. Containers No.	Type	13. Total Quantity	14. Unit Wt/Vol	I. WASTE NO.
a. NON RCRA NON DOT REGULATED MATERIAL (SOIL BORINGS)	XX3	DM	900	P	MA99
b.					
c.					
d.					

J. Additional Descriptions for Materials Listed Above *(include physical state and hazard code.)*
a. 3X55
b.
c.
d.

K. Handling Codes for Wastes Listed Above
a.
b.
c.
d.

15. Special Handling Instructions and Additional Information 808491/800082/75678/39344 24 Hour Emergency Number:
(508) 872-5000 (1)OIS-1 3034FSPXM OILY SOLID (SOIL BORING)

1077635

PETER

PO#177546

16. GENERATOR'S CERTIFICATION: I certify the materials described above on this manifest are not subject to Federal Regulations for reporting proper disposal of hazardous waste.

X Printed/Typed Name: PETER Dillo
Signature
Date Month Day Year: 12/02/15

TRANSPORTER

17. Transporter 1 Acknowledgement of Receipt of Materials
Printed/Typed Name: Rick Cossette
Signature
Date Month Day Year: 12/02/15

18. Transporter 2 Acknowledgement of Receipt of Materials
Printed/Typed Name
Signature
Date Month Day Year

FACILITY

19. Discrepancy Indication Space

20. Facility Owner or Operator: Certification of receipt of hazardous materials covered by this manifest except as noted in item 19
Printed/Typed Name: Daniel L Bwdith 07
Signature
Date Month Day Year: 12/4/15

T/S/D/F COPY

APPENDIX 5A

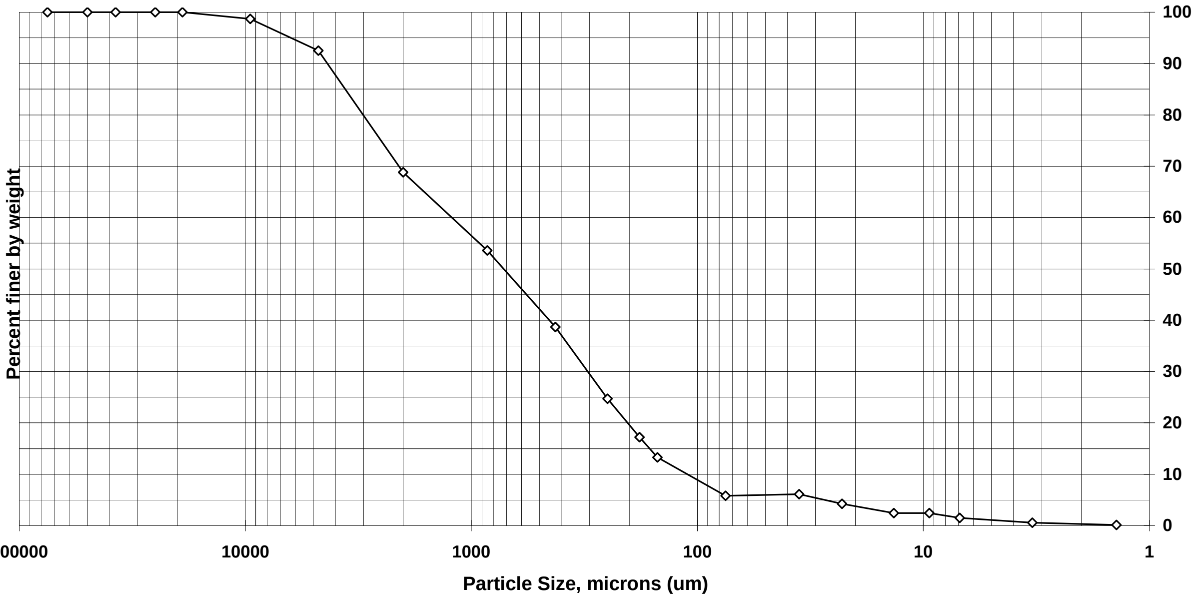
Sieve Results for Sediment and Soil Geotechnical Samples

Appendix 5A. Sieve Results for Sediment and Soil Geotechnical Samples

Particle Size of Soils by ASTM D422

Date Received: 10/28/2015
Sample ID: SD-ECCS-GT **Percent Solids:** 67.8% **Start Date:** 11/12/2015
Lab ID: 200-30482-A-1 **Specific Gravity:** 2.650 **End Date:** 11/18/2015

Shape (> #10): subrounded **Non-soil material:** plant,wood
Hardness (> #10): hard



Sieve size	Particle size, um	Percent finer	Incremental percent
3 inch	75000	100.0	0.0
2 inch	50000	100.0	0.0
1.5 inch	37500	100.0	0.0
1 inch	25000	100.0	0.0
3/4 inch	19000	100.0	0.0
3/8 inch	9500	98.7	1.3
#4	4750	92.5	6.2
#10	2000	68.8	23.7
#20	850	53.6	15.2
#40	425	38.7	14.9
#60	250	24.7	14.0
#80	180	17.2	7.5
#100	150	13.3	3.9
#200	75	5.8	7.5
Hyd1	35.5	6.1	-0.3
Hyd2	22.9	4.3	1.9
Hyd3	13.5	2.4	1.8
Hyd4	9.4	2.4	0.0
Hyd5	6.9	1.5	0.9
Hyd6	3.3	0.6	0.9
Hyd7	1.4	0.1	0.5

Soil Classification	Percent of sample
Gravel	7.5
Sand	86.7
Coarse Sand	23.7
Medium Sand	30.1
Fine Sand	32.9
Silt	4.3
Clay	1.5

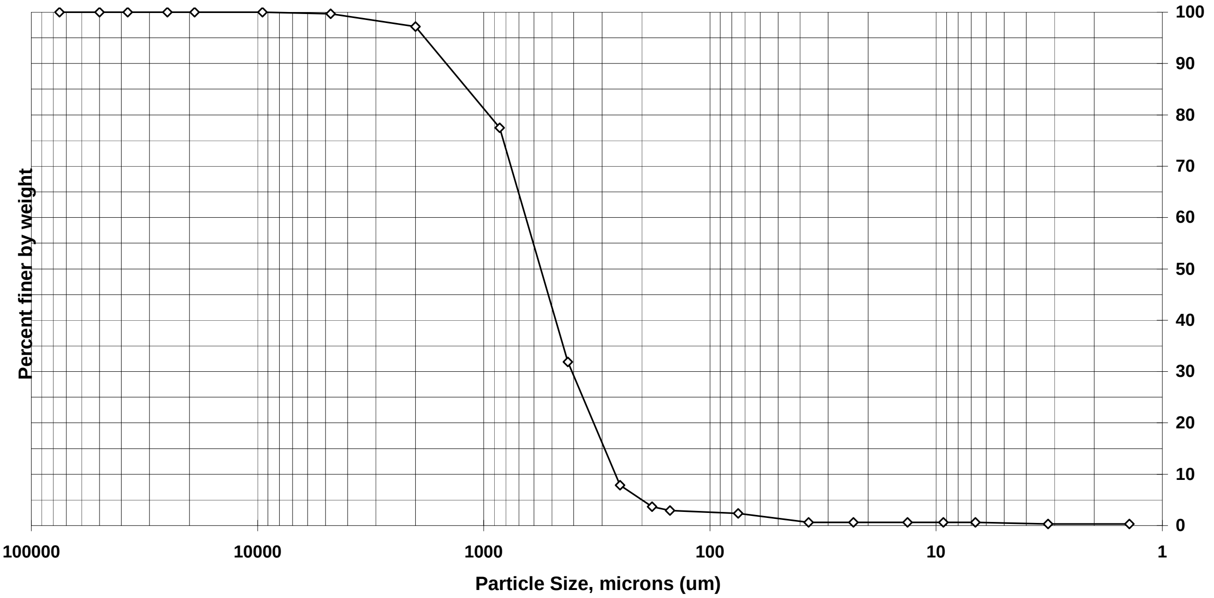
Particle Size of Soils by ASTM D422

				Date Received:	10/17/2015
Sample ID:	SD-LDRC-GT	**Percent Solids:**	81.4%	**Start Date:**	10/19/2015
Lab ID:	200-30316-A-4	**Specific Gravity:**	2.650	**End Date:**	10/28/2015

Shape (> #10): subrounded

Non-soil material: na

Hardness (> #10): hard



Sieve size	Particle size, um	Percent finer	Incremental percent
3 inch	75000	100.0	0.0
2 inch	50000	100.0	0.0
1.5 inch	37500	100.0	0.0
1 inch	25000	100.0	0.0
3/4 inch	19000	100.0	0.0
3/8 inch	9500	100.0	0.0
#4	4750	99.7	0.3
#10	2000	97.2	2.5
#20	850	77.5	19.7
#40	425	31.9	45.6
#60	250	7.9	24.0
#80	180	3.7	4.2
#100	150	2.9	0.8
#200	75	2.4	0.6
Hyd1	36.6	0.6	1.7
Hyd2	23.2	0.6	0.0
Hyd3	13.4	0.6	0.0
Hyd4	9.3	0.6	0.0
Hyd5	6.7	0.6	0.0
Hyd6	3.2	0.3	0.3
Hyd7	1.4	0.3	0.0

Soil Classification	Percent of sample
Gravel	0.3
Sand	97.4
Coarse Sand	2.5
Medium Sand	65.3
Fine Sand	29.6
Silt	1.7
Clay	0.6

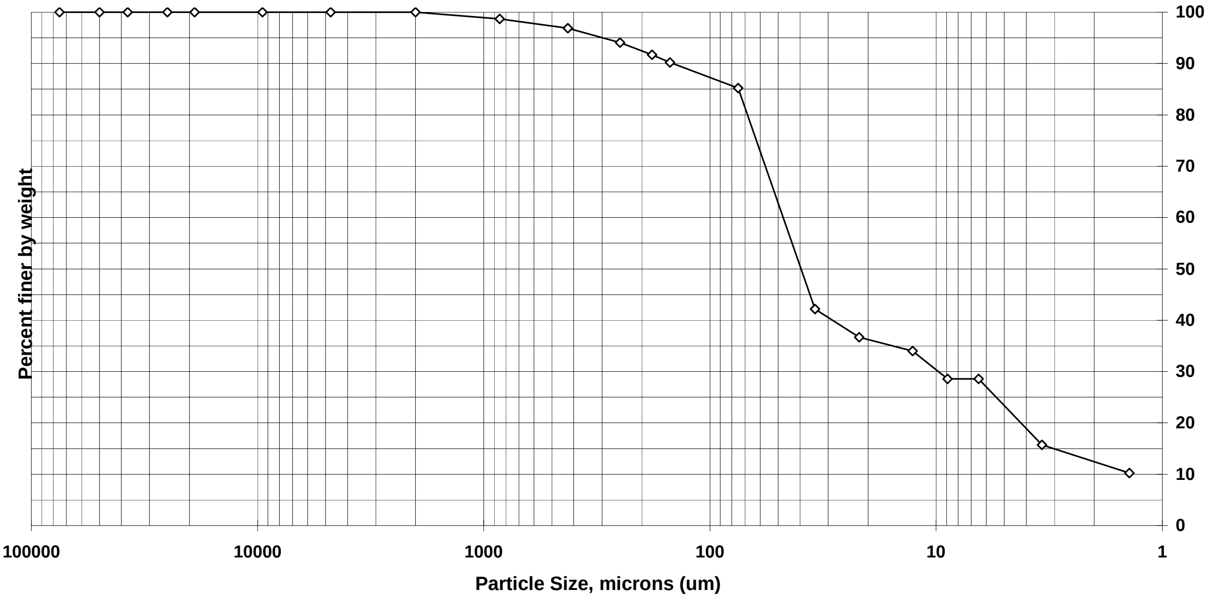
Particle Size of Soils by ASTM D422

				Date Received:	10/17/2015
Sample ID:	SD-LUFP-GT	**Percent Solids:**	33.6%	**Start Date:**	10/19/2015
Lab ID:	200-30316-A-2	**Specific Gravity:**	2.650	**End Date:**	10/28/2015

Shape (> #10): na

Non-soil material: na

Hardness (> #10): na



Sieve size	Particle size, um	Percent finer	Incremental percent
3 inch	75000	100.0	0.0
2 inch	50000	100.0	0.0
1.5 inch	37500	100.0	0.0
1 inch	25000	100.0	0.0
3/4 inch	19000	100.0	0.0
3/8 inch	9500	100.0	0.0
#4	4750	100.0	0.0
#10	2000	100.0	0.0
#20	850	98.7	1.3
#40	425	96.9	1.8
#60	250	94.1	2.8
#80	180	91.7	2.4
#100	150	90.2	1.5
#200	75	85.2	5.0
Hyd1	34.3	42.2	43.0
Hyd2	21.9	36.7	5.5
Hyd3	12.7	34.0	2.7
Hyd4	8.9	28.6	5.4
Hyd5	6.5	28.6	0.0
Hyd6	3.4	15.7	12.9
Hyd7	1.4	10.2	5.5

Soil Classification	Percent of sample
Gravel	0.0
Sand	14.8
Coarse Sand	0.0
Medium Sand	3.1
Fine Sand	11.7
Silt	56.6
Clay	28.6

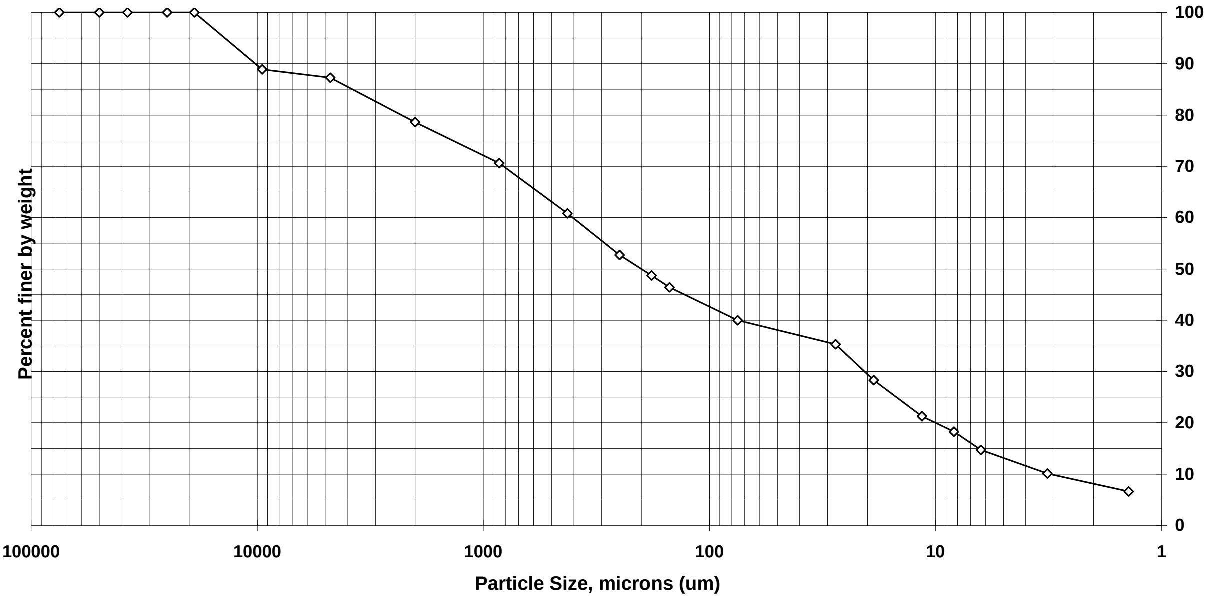
Particle Size of Soils by ASTM D422

				Date Received:	10/23/2015
Sample ID:	SD-MLFP-GT	**Percent Solids:**	74.1%	**Start Date:**	10/23/2015
Lab ID:	200-30385-A-1	**Specific Gravity:**	2.650	**End Date:**	10/29/2015

Shape (> #10): subangular

Non-soil material: plant

Hardness (> #10): hard



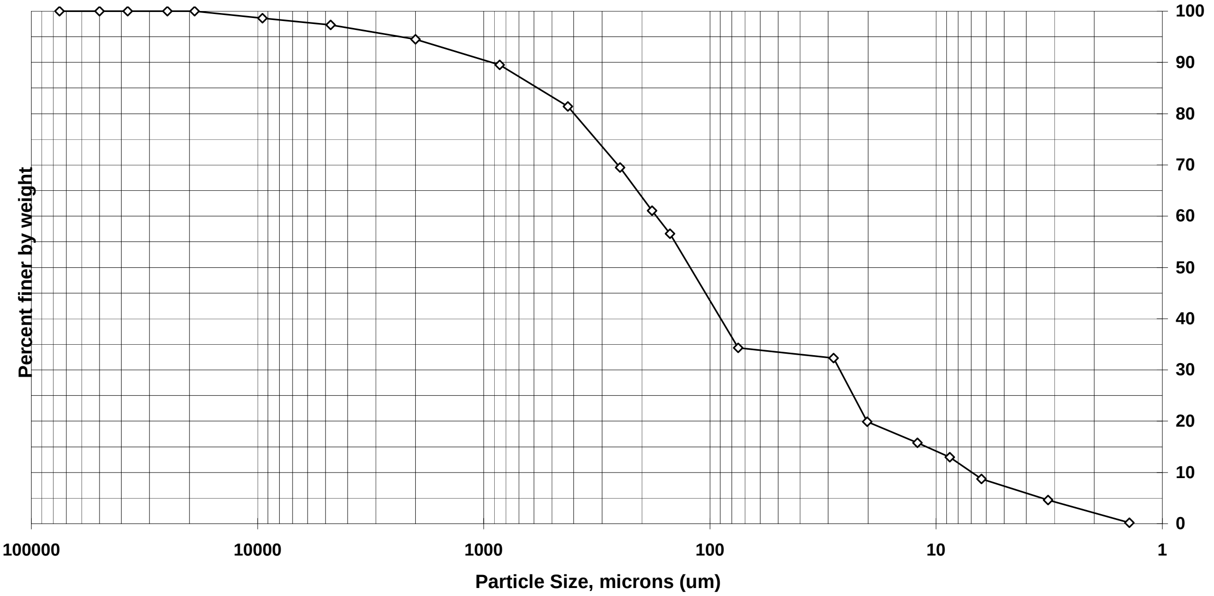
Sieve size	Particle size, um	Percent finer	Incremental percent
3 inch	75000	100.0	0.0
2 inch	50000	100.0	0.0
1.5 inch	37500	100.0	0.0
1 inch	25000	100.0	0.0
3/4 inch	19000	100.0	0.0
3/8 inch	9500	88.9	11.1
#4	4750	87.3	1.6
#10	2000	78.6	8.7
#20	850	70.6	8.0
#40	425	60.8	9.8
#60	250	52.7	8.1
#80	180	48.7	4.0
#100	150	46.4	2.3
#200	75	40.0	6.4
Hyd1	27.7	35.3	4.7
Hyd2	18.8	28.3	7.0
Hyd3	11.5	21.3	7.0
Hyd4	8.3	18.3	3.0
Hyd5	6.3	14.7	3.6
Hyd6	3.2	10.1	4.6
Hyd7	1.4	6.6	3.5

Soil Classification	Percent of sample
Gravel	12.7
Sand	47.3
Coarse Sand	8.7
Medium Sand	17.8
Fine Sand	20.8
Silt	25.3
Clay	14.7

Particle Size of Soils by ASTM D422

Date Received: 10/30/2015
Sample ID: SD-MUAU-GT **Percent Solids:** 51.7% **Start Date:** 11/3/2015
Lab ID: 200-30500-A-1 **Specific Gravity:** 2.650 **End Date:** 11/8/2015

Shape (> #10): subrounded **Non-soil material:** plant,wood
Hardness (> #10): hard



Sieve size	Particle size, um	Percent finer	Incremental percent
3 inch	75000	100.0	0.0
2 inch	50000	100.0	0.0
1.5 inch	37500	100.0	0.0
1 inch	25000	100.0	0.0
3/4 inch	19000	100.0	0.0
3/8 inch	9500	98.6	1.4
#4	4750	97.3	1.3
#10	2000	94.5	2.8
#20	850	89.5	5.0
#40	425	81.4	8.1
#60	250	69.5	11.9
#80	180	61.1	8.4
#100	150	56.6	4.5
#200	75	34.3	22.3
Hyd1	28.4	32.3	2.0
Hyd2	20.2	19.9	12.4
Hyd3	12.1	15.8	4.1
Hyd4	8.7	13.0	2.8
Hyd5	6.3	8.8	4.3
Hyd6	3.2	4.6	4.1
Hyd7	1.4	0.2	4.5

Soil Classification	Percent of sample
Gravel	2.7
Sand	63.0
Coarse Sand	2.8
Medium Sand	13.1
Fine Sand	47.1
Silt	25.6
Clay	8.8

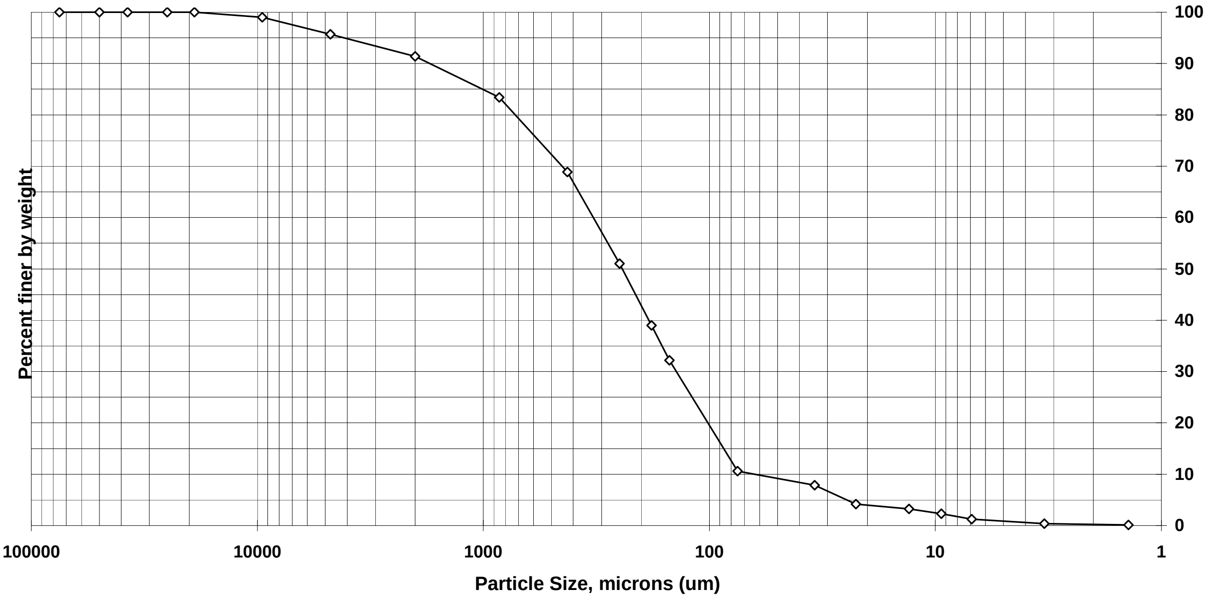
Particle Size of Soils by ASTM D422

				Date Received:	10/30/2015
Sample ID:	SO-MUAU-GT	**Percent Solids:**	94.0%	**Start Date:**	11/3/2015
Lab ID:	200-30500-A-3	**Specific Gravity:**	2.650	**End Date:**	11/8/2015

Shape (> #10): subrounded

Non-soil material: plant

Hardness (> #10): hard



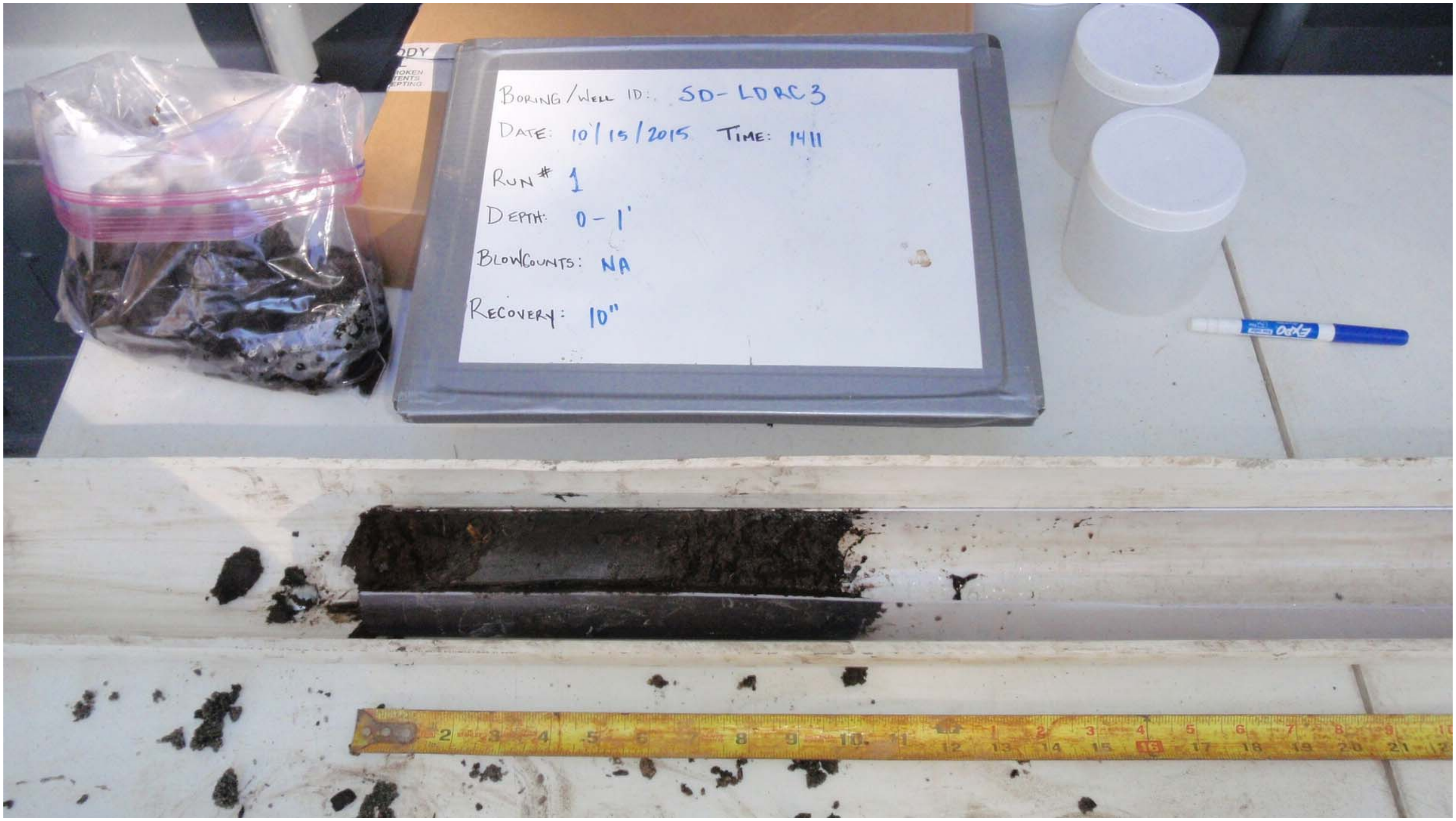
Sieve size	Particle size, um	Percent finer	Incremental percent
3 inch	75000	100.0	0.0
2 inch	50000	100.0	0.0
1.5 inch	37500	100.0	0.0
1 inch	25000	100.0	0.0
3/4 inch	19000	100.0	0.0
3/8 inch	9500	99.0	1.0
#4	4750	95.7	3.3
#10	2000	91.4	4.3
#20	850	83.4	8.0
#40	425	68.9	14.5
#60	250	51.0	17.9
#80	180	39.0	12.0
#100	150	32.2	6.8
#200	75	10.6	21.6
Hyd1	34.2	7.9	2.8
Hyd2	22.5	4.2	3.7
Hyd3	13.1	3.2	0.9
Hyd4	9.4	2.3	0.9
Hyd5	6.9	1.3	1.0
Hyd6	3.3	0.3	0.9
Hyd7	1.4	0.1	0.2

Soil Classification	Percent of sample
Gravel	4.3
Sand	85.1
Coarse Sand	4.3
Medium Sand	22.5
Fine Sand	58.3
Silt	9.3
Clay	1.3

APPENDIX 5B

Representative Photographs of Sediment Sampled in the Lower Drinkwater River Corridor, Lily/Upper Factory Pond, and Middle/Lower Factory Pond

Appendix 5-B. Representative Photographs of Sediment Sampled in the Lower Drinkwater River Corridor, Lilly / Upper Factory Pond, and Middle / Lower Factory Pond



Boring/Well ID: SD-LDRC3
Date: 10/15/2015 Time: 1411
Run # 1
Depth: 0-1'
Blowcounts: NA
Recovery: 10"

Photo 5-B1. Core of representative sediment from which geotechnical sample SD-LDRC-GT was collected.

Appendix 5-B. Representative Photographs of Sediment Sampled in the Lower Drinkwater River Corridor, Lilly / Upper Factory Pond, and Middle / Lower Factory Pond

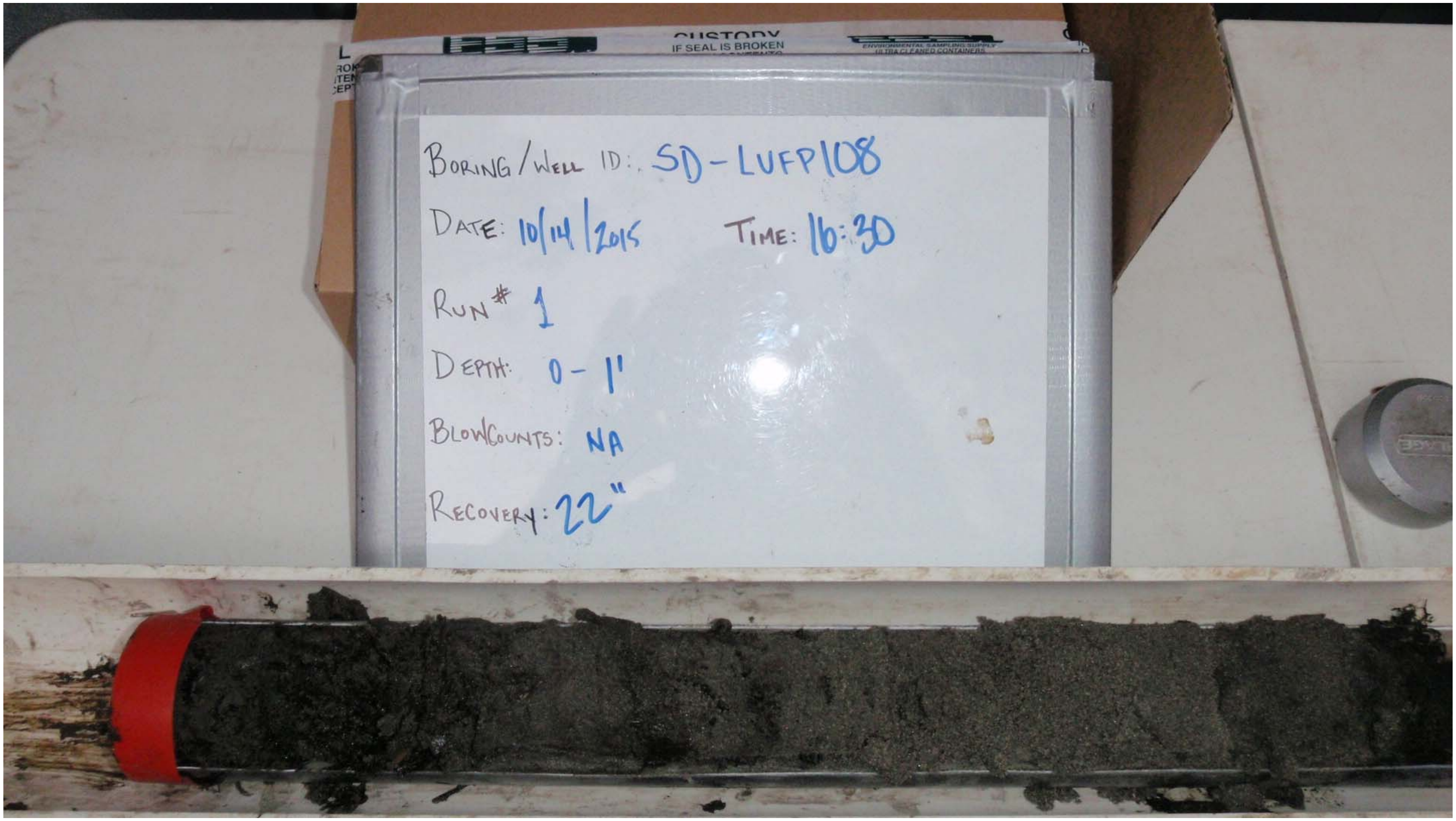
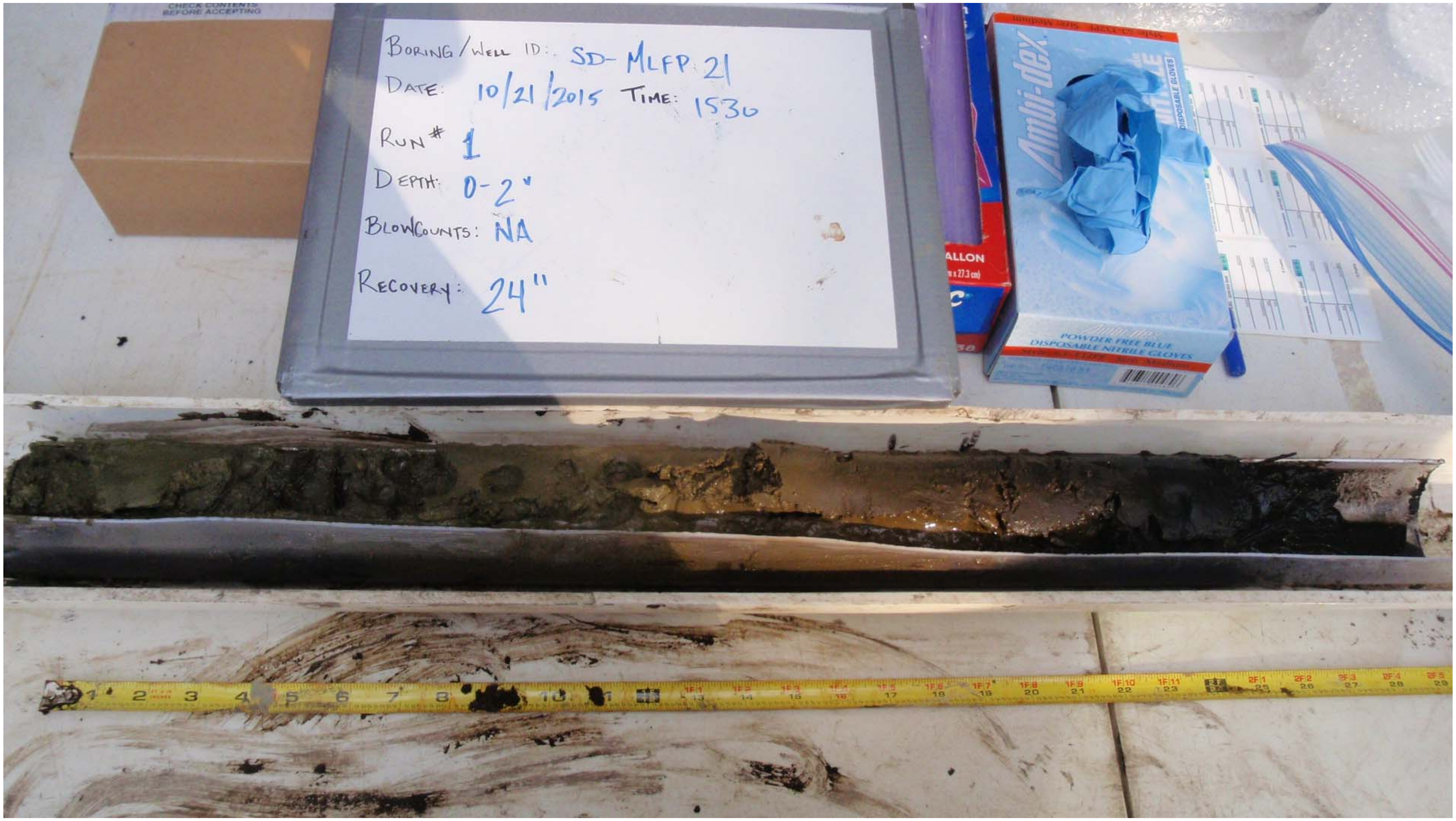


Photo 5-B2. Core of representative sediment from which geotechnical sample SD-LUFP-GT was collected.

Appendix 5-B. Representative Photographs of Sediment Sampled in the Lower Drinkwater River Corridor, Lilly / Upper Factory Pond, and Middle / Lower Factory Pond



Boring/Well ID: SD-MLFP 21
Date: 10/21/2015 Time: 1530
Run # 1
Depth: 0-2'
Blowcounts: NA
Recovery: 24"

Photo 5-B3. Core of representative sediment from which geotechnical sample SD-MLFP-GT was collected.

APPENDIX 6A

Amendment Stabilization Tests for Composite Samples Collected From the Fireworks I Project

AMENDMENT STABILIZATION TESTS
FOR COMPOSITE SAMPLES COLLECTED FROM
THE FIREWORKS I PROJECT

For:
Ron Marnicio
Tetra Tech, Inc
160 Federal Street
Third Floor
Boston, MA 02110

By:
WaterSolve, LLC
5031 68th Street SE
Caledonia, MI 49316
www.gowatersolve.com
616-575-8693

December 14, 2015

1. Scope of Work

WaterSolve, LLC was tasked to perform Amendment tests with Calcimite, Portland cement, and Superabsorbent. The tests performed are outlined in the Scope of Work/Price Form section of the Tetra Tech, Inc. Purchase Order #1119113 (Appendix A).

2.1 Materials & Methods

Six five gallon pails and two coolers were received November 4, 2015. Two pails from each of the three sampling locations labelled; SD-MLFP-BP, SD-LUFP-BP, and SD-ECCS-BP. The coolers contained one five gallon water sample labelled from each sampling location.

2.2 Simulation of Mechanical Dredging

One pail from each sample site was homogenized with a paint stirrer and hand drill. Six inches of sediment and twelve inches of corresponding water were placed into five gallon pails. A large spoon was used to simulate mechanical dredging as described in the Purchase Order. From these pails several 400(+/-5)-gram subsamples were subdivided for the amendment testing and analytical testing. The solids concentration (% dry weight) per ASTM D2216-10 and specific gravity per the SOP (Appendix B) were performed on the simulated dredge spoils. The simulated dredge spoils were sent to Trimatrix for the organic matter testing.

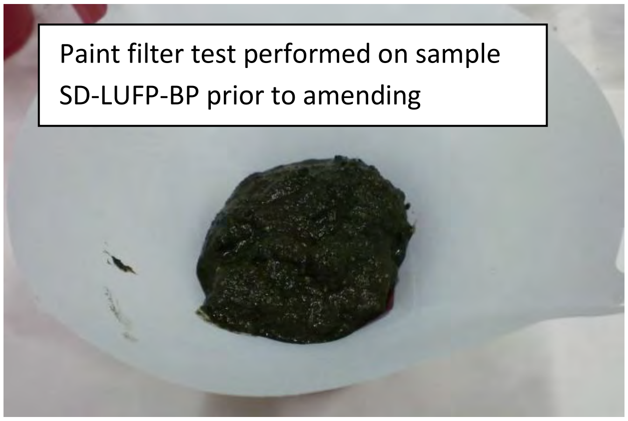
Mechanical dredging simulation

2.3 Amendment testing

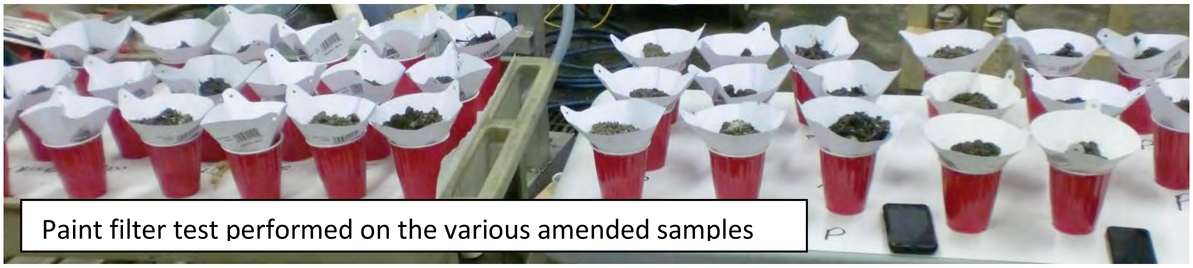
The amendment testing was performed with Calcimite, Portland cement, and superabsorbent Solve 1880 at different concentrations. The paint filter test were performed with approximately 100-mL of the amended samples. The solids concentration (% dry weight) per ASTM D2216-10 and unit weight were performed on the simulated dredge spoils for each amendment rate. There was not enough water released to do TSS on the free water. TSS of the site water was determined using a Hach DR2800.


Sample ECCS:Solve 1880 (400-g:1-g)


Sample LUFP:Calcimite (400-g:60-g)


Paint filter test performed on sample SD-LUFP-BP prior to amending


Free water released during paint filter test


Paint filter test performed on the various amended samples

3.1 Results Simulation of Mechanical Dredging

The results for the three parameters tested; solids concentration (% dry weight), specific gravity, organic matter, and unit weight are summarized in table 1. The full report for organic matter is in Appendix C.

Table 1

Mechanical Dredging results

Sample/Test	% Solids	Specific Gravity	Unit Weight (g/ml)	Organic Matter (g C/g soil)
SD-MLFP-BP	67.5	2.47	2.1	0.0156
SD-LUFP-BP	66.3	2.60	2.0	0.0302
SD-ECCS-BP	30.6	2.00	1.3	0.1126

3.2 Results Amendment Testing

The results from the amendment testing paint filter test are summarized in table 2. The results for the amendment testing for the parameters tested; solids concentration (% dry weight) and unit weight are summarized in table 3. The TSS for the site water samples are: SD-MLFP-BP water 2-mg/L, SD-LUFP-BP water 5-mg/L, SD-ECCS-BP water 2-mg/L. The paint filter tests did not release enough water for TSS analysis. The water released appeared to have a high TSS.

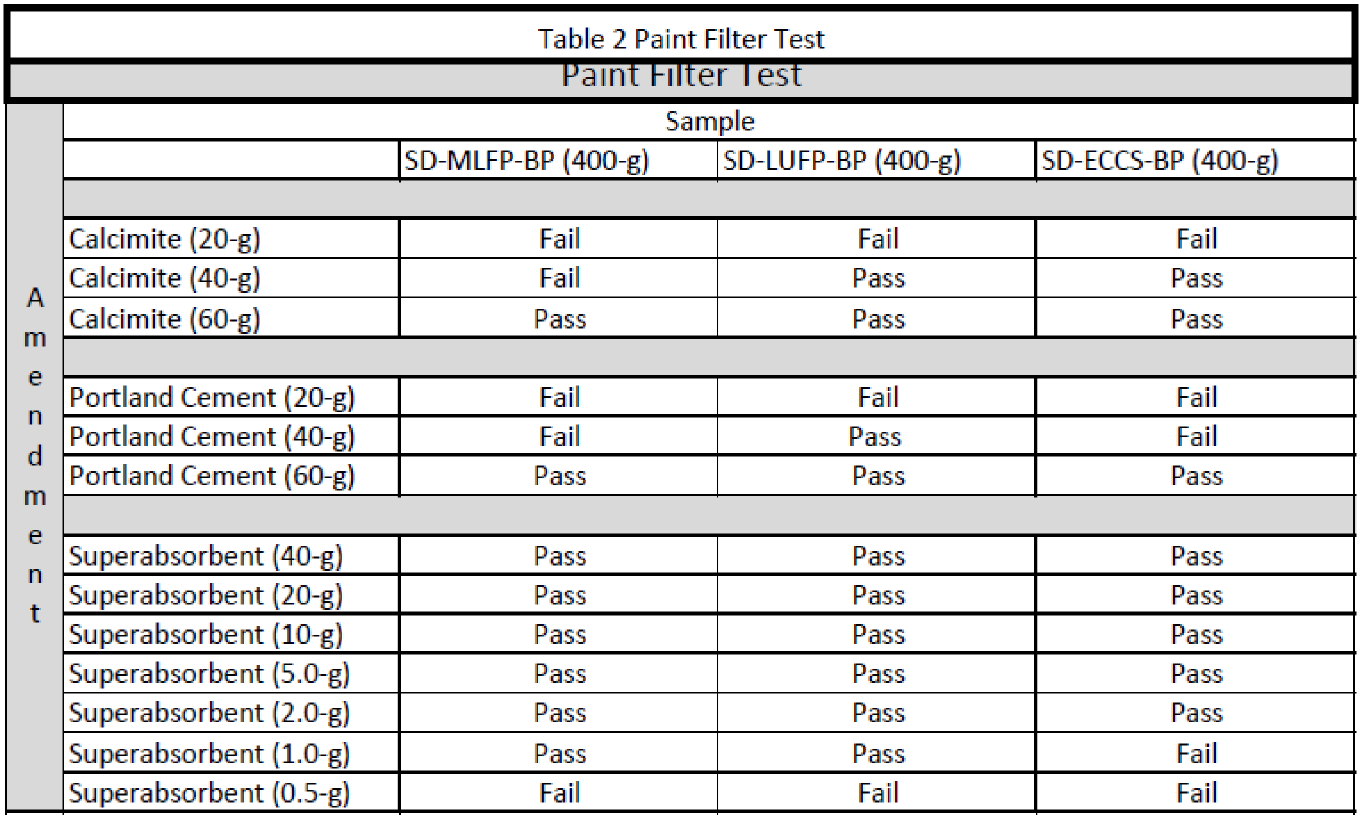


Table 2 Paint Filter Test

Paint Filter Test

	Sample			
		SD-MLFP-BP (400-g)	SD-LUFP-BP (400-g)	SD-ECCS-BP (400-g)
Amendment	Calcimite (20-g)	Fail	Fail	Fail
	Calcimite (40-g)	Fail	Pass	Pass
	Calcimite (60-g)	Pass	Pass	Pass
	Portland Cement (20-g)	Fail	Fail	Fail
	Portland Cement (40-g)	Fail	Pass	Fail
	Portland Cement (60-g)	Pass	Pass	Pass
	Superabsorbent (40-g)	Pass	Pass	Pass
	Superabsorbent (20-g)	Pass	Pass	Pass
	Superabsorbent (10-g)	Pass	Pass	Pass
	Superabsorbent (5.0-g)	Pass	Pass	Pass
	Superabsorbent (2.0-g)	Pass	Pass	Pass
	Superabsorbent (1.0-g)	Pass	Pass	Fail
	Superabsorbent (0.5-g)	Fail	Fail	Fail

Table 3 Amendment Testing

DISH #	SAMPLE (400-G)/AMENDMENT(weight)	UNIT WEIGHT (g/ml)	% SOLIDS
1	SD-MLFP-BD/CALC 60-G	1.9	84.3
2	SD-MLFP-BD/CALC 40-G	1.7	81.4
3	SD-MLFP-BD/CALC 20-G	2.0	88.9
4	SD-MLFP-BD/PORT 60-G	2.0	84.6
5	SD-MLFP-BD/PORT 40-G	2.0	86.4
6	SD-MLFP-BD/PORT 20-G	2.1	83.6
7	SD-MLFP-BD/SUPERABSORBENT 10-G	1.5	77.2
8	SD-MLFP-BD/SUPERABSORBENT 1-G	1.3	84.7
9	SD-MLFP-BD/SUPERABSORBENT .5-G	1.2	77.3
10	SD-LUFP-BD/CALC 60-G	1.9	79.1
11	SD-LUFP-BD/CALC 40-G	1.9	79.5
12	SD-LUFP-BD/CALC 20-G	1.8	73.5
13	SD-LUFP-BD/PORT 60-G	1.9	78.8
14	SD-LUFP-BD/PORT 40-G	1.8	77.8
15	SD-LUFP-BD/PORT 20-G	1.9	73.3
16	SD-LUFP-BD/SUPERABSORBENT 10-G	1.3	77.1
17	SD-LUFP-BD/SUPERABSORBENT 1-G	1.4	73.7
18	SD-LUFP-BD/SUPERABSORBENT .5-G	1.8	73.9
19	SD-ECCS-BD/CALC 60-G	1.5	45.2
20	SD-ECCS-BD/CALC 40-G	1.5	39.4
21	SD-ECCS-BD/CALC 20-G	1.3	34.7
22	SD-ECCS-BD/PORT 60-G	1.5	39.8
23	SD-ECCS-BD/PORT 40-G	1.6	42.4
24	SD-ECCS-BD/PORT 20-G	1.4	34.4
25	SD-ECCS-BD/SUPERABSORBENT 10-G	1.5	30.3
26	SD-ECCS-BD/SUPERABSORBENT 1-G	1.6	29.3
27	SD-ECCS-BD/SUPERABSORBENT .5-G	1.3	27.5
28	SD-MLFP-BP	2.1	67.5
29	SD-LUFP-BP	2.0	66.3
30	SD-ECCS-BP	1.3	30.6

Appendix A PO#1119113

TETRA TECH, INC.

Order Number Must Appear On All Invoices

Purchase Order

Order Number: 1119113 **Task:** 0 **Modification:** 0

Vendor: 140796

Buyer:

Tetra Tech, Inc.
160 Federal St.
3rd Fl.
Boston, MA 02110

Geralyn Poshka
Phone: (973) 630-8337
E-Mail: Geralyn.Poshka@tetratech.com

Seller:

WATERSOLVE LLC
5031 68th St Se
Caledonia, MI 49316

Prime Contract Number: Other - Overhead, Proposal, or Other Contract
Subcontractor Type: Fixed Unit Price
Payment Terms: Due in 30 Days
FOB: FOB DESTINATION
Freight Terms: Freight included in total price.
Ship Via: Standard Shipment

Bill To:
Tetra Tech, Inc.
160 Federal St.
3rd Fl.
Boston, MA 02110
Contact: Accounts Payable

Period of Performance

Delivery/Start Date: October 29, 2015 **Expiration Date:** November 30, 2015

No.	Qty	Item Description	U/M	Unit Price	Ext. Price
1	7800	Seller to perform Analytical Testing Services in support of Tetra Tech, Inc's Fireworks I Project per attached Scope of Work/Price Form & all other attached documents & as directed by Ronald Marnicio, Project Manager	LOT	$1.00	$7,800.00

Reference: Seller's Proposal dated 9/21/2015

The following documents are included and made a part of this purchase order:

1. Scope of Work/Price Form, 2-page document, dated October 28, 2015
2. Terms and Conditions, Off-Site General, Laboratory and Related Activities, 9-page document, revision date January 16, 2012
3. Insurance Requirements, Form No. 197-4-71, 2-page document, revision date October 30, 2012
4. Agreement and Acknowledgement Lower Tier Subcontractor Terms and Conditions, Form No. GC000K78, 2-page document, revision date January 4, 2007

Scope of Work/Price Form
Purchase Order 1119113
October 28, 2015

Watersolve LLC (Seller) to perform Analytical/Testing Services in support of Tetra Tech, Inc's (Buyer) Fireworks I Project to include the following:

Evaluate the "dewaterability" of mechanically dredged sediment from the referenced project site. Testing will be performed on three (3) separate composite samples and will consist of bench scale testing of amendments and adsorbents at WaterSolve's laboratory in Caledonia, Michigan. The organic matter testing will be completed by TriMatrix Laboratories, Inc. (Grand Rapids, MI).

Seller has proposed the following scope of services to perform this evaluation.

1) Sediment Sampling (by others)
- Sediment samples for this testing should be a volumetric averaging of the entire dredge area. Ten gallons of sediment and five gallons of overlying water for each composite sample should be collected for the testing.
- The volumes of sediment and overlying water can be reviewed prior to sample collection and shipment.
- Samples to be shipped to WaterSolve, LLC.

2) Simulation of Mechanical Dredging (Sample Collection for Amendment Testing)
- Raw sediment will be placed in a container.
- 12" of site water will be added to the same container to replicate sediment conditions.
- Sediment samples (approximately 200-ml) will be removed with a scoop starting from the bottom of the sediment column through the water column.
- Solids concentration (% dry weight) and unit weight of each sample will be determined.
- Specific gravity test will be determined on each simulated sample (total of three).
- Organic matter (ASTM 2974- Fractional Organic Carbon) tests will be performed on each simulated sample (total of three).

3) Amendment Testing
- Three (3)
- different amendment materials will be tested for each sample. We propose using Portland cement, calcimite, and a superabsorbent. These are subject to change, but if other products are to be tested, the materials are to be provided by others.
- At least three different amendment concentrations will be tested.
- The material will be evaluated without amendment for comparison purposes.
- The amendment materials will be added to each sample (by weight) using a small spoon and mixed into the sample.

Paint Filter Testing generally following USEPA Method 9095B will be performed on each sample. At least one sample will fail the paint filter test and at least one sample will pass the paint filter test.
- The solids concentration and unit weight will be determined for each sample five minutes after the addition of amendment to allow for the weight/volume of water released to be estimated. This will also be completed for the sample without amendment.
- 4) Evaluation of Released Water
- Total Suspended Solids (TSS) of the water released from each sample will be determined using a HACH 2800 (including the sample without amendment).
- The TSS of the provided site water will also be measured for comparison.

5) Report
- Seller's findings and recommendations will be presented in a report for Buyer's evaluation and use.

6) Schedule
- The above described scope of services will be complete within three (3) weeks of receipt of samples. Start date tentatively scheduled to begin work October 28, 2015. Please coordinate the actual schedule and activities with Tetra Tech, Inc's Ronald Marnicio, Project Manager, Telephone: 617-443-7551; Email: Ronald.marnicio@tetartech.com

Purchase Order 1119113 Total: $7,800.00

TETRA TECH EC, INC.
SUBCONTRACT TERMS AND CONDITIONS
OFF-SITE GENERAL, LABORATORY AND RELATED ACTIVITIES

1. DEFINITIONS

(a) "Work" shall mean the services of Seller's personnel described by Buyer and any other Work as may be added to or performed in connection with the Subcontract.
(b) "Client" shall mean the person or entity by whom Buyer has been issued a Prime Contract to perform services.
(c) "Jobsite" shall mean the area or location designated by Buyer at which Work is being performed.

2. RELATIONSHIP OF PARTIES. Seller, including its employees, agents or representatives, shall be deemed an independent contractor and not an agent or employee of Buyer. All benefits, coverages and claims of its employees shall be the sole obligation of Seller. Unless specifically authorized by Buyer, Seller shall have no authority to make commitments of any kind on behalf of Buyer.

3. REQUIREMENTS FOR SELLER'S EMPLOYEES. Seller shall furnish competent, skilled employees experienced in the type of Work to be performed. Seller shall, when requested by Buyer, promptly remove any person considered by Buyer to be incompetent, unsatisfactory or undesirable.

4. WARRANTY. Seller warrants that Seller and its employees shall, in performing Work hereunder, exercise the degree of skill, care and diligence consistent with the highest industry standards and perform Work in accordance with any and all drawings, specifications or requirements provided by Buyer, and that such Work will be suitable for the purpose intended. Should Seller fail to perform to those standards, it shall (a) without cost to Client or Buyer, reperform and correct any substandard Work; and (b) reimburse Buyer for Buyer's direct, incidental, consequential or other costs resulting from or arising in connection with breach of such warranty. If Seller fails to replace or correct any such Work after reasonable notice, Buyer may, at its sole option, cause such Work to be replaced or corrected and all costs and expenses incurred in connection therewith shall be borne by Seller. Provided, however, that if the deficiency in the Work poses an immediate health and safety risk to Buyer, Client or others, then Buyer shall have the right to direct reperformance and correction of the substandard Work by the most immediate means available, and reasonable costs thereof shall be borne by Seller.

Seller also warrants that any goods supplied are merchantable, of highest quality, comply with specifications, drawings and data submitted to or by Buyer, are free from defects, whether patent or latent, in design, material and workmanship and are suitable for the particular use for which the items are purchased and are free and clear of all liens and encumbrances. Seller shall transfer all manufacturer or vendor warranties associated with the goods supplied to Buyer and/or any entity designated by Buyer.

Any Work corrected as a consequence of this Article shall be subject to the same warranty as provided for the original Work.

The rights and remedies of Buyer as provided in this Article and elsewhere in this Subcontract shall in no way limit any other rights and remedies Buyer may have under this Subcontract or at law or in equity.

5. COMPLIANCE. Seller shall fully comply with all federal, state and local laws, ordinances, statutes, rules, regulations, license and permit conditions or requirements (hereinafter "Laws"), including but not limited to all Laws pertaining to the environment and/or natural resources, all Laws pertaining to employment, all Laws pertaining to health and safety, and any and all other Laws affecting Seller's performance of Work hereunder. Seller shall, if requested, furnish proof of any license or permit required in connection with the performance of Work. All fees and charges in connection with Seller's compliance with applicable Laws shall be borne by Seller. In the event of violation by Seller of any applicable Laws, or the failure of Seller to comply with same, Seller shall pay all fines, penalties and other expenses, including attorneys' fees, imposed upon or incurred by Seller or Buyer in connection therewith.

6. INSURANCE Without limiting any of the other obligations or liabilities of the Seller, the Seller shall at its sole expense, provide and maintain in effect at all times during the performance of the Work and any warranty period, the minimum insurance coverage(s) in accordance with the requirements of Exhibit C, Insurance Requirements (Form No. GC0005ZQ) incorporated herein by reference, for the Seller and any lower tier subcontractors. Prior to the execution of this Subcontract, Seller shall furnish to the Buyer a Certificate of Insurance acceptable to Buyer evidencing compliance with Buyer's requirements. Certificates shall identify on their face the project name and the applicable Subcontract number. Seller is also required to provide an updated or renewal certificate of insurance prior to the expiration date of a certificate. Receipt of certificates which vary from Buyer's Insurance Requirements shall not be

deemed to waive the terms of such Requirements. Except for Workers Compensation and Professional Liability, Seller shall name Buyer its' respective affiliated companies and their officers, directors, and employees as additional Insureds by means of an unrestricted endorsement to its insurances policies. Such insurance shall be primary insurance and contain a Severability of Interest clause. Any other insurance maintained by the additional insureds named above shall not contribute with insurance provided by the Seller's insurer(s) under this additional insured provision. Seller's policies shall provide a waiver of subrogation in favor of Buyer and all additional insureds named above. Buyer may request that Seller provide copies of such policies to Buyer for review within ten (10) days of commencement of Work. Seller shall maintain copies of all such policies. Seller is required to provide 30-days prior written notice of any change to its insurance coverage or that of any approved lower tier subcontractor. If Seller fails to provide or maintain the required insurance, or if the insurance company fails, for whatever reason, to honor any claims made against the insurance, Seller shall be fully and individually liable for any such claims. All deductibles are the responsibility of Seller. Neither Buyer nor Client is maintaining any insurance on behalf of Seller. The requirements contained herein as to types and limits, as well as Buyers approval of insurance coverage to be maintained by Seller, are not intended to and shall not in any manner limit or qualify the liabilities and obligations assumed by Seller under this subcontract. Seller or its lower-tier subcontractor or suppliers shall not be permitted to continue with the Work or maintain a presence on the jobsite unless a current certificate of insurance complying with the requirements of this Subcontract is held by Buyer.

If Professional Liability Coverage, Pollution Legal and Environmental or Impairment Liability Coverage is listed in the Exhibit C, Insurance Requirements, Seller is required to maintain Professional Liability Coverage, Pollution Legal and Environmental Impairment Liability Coverage for a period of one (1) year from contract completion and/or termination. Should the required Professional Liability Coverage, Pollution Legal and Environmental Impairment Liability Coverage be provided on a Claims Made basis, Seller shall either provide "tail coverage" if Seller switches insurance carriers or have the current policies renewed by the same insurance carrier who originally issued the Professional Liability Coverage, Pollution Legal and Environmental Impairment Liability Coverage. If the required Professional Liability Coverage, Pollution Legal and Environmental Impairment Liability Coverage is renewed it must be made retroactive to a date prior to work first commencing under this Subcontract. Seller must show proof that he is maintaining the required Professional Liability Coverage, Pollution Legal and Environmental Impairment Liability Coverage. If Seller subcontracts any of its work or portion thereof, Seller shall flow down this provision as required by this Subcontract to its Subcontractors. The obligations of Seller under this Insurance Article, shall survive termination of this agreement..

7. CHANGES. Buyer may, without invalidating this Subcontract, make changes of any kind within the general scope of this Subcontract. Changes made to this Subcontract shall be incorporated by written Change Order or Amendment only and shall not be binding unless signed by Buyer's Contractual Representative. If a change causes an increase or decrease in the cost of or the time required for performance of this order, Seller shall give written notice within three (3) days of receipt of the change and shall specify in full and complete detail the basis for its assertion of its right to an adjustment within seven (7) days thereafter. Claims asserted thereafter shall be deemed waived.

Not withstanding the above, it is understood and agreed to by the parties that any changes to this subcontract that are initiated by or arise out of Client action or inaction are conditioned upon Client's approval. Seller's subcontract shall be modified to incorporate the change upon Client's written notice that Buyer's contract is modified to reflect the change.

Failure to agree to any adjustment shall be a dispute under Article 12 (Disputes). However, nothing in this Article shall excuse Seller from proceeding with its Work as directed by Buyer.

8. NOTIFICATION OF CHANGES. Seller shall not be entitled to the payment of any additional compensation for any cause other than as specifically provided for in this Subcontract, including without limitation any act, or failure to act by Buyer, or the Client or the happening of any event, thing, or occurrence (hereinafter "changes") unless Seller shall have given Buyer due written notice of any conduct by Buyer or the Client (including actions, inactions, and written or oral communications) that Seller regards as a change to the terms of this Subcontract.

The written notice of change shall set forth all facts required to allow the evaluation of reasons for the change and the evaluation of its merits. Notice shall be given as soon as possible, and whenever possible, prior to the time that the Seller commences performance of the work giving rise to the potential change, or as otherwise specified in the Subcontract, or in all other cases within five (5) days after the happening of the event, thing, or occurrence giving rise to the potential change.

It is the intention of this Article that any difference between the parties, arising under and by virtue of this Subcontract, be brought to the attention of Buyer at the earliest possible time in order that such matters may be settled, if possible, or other appropriate remedial action promptly taken. Seller hereby agrees that it shall have no right to additional compensation, excuse for nonperformance, or any claim that may be based on any act, failure to act, event, thing, or occurrence for which timely written notice of potential changes as herein required was not filed.

9. FORCE MAJEURE. Time is of the essence in Seller's performance of Work under this Order. Seller shall not be considered in default in the performance of its obligations hereunder to the extent that such performance is delayed by causes outside its control and not due to its fault or negligence and not reasonably foreseeable or, if foreseeable, cannot be avoided by the exercise of all reasonable efforts, including acts of civil or military authority, acts of God, acts of war, acts of government, riot, insurrection, blockages, embargoes, sabotage, epidemics, fire, flood, and/or famine. No such interruption shall relieve Seller of its duty to perform or give rise to any damages or additional compensation from the Buyer. Seller has as its sole remedy against Buyer in the event of such interruption the right to seek an extension of time for performance equal to the time lost as a result of said interruption. In the event of such interruption, the Seller shall notify Buyer within two (2) working days in writing of the nature, cause, date of commencement and anticipated extent of such delay and its effect on the scheduling of performance. Any request for an extension of time by reason of such interruption shall be given to the Buyer within two (2) days after the end of the interruption.

10. TERMINATION. Buyer has the absolute right to terminate or suspend Work under this Subcontract by written notice to Seller. Such termination or suspension may be in whole or in part and shall be at the sole discretion of Buyer, may be done at any time and may be for any reason whatsoever. Notice of termination or suspension may specify the schedule and manner and other conditions of the termination or suspension and Seller shall comply therewith. In such event, Seller shall be entitled to payment for the Work performed up to the time of such termination or suspension in accordance with the terms of this Subcontract, including such expenditures as in the judgment of Buyer are necessarily incurred by Seller in the orderly termination or suspension of its Work as prescribed in the notice.

If Seller ceases its operations in the usual course of business or is unable to meet its obligations, or if proceedings under any provision of the federal, state or local bankruptcy laws are initiated against Seller, or if a receiver, trustee, or liquidator is appointed or applied for, or if an assignment for the benefit of creditors is made by Seller, or if Seller fails to perform any of its obligations under this Subcontract, including failure to comply with any of Buyer's instructions, regulations or procedures, or failure to meet the specified schedule of performance, then Seller shall be in default. Buyer may suspend Work until the basis for Seller's default has been corrected to Buyer's satisfaction or terminate this Subcontract for default. Seller shall not be entitled to any compensation for costs incurred during such a suspension. In addition, Seller shall be responsible for any damages suffered by Buyer, its successors and assigns, or Client as a result of the suspension or termination for default.

The foregoing shall be in addition to any other rights Buyer may have under this Subcontract or applicable law.

11. STOP-WORK ORDER. Buyer may, at any time, by written notice to Seller, stop all or part of the Work hereunder for up to ninety (90) days. Upon receiving a stop-work order Seller shall immediately comply with its terms and take all reasonable steps to avoid incurring any additional costs allocable to such Work. Within ninety (90) days after the effective date of the stop-work order, Buyer shall (i) cancel the stop-work order; (ii) terminate all or a portion of the affected, or (iii) continue the stop-work order. Buyer agrees to make a good faith effort to negotiate an equitable adjustment in the delivery schedule and/or price hereunder if the stop-work order results in an increase in time or cost for performance. Seller must assert a claim for equitable adjustment within fifteen (15) days after the end of the Work stoppage.

12. DISPUTES. If any claim, controversy or dispute of any kind or nature whatsoever arises between Buyer and Seller and such dispute cannot be settled through negotiation, then any dispute shall be determined in appropriate legal proceedings, first through non-binding Alternative Dispute Resolution proceedings, if agreed to by the parties, then, if necessary, in a court of law, consistent with Article 16 (Governing Law).

Pending the resolution of any dispute under this Subcontract, the Seller shall proceed as directed by written notice from Buyer. Disputes under this Subcontract shall not affect any other Subcontract in place or other Work being performed by Subcontractor.

If a decision relating to the Prime Contract is issued by the Client under the Prime Contract and the decision relates to the Subcontract, said decision, if binding upon Buyer under the Prime Contract shall also be binding upon Buyer and Seller with respect to such matter. In the event that any Change arises out of or is caused by action or inaction of Client, and provided (i) that due notice as required hereunder has been given and (ii) that Buyer believes the request is reasonable and made in good faith as indicated by Seller's Certification as set out below, Buyer shall pass Seller's request for adjustment through to Client for resolution. The decision of Client with respect to any such request shall be final and binding on Seller and the Change, if any, actually agreed to by Client pursuant to such pass through request shall constitute Seller's sole and exclusive remedy, and Seller shall make no claim against Buyer, in connection therewith.

If any Client decision or judgment is binding upon Buyer and Seller, and Buyer is unable to obtain reimbursement from the Client under the Prime Contract for, or is required to refund or credit any amount with respect to, any item of cost or fee for which Buyer has reimbursed Seller, then Seller shall, on demand, promptly repay such amount to Buyer. Buyer's maximum liability for any matter connected with or related to the Subcontract, which was properly the subject of a claim against the Client under the Prime Contract, shall not exceed the amount of Buyer's recovery from the Client.

In order to induce Buyer to pass through Seller's request to Client, Seller shall with each such request provide a certification signed by an officer stating as follows: "I certify that the claim is made in good faith; that the supporting data are accurate and complete to the best of my knowledge and belief; that the amount requested accurately reflects the contract adjustment for which the Seller believes the Client is liable; and that I am duly authorized to certify the claim on behalf of the Seller."

13. KEY PERSONNEL. The key personnel specified in the Specific Subcontract Requirements, which are attached hereto and form a part of this Subcontract, are considered to be essential to the work being performed hereunder. Prior to diverting any of the specified individuals to other programs, the Seller shall notify not less than ten (10) days in advance and gain approval of the Contractual Representative. Seller shall submit justification (including proposed substitutions) in sufficient detail to permit evaluation. No substitutions or deviations shall be made by the Seller without the written consent of the Contractual Representative.

14. AUTHORIZED REPRESENTATIVES. The authorized representatives for Buyer and Seller for this Subcontract are specified in the Specific Subcontract Requirements, which are attached hereto and form a part of this Subcontract.

Work will be performed under the technical direction of Buyer's Technical Representative. Issues which affect pricing, schedule, scope of work or terms and conditions shall be initiated through the Contractual Representative.

All notices shall be in writing and sent by certified mail return receipt requested, postage prepaid, to the authorized representatives specified in the Specific Subcontract Requirements.

15. LOWER TIER SUBCONTRACTS AND PURCHASE ORDERS. Seller shall not subcontract its Work or any portion thereof without the prior written consent of Buyer. Any approved subcontracts and purchase orders shall be made in the name of Seller, shall not bind nor purport to bind Buyer, shall not relieve the Seller of any obligation under this Subcontract and shall be in such form and contain such provisions as are required by this Subcontract or as Buyer may prescribe, including insurance, claims and losses, health and safety, compliance, and labor disputes. The Seller shall have the sole responsibility of supervising and coordinating the Work of its Subcontractors.

16. GOVERNING LAW. This Subcontract shall be governed by the laws of the State of New Jersey, excluding conflicts of law provisions. Seller shall promptly pay and reimburse Buyer for all costs, expenses, damages, reasonable attorney's fees incurred by Buyer which arise out of the performance or non-performance by the Seller and/or the enforcement of the terms, conditions or obligations of the Subcontract or any bond (if any) furnished in connection therewith.

17. AMENDMENT AND NON-WAIVER. This Subcontract can be modified only by written Change Order under Article 7 or by formal Amendment signed by authorized representatives of Buyer. No other modification, change or amendment shall have any force or effect. Failure by Buyer in any instance to insist upon observance or performance by the Seller of all terms, conditions or provisions of this Subcontract shall not be deemed a waiver by Buyer. No waiver shall be binding upon Buyer unless done pursuant to a formal Change Order or Amendment in writing, signed by Buyer's Contractual Representative, and shall then be for the particular instance only. Payment of any sum by Buyer to Seller with or without the knowledge of any breach shall not be deemed to be a waiver of any such breach or any other breach, nor shall such payment constitute an acceptance of the Work not in accordance with this Subcontract nor relieve Seller of its obligations hereunder.

18. DRAWINGS, DATA AND WORK. Seller shall furnish Buyer with such preliminary and final design drawings and technical data ("Data") as are required for the performance of Work under this Subcontract. Buyer's review of such documents shall be solely for the purpose of ascertaining general conformity with the Drawings and Specifications and shall not include review of efficiency, adequacy or safety of Seller's methods.

Buyer's review or comments of such Data shall not relieve Seller from the entire responsibility for the correctness and suitability of Seller's Work or for any other obligation of Seller hereunder.

Omissions from Data which are manifestly necessary to carry out the Work shall not relieve the Seller from performing such omitted details or Work, but they shall be performed as if fully and correctly set forth and described in the Data.

All documents and information, including but not limited to studies, calculations, assumptions, data, findings, results and reports and other information resulting from the performance of Seller hereunder are the exclusive property of Buyer. Seller shall, unless otherwise directed deliver to Buyer all such documents and information and Buyer shall have the right to use them for any purpose whatsoever.

19. JOBSITE CONDITIONS. Seller warrants that Seller and its employees are familiar with the Work, the Jobsite and its environs, the availability of and access to medical and emergency services, and physical and other conditions, including hazardous substances, materials, agents or vapors, both surface and subsurface, which may exist at the Jobsite, the previous use of Jobsite and all other matters in connection with or relevant to the safe, proper and efficient conduct of the Work to be performed under this Subcontract and that Seller has made allowance for any and all such conditions and contingencies in its pricing.

20. JOBSITE REGULATIONS. Seller shall comply with Buyer's Jobsite Regulations, Health and Safety Requirement (Exhibit E), Project Health and Safety Plan, other required plans, and any and all changes and additions thereto, each of which is incorporated herein and forms a material part of this Subcontract. Seller shall not permit or suffer the introduction or use of intoxicants, narcotics or any illegal activity on the Jobsite, or on any of the grounds occupied or controlled by Seller. Client or Buyer reserves the right to test randomly or for cause Seller's employees for any intoxicant, narcotic or other illegal substance while Seller is employed on the Jobsite. Seller shall cause its employees to consent to such testing.

Seller acknowledges that compliance with jobsite , health and safety rules , regulations and plans as described above is of the essence of this contract and any breach of the foregoing may at Buyer's sole discretion result in disciplinary action up to and including termination. Seller waives all claims and rights of recovery arising out of or in connection with Buyer's exercise of such discretion irrespective of whether based in contract, tort or otherwise (including negligence, warranty , indemnity or strict liability). Should termination of Seller as provided above be proven to be wrongful such termination shall be considered a termination for convenience and as its sole and exclusive remedy Seller shall be entitled to payment for the Work performed up to the time of such termination in accordance with Article 10.

The foregoing shall be in addition to any other rights Buyer may have under this Subcontract or applicable law.

21. ASSIGNMENT. This Subcontract shall not be assigned without the prior written consent of Buyer.

22. INSPECTION. Seller shall provide and maintain an inspection system covering the Work, including material and services, to be furnished under this Subcontract. Records of such system shall be maintained and available to Buyer and/or Client. Buyer and/or Client shall have the right to inspect any Work furnished by Seller and may reject and/or require reperformance of any Work not performed in accordance with the requirements set forth herein. If any Work or portion thereof is determined to be unsuitable, defective or in violation of any law, rule or regulation, including any legal requirement relating to the environment or the handling of hazardous materials, Seller shall bear and pay all expenses incidental to the correction of unsuitability and/or correction of such Work, including without limitation any fines or penalties.

If Seller is providing laboratory services Buyer's Technical Representative has the authority and will determine if analytical data provided by Seller meets the criteria stated in this Subcontract, including any specifications and/or analytical protocols provided by Buyer and/or contained in the Scope of Work. Seller shall advise Buyer promptly if seller has questions regarding the integrity of any analytical data provided by Buyer. Buyer shall determine the acceptability of any analytical data provided hereunder. If Buyer determines Seller's analytical data fails to meet the specified contractual requirements, analytical protocols, or other criteria established in accordance with this Subcontract, Buyer has the option at its discretion to request corrective action or other remedy as provided for in the Paragraph 4, Warranty, or elsewhere in this Subcontract.

Seller recognizes and acknowledges that Buyer will rely on the accuracy and timeliness of Seller's Work in conducting its field activities (for example, field activities may include but are not limited to remediation, or arranging for disposal of hazardous or regulated substances) and that inaccurate or untimely data can result in substantial field rework and re-disposal costs. Seller shall reimburse Buyer for any re-sampling, analytical, re-procurement or other costs incurred by Buyer as a result of Seller's unacceptable analytical including, but not limited to, validation of data, program management time, sample crew time and expenses, insurance, disposal costs, samples, purge water, drums, personal protection equipment, decon water, any other equipment and costs, including proportional share of indirect and overhead costs related to re-sampling, analysis, and re-procurement of analytical services. The foregoing rights and remedies are in addition to any others available to Buyer at law or in equity or elsewhere in this Subcontract.

23. WORK PERFORMED AT SELLER'S RISK. Seller shall perform all Work at its risk and if the Work or any portion thereof shall be damaged in any way before the final completion and acceptance of the Work, Seller shall promptly repair or replace such damaged Work without expense to Client or Buyer. Seller shall be responsible for any loss or damage to equipment or other articles used or held for use in connection with the Work.

24. ENVIRONMENTAL PROTECTION. Unless otherwise provided for in this Subcontract, Seller shall, at no additional cost to Buyer, furnish all necessary or advisable facilities, means, methods and safeguards to prevent any threat of or the actual exposure of any person or organism or the contamination of the environment.

Seller shall not (a) discharge or permit the escape of any substance or material to the soil or groundwater or any other body of water which may pollute the water or in any way become harmful to fish or wildlife or the public; (b) emit or permit the escape of air contaminants, including dust or smoke, from any source whatsoever; (c) cause or allow any other contamination of the air, water, soil or any other environmental vehicle.

25. ENVIRONMENTALLY SENSITIVE ACTIVITIES. Environmentally Sensitive Activities are defined as any which could include or result in the release or threatened release of, or exposure or threatened exposure of any person or property to, any hazardous or regulated substance, material, agent or vapor including without limitation, asbestos, PCBs, ordnance and munitions, radioactive, mixed or hazardous waste, including without limitation, any designated as hazardous or subject to regulation under any applicable law, rule or regulation including without limitation the Toxic Substances Control Act, the Resource Conservation and Control Act and the Comprehensive Environmental Response, Compensation and Liability Act.

In the event that Seller's activities in connection with this Subcontract or its Work hereunder involve Environmentally Sensitive Activities, Seller hereby warrants and guarantees that it and its employees are fully qualified and licensed to perform such Activities and are informed and trained in the particular aspects of the Work under this Subcontract. The obligations of Seller under Article 33 (Claims and Losses) shall extend to any Claim (as defined in that Article) which may be brought against Seller or Buyer or its or their respective officers, directors and employees arising out of or alleged in any way to involve or be based in any Environmentally Sensitive Activity.

26. RIGHT TO RELY. Buyer shall be entitled to rely without independent verification on the accuracy, currency and completeness of information supplied by Seller or its approved subcontractors. The obligations of Seller under Article 33 (Claims and Losses) shall extend to any Claim (as defined in that Article) which may be brought against Seller or Buyer or its or their respective officers, directors and employees arising out of or alleged in any way to involve such information.

27. INDEBTEDNESS AND LIENS. Seller, for itself, its subcontractors and its materialmen covenants that no mechanic's liens or claims shall be filed or maintained by any of them against the Work performed hereunder, including the adjacent land, for or on account of any Work or labor done or materials furnished by any of them under or in connection with this Subcontract. Seller, on behalf of it and its subcontractors and materialmen, expressly waives all rights to have filed or maintained any mechanic's liens or claims against the Work performed hereunder or the adjacent land and agrees that waiving this right shall be an independent covenant and shall operate and be effective with respect to Work and labor done and materials furnished under any supplemental contract or contract for extra or additional Work.

If any mechanic's lien or other claim shall be filed for or an account of Work furnished under this Subcontract, Seller shall, within ten (10) days after notification thereof, discharge such lien or claim or otherwise make provision satisfactory to Buyer. Buyer may withhold any money due Seller until such lien or liens are discharged or paid.

28. LABOR DISPUTES. When an actual or potential labor dispute or other condition delays or threatens to delay the timely performance of Work hereunder, Seller shall immediately notify Buyer in writing. Such notice shall include all relevant information regarding such dispute or other condition. Such notice shall include steps Seller is taking or will take to resolve the dispute.

29. COMMENCEMENT AND COMPLETION OF WORK. Seller shall perform and progress the Work in a prompt and diligent manner, without delay or interference to the completion of the Prime Contract, and agrees to commence the several parts thereof at such times and in such order as Buyer may direct, and shall furnish the several parts and the whole of Work at such times, in conjunction with Work of other trades and subcontractors engaged on the project, as will ensure the uninterrupted progress of the entire Work. In this connection Seller agrees that it shall progress and coordinate its Work with all other trades and subcontractors so as to enable Buyer to obtain the speediest possible completion of the

Prime Contract. Seller recognizes that completion of its Work within the time allowed is of the essence of this Agreement, and damages could result from late completion.

Buyer shall have the right but not the duty to exercise overall supervision and control over the schedule of the Work to be done by Seller. Directives by Buyer as to the time when Work of Seller shall begin and the manner in which it shall be progressed and completed in connection with other Work involved shall be complied with fully and promptly. Such overall supervision and control shall not in any way limit the obligations of Seller to directly supervise and control Seller's own Work and shall not constitute an assumption by Buyer of any responsibility for the detailed means, methods and procedures of Seller.

Before starting any of the on-site Work under the Subcontract, the Seller shall confer with Buyer and agree on: (a) a sequence of procedure; (b) means of access to premises and building; (c) space for storage of materials and equipment; (d) delivery of materials and use of approaches; (e) use of corridors, stairways, elevators, and similar means for Seller's employees; all as applicable to the Subcontract. Delivery of materials and equipment shall be made with a minimum of interference to Client and Buyer operations and personnel.

Seller recognizes that timely completion of the Work can be best assured through orderly and planned performance as required by the Prime Contract and Seller's schedules. Compliance with each of the detailed Work segments, milestones, personnel and resource allocations and other aspects of the Work plans and schedules is of the essence of this Subcontract. Buyer shall have the right to rely on Seller providing such orderly performance and compliance. Seller recognizes and acknowledges that Buyer shall be secure in such expectation and reliance and that such security shall not be impaired by Seller's failure to perform as required by the Subcontract. If reasonable grounds for insecurity do arise with respect to the performance of Seller, Buyer may, in writing, demand adequate assurance of due performance.

The type of assurance required may be specified by Buyer and may include Seller's written commitment, change order, or otherwise, to take steps which are reasonable under the circumstances, including, but not limited to, posting of bonds or security, acceleration, increase in work force or hours, and replacement and/or supplement of personnel, supervision or equipment. The adequacy of Seller's assurance shall be determined solely by Buyer.

After receipt of a justified demand, failure to provide within the time specified in the Notice not exceeding seven days, such assurance of due performance as is specified by Buyer, or as is adequate under the circumstances of the particular case, shall constitute a repudiation of the Subcontract whereupon Buyer may terminate the Subcontract without further liability to Seller and without prejudice to any other rights of Buyer, and such termination shall not affect the covenants of the parties set forth herein with respect to services which have been performed prior to the effective date of termination.

30. PAYMENT. Payment to Seller for Work performed under this Subcontract will be made as stated in the Specific Subcontract Requirements and Exhibit B thereto, which form a part of this Subcontract. Buyer may withhold payment due for, but not limited to, the following reasons: (a) Delays in the Work or faulty Work not corrected promptly; (b) Claims filed against the Seller or evidence that a claim will be filed; (c) Evidence that lower tier subcontractors or workmen have not received payment; (d) The balance unpaid on the Subcontract is, in the judgment of Buyer, insufficient to complete the Work; or (e) Seller has failed to provide Buyer with proof of and/or copies of its insurance policies, as required in Article 6.

Before Seller shall be entitled to final payment, Seller shall furnish Buyer, along with final invoice, satisfactory proof that there are no outstanding debts or liens in connection with this Subcontract, and shall execute and file with Buyer a Subcontractor Release Form, in the form attached as Exhibit D, whereby Seller releases any and all claims against Client and Buyer on account of this Subcontract and agrees to hold harmless Client and Buyer from all future claims, actions and liens.

31. CONFIDENTIALITY AND CONFLICTS OF INTEREST. Unless otherwise authorized by Buyer, Seller shall keep all information relating to this Subcontract and Work hereunder confidential. Further, to the extent that the Work under this Subcontract requires that the Seller be given access to confidential or proprietary business, technical or financial information belonging to the Client, Buyer or other companies, Seller shall after receipt thereof, treat such information as confidential and agrees not to appropriate such information to its own use or to disclose such information to third parties unless specifically authorized by Buyer's Contractual Representative in writing.

Seller, its officers, employees, agents or representatives shall not disclose or release any information, news release, public announcement, advertisement or other such publicity concerning this Subcontract or the Work or services hereunder to any third party without the express approval of Buyer. The restrictions set forth herein shall continue in effect upon completion or termination of this Subcontract. Failure to comply with the provisions of this Article shall be cause for termination of this Subcontract.

This Subcontract is non-exclusive. Buyer may, at its discretion, select and use others to provide the same type of Work contemplated by this Subcontract. Subcontractor is not prohibited from accepting work from other buyers during the term of this Subcontract, including work similar to that being provided hereunder, provided that such work is not in conflict with the business interests of Buyer or the Work being performed hereunder for Buyer or Client. Prior to accepting work from entities other than Buyer for Work arising from the same site or Client, Subcontractor will advise Buyer's Authorized Representative, as designated on the Signature Document, of the name of the entity and general nature of work to be performed in sufficient detail to enable Buyer to make a determination as to whether a potential conflict of interest exists and take appropriate action. The requirements of this Article are in addition to any conflict of interest requirements set forth elsewhere in the Subcontract.

32. PATENT WARRANTY AND INDEMNITY. The Seller hereby makes the following representations and warranties for the benefit of the Buyer: (a) It has a valid license or patent in its name, and has the legal right to use and employ for the benefit of the Buyer any and all technology, equipment, machinery, data, material and information to be used in the performance of, or in connection with, this Contract (hereinafter collectively referred to as "Technology"); (b) It has paid any and all necessary license fees, royalties, and related costs (hereinafter collectively referred to as "Royalties and Fees") for any and all Technology; (c) The Technology is not now, nor has it previously been the subject of an allegation of or law suit for infringement against the Seller or its affiliates.

If the Technology becomes subject of an allegation or suit for infringement, the Seller hereby agrees that it has an ongoing and continuous obligation to notify the Buyer within five (5) business days and shall take such action as directed by the Buyer to fulfill the Seller's indemnity obligations hereunder.

The Seller hereby agrees that all Royalties and Fees related to the Technology shall be the sole responsibility of the Seller and such shall be provided at no additional cost to the Buyer.

The Seller agrees to pay on demand any and all damages, costs and expenses (including without limitation, expenses and fees of legal counsel, court costs and cost of appellate proceedings) incurred by the Buyer in connection with enforcing this provision. The Buyer will not be required to resort to or pursue any of its rights or remedies under or with respect to any other provision of this subcontract, agreement, or collateral before pursuing any rights or remedies under this provision. The Buyer can at its sole option offset its costs and expenses hereunder against any amount owed to the Seller under this or any other contract between the Buyer and the Seller. The Buyer's rights and remedies under this provision are cumulative and not exclusive of any rights or remedies provided by law, this contract or any other contract.

The Seller agrees to include, and require inclusion of, this clause in all subcontracts at any tier for supplies or services (including construction and architect-engineer subcontracts and those for material, supplies, models, samples, or design or testing services) issued by the Seller in connection with the Contract.

33. CLAIMS AND LOSSES. To the fullest extent not prohibited by applicable law, Seller shall indemnify, hold harmless and defend Buyer, its parent, officers, employees, successors, assigns and customers (collectively, "Buyer") from and against all claims, liability, liens, loss, judgements, penalties, suits and damage (collectively, "Claims") whether for breach of the Subcontract, personal injury, death or damage to property and including without limitation, any costs, expenses and attorneys fees arising out of or caused by such Claims whether or not resulting or alleged to result from the negligence, but excluding sole negligence, of Buyer.

The Seller hereby agrees to indemnify the Buyer and its clients, officers, agents, employees and successors against all claims, liability, loss or damage, including without limitation, any cost, expense or attorneys fees for, or allegation of, infringement upon any United States or foreign patent, copyright infringement, or Technology arising out of or relating to the Work and shall pay all costs and damages resulting therefrom.

Without limiting the obligations assumed by Seller under the herein paragraphs of this Article and as a separate obligation hereunder, Seller agrees to defend any claim, action or proceeding which may be brought against Buyer arising out of or in connection with any Claim or the performance of Work hereunder, which is encompassed by the indemnity obligations set forth herein.

The Seller's obligation under this Article shall survive the termination or expiration of this Subcontract.

34. SEVERABILITY. Should any Article, portion or application therefore of this Subcontract be determined by a court of competent jurisdiction to be illegal, unenforceable or in conflict with any applicable law, the validity and enforceability of the remaining Articles, portions or applications thereof, including remaining aspects of an affected Article, shall not be impaired and, to the extent necessary, Buyer and Seller shall negotiate an equitable adjustment in the affected Articles of

this Subcontract. The audit, warranty, indemnification, insurance, confidentiality and conflict of interest requirements of the Subcontract shall survive the termination or expiration of this Subcontract for any reason.

35. HEADINGS. The headings within this Subcontract are for convenience only and are not intended to define, limit or affect construction of the contents of this Subcontract.

36.QUALITY CONTROL REQUIREMENTS. Subcontractor is solely responsible for conformance of its work, services, and goods with the drawings , specifications , quality and other requirements , and warranties thereof , as provided for in or arising in connection with this Subcontract ("Quality Requirements").

Subcontractor shall prepare and implement a formal procedure for the inspection of and verification of compliance with the Quality Requirements which shall at a minimum include requirements for written verification of daily inspections and a commitment that Subcontractor shall provide immediate notice to Contractor of any failures to meet Quality Requirements ("Quality Control Procedures"). Subcontractor's Quality Control Procedures shall be submitted to Contractor for review prior to commencement of work.

In its sole discretion Contractor may but shall not have any duty or responsibility to, review, audit, inspect or otherwise verify for its own benefit Subcontractor's procedures, records and performance related to Subcontractor's achievement of Quality Requirements and compliance with Quality Control Procedures. In no event , however , shall any review, audit , inspection , observance , acceptance or payment or other action or inaction by or of Contractor: (i) constitute any assumption by Contractor of , or relieve Subcontractor from full responsibility for , conformance with Quality Requirements or (ii) give rise to any right of reliance on the part of Subcontractor , its surety or any guarantor that Subcontractor is complying or has complied with Quality Requirements . Subcontractor on its behalf and on behalf of its surety or any guarantor agrees that Contractor has no duty to it or them and that they shall have no right to rely on any action or inaction of Contractor, in connection with Subcontractor's achievement of its Quality Requirements.

INSURANCE REQUIREMENTS CONSTITUTING PART OF

PRIME CONTRACT NO. _____ ORDER NO 1119113 DATED _____

Without limiting any of the other obligations or liabilities of the Seller, the Seller shall provide and maintain minimum insurance coverage(s) as follows:

	TYPE OF COVERAGE	LIMITS OF LIABILITY
1.	WORKERS' COMPENSATION Insurance for statutory obligations imposed by law including, where applicable, coverage under United States Longshoremen's and Harbor Workers' Act and Jones Act. Broad Form All States Endorsement. Waiver of subrogation in favor of Buyer.	STATUTORY
2.	EMPLOYERS' LIABILITY Bodily Injury by Accident Bodily Injury by Disease	$ 1,000,000.00 Each Accident $ 1,000,000.00 Each Disease policy limit $ 1,000,000.00 Disease Each Employee
3.	* COMMERCIAL GENERAL LIABILITY (Occurrence Form) Insurance providing coverage for bodily injury, personal injury, and property damage liability to include: Additional insured-CG20101185-Form B; broad form property damage; explosion, collapse and underground damage; products/completed operations for _1_ years after completion of work; contractual liability assumed under the indemnification provisions of this contract.	$ 1,000,000.00 Each Occurrence $ 1,000,000.00 General Aggregate $ 1,000,000.00 Completed Operations Aggregate
4.	AUTOMOBILE PUBLIC LIABILITY Coverage for bodily injury and property damage liability for all owned, hired, or non-owned motor vehicles including where applicable, Endorsement MCS-90 with pollution coverage for transporters of hazardous waste.	$ 1,000,000.00 Combined Single Limit
5.	WATERCRAFT LIABILITY - PROTECTION & INDEMNITY (Owned, Hired & Non-owned)	$ n/a Per Occurrence
6.	AIRCRAFT LIABILITY (Owned, Hired & Non-owned)	$ n/a Per Occurrence
7.	* EXCESS/UMBRELLA LIABILITY (Following Form Type)	$ 1,000,000.00 Each Occurrence
8.	ASBESTOS LIABILITY Coverage for asbestos removal and/or exceptions.	$ n/a Per Occurrence
9.	CONTRACTOR POLLUTION LIABILITY Coverage for any regulated substance or hazardous waste handling, removal, or remediation.	$ n/a Per Occurrence $ n/a General Aggregate
10.	NUCLEAR ENERGY LIABILITY Coverage for nuclear material transport.	$ n/a Per Occurrence
11.	PROFESSIONAL LIABILITY Coverage for professional services	$ 1,000,000.00 Per Occurrence
12.	RAILROAD PROTECTIVE LIABILITY (IF APPLICABLE) Coverage for operations within 50 feet of any railroad	$ n/a Per Occurrence $ n/a General Aggregate
13.	OTHER	$ n/a Per Occurrence

*Excess Combined Total for Items 3 and 7.

Except as to paragraphs 1, 2, 10 and 11 above, the Owner, Tetra Tech, Inc (Tt) -respective affiliated companies and their officers, directors, and employees shall be designated as additional Insureds by means of an unrestricted endorsement to the above policies with regard to any liability arising out of Seller's operations or completed operations. Buyer may request that copies of policies be delivered within ten days of starting Work. Such insurance shall be primary insurance and contain a Severability of Interest clause. Any other insurance maintained by the additional insureds named above shall not contribute with insurance provided by the Seller's insurer(s) under this additional insured provision

Seller shall, three (3) days following execution of any Subcontract, deliver one (1) copy of Tt Certificate of Insurance Form 194-71, acceptable Accord or other acceptable -insurance carrier form, completed by its insurance carrier or authorized agent certifying that minimum insurance coverages as required above are in effect will not be canceled or changed until thirty (30) days after written notice is given to Tt.

194-71
Revised: October 30, 2012

TETRA TECH, INC.

INSURANCE CERTIFICATION

This is to certify that the undersigned has obtained specific acknowledgment of compliance from Seller's insurance carrier(s) with regard to the Insurance Requirements set forth in Tt Form Number 194-71, including specifically without limitation:

1. **Contractual liability insurance to cover the hold harmless/indemnification provision(s) of this subcontract; and**
2. **Endorsement of coverage to Tt entities as additional insureds on a primary basis to insurance maintained by the additional insureds.**

Seller agrees that (i) Insurance certificates which are to be furnished prior to start of work shall specifically refer to items 1 and 2 above; (ii) Receipt of certificates which vary from the foregoing Insurance Requirements shall not be deemed to waive the terms of such Requirements; and (iii) Buyer may request that copies of policies be delivered within ten days of starting Work.

Water Solve
SELLER'S NAME

Kari Warden 10/29/15
SIGNATURE & DATE

Controller
TITLE
(Corporate Officer)

POLICIES MUST BE ENDORSED TO COVER THESE REQUIREMENTS

194-71
Revised: October 30, 2012

194-71
Revised: October 30, 2012

TETRA TECH EC, INC.

Agreement and Acknowledgement of Lower Tier Subcontractor Terms and Conditions

The undersigned, as the Lower Tier Subcontractor ("LTS") hereby acknowledges that they have received the following contract clauses ("Terms and Conditions") in full text as part of their subcontract/Purchase Order No. ___ from ___ ("Buyer"). The LTS hereby agrees that notwithstanding any other terms to the contrary (including Order of Precedence) they shall strictly comply with the Terms and Conditions with no exceptions.

Checked Provisions are incorporated into the order: (LTS should initial next to each item received.)			
☒	Clauses identified in the "Lower Tier Subcontracts and Purchase Orders" Article of Tetra Tech EC, Inc.'s Terms & Conditions entitled, Off-Site General, Laboratory and Related Activities, document number dtd January 16, 2012	☐	Flow Down Provisions of Prime Contract No. , document number
☒	Insurance Requirements, document number 194-71	☐	Davis Bacon Wage Determinations, document number
☐	Health and Safety Requirements, document number	☐	Service Contract Act Wage Determination,
☐	Project Health & Safety Plan, document number	☐	Letter of Assent, document number
☐	Representations and Certifications, document number	☐	Quality Assurance Provisions, document number
☐	Standard Form (SF) 1413, Statement and Acknowledgment, document number	☐	Anti-Kickback Procedures, document number
☐	Travel Reimbursement Policy, document number	☐	Other:

The parties hereby agree that incorporation of these Terms and Conditions into the subcontract/PO between Buyer and LTS provides for protection of certain third party interest of Tetra Tech EC, Inc. and in no way causes Tetra Tech EC, Inc. to become a party to such subcontract/PO. Tetra Tech EC, Inc. is not a party to any such subcontract/PO between Buyer and LTS, and has no privity of contract with LTS thereunder.

A completed copy of this Agreement and an insurance certificate naming Tetra Tech EC, Inc. as additional insured in accordance with the Insurance

GCS # GC000K78.doc
Revised: January 4, 2007

Requirements must be returned to Tetra Tech EC, Inc.'s Contractual Representative prior to commencement of work by LTS.

NOW, IN WITNESS WHEREOF, AND INTENDING TO BE LEGALLY BOUND, LTS hereby agrees to these Terms and Conditions by their duly authorized representatives:

____
LTS Company Name

____
Authorized Representative's Name & Title

____
Authorized Representative's Signature and Date

GCS # GC000K78.doc
Revised: January 4, 2007

No.	Qty	Item Description	U/M	Unit Price	Ext. Price

PERIOD OF PERFORMANCE: Tentatively scheduled to begin work October 28, 2015 with all work completed by November 30, 2015. Coordinate the actual schedule and activities with Tetra Tech, Inc's Ronald Marnicio, Project Manager, Telephone: 617-443-7551; Email: ronald.marnicio@tetratech.com

ENTIRE AGREEMENT: This Purchase Order contains the entire agreement between the parties as to the Work rendered hereunder. All previous, subsequent, or contemporaneous agreements, representations, warranties, promises, and conditions relating to the subject matter of this Purchase Order are hereby superseded unless specifically added in a written Modification, entitled "Modification" and executed by both parties.

NOW, IN WITNESS WHEREOF, AND INTENDING TO BE LEGALLY BOUND, the parties' duly authorized representatives have executed this Purchase Order.

SELLER: Water Solve, LLC

BY Karri Worden
(TYPED)

SIGNATURE Karri Worden

DATE 10/29/15

Shipping: $0.00
Tax: $0.00
Total: $7,800.00

Approver Name: Geralyn Poshka **Date:**

TETRA TECH, INC.

Work Breakdown Structure - Summary

Line	Project	Task	Expenditure Type	Org	Amount
1	106-4383	0005.0005	Subcontractor-External	194 CES Boston, MA	$7,800.00
					Total: $7,800.00

Requisitions 420211

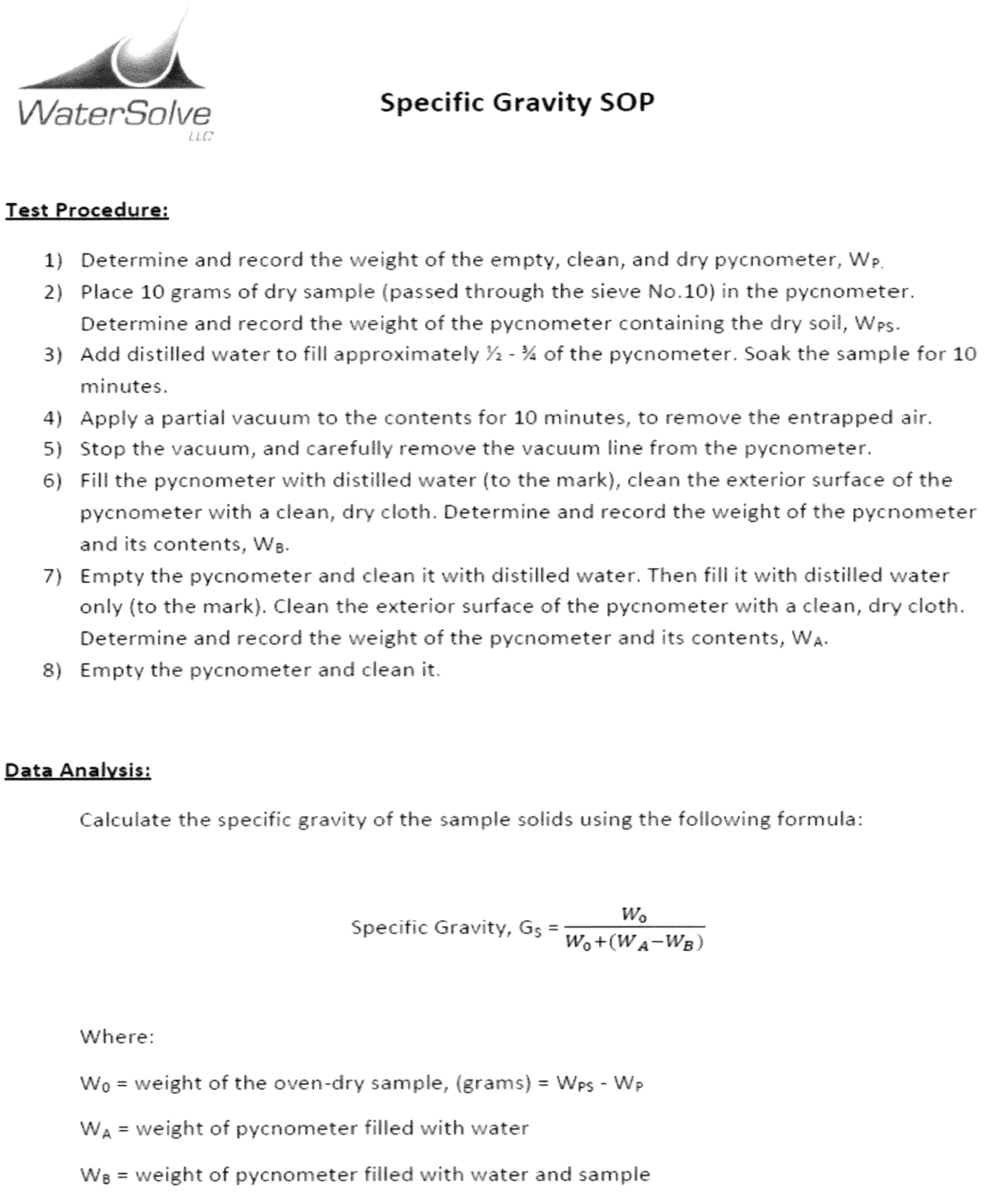
RFP:

Order: 1119113-0-0

Page 1 of 1

Award Date:

Appendix B Specific Gravity SOP and Data Sheets



WaterSolve LLC

Specific Gravity SOP

Test Procedure:

1) Determine and record the weight of the empty, clean, and dry pycnometer, W_P.
2) Place 10 grams of dry sample (passed through the sieve No.10) in the pycnometer. Determine and record the weight of the pycnometer containing the dry soil, W_{PS}.
3) Add distilled water to fill approximately ½ - ¾ of the pycnometer. Soak the sample for 10 minutes.
4) Apply a partial vacuum to the contents for 10 minutes, to remove the entrapped air.
5) Stop the vacuum, and carefully remove the vacuum line from the pycnometer.
6) Fill the pycnometer with distilled water (to the mark), clean the exterior surface of the pycnometer with a clean, dry cloth. Determine and record the weight of the pycnometer and its contents, W_B.
7) Empty the pycnometer and clean it with distilled water. Then fill it with distilled water only (to the mark). Clean the exterior surface of the pycnometer with a clean, dry cloth. Determine and record the weight of the pycnometer and its contents, W_A.
8) Empty the pycnometer and clean it.

Data Analysis:

Calculate the specific gravity of the sample solids using the following formula:

$$\text{Specific Gravity, } G_S = \frac{W_0}{W_0+(W_A-W_B)}$$

Where:

W_0 = weight of the oven-dry sample, (grams) = W_{PS} - W_P

W_A = weight of pycnometer filled with water

W_B = weight of pycnometer filled with water and sample

WaterSolve LLC

Date Tested: 12/4/15

Tested By: DCW

Project Name: FIREWORK / PROJECT TETRAT.

Sample Number: SD-MLFP-BD / SD-LUFP-BD

Sample Description: SEDIMENT

Equations:

$W_0 = W_{PS} - W_P$

$$\text{Specific Gravity } (G_S) = \frac{W_0}{W_0 + (W_A - W_B)}$$

Trial 1

Pycnometer Bottle Number	MLFP	1
W_P = Mass of empty, clean, pycnometer (grams)		41.296
W_{PS} = Mass of empty pycnometer + dry soil (grams)		47.573
W_B = Mass of pycnometer + dry soil + water (grams)		94.765
W_A = Mass of pycnometer + water (grams)		91.033
Specific Gravity (G_S)		2.47

Calculations:

$W_0 = 47.573 - 41.296$

$= 6.277$

$$G_S = \frac{6.277}{6.277 + (91.033 - 94.765}$$

$= 2.47$

Trial 2

Pycnometer Bottle Number	LUFP	2
W_P = Mass of Empty, Clean, Pycnomter (grams)		40.615
W_{PS} = Mass of empty pycnometer + dry soil (grams)		48.282
W_B = Mass of pycnometer + dry soil + water (grams)		95.260
W_A = Mass of pycnometer + water (grams)		90.540
Specific Gravity (G_S)		2.60

Calculations:

$W_0 = 48.282 - 40.615$

$= 7.667$

$$G_S = \frac{7.667}{7.667 + (90.540 - 95.260)}$$

$= 2.60$

WaterSolve LLC

Date Tested: 12/4/15
Tested By: DCW
Project Name: FIREWORK 1 / TETRA TECH
Sample Number: SD-ECCS-DB
Sample Description: SEDIMENT

Equations:

$W_0 = W_{PS} - W_P$

$$\text{Specific Gravity } (G_S) = \frac{W_0}{W_0 + (W_A - W_B)}$$

Trial 1

Pycnometer Bottle Number ECCS	3
W_P = Mass of empty, clean, pycnometer (grams)	41.268
W_{PS} = Mass of empty pycnometer + dry soil (grams)	48.615
W_B = Mass of pycnometer + dry soil + water (grams)	94.688
W_A = Mass of pycnometer + water (grams)	91.003
Specific Gravity (G_S)	2.00

Calculations:

$W_o = 48.615 - 41.268$

$= 7.347$

$$G_S = \frac{7.347}{7.347 + (91.003 - 94.688)}$$

$= 2.00$

Trial 2

Pycnometer Bottle Number	
W_P = Mass of Empty, Clean, Pycnomter (grams)	
W_{PS} = Mass of empty pycnometer + dry soil (grams)	
W_B = Mass of pycnometer + dry soil + water (grams)	
W_A = Mass of pycnometer + water (grams)	
Specific Gravity (G_S)	

Calculations:

Appendix C

TRIMATRIX
LABORATORIES

December 09, 2015

WATERSOLVE, LLC
Attn: Doug Walker
5031 68th St. SE
Calendonia, MI 49316

Project: Laboratory Services

Dear Doug Walker,

Enclosed is a copy of the laboratory report for the following work order(s) received by TriMatrix Laboratories:

Work Order	Received	Description
1511479	11/20/2015	Laboratory Services

This report relates only to the sample(s) as received. Test results are in compliance with the requirements of the National Environmental Laboratory Accreditation Program (NELAP) and/or one of the following certification programs:

ANAB DoD-ELAP/ISO17025 (#ADE-1542); Arkansas DEP (#88-0730/13-049-0); Florida DEP (#E87622-24); Georgia EPD (#E87622-24); Illinois DEP (#200026/003329); Kentucky DEP (AL123065/#0021); Michigan DPH (#0034); Minnesota DPH (#491715); New York ELAP (#11776/53116); North Carolina DNRE (#659); Virginia DCLS (#460153/7952); Wisconsin DNR (#999472650); USDA Soil Import Permit (#P330-14-00305).

Any qualification or narration of results, including sample acceptance requirements and test exceptions to the above referenced programs, is presented in the Statement of Data Qualifications and Project Technical Narrative sections of this report. Estimates of analytical uncertainties and certification documents for the test results contained within this report are available upon request.

If you have any questions or require further information, please do not hesitate to contact me.

Sincerely,

James D. McFadden
Project Chemist

cc: Accounts Payable

PROJECT TECHNICAL NARRATIVE(s)

No Project Narrative is associated with this report.

STATEMENT OF DATA QUALIFICATIONS

Physical/Chemical Parameters by EPA/APHA/ASTM Methods

Qualification: The following reported test methods and analyte(s) are exceptions to our NELAP Fields of Accreditation, or for which accreditation is not required, applicable, or available.

Analysis: ASTM D2974-87

Analyte(s): Fractional Organic Carbon

ANALYTICAL REPORT

Client:	**WATERSOLVE, LLC**	Work Order:	**1511479**
Project:	Laboratory Services	Description:	Laboratory Services
Client Sample ID:	**SD-LUFP-BP**	Sampled:	11/20/15 15:00
Lab Sample ID:	**1511479-01**	Sampled By:	Doug Walker
Matrix:	Sediment	Received:	11/20/15 15:29

Physical/Chemical Parameters by EPA/APHA/ASTM Methods

Analyte	Analytical Result	RL	Unit	Dilution Factor	Method	Date Time Analyzed	By	QC Batch
Fractional Organic Carbon	**0.0302**	0.0010	g C/g Soil	1	ASTM D2974-87	12/05/15 13:45	HLB	1513340

ANALYTICAL REPORT

Client:	**WATERSOLVE, LLC**		Work Order:	**1511479**
Project:	Laboratory Services		Description:	Laboratory Services
Client Sample ID:	**SD-MLFP-BP**		Sampled:	11/20/15 15:00
Lab Sample ID:	**1511479-02**		Sampled By:	Doug Walker
Matrix:	Sediment		Received:	11/20/15 15:29

Physical/Chemical Parameters by EPA/APHA/ASTM Methods

Analyte	Analytical Result	RL	Unit	Dilution Factor	Method	Date Time Analyzed	By	QC Batch
Fractional Organic Carbon	**0.0156**	0.0010	g C/g Soil	1	ASTM D2974-87	12/05/15 13:45	HLB	1513340

TRIMATRIX LABORATORIES

ANALYTICAL REPORT

Client:	**WATERSOLVE, LLC**	Work Order:	**1511479**
Project:	Laboratory Services	Description:	Laboratory Services
Client Sample ID:	**SD-ECCS-BP**	Sampled:	11/20/15 15:00
Lab Sample ID:	**1511479-03**	Sampled By:	Doug Walker
Matrix:	Sediment	Received:	11/20/15 15:29

Physical/Chemical Parameters by EPA/APHA/ASTM Methods

Analyte	Analytical Result	RL	Unit	Dilution Factor	Method	Date Time Analyzed	By	QC Batch
Fractional Organic Carbon	**0.1126**	0.0010	g C/g Soil	1	ASTM D2974-87	12/05/15 13:45	HLB	1513340

TRIMATRIX LABORATORIES

Chain of Custody Record

COC No. 151129424

5560 Corporate Exchange Court SE, Grand Rapids, MI 49512
Phone (616) 975-4500 Fax (616) 942-7463 www.trimatrixlabs.com

Analyses Requested

Pg. 1 of 1

For Lab Use Only
Cart: 3
VOA Rack/Tray:
Receipt Log No. 43-16
Project Chemist: Jim McFadden
Work Order No. 1511479

Client Name: WATERSOLVE, LLC
Address: 5031 68th St. SE
City, State Zip: Caledonia, MI 49316
Phone: (616) 443-4568 Fax:
Email:

Project Name:
Client Project No. / P.O. No.:
Invoice To: ☑ Client ☐ Other (comments)
Contact/Report To:

Analyses Requested: A – FOC by ASTM 2974

Container Type (corresponds to Container Packing List): 3

PRESERVATIVES
A NONE pH~7
B HNO_3 pH<2
C H_2SO_4 pH<2
D 1+1 HCl pH<2
E NaOH pH>12
F ZnAc/NaOH pH>9
G MeOH
H Other (note below)

Schedule	Matrix Code	Sample Number		Field Sample ID	Cooler ID	Sample Date	Sample Time	COMP	GRAB	Matrix	A (3) Number of Containers Submitted	Total	Sample Comments
		01	1	SD-LUFP-BP		11/20/15	15:00		X	SED	1	1	
		02	2	SD-MLFP-BP		11/20/15	15:00		X	SED	1	1	
		03	3	SD-ECCS-BP		11/20/15	15:00		X	SED	1	1	
			4										
			5										
			6										
			7										
			8										
			9										
			10										

Sampled By (print): DOUG WALKER
Sampler's Signature:
Company: WATERSOLVE, LLC

How Shipped? Hand ✓ Carrier
Tracking No.

Comments:

	Date	Time
1. Relinquished By: DOUG WALKER	11/20/15	15:00
1. Received By:		
2. Relinquished By:		
2. Received By:		
3. Relinquished By:		
3. Received For Lab By:	11/20.15	11 9

ORIGINAL - LABORATORY COPY - SAMPLER

SAMPLE RECEIVING / LOG-IN CHECKLIST

TRIMATRIX LABORATORIES

Client: Watersolve, LLC
Work Order #: 1511479
New / Add To
Receipt Record Page/Line #: 43-12
Project Chemist
Sample #s: 01-03

Recorded by (initials/date): JN 11/20/15

☒ Cooler
☐ Box
☐ Other

Qty Received: 1

Thermometer Used: ☒ IR Gun (#202) ☐ Digital Thermometer (#54) ☐ Other (#_____)

☐ See Additional Cooler Information Form

Cooler #: — Time: 1735

Custody Seals:
- ☒ None
- ☐ Present / Intact
- ☐ Present / Not Intact

Coolant Type:
- ☐ Loose Ice
- ☐ Bagged Ice
- ☐ Blue Ice
- ☒ None

Coolant Location:
Dispersed / Top / Middle / Bottom

Temp Blank Present: ☐ Yes ☐ No

If Present, Temperature Blank Location is: ☐ Representative ☐ Not Representative

	Observed °C	Correction Factor °C	Actual °C
Temp Blank			
Sample 1	21.6	0	21.6
Sample 2	21.7	0	21.7
Sample 3	21.2	0	21.2

3 Sample Average °C: 21.5

☐ Cooler ID on COC?
☐ VOC Trip Blank received?

Cooler # Time

Custody Seals:
- ☐ None
- ☐ Present / Intact
- ☐ Present / Not Intact

Coolant Type:
- ☐ Loose Ice
- ☐ Bagged Ice
- ☐ Blue Ice
- ☐ None

Coolant Location:
Dispersed / Top / Middle / Bottom

Temp Blank Present: ☐ Yes ☐ No

If Present, Temperature Blank Location is: ☐ Representative ☐ Not Representative

	Observed °C	Correction Factor °C	Actual °C
Temp Blank			
Sample 1			
Sample 2			
Sample 3			

3 Sample Average °C:

☐ Cooler ID on COC?
☐ VOC Trip Blank received?

Cooler # Time

Custody Seals:
- ☐ None
- ☐ Present / Intact
- ☐ Present / Not Intact

Coolant Type:
- ☐ Loose Ice
- ☐ Bagged Ice
- ☐ Blue Ice
- ☐ None

Coolant Location:
Dispersed / Top / Middle / Bottom

Temp Blank Present: ☐ Yes ☐ No

If Present, Temperature Blank Location is: ☐ Representative ☐ Not Representative

	Observed °C	Correction Factor °C	Actual °C
Temp Blank			
Sample 1			
Sample 2			
Sample 3			

3 Sample Average °C:

☐ Cooler ID on COC?
☐ VOC Trip Blank received?

Cooler # Time

Custody Seals:
- ☐ None
- ☐ Present / Intact
- ☐ Present / Not Intact

Coolant Type:
- ☐ Loose Ice
- ☐ Bagged Ice
- ☐ Blue Ice
- ☐ None

Coolant Location:
Dispersed / Top / Middle / Bottom

Temp Blank Present: ☐ Yes ☐ No

If Present, Temperature Blank Location is: ☐ Representative ☐ Not Representative

	Observed °C	Correction Factor °C	Actual °C
Temp Blank			
Sample 1			
Sample 2			
Sample 3			

3 Sample Average °C:

☐ Cooler ID on COC?
☐ VOC Trip Blank received?

If any shaded areas checked, complete Sample Receiving Non-Conformance and/or Inventory Form

Paperwork Received

Yes	No	
☒	☐	Chain of Custody record(s)? If No, Initiated By ________
☒	✓	Received for Lab Signed/Date/Time?
☐	☒	Shipping document?
☐	☒	Other ________

COC Information

☒ TriMatrix COC ☐ Other ________

COC ID Numbers: 1511294124

Check COC for Accuracy

Yes	No	
☒	☐	Analysis Requested?
☒	☐	Sample ID matches COC?
☒	☐	Sample Date and Time matches COC?
☒		Container type completed on COC?
☒	☐	All container types indicated are received?

Sample Condition Summary

N/A	Yes	No	
	☐	☒	Broken containers/lids?
	☐	☒	Missing or incomplete labels?
	☐	☒	Illegible information on labels?
	☐	☒	Low volume received?
	☐	☒	Inappropriate or non-TriMatrix containers received?
☒	☐	☐	VOC vials / TOX containers have headspace?
☒	☐	☐	Extra sample locations / containers not listed on COC?

Check Sample Preservation

N/A	Yes	No	
	☒	☐	Temperature Blank OR average sample temperature, ≥6° C?
☒	☐	☐	If either is ≥6° C, was thermal preservation required?
☒	☐		If "Yes", Project Chemist Approval Initials: ________
☒	☐		If "Yes" Completed Non Con Cooler - Cont Inventory Form?
☒	☐		Completed Sample Preservation Verification Form?
☒	☐	☐	Samples chemically preserved correctly?
☒	☐		If "No", added orange tag?
	☐	☐	Received pre-preserved VOC soils?

☐ MeOH ☐ Na_2SO_4

Check for Short Hold-Time Prep/Analyses

- ☐ Bacteriological
- ☐ Air Bags
- ☐ EnCores / Methanol Pre-Preserved
- ☐ Formaldehyde/Aldehyde
- ☒ Green-tagged containers
- ☐ Yellow/White-tagged 1 L ambers (SV Prep-Lab)

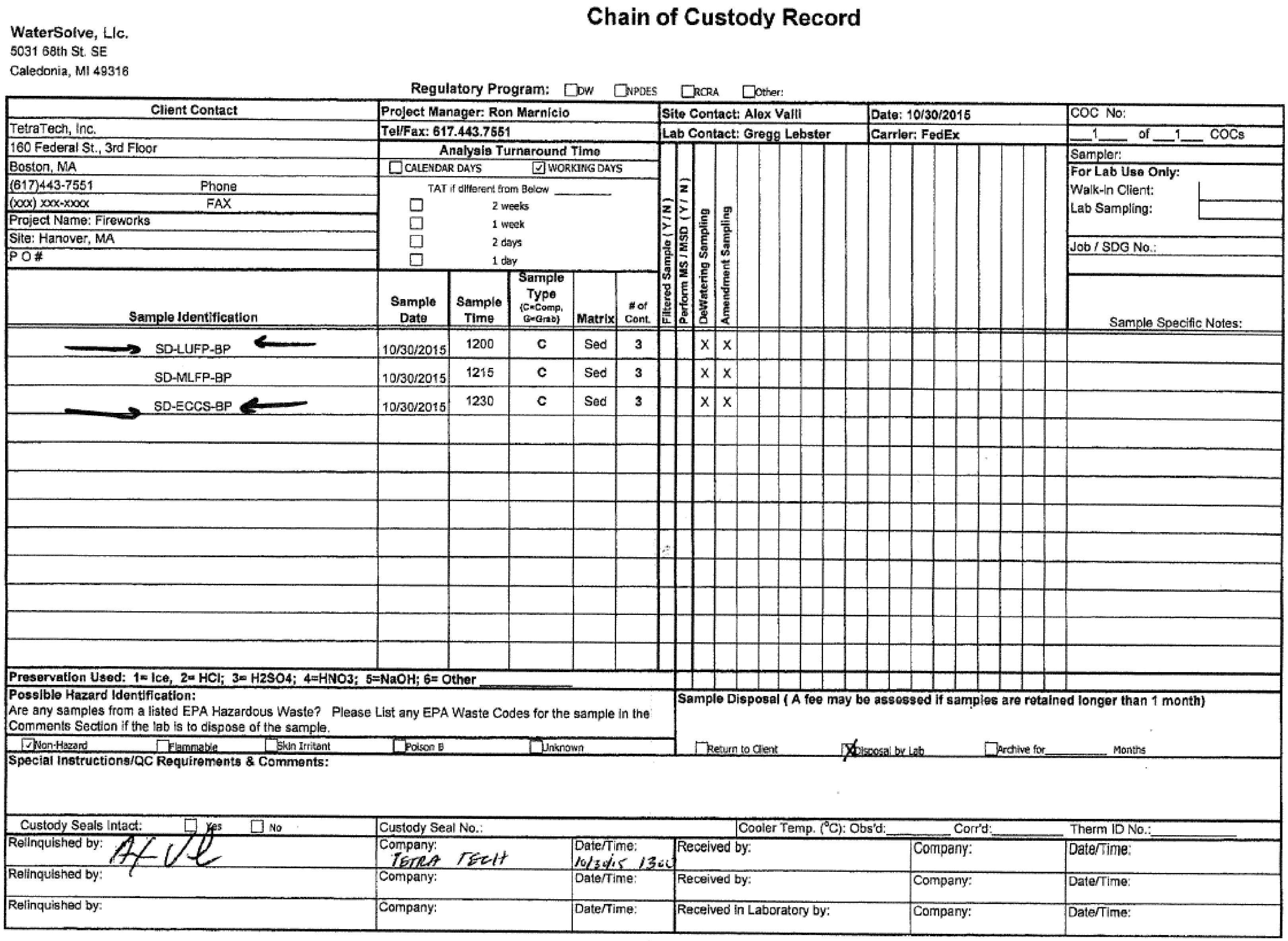
AFTER HOURS ONLY:
COPIES OF COC TO LAB AREA(S)
☐ NONE RECEIVED
☒ RECEIVED, COCs TO LAB(S)

Notes

☐ Trip Blank received ☐ Trip Blank not listed on COC

Cooler Received (Date/Time)	Paperwork Delivered (Date/Time)	≤1 Hour Goal Met?
JN 11/20/15	11/20/15	Yes / No

Appendix D Sample COC



Chain of Custody Record

WaterSolve, Llc.
5031 68th St. SE
Caledonia, MI 49316

Regulatory Program: ☐DW ☐NPDES ☐RCRA ☐Other:

Client Contact
TetraTech, Inc.
160 Federal St., 3rd Floor
Boston, MA
(617)443-7551 Phone
(xxx) xxx-xxxx FAX
Project Name: Fireworks
Site: Hanover, MA
P O #

Project Manager: Ron Marnicio
Tel/Fax: 617.443.7551

Analysis Turnaround Time
☐ CALENDAR DAYS ☑ WORKING DAYS
TAT if different from Below ________
☐ 2 weeks
☐ 1 week
☐ 2 days
☐ 1 day

Site Contact: Alex Valli
Lab Contact: Gregg Lebster

Date: 10/30/2015
Carrier: FedEx

COC No:
__1__ of __1__ COCs
Sampler:
For Lab Use Only:
Walk-in Client:
Lab Sampling:
Job / SDG No.:

Sample Identification	Sample Date	Sample Time	Sample Type (C=Comp, G=Grab)	Matrix	# of Cont.	Filtered Sample (Y / N)	Perform MS / MSD (Y / N)	DeWatering Sampling	Amendment Sampling	Sample Specific Notes:
SD-LUFP-BP	10/30/2015	1200	C	Sed	3			X	X	
SD-MLFP-BP	10/30/2015	1215	C	Sed	3			X	X	
SD-ECCS-BP	10/30/2015	1230	C	Sed	3			X	X	

Preservation Used: 1= Ice, 2= HCl; 3= H2SO4; 4=HNO3; 5=NaOH; 6= Other ________

Possible Hazard Identification:
Are any samples from a listed EPA Hazardous Waste? Please List any EPA Waste Codes for the sample in the Comments Section if the lab is to dispose of the sample.
☑ Non-Hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown

Sample Disposal (A fee may be assessed if samples are retained longer than 1 month)
☐ Return to Client ☒ Disposal by Lab ☐ Archive for ________ Months

Special Instructions/QC Requirements & Comments:

Custody Seals Intact: ☐ Yes ☐ No
Custody Seal No.:
Cooler Temp. (°C): Obs'd: ________ Corr'd: ________
Therm ID No.: ________

Relinquished by: AV	Company: TETRA TECH	Date/Time: 10/30/15 1300	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received by:	Company:	Date/Time:
Relinquished by:	Company:	Date/Time:	Received in Laboratory by:	Company:	Date/Time:

Package Inquiry Home

Package Inquiry

Tina L. Edwards (188433)
eOps Home | Package Inquiry Help | eOpsInfo | Logout
Quick Navigation

Package Inquiry

Report run on Tue Nov 03 06:37:22 CST 2015

PACKAGE TRACKING NUMBER: [redacted] CLEAR REFRESH

Associated Track Numbers GSDR

Package

Form ID:	0215 - US Domestic Preprint Airbill		
Ship Date:	10/30/2015	**Service Commit Date/Time**	11/04/2015 16:30:00
Service Commit Area	A1	**CDO Commit Date/Time**	
Origin LOC ID:	NZWA	**Destination LOC ID:**	GRRA
Service/Packaging Type:	EXPRESS SAVER	**Handling Codes:**	02-DELIVER WEEKDAY
Package Weight:		**Declared/Carriage Value:**	
Shipment Weight:	449.00 lb	**Shipment Declared/Carriage Value:**	
Total Packages: 00008		**Total Customs Value:**	
Shipper Account:	175533958	**Payment Type:**	SHIPPER ACCOUNT 175533958
Shipper Reference:	106 4348 OR SAMPLES	**Commodity Description:**	
eSQI Service Classification:		**MBG Service Classification:**	
Shipper Company:	TETRA TECH	**Recipient Company:**	WATER SOLVE SAMPLE RECEIVNG
Name:	ALEX VALU	**Name:**	
Address:	1000 THE AMERICAN RD	**Address:**	5031 68TH ST SE
Additional Address:		**Additional Address:**	
City:	MORRIS PLAINS	**City:**	CALEDONIA
State/Province:	NJ	**State/Province:**	MI
Postal:	07950-2406	**Postal:**	49316
Country:	US - UNITED STATES	**Country:**	US - UNITED STATES
Shipper Phone:	9736308428	**Recipient Phone:**	

Original Address

PACKAGE TRACKING NUMBER: [redacted] PRIME TRACKING NUMBER: [redacted]

Scans

Filters

All

ID	TRACK TYPE	ASTRA	CONS	SCAN DATE TIME	LOC ID	FedEx ID	SOURCE / SYSTEM NAME	SVC	STATUS / COMMENTS
31	SIPS	Y		11/03/2015 06:10	GRRA	195318	PSCAN		CITY: KENTWOOD STATE: MI SCANNING EMPLOYEE LOC: GRRA ---- POST DATE/TIME 11/03/2015 06:11:08
30	Arrival	N	Y	11/03/2015 05:45	GRRA		TRIP		---- POST DATE/TIME 11/03/2015 05:51:42
29	CONS	N		11/03/2015 05:30	GRRR	168407	TRIP		CONSOLIDATED ID: 304687937302 TRUCK: GRR50 DEST: GRRA M/S: N ---- POST DATE/TIME 11/03/2015 05:51:19
28	ROPS	N	Y	11/03/2015 05:30	GRRR	168407	TRIP		CITY: GRAND RAPIDS STATE: MI SCANNING EMPLOYEE LOC: GRRR ---- POST DATE/TIME 11/03/2015 05:51:18
27	CONS	Y		11/03/2015 05:08	GRRR	394811	PSCAN		CONSOLIDATED ID: 219902254420 BULK: AMJ40657FX DEST: GRRA M/S: N SPLIT NBR: 21 ---- POST DATE/TIME 11/03/2015 05:09:01
26	RIPS	N	Y	11/03/2015 02:30	GRRR		TRIP		CITY: GRAND RAPIDS STATE: MI SCANNING EMPLOYEE LOC: GRRR ---- POST DATE/TIME 11/03/2015 02:50:57
25	CONS	N		11/02/2015 11:45	MEMH	109242	TRIP		CONSOLIDATED ID: 304687913945 TRUCK: MC062 DEST: GRRR M/S: N

APPENDIX 7A

Final Dredge Elutriate Testing MassDEP Project
Hanover, MA Site

FINAL
Dredging Elutriate Testing
MASSDEP Project
Hanover, MA Site

Prepared for

Tetra Tech, CES

December 14, 2015

TETRA TECH

1634 Eastport Plaza Drive
Collinsville, IL 62234
618-345-0669
www.tetratech.com

TABLE OF CONTENTS

Exhibits

Tables

Appendices

ACRONYMS

COC	contaminant of concern
DRET	dredging elutriate testing
ERDC	Engineering Research and Development Center
FS	Feasibility Study
GC/MS-SIM	gas chromatography/mass spectrometry with single ion monitoring
g/L	gram per liter
ID	Identification
Kd	partitioning coefficient in units of liters per kilogram
l/kg	liters per kilogram
MCP	Massachusetts Contingency Plan
MassDEP	Massachusetts Department of Environmental Protection
ug/L	micrograms per liter
um	micron
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
PAH	polynuclear aromatic hydrocarbons
PCBs	polychlorinated biphenyls
PDC	Peoria Disposal Company, Inc.
Tetra Tech	Tetra Tech, Inc.
TSS	total suspended solids
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency

1.0 INTRODUCTION

Tetra Tech Collinsville, Illinois office (Tetra Tech) performed Dredging Elutriate Testing (DRET) in support of the Tetra Tech–CES Fireworks MASSDEP Project. The DRET results will provide data for estimating the degree of contaminant release from the various sediment media due to resuspension at the point of dredging.

To accomplish the key objective of developing definitive data for estimating the degree of contaminant release, Tetra Tech performed DRET in accordance with the "*Dredging Elutriate Test Procedure*", which is included as Appendix A to the primary document – US Army Corps of Engineers, ERDC/EC TR-08-29, "Technical Guidelines for Environmental Dredging of Contaminated Sediments", September 2008. (A copy of the DRET procedure is also included as Appendix A to this document.)

The report that follows will describe the procedures used to perform the DRET, DRET results/findings, and test conclusions and recommendations as appropriate.

2.0 DRET PROCEDURES AND RESULTS

Representative sediment and surface water media from three project locations (LUFP-BP, MLFP-BP, and ECCS-BP) were received by Tetra Tech at the PDC Laboratory in St. Louis, Missouri on November 3, 2015. A total of nine coolers and three 5-gallon buckets were shipped via Federal Express and received intact at the PDC Laboratory facility. Sample Chain-of-Custody records are included in Appendix B.

Each of the coolers contained two 5-gallon poly cubes of surface water for a total of 30 gallons of surface water for each location. Each of the three buckets contained approximately four gallons of wet sediment. The sediment and water sample IDs were identified as follows:

- SD-LUFP-BP
- SD-MLFP-BP
- SD-ECCS-BP

The sediment samples were homogenized by light mixing and samples were collected for total solids determination. The total solids data will be used for calculating the amounts of sediment required to generate each of the sediment slurries used in the DRET. A composite of the surface water samples was also generated by combining two liters of each water sample to generate a total of six liters of surface water composite. The surface water composite sample (SW-COMP) was analyzed for total suspended solids (TSS), Polynuclear Aromatic Hydrocarbons (PAH), Priority Pollutant metals (13 metals), and Polychlorinated Biphenyls (PCB). Photodocumentation of sample receipt and the DRET process/procedure is included in Appendix C.

2.1 Dredge Elutriate Test

A DRET was performed to assess the potential impact(s) to surface water (i.e., mass transfer of contaminants from sediment to surrounding surface water) from possible contaminated sediment during dredging operations. The DRET method is particularly effective for examining the short-term contaminant release at the point of dredging. The test was performed using a solids concentration ranging from 1 to 10 g/L, aeration times of one hour and six hours and settling for one hour after the aeration of the sediment slurry ceased in the test reactors.

2.1.1 DRET Procedure

DRET was performed in accordance with the Dredging Elutriate Test Procedure (USEPA/USACE, 2008). As referenced earlier, a copy of the general DRET procedure used during the testing is presented in Appendix A. It should be noted that because of the sample volumes required for the required test parameters, namely, PCBs, PAHs, and metals, larger containers (reactors) were used instead of the four-liter graduated cylinders specified in the DRET procedure. An overview of this procedure for water quality evaluations is as follows:

- **Step 1: Slurry Preparation.** Sediment and surface water collected from areas of possible dredging were mixed to target concentrations of 1 g/L, 5 g/L, and 10 g/L (0.1%, 0.5%, and 1.0%), dry weight basis. The solids content of the well-mixed sediment in % solids (dry weight basis) was determined by oven drying a small subsample of known mass. (Total Solids Data is included in Appendix D.) Each test container used in the analyses will require a mixed slurry volume of approximately 17 liters.

  The volumes of sediment and water to be mixed for a 17 liter slurry volume will be calculated using the following expressions:

$$V_{se\dim ent} = 17 \frac{c_{slurry}}{c_{se\dim ent}}$$

  and

$$V_{water} = 17 - V_{se\dim ent}$$

  where:

  $V_{sediment}$ = volume of sediment (liters)
  17 = volume of slurry for the 20 liter reactor
  C_{slurry} = desired concentration of slurry (1, 5, or 10 g/L dry weight basis)
  $C_{sediment}$ = predetermined concentration of sediment (g/L dry weight basis)
  V_{water} = volume of disposal site water (liters)

  It should be noted that the actual test procedure followed for the DRET recommended the testing of slurry at concentrations 1 g/L, 5 g/L, and 10 g/L.

- **Step 2: Mixing.** The 17 liters of slurry was mixed by placing appropriate volumes of collected sediment and surface water into a 5-gallon open top reactor and mixing for five minutes with a laboratory blade mixer. The sediment slurries were mixed to a uniform consistency, with no unmixed clumps of sediment remaining.
- **Step 3: Aeration**. The prepared slurries were aerated to ensure that oxidizing conditions were present in the supernatant water during the subsequent settling phase. Bubble aeration was used as a method of sample agitation. The mixed slurries were poured into 5-gallon glass reactors after the initial 5 minute mixing period. Tubing was attached to the aeration source and the tubing was inserted to reach the bottom of the glass reactor. Compressed air was passed through the tubing, and bubbled through the slurries. The flow rates were adjusted to agitate the mixture vigorously for either one hour or six hours depending on what subtest was being performed.
- **Step 4: Settling.** The aeration tubing was removed and the slurries were allowed to undergo quiescent settling for one hour.
- **Step 5: Sample Extraction.** After the period of quiescent settling, an interface will usually be evident between the supernatant water with a lower concentration of suspended solids and the more concentrated settled material below the interface. The supernatant was pumped

from the reactors using a low flow peristaltic pump. Care was taken not to re-suspend the settled material.

- **Step 6: Sample Collection and Analyses. S**ample aliquots were collected from the various supernatants for both total and dissolved analytes/parameters.

As part of the implementation of the DRET study, a total of twelve elutriates were generated as follows:

1. **LUFP-1Hr-1.0%** [10,000 milligrams per liter (mg/L) target TSS concentration] sediment slurry with one hour aeration and a one hour settling time after which the elutriate was collected for the required laboratory analyses;
2. **LUFP-1Hr-0.5%** (5,000 mg/L target TSS concentration) sediment slurry with one hour aeration and a one hour settling time after which the elutriate was collected for the required laboratory analyses; and
3. **LUFP-1Hr-0.1%** (1,000 mg/L target TSS concentration) sediment slurry with one hour aeration and a one hour settling time after which the elutriate was collected for the required laboratory analyses.
4. **MLFP-1Hr-1.0%** [10,000 mg/L target TSS concentration] sediment slurry with one hour aeration and a one hour settling time after which the elutriate was collected for the required laboratory analyses;
5. **MLFP-1Hr-0.5%** (5,000 mg/L target TSS concentration) sediment slurry with one hour aeration and a one hour settling time after which the elutriate was collected for the required laboratory analyses; and
6. **MLFP-1Hr-0.1%** (1,000 mg/L target TSS concentration) sediment slurry with one hour aeration and a one hour settling time after which the elutriate was collected for the required laboratory analyses.
7. **ECCS-1Hr-1.0%** [10,000 mg/L target TSS concentration] sediment slurry with one hour aeration and a one hour settling time after which the elutriate was collected for the required laboratory analyses;
8. **ECCS-1Hr-0.5%** (5,000 mg/L target TSS concentration) sediment slurry with one hour aeration and a one hour settling time after which the elutriate was collected for the required laboratory analyses; and
9. **ECCS-1Hr-0.1%** (1,000 mg/L target TSS concentration) sediment slurry with one hour aeration and a one hour settling time after which the elutriate was collected for the required laboratory analyses.
10. **LUFP-6Hr-1.0%** [10,000 mg/L target TSS concentration] sediment slurry with six hour aeration and a one hour settling time after which the elutriate was collected for the required laboratory analyses.

11. **MLFP-6Hr-1.0%** [10,000 mg/L target TSS concentration] sediment slurry with six hour aeration and a one hour settling time after which the elutriate was collected for the required laboratory analyses.
12. **ECCS-6Hr-1.0%** [10,000 mg/L target TSS concentration] sediment slurry with six hour aeration and a one hour settling time after which the elutriate was collected for the required laboratory analyses.

The sediment slurries referenced above were prepared by mixing homogenized sediment media with the associated surface water samples.

For each elutriate generated, Tetra Tech analyzed one total and one dissolved sample for: PAHs by USEPA Method 8270 (GC/MS-SIM), PCBs by USEPA Method 8082 (Aroclors), and total Priority Pollutant 13 metals by SW846 Method 6020 (including mercury by Method 7470). The results were compared to the most conservative of the MassDEP (Massachusetts Department of Environmental Protection) / MCP (Massachusetts Contingency Plan) Method 1 GW-1, GW-2, and GW-3 Groundwater Standards. A copy of the MassDEP/MCP Method 1 Groundwater Standards has been included as Exhibit 2-1.

2.1.2 DRET Results

2.1.2.1 LUFP-BP 1.0% Sediment Slurry with One Hour Aeration

DRET results associated with the elutriate generated from the LUFP-BP sediment sample involving a 1.0% sediment slurry aerated for one hour followed by a one-hour settling time are presented in Table 3-1 with the raw analytical data presented in Appendix E. Table 3-1 (as well as the other tables associated with the DRET results, i.e., Tables 3-2 and 3-3) presents surface water composite, unfiltered DRET (total) and filtered DRET (dissolved) concentrations of Contaminants of Concern (COC), including PCBs, PAHs, and metals. Additionally, these tables present calculated COC concentrations associated with suspended solids (mg COC/Kg solids) and the calculated partitioning coefficients (Kds). The general relationship between sediment/water partitioning coefficients and COC mobility is that when Kd is between 0.1 L/Kg to 10 L/Kg the COCs are relatively mobile with chemical leaching from the sediment solids to the water column. In the situation where Kd is >10^2 to 10^4 L/Kg and beyond, COCs become increasingly immobile with limited leaching of chemical from the sediment solids to the water column. Note: Surface water characterization raw data is included in Appendix F.

An examination of Table 3-1 shows that during the test no PCBs concentrations were detected in either the unfiltered (total) or filtered (dissolved) elutriate samples above the reporting limit (0.10 ug/L). One PAH compound – naphthalene, was detected at 0.15 ug/L in the unfiltered sample and slightly greater (0.28 ug/L) in the filtered sample, but these concentrations are nearly equivalent to the background surface water naphthalene concentration (0.22 ug/L). In general, target metals were detected in the unfiltered samples at concentrations greater than the reporting limits, with the exception of thallium in the 0.1% solids DRET. The metal concentrations detected in the filtered samples (0.45 um filter media) were below MCP Groundwater Standards with the exception of antimony for the 1.0% solids DRET. Data suggests that the majority of the metal concentrations are particulate-borne with the exception of antimony.

The information presented in Table 3-1 (and the other DRET data tables) can also be used to calculate total concentrations of COCs at the dredge-induced re-suspension source and dissolved concentrations of COCs at the point of compliance. These calculations were not performed during the data evaluation since some inputs required for the calculations are generally obtained from modeling efforts. Therefore, there calculations, if required, will be deferred to the feasibility study (FS) phase of the project. The personnel performing the FS will have a better understanding about how to use the DRET results to meet their project needs.

2.1.2.2 LUFP-BP 0.5% Sediment Slurry with One Hour Aeration

Results of this DRET test are presented in Table 3-2 with the raw analytical data presented in Appendix E. An examination of Table 3-2 shows that during the test no PCBs concentrations were detected in either the unfiltered (total) or filtered (dissolved) elutriate samples. One PAH compound – naphthalene, was detected at 0.16 ug/L in the unfiltered sample and slightly greater (0.20 ug/L) in the filtered sample, but these concentrations are nearly equivalent to the background surface water naphthalene concentration (0.22 ug/L). Also, the PAH compound – fluoranthene, was detected in the DRET dissolved fraction (0.09 ug/L) at about the same concentration as detected in the composite surface water sample (0.06 ug/L). In general, target metals were detected at concentrations greater than the reporting limits in the unfiltered samples with the exception of thallium in the 0.1% solids DRET. The metal concentrations detected in the filtered samples (0.45 um filter media) were all below MCP Groundwater Standards. Data suggests that the majority of the metal concentrations are particulate-borne with the exception of antimony.

2.1.2.3 LUFP-BP 0.1% Sediment Slurry with One Hour Aeration

Results of this DRET test are presented in Table 3-3 with the raw analytical data presented in Appendix E. An examination of Table 3-3 shows that during the test no PCBs concentrations were detected in either the unfiltered (total) or filtered (dissolved) elutriate samples. One PAH compound – naphthalene, was detected at 0.31 ug/L in the unfiltered sample and slightly greater (0.47 ug/L) in the filtered sample, but these concentrations are in the same order of magnitude as the background surface water naphthalene concentration (0.22 ug/L). In general, target metals were detected at concentrations greater than the reporting limits in the unfiltered samples with the exception of thallium. The metal concentrations detected in the filtered samples (0.45 um filter media) were all below MCP Groundwater Standards. Data suggests that the majority of the metal concentrations are particulate-borne with the possible exception of antimony.

2.1.2.4 MLFP-BP 1.0% Sediment Slurry with One Hour Aeration

DRET results associated with the elutriate generated from the MLFP-BP sediment sample involving a 1.0% sediment slurry aerated for one hour followed by a one-hour settling time are presented in Table 3-4 with the raw analytical data presented in Appendix E. Table 3-4 (as well as the other tables associated with the DRET results, i.e., Tables 3-5 and 3-6) presents surface water composite, unfiltered DRET (total) and filtered DRET (dissolved) concentrations of

Contaminants of Concern (COC), including PCBs, PAHs, and metals. Additionally, these tables present calculated COC concentrations associated with suspended solids (mg COC/Kg solids) and the calculated partitioning coefficients (Kds). The general relationship between sediment/water partitioning coefficients and COC mobility is that when Kd is between 0.1 L/Kg to 10 L/Kg the COCs are relatively mobile with chemical leaching from the sediment solids to the water column. In the situation where Kd is >10^2 to 10^4 L/Kg and beyond, COCs become increasingly immobile with limited leaching of chemical from the sediment solids to the water column.

An examination of Table 3-4 shows that during the test no PCBs concentrations were detected in either the unfiltered (total) or filtered (dissolved) elutriate samples above the reporting limit (0.10 ug/L). One PAH compound – naphthalene, was detected at 0.11 ug/L in the unfiltered sample and slightly greater (0.22 ug/L) in the filtered sample, but these concentrations are nearly equivalent to the background surface water naphthalene concentration (0.22 ug/L). Also, the PAH compounds - fluoranthene and pyrene, indicated very low concentrations in the total DRET fraction but non-detect concentrations in the dissolved DRET fraction. Data suggests the PAH detections are particulate-borne. In general, target metals were detected at concentrations greater than the reporting limits in the unfiltered samples. Though lead and mercury were detected in the total DRET fraction at concentrations greater than the MCP Groundwater Standards, the metal concentrations detected in the filtered samples (0.45 um filter media) were below MCP Groundwater Standards for all metals. Data suggests that the majority of the metal concentrations are particulate-borne with the possible exception of antimony.

2.1.2.5 MLFP-BP 0.5% Sediment Slurry with One Hour Aeration

Results of this DRET test are presented in Table 3-5 with the raw analytical data presented in Appendix E. An examination of Table 3-5 shows that during the test no PCBs concentrations were detected in either the unfiltered (total) or filtered (dissolved) elutriate samples above the reporting limit (0.10 ug/L). One PAH compound – naphthalene, was detected at 0.11 ug/L in the unfiltered sample and slightly greater (0.21 ug/L) in the filtered sample, but these concentrations are nearly equivalent to the background surface water naphthalene concentration (0.22 ug/L). Also, the PAH compounds - fluoranthene and pyrene, indicated very low concentrations in the total DRET fraction but non-detect concentrations in the dissolved DRET fraction. It should be noted that fluoranthene was also detected at a very low level in the surface water composite sample. Data suggests the PAH detections are particulate-borne. In general, target metals were detected at concentrations greater than the reporting limits in the unfiltered samples. Though lead and mercury were detected in the total DRET fraction at concentrations greater than the MCP Groundwater Standards, the metal concentrations detected in the filtered samples (0.45 um filter media) were below MCP Groundwater Standards for all metals. Data suggests that the majority of the metal concentrations are particulate-borne with the possible exception of antimony.

2.1.2.6 MLFP-BP 0.1% Sediment Slurry with One Hour Aeration

Results of this DRET test are presented in Table 3-6 with the raw analytical data presented in Appendix E. An examination of Table 3-6 shows that during the test no PCBs concentrations were detected in either the unfiltered (total) or filtered (dissolved) elutriate samples. One PAH compound – naphthalene, was detected at 0.12 ug/L in the unfiltered sample and slightly greater (0.39 ug/L) in the filtered sample, but these concentrations are in the same order of magnitude as the background surface water naphthalene concentration (0.22 ug/L). In general, target metals were detected in the unfiltered samples with the exception of silver and thallium. Though lead and mercury were detected in the total DRET fraction at concentrations greater than the MCP Groundwater Standards, the metal concentrations detected in the filtered samples (0.45 um filter media) were below MCP Groundwater Standards for all metals. Data suggests that the majority of the metal concentrations are particulate-borne.

2.1.2.7 ECCS-BP 1.0% Sediment Slurry with One Hour Aeration

DRET results associated with the elutriate generated from the ECCS-BP sediment sample involving a 1.0% sediment slurry aerated for one hour followed by a one-hour settling time are presented in Table 3-7 with the raw analytical data presented in Appendix E.

Table 3-7 (as well as the other tables associated with the DRET results, i.e., Tables 3-8 and 3-9) presents surface water composite, unfiltered DRET (total) and filtered DRET (dissolved) concentrations of Contaminants of Concern (COC), including PCBs, PAHs, and metals. Additionally, these tables present calculated COC concentrations associated with suspended solids (mg COC/Kg solids) and the calculated partitioning coefficients (Kds). The general relationship between sediment/water partitioning coefficients and COC mobility is that when Kd is between 0.1 L/Kg to 10 L/Kg the COCs are relatively mobile with chemical leaching from the sediment solids to the water column. In the situation where Kd is $>10^2$ to 10^4 L/Kg and beyond, COCs become increasingly immobile with limited leaching of chemical from the sediment solids to the water column.

An examination of Table 3-7 shows that during the test no PCBs concentrations were detected in either the unfiltered (total) or filtered (dissolved) elutriate samples above the reporting limit (0.10 ug/L). One PAH compound – naphthalene, was detected at 0.11 ug/L in the unfiltered sample and slightly greater (0.13 ug/L) in the filtered sample, but these concentrations are nearly equivalent to the background surface water naphthalene concentration (0.22 ug/L). The PAH compounds benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, chrysene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene and pyrene all indicated very low concentrations in the total DRET fraction but non-detect concentrations in the dissolved DRET fraction. Data suggests the PAH detections are particulate-borne. In general, target metals were detected at concentrations greater than the reporting limits in the unfiltered samples for all metals. Antimony was detected in both the total and dissolved DRET fractions at concentrations greater than the MCP Groundwater Standards. Arsenic, lead and mercury were detected at levels greater than the MCP Groundwater Standard in the total DRET fraction but less than the MCP Groundwater Standards in the dissolved DRET fraction. Data suggests that the majority of the metal concentrations are particulate-borne with the exception of antimony and arsenic.

2.1.2.8 ECCS-BP 0.5% Sediment Slurry with One Hour Aeration

Results of this DRET test are presented in Table 3-8 with the raw analytical data presented in Appendix E. An examination of Table 3-8 shows that during the test no PCBs concentrations were detected in either the unfiltered (total) or filtered (dissolved) elutriate samples. One PAH compound – naphthalene, was detected at 0.11 ug/L in the unfiltered sample and slightly greater (0.15 ug/L) in the filtered sample, but these concentrations are nearly equivalent to the background surface water naphthalene concentration (0.22 ug/L). The PAH compounds acenaphthylene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k) fluoranthene, benzo(g,h,i)perylene, chrysene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene all indicated very low concentrations in the total DRET fraction but non-detect concentrations in the dissolved DRET fraction. Data suggests the PAH detections are particulate-borne. In general, target metals were detected at concentrations greater than the reporting limits in the unfiltered samples for all metals with the exception of thallium. Antimony was detected in both the total and dissolved DRET fractions at concentrations greater than the MCP Groundwater Standards. Arsenic, lead and mercury were detected at levels greater than the MCP Groundwater Standard in the total DRET fraction but less than the MCP Groundwater Standards in the dissolved DRET fraction. Data suggests that the majority of the metal concentrations are particulate-borne with the possible exception of antimony and arsenic.

2.1.2.9 ECCS-BP 0.1% Sediment Slurry with One Hour Aeration

Results of this DRET test are presented in Table 3-9 with the raw analytical data presented in Appendix E. An examination of Table 3-9 shows that during the test no PCBs concentrations were detected in either the unfiltered (total) or filtered (dissolved) elutriate samples. One PAH compound – naphthalene, was detected at 0.06 ug/L in the unfiltered sample and slightly greater (0.16 ug/L) in the filtered sample, but these concentrations are nearly equivalent to the background surface water naphthalene concentration (0.22 ug/L). The PAH compounds benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, chrysene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene and pyrene all indicated very low concentrations in the total DRET fraction but non-detect concentrations in the dissolved DRET fraction. Data suggests the PAH detections are particulate-borne. In general, target metals were detected at concentrations greater than the reporting limits in the unfiltered samples for all metals with the exception of selenium and thallium. Antimony was detected in both the total and dissolved DRET fractions at concentrations greater than the MCP Groundwater Standards. Lead and mercury were detected at levels greater than the MCP Groundwater Standard in the total DRET fraction but less than the MCP Groundwater Standards in the dissolved DRET fraction. Data suggests that the majority of the metal concentrations are particulate-borne with the possible exception of antimony and arsenic.

2.1.2.10 LUFP-BP 1.0% Sediment Slurry with Six Hour Aeration

Results of this DRET test are presented in Table 3-10 with the raw analytical data presented in Appendix G. An examination of Table 3-10 shows that during the test no PCBs concentrations were detected in either the unfiltered (total) or filtered (dissolved) elutriate samples. One PAH compound – naphthalene, was detected at 0.14 ug/L in the DRET filtered sample, but this concentration is nearly equivalent to the background surface water naphthalene concentration

(0.22 ug/L). In general, target metals were detected in the unfiltered sample at concentrations greater than the reporting limits for all metals. The metal concentrations detected in the filtered samples (0.45 um filter media) were below MCP Groundwater Standards with the exception of antimony. Data suggests that the majority of the metal concentrations are particulate-borne with the possible exception of antimony and to a lesser degree, arsenic.

2.1.2.11 MLFP-BP 1.0% Sediment Slurry with Six Hour Aeration

Results of this DRET test are presented in Table 3-11 with the raw analytical data presented in Appendix G. An examination of Table 3-11 shows that during the test no PCBs concentrations were detected in either the unfiltered (total) or filtered (dissolved) elutriate samples. One PAH compound – naphthalene, was detected at 0.06 ug/L in the unfiltered sample and slightly greater (0.30 ug/L) in the filtered sample, but these concentrations are nearly equivalent to the background surface water naphthalene concentration (0.22 ug/L). In general, target metals were detected in the unfiltered sample at concentrations greater than the reporting limits for all metals. The metal concentrations detected in the filtered samples (0.45 um filter media) were below MCP Groundwater Standards for all target metals. Data suggests that the majority of the metal concentrations are particulate-borne with the possible exception of antimony and to a lesser degree, arsenic.

2.1.2.12 ECCS-BP 1.0% Sediment Slurry with Six Hour Aeration

Results of this DRET test are presented in Table 3-12 with the raw analytical data presented in Appendix G. An examination of Table 3-12 shows that during the test no PCBs concentrations were detected in either the unfiltered (total) or filtered (dissolved) elutriate samples. One PAH compound – naphthalene, was detected at 0.16 ug/L in the unfiltered sample and slightly greater (0.47 ug/L) in the filtered sample, but these concentrations are nearly equivalent to the background surface water naphthalene concentration (0.22 ug/L). Also, the PAH compounds – Acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, phenanthrene and pyrene all indicated very low to moderately low concentrations in the total DRET fraction but non-detect concentrations in the dissolved DRET fraction. Data suggests the PAH detections are particulate-borne. In general, target metals were detected in the unfiltered sample at concentrations greater than the reporting limits for all metals. The metal concentrations detected in the filtered samples (0.45 um filter media) were below MCP Groundwater Standards for all target metals with the exception of antimony. Data suggests that the majority of the metal concentrations are particulate-borne with the possible exception of antimony and arsenic.

In general, the DRET results presented in Tables 3-1 through 3-12 were relatively similar with no significant COC concentration releases noted between tests with different initial TSS concentrations (initial sediment slurry solids concentrations) or aeration times. The data suggests that there were limited COC release from the sediment to water column (with the possible exception of antimony) during the DRETs which simulates re-suspension conditions that may occur during hydraulic dredging operations.

3.0 FINDINGS/CONCLUSIONS

3.1 Dredge Elutriate Tests

1. No Aroclors were released to the water column during the DRET for all tested sediment media (LUFP-BP, MLFP-BP, and ECCS-BP).
2. DRET data shows that limited concentrations of PAHs and metals were released to the water column during the DRETs. The majority of metals and PAHs compounds detected in the unfiltered samples appeared to be removed to below MPC Groundwater Standards after filtration through 0.45 um filter media.
3. During the DRETs, antimony concentrations exceeded MPC Groundwater Standards concentrations in unfiltered samples for the LUFP-BP and ECCS-BP sediments. However, filtration through 0.45 um filter media removed antimony concentrations to below MPC Groundwater Standards for the LUFP-BP 0.5% DRET (1 hour aeration) but not the LUFP-BP 1.0% DRET (1 hour and 6 hour). This information suggests that some controls (silt curtains, semi-permeable silt curtains, structural barriers, etc.) may have to be applied in the hydraulic dredging zone to remove/limit particulates that may contain metal (particularly antimony) concentrations.
4. DRET data suggests that the majority of the detected metals concentrations are particulate-related with the exception of antimony and to a lesser degree, arsenic. Therefore, the use of filtration will remove a significant amount of COC wasteload from the discharge of a future treatment system.
5. In general, the DRET results for each sediment (i.e. LUFP-BP, MLFP-BP, and ECCS-BP) were relatively similar between tests with different initial TSS concentrations or aeration times.
6. The DRET data suggests that there is limited COC release from the various sediment media to the water column with the exception of antimony for the LUFP-BP and ECCS-BP sediments. The partition coeffluents calculated form the total and dissolved DRET results are associated with COCs that have tendency to have limited mobility. Therefore, when sediment gets re-suspended during dredging operations, the COCs are not likely be transferred from sediment particles to the water column and negatively impact water quality.

4.0 REFERENCES

USEPA/USACE. 2003. *Evaluation of Dredged Material Proposed for Disposal at Island, Nearshore, or Upland Confined Disposal Facilities* — Testing Manual. ERDC/EL TR-03-1.

USACE, 1998. *1998 Evaluation of Dredged Material Proposed For Discharge in Waters of the U.S.* – Testing Manual Inland Testing Manual and ERDC/EL TR-03-1

USACE, 2008. *Technical Guidelines for Environmental Dredging of Contaminated Sediments*, TR-08-29

Tables

Table 3-1
DRET Results
Test Sample LUFP-1Hr-1.0%

Parameters	Units	Surface Water Composite Concentration	DRET Total COC Concentration	DRET Dissolved COC Concentration After Filtration	MCP Groundwater Standard	Estimated COC Concentration Associated with Particulate (F_{ss}) (mg COC/Kg of suspended solids)	Calculated Partitioning Coefficient - K_d (L/Kg)
PCBs							
Aroclor 1016	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1221	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1232	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1242	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1248	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1254	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1260	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclors - Total	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Semivolatile Organics							
Acenaphthene	ug/L	< 0.03	< 0.03	< 0.03	20	a	a
Acenaphthylene	ug/L	< 0.03	< 0.03	< 0.03	30	a	a
Anthracene	ug/L	< 0.03	< 0.03	< 0.03	30	a	a
Benzo(a)anthracene	ug/L	< 0.05	< 0.05	< 0.05	1	a	a
Benzo(a)pyrene	ug/L	< 0.04	< 0.04	< 0.04	0.2	a	a
Benzo(b)fluoranthene	ug/L	< 0.08	< 0.08	< 0.08	1	a	a
Benzo(k)fluoranthene	ug/L	< 0.10	< 0.10	< 0.10	1	a	a
Benzo(g,h,i)perylene	ug/L	< 0.04	< 0.04	< 0.04	20	a	a
Chrysene	ug/L	< 0.03	< 0.03	< 0.03	2	a	a
Dibenzo(a,h)anthracene	ug/L	< 0.04	< 0.04	< 0.04	0.5	a	a
Fluoranthene	ug/L	0.06 J	< 0.05	< 0.05	90	a	a
Fluorene	ug/L	< 0.04	< 0.04	< 0.04	30	a	a
Indeno(1,2,3-cd)pyrene	ug/L	< 0.04	< 0.04	< 0.04	0.5	a	a
Naphthalene	ug/L	0.22	0.15	0.28	140	a	a
Phenanthrene	ug/L	< 0.04	< 0.04	< 0.04	40	a	a
Pyrene	ug/L	< 0.04	< 0.04	< 0.04	20	a	a
Total Metals							
Antimony	ug/L	0.51 J	9.6	7.4	6	1.05	142
Arsenic	ug/L	0.69 J	4.7	1.1	10	1.71	1554

Table 3-1
DRET Results
Test Sample LUFP-1Hr-1.0%

Parameters	Units	Surface Water Composite Concentration	DRET Total COC Concentration	DRET Dissolved COC Concentration After Filtration	MCP Groundwater Standard	Estimated COC Concentration Associated with Particulate (F_{ss}) (mg COC/Kg of suspended solids)	Calculated Partitioning Coefficient - K_d (L/Kg)
Beryllium	ug/L	0.26 J	0.96 J	< 0.017	4	0.45 b	52941
Cadmium	ug/L	0.22 J	1.9	< 0.042	4	0.89 b	42381
Chromium	ug/L	1.1 J	19	0.67 J	100	8.73	13030
Copper	ug/L	2.8 J	24	1.3 J	No reference	10.8	8308
Lead	ug/L	3.1	99	0.85 J	10	46.7	54941
Nickel	ug/L	3.0 J	13	1.1 J	100	5.67	5154
Selenium	ug/L	0.76 J	3.5	< 0.32	10	1.59 b	9938
Silver	ug/L	0.55 J	1.1	< 0.028	7	0.52 b	37143
Thallium	ug/L	< 0.062	0.24	< 0.062	2	0.10 b	3226
Zinc	ug/L	12	150	1.2 J	900	70.9	59083
Mercury	ug/L	0.4	24	< 0.2	2	11.4 b	114000

Test Conditions: Initial TSS concentration in Test Container =~10,000 mg/L; 2,100 mg/L in unfiltered composite after 1 hr settling; 0.4 mg/L after filtration, 99.9 % TSS removed by filtration

ug/L	microgram per liter
COC	contaminant of concern
GW	groundwater
J	estimated value
Kg	kilogram
L	Liter
MCP	Massachusetts Contingency Plan (referenced groundwater standard is most conservative of MCP GW-1, GW-2, and GW-3 Groundwater Standards)
mg	milligram
a =	No apparent COC partitioning (from sediment solids to water column)
b =	C_{diss} was estimated to be ½ COC detection limit
<	less than

Yellow highlighted concentration exceeds MCP Groundwater Standard

Table 3-2
DRET Results
Test Sample LUFP-1Hr-0.5%

Parameters	Units	Surface Water Composite Concentration	DRET Total COC Concentration	DRET Dissolved COC Concentration After Filtration	MCP Groundwater Standard	Estimated COC Concentration Associated with Particulate (F_{ss}) (mg COC/Kg of suspended solids)	Calculated Partitioning Coefficient – K_d (L/Kg)
PCBs							
Aroclor 1016	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1221	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1232	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1242	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1248	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1254	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1260	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclors - Total	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Semivolatile Organics							
Acenaphthene	ug/L	< 0.03	< 0.03	< 0.03	20	a	a
Acenaphthylene	ug/L	< 0.03	< 0.03	< 0.03	30	a	a
Anthracene	ug/L	< 0.03	< 0.03	< 0.03	30	a	a
Benzo(a)anthracene	ug/L	< 0.05	< 0.05	0.08 J	1	a	a
Benzo(a)pyrene	ug/L	< 0.04	< 0.04	< 0.04	0.2	a	a
Benzo(b)fluoranthene	ug/L	< 0.08	< 0.08	< 0.08	1	a	a
Benzo(k)fluoranthene	ug/L	< 0.10	< 0.10	< 0.10	1	a	a
Benzo(g,h,i)perylene	ug/L	< 0.04	< 0.04	< 0.04	20	a	a
Chrysene	ug/L	< 0.03	< 0.03	0.08 J	2	a	a
Dibenzo(a,h)anthracene	ug/L	< 0.04	< 0.04	< 0.04	0.5	a	a
Fluoranthene	ug/L	0.06 J	< 0.05	0.09 J	90	a	a
Fluorene	ug/L	< 0.04	< 0.04	< 0.04	30	a	a
Indeno(1,2,3-cd)pyrene	ug/L	< 0.04	< 0.04	< 0.04	0.5	a	a
Naphthalene	ug/L	0.22	0.16	0.20	140	a	a
Phenanthrene	ug/L	< 0.04	< 0.04	< 0.04	40	a	a
Pyrene	ug/L	< 0.04	< 0.04	0.07 J	20	a	a
Total Metals							
Antimony	ug/L	0.51 J	6.5	3.8	6	2.45	645
Arsenic	ug/L	0.69 J	3.0	0.79 J	10	2.01	2544

Table 3-2
DRET Results
Test Sample LUFP-1Hr-0.5%

Parameters	Units	Surface Water Composite Concentration	DRET Total COC Concentration	DRET Dissolved COC Concentration After Filtration	MCP Groundwater Standard	Estimated COC Concentration Associated with Particulate (F_{ss}) (mg COC/Kg of suspended solids)	Calculated Partitioning Coefficient – K_d (L/Kg)
Beryllium	ug/L	0.26 J	0.56 J	< 0.017	4	0.50 b	58824
Cadmium	ug/L	0.22 J	0.85 J	< 0.042	4	0.75 b	35714
Chromium	ug/L	1.1 J	11	0.60 J	100	9.45	15750
Copper	ug/L	2.8 J	15	0.83 J	No reference	12.9	15542
Lead	ug/L	3.1	58	1.1	10	51.7	47000
Nickel	ug/L	3.0 J	8.4	1.2 J	100	6.54	5450
Selenium	ug/L	0.76 J	2.2	< 0.32	10	1.85 b	11562
Silver	ug/L	0.55 J	0.63 J	0.82 J	7	a	a
Thallium	ug/L	< 0.062	0.14 J	< 0.062	2	0.10 b	3226
Zinc	ug/L	12	93	1.4 J	900	83.3	59500
Mercury	ug/L	0.4	14	< 0.2	2	12.6 b	126000

Test Conditions: Initial TSS concentration in Test Container =~5,000 mg/L; 1,100 mg/L in unfiltered composite after 1 hr settling; < 0.1 mg/L after filtration, 99.9 % TSS removed by filtration

ug/L	microgram per liter
COC	contaminant of concern
GW	groundwater
J	estimated value
Kg	kilogram
L	Liter
MCP	Massachusetts Contingency Plan (referenced groundwater standard is most conservative of MCP GW-1, GW-2, and GW-3 Groundwater Standards)
mg	milligram
a =	No apparent COC partitioning (from sediment solids to water column)
b =	C_{diss} was estimated to be ½ COC detection limit
<	less than

Yellow highlighted concentration exceeds MCP Groundwater Standard

Table 3-3
DRET Results
Test Sample LUFP-1Hr-0.1%

Parameters	Units	Surface Water Composite Concentration	DRET Total COC Concentration	DRET Dissolved COC Concentration After Filtration	MCP Groundwater Standard	Estimated COC Concentration Associated with Particulate (F_{ss}) (mg COC/Kg of suspended solids)	Calculated Partitioning Coefficient - K_d (L/Kg)
PCBs							
Aroclor 1016	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1221	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1232	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1242	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1248	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1254	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1260	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclors - Total	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Semivolatile Organics							
Acenaphthene	ug/L	< 0.03	< 0.03	< 0.03	20	a	a
Acenaphthylene	ug/L	< 0.03	< 0.03	< 0.03	30	a	a
Anthracene	ug/L	< 0.03	< 0.03	< 0.03	30	a	a
Benzo(a)anthracene	ug/L	< 0.05	< 0.05	< 0.05	1	a	a
Benzo(a)pyrene	ug/L	< 0.04	< 0.04	< 0.04	0.2	a	a
Benzo(b)fluoranthene	ug/L	< 0.08	< 0.08	< 0.08	1	a	a
Benzo(k)fluoranthene	ug/L	< 0.10	< 0.10	< 0.10	1	a	a
Benzo(g,h,i)perylene	ug/L	< 0.04	< 0.04	< 0.04	20	a	a
Chrysene	ug/L	< 0.03	< 0.03	< 0.03	2	a	a
Dibenzo(a,h)anthracene	ug/L	< 0.04	< 0.04	< 0.04	0.5	a	a
Fluoranthene	ug/L	0.06 J	< 0.05	< 0.05	90	a	a
Fluorene	ug/L	< 0.04	< 0.04	< 0.04	30	a	a
Indeno(1,2,3-cd)pyrene	ug/L	< 0.04	< 0.04	< 0.04	0.5	a	a
Naphthalene	ug/L	0.22	0.31	0.47	140	a	a
Phenanthrene	ug/L	< 0.04	< 0.04	< 0.04	40	a	a
Pyrene	ug/L	< 0.04	< 0.04	< 0.04	20	a	a
Total Metals							
Antimony	ug/L	0.51 J	2.4 J	1.3 J	6	4.07	3130
Arsenic	ug/L	0.69 J	0.98 J	0.47 J	10	1.89	4021

Table 3-3
DRET Results
Test Sample LUFP-1Hr-0.1%

Parameters	Units	Surface Water Composite Concentration	DRET Total COC Concentration	DRET Dissolved COC Concentration After Filtration	MCP Groundwater Standard	Estimated COC Concentration Associated with Particulate (F_{ss}) (mg COC/Kg of suspended solids)	Calculated Partitioning Coefficient - K_d (L/Kg)
Beryllium	ug/L	0.26 J	0.17 J	< 0.017	4	0.60 b	70588
Cadmium	ug/L	0.22 J	0.16 J	< 0.042	4	0.51 b	24286
Chromium	ug/L	1.1 J	3.5 J	0.38 J	100	11.6	30526
Copper	ug/L	2.8 J	5.5	1.0 J	No reference	16.7	16700
Lead	ug/L	3.1	17	1.4	10	57.8	41286
Nickel	ug/L	3.0 J	3.3 J	0.92 J	100	8.81	9576
Selenium	ug/L	0.76 J	0.67 J	< 0.32	10	1.89 b	11812
Silver	ug/L	0.55 J	0.16 J	0.87 J	7	a	a
Thallium	ug/L	< 0.062	< 0.062	< 0.062	2	a	a
Zinc	ug/L	12	33	1.0 J	900	118	118000
Mercury	ug/L	0.4	7.6	< 0.2	2	27.8 b	278000

Test Conditions: Initial TSS concentration in Test Container =~1,000 mg/L; 270 mg/L in unfiltered composite after 1 hr settling; 0.4 mg/L after filtration, 99.8 % TSS removed by filtration

ug/L	microgram per liter
COC	contaminant of concern
GW	groundwater
J	estimated value
Kg	kilogram
L	Liter
MCP	Massachusetts Contingency Plan (referenced groundwater standard is most conservative of MCP GW-1, GW-2, and GW-3 Groundwater Standards)
mg	milligram
a =	No apparent COC partitioning (from sediment solids to water column)
b =	C_{diss} was estimated to be ½ COC detection limit
<	less than

Yellow highlighted concentration exceeds MCP Groundwater Standard

Table 3-4
DRET Results
Test Sample MLFP-1Hr-1.0%

Parameters	Units	Surface Water Composite Concentration	DRET Total COC Concentration	DRET Dissolved COC Concentration After Filtration	MCP Groundwater Standard	Estimated COC Concentration Associated with Particulate (F_{ss}) (mg COC/Kg of suspended solids)	Calculated Partitioning Coefficient - K_d (L/Kg)
PCBs							
Aroclor 1016	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1221	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1232	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1242	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1248	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1254	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1260	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclors - Total	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Semivolatile Organics							
Acenaphthene	ug/L	< 0.03	< 0.03	< 0.03	20	a	a
Acenaphthylene	ug/L	< 0.03	< 0.03	< 0.03	30	a	a
Anthracene	ug/L	< 0.03	< 0.03	< 0.03	30	a	a
Benzo(a)anthracene	ug/L	< 0.05	< 0.05	< 0.05	1	a	a
Benzo(a)pyrene	ug/L	< 0.04	< 0.04	< 0.04	0.2	a	a
Benzo(b)fluoranthene	ug/L	< 0.08	< 0.08	< 0.08	1	a	a
Benzo(k)fluoranthene	ug/L	< 0.10	< 0.10	< 0.10	1	a	a
Benzo(g,h,i)perylene	ug/L	< 0.04	< 0.04	< 0.04	20	a	a
Chrysene	ug/L	< 0.03	< 0.03	< 0.03	2	a	a
Dibenzo(a,h)anthracene	ug/L	< 0.04	< 0.04	< 0.04	0.5	a	a
Fluoranthene	ug/L	0.06 J	0.05 J	< 0.05	90	0.02 b	800
Fluorene	ug/L	< 0.04	< 0.04	< 0.04	30	a	a
Indeno(1,2,3-cd)pyrene	ug/L	< 0.04	< 0.04	< 0.04	0.5	a	a
Naphthalene	ug/L	0.22	0.11	0.22	140	a	a
Phenanthrene	ug/L	< 0.04	< 0.04	< 0.04	40	a	a
Pyrene	ug/L	< 0.04	0.05 J	< 0.04	20	0.03 b	1500
Total Metals							
Antimony	ug/L	0.51 J	2.8 J	2.7 J	6	0.09	33.3
Arsenic	ug/L	0.69 J	7.8	1.2	10	6	5000

Table 3-4
DRET Results
Test Sample MLFP-1Hr-1.0%

Parameters	Units	Surface Water Composite Concentration	DRET Total COC Concentration	DRET Dissolved COC Concentration After Filtration	MCP Groundwater Standard	Estimated COC Concentration Associated with Particulate (F_{ss}) (mg COC/Kg of suspended solids)	Calculated Partitioning Coefficient - K_d (L/Kg)
Beryllium	ug/L	0.26 J	0.92 J	0.018 J	4	0.82	45556
Cadmium	ug/L	0.22 J	0.74 J	< 0.042	4	0.65 b	30952
Chromium	ug/L	1.1 J	20	< 0.27	100	18.1 b	134074
Copper	ug/L	2.8 J	14	0.71 J	No reference	12.1	17042
Lead	ug/L	3.1	61	0.13 J	10	55.3	425385
Nickel	ug/L	3.0 J	12	1.1 J	100	9.91	9009
Selenium	ug/L	0.76 J	2.5	< 0.32	10	2.13 b	13312
Silver	ug/L	0.55 J	0.44 J	< 0.028	7	0.39 b	16250
Thallium	ug/L	< 0.062	0.28 J	< 0.062	2	0.23 b	7419
Zinc	ug/L	12	73	< 0.50	900	66.1 b	264400
Mercury	ug/L	0.4	12	< 0.2	2	10.8 b	108000

Test Conditions: Initial TSS concentration in Test Container =~10,000 mg/L; 1,100 mg/L in unfiltered composite after 1 hr settling; 0.4 mg/L after filtration, 99.9 % TSS removed by filtration

ug/L	microgram per liter
COC	contaminant of concern
GW	groundwater
J	estimated value
Kg	kilogram
L	Liter
MCP	Massachusetts Contingency Plan (referenced groundwater standard is most conservative of MCP GW-1, GW-2, and GW-3 Groundwater Standards)
mg	milligram
a =	No apparent COC partitioning (from sediment solids to water column)
b =	C_{diss} was estimated to be ½ COC detection limit
<	less than

Yellow highlighted concentration exceeds MCP Groundwater Standard

Table 3-5
DRET Results
Test Sample MLFP-1Hr-0.5%

Parameters	Units	Surface Water Composite Concentration	DRET Total COC Concentration	DRET Dissolved COC Concentration After Filtration	MCP Groundwater Standard	Estimated COC Concentration Associated with Particulate (F_{ss}) (mg COC/Kg of suspended solids)	Calculated Partitioning Coefficient - K_d (L/Kg)
PCBs							
Aroclor 1016	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1221	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1232	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1242	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1248	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1254	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1260	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclors - Total	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Semivolatile Organics							
Acenaphthene	ug/L	< 0.03	< 0.03	< 0.03	20	a	a
Acenaphthylene	ug/L	< 0.03	< 0.03	< 0.03	30	a	a
Anthracene	ug/L	< 0.03	< 0.03	< 0.03	30	a	a
Benzo(a)anthracene	ug/L	< 0.05	< 0.05	< 0.05	1	a	a
Benzo(a)pyrene	ug/L	< 0.04	< 0.04	< 0.04	0.2	a	a
Benzo(b)fluoranthene	ug/L	< 0.08	< 0.08	< 0.08	1	a	a
Benzo(k)fluoranthene	ug/L	< 0.10	< 0.10	< 0.10	1	a	a
Benzo(g,h,i)perylene	ug/L	< 0.04	< 0.04	< 0.04	20	a	a
Chrysene	ug/L	< 0.03	< 0.03	< 0.03	2	a	a
Dibenzo(a,h)anthracene	ug/L	< 0.04	< 0.04	< 0.04	0.5	a	a
Fluoranthene	ug/L	0.06 J	0.05 J	< 0.05	90	0.04 b	1600
Fluorene	ug/L	< 0.04	< 0.04	< 0.04	30	a	a
Indeno(1,2,3-cd)pyrene	ug/L	< 0.04	< 0.04	< 0.04	0.5	a	a
Naphthalene	ug/L	0.22	0.11	0.21	140	a	a
Phenanthrene	ug/L	< 0.04	< 0.04	< 0.04	40	a	a
Pyrene	ug/L	< 0.04	0.05 J	< 0.04	20	0.04 b	2000
Total Metals							
Antimony	ug/L	0.51 J	2.0 J	1.6 J	6	0.59	369
Arsenic	ug/L	0.69 J	4.9	0.86 J	10	5.94	6907

Table 3-5
DRET Results
Test Sample MLFP-1Hr-0.5%

Parameters	Units	Surface Water Composite Concentration	DRET Total COC Concentration	DRET Dissolved COC Concentration After Filtration	MCP Groundwater Standard	Estimated COC Concentration Associated with Particulate (F_{ss}) (mg COC/Kg of suspended solids)	Calculated Partitioning Coefficient - K_d (L/Kg)
Beryllium	ug/L	0.26 J	0.56 J	< 0.017	4	0.81 b	95294
Cadmium	ug/L	0.22 J	0.58 J	< 0.042	4	0.82 b	39048
Chromium	ug/L	1.1 J	12	0.58 J	100	16.8	28966
Copper	ug/L	2.8 J	9.5	0.78 J	No reference	12.8	16410
Lead	ug/L	3.1	41	0.22 J	10	60.0	272727
Nickel	ug/L	3.0 J	7.5	3.0 J	100	6.62	2207
Selenium	ug/L	0.76 J	1.5	< 0.32	10	1.97 b	12312
Silver	ug/L	0.55 J	0.26 J	< 0.028	7	0.36 b	25714
Thallium	ug/L	< 0.062	0.15 J	< 0.062	2	0.18 b	5806
Zinc	ug/L	12	55	0.96 J	900	79.5	82812
Mercury	ug/L	0.4	9.2	< 0.2	2	13.4 b	134000

Test Conditions: Initial TSS concentration in Test Container =~5,000 mg/L; 680 mg/L in unfiltered composite after 1 hr settling; 0.4 mg/L after filtration, 99.9 % TSS removed by filtration

ug/L	microgram per liter
COC	contaminant of concern
GW	groundwater
J	estimated value
Kg	kilogram
L	Liter
MCP	Massachusetts Contingency Plan (referenced groundwater standard is most conservative of MCP GW-1, GW-2, and GW-3 Groundwater Standards)
mg	milligram
a =	No apparent COC partitioning (from sediment solids to water column)
b =	C_{diss} was estimated to be ½ COC detection limit
<	less than

Yellow highlighted concentration exceeds MCP Groundwater Standard

Table 3-6
DRET Results
Test Sample MLFP-1Hr-0.1%

Parameters	Units	Surface Water Composite Concentration	DRET Total COC Concentration	DRET Dissolved COC Concentration After Filtration	MCP Groundwater Standard	Estimated COC Concentration Associated with Particulate (F_{ss}) (mg COC/Kg of suspended solids)	Calculated Partitioning Coefficient - K_d (L/Kg)
PCBs							
Aroclor 1016	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1221	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1232	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1242	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1248	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1254	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1260	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclors - Total	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Semivolatile Organics							
Acenaphthene	ug/L	< 0.03	< 0.03	< 0.03	20	a	a
Acenaphthylene	ug/L	< 0.03	< 0.03	< 0.03	30	a	a
Anthracene	ug/L	< 0.03	< 0.03	< 0.03	30	a	a
Benzo(a)anthracene	ug/L	< 0.05	< 0.05	< 0.05	1	a	a
Benzo(a)pyrene	ug/L	< 0.04	< 0.04	< 0.04	0.2	a	a
Benzo(b)fluoranthene	ug/L	< 0.08	< 0.08	< 0.08	1	a	a
Benzo(k)fluoranthene	ug/L	< 0.10	< 0.10	< 0.10	1	a	a
Benzo(g,h,i)perylene	ug/L	< 0.04	< 0.04	< 0.04	20	a	a
Chrysene	ug/L	< 0.03	< 0.03	< 0.03	2	a	a
Dibenzo(a,h)anthracene	ug/L	< 0.04	< 0.04	< 0.04	0.5	a	a
Fluoranthene	ug/L	0.06 J	< 0.05	< 0.05	90	a	a
Fluorene	ug/L	< 0.04	< 0.04	< 0.04	30	a	a
Indeno(1,2,3-cd)pyrene	ug/L	< 0.04	< 0.04	< 0.04	0.5	a	a
Naphthalene	ug/L	0.22	0.12	0.39	140	a	a
Phenanthrene	ug/L	< 0.04	< 0.04	< 0.04	40	a	a
Pyrene	ug/L	< 0.04	< 0.04	< 0.04	20	a	a
Total Metals							
Antimony	ug/L	0.51 J	0.86 J	0.58 J	6	1.75	3017
Arsenic	ug/L	0.69 J	1.6	0.38 J	10	7.62	20053

Table 3-6
DRET Results
Test Sample MLFP-1Hr-0.1%

Parameters	Units	Surface Water Composite Concentration	DRET Total COC Concentration	DRET Dissolved COC Concentration After Filtration	MCP Groundwater Standard	Estimated COC Concentration Associated with Particulate (F_{ss}) (mg COC/Kg of suspended solids)	Calculated Partitioning Coefficient - K_d (L/Kg)
Beryllium	ug/L	0.26 J	0.17 J	< 0.017	4	1.01 b	118824
Cadmium	ug/L	0.22 J	0.15 J	< 0.042	4	0.81 b	38571
Chromium	ug/L	1.1 J	3.9 J	< 0.27	100	23.5 b	174074
Copper	ug/L	2.8 J	3.8	0.79 J	No reference	18.8	23797
Lead	ug/L	3.1	12	0.45 J	10	72.2	160444
Nickel	ug/L	3.0 J	3.6 J	0.97 J	100	16.4	16907
Selenium	ug/L	0.76 J	0.38 J	< 0.32	10	1.38 b	8625
Silver	ug/L	0.55 J	< 0.028	< 0.028	7	a	a
Thallium	ug/L	< 0.062	< 0.062	< 0.062	2	a	a
Zinc	ug/L	12	20	1.5 J	900	116	77333
Mercury	ug/L	0.4	3.6	< 0.2	2	21.9 b	219000

Test Conditions: Initial TSS concentration in Test Container =~1,000 mg/L; 160 mg/L in unfiltered composite after 1 hr settling; < 0.1 mg/L after filtration, 99.9 % TSS removed by filtration

ug/L	microgram per liter
COC	contaminant of concern
GW	groundwater
J	estimated value
Kg	kilogram
L	Liter
MCP	Massachusetts Contingency Plan (referenced groundwater standard is most conservative of MCP GW-1, GW-2, and GW-3 Groundwater Standards)
mg	milligram
a =	No apparent COC partitioning (from sediment solids to water column)
b =	C_{diss} was estimated to be ½ COC detection limit
<	less than

Yellow highlighted concentration exceeds MCP Groundwater Standard

Table 3-7
DRET Results
Test Sample ECCS-1Hr-1.0%

Parameters	Units	Surface Water Composite Concentration	DRET Total COC Concentration	DRET Dissolved COC Concentration After Filtration	MCP Groundwater Standard	Estimated COC Concentration Associated with Particulate (F_{ss}) (mg COC/Kg of suspended solids)	Calculated Partitioning Coefficient - K_d (L/Kg)
PCBs							
Aroclor 1016	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1221	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1232	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1242	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1248	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1254	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1260	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclors - Total	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Semivolatile Organics							
Acenaphthene	ug/L	< 0.03	< 0.03	< 0.03	20	a	a
Acenaphthylene	ug/L	< 0.03	< 0.03	< 0.03	30	a	a
Anthracene	ug/L	< 0.03	< 0.03	< 0.03	30	a	a
Benzo(a)anthracene	ug/L	< 0.05	0.09 J	< 0.05	1	0.23 b	9200
Benzo(a)pyrene	ug/L	< 0.04	0.11	< 0.04	0.2	0.32 b	16000
Benzo(b)fluoranthene	ug/L	< 0.08	0.13	< 0.08	1	0.32 b	8000
Benzo(k)fluoranthene	ug/L	< 0.10	0.11	< 0.10	1	0.21 b	4200
Benzo(g,h,i)perylene	ug/L	< 0.04	0.10	< 0.04	20	0.29 b	14500
Chrysene	ug/L	< 0.03	0.15	< 0.03	2	0.48 b	32000
Dibenzo(a,h)anthracene	ug/L	< 0.04	< 0.04	< 0.04	0.5	a	a
Fluoranthene	ug/L	0.06 J	0.25	< 0.05	90	0.80 b	32000
Fluorene	ug/L	< 0.04	< 0.04	< 0.04	30	a	a
Indeno(1,2,3-cd)pyrene	ug/L	< 0.04	0.08 J	< 0.04	0.5	0.21 b	10500
Naphthalene	ug/L	0.22	0.11	0.13	140	a	a
Phenanthrene	ug/L	< 0.04	0.13	< 0.04	40	0.39 b	19500
Pyrene	ug/L	< 0.04	0.25	< 0.04	20	0.82 b	41000
Total Metals							
Antimony	ug/L	0.51 J	1000	120	6	3140	26167
Arsenic	ug/L	0.69 J	15	2.9	10	43.2	14897

Table 3-7
DRET Results
Test Sample ECCS-1Hr-1.0%

Parameters	Units	Surface Water Composite Concentration	DRET Total COC Concentration	DRET Dissolved COC Concentration After Filtration	MCP Groundwater Standard	Estimated COC Concentration Associated with Particulate (F_{ss}) (mg COC/Kg of suspended solids)	Calculated Partitioning Coefficient - K_d (L/Kg)
Beryllium	ug/L	0.26 J	0.45 J	< 0.017	4	1.58 b	185882
Cadmium	ug/L	0.22 J	3.1	< 0.042	4	11.0 b	523810
Chromium	ug/L	1.1 J	13	< 0.27	100	45.9 b	340000
Copper	ug/L	2.8 J	57	0.33 J	No reference	202	612121
Lead	ug/L	3.1	160	0.55 J	10	569	1034545
Nickel	ug/L	3.0 J	17	2.3 J	100	52.5	22826
Selenium	ug/L	0.76 J	1.4	0.38 J	10	3.64	9579
Silver	ug/L	0.55 J	2.0 J	0.20 J	7	6.43	32150
Thallium	ug/L	< 0.062	0.066 J	< 0.062	2	0.12 b	3871
Zinc	ug/L	12	280	< 0.50	900	999 b	3996000
Mercury	ug/L	0.4	490	0.4	2	1750	4375000

Test Conditions: Initial TSS concentration in Test Container =~10,000 mg/L; 280 mg/L in unfiltered composite after 1 hr settling; 2.4 mg/L after filtration, 99.1 % TSS removed by filtration

ug/L	microgram per liter
COC	contaminant of concern
GW	groundwater
J	estimated value
Kg	kilogram
L	Liter
MCP	Massachusetts Contingency Plan (referenced groundwater standard is most conservative of MCP GW-1, GW-2, and GW-3 Groundwater Standards)
mg	milligram
a =	No apparent COC partitioning (from sediment solids to water column)
b =	C_{diss} was estimated to be ½ COC detection limit
<	less than

Yellow highlighted concentration exceeds MCP Groundwater Standard

Table 3-8
DRET Results
Test Sample ECCS-1Hr-0.5%

Parameters	Units	Surface Water Composite Concentration	DRET Total COC Concentration	DRET Dissolved COC Concentration After Filtration	MCP Groundwater Standard	Estimated COC Concentration Associated with Particulate (F_{ss}) (mg COC/Kg of suspended solids)	Calculated Partitioning Coefficient - K_d (L/Kg)
PCBs							
Aroclor 1016	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1221	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1232	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1242	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1248	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1254	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1260	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclors - Total	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Semivolatile Organics							
Acenaphthene	ug/L	< 0.03	< 0.03	< 0.03	20	a	a
Acenaphthylene	ug/L	< 0.03	0.07 J	< 0.03	30	0.28 b	18667
Anthracene	ug/L	< 0.03	< 0.03	< 0.03	30	a	a
Benzo(a)anthracene	ug/L	< 0.05	0.13	< 0.05	1	0.52 b	20800
Benzo(a)pyrene	ug/L	< 0.04	0.18	< 0.04	0.2	0.80 b	40000
Benzo(b)fluoranthene	ug/L	< 0.08	0.20	< 0.08	1	0.80 b	20000
Benzo(k)fluoranthene	ug/L	< 0.10	0.17	< 0.10	1	0.60 b	12000
Benzo(g,h,i)perylene	ug/L	< 0.04	0.15	< 0.04	20	0.65 b	32500
Chrysene	ug/L	< 0.03	0.23	< 0.03	2	1.08 b	72000
Dibenzo(a,h)anthracene	ug/L	< 0.04	< 0.04	< 0.04	0.5	a	a
Fluoranthene	ug/L	0.06 J	0.36	< 0.05	90	1.68 b	67200
Fluorene	ug/L	< 0.04	< 0.04	< 0.04	30	a	a
Indeno(1,2,3-cd)pyrene	ug/L	< 0.04	0.13	< 0.04	0.5	0.55 b	27500
Naphthalene	ug/L	0.22	0.11	0.15	140	a	a
Phenanthrene	ug/L	< 0.04	0.19	< 0.04	40	0.85 b	42500
Pyrene	ug/L	< 0.04	0.35	< 0.04	20	1.65 b	82500
Total Metals							
Antimony	ug/L	0.51 J	720	76	6	3220	42368
Arsenic	ug/L	0.69 J	11	2.0	10	45	22500

Table 3-8
DRET Results
Test Sample ECCS-1Hr-0.5%

Parameters	Units	Surface Water Composite Concentration	DRET Total COC Concentration	DRET Dissolved COC Concentration After Filtration	MCP Groundwater Standard	Estimated COC Concentration Associated with Particulate (F_{ss}) (mg COC/Kg of suspended solids)	Calculated Partitioning Coefficient - K_d (L/Kg)
Beryllium	ug/L	0.26 J	0.32 J	< 0.017	4	1.56 b	183529
Cadmium	ug/L	0.22 J	1.9	< 0.042	4	9.40 b	447619
Chromium	ug/L	1.1 J	11	< 0.27	100	54.3 b	402222
Copper	ug/L	2.8 J	44	0.67 J	No reference	217	323881
Lead	ug/L	3.1	120	0.95 J	10	595	626316
Nickel	ug/L	3.0 J	14	2.1 J	100	59.5	28333
Selenium	ug/L	0.76 J	1.6	0.43 J	10	5.85	13605
Silver	ug/L	0.55 J	1.5 J	0.089 J	7	7.06	79326
Thallium	ug/L	< 0.062	< 0.062	< 0.062	2	a	a
Zinc	ug/L	12	200	0.56 J	900	997	1780357
Mercury	ug/L	0.4	350	0.3	2	1750	5833333

Test Conditions: Initial TSS concentration in Test Container =~5,000 mg/L; 200 mg/L in unfiltered composite after 1 hr settling; 1.2 mg/L after filtration, 99.4 % TSS removed by filtration

ug/L	microgram per liter
COC	contaminant of concern
GW	groundwater
J	estimated value
Kg	kilogram
L	Liter
MCP	Massachusetts Contingency Plan (referenced groundwater standard is most conservative of MCP GW-1, GW-2, and GW-3 Groundwater Standards)
mg	milligram
a =	No apparent COC partitioning (from sediment solids to water column)
b =	C_{diss} was estimated to be ½ COC detection limit
<	less than

Yellow highlighted concentration exceeds MCP Groundwater Standard

Table 3-9
DRET Results
Test Sample ECCS-1Hr-0.1%

Parameters	Units	Surface Water Composite Concentration	DRET Total COC Concentration	DRET Dissolved COC Concentration After Filtration	MCP Groundwater Standard	Estimated COC Concentration Associated with Particulate (F_{ss}) (mg COC/Kg of suspended solids)	Calculated Partitioning Coefficient K_d (L/Kg)
PCBs							
Aroclor 1016	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1221	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1232	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1242	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1248	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1254	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1260	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclors - Total	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Semivolatile Organics							
Acenaphthene	ug/L	< 0.03	< 0.03	< 0.03	20	a	a
Acenaphthylene	ug/L	< 0.03	< 0.03	< 0.03	30	a	a
Anthracene	ug/L	< 0.03	< 0.03	< 0.03	30	a	a
Benzo(a)anthracene	ug/L	< 0.05	0.11	< 0.05	1	1.12 b	44800
Benzo(a)pyrene	ug/L	< 0.04	0.15	< 0.04	0.2	1.71 b	85500
Benzo(b)fluoranthene	ug/L	< 0.08	0.16	< 0.08	1	1.58 b	39500
Benzo(k)fluoranthene	ug/L	< 0.10	0.15	< 0.10	1	1.32 b	26400
Benzo(g,h,i)perylene	ug/L	< 0.04	0.11	< 0.04	20	1.18 b	59000
Chrysene	ug/L	< 0.03	0.18	< 0.03	2	2.17 b	144667
Dibenzo(a,h)anthracene	ug/L	< 0.04	< 0.04	< 0.04	0.5	a	a
Fluoranthene	ug/L	0.06 J	0.28	< 0.05	90	3.36 b	134400
Fluorene	ug/L	< 0.04	< 0.04	< 0.04	30	a	a
Indeno(1,2,3-cd)pyrene	ug/L	< 0.04	0.10	< 0.04	0.5	1.05 b	52500
Naphthalene	ug/L	0.22	0.06 J	0.16	140	a	a
Phenanthrene	ug/L	< 0.04	0.14	< 0.04	40	1.58 b	79000
Pyrene	ug/L	< 0.04	0.28	< 0.04	20	3.42 b	171000
Total Metals							
Antimony	ug/L	0.51 J	210	25	6	2430	97200
Arsenic	ug/L	0.69 J	3.4	0.66 J	10	36.1	54697

Table 3-9
DRET Results
Test Sample ECCS-1Hr-0.1%

Parameters	Units	Surface Water Composite Concentration	DRET Total COC Concentration	DRET Dissolved COC Concentration After Filtration	MCP Groundwater Standard	Estimated COC Concentration Associated with Particulate (F_{ss}) (mg COC/Kg of suspended solids)	Calculated Partitioning Coefficient K_d (L/Kg)
Beryllium	ug/L	0.26 J	0.024 J	< 0.017	4	0.20 b	23529
Cadmium	ug/L	0.22 J	0.17 J	< 0.042	4	1.96 b	93333
Chromium	ug/L	1.1 J	3.7 J	0.39 J	100	43.6	111795
Copper	ug/L	2.8 J	14	0.65 J	No reference	176	270769
Lead	ug/L	3.1	36	1.1	10	459	417273
Nickel	ug/L	3.0 J	6.3	1.8 J	100	59.2	32889
Selenium	ug/L	0.76 J	< 0.32	0.61 J	10	a	a
Silver	ug/L	0.55 J	0.51	0.034 J	7	6.26	184118
Thallium	ug/L	< 0.062	< 0.062	< 0.062	2	a	a
Zinc	ug/L	12	75	1.3 J	900	970	746154
Mercury	ug/L	0.4	120	< 0.2	2	1580 b	15800000

Test Conditions: Initial TSS concentration in Test Container =~1,000 mg/L; 76 mg/L in unfiltered composite after 1 hr settling; 1.2 mg/L after filtration, 98.4 % TSS removed by filtration

ug/L	microgram per liter
COC	contaminant of concern
GW	groundwater
J	estimated value
Kg	kilogram
L	Liter
MCP	Massachusetts Contingency Plan (referenced groundwater standard is most conservative of MCP GW-1, GW-2, and GW-3 Groundwater Standards)
mg	milligram
a =	No apparent COC partitioning (from sediment solids to water column)
b =	C_{diss} was estimated to be ½ COC detection limit
<	less than

Yellow highlighted concentration exceeds MCP Groundwater Standard

Table 3-10
DRET Results
Test Sample LUFP-6Hr-1.0%

Parameters	Units	Surface Water Composite Concentration	DRET Total COC Concentration	DRET Dissolved COC Concentration After Filtration	MCP Groundwater Standard	Estimated COC Concentration Associated with Particulate (F_{ss}) (mg COC/Kg of suspended solids)	Calculated Partitioning Coefficient K_d (L/Kg)
PCBs							
Aroclor 1016	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1221	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1232	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1242	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1248	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1254	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1260	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclors - Total	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Semivolatile Organics							
Acenaphthene	ug/L	< 0.03	< 0.03	< 0.03	20	a	a
Acenaphthylene	ug/L	< 0.03	< 0.03	< 0.03	30	a	a
Anthracene	ug/L	< 0.03	< 0.03	< 0.03	30	a	a
Benzo(a)anthracene	ug/L	< 0.05	< 0.05	< 0.05	1	a	a
Benzo(a)pyrene	ug/L	< 0.04	< 0.04	< 0.04	0.2	a	a
Benzo(b)fluoranthene	ug/L	< 0.08	< 0.08	< 0.08	1	a	a
Benzo(k)fluoranthene	ug/L	< 0.10	< 0.10	< 0.10	1	a	a
Benzo(g,h,i)perylene	ug/L	< 0.04	< 0.04	< 0.04	20	a	a
Chrysene	ug/L	< 0.03	< 0.03	< 0.03	2	a	a
Dibenzo(a,h)anthracene	ug/L	< 0.04	< 0.04	< 0.04	0.5	a	a
Fluoranthene	ug/L	0.06 J	< 0.05	< 0.05	90	a	a
Fluorene	ug/L	< 0.04	< 0.04	< 0.04	30	a	a
Indeno(1,2,3-cd)pyrene	ug/L	< 0.04	< 0.04	< 0.04	0.5	a	a
Naphthalene	ug/L	0.22	< 0.03	0.14	140	a	a
Phenanthrene	ug/L	< 0.04	< 0.04	< 0.04	40	a	a
Pyrene	ug/L	< 0.04	< 0.04	< 0.04	20	a	a
Total Metals							
Antimony	ug/L	0.51 J	13	10	6	1.0	100
Arsenic	ug/L	0.69 J	6.9	1.4	10	1.83	1307

Table 3-10
DRET Results
Test Sample LUFP-6Hr-1.0%

Parameters	Units	Surface Water Composite Concentration	DRET Total COC Concentration	DRET Dissolved COC Concentration After Filtration	MCP Groundwater Standard	Estimated COC Concentration Associated with Particulate (F_{ss}) (mg COC/Kg of suspended solids)	Calculated Partitioning Coefficient K_d (L/Kg)
Beryllium	ug/L	0.26 J	1.2	< 0.017	4	0.40 b	47059
Cadmium	ug/L	0.22 J	2.8	< 0.042	4	0.93 b	44286
Chromium	ug/L	1.1 J	24	< 0.27	100	7.96 b	61231
Copper	ug/L	2.8 J	34	0.43 J	No reference	11.2	26047
Lead	ug/L	3.1	130	0.80 J	10	43.1	53875
Nickel	ug/L	3.0 J	17	1.0 J	100	5.33	5330
Selenium	ug/L	0.76 J	3.9	< 0.32	10	1.25 b	7812
Silver	ug/L	0.55 J	1.5 J	< 0.028	7	0.50 b	35714
Thallium	ug/L	< 0.062	0.23 J	< 0.062	2	0.07 b	2258
Zinc	ug/L	12	230	< 0.50	900	76.6 b	306400
Mercury	ug/L	0.4	35	< 0.2	2	11.6 b	116000

Test Conditions: Initial TSS concentration in Test Container =~10,000 mg/L; 3,000 mg/L in unfiltered composite after 1 hr settling; 0.1 mg/L after filtration, 99.9 % TSS removed by filtration

ug/L	microgram per liter
COC	contaminant of concern
GW	groundwater
J	estimated value
Kg	kilogram
L	Liter
MCP	Massachusetts Contingency Plan (referenced groundwater standard is most conservative of MCP GW-1, GW-2, and GW-3 Groundwater Standards)
mg	milligram
a =	No apparent COC partitioning (from sediment solids to water column)
b =	C_{diss} was estimated to be ½ COC detection limit
<	less than

Yellow highlighted concentration exceeds MCP Groundwater Standard

Table 3-11
DRET Results
Test Sample MLFP-6Hr-1.0%

Parameters	Units	Surface Water Composite Concentration	DRET Total COC Concentration	DRET Dissolved COC Concentration After Filtration	MCP Groundwater Standard	Estimated COC Concentration Associated with Particulate (F_{ss}) (mg COC/Kg of suspended solids)	Calculated Partitioning Coefficient K_d (L/Kg)
PCBs							
Aroclor 1016	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1221	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1232	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1242	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1248	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1254	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1260	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclors - Total	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Semivolatile Organics							
Acenaphthene	ug/L	< 0.03	< 0.03	< 0.03	20	a	a
Acenaphthylene	ug/L	< 0.03	< 0.03	< 0.03	30	a	a
Anthracene	ug/L	< 0.03	< 0.03	< 0.03	30	a	a
Benzo(a)anthracene	ug/L	< 0.05	< 0.05	< 0.05	1	a	a
Benzo(a)pyrene	ug/L	< 0.04	< 0.04	< 0.04	0.2	a	a
Benzo(b)fluoranthene	ug/L	< 0.08	< 0.08	< 0.08	1	a	a
Benzo(k)fluoranthene	ug/L	< 0.10	< 0.10	< 0.10	1	a	a
Benzo(g,h,i)perylene	ug/L	< 0.04	< 0.04	< 0.04	20	a	a
Chrysene	ug/L	< 0.03	< 0.03	< 0.03	2	a	a
Dibenzo(a,h)anthracene	ug/L	< 0.04	< 0.04	< 0.04	0.5	a	a
Fluoranthene	ug/L	0.06 J	< 0.05	< 0.05	90	a	a
Fluorene	ug/L	< 0.04	< 0.04	< 0.04	30	a	a
Indeno(1,2,3-cd)pyrene	ug/L	< 0.04	< 0.04	< 0.04	0.5	a	a
Naphthalene	ug/L	0.22	0.06 J	0.30	140	a	a
Phenanthrene	ug/L	< 0.04	< 0.04	< 0.04	40	a	a
Pyrene	ug/L	< 0.04	< 0.04	< 0.04	20	a	a
Total Metals							
Antimony	ug/L	0.51 J	4.2	3.8	6	0.25	65.8
Arsenic	ug/L	0.69 J	11	1.6	10	5.88	3675

Table 3-11
DRET Results
Test Sample MLFP-6Hr-1.0%

Parameters	Units	Surface Water Composite Concentration	DRET Total COC Concentration	DRET Dissolved COC Concentration After Filtration	MCP Groundwater Standard	Estimated COC Concentration Associated with Particulate (F_{ss}) (mg COC/Kg of suspended solids)	Calculated Partitioning Coefficient K_d (L/Kg)
Beryllium	ug/L	0.26 J	1.1	< 0.017	4	0.68 b	80000
Cadmium	ug/L	0.22 J	1.1	< 0.042	4	0.67 b	31905
Chromium	ug/L	1.1 J	22	< 0.27	100	13.7 b	101481
Copper	ug/L	2.8 J	21	0.56 J	No reference	12.8	22857
Lead	ug/L	3.1	87	0.31 J	10	54.2	174839
Nickel	ug/L	3.0 J	14	1.0 J	100	8.12	8120
Selenium	ug/L	0.76 J	3.4	< 0.32	10	2.02 b	12625
Silver	ug/L	0.55 J	0.74 J	< 0.028	7	0.45 b	32143
Thallium	ug/L	< 0.062	0.23 J	< 0.062	2	0.12 b	3871
Zinc	ug/L	12	120	< 0.50	900	74.8 b	299200
Mercury	ug/L	0.4	19	< 0.2	2	11.8 b	118000

Test Conditions: Initial TSS concentration in Test Container =~10,000 mg/L; 1,600 mg/L in unfiltered composite after 1 hr settling; 1.2 mg/L after filtration, 99.9 % TSS removed by filtration

ug/L	microgram per liter
COC	contaminant of concern
GW	groundwater
J	estimated value
Kg	kilogram
L	Liter
MCP	Massachusetts Contingency Plan (referenced groundwater standard is most conservative of MCP GW-1, GW-2, and GW-3 Groundwater Standards)
mg	milligram
a =	No apparent COC partitioning (from sediment solids to water column)
b =	C_{diss} was estimated to be ½ COC detection limit
<	less than

Yellow highlighted concentration exceeds MCP Groundwater Standard

Table 3-12
DRET Results
Test Sample ECCS-6Hr-1.0%

Parameters	Units	Surface Water Composite Concentration	DRET Total COC Concentration	DRET Dissolved COC Concentration After Filtration	MCP Groundwater Standard	Estimated COC Concentration Associated with Particulate (F_{ss}) (mg COC/Kg of suspended solids)	Calculated Partitioning Coefficient K_d (L/Kg)
PCBs							
Aroclor 1016	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1221	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1232	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1242	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1248	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1254	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclor 1260	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Aroclors - Total	ug/L	< 0.1	< 0.1	< 0.1	0.5	a	a
Semivolatile Organics							
Acenaphthene	ug/L	< 0.03	< 0.03	< 0.03	20	a	a
Acenaphthylene	ug/L	< 0.03	0.15	< 0.03	30	0.40 b	26667
Anthracene	ug/L	< 0.03	0.06 J	< 0.03	30	0.13 b	8667
Benzo(a)anthracene	ug/L	< 0.05	0.26	< 0.05	1	0.69 b	27600
Benzo(a)pyrene	ug/L	< 0.04	0.38	< 0.04	0.2	1.06 b	53000
Benzo(b)fluoranthene	ug/L	< 0.08	0.38	< 0.08	1	1.0 b	25000
Benzo(k)fluoranthene	ug/L	< 0.10	0.38	< 0.10	1	0.97 b	19400
Benzo(g,h,i)perylene	ug/L	< 0.04	0.25	< 0.04	20	0.68 b	34000
Chrysene	ug/L	< 0.03	0.45	< 0.03	2	1.28 b	85333
Dibenzo(a,h)anthracene	ug/L	< 0.04	0.08 J	< 0.04	0.5	0.18 b	9000
Fluoranthene	ug/L	0.06 J	0.73	< 0.05	90	2.07 b	82800
Fluorene	ug/L	< 0.04	0.06 J	< 0.04	30	0.12 b	6000
Indeno(1,2,3-cd)pyrene	ug/L	< 0.04	0.23	< 0.04	0.5	0.62 b	31000
Naphthalene	ug/L	0.22	0.16	0.47	140	a	a
Phenanthrene	ug/L	< 0.04	0.42	< 0.04	40	1.18 b	59000
Pyrene	ug/L	< 0.04	0.74	< 0.04	20	2.12 b	106000
Total Metals							
Antimony	ug/L	0.51 J	1200	170	6	3030	17824
Arsenic	ug/L	0.69 J	19	3.6	10	45.3	12583

Table 3-12
DRET Results
Test Sample ECCS-6Hr-1.0%

Parameters	Units	Surface Water Composite Concentration	DRET Total COC Concentration	DRET Dissolved COC Concentration After Filtration	MCP Groundwater Standard	Estimated COC Concentration Associated with Particulate (F_{ss}) (mg COC/Kg of suspended solids)	Calculated Partitioning Coefficient K_d (L/Kg)
Beryllium	ug/L	0.26 J	0.58 J	< 0.017	4	1.68 b	197647
Cadmium	ug/L	0.22 J	3.3	< 0.042	4	9.64 b	459048
Chromium	ug/L	1.1 J	18	< 0.27	100	52.5 b	388889
Copper	ug/L	2.8 J	74	0.57 J	No reference	216	378947
Lead	ug/L	3.1	200	0.66 J	10	586	887879
Nickel	ug/L	3.0 J	22	2.2 J	100	58.2	26454
Selenium	ug/L	0.76 J	2.4	< 0.32	10	6.59 b	41188
Silver	ug/L	0.55 J	2.4 J	< 0.028	7	7.02 b	501429
Thallium	ug/L	< 0.062	0.076 J	< 0.062	2	0.13 b	4194
Zinc	ug/L	12	340	1.7 J	900	995	585294
Mercury	ug/L	0.4	600	0.5	2	1760	3520000

Test Conditions: Initial TSS concentration in Test Container =~10,000 mg/L; 340 mg/L in unfiltered composite after 1 hr settling; 0.1 mg/L after filtration, 99.9 % TSS removed by filtration

ug/L	microgram per liter
COC	contaminant of concern
GW	groundwater
J	estimated value
Kg	kilogram
L	Liter
MCP	Massachusetts Contingency Plan (referenced groundwater standard is most conservative of MCP GW-1, GW-2, and GW-3 Groundwater Standards)
mg	milligram
a =	No apparent COC partitioning (from sediment solids to water column)
b =	C_{diss} was estimated to be ½ COC detection limit
<	less than

Yellow highlighted concentration exceeds MCP Groundwater Standard

Exhibits

Exhibit 2-1

MCP Method 1 Groundwater Standards
Applicable in Areas Where the Groundwater is Considered to be One or More of the Following Categories Per 310 CMR 40.0932

Oil and/or Hazardous Material	CAS Number	GW-1 Standard ug/liter (ppb)	GW-2 Standard ug/liter (ppb)	GW-3 Standard ug/liter (ppb)
ACENAPHTHENE	83-32-9	20	NA	10000
ACENAPHTHYLENE	208-96-8	30	10000	40
ACETONE	67-64-1	6300	50000	50000
ALDRIN	309-00-2	0.5	2	30
ANTHRACENE	120-12-7	60	NA	30
ANTIMONY	7440-36-0	6	NA	8000
ARSENIC	7440-38-2	10	NA	900
BARIUM	7440-39-3	2000	NA	50000
BENZENE	71-43-2	5	1000	10000
BENZO(a)ANTHRACENE	56-55-3	1	NA	1000
BENZO(a)PYRENE	50-32-8	0.2	NA	500
BENZO(b)FLUORANTHENE	205-99-2	1	NA	400
BENZO(g,h,i)PERYLENE	191-24-2	50	NA	20
BENZO(k)FLUORANTHENE	207-08-9	1	NA	100
BERYLLIUM	7440-41-7	4	NA	200
BIPHENYL, 1,1-	92-52-4	0.9	200	50000
BIS(2-CHLOROETHYL)ETHER	111-44-4	30	30	50000
BIS(2-CHLOROISOPROPYL)ETHER	108-60-1	30	100	50000
BIS(2-ETHYLHEXYL)PHTHALATE	117-81-7	6	NA	50000
BROMODICHLOROMETHANE	75-27-4	3	6	50000
BROMOFORM	75-25-2	4	700	50000
BROMOMETHANE	74-83-9	10	7	800
CADMIUM	7440-43-9	5	NA	4
CARBON TETRACHLORIDE	56-23-5	5	2	5000
CHLORDANE	12789-03-6	2	NA	2
CHLOROANILINE, p-	106-47-8	20	30000	300
CHLOROBENZENE	108-90-7	100	200	1000

Exhibit 2-1

MCP Method 1 Groundwater Standards
Applicable in Areas Where the Groundwater is Considered to be One or More of the Following Categories Per 310 CMR 40.0932

Oil and/or Hazardous Material	CAS Number	GW-1 Standard ug/liter (ppb)	GW-2 Standard ug/liter (ppb)	GW-3 Standard ug/liter (ppb)
CHLOROFORM	67-66-3	70	50	20000
CHLOROPHENOL, 2-	95-57-8	10	20000	7000
CHROMIUM (TOTAL)	7440-47-3	100	NA	300
CHROMIUM(III)	16065-83-1	100	NA	600
CHROMIUM(VI)	18540-29-9	100	NA	300
CHRYSENE	218-01-9	2	NA	70
CYANIDE	57-12-5	200	NA	30
DIBENZO(a,h)ANTHRACENE	53-70-3	0.5	NA	40
DIBROMOCHLOROMETHANE	124-48-1	2	20	50000
DICHLOROBENZENE, 1,2- (o-DCB)	95-50-1	600	8000	2000
DICHLOROBENZENE, 1,3- (m-DCB)	541-73-1	100	6000	50000
DICHLOROBENZENE, 1,4- (p-DCB)	106-46-7	5	60	8000
DICHLOROBENZIDINE, 3,3'-	91-94-1	80	NA	2000
DICHLORODIPHENYL DICHLOROETHANE, P,P'- (DDD)	72-54-8	0.2	NA	50
DICHLORODIPHENYLDICHLOROETHYLENE,P,P'- (DDE)	72-55-9	0.05	NA	400
DICHLORODIPHENYLTRICHLOROETHANE, P,P'- (DDT)	50-29-3	0.3	NA	1
DICHLOROETHANE, 1,1-	75-34-3	70	2000	20000
DICHLOROETHANE, 1,2-	107-06-2	5	5	20000
DICHLOROETHYLENE, 1,1-	75-35-4	7	80	30000
DICHLOROETHYLENE, CIS-1,2-	156-59-2	70	20	50000
DICHLOROETHYLENE, TRANS-1,2-	156-60-5	100	80	50000
DICHLOROMETHANE	75-09-2	5	2000	50000
DICHLOROPHENOL, 2,4-	120-83-2	10	30000	2000
DICHLOROPROPANE, 1,2-	78-87-5	5	3	50000
DICHLOROPROPENE, 1,3-	542-75-6	0.4	10	200
DIELDRIN	60-57-1	0.1	8	0.5
DIETHYL PHTHALATE	84-66-2	2000	50000	9000

Exhibit 2-1

MCP Method 1 Groundwater Standards Applicable in Areas Where the Groundwater is Considered to be One or More of the Following Categories Per 310 CMR 40.0932

Oil and/or Hazardous Material	CAS Number	GW-1 Standard ug/liter (ppb)	GW-2 Standard ug/liter (ppb)	GW-3 Standard ug/liter (ppb)
DIMETHYL PHTHALATE	131-11-3	300	50000	50000
DIMETHYLPHENOL, 2,4-	105-67-9	60	40000	50000
DINITROPHENOL, 2,4-	51-28-5	200	50000	20000
DINITROTOLUENE, 2,4-	121-14-2	30	20000	50000
DIOXANE, 1,4-	123-91-1	0.3	6000	50000
ENDOSULFAN	115-29-7	10	NA	2
ENDRIN	72-20-8	2	NA	5
ETHYLBENZENE	100-41-4	700	20000	5000
ETHYLENE DIBROMIDE	106-93-4	0.02	2	50000
FLUORANTHENE	206-44-0	90	NA	200
FLUORENE	86-73-7	30	NA	40
HEPTACHLOR	76-44-8	0.4	2	1
HEPTACHLOR EPOXIDE	1024-57-3	0.2	7	2
HEXACHLOROBENZENE	118-74-1	1	1	6000
HEXACHLOROBUTADIENE	87-68-3	0.6	50	3000
HEXACHLOROCYCLOHEXANE, GAMMA (gamma-HCH)	58-89-9	0.2	200	4
HEXACHLOROETHANE	67-72-1	8	100	50000
HMX	2691-41-0	200	50000	50000
INDENO(1,2,3-cd)PYRENE	193-39-5	0.5	NA	100
LEAD	7439-92-1	15	NA	10
MERCURY	7439-97-6	2	NA	20
METHOXYCHLOR	72-43-5	40	NA	10
METHYL ETHYL KETONE	78-93-3	4000	50000	50000
METHYL ISOBUTYL KETONE	108-10-1	350	50000	50000
METHYL MERCURY	22967-92-6	0.3	NA	20
METHYL TERT BUTYL ETHER	1634-04-4	70	50000	50000
METHYLNAPHTHALENE, 2-	91-57-6	10	2000	20000

Exhibit 2-1

MCP Method 1 Groundwater Standards
Applicable in Areas Where the Groundwater is Considered to be One or More of the Following Categories Per 310 CMR 40.0932

Oil and/or Hazardous Material	CAS Number	GW-1 Standard ug/liter (ppb)	GW-2 Standard ug/liter (ppb)	GW-3 Standard ug/liter (ppb)
NAPHTHALENE	91-20-3	140	700	20000
NICKEL	7440-02-0	100	NA	200
PENTACHLOROPHENOL	87-86-5	1	NA	200
PERCHLORATE	NA	2	NA	1000
PETROLEUM HYDROCARBONS	NA	200	5000	5000
Aliphatics C5 to C8	NA	300	3000	50000
C9 to C12	NA	700	5000	50000
C9 to C18	NA	700	5000	50000
C19 to C36	NA	14000	NA	50000
Aromatics C9 to C10	NA	200	4000	50000
C11 to C22	NA	200	50000	5000
PHENANTHRENE	85-01-8	40	NA	10000
PHENOL	108-95-2	1000	50000	2000
POLYCHLORINATED BIPHENYLS (PCBs)	1336-36-3	0.5	5	10
PYRENE	129-00-0	60	NA	20
RDX	121-82-4	1	50000	50000
SELENIUM	7782-49-2	50	NA	100
SILVER	7440-22-4	100	NA	7
STYRENE	100-42-5	100	100	6000
TCDD, 2,3,7,8- (equivalents)	1746-01-6	0.00003	NA	0.04
TETRACHLOROETHANE, 1,1,1,2-	630-20-6	5	10	50000
TETRACHLOROETHANE, 1,1,2,2-	79-34-5	2	9	50000
TETRACHLOROETHYLENE	127-18-4	5	50	30000
THALLIUM	7440-28-0	2	NA	3000
TOLUENE	108-88-3	1000	50000	40000
TRICHLOROBENZENE, 1,2,4-	120-82-1	70	200	50000
TRICHLOROETHANE, 1,1,1-	71-55-6	200	4000	20000

Exhibit 2-1

MCP Method 1 Groundwater Standards Applicable in Areas Where the Groundwater is Considered to be One or More of the Following Categories Per 310 CMR 40.0932

Oil and/or Hazardous Material	CAS Number	GW-1 Standard ug/liter (ppb)	GW-2 Standard ug/liter (ppb)	GW-3 Standard ug/liter (ppb)
TRICHLOROETHANE, 1,1,2-	79-00-5	5	900	50000
TRICHLOROETHYLENE	79-01-6	5	5	5000
TRICHLOROPHENOL, 2,4,5-	95-95-4	200	50000	3000
TRICHLOROPHENOL 2,4,6-	88-06-2	10	5000	500
VANADIUM	7440-62-2	30	NA	4000
VINYL CHLORIDE	75-01-4	2	2	50000
XYLENES (Mixed Isomers)	1330-20-7	10000	3000	5000
ZINC	7440-66-6	5000	NA	900

NA - Not Applicable

* - The Total Chromium standard is applicable in the absence of species-specific data for Chromium III and Chromium VI.

** - Cyanide expressed as Physiologically Available Cyanide (PAC). In the absence of measured Physiologically Available Cyanide, the standard is applicable to Total Cyanide.

\+ - The Total Petroleum Hydrocarbon (TPH) standard may be used as an alternative to the appropriate combinations of the Aliphatic and Aromatic Hydrocarbon Fraction standards. The use of the general TPH standard is a valid option only for C9 and greater petroleum hydrocarbons; it is not appropriate for the characterization of risks associated with lighter (gasoline-range) hydrocarbons.

++ - The Department periodically reviews the scientific basis for these Standards and amends them, as appropriate, to incorporate new scientific information.

Appendix A

DRET Procedure (ERDC/EL TR-08-29)

Appendix A: Dredging Elutriate Test Procedure

Introduction

This appendix provides detailed step-by-step procedures for conducting tests for evaluation of contaminant release at the point of dredging. The background, rationale, and tiered framework for application of these procedures are discussed in Chapter 7 of the main text. Two test procedures are included in this appendix:

1. Dredging Elutriate Test (DRET) for water quality evaluations.
2. DRET for water column toxicity evaluations.

The detailed test procedures described here are patterned after those for the effluent elutriate test (U.S. Army Corps of Engineers (USACE) 2003).

Dredging elutriate tests for water quality evaluation

DRET test procedures were developed by USACE as a predictive tool for estimating the degree of contaminant release from sediments due to resuspension at the point of dredging (DiGiano et al. 1993, 1995). The DRET test consists of mixing sediment and site water at a total suspended solids concentration of typically 1 to 10 g/l (considered representative of resuspended sediment as generated at the dredgehead source; see Section 7.3.4), aerating the slurry for 1 hr, allowing the slurry to settle for a period of 1 hr, and analyzing the elutriate for TSS and both dissolved and total concentrations of contaminants. DRET results only apply to releases due to dredging-induced resuspension, and would not be necessarily representative of releases resulting from debris removal activities, propeller wash, spudding/anchoring activities, and other potential resuspended and dissolved contaminant loss sources. However, the DRET results provide information on the potential for contaminant release from dispersal of sediment in the water column.

DRET is designed to simulate the quality of water resulting from sediment resuspension at the point of dredging. The aeration step in the test accounts for geochemical changes occurring in the water column during resuspension. Test procedures allow for estimates of dissolved contaminant concentrations in milligrams per liter and particulate-associated contaminant concentrations in milligrams per kilogram suspended solids (SS). The test consists of mixing a sediment sample with dredging site water to form a slurry, allowing the slurry to settle, then extracting a dredging elutriate sample for chemical analysis. Field verification studies have shown that the DRET is a conservative predictor of contaminant release at the point of dredging (DiGiano et al. 1993, 1995).

The DRET should be conducted, and appropriate chemical analyses should be performed, as soon as possible after sample collection. If DRETs for both water quality and toxicity evaluations are to be conducted, sufficient elutriate should be prepared for both purposes. The volume of elutriate needed for water quality evaluations will vary depending upon the number and types of chemical analyses to be conducted. Both dissolved and total concentrations of contaminants may be determined. The volume required for each analysis, the number of variables measured, and the desired analytical replication will influence the total elutriate sample volume required. A 4-L cylinder is normally used to prepare the elutriate, and the supernatant volume available for sample extraction will vary from approximately 1,500 to 2,000 mL, depending on the sediment properties, settling times, and initial concentration of the slurry. It may be necessary to composite several extracted sample volumes or to use large diameter cylinders to obtain the total required volume.

Apparatus

The following items are required:

- Laboratory mixer, preferably with Teflon shaft and blades.
- Several 4-L graduated cylinders. Larger cylinders may be used if large sample volumes are required for analytical purposes. Nalgene cylinders are acceptable for testing involving analysis of inorganic compounds such as metals and nutrients. Glass cylinders are required for testing involving analysis of organic compounds.
- Assorted glassware for sample extraction and handling.
- Compressed air source with deionized water trap and tubing for bubble aeration of slurry.
- Vacuum or pressure filtration equipment, including vacuum pump or compressed air source and an appropriate filter holder capable of accommodating 47-, 105-, or 155-mm-diameter filters.

- Presoaked filters with a 0.45-um pore-size diameter.
- Plastic sample bottles, 500-mL capacity for storage of water and liquid phase samples for metal and nutrient analyses.
- Wide-mouth, 1-gal-capacity glass jars with Teflon-lined screw-type lids for sample mixing. These jars should also be used for sample containers when samples are to be analyzed for organic COC.

Prior to use, all glassware, filtration equipment, and filters should be thoroughly cleaned. Wash all glassware with detergent, rinse five times with tap water, place in a clean 10-percent (or stronger) HCl acid bath for a minimum of 4 hr, rinse five times with tap water, and then rinse five times with distilled or deionized water. Soak filters for a minimum of 2 hr in 5 molar HCl bath, and then rinse 10 times with distilled water. It is also a good practice to discard the first 50 mL of filtrate.

Dredging elutriate test procedure

The step-by-step procedure for conducting the DRET is outlined below and is illustrated in Figure A1.

Step 1 – Slurry preparation. The sediment and water from the proposed dredging site should be mixed to the target concentration (1 to 10 g/L, typically 5 to 10 g/L dry weight basis, see Section 7.3.4). Predetermine the concentration of the well-mixed sediment in grams per liter (dry weight basis) by oven drying a small subsample of known volume. Each 4-L cylinder to be filled will require a mixed slurry volume of 3-3/4 L. The volumes of sediment and water to be mixed for a 3-3/4-L slurry volume may be calculated using the following expressions:

$$V_{\text{sediment}} = 3.75 \frac{C_{\text{slurry}}}{C_{\text{sediment}}} \quad \text{(A1)}$$

and

$$V_{\text{water}} = 3.75 - V_{\text{sediment}} \quad \text{(A2)}$$

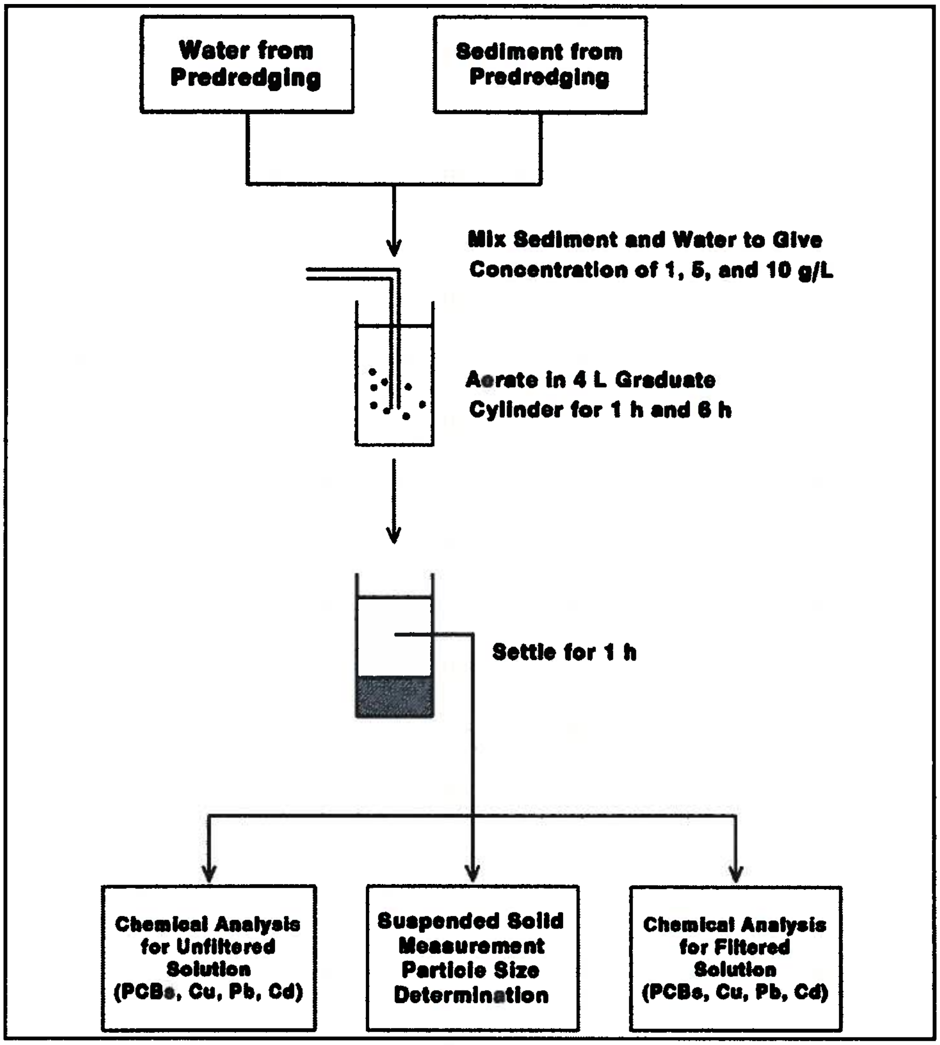


Figure A1. Schematic of the Dredging Elutriate Test (DRET).

where:

$V_{sediment}$ = volume of sediment (liters)
3.75 = volume of slurry for 4-L cylinder (liters)
C_{slurry} = desired concentration of slurry (typically 5 to 10 g/L dry weight basis, see Section 7.3.4)
$C_{sediment}$ = predetermined concentration of sediment (g/L dry weight basis)
V_{water} = volume of disposal site water (liters)

Step 2 – Mixing. Mix the 3-3/4 L of slurry by placing appropriate volumes of sediment and water from the proposed dredging site in a 1-gal glass jar and mixing for 5 min with the laboratory mixer. The slurry should be mixed to a uniform consistency, with no unmixed clumps of sediment.

Step 3 – Aeration. The prepared slurry must be aerated to ensure that oxidizing conditions will be present in the supernatant water during the subsequent settling phase. Bubble aeration is therefore used as a method of sample agitation. Pour the mixed slurry into a 4-L graduated cylinder. Attach glass tubing to the aeration source and insert the tubing to the bottom of the cylinder. The tubing can be held in place by insertion through a predrilled No. 4 stopper placed in the top of the cylinder. Compressed air should be passed through a deionized water trap, through the tubing, and bubbled through the slurry. The flow rate should be adjusted to agitate the mixture vigorously for 1 hr.

Step 4 – Settling. Remove the tubing, and allow the aerated slurry to undergo quiescent settling for 1 hr.

Step 5 – Sample Extraction. After the period of quiescent settling, an interface will usually be evident between the supernatant water with a low concentration of suspended solids and the more concentrated settled material below the interface. Samples of the supernatant water should be extracted from the cylinder at a point about 2 in. above the interface using a syringe and tubing. Care should be taken not to resuspend the settled material.

Step 6 – Sample Preservation and Analyses. The sample should be analyzed as soon as possible after extraction. The elutriate samples should be split and analyzed for both dissolved and total concentrations of COC and TOC and for total suspended solids in milligrams per liter. This will allow the calculation of the fraction of analytes in the total suspended solids in milligrams per kilogram SS. Filtration using 0.45-um filters should be used to obtain subsamples for analysis of dissolved concentrations. Samples to be analyzed for dissolved pesticides or polychlorinated biphenyls (PCBs) must be free of particles but should not be filtered because of the tendency for these materials to adsorb on the filter. However, particulate matter can be removed before analysis by high-speed centrifugation at 10,000 times gravity using Teflon, glass, or aluminum centrifuge tubes (Fulk et al. 1975). The total suspended solids concentration can also be determined by filtration (0.45 um).

Chemical analyses

Chemical analyses of the elutriate samples should be performed according to the guidance in Chapter 9 of the ITM (USEPA/USACE 1998).

Released contaminant concentrations

Dissolved Concentrations. The measured dissolved contaminant concentrations are indicative of the dissolved contaminant concentrations that would be expected to build up in the vicinity of the dredge if no transport and dispersion were to occur. It is comparable to an equilibrium dissolved concentration that would result from dredge-induced resuspension where the TSS concentrations remaining in suspension would be less than 1 g/L. In circumstances where transport and dispersion occur, the dissolved contaminant concentrations and the TSS concentration will be diluted and contaminant repartitioning between the TSS and the water column will occur. The dissolved concentrations downstream of the dredge would have to be predicted using short-, mid- and possibly long-term (near-, mid- and possibly far-field) fate and transport models that, at a minimum, consider advection, dispersion, settling, partitioning, and potentially erosion.

Calculation of Particulate-Associated Concentrations. Measured total and dissolved contaminant concentrations and measured TSS and TOC concentrations are used to characterize the partitioning of the contaminants between the particulate and dissolved phases. The particulate –associated concentration of a COC may be calculated in terms of milligrams of contaminant per kilogram SS as follows:

$$F_{SS} = \left(1 \times 10^6\right) \frac{C_{total} - C_{diss}}{SS} \tag{A3}$$

where

F_{SS} = particulate-associated concentration (mg analyte/kg of suspended solids)
C_{total} = total concentration (mg analyte/L of sample)
C_{diss} = dissolved concentration (mg analyte/L of sample)
SS = total suspended solids concentration (mg solids/L of samples)

Calculating Total Concentrations. Calculating total concentration of COCs at the dredging-induced resuspension source is based on the DRET results and an estimate of the TSS at the source under the anticipated operating conditions at the site (in the dredge zone). The total COC concentration in milligrams per liter in the water column may be estimated as:

$$C_o = C_{diss} + \frac{F_{SS}(SS_o)}{\left(1\times10^{6}\right)} \qquad \text{(A4)}$$

where

C_o = estimated initial total concentration in water column at the source (mg analyte/L of water)
C_{diss} = dissolved concentration determined by DRET tests (mg analyte/L of sample)
F_{SS} = fraction of analyte in the total suspended solids calculated from DRET results (mg analyte/kg of suspended solids)
SS_o = suspended solids concentration in the water column at the resuspension source (dredge zone), estimated from evaluation of sediment resuspension and/or modeling (mg/L)
(1×10^6) = conversion factor, mg/mg to mg/kg

Calculating total concentration of COCs in the water column at the point of compliance is based on initial total contaminant concentration, plume dispersion, and settling. The total concentrations downstream of the dredge would have to be predicted using short-, mid- and possibly long-term (near-, mid- and possibly far-field) fate and transport models that, at a minimum, consider advection, dispersion, settling, partitioning, and potentially erosion. The total concentration in the plume is updated continuously as suspended solids and associated contaminant concentration settle out of the plume and as the plume is diluted by dispersion (turbulent diffusion).

Calculating Partitioning Coefficient. A short-term partitioning coefficient can be computed from the measured dissolved contaminant concentrations and the computed particulate-associated contaminant concentration. The partitioning coefficient K_d, in L/kg, is computed as follows:

$$K_d = \frac{F_{SS}}{C_{diss}} \tag{A5}$$

The partitioning coefficient is used in a fate and transport model along with an estimate of the resuspension source strength to predict the contaminant concentration downstream of the dredging. Procedures to estimate the resuspension source strength are given in Chapter 7.

Calculating Dissolved Concentrations at Point of Compliance. Predicting dissolved concentration at the point of compliance is primarily a function of the initial total contaminant concentration, dilution, and settling. The total concentration is approximated as:

$$C_t = \frac{\left[C_o - \frac{R_{SS}F_{SS}SS_o}{\left(1 \times 10^6\right)}\right]}{D} \tag{A6}$$

where

C_t = estimated total concentration in water column at the point of compliance (mg analyte/L of water)
R_{SS} = fraction of resuspended solids that settled before reaching the point of compliance
D = dilution ratio between source and point of compliance (volume of water column mixed with one volume of source)

The dissolved concentration at the point of compliance can be estimated by equilibrium partitioning. The dissolved concentration is computed by multiplying the total concentration by the fraction dissolved in the water column. The fraction of the total contaminant that is dissolved is a function of the TSS concentration and the partitioning coefficient as follows:

$$F_d = \frac{10^6}{10^6 + K_d SS} \tag{A7}$$

where

F_d = fraction dissolved in water column at the point of compliance
SS = suspended solids concentration at the point of compliance

$$SS = \frac{(1 - R_{SS})SS_o}{D} \tag{A8}$$

The dissolved contaminant concentration at the point of compliance can be estimated as:

$$C_d = F_d\,C_t \tag{A9}$$

where

C_d = dissolved concentration at the point of compliance (mg analyte/L of water)

Dredging elutriate for water column toxicity

For water column toxicity evaluations, a dredging elutriate for the suspended phase is prepared and used as a test medium for water column toxicity tests. This procedure is essentially the same as that for water quality evaluations, except that the elutriate sample is handled differently following extraction. The volume of effluent elutriate required for toxicity testing will be influenced by the number of species to be tested, their size, and requirements for water change during the test. A 4-L cylinder is normally used to prepare the effluent elutriate, and the resulting supernatant volume will vary from approximately 1,500 to 2,000 mL, depending on the sediment properties, settling times, and initial concentration of the slurry. It may be necessary to composite several extracted sample volumes or to use large-diameter cylinders to obtain the total required volume.

Elutriate apparatus

The apparatus necessary for preparation of dredging elutriate is described earlier in the "Apparatus" section on page 279. However, for biological testing the elutriate is not filtered, so only items a through d are required to prepare dredging elutriate for toxicity testing.

Prior to use, all glassware should be thoroughly cleaned. Wash all glassware with detergent, rinse five times with tap water, place in a clean bath for a minimum of 4 hr, rinse five times with tap water, and then rinse five times with distilled or deionized water.

Dredging elutriate procedure

The step-by-step procedure for preparing the dredging elutriate for use in toxicity tests is outlined below.

- **Step 1 - Slurry preparation.** Given earlier for the DRET procedure.
- **Step 2 - Mixing.** Given earlier for the DRET procedure.
- **Step 3 - Aeration.** Given earlier for the DRET procedure.
- **Step 4 - Settling.** Given earlier for the DRET procedure.
- **Step 5 - Sample extraction.** After the appropriate period of quiescent settling, an interface will usually be evident between the supernatant water, with a low concentration of suspended solids above, and the more concentrated settled material below the interface. The liquid plus the material remaining in suspension after the settling period represents the 100 percent dredging elutriate for toxicity testing. Carefully siphon the supernatant, without disturbing the settled material, and immediately use it for toxicity testing. The suspension should be clear enough at the first observation time for the organisms to be visible. With some very fine-grained dredged materials, it may be necessary to centrifuge the supernatant for a short time to achieve this.

Toxicity tests should be performed according to the guidance in Chapter 11 of the ITM (USEPA/USACE 1998), using the elutriate prepared as described in this section as the test medium. Results should be evaluated in light of mixing considerations.

Dredging elutriate toxicity evaluation

The end result of this evaluation is the 96-hr LC50 or 96-hr EC50 expressed as a percentage of the suspended dredged material concentration (or 100 percent elutriate). The LC50 is the dilution of the elutriate that would be expected to produce 50 percent mortality, and the EC50 is the dilution of the elutriate that would be expected to produce an effect of concern other than mortality (such as infertility) in 50 percent of the organisms. To provide protection from chronic toxicity, a toxicity criteria of 1 percent of the LC50 is often used. The toxicity test can also be used to determine other endpoints that might be needed for the evaluation; these are the NOEL (no observable effects level) and the LOEL (lowest observable effects levels). These values are important when less than 50 percent mortality is observed in the toxicity test. The toxicity test endpoints determine the magnitude of the dilution required to render the contaminant releases from dredge-induced resuspension acceptable. The dilution available between the release source and the point of compliance can be estimated using fate and transport models. This result is then compared with the dilution required at the point of compliance.

References

DiGiano, F. A., C. T. Miller, and J. Yoon. 1993. Predicting release of PCBs at the point of dredging. *Journal of Environmental Engineering* 119(1):72-89, American Society of Civil Engineers.

___________. 1995. *Dredging Elutriate Test (DRET) development*. Contract Report D-95-1. Vicksburg, MS: U.S. Army Engineer Waterways Experiment Station. *http://el.erdc.usace.army.mil/publications*.

Fulk, R., D. Gruber, and R. Wullschleger. 1975. *Laboratory study of the release of pesticide and PCB materials to the water column during dredging and disposal operations*. Contract Report D-75-6. Prepared by Envirex, Inc. Vicksburg, MS: U.S. Army Engineer Waterways Experiment Station. *http://el.erdc.usace.army.mil/publications*.

U.S. Army Corps of Engineers (USACE). 2003. *Evaluation of dredged material proposed for disposal at island, nearshore, or upland confined disposal facilities - testing manual*. Technical Report ERDC/EL TR-03-1. Vicksburg, MS: U.S. Army Engineer Research and Development Center. *http://el.erdc.usace.army.mil/dots/pdfs/trel03-1.pdf*.

U.S. Environmental Protection Agency/United Sates Army Corps of Engineers (USEPA/USACE). 1998. *Evaluation of dredged material proposed for discharge in waters of the U.S. – Testing manual*. EPA-823-B-98-004. Washington, DC: EPA Office of Water and U.S. Army Corps of Engineers. *http://www.epa.gov/waterscience/itm/ITM/inland.pdf*.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*
September 2008

2. REPORT TYPE
Final report

3. DATES COVERED *(From - To)*

4. TITLE AND SUBTITLE
Technical Guidelines for Environmental Dredging of Contaminated Sediments

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)
Michael R. Palermo, Paul R. Schroeder, Trudy J. Estes,
and Norman R. Francingues

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Environmental Laboratory
U.S. Army Engineer Research and Development Center
3909 Halls Ferry Road
Vicksburg, MS 39180-6199

8. PERFORMING ORGANIZATION REPORT NUMBER

ERDC/EL TR-08-29

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)
U.S. Environmental Protection Agency
Office of Solid Waste and Emergency Response
Washington, DC 20314-1000

10. SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES

14. ABSTRACT

This report provides technical guidelines for evaluating environmental dredging as a sediment remedy component. This document supports the *Contaminated Sediment Remediation Guidance for Hazardous Waste Sites*, released by the U.S. Environmental Protection Agency (USEPA) in 2005, by providing detailed information regarding evaluation of environmental dredging as a remedy component. This document is intended to be applicable to contaminated sediment sites evaluated under various environmental laws and regulatory programs. The intended audience for this report includes all stakeholders potentially involved in evaluating environmental dredging for purposes of a feasibility study, remedial design, and implementation.

The scope of this document is limited to the technical aspects of the environmental dredging process itself, but it is important that environmental dredging be integrated with other components such as transport, dewatering, treatment, and rehandling and disposal options. This report covers initial evaluation, pertinent site conditions and sediment characteristics, environmental dredging performance standards, equipment capabilities and selection, evaluation of production, duration, and transport, methods for estimating resuspension, residuals and release, control measures, operating methods and strategies, and monitoring.

15. SUBJECT TERMS

Contaminated sediment	Environmental dredging
Dredging equipment	Sediment remediation

16. SECURITY CLASSIFICATION OF:

a. REPORT	b. ABSTRACT	c. THIS PAGE
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED

17. LIMITATION OF ABSTRACT

18. NUMBER OF PAGES
304

19a. NAME OF RESPONSIBLE PERSON

19b. TELEPHONE NUMBER *(include area code)*

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std. 239.18

Appendix B

Chain-of-Custody Documentation

PDC Laboratories, Inc. – St. Louis
3278 N. Highway 67 (Lindbergh)
Florissant, MO 63033
www.pdclab.com www.environmetrics.net

CHAIN OF CUSTODY RECORD

Phone (314) 432-0550 or (314) 921-4488
Fax (314) 432-4977 or (314) 921-4494

State where samples collected MA

(Instructions/Sample Acceptance Policy on Reverse)

ALL SHADED AREAS MUST BE COMPLETED BY CLIENT (PLEASE PRINT)

① CLIENT: Tetra Tech
ADDRESS: 160 Federal Steet, 3rd Floor
CITY STATE ZIP: Boston, MA 02110
CONTACT PERSON: Ron Marnicio

PROJECT NUMBER: 106-4383
P.O. NUMBER:
MEANS SHIPPED: FedEx
PHONE NUMBER: 617-443-7500
FAX NUMBER:
EMAIL ADDRESS: Ron.Marnicio@tetratech.com
SAMPLER: Alex Vail
SAMPLER'S SIGNATURE: AVl

MATRIX TYPES:
WW-WASTEWATER
DW-DRINKING WATER
GW-GROUNDWATER
WWSL-SLUDGE
NAS-SOLID
LCHT-LEACHATE
NL-NONAQUEOUS LIQUID
SOL-SOILS

③ ANALYSIS REQUESTED

④ (FOR LAB USE ONLY)
LOGIN # ____________
LOGGED BY: ____________
LAB PROJ #
TEMPLATE:
PROJ. MGR:

② SAMPLE DESCRIPTION AS YOU WANT ON REPORT	DATE COLLECTED	TIME COLLECTED	SAMPLE TYPE GRAB	COMP	MATRIX TYPE	Bottle Count	Dredge Elutriate						REMARKS
SD-LUFP-BP	10/29/2015	1330		C	Sed	7	X						5 gal Sed, 30Gal H2O
SD-MLFP-BP	10/29/2015	1345		C	Sed	7	X						5 gal Sed, 30Gal H2O
SD-ECCS-BP	10/29/2015	1400		C	Sed	7	X						5 gal Sed, 30Gal H2O

⑤ TURNAROUND TIME (RUSH TAT IS SUBJECT TO PDC LABS APROVAL AND SURCHARGE)
☒ Normal (6-10 Bus. Days) ☐ Rush (5 Bus. Days) ☐ *Fastrak*™ (3 Bus. Days) ☐ 1-2 Bus. Days ☐ Same Day
DATE DUE ____________

RESULTS BY: ☒ E-MAIL ☐ FAX ☐ PHONE CALL PHONE/FAX # IF DIFFERENT FROM ABOVE

The sample temperature will be measured upon receipt at the lab. By initialing this area, you request that the lab notify you, before proceeding with analysis, if the sample temperature is outside of the range of 0.1-6.0°C. By not initialing this area, you allow the lab to proceed with analytical testing regardless of the sample temperature. ____________

⑥

⑦ RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY	DATE	TIME
				11/3/2015	1015
RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY:	DATE	TIME
RELINQUISHED BY (SIGNATURE)	DATE	TIME	RECEIVED BY	DATE	TIME
RELINQUISHED BY (SIGNATURE)	DATE	TIME	RECEIVED BY	DATE	TIME

⑧ COMMENTS: (FOR LAB USE ONLY)

SAMPLE TEMPERATURE UPON RECEIPT ______ °C

CHILL PROCESS STARTED PRIOR TO RECEIPT	Y OR N
SAMPLE(S) RECEIVED ON ICE	Y OR N
PROPER BOTTLES RECEIVED IN GOOD CONDITION	Y OR N
BOTTLES FILLED WITH ADEQUATE VOLUME	Y OR N
SAMPLES RECEIVED WITHIN HOLD TIME(S) (EXCLUDES TYPICAL FIELD PARAMETERS)	Y OR N
DATE AND TIME TAKEN FROM SAMPLE BOTTLE	

Thank you for using PDC Laboratories, Inc. Locations in Peoria, IL; St. Louis, MO; and Springfield, MO

PAGE ______ OF ______

3278 N. Highway 67 (Lindbergh)
Florissant, MO 63033
www.pdclab.com

Phone (314) 432-0550 or (314) 921-4488
Fax (314) 432-4977

State where samples collected ______

(Instructions/Sample Acceptance Policy on Reverse)

ALL SHADED AREAS MUST BE COMPLETED BY CLIENT (PLEASE PRINT)

① CLIENT [redacted]	PROJECT NUMBER -AML-T 35103	P.O. NUMBER	MEANS SHIPPED	③ ANALYSIS REQUESTED
ADDRESS [redacted]	PHONE NUMBER 314-441-5862	FAX NUMBER	EMAIL ADDRESS	
CITY STATE ZIP [redacted]	SAMPLER		**MATRIX TYPES:** WW-WASTEWATER DW-DRINKING WATER GW-GROUND WATER WWSL-SLUDGE NAS-SOLID L'CHT-LEACHATE NAL-NONAQUEOUS SOIL-SOILS	
CONTACT PERSON [redacted]	SAMPLER'S SIGNATURE			

④ (FOR LAB USE ONLY)

LOGIN # ______
LOGGED BY: ______
LAB PROJ. #
TEMPLATE:
PROJ. MGR.:

② SAMPLE DESCRIPTION AS YOU WANT ON REPORT	DATE COLLECTED	TIME COLLECTED	SAMPLE TYPE GRAB	SAMPLE TYPE COMP	MATRIX TYPE	Bottle Count	Total Solids							REMARKS
[redacted]	11/3/2015	[redacted]	[redacted]		[redacted]	[redacted]	X							SEE EMAIL
SD-LUFP-BPDUP	|	1200	X		|	1	X						"New Treatability
[redacted]	|	1215	X		|	1	X						[redacted]
SD-MLFB-BPDUP	|	1215	X		|	1	X						For Project
SD-ECCS-BP	|	1230	X		|	1	X						Details
SD-ECCS-BPDUP	↓	1230	X		↓	1	X							
		11/3/2015												

⑤ TURNAROUND TIME (RUSH TAT IS SUBJECT TO PDC LABS APPROVAL AND SURCHARGE)

NORMAL (8-10 Bus. Days) RUSH (5 Bus. Days) *Fastrak*$_{TM}$ (3 Bus. Days) 1-2 Bus. Days Same Day

DATE DUE ASAP

RESULTS BY: [✓ E-MAIL] FAX PHONE CALL PHONE/FAX# IF DIFFERENT FROM ABOVE

The sample temperature will be measured upon receipt at the lab. By initialing this area, you request that the lab notify you, before proceeding with analysis, if the sample temperature is outside of the range of 0.1-6.0°C. By not initialing this area, you allow the lab to proceed with analytical testing regardless of the sample temperature. ______

⑥

⑦ RELINQUISHED BY: (SIGNATURE)	DATE 11/3/2015	TIME 1245	RECEIVED BY: [redacted]	DATE 11/3/15	TIME 12:45
RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY:	DATE	TIME
RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY:	DATE	TIME
RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY:	DATE	TIME

⑧ COMMENTS:(FOR LAB USE ONLY)

1.1

SAMPLE TEMPERATURE UPON RECEIPT ____ °C
CHILL PROCESS STARTED PRIOR TO RECEIPT Y OR N
SAMPLES(S) RECEIVED ON ICE Y OR N
PROPER BOTTLES RECEIVED IN GOOD CONDITION Y OR N
BOTTLES FILLED WITH ADEQUATE VOLUME Y OR N
SAMPLES RECEIVED WITHIN HOLD TIME(S) Y OR N
(EXCLUDES TYPICAL FIELD PARAMETERS)
DATE AND TME TAKEN FROM SAMPLE BOTTLE ____

Thank you for using PDC Laboratories, Inc. Locations in Peoria, IL; St. Louis, MO; and Springfield, MO

PAGE ____ OF ____

3278 N. Highway 67 (Lindbergh)
Florissant, MO 63033
www.pdclab.com

Phone (314) 432-0550 or (314) 921-4488
Fax (314) 432-4977

State where samples collected ________

(Instructions/Sample Acceptance Policy on Reverse)

ALL SHADED AREAS MUST BE COMPLETED BY CLIENT (PLEASE PRINT)

① CLIENT	PROJECT NUMBER AML-T35103	P.O. NUMBER	MEANS SHIPPED
ADDRESS	PHONE NUMBER 941-5862	FAX NUMBER	EMAIL ADDRESS
CITY STATE ZIP	SAMPLER		MATRIX TYPES: WW-WASTEWATER DW-DRINKING WATER GW-GROUND WATER WWSL-SLUDGE NAS-SOLID L'CHT-LEACHATE NAL-NONAQUEOUS SOIL-SOILS
CONTACT PERSON	SAMPLER'S SIGNATURE		

③ ANALYSIS REQUESTED

④ (FOR LAB USE ONLY)

LOGIN # ____________

LOGGED BY: ____________

LAB PROJ. #

TEMPLATE:

PROJ. MGR.:

② SAMPLE DESCRIPTION AS YOU WANT ON REPORT	DATE COLLECTED	TIME COLLECTED	SAMPLE TYPE GRAB	SAMPLE TYPE COMP	MATRIX TYPE	Bottle Count			METALS					REMARKS
	/			X			X	X	X	X				
														"New Treatability
														Study" 10/28/2
														For Project
														Details
		11/2/2015												
SD-MLFB-BP and SD-ECCJ-BP														

⑤ TURNAROUND TIME (RUSH TAT IS SUBJECT TO PDC LABS APPROVAL AND SURCHARGE)

[✓ NORMAL (8-10 Bus. Days)] RUSH (5 Bus. Days) Fastrak™ (3 Bus. Days) 1-2 Bus. Days Same Day

DATE DUE ____________

RESULTS BY: E-MAIL FAX PHONE CALL PHONE/FAX# IF DIFFERENT FROM ABOVE

The sample temperature will be measured upon receipt at the lab. By initialing this area, you request that the lab notify you, before proceeding with analysis, if the sample temperature is outside of the range of 0.1-6.0°C. By not initialing this area, you allow the lab to proceed with analytical testing regardless of the sample temperature. ____________

⑥

⑦ RELINQUISHED BY: (SIGNATURE)	DATE	TIME 1510	RECEIVED BY:	DATE 11/3/15	TIME 1510
RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY:	DATE	TIME
RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY:	DATE	TIME
RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY:	DATE	TIME

⑧ COMMENTS:(FOR LAB USE ONLY)

SAMPLE TEMPERATURE UPON RECEIPT 14.7 °C
CHILL PROCESS STARTED PRIOR TO RECEIPT [✓ Y] OR N
SAMPLES(S) RECEIVED ON ICE [✓ Y] OR N
PROPER BOTTLES RECEIVED IN GOOD CONDITION [✓ Y] OR N
BOTTLES FILLED WITH ADEQUATE VOLUME [✓ Y] OR N
SAMPLES RECEIVED WITHIN HOLD TIME(S) (EXCLUDES TYPICAL FIELD PARAMETERS) [✓ Y] OR N
DATE AND TME TAKEN FROM SAMPLE BOTTLE ______

Thank you for using PDC Laboratories, Inc. Locations in Peoria, IL; St. Louis, MO; and Springfield, MO

PAGE ______ OF ______

3278 N. Highway 67 (Lindbergh)
Florissant, MO 63033
www.pdclab.com

Phone (314) 432-0550 or (314) 921-4488
Fax (314) 432-4977

State where samples collected ________

(Instructions/Sample Acceptance Policy on Reverse)

ALL SHADED AREAS MUST BE COMPLETED BY CLIENT (PLEASE PRINT)

①
CLIENT: TETRA TECH
ADDRESS: 1634 EASTPORT PLAZA DR
CITY STATE ZIP: COLLINSVILLE, IL 62234
CONTACT PERSON: P. SMITH / M. Sweller
PROJECT NUMBER: T35163
P.O. NUMBER:
MEANS SHIPPED:
PHONE NUMBER:
FAX NUMBER:
EMAIL ADDRESS:
SAMPLER: P. Smit
SAMPLER'S SIGNATURE:

MATRIX TYPES:
WW-WASTEWATER
DW-DRINKING WATER
GW-GROUND WATER
WWSL-SLUDGE
NAS-SOLID
L'CHT-LEACHATE
NAL-NONAQUEOUS
SOIL-SOILS

③ ANALYSIS REQUESTED

④ (FOR LAB USE ONLY)
LOGIN # ________
LOGGED BY: ________
LAB PROJ. #
TEMPLATE:
PROJ. MGR.:

②

SAMPLE DESCRIPTION AS YOU WANT ON REPORT	DATE COLLECTED	TIME COLLECTED	SAMPLE TYPE GRAB	SAMPLE TYPE COMP	MATRIX TYPE	Bottle Count	PAH							REMARKS
LUFP-1H-1.0%							X	X	X	X				SEE EMAIL
LUFP-1H-0.5%		1250	✓		WAT	6	X	X	X					"NEW TREATABILIT
LUFP-1H-0.1%		1255	✓		WAT	6	X	X	X	X				STUDY" 11/28/2015
MLFP-1H-1.0%		1308	✓		WAT	6	X		X	X				FOR PROJECT
MLFP-1H-0.5%		1315	✓		WAT	6	X		X					DETAILS
MLFP-1H-0.1%		1321	✓		WAT	6	X	X	X	X				
LUFP-1H-1.0% F		1400	✓		WAT	6	X	X	X	X				
LUFP-1H-0.5% F		1410	✓		WAT	6	X	X	X	X				
LUFP-1H-0.1% F		1425	✓		WAT	6	X	X	X	X				
MLFP-1H-1.0% F		1445	✓		WAT	6	X	X	X	X				
MLFP-1H-0.5% F		1455	✓		″	6	X	X	X	X				
MLFP-1H-0.1% F	↓	1510	✓		WAT	6	X	X	X					

⑤ TURNAROUN TIME (RUSH TAT IS SUBJECT TO PDC LABS APPROVAL AND SURCHARGE)
[✓ NOR (8-10 Bus. Days)] RUSH (5 Bus. Days) Fastrak$_{TM}$ (3 Bus. Days) 1-2 Bus. Days Same Day
DATE DUE ________

RESULTS BY: E-MAIL FAX PHONE CALL PHONE/FAX# IF DIFFERENT FROM ABOVE

⑥ The sample temperature will be measured upon receipt at the lab. By initialing this area, you request that the lab notify you, before proceeding with analysis, if the sample temperature is outside of the range of 0.1-6.0°C. By not initialing this area, you allow the lab to proceed with analytical testing regardless of the sample temperature. ________

⑦

RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY:	DATE	TIME
		16:00	Heather Coulson	11/4/15	16:00
RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY:	DATE	TIME
RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY:	DATE	TIME
RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY:	DATE	TIME

⑧ COMMENTS:(FOR LAB USE ONLY)

SAMPLE TEMPERATURE UPON RECEIPT [illegible] °C
CHILL PROCESS STARTED PRIOR TO RECEIPT [✓ Y] OR N
SAMPLES(S) RECEIVED ON ICE [✓ Y] OR N
PROPER BOTTLES RECEIVED IN GOOD CONDITION [✓ Y] OR N
BOTTLES FILLED WITH ADEQUATE VOLUME [✓ Y] OR N
SAMPLES RECEIVED WITHIN HOLD TIME(S) (EXCLUDES TYPICAL FIELD PARAMETERS) [✓ Y] OR N
DATE AND TME TAKEN FROM SAMPLE BOTTLE ________

Thank you for using PDC Laboratories, Inc. Locations in Peoria, IL; St. Louis, MO; and Springfield, MO

PAGE ______OF______

3278 N. Highway 67 (Lindbergh)
Florissant, MO 63033
www.pdclab.com

Phone (314) 432-0550 or (314) 921-4488
Fax (314) 432-4977

(Instructions/Sample Acceptance Policy on Reverse)

ALL SHADED AREAS MUST BE COMPLETED BY CLIENT (PLEASE PRINT)

① CLIENT TETRA TECH	PROJECT NUMBER	P. O. NUMBER	MEANS SHIPPED
ADDRESS	PHONE NUMBER	FAX NUMBER	EMAIL ADDRESS
CITY STATE ZIP	SAMPLER		MATRIX TYPES: WW-WASTEWATER DW-DRINKING WATER GW-GROUND WATER WWSL-SLUDGE NAS-SOLID L'CHT-LEACHATE NAL-NONAQUEOUS SOIL-SOILS
CONTACT PERSON	SAMPLER'S SIGNATURE		

③ ANALYSIS REQUESTED

④ (FOR LAB USE ONLY)

LOGIN # ____________
LOGGED BY: ____________
LAB PROJ. #
TEMPLATE:
PROJ. MGR.:

② SAMPLE DESCRIPTION AS YOU WANT ON REPORT	DATE COLLECTED	TIME COLLECTED	SAMPLE TYPE GRAB	SAMPLE TYPE COMP	MATRIX TYPE	Bottle Count								REMARKS
	11/5/2015	1300	✓	~~✓~~		5	X	X	X	X				SEE EMAIL
		1305	✓	~~✓~~	WAT	5	X	X	X	X				"New Treatability
ECCS-1H-0.1%		1310	✓	~~✓~~	WAT	5	X	X	X	X				Study", 11/28/10
		1320	✓	~~✓~~	WAT	5	X	X	X	X				For Project
		1325	✓	~~✓~~	WAT		X	X	X	X				Details &
		1330	✓	~~✓~~ 11/5/2015	WAT	5	X	X	X	X				Specifications
				11/5/15										

⑤ TURNAROUND TIME (RUSH TAT IS SUBJECT TO PDC LABS APPROVAL AND SURCHARGE)
[✓ NORMAL (8-10 Bus. Days)] RUSH (5 Bus. Days) *Fastrak*™ (3 Bus. Days) 1-2 Bus. Days Same Day
DATE DUE ____________

RESULTS BY: [✓ E-MAIL] FAX PHONE CALL PHONE/FAX# IF DIFFERENT FROM ABOVE

The sample temperature will be measured upon receipt at the lab. By initialing this area, you request that the lab notify you, before proceeding with analysis, if the sample temperature is outside of the range of 0.1-6.0°C. By not initialing this area, you allow the lab to proceed with analytical testing regardless of the sample temperature. ____________

⑥

⑦ RELINQUISHED BY: (SIGNATURE)	DATE 11/5/2015	TIME 1413	RECEIVED BY:	DATE 11/5/15	TIME 14:15
RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY:	DATE	TIME
RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY:	DATE	TIME
RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY:	DATE	TIME

⑧ COMMENTS:(FOR LAB USE ONLY)

SAMPLE TEMPERATURE UPON RECEIPT	______°C
CHILL PROCESS STARTED PRIOR TO RECEIPT	Y OR N
SAMPLES(S) RECEIVED ON ICE	Y OR N
PROPER BOTTLES RECEIVED IN GOOD CONDITION	Y OR N
BOTTLES FILLED WITH ADEQUATE VOLUME	Y OR N
SAMPLES RECEIVED WITHIN HOLD TIME(S) (EXCLUDES TYPICAL FIELD PARAMETERS)	Y OR N
DATE AND TME TAKEN FROM SAMPLE BOTTLE	______

Thank you for using PDC Laboratories, Inc. Locations in Peoria, IL; St. Louis, MO; and Springfield, MO

PAGE ______OF______

3278 N. Highway 67 (Lindbergh)
Florissant, MO 63033
www.pdclab.com

Phone (314) 432-0550 or (314) 921-4488
Fax (314) 432-4977

(Instructions/Sample Acceptance Policy on Reverse)

ALL SHADED AREAS MUST BE COMPLETED BY CLIENT (PLEASE PRINT)

① CLIENT [illegible]

ADDRESS [illegible]

CITY STATE ZIP [illegible]

CONTACT PERSON [illegible]

PROJECT NUMBER 11/5/2015

P. O. NUMBER

MEANS SHIPPED

PHONE NUMBER

FAX NUMBER

EMAIL ADDRESS

SAMPLER [illegible]

SAMPLER'S SIGNATURE

MATRIX TYPES:
WW-WASTEWATER
DW-DRINKING WATER
GW-GROUND WATER
WWSL-SLUDGE
NAS-SOLID
L'CHT-LEACHATE
NAL-NONAQUEOUS
SOIL-SOILS

③ ANALYSIS REQUESTED

④ (FOR LAB USE ONLY)

LOGIN # ____

LOGGED BY: ____

LAB PROJ. #

TEMPLATE:

PROJ. MGR.

② SAMPLE DESCRIPTION AS YOU WANT ON REPORT	DATE COLLECTED	TIME COLLECTED	SAMPLE TYPE GRAB	SAMPLE TYPE COMP	MATRIX TYPE	Bottle Count	PAHs	PCBs	[illegible]	TSS				REMARKS
LUFP-6H-1.0%	11/5/2015	[illegible]	✓				X	X	X					SEE EMAIL
MLFP-6H-1.0%	)	1450	✓			5	X	X	X	X				
ECCS-6H-1.0%	|	1500	✓		WAT	5	X	X	X	X				"STUDY", 11/28/20
LUFP-6H-1.0% F	|	1515	✓		WAT	5	X	X	X					
MLFP-6H-1.0% F	|	1525	✓		WAT	5	X	X	X	X				DETAILS &
ECCS-6H-1.0% F	↓	1535	✓		WAT	5	X	X	X	X				SPECIFICATIONS

11/5/2015

⑤ TURNAROUND TIME (RUSH TAT IS SUBJECT TO PDC LABS APPROVAL AND SURCHARGE)
NORMAL (8-10 Bus. Days) USH (5 Bus. Days) *Fastrak*™ (3 Bus. Days) 1-2 Bus. Days Same Day
DATE DUE ____

RESULTS BY. E-MAIL FAX PHONE CALL PHONE/FAX# IF DIFFERENT FROM ABOVE

The sample temperature will be measured upon receipt at the lab. By initialing this area, you request that the lab notify you, before proceeding with analysis, if the sample temperature is outside of the range of 0.1-6.0°C. By not initialing this area, you allow the lab to proceed with analytical testing regardless of the sample temperature. ____

⑥

⑦ RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY:	DATE	TIME
	11/5		H Collin Carleard	11/5/15	16:30
RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY:	DATE	TIME
RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY:	DATE	TIME
RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY:	DATE	TIME

⑧ COMMENTS:(FOR LAB USE ONLY) ____

SAMPLE TEMPERATURE UPON RECEIPT 1.1 °C
CHILL PROCESS STARTED PRIOR TO RECEIPT [✓ Y] OR N
SAMPLES(S) RECEIVED ON ICE [✓ Y] OR N
PROPER BOTTLES RECEIVED IN GOOD CONDITION [✓ Y] OR N
BOTTLES FILLED WITH ADEQUATE VOLUME [✓ Y] OR N
SAMPLES RECEIVED WITHIN HOLD TIME(S) (EXCLUDES TYPICAL FIELD PARAMETERS) OR N
DATE AND TME TAKEN FROM SAMPLE BOTTLE ____

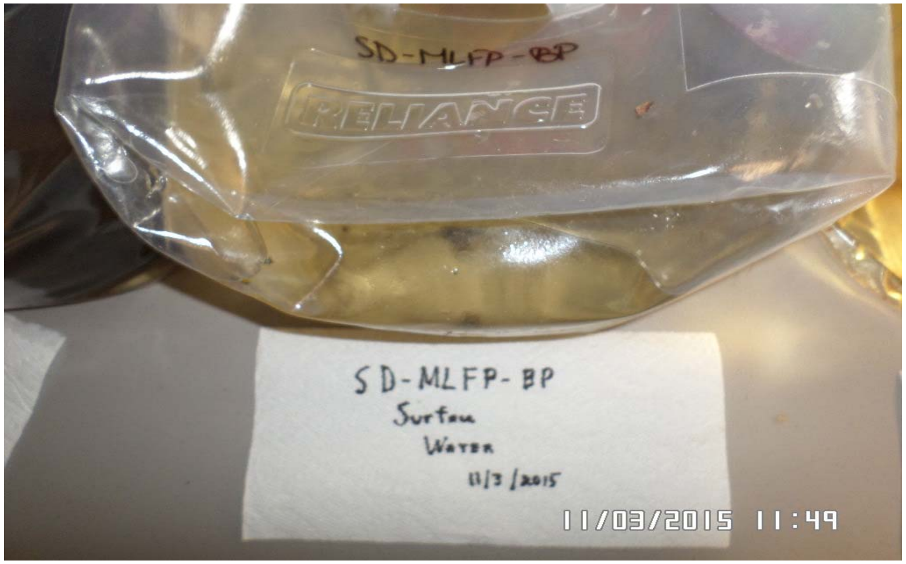
Thank you for using PDC Laboratories, Inc. Locations in Peoria, IL; St. Louis, MO; and Springfield, MO

PAGE ____ OF 1

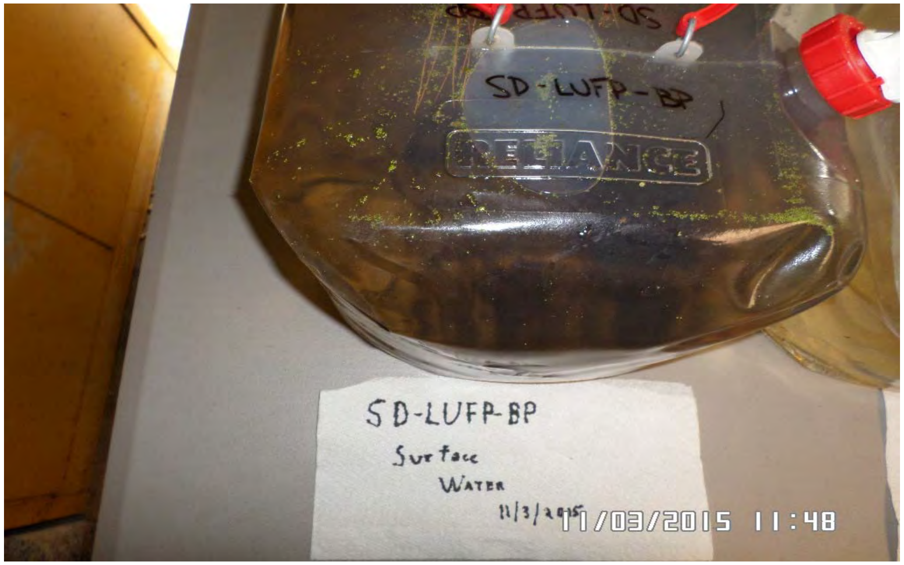
Appendix C

DRET Photodocumentation

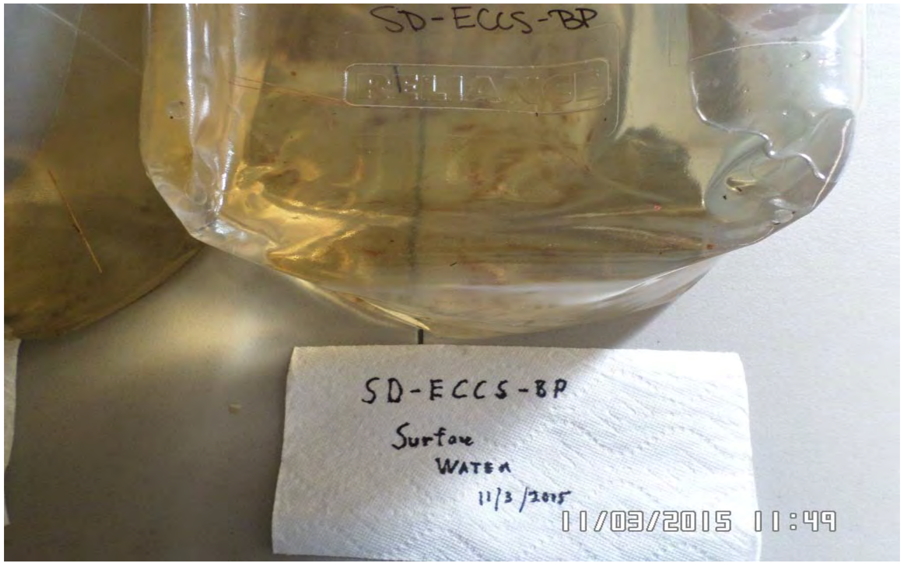
Sediment and Surface Water Media Receipt at PDC.



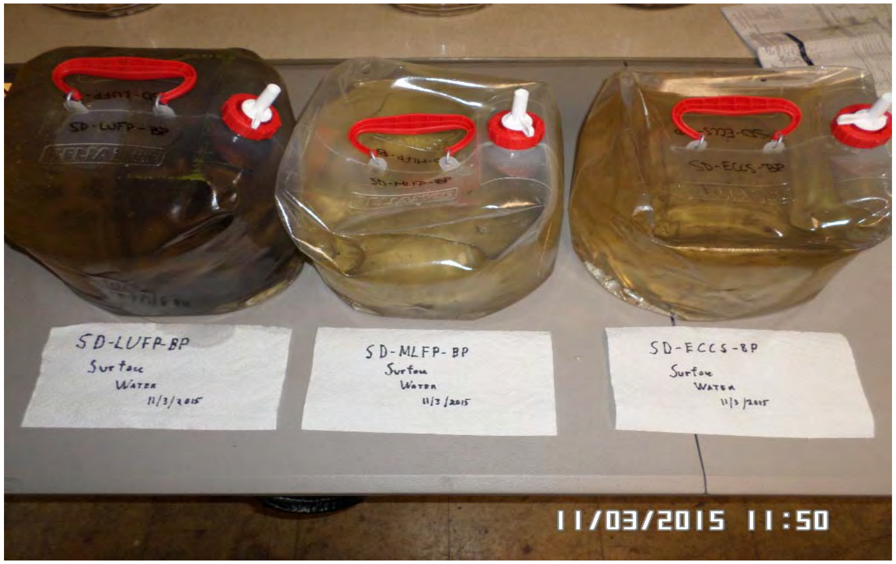
Surface Water from MLFP-BP Area.



Surface Water from LUFP-BP Area.



Surface Water from ECCS-BP Area.



Comparison of 3 Surface Water Samples (LUFP, MLFP, and ECCS).

MLFP-BP Sediment after light homogenization.

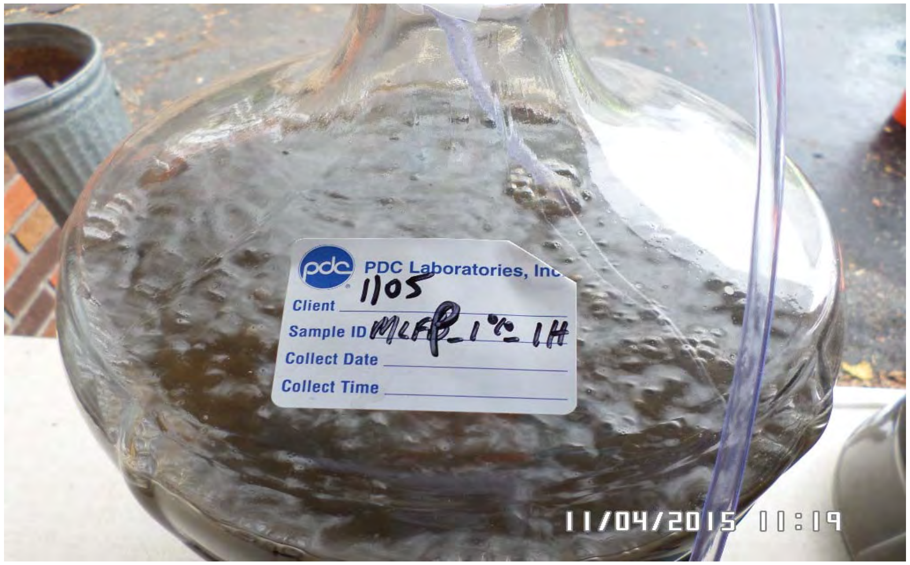
LUFP-BP Sediment after light homogenization.

ECCS-BP Sediment after light homogenization.

3 LUFP –BP Sediment Slurries (1.0%, 0.5%, and 0.1% solids).

3 MLFP-BP Sediment Slurries (1.0%, 0.5%, and 0.1% solids).

LUFP-BP Sediment at 0.5% solids during 1 hour aeration.



MLFP-BP Sediment at 1.0% solids during 1 hour aeration.

LUFP-BP Sediment Slurry (1 hour aeration at 1.0% solids) after one hour settling.

LUFP-BP Sediment Slurry (1 hour aeration at 0.1% solids) after one hour settling.

LUFP-BP Sediment Slurry (1 hour aeration at 0.5% solids) after one hour settling.

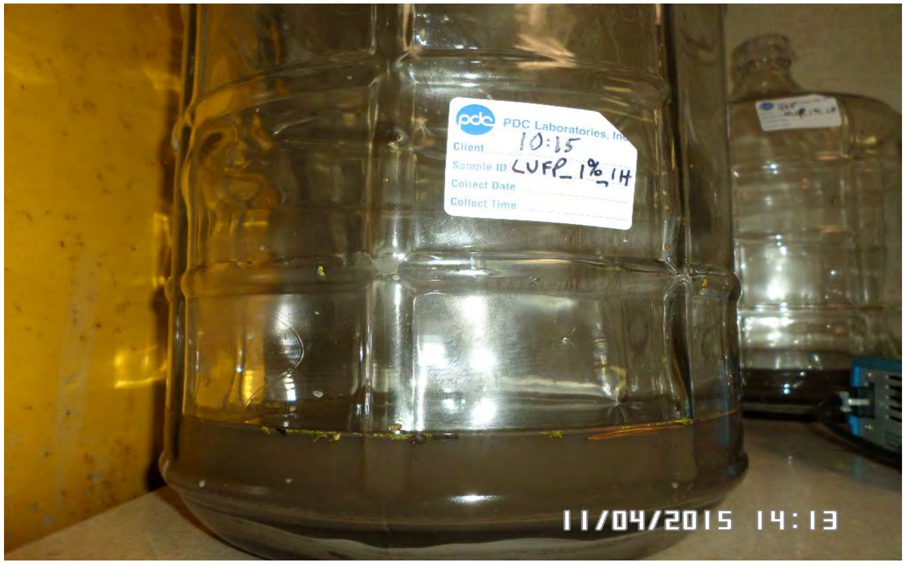
Pumping off LUFP-BP supernatants after one hour settling period.
(View 1 of 2)

Pumping off LUFP-BP supernatants after one hour settling period.
(View 2 of 2)

MLFP-BP Sediment Slurry (1 hour aeration at 0.5% solids) after one hour settling.

MLFP-BP Sediment Slurry (1 hour aeration at 1.0% solids) after one hour settling.

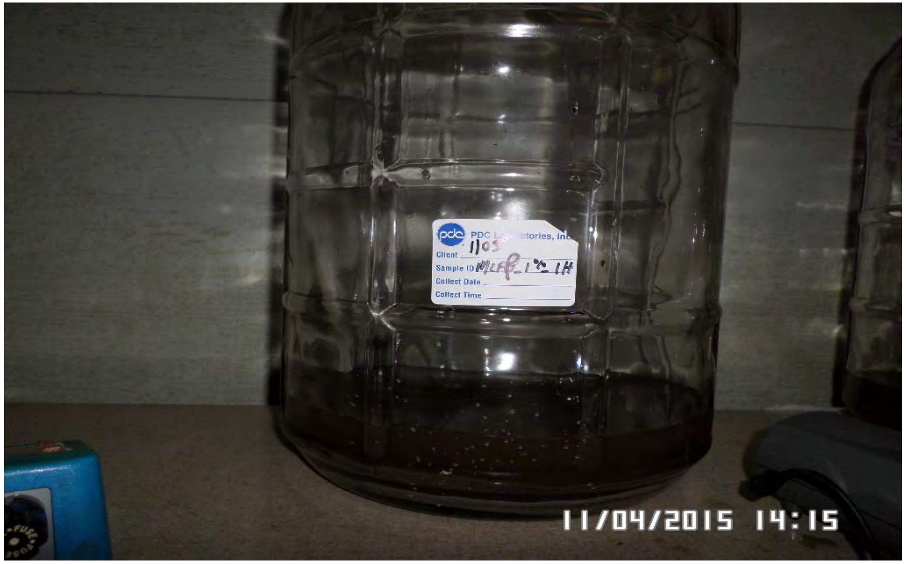
MLFP-BP Sediment Slurry (1 hour aeration at 0.1% solids) after one hour settling.



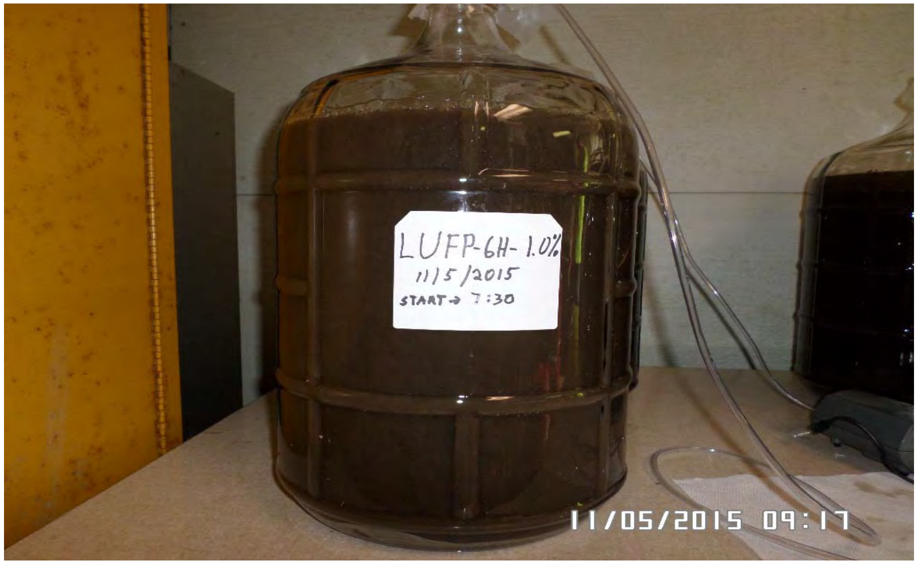
LUFP-BP Sediment after pumping off supernatant (1 hour aeration at 1.0% solids).

LUFP-BP Sediment after pumping off supernatant (1 hour aeration at 0.1% solids).

LUFP-BP Sediment after pumping off supernatant (1 hour aeration at 0.5% solids).



MLFP-BP Sediment after pumping off supernatant (1 hour aeration at 1.0% solids).



LUFP-BP Sediment Slurry (6 hour aeration at 1.0% solids) during aeration stage.

ECCS-BP Sediment Slurry (6 hour aeration at 1.0% solids) during aeration stage.

MLFP-BP Sediment Slurry (6 hour aeration at 1.0% solids) during aeration stage.

ECCS-BP Sediment Slurry (1 hour aeration at 1.0% solids) during aeration stage.

ECCS-BP Sediment Slurry (1 hour aeration at 0.5% solids) during aeration stage.

3 ECCS –BP Sediment Slurries (1.0%, 0.5%, and 0.1% solids) during 1 hour aeration stage.

ECCS-BP Sediment Slurry (1 hour aeration at 0.1% solids) during aeration stage.

ECCS-BP (1 hour aeration) supernatants (1%, 0.5%, and 0.1% l to r)

Pumping off 6 hour aeration supernatants (LUFP-BP and MLFP-BP) after one hour settling stage.

LUFP-BP, MLFP-BP, and ECCS-BP (6 hour aeration at 1.0% solids) supernatants after one hour settling.

Appendix D

Total Solids Analytical Results - Data Sheets

PDC Laboratories, Inc.
PROFESSIONAL ŁDEPENDABLE ŁCOMMITTED

November 04, 2015

Paul Smith
TETRA TECH
1634 Eport Plaza Dr
Collinsville, IL 62234

Dear Paul Smith:

Please find enclosed the **revised** analytical results for the sample(s) the laboratory received on **11/3/15 12:45 pm** and logged in under work order **5110316**. All testing is performed according to our current TNI certifications unless otherwise noted. This report cannot be reproduced, except in full, without the written permission of PDC Laboratories, Inc.

If you have any questions regarding your report, please contact your project manager. Quality and timely data is of the utmost importance to us.

PDC Laboratories, Inc. appreciates the opportunity to provide you with analytical expertise. We are always trying to improve our customer service and we welcome you to contact the Vice President , John LaPayne with any feedback you have about your experience with our laboratory.

Sincerely,

Roxann Shull

Roxann Shull
Client Services Supervisor
(314) 432-0550
rshull@pdclab.com

REVISED ANALYTICAL RESULTS

Sample: **5110316-01**
Name: SD-LUFP-BP
Matrix: Solid
Sampled: 11/03/15 12:00
Received: 11/03/15 12:45
PO #: 2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
General Chemistry - STL								
Solids - total solids (TS)	32	%			0.050	11/03/15 13:50	KMN	SM 2540G 18Ed*

Sample: **5110316-02**
Name: SD-LUFP-BPDUP
Matrix: Solid
Sampled: 11/03/15 12:00
Received: 11/03/15 12:45
PO #: 2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
General Chemistry - STL								
Solids - total solids (TS)	34	%			0.050	11/03/15 13:50	KMN	SM 2540G 18Ed*

Sample: **5110316-03**
Name: SD-MLFP-BP
Matrix: Solid
Sampled: 11/03/15 12:15
Received: 11/03/15 12:45
PO #: 2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
General Chemistry - STL								
Solids - total solids (TS)	38	%			0.050	11/03/15 13:50	KMN	SM 2540G 18Ed*

Sample: **5110316-04**
Name: SD-MLFP-BPDUP
Matrix: Solid
Sampled: 11/03/15 12:15
Received: 11/03/15 12:45
PO #: 2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
General Chemistry - STL								
Solids - total solids (TS)	39	%			0.050	11/03/15 13:50	KMN	SM 2540G 18Ed*

Sample: **5110316-05**
Name: SD-ECCS-BP
Matrix: Solid
Sampled: 11/03/15 12:30
Received: 11/03/15 12:45
PO #: 2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
General Chemistry - STL								
Solids - total solids (TS)	51	%			0.050	11/03/15 13:50	KMN	SM 2540G 18Ed*

REVISED ANALYTICAL RESULTS

Sample:	**5110316-06**	**Sampled:**	11/03/15 12:30
Name:	SD-ECCS-BPDUP	**Received:**	11/03/15 12:45
Matrix:	Solid	**PO #:**	2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
General Chemistry - STL								
Solids - total solids (TS)	50	%			0.050	11/03/15 13:50	KMN	SM 2540G 18Ed*

QC SAMPLE RESULTS

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch B518527 - 04-No Prep WC Solid - SM 2540G 18Ed									
Blank (B518527-BLK1)				Prepared & Analyzed: 11/03/15					
Solids - total solids (TS)	< 0.050	%							
Duplicate (B518527-DUP1)	**Sample: 5110316-01**			Prepared & Analyzed: 11/03/15					
Solids - total solids (TS)	32.6	%			32.3			0.7	20

NOTES

Specific method revisions used for analysis are available upon request.

Memos

Revised report due to incorrect sample id for PDC Sample Number 5110316-03 & 04, Per Paul Smith 11/04/2015.

Certifications

PIA - Peoria, IL
    TNI Accreditation for Drinking Water, Wastewater, Hazardous and Solid Wastes Fields of Testing through IL EPA Lab No. 100230
    Illinois Department of Public Health Bacteriological Analysis in Drinking Water Approved Laboratory Registry No. 17553
    Missouri Department of Natural Resources Certificate of Approval for Microbiological Laboratory Service No. 870
    Drinking Water Certifications: Iowa (240); Kansas (E-10338); Missouri (870)
    Wastewater Certifications: Arkansas (88-0677); Iowa (240); Kansas (E-10338)
    Hazardous/Solid Waste Certifications: Arkansas (88-0677); Iowa (240); Kansas (E-10338)

SPMO - Springfield, MO
    USEPA DMR-QA Program

STL - St. Louis, MO
    TNI Accreditation for Wastewater, Hazardous and Solid Wastes Fields of Testing through KS Lab No. E-10389
    Illinois Department of Public Health Bacteriological Analysis in Drinking Water Approved Laboratory Registry No. 171050
    Drinking Water Certifications: Missouri (1050)
    Missouri Department of Natural Resources

* Not a TNI accredited analyte

Roxann Shull

NELAP ACCREDITED TNI LABORATORY

Certified by: Roxann Shull, Client Services Supervisor

PDC Laboratories, Inc. – St. Louis
3278 N. Highway 67 (Lindbergh)
Florissant, MO 63033
www.pdclab.com

CHAIN OF CUSTODY RECORD

Phone (314) 432-0550 or (314) 921-4488
Fax (314) 432-4977

State where samples collected MA

(Instructions/Sample Acceptance Policy on Reverse)

Page 6 of 6

ALL SHADED AREAS MUST BE COMPLETED BY CLIENT (PLEASE PRINT)

① CLIENT: TETRA TECH
ADDRESS: 1634 EASTPORT PLAZA
CITY STATE ZIP: COLLINSVILLE, IL 62234
CONTACT PERSON: P. SMITH / R. SWALLER

PROJECT NUMBER: 100-AML-T 35103
P.O. NUMBER:
MEANS SHIPPED:
PHONE NUMBER: 314-941-5862
FAX NUMBER:
EMAIL ADDRESS:
SAMPLER: R. SWALLER
SAMPLER'S SIGNATURE:

MATRIX TYPES:
WW-WASTEWATER
DW-DRINKING WATER
GW-GROUND WATER
WWSL-SLUDGE
NAS-SOLID
L'CHT-LEACHATE
NAL-NONAQUEOUS
SOIL-SOILS

③ ANALYSIS REQUESTED

④ (FOR LAB USE ONLY)
LOGIN # 5110316
LOGGED BY: HC
LAB PROJ. #
TEMPLATE:
PROJ. MGR.:

② SAMPLE DESCRIPTION AS YOU WANT ON REPORT	DATE COLLECTED	TIME COLLECTED	SAMPLE TYPE GRAB	SAMPLE TYPE COMP	MATRIX TYPE	Bottle Count	Total Solids	REMARKS
SD-LUFP-BP	11/3/2015	1200	X		SED	1	X	SEE EMAIL
SD-LUFP-BPDUP	↓	1200	X		↓	1	X	"New Treatability
SD-MLFB-BP MLFP*	↓	1215	X		↓	1	X	Study", 10/28/2015
SD-MLFB-BPDUP MLFP*	↓	1215	X		↓	1	X	For Project
SD-ECLS-BP	↓	1230	X		↓	1	X	DETAILS
SD-ECLS-BPDUP	↓	1230	X		↓	1	X	

11/3/2015

*note Change to Sample Description – @ 11/4/15 per P.S. 11/4/15

⑤ TURNAROUND TIME (RUSH TAT IS SUBJECT TO PDC LABS APPROVAL AND SURCHARGE)
NORMAL (8-10 Bus. Days) RUSH (5 Bus. Days) *Fastrak*™ (3 Bus. Days) 1-2 Bus. Days Same Day
DATE DUE ASAP → 8:00AM 11/4/2015
RESULTS BY: [✓ E-MAIL] FAX PHONE CALL PHONE/FAX# IF DIFFERENT FROM ABOVE

⑥ The sample temperature will be measured upon receipt at the lab. By initialing this area, you request that the lab notify you, before proceeding with analysis, if the sample temperature is outside of the range of 0.1-6.0°C. By not initialing this area, you allow the lab to proceed with analytical testing regardless of the sample temperature. ______

⑦ RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY:	DATE	TIME
	11/3/2015	1245	Heather Carlcutt	11/3/15	12:45
RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY:	DATE	TIME
RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY:	DATE	TIME
RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY:	DATE	TIME

⑧ COMMENTS:(FOR LAB USE ONLY)

SAMPLE TEMPERATURE UPON RECEIPT 19.1 °C
CHILL PROCESS STARTED PRIOR TO RECEIPT [✓ Y] OR N
SAMPLES(S) RECEIVED ON ICE [✓ Y] OR N
PROPER BOTTLES RECEIVED IN GOOD CONDITION [✓ Y] OR N
BOTTLES FILLED WITH ADEQUATE VOLUME [✓ Y] OR N
SAMPLES RECEIVED WITHIN HOLD TIME(S) (EXCLUDES TYPICAL FIELD PARAMETERS) [✓ Y] OR N
DATE AND TME TAKEN FROM SAMPLE BOTTLE ______

Appendix E

DRET Analytical Results (One-Hour Aeration Tests) - Data Sheets

PDC Laboratories, Inc.
PROFESSIONAL ŁDEPENDABLE ŁCOMMITTED

November 18, 2015

Paul Smith
TETRA TECH
1634 Eport Plaza Dr
Collinsville, IL 62234

Dear Paul Smith:

Please find enclosed the analytical results for the sample(s) the laboratory received on **11/4/15 4:00 pm** and logged in under work order **5110751**. All testing is performed according to our current TNI certifications unless otherwise noted. This report cannot be reproduced, except in full, without the written permission of PDC Laboratories, Inc.

If you have any questions regarding your report, please contact your project manager. Quality and timely data is of the utmost importance to us.

PDC Laboratories, Inc. appreciates the opportunity to provide you with analytical expertise. We are always trying to improve our customer service and we welcome you to contact the Vice President , John LaPayne with any feedback you have about your experience with our laboratory.

Sincerely,

Roxann Shull

Roxann Shull
Client Services Supervisor
(314) 432-0550
rshull@pdclab.com

NELAP ACCREDITED
TNI
LABORATORY

ANALYTICAL RESULTS

Sample: **5110751-01**
Name: LUFP-1H-1.0%
Matrix: Ground Water - Grab

Sampled: 11/04/15 12:45
Received: 11/04/15 16:00
PO #: 2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
General Chemistry - STL								
Solids - total suspended solids (TSS)	2100	mg/L		0.50	10	11/06/15 10:52	KLA	SM 2540D
Polychlorinated Biphenyls (PCBs) - STL								
Aroclor 1016	< 0.1	ug/L		0.1	0.5	11/07/15 20:34	BP	SW 8082*
Aroclor 1221	< 0.1	ug/L		0.1	0.5	11/07/15 20:34	BP	SW 8082*
Aroclor 1232	< 0.1	ug/L		0.1	0.5	11/07/15 20:34	BP	SW 8082*
Aroclor 1242	< 0.1	ug/L		0.1	0.5	11/07/15 20:34	BP	SW 8082*
Aroclor 1248	< 0.1	ug/L		0.1	0.5	11/07/15 20:34	BP	SW 8082*
Aroclor 1254	< 0.1	ug/L		0.1	0.5	11/07/15 20:34	BP	SW 8082*
Aroclor 1260	< 0.1	ug/L		0.1	0.5	11/07/15 20:34	BP	SW 8082*
Aroclors - Total	< 0.1	ug/L		0.1	0.5	11/07/15 20:34	BP	SW 8082*
Surrogate: TCMX	*89 %*	*41-135*				*11/07/15 20:34*	*BP*	*SW 8082**
Surrogate: Decachlorobiphenyl	*101 %*	*36-148*				*11/07/15 20:34*	*BP*	*SW 8082**
Semivolatile Organics - SIM - STL								
Naphthalene	0.15	ug/L		0.03	0.10	11/16/15 22:33	BP	SW 8270C
Acenaphthylene	< 0.03	ug/L		0.03	0.10	11/16/15 22:33	BP	SW 8270C
Acenaphthene	< 0.03	ug/L		0.03	0.10	11/16/15 22:33	BP	SW 8270C
Fluorene	< 0.04	ug/L		0.04	0.10	11/16/15 22:33	BP	SW 8270C
Phenanthrene	< 0.04	ug/L		0.04	0.10	11/16/15 22:33	BP	SW 8270C
Anthracene	< 0.03	ug/L		0.03	0.10	11/16/15 22:33	BP	SW 8270C
Fluoranthene	< 0.05	ug/L		0.05	0.10	11/16/15 22:33	BP	SW 8270C
Pyrene	< 0.04	ug/L		0.04	0.10	11/16/15 22:33	BP	SW 8270C
Benzo(a)anthracene	< 0.05	ug/L		0.05	0.10	11/16/15 22:33	BP	SW 8270C
Chrysene	< 0.03	ug/L		0.03	0.10	11/16/15 22:33	BP	SW 8270C
Benzo(b)fluoranthene	< 0.08	ug/L		0.08	0.10	11/16/15 22:33	BP	SW 8270C
Benzo(k)fluoranthene	< 0.10	ug/L		0.10	0.10	11/16/15 22:33	BP	SW 8270C
Benzo(a)pyrene	< 0.04	ug/L		0.04	0.10	11/16/15 22:33	BP	SW 8270C
Indeno(1,2,3-cd)pyrene	< 0.04	ug/L		0.04	0.10	11/16/15 22:33	BP	SW 8270C
Dibenzo(a,h)anthracene	< 0.04	ug/L		0.04	0.10	11/16/15 22:33	BP	SW 8270C
Benzo(g,h,i)perylene	< 0.04	ug/L		0.04	0.10	11/16/15 22:33	BP	SW 8270C
Total Metals - PIA								
Antimony	9.6	ug/L		0.036	3.0	11/12/15 11:51	JMW	SW 6020
Arsenic	4.7	ug/L		0.13	1.0	11/12/15 11:51	JMW	SW 6020
Beryllium	0.96	ug/L	J	0.017	1.0	11/12/15 11:51	JMW	SW 6020
Cadmium	1.9	ug/L		0.042	1.0	11/12/15 11:51	JMW	SW 6020
Chromium	19	ug/L		0.27	4.0	11/12/15 11:51	JMW	SW 6020
Copper	24	ug/L		0.025	3.0	11/12/15 11:51	JMW	SW 6020
Lead	99	ug/L		0.025	1.0	11/12/15 11:51	JMW	SW 6020
Nickel	13	ug/L		0.075	5.0	11/12/15 11:51	JMW	SW 6020
Selenium	3.5	ug/L		0.32	1.0	11/12/15 11:51	JMW	SW 6020

ANALYTICAL RESULTS

Sample:	**5110751-01**	**Sampled:**	11/04/15 12:45
Name:	LUFP-1H-1.0%	**Received:**	11/04/15 16:00
Matrix:	Ground Water - Grab	**PO #:**	2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
Silver	1.1	ug/L	J	0.028	5.0	11/12/15 11:51	JMW	SW 6020
Thallium	0.24	ug/L	J	0.062	1.0	11/12/15 11:51	JMW	SW 6020
Zinc	150	ug/L		0.50	6.0	11/12/15 11:51	JMW	SW 6020
Total Metals - STL								
Mercury	24	ug/L		1.0	1.0	11/12/15 11:10	WPS	SW 7470

ANALYTICAL RESULTS

Sample: **5110751-02**
Name: LUFP-1H-0.5%
Matrix: Ground Water - Grab

Sampled: 11/04/15 12:50
Received: 11/04/15 16:00
PO #: 2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
General Chemistry - STL								
Solids - total suspended solids (TSS)	1100	mg/L		0.50	10	11/06/15 10:52	KLA	SM 2540D
Polychlorinated Biphenyls (PCBs) - STL								
Aroclor 1016	< 0.1	ug/L		0.1	0.5	11/07/15 20:59	BP	SW 8082*
Aroclor 1221	< 0.1	ug/L		0.1	0.5	11/07/15 20:59	BP	SW 8082*
Aroclor 1232	< 0.1	ug/L		0.1	0.5	11/07/15 20:59	BP	SW 8082*
Aroclor 1242	< 0.1	ug/L		0.1	0.5	11/07/15 20:59	BP	SW 8082*
Aroclor 1248	< 0.1	ug/L		0.1	0.5	11/07/15 20:59	BP	SW 8082*
Aroclor 1254	< 0.1	ug/L		0.1	0.5	11/07/15 20:59	BP	SW 8082*
Aroclor 1260	< 0.1	ug/L		0.1	0.5	11/07/15 20:59	BP	SW 8082*
Aroclors - Total	< 0.1	ug/L		0.1	0.5	11/07/15 20:59	BP	SW 8082*
Surrogate: TCMX	*85 %*	*41-135*				*11/07/15 20:59*	*BP*	*SW 8082**
Surrogate: Decachlorobiphenyl	*96 %*	*36-148*				*11/07/15 20:59*	*BP*	*SW 8082**
Semivolatile Organics - SIM - STL								
Naphthalene	0.16	ug/L		0.03	0.10	11/16/15 23:00	BP	SW 8270C
Acenaphthylene	< 0.03	ug/L		0.03	0.10	11/16/15 23:00	BP	SW 8270C
Acenaphthene	< 0.03	ug/L		0.03	0.10	11/16/15 23:00	BP	SW 8270C
Fluorene	< 0.04	ug/L		0.04	0.10	11/16/15 23:00	BP	SW 8270C
Phenanthrene	< 0.04	ug/L		0.04	0.10	11/16/15 23:00	BP	SW 8270C
Anthracene	< 0.03	ug/L		0.03	0.10	11/16/15 23:00	BP	SW 8270C
Fluoranthene	< 0.05	ug/L		0.05	0.10	11/16/15 23:00	BP	SW 8270C
Pyrene	< 0.04	ug/L		0.04	0.10	11/16/15 23:00	BP	SW 8270C
Benzo(a)anthracene	< 0.05	ug/L		0.05	0.10	11/16/15 23:00	BP	SW 8270C
Chrysene	< 0.03	ug/L		0.03	0.10	11/16/15 23:00	BP	SW 8270C
Benzo(b)fluoranthene	< 0.08	ug/L		0.08	0.10	11/16/15 23:00	BP	SW 8270C
Benzo(k)fluoranthene	< 0.10	ug/L		0.10	0.10	11/16/15 23:00	BP	SW 8270C
Benzo(a)pyrene	< 0.04	ug/L		0.04	0.10	11/16/15 23:00	BP	SW 8270C
Indeno(1,2,3-cd)pyrene	< 0.04	ug/L		0.04	0.10	11/16/15 23:00	BP	SW 8270C
Dibenzo(a,h)anthracene	< 0.04	ug/L		0.04	0.10	11/16/15 23:00	BP	SW 8270C
Benzo(g,h,i)perylene	< 0.04	ug/L		0.04	0.10	11/16/15 23:00	BP	SW 8270C
Total Metals - PIA								
Antimony	6.5	ug/L		0.036	3.0	11/12/15 11:55	JMW	SW 6020
Arsenic	3.0	ug/L		0.13	1.0	11/12/15 11:55	JMW	SW 6020
Beryllium	0.56	ug/L	J	0.017	1.0	11/12/15 11:55	JMW	SW 6020
Cadmium	0.85	ug/L	J	0.042	1.0	11/12/15 11:55	JMW	SW 6020
Chromium	11	ug/L		0.27	4.0	11/12/15 11:55	JMW	SW 6020
Copper	15	ug/L		0.025	3.0	11/12/15 11:55	JMW	SW 6020
Lead	58	ug/L		0.025	1.0	11/12/15 11:55	JMW	SW 6020
Nickel	8.4	ug/L		0.075	5.0	11/12/15 11:55	JMW	SW 6020
Selenium	2.2	ug/L		0.32	1.0	11/12/15 11:55	JMW	SW 6020

ANALYTICAL RESULTS

Sample:	**5110751-02**	**Sampled:**	11/04/15 12:50
Name:	LUFP-1H-0.5%	**Received:**	11/04/15 16:00
Matrix:	Ground Water - Grab	**PO #:**	2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
Silver	0.63	ug/L	J	0.028	5.0	11/12/15 11:55	JMW	SW 6020
Thallium	0.14	ug/L	J	0.062	1.0	11/12/15 11:55	JMW	SW 6020
Zinc	93	ug/L		0.50	6.0	11/12/15 11:55	JMW	SW 6020
Total Metals - STL								
Mercury	14	ug/L		0.2	0.2	11/12/15 11:10	WPS	SW 7470

ANALYTICAL RESULTS

Sample: **5110751-03**
Name: LUFP-1H-0.1%
Matrix: Ground Water - Grab

Sampled: 11/04/15 12:55
Received: 11/04/15 16:00
PO #: 2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
General Chemistry - STL								
Solids - total suspended solids (TSS)	270	mg/L		0.50	10	11/06/15 10:52	KLA	SM 2540D
Polychlorinated Biphenyls (PCBs) - STL								
Aroclor 1016	< 0.1	ug/L		0.1	0.5	11/07/15 21:25	BP	SW 8082*
Aroclor 1221	< 0.1	ug/L		0.1	0.5	11/07/15 21:25	BP	SW 8082*
Aroclor 1232	< 0.1	ug/L		0.1	0.5	11/07/15 21:25	BP	SW 8082*
Aroclor 1242	< 0.1	ug/L		0.1	0.5	11/07/15 21:25	BP	SW 8082*
Aroclor 1248	< 0.1	ug/L		0.1	0.5	11/07/15 21:25	BP	SW 8082*
Aroclor 1254	< 0.1	ug/L		0.1	0.5	11/07/15 21:25	BP	SW 8082*
Aroclor 1260	< 0.1	ug/L		0.1	0.5	11/07/15 21:25	BP	SW 8082*
Aroclors - Total	< 0.1	ug/L		0.1	0.5	11/07/15 21:25	BP	SW 8082*
Surrogate: TCMX	*85 %*	*41-135*				*11/07/15 21:25*	*BP*	*SW 8082**
Surrogate: Decachlorobiphenyl	*96 %*	*36-148*				*11/07/15 21:25*	*BP*	*SW 8082**
Semivolatile Organics - SIM - STL								
Naphthalene	0.31	ug/L		0.03	0.10	11/16/15 23:26	BP	SW 8270C
Acenaphthylene	< 0.03	ug/L		0.03	0.10	11/16/15 23:26	BP	SW 8270C
Acenaphthene	< 0.03	ug/L		0.03	0.10	11/16/15 23:26	BP	SW 8270C
Fluorene	< 0.04	ug/L		0.04	0.10	11/16/15 23:26	BP	SW 8270C
Phenanthrene	< 0.04	ug/L		0.04	0.10	11/16/15 23:26	BP	SW 8270C
Anthracene	< 0.03	ug/L		0.03	0.10	11/16/15 23:26	BP	SW 8270C
Fluoranthene	< 0.05	ug/L		0.05	0.10	11/16/15 23:26	BP	SW 8270C
Pyrene	< 0.04	ug/L		0.04	0.10	11/16/15 23:26	BP	SW 8270C
Benzo(a)anthracene	< 0.05	ug/L		0.05	0.10	11/16/15 23:26	BP	SW 8270C
Chrysene	< 0.03	ug/L		0.03	0.10	11/16/15 23:26	BP	SW 8270C
Benzo(b)fluoranthene	< 0.08	ug/L		0.08	0.10	11/16/15 23:26	BP	SW 8270C
Benzo(k)fluoranthene	< 0.10	ug/L		0.10	0.10	11/16/15 23:26	BP	SW 8270C
Benzo(a)pyrene	< 0.04	ug/L		0.04	0.10	11/16/15 23:26	BP	SW 8270C
Indeno(1,2,3-cd)pyrene	< 0.04	ug/L		0.04	0.10	11/16/15 23:26	BP	SW 8270C
Dibenzo(a,h)anthracene	< 0.04	ug/L		0.04	0.10	11/16/15 23:26	BP	SW 8270C
Benzo(g,h,i)perylene	< 0.04	ug/L		0.04	0.10	11/16/15 23:26	BP	SW 8270C
Total Metals - PIA								
Antimony	2.4	ug/L	J	0.036	3.0	11/12/15 11:59	JMW	SW 6020
Arsenic	0.98	ug/L	J	0.13	1.0	11/12/15 11:59	JMW	SW 6020
Beryllium	0.17	ug/L	J	0.017	1.0	11/12/15 11:59	JMW	SW 6020
Cadmium	0.16	ug/L	J	0.042	1.0	11/12/15 11:59	JMW	SW 6020
Chromium	3.5	ug/L	J	0.27	4.0	11/12/15 11:59	JMW	SW 6020
Copper	5.5	ug/L		0.025	3.0	11/12/15 11:59	JMW	SW 6020
Lead	17	ug/L		0.025	1.0	11/12/15 11:59	JMW	SW 6020
Nickel	3.3	ug/L	J	0.075	5.0	11/12/15 11:59	JMW	SW 6020
Selenium	0.67	ug/L	J	0.32	1.0	11/12/15 11:59	JMW	SW 6020

ANALYTICAL RESULTS

Sample:	**5110751-03**	**Sampled:**	11/04/15 12:55
Name:	LUFP-1H-0.1%	**Received:**	11/04/15 16:00
Matrix:	Ground Water - Grab	**PO #:**	2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
Silver	0.16	ug/L	J	0.028	5.0	11/12/15 11:59	JMW	SW 6020
Thallium	< 0.062	ug/L		0.062	1.0	11/12/15 11:59	JMW	SW 6020
Zinc	33	ug/L		0.50	6.0	11/12/15 11:59	JMW	SW 6020
Total Metals - STL								
Mercury	7.6	ug/L		0.2	0.2	11/12/15 11:10	WPS	SW 7470

ANALYTICAL RESULTS

Sample:	**5110751-04**	**Sampled:**	11/04/15 13:08
Name:	MLFP-1H-1.0%	**Received:**	11/04/15 16:00
Matrix:	Ground Water - Grab	**PO #:**	2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
General Chemistry - STL								
Solids - total suspended solids (TSS)	1100	mg/L		0.50	10	11/06/15 10:52	KLA	SM 2540D
Polychlorinated Biphenyls (PCBs) - STL								
Aroclor 1016	< 0.1	ug/L		0.1	0.5	11/07/15 21:51	BP	SW 8082*
Aroclor 1221	< 0.1	ug/L		0.1	0.5	11/07/15 21:51	BP	SW 8082*
Aroclor 1232	< 0.1	ug/L		0.1	0.5	11/07/15 21:51	BP	SW 8082*
Aroclor 1242	< 0.1	ug/L		0.1	0.5	11/07/15 21:51	BP	SW 8082*
Aroclor 1248	< 0.1	ug/L		0.1	0.5	11/07/15 21:51	BP	SW 8082*
Aroclor 1254	< 0.1	ug/L		0.1	0.5	11/07/15 21:51	BP	SW 8082*
Aroclor 1260	< 0.1	ug/L		0.1	0.5	11/07/15 21:51	BP	SW 8082*
Aroclors - Total	< 0.1	ug/L		0.1	0.5	11/07/15 21:51	BP	SW 8082*
Surrogate: TCMX	*69 %*	*41-135*				*11/07/15 21:51*	*BP*	*SW 8082**
Surrogate: Decachlorobiphenyl	*79 %*	*36-148*				*11/07/15 21:51*	*BP*	*SW 8082**
Semivolatile Organics - SIM - STL								
Naphthalene	0.11	ug/L		0.03	0.10	11/16/15 23:52	BP	SW 8270C
Acenaphthylene	< 0.03	ug/L		0.03	0.10	11/16/15 23:52	BP	SW 8270C
Acenaphthene	< 0.03	ug/L		0.03	0.10	11/16/15 23:52	BP	SW 8270C
Fluorene	< 0.04	ug/L		0.04	0.10	11/16/15 23:52	BP	SW 8270C
Phenanthrene	< 0.04	ug/L		0.04	0.10	11/16/15 23:52	BP	SW 8270C
Anthracene	< 0.03	ug/L		0.03	0.10	11/16/15 23:52	BP	SW 8270C
Fluoranthene	0.05	ug/L	J	0.05	0.10	11/16/15 23:52	BP	SW 8270C
Pyrene	0.05	ug/L	J	0.04	0.10	11/16/15 23:52	BP	SW 8270C
Benzo(a)anthracene	< 0.05	ug/L		0.05	0.10	11/16/15 23:52	BP	SW 8270C
Chrysene	< 0.03	ug/L		0.03	0.10	11/16/15 23:52	BP	SW 8270C
Benzo(b)fluoranthene	< 0.08	ug/L		0.08	0.10	11/16/15 23:52	BP	SW 8270C
Benzo(k)fluoranthene	< 0.10	ug/L		0.10	0.10	11/16/15 23:52	BP	SW 8270C
Benzo(a)pyrene	< 0.04	ug/L		0.04	0.10	11/16/15 23:52	BP	SW 8270C
Indeno(1,2,3-cd)pyrene	< 0.04	ug/L		0.04	0.10	11/16/15 23:52	BP	SW 8270C
Dibenzo(a,h)anthracene	< 0.04	ug/L		0.04	0.10	11/16/15 23:52	BP	SW 8270C
Benzo(g,h,i)perylene	< 0.04	ug/L		0.04	0.10	11/16/15 23:52	BP	SW 8270C
Total Metals - PIA								
Antimony	2.8	ug/L	J	0.036	3.0	11/12/15 12:03	JMW	SW 6020
Arsenic	7.8	ug/L		0.13	1.0	11/12/15 12:03	JMW	SW 6020
Beryllium	0.92	ug/L	J	0.017	1.0	11/12/15 12:03	JMW	SW 6020
Cadmium	0.74	ug/L	J	0.042	1.0	11/12/15 12:03	JMW	SW 6020
Chromium	20	ug/L		0.27	4.0	11/12/15 12:03	JMW	SW 6020
Copper	14	ug/L		0.025	3.0	11/12/15 12:03	JMW	SW 6020
Lead	61	ug/L		0.025	1.0	11/12/15 12:03	JMW	SW 6020
Nickel	12	ug/L		0.075	5.0	11/12/15 12:03	JMW	SW 6020
Selenium	2.5	ug/L		0.32	1.0	11/12/15 12:03	JMW	SW 6020

ANALYTICAL RESULTS

Sample:	**5110751-04**	**Sampled:**	11/04/15 13:08
Name:	MLFP-1H-1.0%	**Received:**	11/04/15 16:00
Matrix:	Ground Water - Grab	**PO #:**	2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
Silver	0.44	ug/L	J	0.028	5.0	11/12/15 12:03	JMW	SW 6020
Thallium	0.28	ug/L	J	0.062	1.0	11/12/15 12:03	JMW	SW 6020
Zinc	73	ug/L		0.50	6.0	11/12/15 12:03	JMW	SW 6020
Total Metals - STL								
Mercury	12	ug/L		0.2	0.2	11/12/15 11:10	WPS	SW 7470

ANALYTICAL RESULTS

Sample: **5110751-05**
Name: MLFP-1H-0.5%
Matrix: Ground Water - Grab

Sampled: 11/04/15 13:15
Received: 11/04/15 16:00
PO #: 2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
General Chemistry - STL								
Solids - total suspended solids (TSS)	680	mg/L		0.50	10	11/06/15 10:52	KLA	SM 2540D
Polychlorinated Biphenyls (PCBs) - STL								
Aroclor 1016	< 0.1	ug/L		0.1	0.5	11/07/15 22:16	BP	SW 8082*
Aroclor 1221	< 0.1	ug/L		0.1	0.5	11/07/15 22:16	BP	SW 8082*
Aroclor 1232	< 0.1	ug/L		0.1	0.5	11/07/15 22:16	BP	SW 8082*
Aroclor 1242	< 0.1	ug/L		0.1	0.5	11/07/15 22:16	BP	SW 8082*
Aroclor 1248	< 0.1	ug/L		0.1	0.5	11/07/15 22:16	BP	SW 8082*
Aroclor 1254	< 0.1	ug/L		0.1	0.5	11/07/15 22:16	BP	SW 8082*
Aroclor 1260	< 0.1	ug/L		0.1	0.5	11/07/15 22:16	BP	SW 8082*
Aroclors - Total	< 0.1	ug/L		0.1	0.5	11/07/15 22:16	BP	SW 8082*
Surrogate: TCMX	*73 %*	*41-135*				*11/07/15 22:16*	*BP*	*SW 8082**
Surrogate: Decachlorobiphenyl	*82 %*	*36-148*				*11/07/15 22:16*	*BP*	*SW 8082**
Semivolatile Organics - SIM - STL								
Naphthalene	0.11	ug/L		0.03	0.10	11/17/15 00:19	BP	SW 8270C
Acenaphthylene	< 0.03	ug/L		0.03	0.10	11/17/15 00:19	BP	SW 8270C
Acenaphthene	< 0.03	ug/L		0.03	0.10	11/17/15 00:19	BP	SW 8270C
Fluorene	< 0.04	ug/L		0.04	0.10	11/17/15 00:19	BP	SW 8270C
Phenanthrene	< 0.04	ug/L		0.04	0.10	11/17/15 00:19	BP	SW 8270C
Anthracene	< 0.03	ug/L		0.03	0.10	11/17/15 00:19	BP	SW 8270C
Fluoranthene	0.05	ug/L	J	0.05	0.10	11/17/15 00:19	BP	SW 8270C
Pyrene	0.05	ug/L	J	0.04	0.10	11/17/15 00:19	BP	SW 8270C
Benzo(a)anthracene	< 0.05	ug/L		0.05	0.10	11/17/15 00:19	BP	SW 8270C
Chrysene	< 0.03	ug/L		0.03	0.10	11/17/15 00:19	BP	SW 8270C
Benzo(b)fluoranthene	< 0.08	ug/L		0.08	0.10	11/17/15 00:19	BP	SW 8270C
Benzo(k)fluoranthene	< 0.10	ug/L		0.10	0.10	11/17/15 00:19	BP	SW 8270C
Benzo(a)pyrene	< 0.04	ug/L		0.04	0.10	11/17/15 00:19	BP	SW 8270C
Indeno(1,2,3-cd)pyrene	< 0.04	ug/L		0.04	0.10	11/17/15 00:19	BP	SW 8270C
Dibenzo(a,h)anthracene	< 0.04	ug/L		0.04	0.10	11/17/15 00:19	BP	SW 8270C
Benzo(g,h,i)perylene	< 0.04	ug/L		0.04	0.10	11/17/15 00:19	BP	SW 8270C
Total Metals - PIA								
Antimony	2.0	ug/L	J	0.036	3.0	11/12/15 12:08	JMW	SW 6020
Arsenic	4.9	ug/L		0.13	1.0	11/12/15 12:08	JMW	SW 6020
Beryllium	0.56	ug/L	J	0.017	1.0	11/12/15 12:08	JMW	SW 6020
Cadmium	0.58	ug/L	J	0.042	1.0	11/12/15 12:08	JMW	SW 6020
Chromium	12	ug/L		0.27	4.0	11/12/15 12:08	JMW	SW 6020
Copper	9.5	ug/L		0.025	3.0	11/12/15 12:08	JMW	SW 6020
Lead	41	ug/L		0.025	1.0	11/12/15 12:08	JMW	SW 6020
Nickel	7.5	ug/L		0.075	5.0	11/12/15 12:08	JMW	SW 6020
Selenium	1.5	ug/L		0.32	1.0	11/12/15 12:08	JMW	SW 6020

ANALYTICAL RESULTS

Sample:	**5110751-05**	**Sampled:**	11/04/15 13:15
Name:	MLFP-1H-0.5%	**Received:**	11/04/15 16:00
Matrix:	Ground Water - Grab	**PO #:**	2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
Silver	0.26	ug/L	J	0.028	5.0	11/12/15 12:08	JMW	SW 6020
Thallium	0.15	ug/L	J	0.062	1.0	11/12/15 12:08	JMW	SW 6020
Zinc	55	ug/L		0.50	6.0	11/12/15 12:08	JMW	SW 6020
Total Metals - STL								
Mercury	9.2	ug/L		0.2	0.2	11/12/15 11:10	WPS	SW 7470

ANALYTICAL RESULTS

Sample: **5110751-06**
Name: MLFP-1H-0.1%
Matrix: Ground Water - Grab

Sampled: 11/04/15 13:21
Received: 11/04/15 16:00
PO #: 2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
General Chemistry - STL								
Solids - total suspended solids (TSS)	160	mg/L		0.33	6.7	11/05/15 16:20	KMM	SM 2540D
Polychlorinated Biphenyls (PCBs) - STL								
Aroclor 1016	< 0.1	ug/L		0.1	0.5	11/07/15 22:42	BP	SW 8082*
Aroclor 1221	< 0.1	ug/L		0.1	0.5	11/07/15 22:42	BP	SW 8082*
Aroclor 1232	< 0.1	ug/L		0.1	0.5	11/07/15 22:42	BP	SW 8082*
Aroclor 1242	< 0.1	ug/L		0.1	0.5	11/07/15 22:42	BP	SW 8082*
Aroclor 1248	< 0.1	ug/L		0.1	0.5	11/07/15 22:42	BP	SW 8082*
Aroclor 1254	< 0.1	ug/L		0.1	0.5	11/07/15 22:42	BP	SW 8082*
Aroclor 1260	< 0.1	ug/L		0.1	0.5	11/07/15 22:42	BP	SW 8082*
Aroclors - Total	< 0.1	ug/L		0.1	0.5	11/07/15 22:42	BP	SW 8082*
Surrogate: TCMX	*78 %*	*41-135*				*11/07/15 22:42*	*BP*	*SW 8082**
Surrogate: Decachlorobiphenyl	*90 %*	*36-148*				*11/07/15 22:42*	*BP*	*SW 8082**
Semivolatile Organics - SIM - STL								
Naphthalene	0.12	ug/L		0.03	0.10	11/17/15 00:45	BP	SW 8270C
Acenaphthylene	< 0.03	ug/L		0.03	0.10	11/17/15 00:45	BP	SW 8270C
Acenaphthene	< 0.03	ug/L		0.03	0.10	11/17/15 00:45	BP	SW 8270C
Fluorene	< 0.04	ug/L		0.04	0.10	11/17/15 00:45	BP	SW 8270C
Phenanthrene	< 0.04	ug/L		0.04	0.10	11/17/15 00:45	BP	SW 8270C
Anthracene	< 0.03	ug/L		0.03	0.10	11/17/15 00:45	BP	SW 8270C
Fluoranthene	< 0.05	ug/L		0.05	0.10	11/17/15 00:45	BP	SW 8270C
Pyrene	< 0.04	ug/L		0.04	0.10	11/17/15 00:45	BP	SW 8270C
Benzo(a)anthracene	< 0.05	ug/L		0.05	0.10	11/17/15 00:45	BP	SW 8270C
Chrysene	< 0.03	ug/L		0.03	0.10	11/17/15 00:45	BP	SW 8270C
Benzo(b)fluoranthene	< 0.08	ug/L		0.08	0.10	11/17/15 00:45	BP	SW 8270C
Benzo(k)fluoranthene	< 0.10	ug/L		0.10	0.10	11/17/15 00:45	BP	SW 8270C
Benzo(a)pyrene	< 0.04	ug/L		0.04	0.10	11/17/15 00:45	BP	SW 8270C
Indeno(1,2,3-cd)pyrene	< 0.04	ug/L		0.04	0.10	11/17/15 00:45	BP	SW 8270C
Dibenzo(a,h)anthracene	< 0.04	ug/L		0.04	0.10	11/17/15 00:45	BP	SW 8270C
Benzo(g,h,i)perylene	< 0.04	ug/L		0.04	0.10	11/17/15 00:45	BP	SW 8270C
Total Metals - PIA								
Antimony	0.86	ug/L	J	0.036	3.0	11/12/15 12:12	JMW	SW 6020
Arsenic	1.6	ug/L		0.13	1.0	11/12/15 12:12	JMW	SW 6020
Beryllium	0.17	ug/L	J	0.017	1.0	11/12/15 12:12	JMW	SW 6020
Cadmium	0.15	ug/L	J	0.042	1.0	11/12/15 12:12	JMW	SW 6020
Chromium	3.9	ug/L	J	0.27	4.0	11/12/15 12:12	JMW	SW 6020
Copper	3.8	ug/L		0.025	3.0	11/12/15 12:12	JMW	SW 6020
Lead	12	ug/L		0.025	1.0	11/12/15 12:12	JMW	SW 6020
Nickel	3.6	ug/L	J	0.075	5.0	11/12/15 12:12	JMW	SW 6020
Selenium	0.38	ug/L	J	0.32	1.0	11/12/15 12:12	JMW	SW 6020

ANALYTICAL RESULTS

Sample:	**5110751-06**	**Sampled:**	11/04/15 13:21
Name:	MLFP-1H-0.1%	**Received:**	11/04/15 16:00
Matrix:	Ground Water - Grab	**PO #:**	2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
Silver	< 0.028	ug/L		0.028	5.0	11/12/15 12:12	JMW	SW 6020
Thallium	< 0.062	ug/L		0.062	1.0	11/12/15 12:12	JMW	SW 6020
Zinc	20	ug/L		0.50	6.0	11/12/15 12:12	JMW	SW 6020
Total Metals - STL								
Mercury	3.6	ug/L		0.2	0.2	11/12/15 11:10	WPS	SW 7470

ANALYTICAL RESULTS

Sample:	**5110751-07**	**Sampled:**	11/04/15 14:00
Name:	LUFP-1H-1.0%F	**Received:**	11/04/15 16:00
Matrix:	Ground Water - Grab	**PO #:**	2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
General Chemistry - STL								
Solids - total suspended solids (TSS)	0.40	mg/L	J	0.10	2.0	11/05/15 16:20	KMM	SM 2540D
Polychlorinated Biphenyls (PCBs) - STL								
Aroclor 1016	< 0.1	ug/L		0.1	0.5	11/07/15 23:08	BP	SW 8082*
Aroclor 1221	< 0.1	ug/L		0.1	0.5	11/07/15 23:08	BP	SW 8082*
Aroclor 1232	< 0.1	ug/L		0.1	0.5	11/07/15 23:08	BP	SW 8082*
Aroclor 1242	< 0.1	ug/L		0.1	0.5	11/07/15 23:08	BP	SW 8082*
Aroclor 1248	< 0.1	ug/L		0.1	0.5	11/07/15 23:08	BP	SW 8082*
Aroclor 1254	< 0.1	ug/L		0.1	0.5	11/07/15 23:08	BP	SW 8082*
Aroclor 1260	< 0.1	ug/L		0.1	0.5	11/07/15 23:08	BP	SW 8082*
Aroclors - Total	< 0.1	ug/L		0.1	0.5	11/07/15 23:08	BP	SW 8082*
Surrogate: TCMX	*82 %*	*41-135*				*11/07/15 23:08*	*BP*	*SW 8082**
Surrogate: Decachlorobiphenyl	*96 %*	*36-148*				*11/07/15 23:08*	*BP*	*SW 8082**
Semivolatile Organics - SIM - STL								
Naphthalene	0.28	ug/L		0.03	0.10	11/17/15 01:12	BP	SW 8270C
Acenaphthylene	< 0.03	ug/L		0.03	0.10	11/17/15 01:12	BP	SW 8270C
Acenaphthene	< 0.03	ug/L		0.03	0.10	11/17/15 01:12	BP	SW 8270C
Fluorene	< 0.04	ug/L		0.04	0.10	11/17/15 01:12	BP	SW 8270C
Phenanthrene	< 0.04	ug/L		0.04	0.10	11/17/15 01:12	BP	SW 8270C
Anthracene	< 0.03	ug/L		0.03	0.10	11/17/15 01:12	BP	SW 8270C
Fluoranthene	< 0.05	ug/L		0.05	0.10	11/17/15 01:12	BP	SW 8270C
Pyrene	< 0.04	ug/L		0.04	0.10	11/17/15 01:12	BP	SW 8270C
Benzo(a)anthracene	< 0.05	ug/L		0.05	0.10	11/17/15 01:12	BP	SW 8270C
Chrysene	< 0.03	ug/L		0.03	0.10	11/17/15 01:12	BP	SW 8270C
Benzo(b)fluoranthene	< 0.08	ug/L		0.08	0.10	11/17/15 01:12	BP	SW 8270C
Benzo(k)fluoranthene	< 0.10	ug/L		0.10	0.10	11/17/15 01:12	BP	SW 8270C
Benzo(a)pyrene	< 0.04	ug/L		0.04	0.10	11/17/15 01:12	BP	SW 8270C
Indeno(1,2,3-cd)pyrene	< 0.04	ug/L		0.04	0.10	11/17/15 01:12	BP	SW 8270C
Dibenzo(a,h)anthracene	< 0.04	ug/L		0.04	0.10	11/17/15 01:12	BP	SW 8270C
Benzo(g,h,i)perylene	< 0.04	ug/L		0.04	0.10	11/17/15 01:12	BP	SW 8270C
Total Metals - PIA								
Antimony	7.4	ug/L		0.036	3.0	11/12/15 12:16	JMW	SW 6020
Arsenic	1.1	ug/L		0.13	1.0	11/12/15 12:16	JMW	SW 6020
Beryllium	< 0.017	ug/L		0.017	1.0	11/12/15 12:16	JMW	SW 6020
Cadmium	< 0.042	ug/L		0.042	1.0	11/12/15 12:16	JMW	SW 6020
Chromium	0.67	ug/L	J	0.27	4.0	11/12/15 12:16	JMW	SW 6020
Copper	1.3	ug/L	J	0.025	3.0	11/12/15 12:16	JMW	SW 6020
Lead	0.85	ug/L	J	0.025	1.0	11/12/15 12:16	JMW	SW 6020
Nickel	1.1	ug/L	J	0.075	5.0	11/12/15 12:16	JMW	SW 6020
Selenium	< 0.32	ug/L		0.32	1.0	11/12/15 12:16	JMW	SW 6020

ANALYTICAL RESULTS

Sample:	**5110751-07**	**Sampled:**	11/04/15 14:00
Name:	LUFP-1H-1.0%F	**Received:**	11/04/15 16:00
Matrix:	Ground Water - Grab	**PO #:**	2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
Silver	< 0.028	ug/L		0.028	5.0	11/12/15 12:16	JMW	SW 6020
Thallium	< 0.062	ug/L		0.062	1.0	11/12/15 12:16	JMW	SW 6020
Zinc	1.2	ug/L	J	0.50	6.0	11/12/15 12:16	JMW	SW 6020
Total Metals - STL								
Mercury	< 0.2	ug/L		0.2	0.2	11/12/15 11:10	WPS	SW 7470

ANALYTICAL RESULTS

Sample: **5110751-08**
Name: LUFP-1H-0.5%F
Matrix: Ground Water - Grab

Sampled: 11/04/15 14:10
Received: 11/04/15 16:00
PO #: 2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
General Chemistry - STL								
Solids - total suspended solids (TSS)	< 0.10	mg/L		0.10	2.0	11/05/15 16:20	KMM	SM 2540D
Polychlorinated Biphenyls (PCBs) - STL								
Aroclor 1016	< 0.1	ug/L		0.1	0.5	11/07/15 23:33	BP	SW 8082*
Aroclor 1221	< 0.1	ug/L		0.1	0.5	11/07/15 23:33	BP	SW 8082*
Aroclor 1232	< 0.1	ug/L		0.1	0.5	11/07/15 23:33	BP	SW 8082*
Aroclor 1242	< 0.1	ug/L		0.1	0.5	11/07/15 23:33	BP	SW 8082*
Aroclor 1248	< 0.1	ug/L		0.1	0.5	11/07/15 23:33	BP	SW 8082*
Aroclor 1254	< 0.1	ug/L		0.1	0.5	11/07/15 23:33	BP	SW 8082*
Aroclor 1260	< 0.1	ug/L		0.1	0.5	11/07/15 23:33	BP	SW 8082*
Aroclors - Total	< 0.1	ug/L		0.1	0.5	11/07/15 23:33	BP	SW 8082*
Surrogate: TCMX	*79 %*	*41-135*				*11/07/15 23:33*	*BP*	*SW 8082**
Surrogate: Decachlorobiphenyl	*91 %*	*36-148*				*11/07/15 23:33*	*BP*	*SW 8082**
Semivolatile Organics - SIM - STL								
Naphthalene	0.20	ug/L		0.03	0.10	11/17/15 01:38	BP	SW 8270C
Acenaphthylene	< 0.03	ug/L		0.03	0.10	11/17/15 01:38	BP	SW 8270C
Acenaphthene	< 0.03	ug/L		0.03	0.10	11/17/15 01:38	BP	SW 8270C
Fluorene	< 0.04	ug/L		0.04	0.10	11/17/15 01:38	BP	SW 8270C
Phenanthrene	< 0.04	ug/L		0.04	0.10	11/17/15 01:38	BP	SW 8270C
Anthracene	< 0.03	ug/L		0.03	0.10	11/17/15 01:38	BP	SW 8270C
Fluoranthene	0.09	ug/L	J	0.05	0.10	11/17/15 01:38	BP	SW 8270C
Pyrene	0.07	ug/L	J	0.04	0.10	11/17/15 01:38	BP	SW 8270C
Benzo(a)anthracene	0.08	ug/L	J	0.05	0.10	11/17/15 01:38	BP	SW 8270C
Chrysene	0.08	ug/L	J	0.03	0.10	11/17/15 01:38	BP	SW 8270C
Benzo(b)fluoranthene	< 0.08	ug/L		0.08	0.10	11/17/15 01:38	BP	SW 8270C
Benzo(k)fluoranthene	< 0.10	ug/L		0.10	0.10	11/17/15 01:38	BP	SW 8270C
Benzo(a)pyrene	< 0.04	ug/L		0.04	0.10	11/17/15 01:38	BP	SW 8270C
Indeno(1,2,3-cd)pyrene	< 0.04	ug/L		0.04	0.10	11/17/15 01:38	BP	SW 8270C
Dibenzo(a,h)anthracene	< 0.04	ug/L		0.04	0.10	11/17/15 01:38	BP	SW 8270C
Benzo(g,h,i)perylene	< 0.04	ug/L		0.04	0.10	11/17/15 01:38	BP	SW 8270C
Total Metals - PIA								
Antimony	3.8	ug/L		0.036	3.0	11/12/15 12:20	JMW	SW 6020
Arsenic	0.79	ug/L	J	0.13	1.0	11/12/15 12:20	JMW	SW 6020
Beryllium	< 0.017	ug/L		0.017	1.0	11/12/15 12:20	JMW	SW 6020
Cadmium	< 0.042	ug/L		0.042	1.0	11/12/15 12:20	JMW	SW 6020
Chromium	0.60	ug/L	J	0.27	4.0	11/12/15 12:20	JMW	SW 6020
Copper	0.83	ug/L	J	0.025	3.0	11/12/15 12:20	JMW	SW 6020
Lead	1.1	ug/L		0.025	1.0	11/12/15 12:20	JMW	SW 6020
Nickel	1.2	ug/L	J	0.075	5.0	11/12/15 12:20	JMW	SW 6020
Selenium	< 0.32	ug/L		0.32	1.0	11/12/15 12:20	JMW	SW 6020

ANALYTICAL RESULTS

Sample: **5110751-08**
Name: LUFP-1H-0.5%F
Matrix: Ground Water - Grab

Sampled: 11/04/15 14:10
Received: 11/04/15 16:00
PO #: 2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
Silver	0.82	ug/L	J	0.028	5.0	11/12/15 12:20	JMW	SW 6020
Thallium	< 0.062	ug/L		0.062	1.0	11/12/15 12:20	JMW	SW 6020
Zinc	1.4	ug/L	J	0.50	6.0	11/12/15 12:20	JMW	SW 6020
Total Metals - STL								
Mercury	< 0.2	ug/L		0.2	0.2	11/12/15 11:10	WPS	SW 7470

ANALYTICAL RESULTS

Sample: **5110751-09**
Name: LUFP-1H-0.1%F
Matrix: Ground Water - Grab

Sampled: 11/04/15 14:25
Received: 11/04/15 16:00
PO #: 2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
General Chemistry - STL								
Solids - total suspended solids (TSS)	0.40	mg/L	J	0.10	2.0	11/05/15 16:20	KMM	SM 2540D
Polychlorinated Biphenyls (PCBs) - STL								
Aroclor 1016	< 0.1	ug/L		0.1	0.5	11/07/15 23:59	BP	SW 8082*
Aroclor 1221	< 0.1	ug/L		0.1	0.5	11/07/15 23:59	BP	SW 8082*
Aroclor 1232	< 0.1	ug/L		0.1	0.5	11/07/15 23:59	BP	SW 8082*
Aroclor 1242	< 0.1	ug/L		0.1	0.5	11/07/15 23:59	BP	SW 8082*
Aroclor 1248	< 0.1	ug/L		0.1	0.5	11/07/15 23:59	BP	SW 8082*
Aroclor 1254	< 0.1	ug/L		0.1	0.5	11/07/15 23:59	BP	SW 8082*
Aroclor 1260	< 0.1	ug/L		0.1	0.5	11/07/15 23:59	BP	SW 8082*
Aroclors - Total	< 0.1	ug/L		0.1	0.5	11/07/15 23:59	BP	SW 8082*
Surrogate: TCMX	*88 %*	*41-135*				*11/07/15 23:59*	*BP*	*SW 8082**
Surrogate: Decachlorobiphenyl	*101 %*	*36-148*				*11/07/15 23:59*	*BP*	*SW 8082**
Semivolatile Organics - SIM - STL								
Naphthalene	0.47	ug/L		0.03	0.10	11/17/15 02:05	BP	SW 8270C
Acenaphthylene	< 0.03	ug/L		0.03	0.10	11/17/15 02:05	BP	SW 8270C
Acenaphthene	< 0.03	ug/L		0.03	0.10	11/17/15 02:05	BP	SW 8270C
Fluorene	< 0.04	ug/L		0.04	0.10	11/17/15 02:05	BP	SW 8270C
Phenanthrene	< 0.04	ug/L		0.04	0.10	11/17/15 02:05	BP	SW 8270C
Anthracene	< 0.03	ug/L		0.03	0.10	11/17/15 02:05	BP	SW 8270C
Fluoranthene	< 0.05	ug/L		0.05	0.10	11/17/15 02:05	BP	SW 8270C
Pyrene	< 0.04	ug/L		0.04	0.10	11/17/15 02:05	BP	SW 8270C
Benzo(a)anthracene	< 0.05	ug/L		0.05	0.10	11/17/15 02:05	BP	SW 8270C
Chrysene	< 0.03	ug/L		0.03	0.10	11/17/15 02:05	BP	SW 8270C
Benzo(b)fluoranthene	< 0.08	ug/L		0.08	0.10	11/17/15 02:05	BP	SW 8270C
Benzo(k)fluoranthene	< 0.10	ug/L		0.10	0.10	11/17/15 02:05	BP	SW 8270C
Benzo(a)pyrene	< 0.04	ug/L		0.04	0.10	11/17/15 02:05	BP	SW 8270C
Indeno(1,2,3-cd)pyrene	< 0.04	ug/L		0.04	0.10	11/17/15 02:05	BP	SW 8270C
Dibenzo(a,h)anthracene	< 0.04	ug/L		0.04	0.10	11/17/15 02:05	BP	SW 8270C
Benzo(g,h,i)perylene	< 0.04	ug/L		0.04	0.10	11/17/15 02:05	BP	SW 8270C
Total Metals - PIA								
Antimony	1.3	ug/L	J	0.036	3.0	11/12/15 12:43	JMW	SW 6020
Arsenic	0.47	ug/L	J	0.13	1.0	11/12/15 12:43	JMW	SW 6020
Beryllium	< 0.017	ug/L		0.017	1.0	11/12/15 12:43	JMW	SW 6020
Cadmium	< 0.042	ug/L		0.042	1.0	11/12/15 12:43	JMW	SW 6020
Chromium	0.38	ug/L	J	0.27	4.0	11/12/15 12:43	JMW	SW 6020
Copper	1.0	ug/L	J	0.025	3.0	11/12/15 12:43	JMW	SW 6020
Lead	1.4	ug/L		0.025	1.0	11/12/15 12:43	JMW	SW 6020
Nickel	0.92	ug/L	J	0.075	5.0	11/12/15 12:43	JMW	SW 6020
Selenium	< 0.32	ug/L		0.32	1.0	11/12/15 12:43	JMW	SW 6020

ANALYTICAL RESULTS

Sample:	**5110751-09**	**Sampled:**	11/04/15 14:25
Name:	LUFP-1H-0.1%F	**Received:**	11/04/15 16:00
Matrix:	Ground Water - Grab	**PO #:**	2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
Silver	0.87	ug/L	J	0.028	5.0	11/12/15 12:43	JMW	SW 6020
Thallium	< 0.062	ug/L		0.062	1.0	11/12/15 12:43	JMW	SW 6020
Zinc	1.0	ug/L	J	0.50	6.0	11/12/15 12:43	JMW	SW 6020
Total Metals - STL								
Mercury	< 0.2	ug/L		0.2	0.2	11/12/15 11:10	WPS	SW 7470

ANALYTICAL RESULTS

Sample: **5110751-10**
Name: MLFP-1H-1.0%F
Matrix: Ground Water - Grab

Sampled: 11/04/15 14:45
Received: 11/04/15 16:00
PO #: 2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
General Chemistry - STL								
Solids - total suspended solids (TSS)	0.40	mg/L	J	0.10	2.0	11/05/15 16:20	KMM	SM 2540D
Polychlorinated Biphenyls (PCBs) - STL								
Aroclor 1016	< 0.1	ug/L		0.1	0.5	11/08/15 00:25	BP	SW 8082*
Aroclor 1221	< 0.1	ug/L		0.1	0.5	11/08/15 00:25	BP	SW 8082*
Aroclor 1232	< 0.1	ug/L		0.1	0.5	11/08/15 00:25	BP	SW 8082*
Aroclor 1242	< 0.1	ug/L		0.1	0.5	11/08/15 00:25	BP	SW 8082*
Aroclor 1248	< 0.1	ug/L		0.1	0.5	11/08/15 00:25	BP	SW 8082*
Aroclor 1254	< 0.1	ug/L		0.1	0.5	11/08/15 00:25	BP	SW 8082*
Aroclor 1260	< 0.1	ug/L		0.1	0.5	11/08/15 00:25	BP	SW 8082*
Aroclors - Total	< 0.1	ug/L		0.1	0.5	11/08/15 00:25	BP	SW 8082*
Surrogate: TCMX	*78 %*	*41-135*				*11/08/15 00:25*	*BP*	*SW 8082**
Surrogate: Decachlorobiphenyl	*90 %*	*36-148*				*11/08/15 00:25*	*BP*	*SW 8082**
Semivolatile Organics - SIM - STL								
Naphthalene	0.22	ug/L		0.03	0.10	11/17/15 02:31	BP	SW 8270C
Acenaphthylene	< 0.03	ug/L		0.03	0.10	11/17/15 02:31	BP	SW 8270C
Acenaphthene	< 0.03	ug/L		0.03	0.10	11/17/15 02:31	BP	SW 8270C
Fluorene	< 0.04	ug/L		0.04	0.10	11/17/15 02:31	BP	SW 8270C
Phenanthrene	< 0.04	ug/L		0.04	0.10	11/17/15 02:31	BP	SW 8270C
Anthracene	< 0.03	ug/L		0.03	0.10	11/17/15 02:31	BP	SW 8270C
Fluoranthene	< 0.05	ug/L		0.05	0.10	11/17/15 02:31	BP	SW 8270C
Pyrene	< 0.04	ug/L		0.04	0.10	11/17/15 02:31	BP	SW 8270C
Benzo(a)anthracene	< 0.05	ug/L		0.05	0.10	11/17/15 02:31	BP	SW 8270C
Chrysene	< 0.03	ug/L		0.03	0.10	11/17/15 02:31	BP	SW 8270C
Benzo(b)fluoranthene	< 0.08	ug/L		0.08	0.10	11/17/15 02:31	BP	SW 8270C
Benzo(k)fluoranthene	< 0.10	ug/L		0.10	0.10	11/17/15 02:31	BP	SW 8270C
Benzo(a)pyrene	< 0.04	ug/L		0.04	0.10	11/17/15 02:31	BP	SW 8270C
Indeno(1,2,3-cd)pyrene	< 0.04	ug/L		0.04	0.10	11/17/15 02:31	BP	SW 8270C
Dibenzo(a,h)anthracene	< 0.04	ug/L		0.04	0.10	11/17/15 02:31	BP	SW 8270C
Benzo(g,h,i)perylene	< 0.04	ug/L		0.04	0.10	11/17/15 02:31	BP	SW 8270C
Total Metals - PIA								
Antimony	2.7	ug/L	J	0.036	3.0	11/12/15 12:47	JMW	SW 6020
Arsenic	1.2	ug/L		0.13	1.0	11/12/15 12:47	JMW	SW 6020
Beryllium	0.018	ug/L	J	0.017	1.0	11/12/15 12:47	JMW	SW 6020
Cadmium	< 0.042	ug/L		0.042	1.0	11/12/15 12:47	JMW	SW 6020
Chromium	< 0.27	ug/L		0.27	4.0	11/12/15 12:47	JMW	SW 6020
Copper	0.71	ug/L	J	0.025	3.0	11/12/15 12:47	JMW	SW 6020
Lead	0.13	ug/L	J	0.025	1.0	11/12/15 12:47	JMW	SW 6020
Nickel	1.1	ug/L	J	0.075	5.0	11/12/15 12:47	JMW	SW 6020
Selenium	< 0.32	ug/L		0.32	1.0	11/12/15 12:47	JMW	SW 6020

ANALYTICAL RESULTS

Sample: **5110751-10**
Name: MLFP-1H-1.0%F
Matrix: Ground Water - Grab

Sampled: 11/04/15 14:45
Received: 11/04/15 16:00
PO #: 2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
Silver	< 0.028	ug/L		0.028	5.0	11/12/15 12:47	JMW	SW 6020
Thallium	< 0.062	ug/L		0.062	1.0	11/12/15 12:47	JMW	SW 6020
Zinc	< 0.50	ug/L		0.50	6.0	11/12/15 12:47	JMW	SW 6020
Total Metals - STL								
Mercury	< 0.2	ug/L		0.2	0.2	11/12/15 11:10	WPS	SW 7470

ANALYTICAL RESULTS

Sample: **5110751-11**
Name: MLFP-1H-0.5%F
Matrix: Ground Water - Grab

Sampled: 11/04/15 14:55
Received: 11/04/15 16:00
PO #: 2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
General Chemistry - STL								
Solids - total suspended solids (TSS)	0.40	mg/L	J	0.10	2.0	11/05/15 16:20	KMM	SM 2540D
Polychlorinated Biphenyls (PCBs) - STL								
Aroclor 1016	< 0.1	ug/L		0.1	0.5	11/08/15 00:50	BP	SW 8082*
Aroclor 1221	< 0.1	ug/L		0.1	0.5	11/08/15 00:50	BP	SW 8082*
Aroclor 1232	< 0.1	ug/L		0.1	0.5	11/08/15 00:50	BP	SW 8082*
Aroclor 1242	< 0.1	ug/L		0.1	0.5	11/08/15 00:50	BP	SW 8082*
Aroclor 1248	< 0.1	ug/L		0.1	0.5	11/08/15 00:50	BP	SW 8082*
Aroclor 1254	< 0.1	ug/L		0.1	0.5	11/08/15 00:50	BP	SW 8082*
Aroclor 1260	< 0.1	ug/L		0.1	0.5	11/08/15 00:50	BP	SW 8082*
Aroclors - Total	< 0.1	ug/L		0.1	0.5	11/08/15 00:50	BP	SW 8082*
Surrogate: TCMX	*99 %*	*41-135*				*11/08/15 00:50*	*BP*	*SW 8082**
Surrogate: Decachlorobiphenyl	*117 %*	*36-148*				*11/08/15 00:50*	*BP*	*SW 8082**
Semivolatile Organics - SIM - STL								
Naphthalene	0.21	ug/L		0.03	0.10	11/17/15 02:57	BP	SW 8270C
Acenaphthylene	< 0.03	ug/L		0.03	0.10	11/17/15 02:57	BP	SW 8270C
Acenaphthene	< 0.03	ug/L		0.03	0.10	11/17/15 02:57	BP	SW 8270C
Fluorene	< 0.04	ug/L		0.04	0.10	11/17/15 02:57	BP	SW 8270C
Phenanthrene	< 0.04	ug/L		0.04	0.10	11/17/15 02:57	BP	SW 8270C
Anthracene	< 0.03	ug/L		0.03	0.10	11/17/15 02:57	BP	SW 8270C
Fluoranthene	< 0.05	ug/L		0.05	0.10	11/17/15 02:57	BP	SW 8270C
Pyrene	< 0.04	ug/L		0.04	0.10	11/17/15 02:57	BP	SW 8270C
Benzo(a)anthracene	< 0.05	ug/L		0.05	0.10	11/17/15 02:57	BP	SW 8270C
Chrysene	< 0.03	ug/L		0.03	0.10	11/17/15 02:57	BP	SW 8270C
Benzo(b)fluoranthene	< 0.08	ug/L		0.08	0.10	11/17/15 02:57	BP	SW 8270C
Benzo(k)fluoranthene	< 0.10	ug/L		0.10	0.10	11/17/15 02:57	BP	SW 8270C
Benzo(a)pyrene	< 0.04	ug/L		0.04	0.10	11/17/15 02:57	BP	SW 8270C
Indeno(1,2,3-cd)pyrene	< 0.04	ug/L		0.04	0.10	11/17/15 02:57	BP	SW 8270C
Dibenzo(a,h)anthracene	< 0.04	ug/L		0.04	0.10	11/17/15 02:57	BP	SW 8270C
Benzo(g,h,i)perylene	< 0.04	ug/L		0.04	0.10	11/17/15 02:57	BP	SW 8270C
Total Metals - PIA								
Antimony	1.6	ug/L	J	0.036	3.0	11/12/15 12:51	JMW	SW 6020
Arsenic	0.86	ug/L	J	0.13	1.0	11/12/15 12:51	JMW	SW 6020
Beryllium	< 0.017	ug/L		0.017	1.0	11/12/15 12:51	JMW	SW 6020
Cadmium	< 0.042	ug/L		0.042	1.0	11/12/15 12:51	JMW	SW 6020
Chromium	0.58	ug/L	J	0.27	4.0	11/12/15 12:51	JMW	SW 6020
Copper	0.78	ug/L	J	0.025	3.0	11/12/15 12:51	JMW	SW 6020
Lead	0.22	ug/L	J	0.025	1.0	11/12/15 12:51	JMW	SW 6020
Nickel	3.0	ug/L	J	0.075	5.0	11/12/15 12:51	JMW	SW 6020
Selenium	< 0.32	ug/L		0.32	1.0	11/12/15 12:51	JMW	SW 6020

ANALYTICAL RESULTS

Sample: **5110751-11**
Name: MLFP-1H-0.5%F
Matrix: Ground Water - Grab

Sampled: 11/04/15 14:55
Received: 11/04/15 16:00
PO #: 2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
Silver	< 0.028	ug/L		0.028	5.0	11/12/15 12:51	JMW	SW 6020
Thallium	< 0.062	ug/L		0.062	1.0	11/12/15 12:51	JMW	SW 6020
Zinc	0.96	ug/L	J	0.50	6.0	11/12/15 12:51	JMW	SW 6020
Total Metals - STL								
Mercury	< 0.2	ug/L		0.2	0.2	11/12/15 11:10	WPS	SW 7470

ANALYTICAL RESULTS

Sample: **5110751-12**
Name: MLFP-1H-0.1%F
Matrix: Ground Water - Grab

Sampled: 11/04/15 15:10
Received: 11/04/15 16:00
PO #: 2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
General Chemistry - STL								
Solids - total suspended solids (TSS)	< 0.10	mg/L		0.10	2.0	11/05/15 16:20	KMM	SM 2540D
Polychlorinated Biphenyls (PCBs) - STL								
Aroclor 1016	< 0.1	ug/L		0.1	0.5	11/08/15 01:16	BP	SW 8082*
Aroclor 1221	< 0.1	ug/L		0.1	0.5	11/08/15 01:16	BP	SW 8082*
Aroclor 1232	< 0.1	ug/L		0.1	0.5	11/08/15 01:16	BP	SW 8082*
Aroclor 1242	< 0.1	ug/L		0.1	0.5	11/08/15 01:16	BP	SW 8082*
Aroclor 1248	< 0.1	ug/L		0.1	0.5	11/08/15 01:16	BP	SW 8082*
Aroclor 1254	< 0.1	ug/L		0.1	0.5	11/08/15 01:16	BP	SW 8082*
Aroclor 1260	< 0.1	ug/L		0.1	0.5	11/08/15 01:16	BP	SW 8082*
Aroclors - Total	< 0.1	ug/L		0.1	0.5	11/08/15 01:16	BP	SW 8082*
Surrogate: TCMX	*93 %*	*41-135*				*11/08/15 01:16*	*BP*	*SW 8082**
Surrogate: Decachlorobiphenyl	*104 %*	*36-148*				*11/08/15 01:16*	*BP*	*SW 8082**
Semivolatile Organics - SIM - STL								
Naphthalene	0.39	ug/L		0.03	0.10	11/17/15 03:24	BP	SW 8270C
Acenaphthylene	< 0.03	ug/L		0.03	0.10	11/17/15 03:24	BP	SW 8270C
Acenaphthene	< 0.03	ug/L		0.03	0.10	11/17/15 03:24	BP	SW 8270C
Fluorene	< 0.04	ug/L		0.04	0.10	11/17/15 03:24	BP	SW 8270C
Phenanthrene	< 0.04	ug/L		0.04	0.10	11/17/15 03:24	BP	SW 8270C
Anthracene	< 0.03	ug/L		0.03	0.10	11/17/15 03:24	BP	SW 8270C
Fluoranthene	< 0.05	ug/L		0.05	0.10	11/17/15 03:24	BP	SW 8270C
Pyrene	< 0.04	ug/L		0.04	0.10	11/17/15 03:24	BP	SW 8270C
Benzo(a)anthracene	< 0.05	ug/L		0.05	0.10	11/17/15 03:24	BP	SW 8270C
Chrysene	< 0.03	ug/L		0.03	0.10	11/17/15 03:24	BP	SW 8270C
Benzo(b)fluoranthene	< 0.08	ug/L		0.08	0.10	11/17/15 03:24	BP	SW 8270C
Benzo(k)fluoranthene	< 0.10	ug/L		0.10	0.10	11/17/15 03:24	BP	SW 8270C
Benzo(a)pyrene	< 0.04	ug/L		0.04	0.10	11/17/15 03:24	BP	SW 8270C
Indeno(1,2,3-cd)pyrene	< 0.04	ug/L		0.04	0.10	11/17/15 03:24	BP	SW 8270C
Dibenzo(a,h)anthracene	< 0.04	ug/L		0.04	0.10	11/17/15 03:24	BP	SW 8270C
Benzo(g,h,i)perylene	< 0.04	ug/L		0.04	0.10	11/17/15 03:24	BP	SW 8270C
Total Metals - PIA								
Antimony	0.58	ug/L	J	0.036	3.0	11/12/15 12:56	JMW	SW 6020
Arsenic	0.38	ug/L	J	0.13	1.0	11/12/15 12:56	JMW	SW 6020
Beryllium	< 0.017	ug/L		0.017	1.0	11/12/15 12:56	JMW	SW 6020
Cadmium	< 0.042	ug/L		0.042	1.0	11/12/15 12:56	JMW	SW 6020
Chromium	< 0.27	ug/L		0.27	4.0	11/12/15 12:56	JMW	SW 6020
Copper	0.79	ug/L	J	0.025	3.0	11/12/15 12:56	JMW	SW 6020
Lead	0.45	ug/L	J	0.025	1.0	11/12/15 12:56	JMW	SW 6020
Nickel	0.97	ug/L	J	0.075	5.0	11/12/15 12:56	JMW	SW 6020
Selenium	< 0.32	ug/L		0.32	1.0	11/12/15 12:56	JMW	SW 6020

ANALYTICAL RESULTS

Sample:	**5110751-12**	**Sampled:**	11/04/15 15:10
Name:	MLFP-1H-0.1%F	**Received:**	11/04/15 16:00
Matrix:	Ground Water - Grab	**PO #:**	2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
Silver	< 0.028	ug/L		0.028	5.0	11/12/15 12:56	JMW	SW 6020
Thallium	< 0.062	ug/L		0.062	1.0	11/12/15 12:56	JMW	SW 6020
Zinc	1.5	ug/L	J	0.50	6.0	11/12/15 12:56	JMW	SW 6020
Total Metals - STL								
Mercury	< 0.2	ug/L		0.2	0.2	11/12/15 11:10	WPS	SW 7470

QC SAMPLE RESULTS

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch B518691 - 04 SW 3510 (625/8270) - SW 8270C									
Blank (B518691-BLK1)				Prepared: 11/10/15 Analyzed: 11/16/15					
Naphthalene	< 0.03	ug/L							
Acenaphthylene	< 0.03	ug/L							
Acenaphthene	< 0.03	ug/L							
Fluorene	< 0.04	ug/L							
Phenanthrene	< 0.04	ug/L							
Anthracene	< 0.03	ug/L							
Fluoranthene	< 0.05	ug/L							
Pyrene	< 0.04	ug/L							
Benzo(a)anthracene	< 0.05	ug/L							
Chrysene	< 0.03	ug/L							
Benzo(b)fluoranthene	< 0.08	ug/L							
Benzo(k)fluoranthene	< 0.10	ug/L							
Benzo(a)pyrene	< 0.04	ug/L							
Indeno(1,2,3-cd)pyrene	< 0.04	ug/L							
Dibenzo(a,h)anthracene	< 0.04	ug/L							
Benzo(g,h,i)perylene	< 0.04	ug/L							
Surrogate: Nitrobenzene-d5	*93*	*ug/L*		*160.0*		*58*	*18.5-97.5*		
Surrogate: 2-Fluorobiphenyl	*91*	*ug/L*		*160.0*		*57*	*13.9-97.2*		
Surrogate: p-Terphenyl-d14	*110*	*ug/L*		*160.0*		*69*	*17.5-104*		
LCS (B518691-BS1)				Prepared & Analyzed: 11/10/15					
Naphthalene	52.0	ug/L		80.00		65	51-87.6		
Acenaphthylene	47.1	ug/L		80.00		59	46.5-86.8		
Acenaphthene	51.9	ug/L		80.00		65	49.1-89.7		
Fluorene	48.8	ug/L		80.00		61	53.5-88.1		
Phenanthrene	52.2	ug/L		80.00		65	50.4-94.4		
Anthracene	51.4	ug/L		80.00		64	49.6-92.1		
Fluoranthene	46.7	ug/L		80.00		58	49-93.6		
Pyrene	47.5	ug/L		80.00		59	44.5-88.4		
Benzo(a)anthracene	44.8	ug/L		80.00		56	43.8-90.5		
Chrysene	51.4	ug/L		80.00		64	46.5-92.3		
Benzo(b)fluoranthene	54.9	ug/L		80.00		69	50.4-93.5		
Benzo(k)fluoranthene	49.4	ug/L		80.00		62	50.2-91.1		
Benzo(a)pyrene	52.9	ug/L		80.00		66	50.6-89.8		
Indeno(1,2,3-cd)pyrene	61.6	ug/L		80.00		77	46-90.3		
Dibenzo(a,h)anthracene	58.6	ug/L		80.00		73	46.1-91.3		
Benzo(g,h,i)perylene	61.1	ug/L		80.00		76	36.7-107		
Surrogate: Nitrobenzene-d5	*44*	*ug/L*		*80.00*		*54*	*18.5-97.5*		
Surrogate: 2-Fluorobiphenyl	*37*	*ug/L*		*80.00*		*46*	*13.9-97.2*		
Surrogate: p-Terphenyl-d14	*44*	*ug/L*		*80.00*		*55*	*17.5-104*		
Matrix Spike (B518691-MS1)	**Sample: 5110751-01**			Prepared: 11/10/15 Analyzed: 11/11/15					
Naphthalene	43.1	ug/L		80.00	0.15	54	25.5-91.4		
Acenaphthylene	39.8	ug/L		80.00	ND	50	20-91.3		
Acenaphthene	43.2	ug/L		80.00	ND	54	22.1-95.9		
Fluorene	40.7	ug/L		80.00	ND	51	21.9-97.6		
Phenanthrene	42.9	ug/L		80.00	ND	54	27.7-96.7		

QC SAMPLE RESULTS

Batch B518691 - 04 SW 3510 (625/8270) - SW 8270C

Matrix Spike (B518691-MS1) **Sample: 5110751-01** Prepared: 11/10/15 Analyzed: 11/11/15

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Anthracene	41.9	ug/L		80.00	ND	52	23.5-95.9		
Fluoranthene	39.2	ug/L		80.00	ND	49	24.8-97.1		
Pyrene	39.8	ug/L		80.00	ND	50	25.5-92.4		
Benzo(a)anthracene	38.0	ug/L		80.00	ND	48	25.1-92		
Chrysene	42.9	ug/L		80.00	ND	54	27-95.1		
Benzo(b)fluoranthene	44.9	ug/L		80.00	ND	56	28-100		
Benzo(k)fluoranthene	39.4	ug/L		80.00	ND	49	21.1-98.1		
Benzo(a)pyrene	43.2	ug/L		80.00	ND	54	16.9-98.8		
Indeno(1,2,3-cd)pyrene	46.4	ug/L		80.00	ND	58	25-92.2		
Dibenzo(a,h)anthracene	43.6	ug/L		80.00	ND	54	27.2-91.2		
Benzo(g,h,i)perylene	46.9	ug/L		80.00	ND	59	13.6-110		
Surrogate: Nitrobenzene-d5	*40*	*ug/L*		*80.00*		*51*	*18.5-97.5*		
Surrogate: 2-Fluorobiphenyl	*41*	*ug/L*		*80.00*		*51*	*13.9-97.2*		
Surrogate: p-Terphenyl-d14	*42*	*ug/L*		*80.00*		*52*	*17.5-104*		

Batch B518694 - 04 SW 3510 (608/8081/8082) - SW 8082

Blank (B518694-BLK1) Prepared & Analyzed: 11/07/15

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Aroclor 1016	< 0.1	ug/L							
Aroclor 1221	< 0.1	ug/L							
Aroclor 1232	< 0.1	ug/L							
Aroclor 1242	< 0.1	ug/L							
Aroclor 1248	< 0.1	ug/L							
Aroclor 1254	< 0.1	ug/L							
Aroclor 1260	< 0.1	ug/L							
Aroclors - Total	< 0.1	ug/L							
Surrogate: TCMX	*0.16*	*ug/L*		*0.2000*		*80*	*41-135*		
Surrogate: Decachlorobiphenyl	*0.18*	*ug/L*		*0.2000*		*91*	*36-148*		

LCS (B518694-BS1) Prepared & Analyzed: 11/07/15

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Aroclor 1016	4	ug/L		5.000		84	43.1-112		
Aroclor 1260	4	ug/L		5.000		72	44.6-107		
Surrogate: TCMX	*0.18*	*ug/L*		*0.2000*		*89*	*41-135*		
Surrogate: Decachlorobiphenyl	*0.20*	*ug/L*		*0.2000*		*99*	*36-148*		

Matrix Spike (B518694-MS1) **Sample: 5110751-02** Prepared: 11/07/15 Analyzed: 11/08/15

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Aroclor 1016	4	ug/L		5.000	ND	83	77.2-124		
Aroclor 1260	4	ug/L		5.000	ND	71	52.6-137		
Surrogate: TCMX	*0.18*	*ug/L*		*0.2000*		*89*	*41-135*		
Surrogate: Decachlorobiphenyl	*0.20*	*ug/L*		*0.2000*		*101*	*36-148*		

Batch B518707 - 04-No Prep WC - SM 2540D

Blank (B518707-BLK1) Prepared & Analyzed: 11/05/15

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Solids - total suspended solids (TSS)	< 0.10	mg/L							

LCS (B518707-BS1) Prepared & Analyzed: 11/05/15

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Solids - total suspended solids (TSS)	101	mg/L		100.0		101	82.9-110		

Duplicate (B518707-DUP1) **Sample: 5110604-02** Prepared & Analyzed: 11/05/15

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Solids - total suspended solids (TSS)	1.20	mg/L	J		1.20			0	5

QC SAMPLE RESULTS

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch B518707 - 04-No Prep WC - SM 2540D									
Duplicate (B518707-DUP2)	**Sample: 5110920-02**			Prepared & Analyzed: 11/05/15					
Solids - total suspended solids (TSS)	728	mg/L			735			1	5
Batch B518747 - 04-No Prep WC - SM 2540D									
Blank (B518747-BLK1)				Prepared & Analyzed: 11/06/15					
Solids - total suspended solids (TSS)	< 0.10	mg/L							
LCS (B518747-BS1)				Prepared & Analyzed: 11/06/15					
Solids - total suspended solids (TSS)	100	mg/L		100.0		100	82.9-110		
Duplicate (B518747-DUP1)	**Sample: 5110612-01**			Prepared & Analyzed: 11/06/15					
Solids - total suspended solids (TSS)	5.20	mg/L			5.20			0	5
Duplicate (B518747-DUP2)	**Sample: 5110964-01**			Prepared & Analyzed: 11/06/15					
Solids - total suspended solids (TSS)	2.80	mg/L	X		4.00			35	5
Batch B518875 - SW 3015 - SW 6020									
Blank (B518875-BLK1)				Prepared: 11/09/15 Analyzed: 11/12/15					
Antimony	< 0.036	ug/L							
Arsenic	< 0.13	ug/L							
Beryllium	< 0.017	ug/L							
Cadmium	< 0.042	ug/L							
Chromium	< 0.27	ug/L							
Copper	< 0.025	ug/L							
Lead	< 0.025	ug/L							
Nickel	< 0.075	ug/L							
Selenium	0.407	ug/L	J						
Silver	0.0350	ug/L	J						
Thallium	< 0.062	ug/L							
Zinc	< 0.50	ug/L							
LCS (B518875-BS1)				Prepared: 11/09/15 Analyzed: 11/12/15					
Antimony	518	ug/L		555.6		93	80-120		
Arsenic	502	ug/L		555.6		90	80-120		
Beryllium	586	ug/L		555.6		106	80-120		
Cadmium	532	ug/L		555.6		96	80-120		
Chromium	538	ug/L		555.6		97	80-120		
Copper	545	ug/L		555.6		98	80-120		
Lead	567	ug/L		555.6		102	80-120		
Nickel	544	ug/L		555.6		98	80-120		
Selenium	523	ug/L		555.6		94	80-120		
Silver	636	ug/L		555.6		114	80-120		
Thallium	524	ug/L		555.6		94	80-120		
Zinc	493	ug/L		555.6		89	80-120		
Matrix Spike (B518875-MS1)	**Sample: 5110119-08**			Prepared: 11/09/15 Analyzed: 11/12/15					
Antimony	0.144	ug/L	J		0.102		75-125		
Arsenic	536	ug/L		555.6	0.453	96	75-125		
Beryllium	595	ug/L		555.6	0.108	107	75-125		
Cadmium	565	ug/L		555.6	ND	102	75-125		
Chromium	569	ug/L		555.6	0.618	102	75-125		

QC SAMPLE RESULTS

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch B518875 - SW 3015 - SW 6020									
Matrix Spike (B518875-MS1)	**Sample: 5110119-08**			Prepared: 11/09/15 Analyzed: 11/12/15					
Copper	551	ug/L		555.6	0.752	99	75-125		
Lead	563	ug/L		555.6	0.148	101	75-125		
Nickel	554	ug/L		555.6	1.26	99	75-125		
Selenium	557	ug/L		555.6	1.13	100	75-125		
Silver	134	ug/L	Q1	555.6	0.576	24	75-125		
Thallium	0.172	ug/L	J		0.232		75-125		
Zinc	526	ug/L		555.6	1.48	94	75-125		
Matrix Spike Dup (B518875-MSD1)	**Sample: 5110119-08**			Prepared: 11/09/15 Analyzed: 11/12/15					
Antimony	0.120	ug/L	J		0.102		75-125	18	20
Arsenic	551	ug/L		555.6	0.453	99	75-125	3	20
Beryllium	609	ug/L		555.6	0.108	110	75-125	2	20
Cadmium	548	ug/L		555.6	ND	99	75-125	3	20
Chromium	574	ug/L		555.6	0.618	103	75-125	0.9	20
Copper	560	ug/L		555.6	0.752	101	75-125	2	20
Lead	569	ug/L		555.6	0.148	102	75-125	1	20
Nickel	561	ug/L		555.6	1.26	101	75-125	1	20
Selenium	571	ug/L		555.6	1.13	103	75-125	2	20
Silver	124	ug/L	Q2	555.6	0.576	22	75-125	8	20
Thallium	0.141	ug/L	J		0.232		75-125	20	20
Zinc	524	ug/L		555.6	1.48	94	75-125	0.4	20
Batch B519099 - 04-SW 7470A/245.1 - SW 7470									
Blank (B519099-BLK1)				Prepared & Analyzed: 11/12/15					
Mercury	< 0.2	ug/L							
LCS (B519099-BS1)				Prepared & Analyzed: 11/12/15					
Mercury	1.97	ug/L		2.000		98	85-115		
Matrix Spike (B519099-MS1)	**Sample: 5110751-12**			Prepared & Analyzed: 11/12/15					
Mercury	2.12	ug/L		2.000	ND	106	50-150		
Matrix Spike (B519099-MS2)	**Sample: 5111306-01**			Prepared & Analyzed: 11/12/15					
Mercury	22.5	ug/L		20.00	ND	112	50-150		
Matrix Spike Dup (B519099-MSD1)	**Sample: 5110751-12**			Prepared & Analyzed: 11/12/15					
Mercury	2.23	ug/L		2.000	ND	112	50-150	5	20
Matrix Spike Dup (B519099-MSD2)	**Sample: 5111306-01**			Prepared & Analyzed: 11/12/15					
Mercury	21.3	ug/L		20.00	ND	106	50-150	5	20

NOTES

Specific method revisions used for analysis are available upon request.

Certifications

PIA - Peoria, IL
TNI Accreditation for Drinking Water, Wastewater, Hazardous and Solid Wastes Fields of Testing through IL EPA Lab No. 100230
Illinois Department of Public Health Bacteriological Analysis in Drinking Water Approved Laboratory Registry No. 17553
Missouri Department of Natural Resources Certificate of Approval for Microbiological Laboratory Service No. 870
Drinking Water Certifications: Iowa (240); Kansas (E-10338); Missouri (870)
Wastewater Certifications: Arkansas (88-0677); Iowa (240); Kansas (E-10338)
Hazardous/Solid Waste Certifications: Arkansas (88-0677); Iowa (240); Kansas (E-10338)

SPMO - Springfield, MO
USEPA DMR-QA Program

STL - St. Louis, MO
TNI Accreditation for Wastewater, Hazardous and Solid Wastes Fields of Testing through KS Lab No. E-10389
Illinois Department of Public Health Bacteriological Analysis in Drinking Water Approved Laboratory Registry No. 171050
Drinking Water Certifications: Missouri (1050)
Missouri Department of Natural Resources

* Not a TNI accredited analyte

Qualifiers

J	Estimated value; value between the Method Detection Limit and Method Reporting Limit.
Q1	Matrix Spike failed % Recovery
Q2	Matrix Spike Duplicate failed % Recovery
X	Values are both under 25 mg/L and within one method reporting limit of each other

Roxann Shull

Certified by: Roxann Shull, Client Services Supervisor

PDC Laboratories, Inc. – St. Louis
3278 N. Highway 67 (Lindbergh)
Florissant, MO 63033
www.pdclab.com

CHAIN OF CUSTODY RECORD

Phone (314) 432-0550 or (314) 921-4488
Fax (314) 432-4977

State where samples collected UA

(Instructions/Sample Acceptance Policy on Reverse)

ALL SHADED AREAS MUST BE COMPLETED BY CLIENT (PLEASE PRINT)

① CLIENT TETRA TECH
ADDRESS 1634 EASTPORT PLAZA Dr
CITY STATE ZIP COLLINSVILLE, IL 62234
CONTACT PERSON P. SMITH / N. Swaller

PROJECT NUMBER T35103
P.O. NUMBER
MEANS SHIPPED
PHONE NUMBER
FAX NUMBER
EMAIL ADDRESS
SAMPLER P. SMITH
SAMPLER'S SIGNATURE

MATRIX TYPES:
WW-WASTEWATER
DW-DRINKING WATER
GW-GROUND WATER
WWSL-SLUDGE
NAS-SOLID
L'CHT-LEACHATE
NAL-NONAQUEOUS
SOIL-SOILS

④ (FOR LAB USE ONLY)
LOGIN # 5110251
LOGGED BY: HE
LAB PROJ. #
TEMPLATE:
PROJ. MGR.:

② SAMPLE DESCRIPTION AS YOU WANT ON REPORT	DATE COLLECTED	TIME COLLECTED	SAMPLE TYPE GRAB	SAMPLE TYPE COMP	MATRIX TYPE	Bottle Count	③ ANALYSIS REQUESTED PAHs	PCBs	METAL	TSS				REMARKS
LUFP-1H-1.0%	11/4/2015	1245	✓		WAT	6	X	X	X	X				SEE EMAIL
LUFP-1H-0.5%		1250	✓		WAT	6	X	X	X	X				"NEW TREATABILITY
LUFP-1H-0.1%		1255	✓		WAT	6	X	X	X	X				STUDY", 11/28/2015
MLFP-1H-1.0%		1308	✓		WAT	6	X	X	X	X				FOR PROJECT
MLFP-1H-0.5%		1315	✓		WAT	6	X	X	X	X				DETAILS
MLFP-1H-0.1%		1321	✓		WAT	6	X	X	X	X				
LUFP-1H-1.0% F		1400	✓		WAT	6	X	X	X	X				
LUFP-1H-0.5% F		1410	✓		WAT	6	X	X	X	X				
LUFP-1H-0.1% F		1425	✓		WAT	6	X	X	X	X				
MLFP-1H-1.0% F		1445	✓		WAT	6	X	X	X	X				
MLFP-1H-0.5% F		1455	✓		WAT	6	X	X	X	X				
MLFP-1H-0.1% F	↓	1510	✓		WAT	6	X	X	X	X				

⑤ TURNAROUND TIME (RUSH TAT IS SUBJECT TO PDC LABS APPROVAL AND SURCHARGE)
[✓ NORMAL (8-10 Bus. Days)] RUSH (5 Bus. Days) *Fastrak*™ (3 Bus. Days) 1-2 Bus. Days Same Day
DATE DUE
RESULTS BY: [✓ E-MAIL] FAX PHONE CALL PHONE/FAX# IF DIFFERENT FROM ABOVE

⑥ The sample temperature will be measured upon receipt at the lab. By initialing this area, you request that the lab notify you, before proceeding with analysis, if the sample temperature is outside of the range of 0.1-6.0°C. By not initialing this area, you allow the lab to proceed with analytical testing regardless of the sample temperature. ______

⑦ RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY:	DATE	TIME
	11/4/2015	16:00	Heather Cearlant	11/4/15	16:00
RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY:	DATE	TIME
RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY:	DATE	TIME
RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY:	DATE	TIME

⑧ COMMENTS:(FOR LAB USE ONLY)

SAMPLE TEMPERATURE UPON RECEIPT 18.6 °C
CHILL PROCESS STARTED PRIOR TO RECEIPT [✓ Y] OR N
SAMPLES(S) RECEIVED ON ICE [✓ Y] OR N
PROPER BOTTLES RECEIVED IN GOOD CONDITION [✓ Y] OR N
BOTTLES FILLED WITH ADEQUATE VOLUME [✓ Y] OR N
SAMPLES RECEIVED WITHIN HOLD TIME(S) [✓ Y] OR N
(EXCLUDES TYPICAL FIELD PARAMETERS)
DATE AND TME TAKEN FROM SAMPLE BOTTLE ______

Thank you for using PDC Laboratories, Inc. Locations in Peoria, IL; St. Louis, MO; and Springfield, MO

PAGE 1 OF 1

SUBCONTRACT ORDER
Transfer Chain of Custody

PDC Laboratories, Inc.

5110751

SENDING LABORATORY

PDC Laboratories, Inc.
3278 N Highway 67
Florissant, MO 63033
(800) 333-3278

RECEIVING LABORATORY

PDC Laboratories, Inc.
2231 W Altorfer Dr
Peoria, IL 61615
(309) 692-9688

Sample: **5110751-01**
Name: LUFP-1H-1.0%

Sampled: 11/04/15 12:45
Matrix: Water

Analysis	Due	Expires	Comments
Ag 6020 Tot	11/16/15 16:00	05/02/16 12:45	ALL 6020 METALS REPORT TO MDL
As 6020 Tot	11/16/15 16:00	05/02/16 12:45	
Be 6020 Tot	11/16/15 16:00	05/02/16 12:45	
Cd 6020 Tot	11/16/15 16:00	05/02/16 12:45	
Cr 6020 Tot	11/16/15 16:00	05/02/16 12:45	
Cu 6020 Tot	11/16/15 16:00	05/02/16 12:45	
Ni 6020 Tot	11/16/15 16:00	05/02/16 12:45	
Pb 6020 Tot	11/16/15 16:00	05/02/16 12:45	
Sb 6020 Tot	11/16/15 16:00	05/02/16 12:45	
Se 6020 Tot	11/16/15 16:00	05/02/16 12:45	
Tl 6020 Tot	11/16/15 16:00	05/02/16 12:45	
Zn 6020 Tot	11/16/15 16:00	05/02/16 12:45	

SUBCONTRACT ORDER
Transfer Chain of Custody

PDC Laboratories, Inc.
5110751

SENDING LABORATORY

PDC Laboratories, Inc.
3278 N Highway 67
Florissant, MO 63033
(800) 333-3278

RECEIVING LABORATORY

PDC Laboratories, Inc.
2231 W Altorfer Dr
Peoria, IL 61615
(309) 692-9688

Sample: 5110751-02
Name: LUFP-1H-0.5%

Sampled: 11/04/15 12:50
Matrix: Water

Analysis	Due	Expires	Comments
Ag 6020 Tot	11/16/15 16:00	05/02/16 12:50	ALL 6020 METALS REPORT TO MDL
As 6020 Tot	11/16/15 16:00	05/02/16 12:50	
Be 6020 Tot	11/16/15 16:00	05/02/16 12:50	
Cd 6020 Tot	11/16/15 16:00	05/02/16 12:50	
Cr 6020 Tot	11/16/15 16:00	05/02/16 12:50	
Cu 6020 Tot	11/16/15 16:00	05/02/16 12:50	
Ni 6020 Tot	11/16/15 16:00	05/02/16 12:50	
Pb 6020 Tot	11/16/15 16:00	05/02/16 12:50	
Sb 6020 Tot	11/16/15 16:00	05/02/16 12:50	
Se 6020 Tot	11/16/15 16:00	05/02/16 12:50	
Tl 6020 Tot	11/16/15 16:00	05/02/16 12:50	
Zn 6020 Tot	11/16/15 16:00	05/02/16 12:50	

SUBCONTRACT ORDER
Transfer Chain of Custody

PDC Laboratories, Inc.
5110751

SENDING LABORATORY	**RECEIVING LABORATORY**
PDC Laboratories, Inc. 3278 N Highway 67 Florissant, MO 63033 (800) 333-3278	PDC Laboratories, Inc. 2231 W Altorfer Dr Peoria, IL 61615 (309) 692-9688

Sample: 5110751-03
Name: LUFP-1H-0.1%
Sampled: 11/04/15 12:55
Matrix: Water

Analysis	Due	Expires	Comments
Ag 6020 Tot	11/16/15 16:00	05/02/16 12:55	ALL 6020 METALS REPORT TO MDL
As 6020 Tot	11/16/15 16:00	05/02/16 12:55	
Be 6020 Tot	11/16/15 16:00	05/02/16 12:55	
Cd 6020 Tot	11/16/15 16:00	05/02/16 12:55	
Cr 6020 Tot	11/16/15 16:00	05/02/16 12:55	
Cu 6020 Tot	11/16/15 16:00	05/02/16 12:55	
Ni 6020 Tot	11/16/15 16:00	05/02/16 12:55	
Pb 6020 Tot	11/16/15 16:00	05/02/16 12:55	
Sb 6020 Tot	11/16/15 16:00	05/02/16 12:55	
Se 6020 Tot	11/16/15 16:00	05/02/16 12:55	
Tl 6020 Tot	11/16/15 16:00	05/02/16 12:55	
Zn 6020 Tot	11/16/15 16:00	05/02/16 12:55	

SUBCONTRACT ORDER

Transfer Chain of Custody

PDC Laboratories, Inc.

5110751

SENDING LABORATORY

PDC Laboratories, Inc.
3278 N Highway 67
Florissant, MO 63033
(800) 333-3278

RECEIVING LABORATORY

PDC Laboratories, Inc.
2231 W Altorfer Dr
Peoria, IL 61615
(309) 692-9688

Sample: **5110751-04**
Name: MLFP-1H-1.0%

Sampled: 11/04/15 13:08
Matrix: Water

Analysis	Due	Expires	Comments
Ag 6020 Tot	11/16/15 16:00	05/02/16 13:08	ALL 6020 METALS REPORT TO MDL
As 6020 Tot	11/16/15 16:00	05/02/16 13:08	
Be 6020 Tot	11/16/15 16:00	05/02/16 13:08	
Cd 6020 Tot	11/16/15 16:00	05/02/16 13:08	
Cr 6020 Tot	11/16/15 16:00	05/02/16 13:08	
Cu 6020 Tot	11/16/15 16:00	05/02/16 13:08	
Ni 6020 Tot	11/16/15 16:00	05/02/16 13:08	
Pb 6020 Tot	11/16/15 16:00	05/02/16 13:08	
Sb 6020 Tot	11/16/15 16:00	05/02/16 13:08	
Se 6020 Tot	11/16/15 16:00	05/02/16 13:08	
Tl 6020 Tot	11/16/15 16:00	05/02/16 13:08	
Zn 6020 Tot	11/16/15 16:00	05/02/16 13:08	

SUBCONTRACT ORDER

Transfer Chain of Custody

PDC Laboratories, Inc.

5110751

SENDING LABORATORY

PDC Laboratories, Inc.
3278 N Highway 67
Florissant, MO 63033
(800) 333-3278

RECEIVING LABORATORY

PDC Laboratories, Inc.
2231 W Altorfer Dr
Peoria, IL 61615
(309) 692-9688

Sample: **5110751-05**
Name: MLFP-1H-0.5%

Sampled: 11/04/15 13:15
Matrix: Water

Analysis	Due	Expires	Comments
Ag 6020 Tot	11/16/15 16:00	05/02/16 13:15	ALL 6020 METALS REPORT TO MDL
As 6020 Tot	11/16/15 16:00	05/02/16 13:15	
Be 6020 Tot	11/16/15 16:00	05/02/16 13:15	
Cd 6020 Tot	11/16/15 16:00	05/02/16 13:15	
Cr 6020 Tot	11/16/15 16:00	05/02/16 13:15	
Cu 6020 Tot	11/16/15 16:00	05/02/16 13:15	
Ni 6020 Tot	11/16/15 16:00	05/02/16 13:15	
Pb 6020 Tot	11/16/15 16:00	05/02/16 13:15	
Sb 6020 Tot	11/16/15 16:00	05/02/16 13:15	
Se 6020 Tot	11/16/15 16:00	05/02/16 13:15	
Tl 6020 Tot	11/16/15 16:00	05/02/16 13:15	
Zn 6020 Tot	11/16/15 16:00	05/02/16 13:15	

SUBCONTRACT ORDER
Transfer Chain of Custody

PDC Laboratories, Inc.

5110751

SENDING LABORATORY

PDC Laboratories, Inc.
3278 N Highway 67
Florissant, MO 63033
(800) 333-3278

RECEIVING LABORATORY

PDC Laboratories, Inc.
2231 W Altorfer Dr
Peoria, IL 61615
(309) 692-9688

Sample: 5110751-06
Name: MLFP-1H-0.1%

Sampled: 11/04/15 13:21
Matrix: Water

Analysis	Due	Expires	Comments
Ag 6020 Tot	11/16/15 16:00	05/02/16 13:21	ALL 6020 METALS REPORT TO MDL
As 6020 Tot	11/16/15 16:00	05/02/16 13:21	
Be 6020 Tot	11/16/15 16:00	05/02/16 13:21	
Cd 6020 Tot	11/16/15 16:00	05/02/16 13:21	
Cr 6020 Tot	11/16/15 16:00	05/02/16 13:21	
Cu 6020 Tot	11/16/15 16:00	05/02/16 13:21	
Ni 6020 Tot	11/16/15 16:00	05/02/16 13:21	
Pb 6020 Tot	11/16/15 16:00	05/02/16 13:21	
Sb 6020 Tot	11/16/15 16:00	05/02/16 13:21	
Se 6020 Tot	11/16/15 16:00	05/02/16 13:21	
Tl 6020 Tot	11/16/15 16:00	05/02/16 13:21	
Zn 6020 Tot	11/16/15 16:00	05/02/16 13:21	

SUBCONTRACT ORDER

Transfer Chain of Custody

PDC Laboratories, Inc.

5110751

SENDING LABORATORY

PDC Laboratories, Inc.
3278 N Highway 67
Florissant, MO 63033
(800) 333-3278

RECEIVING LABORATORY

PDC Laboratories, Inc.
2231 W Altorfer Dr
Peoria, IL 61615
(309) 692-9688

Sample: 5110751-07
Name: LUFP-1H-1.0%F

Sampled: 11/04/15 14:00
Matrix: Water

Analysis	Due	Expires	Comments
Ag 6020 Tot	11/16/15 16:00	05/02/16 14:00	ALL 6020 METALS REPORT TO MDL
As 6020 Tot	11/16/15 16:00	05/02/16 14:00	
Be 6020 Tot	11/16/15 16:00	05/02/16 14:00	
Cd 6020 Tot	11/16/15 16:00	05/02/16 14:00	
Cr 6020 Tot	11/16/15 16:00	05/02/16 14:00	
Cu 6020 Tot	11/16/15 16:00	05/02/16 14:00	
Ni 6020 Tot	11/16/15 16:00	05/02/16 14:00	
Pb 6020 Tot	11/16/15 16:00	05/02/16 14:00	
Sb 6020 Tot	11/16/15 16:00	05/02/16 14:00	
Se 6020 Tot	11/16/15 16:00	05/02/16 14:00	
Tl 6020 Tot	11/16/15 16:00	05/02/16 14:00	
Zn 6020 Tot	11/16/15 16:00	05/02/16 14:00	

SUBCONTRACT ORDER
Transfer Chain of Custody

PDC Laboratories, Inc.

5110751

SENDING LABORATORY

PDC Laboratories, Inc.
3278 N Highway 67
Florissant, MO 63033
(800) 333-3278

RECEIVING LABORATORY

PDC Laboratories, Inc.
2231 W Altorfer Dr
Peoria, IL 61615
(309) 692-9688

Sample: **5110751-08**
Name: LUFP-1H-0.5%F

Sampled: 11/04/15 14:10
Matrix: Water

Analysis	Due	Expires	Comments
Ag 6020 Tot	11/16/15 16:00	05/02/16 14:10	ALL 6020 METALS REPORT TO MDL
As 6020 Tot	11/16/15 16:00	05/02/16 14:10	
Be 6020 Tot	11/16/15 16:00	05/02/16 14:10	
Cd 6020 Tot	11/16/15 16:00	05/02/16 14:10	
Cr 6020 Tot	11/16/15 16:00	05/02/16 14:10	
Cu 6020 Tot	11/16/15 16:00	05/02/16 14:10	
Ni 6020 Tot	11/16/15 16:00	05/02/16 14:10	
Pb 6020 Tot	11/16/15 16:00	05/02/16 14:10	
Sb 6020 Tot	11/16/15 16:00	05/02/16 14:10	
Se 6020 Tot	11/16/15 16:00	05/02/16 14:10	
Tl 6020 Tot	11/16/15 16:00	05/02/16 14:10	
Zn 6020 Tot	11/16/15 16:00	05/02/16 14:10	

SUBCONTRACT ORDER

Transfer Chain of Custody

PDC Laboratories, Inc.

5110751

SENDING LABORATORY

PDC Laboratories, Inc.
3278 N Highway 67
Florissant, MO 63033
(800) 333-3278

RECEIVING LABORATORY

PDC Laboratories, Inc.
2231 W Altorfer Dr
Peoria, IL 61615
(309) 692-9688

Sample: **5110751-09**
Name: LUFP-1H-0.1%F

Sampled: 11/04/15 14:25
Matrix: Water

Analysis	Due	Expires	Comments
Ag 6020 Tot	11/16/15 16:00	05/02/16 14:25	ALL 6020 METALS REPORT TO MDL
As 6020 Tot	11/16/15 16:00	05/02/16 14:25	
Be 6020 Tot	11/16/15 16:00	05/02/16 14:25	
Cd 6020 Tot	11/16/15 16:00	05/02/16 14:25	
Cr 6020 Tot	11/16/15 16:00	05/02/16 14:25	
Cu 6020 Tot	11/16/15 16:00	05/02/16 14:25	
Ni 6020 Tot	11/16/15 16:00	05/02/16 14:25	
Pb 6020 Tot	11/16/15 16:00	05/02/16 14:25	
Sb 6020 Tot	11/16/15 16:00	05/02/16 14:25	
Se 6020 Tot	11/16/15 16:00	05/02/16 14:25	
Tl 6020 Tot	11/16/15 16:00	05/02/16 14:25	
Zn 6020 Tot	11/16/15 16:00	05/02/16 14:25	

SUBCONTRACT ORDER
Transfer Chain of Custody

PDC Laboratories, Inc.
5110751

SENDING LABORATORY

PDC Laboratories, Inc.
3278 N Highway 67
Florissant, MO 63033
(800) 333-3278

RECEIVING LABORATORY

PDC Laboratories, Inc.
2231 W Altorfer Dr
Peoria, IL 61615
(309) 692-9688

Sample: **5110751-10**
Name: MLFP-1H-1.0%F

Sampled: 11/04/15 14:45
Matrix: Water

Analysis	Due	Expires	Comments
Ag 6020 Tot	11/16/15 16:00	05/02/16 14:45	ALL 6020 METALS REPORT TO MDL
As 6020 Tot	11/16/15 16:00	05/02/16 14:45	
Be 6020 Tot	11/16/15 16:00	05/02/16 14:45	
Cd 6020 Tot	11/16/15 16:00	05/02/16 14:45	
Cr 6020 Tot	11/16/15 16:00	05/02/16 14:45	
Cu 6020 Tot	11/16/15 16:00	05/02/16 14:45	
Ni 6020 Tot	11/16/15 16:00	05/02/16 14:45	
Pb 6020 Tot	11/16/15 16:00	05/02/16 14:45	
Sb 6020 Tot	11/16/15 16:00	05/02/16 14:45	
Se 6020 Tot	11/16/15 16:00	05/02/16 14:45	
Tl 6020 Tot	11/16/15 16:00	05/02/16 14:45	
Zn 6020 Tot	11/16/15 16:00	05/02/16 14:45	

SUBCONTRACT ORDER

Transfer Chain of Custody

PDC Laboratories, Inc.

5110751

SENDING LABORATORY

PDC Laboratories, Inc.
3278 N Highway 67
Florissant, MO 63033
(800) 333-3278

RECEIVING LABORATORY

PDC Laboratories, Inc.
2231 W Altorfer Dr
Peoria, IL 61615
(309) 692-9688

Sample: **5110751-11**
Name: MLFP-1H-0.5%F

Sampled: 11/04/15 14:55
Matrix: Water

Analysis	Due	Expires	Comments
Ag 6020 Tot	11/16/15 16:00	05/02/16 14:55	ALL 6020 METALS REPORT TO MDL
As 6020 Tot	11/16/15 16:00	05/02/16 14:55	
Be 6020 Tot	11/16/15 16:00	05/02/16 14:55	
Cd 6020 Tot	11/16/15 16:00	05/02/16 14:55	
Cr 6020 Tot	11/16/15 16:00	05/02/16 14:55	
Cu 6020 Tot	11/16/15 16:00	05/02/16 14:55	
Ni 6020 Tot	11/16/15 16:00	05/02/16 14:55	
Pb 6020 Tot	11/16/15 16:00	05/02/16 14:55	
Sb 6020 Tot	11/16/15 16:00	05/02/16 14:55	
Se 6020 Tot	11/16/15 16:00	05/02/16 14:55	
Tl 6020 Tot	11/16/15 16:00	05/02/16 14:55	
Zn 6020 Tot	11/16/15 16:00	05/02/16 14:55	

SUBCONTRACT ORDER

Transfer Chain of Custody

PDC Laboratories, Inc.

5110751

SENDING LABORATORY	**RECEIVING LABORATORY**
PDC Laboratories, Inc. 3278 N Highway 67 Florissant, MO 63033 (800) 333-3278	PDC Laboratories, Inc. 2231 W Altorfer Dr Peoria, IL 61615 (309) 692-9688

Sample: 5110751-12
Name: MLFP-1H-0.1%F

Sampled: 11/04/15 15:10
Matrix: Water

Analysis	Due	Expires	Comments
Ag 6020 Tot	11/16/15 16:00	05/02/16 15:10	ALL 6020 METALS REPORT TO MDL
As 6020 Tot	11/16/15 16:00	05/02/16 15:10	
Be 6020 Tot	11/16/15 16:00	05/02/16 15:10	
Cd 6020 Tot	11/16/15 16:00	05/02/16 15:10	
Cr 6020 Tot	11/16/15 16:00	05/02/16 15:10	
Cu 6020 Tot	11/16/15 16:00	05/02/16 15:10	
Ni 6020 Tot	11/16/15 16:00	05/02/16 15:10	
Pb 6020 Tot	11/16/15 16:00	05/02/16 15:10	
Sb 6020 Tot	11/16/15 16:00	05/02/16 15:10	
Se 6020 Tot	11/16/15 16:00	05/02/16 15:10	
Tl 6020 Tot	11/16/15 16:00	05/02/16 15:10	
Zn 6020 Tot	11/16/15 16:00	05/02/16 15:10	

Please email results to Roxann Shull at rshull@pdclab.com

Date Shipped: 11/5/15 Total # of Containers: 12 Sample Origin (State): _____ PO #: ____________

Turn-Around Time Requested ☑ NORMAL ☐ RUSH Date Results Needed: ______________

Heather Earhart 11/5/15
Relinquished By Date/Time Received By Date/Time

Relinquished By Date/Time Received By Date/Time 11/6/15 1035a

Sample Temperature Upon Receipt 10 °C
Sample(s) Received on Ice [✓ Y] or N
Proper Bottles Received in Good Condition [✓ Y] or N
Bottles Filled with Adequate Volume [✓ Y] or N
Samples Received Within Hold Time [✓ Y] or N
Date/Time Taken From Sample Bottle Y or [✓ N]

PDC Laboratories, Inc.
PROFESSIONAL ŁDEPENDABLE ŁCOMMITTED

November 18, 2015

Paul Smith
TETRA TECH
1634 Eport Plaza Dr
Collinsville, IL 62234

Dear Paul Smith:

Please find enclosed the analytical results for the sample(s) the laboratory received on **11/5/15 2:15 pm** and logged in under work order **5111254**. All testing is performed according to our current TNI certifications unless otherwise noted. This report cannot be reproduced, except in full, without the written permission of PDC Laboratories, Inc.

If you have any questions regarding your report, please contact your project manager. Quality and timely data is of the utmost importance to us.

PDC Laboratories, Inc. appreciates the opportunity to provide you with analytical expertise. We are always trying to improve our customer service and we welcome you to contact the Vice President , John LaPayne with any feedback you have about your experience with our laboratory.

Sincerely,

Roxann Shull

Roxann Shull
Client Services Supervisor
(314) 432-0550
rshull@pdclab.com

NELAP ACCREDITED TNI LABORATORY

ANALYTICAL RESULTS

Sample:	**5111254-01**	**Sampled:**	11/05/15 13:00
Name:	ECCS-1H-1.0%	**Received:**	11/05/15 14:15
Matrix:	Ground Water - Grab	**PO #:**	2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
General Chemistry - STL								
Solids - total suspended solids (TSS)	280	mg/L		0.50	10	11/09/15 15:17	KLA	SM 2540D
Polychlorinated Biphenyls (PCBs) - STL								
Aroclor 1016	< 0.1	ug/L		0.1	0.5	11/09/15 23:23	BP	SW 8082*
Aroclor 1221	< 0.1	ug/L		0.1	0.5	11/09/15 23:23	BP	SW 8082*
Aroclor 1232	< 0.1	ug/L		0.1	0.5	11/09/15 23:23	BP	SW 8082*
Aroclor 1242	< 0.1	ug/L		0.1	0.5	11/09/15 23:23	BP	SW 8082*
Aroclor 1248	< 0.1	ug/L		0.1	0.5	11/09/15 23:23	BP	SW 8082*
Aroclor 1254	< 0.1	ug/L		0.1	0.5	11/09/15 23:23	BP	SW 8082*
Aroclor 1260	< 0.1	ug/L		0.1	0.5	11/09/15 23:23	BP	SW 8082*
Aroclors - Total	< 0.1	ug/L		0.1	0.5	11/09/15 23:23	BP	SW 8082*
Surrogate: TCMX	*78 %*	*41-135*				*11/09/15 23:23*	*BP*	*SW 8082**
Surrogate: Decachlorobiphenyl	*90 %*	*36-148*				*11/09/15 23:23*	*BP*	*SW 8082**
Semivolatile Organics - SIM - STL								
Naphthalene	0.11	ug/L		0.03	0.10	11/17/15 16:41	BP	SW 8270C
Acenaphthylene	< 0.03	ug/L		0.03	0.10	11/17/15 16:41	BP	SW 8270C
Acenaphthene	< 0.03	ug/L		0.03	0.10	11/17/15 16:41	BP	SW 8270C
Fluorene	< 0.04	ug/L		0.04	0.10	11/17/15 16:41	BP	SW 8270C
Phenanthrene	0.13	ug/L		0.04	0.10	11/17/15 16:41	BP	SW 8270C
Anthracene	< 0.03	ug/L		0.03	0.10	11/17/15 16:41	BP	SW 8270C
Fluoranthene	0.25	ug/L		0.05	0.10	11/17/15 16:41	BP	SW 8270C
Pyrene	0.25	ug/L		0.04	0.10	11/17/15 16:41	BP	SW 8270C
Benzo(a)anthracene	0.09	ug/L	J	0.05	0.10	11/17/15 16:41	BP	SW 8270C
Chrysene	0.15	ug/L		0.03	0.10	11/17/15 16:41	BP	SW 8270C
Benzo(b)fluoranthene	0.13	ug/L		0.08	0.10	11/17/15 16:41	BP	SW 8270C
Benzo(k)fluoranthene	0.11	ug/L		0.10	0.10	11/17/15 16:41	BP	SW 8270C
Benzo(a)pyrene	0.11	ug/L		0.04	0.10	11/17/15 16:41	BP	SW 8270C
Indeno(1,2,3-cd)pyrene	0.08	ug/L	J	0.04	0.10	11/17/15 16:41	BP	SW 8270C
Dibenzo(a,h)anthracene	< 0.04	ug/L		0.04	0.10	11/17/15 16:41	BP	SW 8270C
Benzo(g,h,i)perylene	0.10	ug/L		0.04	0.10	11/17/15 16:41	BP	SW 8270C
Total Metals - PIA								
Antimony	1000	ug/L		0.036	3.0	11/13/15 15:25	JMW	SW 6020
Arsenic	15	ug/L		0.13	1.0	11/13/15 15:25	JMW	SW 6020
Beryllium	0.45	ug/L	J	0.017	1.0	11/13/15 15:25	JMW	SW 6020
Cadmium	3.1	ug/L		0.042	1.0	11/13/15 15:25	JMW	SW 6020
Chromium	13	ug/L		0.27	4.0	11/13/15 15:25	JMW	SW 6020
Copper	57	ug/L		0.025	3.0	11/13/15 15:25	JMW	SW 6020
Lead	160	ug/L		0.025	1.0	11/13/15 15:25	JMW	SW 6020
Nickel	17	ug/L		0.075	5.0	11/13/15 15:25	JMW	SW 6020
Selenium	1.4	ug/L		0.32	1.0	11/13/15 15:25	JMW	SW 6020

ANALYTICAL RESULTS

Sample:	**5111254-01**	**Sampled:**	11/05/15 13:00
Name:	ECCS-1H-1.0%	**Received:**	11/05/15 14:15
Matrix:	Ground Water - Grab	**PO #:**	2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
Silver	2.0	ug/L	J	0.028	5.0	11/16/15 10:20	JMW	SW 6020
Thallium	0.066	ug/L	J	0.062	1.0	11/13/15 15:25	JMW	SW 6020
Zinc	280	ug/L		0.50	6.0	11/13/15 15:25	JMW	SW 6020
Total Metals - STL								
Mercury	490	ug/L		20	20	11/17/15 13:51	WPS	SW 7470

ANALYTICAL RESULTS

Sample: **5111254-02**
Name: ECCS-1H-0.5%
Matrix: Ground Water - Grab

Sampled: 11/05/15 13:05
Received: 11/05/15 14:15
PO #: 2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
General Chemistry - STL								
Solids - total suspended solids (TSS)	200	mg/L		0.50	10	11/09/15 15:17	KLA	SM 2540D
Polychlorinated Biphenyls (PCBs) - STL								
Aroclor 1016	< 0.1	ug/L		0.1	0.5	11/09/15 23:48	BP	SW 8082*
Aroclor 1221	< 0.1	ug/L		0.1	0.5	11/09/15 23:48	BP	SW 8082*
Aroclor 1232	< 0.1	ug/L		0.1	0.5	11/09/15 23:48	BP	SW 8082*
Aroclor 1242	< 0.1	ug/L		0.1	0.5	11/09/15 23:48	BP	SW 8082*
Aroclor 1248	< 0.1	ug/L		0.1	0.5	11/09/15 23:48	BP	SW 8082*
Aroclor 1254	< 0.1	ug/L		0.1	0.5	11/09/15 23:48	BP	SW 8082*
Aroclor 1260	< 0.1	ug/L		0.1	0.5	11/09/15 23:48	BP	SW 8082*
Aroclors - Total	< 0.1	ug/L		0.1	0.5	11/09/15 23:48	BP	SW 8082*
Surrogate: TCMX	*88 %*	*41-135*				*11/09/15 23:48*	*BP*	*SW 8082**
Surrogate: Decachlorobiphenyl	*103 %*	*36-148*				*11/09/15 23:48*	*BP*	*SW 8082**
Semivolatile Organics - SIM - STL								
Naphthalene	0.11	ug/L		0.03	0.10	11/17/15 17:07	BP	SW 8270C
Acenaphthylene	0.07	ug/L	J	0.03	0.10	11/17/15 17:07	BP	SW 8270C
Acenaphthene	< 0.03	ug/L		0.03	0.10	11/17/15 17:07	BP	SW 8270C
Fluorene	< 0.04	ug/L		0.04	0.10	11/17/15 17:07	BP	SW 8270C
Phenanthrene	0.19	ug/L		0.04	0.10	11/17/15 17:07	BP	SW 8270C
Anthracene	< 0.03	ug/L		0.03	0.10	11/17/15 17:07	BP	SW 8270C
Fluoranthene	0.36	ug/L		0.05	0.10	11/17/15 17:07	BP	SW 8270C
Pyrene	0.35	ug/L		0.04	0.10	11/17/15 17:07	BP	SW 8270C
Benzo(a)anthracene	0.13	ug/L		0.05	0.10	11/17/15 17:07	BP	SW 8270C
Chrysene	0.23	ug/L		0.03	0.10	11/17/15 17:07	BP	SW 8270C
Benzo(b)fluoranthene	0.20	ug/L		0.08	0.10	11/17/15 17:07	BP	SW 8270C
Benzo(k)fluoranthene	0.17	ug/L		0.10	0.10	11/17/15 17:07	BP	SW 8270C
Benzo(a)pyrene	0.18	ug/L		0.04	0.10	11/17/15 17:07	BP	SW 8270C
Indeno(1,2,3-cd)pyrene	0.13	ug/L		0.04	0.10	11/17/15 17:07	BP	SW 8270C
Dibenzo(a,h)anthracene	< 0.04	ug/L		0.04	0.10	11/17/15 17:07	BP	SW 8270C
Benzo(g,h,i)perylene	0.15	ug/L		0.04	0.10	11/17/15 17:07	BP	SW 8270C
Total Metals - PIA								
Antimony	720	ug/L		0.036	3.0	11/13/15 15:29	JMW	SW 6020
Arsenic	11	ug/L		0.13	1.0	11/13/15 15:29	JMW	SW 6020
Beryllium	0.32	ug/L	J	0.017	1.0	11/13/15 15:29	JMW	SW 6020
Cadmium	1.9	ug/L		0.042	1.0	11/13/15 15:29	JMW	SW 6020
Chromium	11	ug/L		0.27	4.0	11/13/15 15:29	JMW	SW 6020
Copper	44	ug/L		0.025	3.0	11/13/15 15:29	JMW	SW 6020
Lead	120	ug/L		0.025	1.0	11/13/15 15:29	JMW	SW 6020
Nickel	14	ug/L		0.075	5.0	11/13/15 15:29	JMW	SW 6020
Selenium	1.6	ug/L		0.32	1.0	11/13/15 15:29	JMW	SW 6020

ANALYTICAL RESULTS

Sample: **5111254-02**
Name: ECCS-1H-0.5%
Matrix: Ground Water - Grab

Sampled: 11/05/15 13:05
Received: 11/05/15 14:15
PO #: 2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
Silver	1.5	ug/L	J	0.028	5.0	11/16/15 10:24	JMW	SW 6020
Thallium	< 0.062	ug/L		0.062	1.0	11/13/15 15:29	JMW	SW 6020
Zinc	200	ug/L		0.50	6.0	11/13/15 15:29	JMW	SW 6020
Total Metals - STL								
Mercury	350	ug/L		20	20	11/17/15 13:51	WPS	SW 7470

ANALYTICAL RESULTS

Sample:	**5111254-03**	**Sampled:**	11/05/15 13:10
Name:	ECCS-1H-0.1%	**Received:**	11/05/15 14:15
Matrix:	Ground Water - Grab	**PO #:**	2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
General Chemistry - STL								
Solids - total suspended solids (TSS)	76	mg/L		0.25	5.0	11/10/15 14:45	KMN	SM 2540D
Polychlorinated Biphenyls (PCBs) - STL								
Aroclor 1016	< 0.1	ug/L		0.1	0.5	11/10/15 00:14	BP	SW 8082*
Aroclor 1221	< 0.1	ug/L		0.1	0.5	11/10/15 00:14	BP	SW 8082*
Aroclor 1232	< 0.1	ug/L		0.1	0.5	11/10/15 00:14	BP	SW 8082*
Aroclor 1242	< 0.1	ug/L		0.1	0.5	11/10/15 00:14	BP	SW 8082*
Aroclor 1248	< 0.1	ug/L		0.1	0.5	11/10/15 00:14	BP	SW 8082*
Aroclor 1254	< 0.1	ug/L		0.1	0.5	11/10/15 00:14	BP	SW 8082*
Aroclor 1260	< 0.1	ug/L		0.1	0.5	11/10/15 00:14	BP	SW 8082*
Aroclors - Total	< 0.1	ug/L		0.1	0.5	11/10/15 00:14	BP	SW 8082*
Surrogate: TCMX	*88 %*	*41-135*				*11/10/15 00:14*	*BP*	*SW 8082**
Surrogate: Decachlorobiphenyl	*105 %*	*36-148*				*11/10/15 00:14*	*BP*	*SW 8082**
Semivolatile Organics - SIM - STL								
Naphthalene	0.06	ug/L	J	0.03	0.10	11/17/15 17:33	BP	SW 8270C
Acenaphthylene	< 0.03	ug/L		0.03	0.10	11/17/15 17:33	BP	SW 8270C
Acenaphthene	< 0.03	ug/L		0.03	0.10	11/17/15 17:33	BP	SW 8270C
Fluorene	< 0.04	ug/L		0.04	0.10	11/17/15 17:33	BP	SW 8270C
Phenanthrene	0.14	ug/L		0.04	0.10	11/17/15 17:33	BP	SW 8270C
Anthracene	< 0.03	ug/L		0.03	0.10	11/17/15 17:33	BP	SW 8270C
Fluoranthene	0.28	ug/L		0.05	0.10	11/17/15 17:33	BP	SW 8270C
Pyrene	0.28	ug/L		0.04	0.10	11/17/15 17:33	BP	SW 8270C
Benzo(a)anthracene	0.11	ug/L		0.05	0.10	11/17/15 17:33	BP	SW 8270C
Chrysene	0.18	ug/L		0.03	0.10	11/17/15 17:33	BP	SW 8270C
Benzo(b)fluoranthene	0.16	ug/L		0.08	0.10	11/17/15 17:33	BP	SW 8270C
Benzo(k)fluoranthene	0.15	ug/L		0.10	0.10	11/17/15 17:33	BP	SW 8270C
Benzo(a)pyrene	0.15	ug/L		0.04	0.10	11/17/15 17:33	BP	SW 8270C
Indeno(1,2,3-cd)pyrene	0.10	ug/L		0.04	0.10	11/17/15 17:33	BP	SW 8270C
Dibenzo(a,h)anthracene	< 0.04	ug/L		0.04	0.10	11/17/15 17:33	BP	SW 8270C
Benzo(g,h,i)perylene	0.11	ug/L		0.04	0.10	11/17/15 17:33	BP	SW 8270C
Total Metals - PIA								
Antimony	210	ug/L		0.036	3.0	11/13/15 15:33	JMW	SW 6020
Arsenic	3.4	ug/L		0.13	1.0	11/13/15 15:33	JMW	SW 6020
Beryllium	0.024	ug/L	J	0.017	1.0	11/13/15 15:33	JMW	SW 6020
Cadmium	0.17	ug/L	J	0.042	1.0	11/13/15 15:33	JMW	SW 6020
Chromium	3.7	ug/L	J	0.27	4.0	11/13/15 15:33	JMW	SW 6020
Copper	14	ug/L		0.025	3.0	11/13/15 15:33	JMW	SW 6020
Lead	36	ug/L		0.025	1.0	11/13/15 15:33	JMW	SW 6020
Nickel	6.3	ug/L		0.075	5.0	11/13/15 15:33	JMW	SW 6020
Selenium	< 0.32	ug/L		0.32	1.0	11/13/15 15:33	JMW	SW 6020

ANALYTICAL RESULTS

Sample:	**5111254-03**	**Sampled:**	11/05/15 13:10
Name:	ECCS-1H-0.1%	**Received:**	11/05/15 14:15
Matrix:	Ground Water - Grab	**PO #:**	2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
Silver	0.51	ug/L	J	0.028	5.0	11/16/15 10:28	JMW	SW 6020
Thallium	< 0.062	ug/L		0.062	1.0	11/13/15 15:33	JMW	SW 6020
Zinc	75	ug/L		0.50	6.0	11/13/15 15:33	JMW	SW 6020
Total Metals - STL								
Mercury	120	ug/L	NA, Q4, R	20	20	11/17/15 13:51	WPS	SW 7470

ANALYTICAL RESULTS

Sample: **5111254-04**
Name: ECCS-1H-1.0%F
Matrix: Ground Water - Grab

Sampled: 11/05/15 13:20
Received: 11/05/15 14:15
PO #: 2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
General Chemistry - STL								
Solids - total suspended solids (TSS)	2.4	mg/L		0.10	2.0	11/10/15 14:45	KMN	SM 2540D
Polychlorinated Biphenyls (PCBs) - STL								
Aroclor 1016	< 0.1	ug/L	Q1	0.1	0.5	11/10/15 00:40	BP	SW 8082*
Aroclor 1221	< 0.1	ug/L		0.1	0.5	11/10/15 00:40	BP	SW 8082*
Aroclor 1232	< 0.1	ug/L		0.1	0.5	11/10/15 00:40	BP	SW 8082*
Aroclor 1242	< 0.1	ug/L		0.1	0.5	11/10/15 00:40	BP	SW 8082*
Aroclor 1248	< 0.1	ug/L		0.1	0.5	11/10/15 00:40	BP	SW 8082*
Aroclor 1254	< 0.1	ug/L		0.1	0.5	11/10/15 00:40	BP	SW 8082*
Aroclor 1260	< 0.1	ug/L		0.1	0.5	11/10/15 00:40	BP	SW 8082*
Aroclors - Total	< 0.1	ug/L		0.1	0.5	11/10/15 00:40	BP	SW 8082*
Surrogate: TCMX	*85 %*	*41-135*				*11/10/15 00:40*	*BP*	*SW 8082**
Surrogate: Decachlorobiphenyl	*100 %*	*36-148*				*11/10/15 00:40*	*BP*	*SW 8082**
Semivolatile Organics - SIM - STL								
Naphthalene	0.13	ug/L		0.03	0.10	11/17/15 18:00	BP	SW 8270C
Acenaphthylene	< 0.03	ug/L		0.03	0.10	11/17/15 18:00	BP	SW 8270C
Acenaphthene	< 0.03	ug/L		0.03	0.10	11/17/15 18:00	BP	SW 8270C
Fluorene	< 0.04	ug/L		0.04	0.10	11/17/15 18:00	BP	SW 8270C
Phenanthrene	< 0.04	ug/L		0.04	0.10	11/17/15 18:00	BP	SW 8270C
Anthracene	< 0.03	ug/L		0.03	0.10	11/17/15 18:00	BP	SW 8270C
Fluoranthene	< 0.05	ug/L		0.05	0.10	11/17/15 18:00	BP	SW 8270C
Pyrene	< 0.04	ug/L		0.04	0.10	11/17/15 18:00	BP	SW 8270C
Benzo(a)anthracene	< 0.05	ug/L		0.05	0.10	11/17/15 18:00	BP	SW 8270C
Chrysene	< 0.03	ug/L		0.03	0.10	11/17/15 18:00	BP	SW 8270C
Benzo(b)fluoranthene	< 0.08	ug/L		0.08	0.10	11/17/15 18:00	BP	SW 8270C
Benzo(k)fluoranthene	< 0.10	ug/L		0.10	0.10	11/17/15 18:00	BP	SW 8270C
Benzo(a)pyrene	< 0.04	ug/L		0.04	0.10	11/17/15 18:00	BP	SW 8270C
Indeno(1,2,3-cd)pyrene	< 0.04	ug/L		0.04	0.10	11/17/15 18:00	BP	SW 8270C
Dibenzo(a,h)anthracene	< 0.04	ug/L		0.04	0.10	11/17/15 18:00	BP	SW 8270C
Benzo(g,h,i)perylene	< 0.04	ug/L		0.04	0.10	11/17/15 18:00	BP	SW 8270C
Total Metals - PIA								
Antimony	120	ug/L		0.036	3.0	11/13/15 15:37	JMW	SW 6020
Arsenic	2.9	ug/L		0.13	1.0	11/13/15 15:37	JMW	SW 6020
Beryllium	< 0.017	ug/L		0.017	1.0	11/13/15 15:37	JMW	SW 6020
Cadmium	< 0.042	ug/L		0.042	1.0	11/13/15 15:37	JMW	SW 6020
Chromium	< 0.27	ug/L		0.27	4.0	11/13/15 15:37	JMW	SW 6020
Copper	0.33	ug/L	J	0.025	3.0	11/13/15 15:37	JMW	SW 6020
Lead	0.55	ug/L	J	0.025	1.0	11/13/15 15:37	JMW	SW 6020
Nickel	2.3	ug/L	J	0.075	5.0	11/13/15 15:37	JMW	SW 6020
Selenium	0.38	ug/L	J	0.32	1.0	11/13/15 15:37	JMW	SW 6020

ANALYTICAL RESULTS

Sample: **5111254-04**
Name: ECCS-1H-1.0%F
Matrix: Ground Water - Grab

Sampled: 11/05/15 13:20
Received: 11/05/15 14:15
PO #: 2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
Silver	0.20	ug/L	J	0.028	5.0	11/16/15 11:44	JMW	SW 6020
Thallium	< 0.062	ug/L		0.062	1.0	11/13/15 15:37	JMW	SW 6020
Zinc	< 0.50	ug/L		0.50	6.0	11/13/15 15:37	JMW	SW 6020
Total Metals - STL								
Mercury	0.4	ug/L		0.2	0.2	11/17/15 13:51	WPS	SW 7470

ANALYTICAL RESULTS

Sample: **5111254-05**
Name: ECCS-1H-0.5%F
Matrix: Ground Water - Grab

Sampled: 11/05/15 13:25
Received: 11/05/15 14:15
PO #: 2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
General Chemistry - STL								
Solids - total suspended solids (TSS)	1.2	mg/L	J	0.10	2.0	11/10/15 14:45	KMN	SM 2540D
Polychlorinated Biphenyls (PCBs) - STL								
Aroclor 1016	< 0.1	ug/L		0.1	0.5	11/10/15 01:05	BP	SW 8082*
Aroclor 1221	< 0.1	ug/L		0.1	0.5	11/10/15 01:05	BP	SW 8082*
Aroclor 1232	< 0.1	ug/L		0.1	0.5	11/10/15 01:05	BP	SW 8082*
Aroclor 1242	< 0.1	ug/L		0.1	0.5	11/10/15 01:05	BP	SW 8082*
Aroclor 1248	< 0.1	ug/L		0.1	0.5	11/10/15 01:05	BP	SW 8082*
Aroclor 1254	< 0.1	ug/L		0.1	0.5	11/10/15 01:05	BP	SW 8082*
Aroclor 1260	< 0.1	ug/L		0.1	0.5	11/10/15 01:05	BP	SW 8082*
Aroclors - Total	< 0.1	ug/L		0.1	0.5	11/10/15 01:05	BP	SW 8082*
Surrogate: TCMX	*84 %*	*41-135*				*11/10/15 01:05*	*BP*	*SW 8082**
Surrogate: Decachlorobiphenyl	*100 %*	*36-148*				*11/10/15 01:05*	*BP*	*SW 8082**
Semivolatile Organics - SIM - STL								
Naphthalene	0.15	ug/L		0.03	0.10	11/17/15 18:26	BP	SW 8270C
Acenaphthylene	< 0.03	ug/L		0.03	0.10	11/17/15 18:26	BP	SW 8270C
Acenaphthene	< 0.03	ug/L		0.03	0.10	11/17/15 18:26	BP	SW 8270C
Fluorene	< 0.04	ug/L		0.04	0.10	11/17/15 18:26	BP	SW 8270C
Phenanthrene	< 0.04	ug/L		0.04	0.10	11/17/15 18:26	BP	SW 8270C
Anthracene	< 0.03	ug/L		0.03	0.10	11/17/15 18:26	BP	SW 8270C
Fluoranthene	< 0.05	ug/L		0.05	0.10	11/17/15 18:26	BP	SW 8270C
Pyrene	< 0.04	ug/L		0.04	0.10	11/17/15 18:26	BP	SW 8270C
Benzo(a)anthracene	< 0.05	ug/L		0.05	0.10	11/17/15 18:26	BP	SW 8270C
Chrysene	< 0.03	ug/L		0.03	0.10	11/17/15 18:26	BP	SW 8270C
Benzo(b)fluoranthene	< 0.08	ug/L		0.08	0.10	11/17/15 18:26	BP	SW 8270C
Benzo(k)fluoranthene	< 0.10	ug/L		0.10	0.10	11/17/15 18:26	BP	SW 8270C
Benzo(a)pyrene	< 0.04	ug/L		0.04	0.10	11/17/15 18:26	BP	SW 8270C
Indeno(1,2,3-cd)pyrene	< 0.04	ug/L		0.04	0.10	11/17/15 18:26	BP	SW 8270C
Dibenzo(a,h)anthracene	< 0.04	ug/L		0.04	0.10	11/17/15 18:26	BP	SW 8270C
Benzo(g,h,i)perylene	< 0.04	ug/L		0.04	0.10	11/17/15 18:26	BP	SW 8270C
Total Metals - PIA								
Antimony	76	ug/L		0.036	3.0	11/13/15 15:41	JMW	SW 6020
Arsenic	2.0	ug/L		0.13	1.0	11/13/15 15:41	JMW	SW 6020
Beryllium	< 0.017	ug/L		0.017	1.0	11/13/15 15:41	JMW	SW 6020
Cadmium	< 0.042	ug/L		0.042	1.0	11/13/15 15:41	JMW	SW 6020
Chromium	< 0.27	ug/L		0.27	4.0	11/13/15 15:41	JMW	SW 6020
Copper	0.67	ug/L	J	0.025	3.0	11/13/15 15:41	JMW	SW 6020
Lead	0.95	ug/L	J	0.025	1.0	11/13/15 15:41	JMW	SW 6020
Nickel	2.1	ug/L	J	0.075	5.0	11/13/15 15:41	JMW	SW 6020
Selenium	0.43	ug/L	J	0.32	1.0	11/13/15 15:41	JMW	SW 6020

ANALYTICAL RESULTS

Sample: **5111254-05**
Name: ECCS-1H-0.5%F
Matrix: Ground Water - Grab

Sampled: 11/05/15 13:25
Received: 11/05/15 14:15
PO #: 2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
Silver	0.089	ug/L	J	0.028	5.0	11/16/15 11:48	JMW	SW 6020
Thallium	< 0.062	ug/L		0.062	1.0	11/13/15 15:41	JMW	SW 6020
Zinc	0.56	ug/L	J	0.50	6.0	11/13/15 15:41	JMW	SW 6020
Total Metals - STL								
Mercury	0.3	ug/L		0.2	0.2	11/17/15 13:51	WPS	SW 7470

ANALYTICAL RESULTS

Sample: **5111254-06**
Name: ECCS-1H-0.1%F
Matrix: Ground Water - Grab

Sampled: 11/05/15 13:30
Received: 11/05/15 14:15
PO #: 2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
General Chemistry - STL								
Solids - total suspended solids (TSS)	1.2	mg/L	J	0.10	2.0	11/10/15 14:45	KMN	SM 2540D
Polychlorinated Biphenyls (PCBs) - STL								
Aroclor 1016	< 0.1	ug/L		0.1	0.5	11/10/15 01:31	BP	SW 8082*
Aroclor 1221	< 0.1	ug/L		0.1	0.5	11/10/15 01:31	BP	SW 8082*
Aroclor 1232	< 0.1	ug/L		0.1	0.5	11/10/15 01:31	BP	SW 8082*
Aroclor 1242	< 0.1	ug/L		0.1	0.5	11/10/15 01:31	BP	SW 8082*
Aroclor 1248	< 0.1	ug/L		0.1	0.5	11/10/15 01:31	BP	SW 8082*
Aroclor 1254	< 0.1	ug/L		0.1	0.5	11/10/15 01:31	BP	SW 8082*
Aroclor 1260	< 0.1	ug/L		0.1	0.5	11/10/15 01:31	BP	SW 8082*
Aroclors - Total	< 0.1	ug/L		0.1	0.5	11/10/15 01:31	BP	SW 8082*
Surrogate: TCMX	*83 %*	*41-135*				*11/10/15 01:31*	*BP*	*SW 8082**
Surrogate: Decachlorobiphenyl	*98 %*	*36-148*				*11/10/15 01:31*	*BP*	*SW 8082**
Semivolatile Organics - SIM - STL								
Naphthalene	0.16	ug/L		0.03	0.10	11/17/15 18:53	BP	SW 8270C
Acenaphthylene	< 0.03	ug/L		0.03	0.10	11/17/15 18:53	BP	SW 8270C
Acenaphthene	< 0.03	ug/L		0.03	0.10	11/17/15 18:53	BP	SW 8270C
Fluorene	< 0.04	ug/L		0.04	0.10	11/17/15 18:53	BP	SW 8270C
Phenanthrene	< 0.04	ug/L		0.04	0.10	11/17/15 18:53	BP	SW 8270C
Anthracene	< 0.03	ug/L		0.03	0.10	11/17/15 18:53	BP	SW 8270C
Fluoranthene	< 0.05	ug/L		0.05	0.10	11/17/15 18:53	BP	SW 8270C
Pyrene	< 0.04	ug/L		0.04	0.10	11/17/15 18:53	BP	SW 8270C
Benzo(a)anthracene	< 0.05	ug/L		0.05	0.10	11/17/15 18:53	BP	SW 8270C
Chrysene	< 0.03	ug/L		0.03	0.10	11/17/15 18:53	BP	SW 8270C
Benzo(b)fluoranthene	< 0.08	ug/L		0.08	0.10	11/17/15 18:53	BP	SW 8270C
Benzo(k)fluoranthene	< 0.10	ug/L		0.10	0.10	11/17/15 18:53	BP	SW 8270C
Benzo(a)pyrene	< 0.04	ug/L		0.04	0.10	11/17/15 18:53	BP	SW 8270C
Indeno(1,2,3-cd)pyrene	< 0.04	ug/L		0.04	0.10	11/17/15 18:53	BP	SW 8270C
Dibenzo(a,h)anthracene	< 0.04	ug/L		0.04	0.10	11/17/15 18:53	BP	SW 8270C
Benzo(g,h,i)perylene	< 0.04	ug/L		0.04	0.10	11/17/15 18:53	BP	SW 8270C
Total Metals - PIA								
Antimony	25	ug/L		0.036	3.0	11/13/15 15:45	JMW	SW 6020
Arsenic	0.66	ug/L	J	0.13	1.0	11/13/15 15:45	JMW	SW 6020
Beryllium	< 0.017	ug/L		0.017	1.0	11/13/15 15:45	JMW	SW 6020
Cadmium	< 0.042	ug/L		0.042	1.0	11/13/15 15:45	JMW	SW 6020
Chromium	0.39	ug/L	J	0.27	4.0	11/13/15 15:45	JMW	SW 6020
Copper	0.65	ug/L	J	0.025	3.0	11/13/15 15:45	JMW	SW 6020
Lead	1.1	ug/L		0.025	1.0	11/13/15 15:45	JMW	SW 6020
Nickel	1.8	ug/L	J	0.075	5.0	11/13/15 15:45	JMW	SW 6020
Selenium	0.61	ug/L	J	0.32	1.0	11/13/15 15:45	JMW	SW 6020

ANALYTICAL RESULTS

Sample: **5111254-06**
Name: ECCS-1H-0.1%F
Matrix: Ground Water - Grab

Sampled: 11/05/15 13:30
Received: 11/05/15 14:15
PO #: 2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
Silver	0.034	ug/L	J	0.028	5.0	11/16/15 11:52	JMW	SW 6020
Thallium	< 0.062	ug/L		0.062	1.0	11/13/15 15:45	JMW	SW 6020
Zinc	1.3	ug/L	J	0.50	6.0	11/13/15 15:45	JMW	SW 6020
Total Metals - STL								
Mercury	< 0.2	ug/L		0.2	0.2	11/17/15 13:51	WPS	SW 7470

QC SAMPLE RESULTS

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch B518864 - 04 SW 3510 (608/8081/8082) - SW 8082									
Blank (B518864-BLK1)				Prepared & Analyzed: 11/09/15					
Aroclor 1016	< 0.1	ug/L							
Aroclor 1221	< 0.1	ug/L							
Aroclor 1232	< 0.1	ug/L							
Aroclor 1242	< 0.1	ug/L							
Aroclor 1248	< 0.1	ug/L							
Aroclor 1254	< 0.1	ug/L							
Aroclor 1260	< 0.1	ug/L							
Aroclors - Total	< 0.1	ug/L							
Surrogate: TCMX	*0.16*	*ug/L*		*0.2000*		*80*	*41-135*		
Surrogate: Decachlorobiphenyl	*0.18*	*ug/L*		*0.2000*		*88*	*36-148*		
LCS (B518864-BS1)				Prepared & Analyzed: 11/09/15					
Aroclor 1016	3	ug/L		5.000		68	43.1-112		
Aroclor 1260	3	ug/L		5.000		58	44.6-107		
Surrogate: TCMX	*0.15*	*ug/L*		*0.2000*		*73*	*41-135*		
Surrogate: Decachlorobiphenyl	*0.16*	*ug/L*		*0.2000*		*80*	*36-148*		
Matrix Spike (B518864-MS1)	**Sample: 5111254-04**			Prepared: 11/09/15 Analyzed: 11/10/15					
Aroclor 1016	4	ug/L	Q1	5.000	ND	71	77.2-124		
Aroclor 1260	3	ug/L		5.000	ND	61	52.6-137		
Surrogate: TCMX	*0.15*	*ug/L*		*0.2000*		*76*	*41-135*		
Surrogate: Decachlorobiphenyl	*0.18*	*ug/L*		*0.2000*		*88*	*36-148*		
Batch B518865 - 04 SW 3510 (625/8270) - SW 8270C									
Blank (B518865-BLK1)				Prepared: 11/12/15 Analyzed: 11/13/15					
Naphthalene	< 0.03	ug/L							
Acenaphthylene	< 0.03	ug/L							
Acenaphthene	< 0.03	ug/L							
Fluorene	< 0.04	ug/L							
Phenanthrene	< 0.04	ug/L							
Anthracene	< 0.03	ug/L							
Fluoranthene	< 0.05	ug/L							
Pyrene	< 0.04	ug/L							
Benzo(a)anthracene	< 0.05	ug/L							
Chrysene	< 0.03	ug/L							
Benzo(b)fluoranthene	< 0.08	ug/L							
Benzo(k)fluoranthene	< 0.10	ug/L							
Benzo(a)pyrene	< 0.04	ug/L							
Indeno(1,2,3-cd)pyrene	< 0.04	ug/L							
Dibenzo(a,h)anthracene	< 0.04	ug/L							
Benzo(g,h,i)perylene	< 0.04	ug/L							
Surrogate: Nitrobenzene-d5	*45*	*ug/L*		*80.00*		*57*	*18.5-97.5*		
Surrogate: 2-Fluorobiphenyl	*41*	*ug/L*		*80.00*		*52*	*13.9-97.2*		
Surrogate: p-Terphenyl-d14	*48*	*ug/L*		*80.00*		*59*	*17.5-104*		
LCS (B518865-BS1)				Prepared & Analyzed: 11/12/15					
Naphthalene	48.1	ug/L		80.00		60	51-87.6		
Acenaphthylene	45.9	ug/L		80.00		57	46.5-86.8		

QC SAMPLE RESULTS

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch B518865 - 04 SW 3510 (625/8270) - SW 8270C									
LCS (B518865-BS1)				Prepared & Analyzed: 11/12/15					
Acenaphthene	49.7	ug/L		80.00		62	49.1-89.7		
Fluorene	45.5	ug/L		80.00		57	53.5-88.1		
Phenanthrene	48.1	ug/L		80.00		60	50.4-94.4		
Anthracene	47.8	ug/L		80.00		60	49.6-92.1		
Fluoranthene	43.3	ug/L		80.00		54	49-93.6		
Pyrene	42.6	ug/L		80.00		53	44.5-88.4		
Benzo(a)anthracene	41.2	ug/L		80.00		51	43.8-90.5		
Chrysene	46.4	ug/L		80.00		58	46.5-92.3		
Benzo(b)fluoranthene	47.2	ug/L		80.00		59	50.4-93.5		
Benzo(k)fluoranthene	44.9	ug/L		80.00		56	50.2-91.1		
Benzo(a)pyrene	49.0	ug/L		80.00		61	50.6-89.8		
Indeno(1,2,3-cd)pyrene	49.3	ug/L		80.00		62	46-90.3		
Dibenzo(a,h)anthracene	46.1	ug/L		80.00		58	46.1-91.3		
Benzo(g,h,i)perylene	46.6	ug/L		80.00		58	36.7-107		
Surrogate: Nitrobenzene-d5	*43*	*ug/L*		*80.00*		*53*	*18.5-97.5*		
Surrogate: 2-Fluorobiphenyl	*40*	*ug/L*		*80.00*		*50*	*13.9-97.2*		
Surrogate: p-Terphenyl-d14	*40*	*ug/L*		*80.00*		*50*	*17.5-104*		
Matrix Spike (B518865-MS1)	**Sample: 5111254-06**			Prepared: 11/12/15 Analyzed: 11/14/15					
Naphthalene	45.4	ug/L		80.00	0.16	57	25.5-91.4		
Acenaphthylene	42.3	ug/L		80.00	ND	53	20-91.3		
Acenaphthene	46.1	ug/L		80.00	ND	58	22.1-95.9		
Fluorene	42.9	ug/L		80.00	ND	54	21.9-97.6		
Phenanthrene	44.4	ug/L		80.00	ND	56	27.7-96.7		
Anthracene	43.7	ug/L		80.00	ND	55	23.5-95.9		
Fluoranthene	39.9	ug/L		80.00	ND	50	24.8-97.1		
Pyrene	38.7	ug/L		80.00	ND	48	25.5-92.4		
Benzo(a)anthracene	37.0	ug/L		80.00	ND	46	25.1-92		
Chrysene	42.1	ug/L		80.00	ND	53	27-95.1		
Benzo(b)fluoranthene	45.5	ug/L		80.00	ND	57	28-100		
Benzo(k)fluoranthene	42.2	ug/L		80.00	ND	53	21.1-98.1		
Benzo(a)pyrene	44.3	ug/L		80.00	ND	55	16.9-98.8		
Indeno(1,2,3-cd)pyrene	47.8	ug/L		80.00	ND	60	25-92.2		
Dibenzo(a,h)anthracene	44.3	ug/L		80.00	ND	55	27.2-91.2		
Benzo(g,h,i)perylene	45.4	ug/L		80.00	ND	57	13.6-110		
Surrogate: Nitrobenzene-d5	*42*	*ug/L*		*80.00*		*52*	*18.5-97.5*		
Surrogate: 2-Fluorobiphenyl	*40*	*ug/L*		*80.00*		*50*	*13.9-97.2*		
Surrogate: p-Terphenyl-d14	*38*	*ug/L*		*80.00*		*48*	*17.5-104*		
Batch B518889 - 04-No Prep WC - SM 2540D									
Blank (B518889-BLK1)				Prepared & Analyzed: 11/09/15					
Solids - total suspended solids (TSS)	< 0.10	mg/L							
LCS (B518889-BS1)				Prepared & Analyzed: 11/09/15					
Solids - total suspended solids (TSS)	98.0	mg/L		100.0		98	82.9-110		
Duplicate (B518889-DUP1)	**Sample: 5111254-01**			Prepared & Analyzed: 11/09/15					
Solids - total suspended solids (TSS)	276	mg/L			282			2	5

QC SAMPLE RESULTS

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch B518889 - 04-No Prep WC - SM 2540D									
Duplicate (B518889-DUP2)	**Sample: 5111254-02**			Prepared & Analyzed: 11/09/15					
Solids - total suspended solids (TSS)	208	mg/L			202			3	5
Batch B518945 - 04-No Prep WC - SM 2540D									
Blank (B518945-BLK1)				Prepared & Analyzed: 11/10/15					
Solids - total suspended solids (TSS)	0.400	mg/L	J						
LCS (B518945-BS1)				Prepared & Analyzed: 11/10/15					
Solids - total suspended solids (TSS)	99.0	mg/L		100.0		99	82.9-110		
Duplicate (B518945-DUP1)	**Sample: 5111254-05**			Prepared & Analyzed: 11/10/15					
Solids - total suspended solids (TSS)	0.641	mg/L	J		1.20			61	5
Duplicate (B518945-DUP2)	**Sample: 5111278-01**			Prepared & Analyzed: 11/10/15					
Solids - total suspended solids (TSS)	1710	mg/L			1710			0	5
Batch B519147 - SW 3015 - SW 6020									
Blank (B519147-BLK1)				Prepared: 11/12/15 Analyzed: 11/13/15					
Antimony	< 0.036	ug/L							
Arsenic	< 0.13	ug/L							
Beryllium	< 0.017	ug/L							
Cadmium	< 0.042	ug/L							
Chromium	< 0.27	ug/L							
Copper	< 0.025	ug/L							
Lead	< 0.025	ug/L							
Nickel	< 0.075	ug/L							
Selenium	< 0.32	ug/L							
Silver	< 0.028	ug/L							
Thallium	< 0.062	ug/L							
Zinc	< 0.50	ug/L							
LCS (B519147-BS1)				Prepared: 11/12/15 Analyzed: 11/13/15					
Antimony	517	ug/L		555.6		93	80-120		
Arsenic	564	ug/L		555.6		102	80-120		
Beryllium	563	ug/L		555.6		101	80-120		
Cadmium	586	ug/L		555.6		106	80-120		
Chromium	584	ug/L		555.6		105	80-120		
Copper	584	ug/L		555.6		105	80-120		
Lead	574	ug/L		555.6		103	80-120		
Nickel	585	ug/L		555.6		105	80-120		
Selenium	595	ug/L		555.6		107	80-120		
Silver	583	ug/L		555.6		105	80-120		
Thallium	537	ug/L		555.6		97	80-120		
Zinc	581	ug/L		555.6		105	80-120		
Matrix Spike (B519147-MS1)	**Sample: 5111753-02**			Prepared: 11/12/15 Analyzed: 11/13/15					
Antimony	570	ug/L		555.6	0.143	103	75-125		
Arsenic	636	ug/L		555.6	4.34	114	75-125		
Beryllium	637	ug/L		555.6	ND	115	75-125		
Cadmium	567	ug/L		555.6	ND	102	75-125		
Chromium	641	ug/L		555.6	0.768	115	75-125		

QC SAMPLE RESULTS

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch B519147 - SW 3015 - SW 6020									
Matrix Spike (B519147-MS1)	**Sample: 5111753-02**			Prepared: 11/12/15 Analyzed: 11/16/15					
Copper	591	ug/L		555.6	0.613	106	75-125		
Lead	502	ug/L		555.6	0.232	90	75-125		
Nickel	626	ug/L		555.6	11.5	111	75-125		
Selenium	652	ug/L		555.6	1.12	117	75-125		
Silver	603	ug/L		555.6	ND	109	75-125		
Thallium	< 0.062	ug/L			ND		75-125		
Zinc	595	ug/L		555.6	7.14	106	75-125		
Matrix Spike Dup (B519147-MSD1)	**Sample: 5111753-02**			Prepared: 11/12/15 Analyzed: 11/13/15					
Antimony	595	ug/L		555.6	0.143	107	75-125	4	20
Arsenic	649	ug/L		555.6	4.34	116	75-125	2	20
Beryllium	639	ug/L		555.6	ND	115	75-125	0.2	20
Cadmium	579	ug/L		555.6	ND	104	75-125	2	20
Chromium	659	ug/L		555.6	0.768	118	75-125	3	20
Copper	606	ug/L		555.6	0.613	109	75-125	3	20
Lead	517	ug/L		555.6	0.232	93	75-125	3	20
Nickel	640	ug/L		555.6	11.5	113	75-125	2	20
Selenium	657	ug/L		555.6	1.12	118	75-125	0.8	20
Silver	632	ug/L		555.6	ND	114	75-125	5	20
Thallium	< 0.062	ug/L			ND		75-125		20
Zinc	608	ug/L		555.6	7.14	108	75-125	2	20
Batch B519368 - 04-SW 7470A/245.1 - SW 7470									
Blank (B519368-BLK1)				Prepared & Analyzed: 11/17/15					
Mercury	< 0.2	ug/L							
LCS (B519368-BS1)				Prepared & Analyzed: 11/17/15					
Mercury	2.15	ug/L		2.000		108	85-115		
Matrix Spike (B519368-MS1)	**Sample: 5111254-03**			Prepared & Analyzed: 11/17/15					
Mercury	< 0.2	ug/L	NA, Q4, R	2.000	117	NR	50-150		
Matrix Spike (B519368-MS2)	**Sample: 5111652-01**			Prepared & Analyzed: 11/17/15					
Mercury	20.8	ug/L		20.00	ND	104	50-150		
Matrix Spike Dup (B519368-MSD1)	**Sample: 5111254-03**			Prepared & Analyzed: 11/17/15					
Mercury	< 0.2	ug/L	NA, Q4, R	2.000	117	NR	50-150		20
Matrix Spike Dup (B519368-MSD2)	**Sample: 5111652-01**			Prepared & Analyzed: 11/17/15					
Mercury	20.6	ug/L		20.00	ND	103	50-150	1	20

NOTES

Specific method revisions used for analysis are available upon request.

Certifications

PIA - Peoria, IL
- TNI Accreditation for Drinking Water, Wastewater, Hazardous and Solid Wastes Fields of Testing through IL EPA Lab No. 100230
- Illinois Department of Public Health Bacteriological Analysis in Drinking Water Approved Laboratory Registry No. 17553
- Missouri Department of Natural Resources Certificate of Approval for Microbiological Laboratory Service No. 870
- Drinking Water Certifications: Iowa (240); Kansas (E-10338); Missouri (870)
- Wastewater Certifications: Arkansas (88-0677); Iowa (240); Kansas (E-10338)
- Hazardous/Solid Waste Certifications: Arkansas (88-0677); Iowa (240); Kansas (E-10338)

SPMO - Springfield, MO
- USEPA DMR-QA Program

STL - St. Louis, MO
- TNI Accreditation for Wastewater, Hazardous and Solid Wastes Fields of Testing through KS Lab No. E-10389
- Illinois Department of Public Health Bacteriological Analysis in Drinking Water Approved Laboratory Registry No. 171050
- Drinking Water Certifications: Missouri (1050)
- Missouri Department of Natural Resources

* Not a TNI accredited analyte

Qualifiers

J	Estimated value; value between the Method Detection Limit and Method Reporting Limit.
NA	Not Analyzed.
Q1	Matrix Spike failed % Recovery
Q4	The matrix spike recovery result is unusable since the analyte concentration in the sample is greater than four times the spike level. The associated blank spike was acceptable.
R	Matrix Spike/Matrix Spike Duplicate Failed %Relative Percent Difference

Roxann Shull

Certified by: Roxann Shull, Client Services Supervisor

PDC Laboratories, Inc. – St. Louis
3278 N. Highway 67 (Lindbergh)
Florissant, MO 63033
www.pdclab.com

CHAIN OF CUSTODY RECORD

Phone (314) 432-0550 or (314) 921-4488
Fax (314) 432-4977

State where samples collected MA

(Instructions/Sample Acceptance Policy on Reverse)

ALL SHADED AREAS MUST BE COMPLETED BY CLIENT (PLEASE PRINT)

① CLIENT: TETRA TECH
ADDRESS: 1634 EASTPORT PLAZA DR.
CITY STATE ZIP: Collinsville, IL
CONTACT PERSON: P. SMITH

PROJECT NUMBER: T35103
P.O. NUMBER:
MEANS SHIPPED:
PHONE NUMBER:
FAX NUMBER:
EMAIL ADDRESS:
SAMPLER: P. SMITH
SAMPLER'S SIGNATURE: P. Smith

MATRIX TYPES:
WW-WASTEWATER
DW-DRINKING WATER
GW-GROUND WATER
WWSL-SLUDGE
NAS-SOLID
L'CHT-LEACHATE
NAL-NONAQUEOUS
SOIL-SOILS

④ (FOR LAB USE ONLY)
LOGIN # 511254
LOGGED BY: HE
LAB PROJ. #
TEMPLATE:
PROJ. MGR.:

② SAMPLE DESCRIPTION AS YOU WANT ON REPORT	DATE COLLECTED	TIME COLLECTED	SAMPLE TYPE GRAB	SAMPLE TYPE COMP	MATRIX TYPE	Bottle Count	③ ANALYSIS REQUESTED PAHs	PCBs	METALS	TSS				REMARKS
ECCS-1H-1.0%	11/5/2015	1300	✓	~~✓~~	WAT	5	X	X	X	X				SEE EMAIL
ECCS-1H-0.5%	↓	1305	✓	~~✓~~	WAT	5	X	X	X	X				"NEW TREATABILITY
ECCS-1H-0.1%	↓	1310	✓	~~✓~~	WAT	5	X	X	X	X				STUDY", 11/28/2015
ECCS-1H-1.0%F	↓	1320	✓	~~✓~~	WAT	5	X	X	X	X				FOR PROJECT
ECCS-1H-0.5%F	↓	1325	✓	~~✓~~	WAT	5	X	X	X	X				DETAILS &
ECCS-1H-0.1%F	↓	1330	✓	~~✓~~ PJS 11/5/2015	WAT	5	X	X	X	X				SPECIFICATIONS

PJS 11/5/2015

⑤ TURNAROUND TIME (RUSH TAT IS SUBJECT TO PDC LABS APPROVAL AND SURCHARGE)
[✓ NORMAL (8-10 Bus. Days)] RUSH (5 Bus. Days) *Fastrak*™ (3 Bus. Days) 1-2 Bus. Days Same Day
DATE DUE ______
RESULTS BY: [✓ E-MAIL] FAX PHONE CALL PHONE/FAX# IF DIFFERENT FROM ABOVE

⑥ The sample temperature will be measured upon receipt at the lab. By initialing this area, you request that the lab notify you, before proceeding with analysis, if the sample temperature is outside of the range of 0.1-6.0°C. By not initialing this area, you allow the lab to proceed with analytical testing regardless of the sample temperature. ______

⑦ RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY:	DATE	TIME
P. Smith	11/5/2015	1413		11/6/15	14:15
RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY:	DATE	TIME
RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY:	DATE	TIME
RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY:	DATE	TIME

⑧ COMMENTS: (FOR LAB USE ONLY)

SAMPLE TEMPERATURE UPON RECEIPT 18.7 °C
CHILL PROCESS STARTED PRIOR TO RECEIPT [✓ Y] OR N
SAMPLES(S) RECEIVED ON ICE [✓ Y] OR N
PROPER BOTTLES RECEIVED IN GOOD CONDITION [✓ Y] OR N
BOTTLES FILLED WITH ADEQUATE VOLUME [✓ Y] OR N
SAMPLES RECEIVED WITHIN HOLD TIME(S) (EXCLUDES TYPICAL FIELD PARAMETERS) [✓ Y] OR N
DATE AND TME TAKEN FROM SAMPLE BOTTLE ______

Thank you for using PDC Laboratories, Inc. Locations in Peoria, IL; St. Louis, MO; and Springfield, MO

PAGE 1 OF 1

SUBCONTRACT ORDER

Transfer Chain of Custody

PDC Laboratories, Inc.

5111254

SENDING LABORATORY:

PDC Laboratories, Inc.
3278 N Highway 67
Florissant, MO 63033
(800) 333-3278

RECEIVING LABORATORY:

PDC Laboratories, Inc.
2231 W Altorfer Dr
Peoria, IL 61615
(309) 692-9688

Sample: 5111254-01
Name: ECCS-1H-1.0%

Sampled: 11/05/15 13:00
Matrix: Water

Analysis	Due	Expires	Comments
Ag 6020 Tot	11/17/15 16:00	05/03/16 13:00	ALL 6020 METALS REPORT TO MDL
As 6020 Tot	11/17/15 16:00	05/03/16 13:00	
Be 6020 Tot	11/17/15 16:00	05/03/16 13:00	
Cd 6020 Tot	11/17/15 16:00	05/03/16 13:00	
Cr 6020 Tot	11/17/15 16:00	05/03/16 13:00	
Cu 6020 Tot	11/17/15 16:00	05/03/16 13:00	
Ni 6020 Tot	11/17/15 16:00	05/03/16 13:00	
Pb 6020 Tot	11/17/15 16:00	05/03/16 13:00	
Sb 6020 Tot	11/17/15 16:00	05/03/16 13:00	
Se 6020 Tot	11/17/15 16:00	05/03/16 13:00	
Tl 6020 Tot	11/17/15 16:00	05/03/16 13:00	
Zn 6020 Tot	11/17/15 16:00	05/03/16 13:00	

SUBCONTRACT ORDER
Transfer Chain of Custody

PDC Laboratories, Inc

5111254

SENDING LABORATORY

PDC Laboratories, Inc.
3278 N Highway 67
Florissant, MO 63033
(800) 333-3278

RECEIVING LABORATORY

PDC Laboratories, Inc.
2231 W Altorfer Dr
Peoria, IL 61615
(309) 692-9688

Sample: 5111254-02
Name: ECCS-1H-0.5%

Sampled: 11/05/15 13:05
Matrix: Water

Analysis	Due	Expires	Comments
Ag 6020 Tot	11/17/15 16:00	05/03/16 13:05	ALL 6020 METALS REPORT TO MDL
As 6020 Tot	11/17/15 16:00	05/03/16 13:05	
Be 6020 Tot	11/17/15 16:00	05/03/16 13:05	
Cd 6020 Tot	11/17/15 16:00	05/03/16 13:05	
Cr 6020 Tot	11/17/15 16:00	05/03/16 13:05	
Cu 6020 Tot	11/17/15 16:00	05/03/16 13:05	
Ni 6020 Tot	11/17/15 16:00	05/03/16 13:05	
Pb 6020 Tot	11/17/15 16:00	05/03/16 13:05	
Sb 6020 Tot	11/17/15 16:00	05/03/16 13:05	
Se 6020 Tot	11/17/15 16:00	05/03/16 13:05	
Tl 6020 Tot	11/17/15 16:00	05/03/16 13:05	
Zn 6020 Tot	11/17/15 16:00	05/03/16 13:05	

SUBCONTRACT ORDER

Transfer Chain of Custody

PDC Laboratories, Inc.

5111254

SENDING LABORATORY

PDC Laboratories, Inc.
3278 N Highway 67
Florissant, MO 63033
(800) 333-3278

RECEIVING LABORATORY

PDC Laboratories, Inc.
2231 W Altorfer Dr
Peoria, IL 61615
(309) 692-9688

Sample: 5111254-03
Name: ECCS-1H-0.1%

Sampled: 11/05/15 13:10
Matrix: Water

Analysis	Due	Expires	Comments
Ag 6020 Tot	11/17/15 16:00	05/03/16 13:10	ALL 6020 METALS REPORT TO MDL
As 6020 Tot	11/17/15 16:00	05/03/16 13:10	
Be 6020 Tot	11/17/15 16:00	05/03/16 13:10	
Cd 6020 Tot	11/17/15 16:00	05/03/16 13:10	
Cr 6020 Tot	11/17/15 16:00	05/03/16 13:10	
Cu 6020 Tot	11/17/15 16:00	05/03/16 13:10	
Ni 6020 Tot	11/17/15 16:00	05/03/16 13:10	
Pb 6020 Tot	11/17/15 16:00	05/03/16 13:10	
Sb 6020 Tot	11/17/15 16:00	05/03/16 13:10	
Se 6020 Tot	11/17/15 16:00	05/03/16 13:10	
Tl 6020 Tot	11/17/15 16:00	05/03/16 13:10	
Zn 6020 Tot	11/17/15 16:00	05/03/16 13:10	

SUBCONTRACT ORDER
Transfer Chain of Custody

PDC Laboratories, Inc.

5111254

SENDING LABORATORY

PDC Laboratories, Inc.
3278 N Highway 67
Florissant, MO 63033
(800) 333-3278

RECEIVING LABORATORY

PDC Laboratories, Inc.
2231 W Altorfer Dr
Peoria, IL 61615
(309) 692-9688

Sample: 5111254-04
Name: ECCS-1H-1.0%F

Sampled: 11/05/15 13:20
Matrix: Water

Analysis	Due	Expires	Comments
Ag 6020 Tot	11/17/15 16:00	05/03/16 13:20	ALL 6020 METALS REPORT TO MDL
As 6020 Tot	11/17/15 16:00	05/03/16 13:20	
Be 6020 Tot	11/17/15 16:00	05/03/16 13:20	
Cd 6020 Tot	11/17/15 16:00	05/03/16 13:20	
Cr 6020 Tot	11/17/15 16:00	05/03/16 13:20	
Cu 6020 Tot	11/17/15 16:00	05/03/16 13:20	
Ni 6020 Tot	11/17/15 16:00	05/03/16 13:20	
Pb 6020 Tot	11/17/15 16:00	05/03/16 13:20	
Sb 6020 Tot	11/17/15 16:00	05/03/16 13:20	
Se 6020 Tot	11/17/15 16:00	05/03/16 13:20	
Tl 6020 Tot	11/17/15 16:00	05/03/16 13:20	
Zn 6020 Tot	11/17/15 16:00	05/03/16 13:20	

SUBCONTRACT ORDER
Transfer Chain of Custody

PDC Laboratories, Inc.

5111254

SENDING LABORATORY

PDC Laboratories, Inc.
3278 N Highway 67
Florissant, MO 63033
(800) 333-3278

RECEIVING LABORATORY

PDC Laboratories, Inc.
2231 W Altorfer Dr
Peoria, IL 61615
(309) 692-9688

Sample: **5111254-05**
Name: ECCS-1H-0.5%F

Sampled: 11/05/15 13:25
Matrix: Water

Analysis	Due	Expires	Comments
Ag 6020 Tot	11/17/15 16:00	05/03/16 13:25	ALL 6020 METALS REPORT TO MDL
As 6020 Tot	11/17/15 16:00	05/03/16 13:25	
Be 6020 Tot	11/17/15 16:00	05/03/16 13:25	
Cd 6020 Tot	11/17/15 16:00	05/03/16 13:25	
Cr 6020 Tot	11/17/15 16:00	05/03/16 13:25	
Cu 6020 Tot	11/17/15 16:00	05/03/16 13:25	
Ni 6020 Tot	11/17/15 16:00	05/03/16 13:25	
Pb 6020 Tot	11/17/15 16:00	05/03/16 13:25	
Sb 6020 Tot	11/17/15 16:00	05/03/16 13:25	
Se 6020 Tot	11/17/15 16:00	05/03/16 13:25	
Tl 6020 Tot	11/17/15 16:00	05/03/16 13:25	
Zn 6020 Tot	11/17/15 16:00	05/03/16 13:25	

SUBCONTRACT ORDER
Transfer Chain of Custody

PDC Laboratories, Inc.

5111254

SENDING LABORATORY

PDC Laboratories, Inc.
3278 N Highway 67
Florissant, MO 63033
(800) 333-3278

RECEIVING LABORATORY

PDC Laboratories, Inc.
2231 W Altorfer Dr
Peoria, IL 61615
(309) 692-9688

Sample: 5111254-06
Name: ECCS-1H-0.1%F

Sampled: 11/05/15 13:30
Matrix: Water

Analysis	Due	Expires	Comments
Ag 6020 Tot	11/17/15 16:00	05/03/16 13:30	ALL 6020 METALS REPORT TO MDL
As 6020 Tot	11/17/15 16:00	05/03/16 13:30	
Be 6020 Tot	11/17/15 16:00	05/03/16 13:30	
Cd 6020 Tot	11/17/15 16:00	05/03/16 13:30	
Cr 6020 Tot	11/17/15 16:00	05/03/16 13:30	
Cu 6020 Tot	11/17/15 16:00	05/03/16 13:30	
Ni 6020 Tot	11/17/15 16:00	05/03/16 13:30	
Pb 6020 Tot	11/17/15 16:00	05/03/16 13:30	
Sb 6020 Tot	11/17/15 16:00	05/03/16 13:30	
Se 6020 Tot	11/17/15 16:00	05/03/16 13:30	
Tl 6020 Tot	11/17/15 16:00	05/03/16 13:30	
Zn 6020 Tot	11/17/15 16:00	05/03/16 13:30	

Please email results to Roxann Shull at rshull@pdclab.com

Date Shipped: 11/9/15 Total # of Containers: 6 Sample Origin (State): _____ PO #: ____________

Turn-Around Time Requested ☑ NORMAL ☐ RUSH Date Results Needed: ______________

Relinquished By	Date/Time	Received By	Date/Time
Heather Carlat	11/9/15		
			11/10/15 1010

Sample Temperature Upon Receipt 5 °C
Sample(s) Received on Ice [✓ Y] or N
Proper Bottles Received in Good Condition [✓ Y] or N
Bottles Filled with Adequate Volume [✓ Y] or N
Samples Received Within Hold Time [✓ Y] or N
Date/Time Taken From Sample Bottle Y or [✓ N]

Appendix F

Surface Water Characterization Data

PDC Laboratories, Inc.

PROFESSIONAL ŁDEPENDABLE ŁCOMMITTED

November 17, 2015

Paul Smith
TETRA TECH
1634 Eport Plaza Dr
Collinsville, IL 62234

Dear Paul Smith:

Please find enclosed the analytical results for the sample(s) the laboratory received on **11/3/15 3:10 pm** and logged in under work order **5110421**. All testing is performed according to our current TNI certifications unless otherwise noted. This report cannot be reproduced, except in full, without the written permission of PDC Laboratories, Inc.

If you have any questions regarding your report, please contact your project manager. Quality and timely data is of the utmost importance to us.

PDC Laboratories, Inc. appreciates the opportunity to provide you with analytical expertise. We are always trying to improve our customer service and we welcome you to contact the Vice President , John LaPayne with any feedback you have about your experience with our laboratory.

Sincerely,

Roxann Shull

Roxann Shull
Client Services Supervisor
(314) 432-0550
rshull@pdclab.com

ANALYTICAL RESULTS

Sample: **5110421-01**
Name: SW-COMP
Matrix: Ground Water

Sampled: 11/03/15 14:00
Received: 11/03/15 15:10
PO #: 2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
General Chemistry - STL								
Solids - total suspended solids (TSS)	21	mg/L		0.10	2.0	11/05/15 10:30	KLA	SM 2540D
Polychlorinated Biphenyls (PCBs) - STL								
Aroclor 1016	< 0.1	ug/L		0.1	0.5	11/07/15 20:08	BP	SW 8082*
Aroclor 1221	< 0.1	ug/L		0.1	0.5	11/07/15 20:08	BP	SW 8082*
Aroclor 1232	< 0.1	ug/L		0.1	0.5	11/07/15 20:08	BP	SW 8082*
Aroclor 1242	< 0.1	ug/L		0.1	0.5	11/07/15 20:08	BP	SW 8082*
Aroclor 1248	< 0.1	ug/L		0.1	0.5	11/07/15 20:08	BP	SW 8082*
Aroclor 1254	< 0.1	ug/L		0.1	0.5	11/07/15 20:08	BP	SW 8082*
Aroclor 1260	< 0.1	ug/L		0.1	0.5	11/07/15 20:08	BP	SW 8082*
Aroclors - Total	< 0.1	ug/L		0.1	0.5	11/07/15 20:08	BP	SW 8082*
Surrogate: TCMX	*91 %*	*41-135*				*11/07/15 20:08*	*BP*	*SW 8082**
Surrogate: Decachlorobiphenyl	*101 %*	*36-148*				*11/07/15 20:08*	*BP*	*SW 8082**
Semivolatile Organics - SIM - STL								
Naphthalene	0.22	ug/L		0.03	0.10	11/16/15 22:07	BP	SW 8270C
Acenaphthylene	< 0.03	ug/L		0.03	0.10	11/16/15 22:07	BP	SW 8270C
Acenaphthene	< 0.03	ug/L		0.03	0.10	11/16/15 22:07	BP	SW 8270C
Fluorene	< 0.04	ug/L		0.04	0.10	11/16/15 22:07	BP	SW 8270C
Phenanthrene	< 0.04	ug/L		0.04	0.10	11/16/15 22:07	BP	SW 8270C
Anthracene	< 0.03	ug/L		0.03	0.10	11/16/15 22:07	BP	SW 8270C
Fluoranthene	0.06	ug/L	J	0.05	0.10	11/16/15 22:07	BP	SW 8270C
Pyrene	< 0.04	ug/L		0.04	0.10	11/16/15 22:07	BP	SW 8270C
Benzo(a)anthracene	< 0.05	ug/L		0.05	0.10	11/16/15 22:07	BP	SW 8270C
Chrysene	< 0.03	ug/L		0.03	0.10	11/16/15 22:07	BP	SW 8270C
Benzo(b)fluoranthene	< 0.08	ug/L		0.08	0.10	11/16/15 22:07	BP	SW 8270C
Benzo(k)fluoranthene	< 0.10	ug/L		0.10	0.10	11/16/15 22:07	BP	SW 8270C
Benzo(a)pyrene	< 0.04	ug/L		0.04	0.10	11/16/15 22:07	BP	SW 8270C
Indeno(1,2,3-cd)pyrene	< 0.04	ug/L		0.04	0.10	11/16/15 22:07	BP	SW 8270C
Dibenzo(a,h)anthracene	< 0.04	ug/L		0.04	0.10	11/16/15 22:07	BP	SW 8270C
Benzo(g,h,i)perylene	< 0.04	ug/L		0.04	0.10	11/16/15 22:07	BP	SW 8270C
Total Metals - PIA								
Antimony	0.51	ug/L	J	0.036	3.0	11/12/15 11:04	JMW	SW 6020
Arsenic	0.69	ug/L	J	0.13	1.0	11/12/15 11:04	JMW	SW 6020
Beryllium	0.26	ug/L	J	0.017	1.0	11/12/15 11:04	JMW	SW 6020
Cadmium	0.22	ug/L	J	0.042	1.0	11/12/15 11:04	JMW	SW 6020
Chromium	1.1	ug/L	J	0.27	4.0	11/12/15 11:04	JMW	SW 6020
Copper	2.8	ug/L	J	0.025	3.0	11/12/15 11:04	JMW	SW 6020
Lead	3.1	ug/L		0.025	1.0	11/12/15 11:04	JMW	SW 6020
Nickel	3.0	ug/L	J	0.075	5.0	11/12/15 11:04	JMW	SW 6020
Selenium	0.76	ug/L	J	0.32	1.0	11/12/15 11:04	JMW	SW 6020

ANALYTICAL RESULTS

Sample:	**5110421-01**	**Sampled:**	11/03/15 14:00
Name:	SW-COMP	**Received:**	11/03/15 15:10
Matrix:	Ground Water	**PO #:**	2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
Silver	0.55	ug/L	J	0.028	5.0	11/12/15 11:04	JMW	SW 6020
Thallium	< 0.062	ug/L		0.062	1.0	11/12/15 11:04	JMW	SW 6020
Zinc	12	ug/L		0.50	6.0	11/12/15 11:04	JMW	SW 6020
Total Metals - STL								
Mercury	0.4	ug/L		0.2	0.2	11/05/15 11:47	WPS	SW 7470

QC SAMPLE RESULTS

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch B518636 - 04-SW 7470A/245.1 - SW 7470									
Blank (B518636-BLK1)				Prepared & Analyzed: 11/05/15					
Mercury	< 0.2	ug/L							
LCS (B518636-BS1)				Prepared & Analyzed: 11/05/15					
Mercury	1.96	ug/L		2.000		98	85-115		
Matrix Spike (B518636-MS1)	**Sample: 5104336-01**			Prepared & Analyzed: 11/05/15					
Mercury	21.0	ug/L		20.00	ND	105	50-150		
Matrix Spike (B518636-MS2)	**Sample: 5104336-06**			Prepared & Analyzed: 11/05/15					
Mercury	19.9	ug/L		20.00	ND	100	50-150		
Matrix Spike Dup (B518636-MSD1)	**Sample: 5104336-01**			Prepared & Analyzed: 11/05/15					
Mercury	21.2	ug/L		20.00	ND	106	50-150	0.9	20
Matrix Spike Dup (B518636-MSD2)	**Sample: 5104336-06**			Prepared & Analyzed: 11/05/15					
Mercury	20.4	ug/L		20.00	ND	102	50-150	2	20
Batch B518654 - 04-No Prep WC - SM 2540D									
Blank (B518654-BLK1)				Prepared & Analyzed: 11/05/15					
Solids - total suspended solids (TSS)	< 0.10	mg/L							
LCS (B518654-BS1)				Prepared & Analyzed: 11/05/15					
Solids - total suspended solids (TSS)	99.0	mg/L		100.0		99	82.9-110		
Duplicate (B518654-DUP1)	**Sample: 5110622-01**			Prepared & Analyzed: 11/05/15					
Solids - total suspended solids (TSS)	4.40	mg/L			4.40			0	5
Duplicate (B518654-DUP2)	**Sample: 5110648-02**			Prepared & Analyzed: 11/05/15					
Solids - total suspended solids (TSS)	2430	mg/L			2450			1	5
Batch B518691 - 04 SW 3510 (625/8270) - SW 8270C									
Blank (B518691-BLK1)				Prepared: 11/10/15 Analyzed: 11/16/15					
Naphthalene	< 0.03	ug/L							
Acenaphthylene	< 0.03	ug/L							
Acenaphthene	< 0.03	ug/L							
Fluorene	< 0.04	ug/L							
Phenanthrene	< 0.04	ug/L							
Anthracene	< 0.03	ug/L							
Fluoranthene	< 0.05	ug/L							
Pyrene	< 0.04	ug/L							
Benzo(a)anthracene	< 0.05	ug/L							
Chrysene	< 0.03	ug/L							
Benzo(b)fluoranthene	< 0.08	ug/L							
Benzo(k)fluoranthene	< 0.10	ug/L							
Benzo(a)pyrene	< 0.04	ug/L							
Indeno(1,2,3-cd)pyrene	< 0.04	ug/L							
Dibenzo(a,h)anthracene	< 0.04	ug/L							
Benzo(g,h,i)perylene	< 0.04	ug/L							
Surrogate: Nitrobenzene-d5	*93*	*ug/L*		*160.0*		*58*	*18.5-97.5*		
Surrogate: 2-Fluorobiphenyl	*91*	*ug/L*		*160.0*		*57*	*13.9-97.2*		
Surrogate: p-Terphenyl-d14	*110*	*ug/L*		*160.0*		*69*	*17.5-104*		
LCS (B518691-BS1)				Prepared & Analyzed: 11/10/15					
Naphthalene	52.0	ug/L		80.00		65	51-87.6		

QC SAMPLE RESULTS

Batch B518691 - 04 SW 3510 (625/8270) - SW 8270C

LCS (B518691-BS1) Prepared & Analyzed: 11/10/15

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Acenaphthylene	47.1	ug/L		80.00		59	46.5-86.8		
Acenaphthene	51.9	ug/L		80.00		65	49.1-89.7		
Fluorene	48.8	ug/L		80.00		61	53.5-88.1		
Phenanthrene	52.2	ug/L		80.00		65	50.4-94.4		
Anthracene	51.4	ug/L		80.00		64	49.6-92.1		
Fluoranthene	46.7	ug/L		80.00		58	49-93.6		
Pyrene	47.5	ug/L		80.00		59	44.5-88.4		
Benzo(a)anthracene	44.8	ug/L		80.00		56	43.8-90.5		
Chrysene	51.4	ug/L		80.00		64	46.5-92.3		
Benzo(b)fluoranthene	54.9	ug/L		80.00		69	50.4-93.5		
Benzo(k)fluoranthene	49.4	ug/L		80.00		62	50.2-91.1		
Benzo(a)pyrene	52.9	ug/L		80.00		66	50.6-89.8		
Indeno(1,2,3-cd)pyrene	61.6	ug/L		80.00		77	46-90.3		
Dibenzo(a,h)anthracene	58.6	ug/L		80.00		73	46.1-91.3		
Benzo(g,h,i)perylene	61.1	ug/L		80.00		76	36.7-107		
Surrogate: Nitrobenzene-d5	*44*	*ug/L*		*80.00*		*54*	*18.5-97.5*		
Surrogate: 2-Fluorobiphenyl	*37*	*ug/L*		*80.00*		*46*	*13.9-97.2*		
Surrogate: p-Terphenyl-d14	*44*	*ug/L*		*80.00*		*55*	*17.5-104*		

Matrix Spike (B518691-MS1) **Sample: 5110751-01** Prepared: 11/10/15 Analyzed: 11/11/15

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Naphthalene	43.1	ug/L		80.00	0.15	54	25.5-91.4		
Acenaphthylene	39.8	ug/L		80.00	ND	50	20-91.3		
Acenaphthene	43.2	ug/L		80.00	ND	54	22.1-95.9		
Fluorene	40.7	ug/L		80.00	ND	51	21.9-97.6		
Phenanthrene	42.9	ug/L		80.00	ND	54	27.7-96.7		
Anthracene	41.9	ug/L		80.00	ND	52	23.5-95.9		
Fluoranthene	39.2	ug/L		80.00	ND	49	24.8-97.1		
Pyrene	39.8	ug/L		80.00	ND	50	25.5-92.4		
Benzo(a)anthracene	38.0	ug/L		80.00	ND	48	25.1-92		
Chrysene	42.9	ug/L		80.00	ND	54	27-95.1		
Benzo(b)fluoranthene	44.9	ug/L		80.00	ND	56	28-100		
Benzo(k)fluoranthene	39.4	ug/L		80.00	ND	49	21.1-98.1		
Benzo(a)pyrene	43.2	ug/L		80.00	ND	54	16.9-98.8		
Indeno(1,2,3-cd)pyrene	46.4	ug/L		80.00	ND	58	25-92.2		
Dibenzo(a,h)anthracene	43.6	ug/L		80.00	ND	54	27.2-91.2		
Benzo(g,h,i)perylene	46.9	ug/L		80.00	ND	59	13.6-110		
Surrogate: Nitrobenzene-d5	*40*	*ug/L*		*80.00*		*51*	*18.5-97.5*		
Surrogate: 2-Fluorobiphenyl	*41*	*ug/L*		*80.00*		*51*	*13.9-97.2*		
Surrogate: p-Terphenyl-d14	*42*	*ug/L*		*80.00*		*52*	*17.5-104*		

Batch B518694 - 04 SW 3510 (608/8081/8082) - SW 8082

Blank (B518694-BLK1) Prepared & Analyzed: 11/07/15

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Aroclor 1016	< 0.1	ug/L							
Aroclor 1221	< 0.1	ug/L							
Aroclor 1232	< 0.1	ug/L							
Aroclor 1242	< 0.1	ug/L							

QC SAMPLE RESULTS

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch B518694 - 04 SW 3510 (608/8081/8082) - SW 8082									
Blank (B518694-BLK1)				Prepared & Analyzed: 11/07/15					
Aroclor 1248	< 0.1	ug/L							
Aroclor 1254	< 0.1	ug/L							
Aroclor 1260	< 0.1	ug/L							
Aroclors - Total	< 0.1	ug/L							
Surrogate: TCMX	*0.16*	*ug/L*		*0.2000*		*80*	*41-135*		
Surrogate: Decachlorobiphenyl	*0.18*	*ug/L*		*0.2000*		*91*	*36-148*		
LCS (B518694-BS1)				Prepared & Analyzed: 11/07/15					
Aroclor 1016	4	ug/L		5.000		84	43.1-112		
Aroclor 1260	4	ug/L		5.000		72	44.6-107		
Surrogate: TCMX	*0.18*	*ug/L*		*0.2000*		*89*	*41-135*		
Surrogate: Decachlorobiphenyl	*0.20*	*ug/L*		*0.2000*		*99*	*36-148*		
Matrix Spike (B518694-MS1)	**Sample: 5110751-02**			Prepared: 11/07/15 Analyzed: 11/08/15					
Aroclor 1016	4	ug/L		5.000	ND	83	77.2-124		
Aroclor 1260	4	ug/L		5.000	ND	71	52.6-137		
Surrogate: TCMX	*0.18*	*ug/L*		*0.2000*		*89*	*41-135*		
Surrogate: Decachlorobiphenyl	*0.20*	*ug/L*		*0.2000*		*101*	*36-148*		
Batch B518875 - SW 3015 - SW 6020									
Blank (B518875-BLK1)				Prepared: 11/09/15 Analyzed: 11/12/15					
Antimony	< 0.036	ug/L							
Arsenic	< 0.13	ug/L							
Beryllium	< 0.017	ug/L							
Cadmium	< 0.042	ug/L							
Chromium	< 0.27	ug/L							
Copper	< 0.025	ug/L							
Lead	< 0.025	ug/L							
Nickel	< 0.075	ug/L							
Selenium	0.407	ug/L	J						
Silver	0.0350	ug/L	J						
Thallium	< 0.062	ug/L							
Zinc	< 0.50	ug/L							
LCS (B518875-BS1)				Prepared: 11/09/15 Analyzed: 11/12/15					
Antimony	518	ug/L		555.6		93	80-120		
Arsenic	502	ug/L		555.6		90	80-120		
Beryllium	586	ug/L		555.6		106	80-120		
Cadmium	532	ug/L		555.6		96	80-120		
Chromium	538	ug/L		555.6		97	80-120		
Copper	545	ug/L		555.6		98	80-120		
Lead	567	ug/L		555.6		102	80-120		
Nickel	544	ug/L		555.6		98	80-120		
Selenium	523	ug/L		555.6		94	80-120		
Silver	636	ug/L		555.6		114	80-120		
Thallium	524	ug/L		555.6		94	80-120		
Zinc	493	ug/L		555.6		89	80-120		
Matrix Spike (B518875-MS1)	**Sample: 5110119-08**			Prepared: 11/09/15 Analyzed: 11/12/15					

QC SAMPLE RESULTS

Batch B518875 - SW 3015 - SW 6020

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Matrix Spike (B518875-MS1)	**Sample: 5110119-08**			Prepared: 11/09/15 Analyzed: 11/12/15					
Antimony	0.144	ug/L	J		0.102		75-125		
Arsenic	536	ug/L		555.6	0.453	96	75-125		
Beryllium	595	ug/L		555.6	0.108	107	75-125		
Cadmium	565	ug/L		555.6	ND	102	75-125		
Chromium	569	ug/L		555.6	0.618	102	75-125		
Copper	551	ug/L		555.6	0.752	99	75-125		
Lead	563	ug/L		555.6	0.148	101	75-125		
Nickel	554	ug/L		555.6	1.26	99	75-125		
Selenium	557	ug/L		555.6	1.13	100	75-125		
Silver	134	ug/L	Q1	555.6	0.576	24	75-125		
Thallium	0.172	ug/L	J		0.232		75-125		
Zinc	526	ug/L		555.6	1.48	94	75-125		
Matrix Spike Dup (B518875-MSD1)	**Sample: 5110119-08**			Prepared: 11/09/15 Analyzed: 11/12/15					
Antimony	0.120	ug/L	J		0.102		75-125	18	20
Arsenic	551	ug/L		555.6	0.453	99	75-125	3	20
Beryllium	609	ug/L		555.6	0.108	110	75-125	2	20
Cadmium	548	ug/L		555.6	ND	99	75-125	3	20
Chromium	574	ug/L		555.6	0.618	103	75-125	0.9	20
Copper	560	ug/L		555.6	0.752	101	75-125	2	20
Lead	569	ug/L		555.6	0.148	102	75-125	1	20
Nickel	561	ug/L		555.6	1.26	101	75-125	1	20
Selenium	571	ug/L		555.6	1.13	103	75-125	2	20
Silver	124	ug/L	Q2	555.6	0.576	22	75-125	8	20
Thallium	0.141	ug/L	J		0.232		75-125	20	20
Zinc	524	ug/L		555.6	1.48	94	75-125	0.4	20

NOTES

Specific method revisions used for analysis are available upon request.

Certifications

PIA - Peoria, IL
TNI Accreditation for Drinking Water, Wastewater, Hazardous and Solid Wastes Fields of Testing through IL EPA Lab No. 100230
Illinois Department of Public Health Bacteriological Analysis in Drinking Water Approved Laboratory Registry No. 17553
Missouri Department of Natural Resources Certificate of Approval for Microbiological Laboratory Service No. 870
Drinking Water Certifications: Iowa (240); Kansas (E-10338); Missouri (870)
Wastewater Certifications: Arkansas (88-0677); Iowa (240); Kansas (E-10338)
Hazardous/Solid Waste Certifications: Arkansas (88-0677); Iowa (240); Kansas (E-10338)

SPMO - Springfield, MO
USEPA DMR-QA Program

STL - St. Louis, MO
TNI Accreditation for Wastewater, Hazardous and Solid Wastes Fields of Testing through KS Lab No. E-10389
Illinois Department of Public Health Bacteriological Analysis in Drinking Water Approved Laboratory Registry No. 171050
Drinking Water Certifications: Missouri (1050)
Missouri Department of Natural Resources

* Not a TNI accredited analyte

Qualifiers

J	Estimated value; value between the Method Detection Limit and Method Reporting Limit.
Q1	Matrix Spike failed % Recovery
Q2	Matrix Spike Duplicate failed % Recovery

Roxann Shull

Certified by: Roxann Shull, Client Services Supervisor

PDC Laboratories, Inc. – St. Louis
3278 N. Highway 67 (Lindbergh)
Florissant, MO 63033
www.pdclab.com

CHAIN OF CUSTODY RECORD

Phone (314) 432-0550 or (314) 921-4488
Fax (314) 432-4977

State where samples collected MA

(Instructions/Sample Acceptance Policy on Reverse)

ALL SHADED AREAS MUST BE COMPLETED BY CLIENT (PLEASE PRINT)

① CLIENT TETRA TECH
ADDRESS 1634 EASTPORT PLAZA DR,
CITY STATE ZIP COLLINSVILLE, IL 62234
CONTACT PERSON P. SMITH / R. SWALLER

PROJECT NUMBER 100-AWL-T35103
P. O. NUMBER
MEANS SHIPPED
PHONE NUMBER 314-941-5862
FAX NUMBER
EMAIL ADDRESS
SAMPLER P. SMITH
SAMPLER'S SIGNATURE

MATRIX TYPES:
WW-WASTEWATER
DW-DRINKING WATER
GW-GROUND WATER
WWSL-SLUDGE
NAS-SOLID
L'CHT-LEACHATE
NAL-NONAQUEOUS
SOIL-SOILS

④ (FOR LAB USE ONLY)
LOGIN # 511042I
LOGGED BY: HC
LAB PROJ. #
TEMPLATE:
PROJ. MGR.:

③ ANALYSIS REQUESTED

② SAMPLE DESCRIPTION AS YOU WANT ON REPORT	DATE COLLECTED	TIME COLLECTED	SAMPLE TYPE GRAB	SAMPLE TYPE COMP	MATRIX TYPE	Bottle Count	PAHs	PCBs	METALS	TSS			REMARKS
SW- COMP	11/3/2015	1400		X	WAT	6	X	X	X	X			SEE EMAIL "New TREATABILITY STUDY" 10/28/2015 For Project Detail
	11/3/2015												
Note - SW-COMP is SD-LUFB-BP SD-MLFB-BP and SD-ECCJ-BP													

⑤ TURNAROUND TIME (RUSH TAT IS SUBJECT TO PDC LABS APPROVAL AND SURCHARGE)
[✓ NORMAL (8-10 Bus. Days)] RUSH (5 Bus. Days) *Fastrak*™ (3 Bus. Days) 1-2 Bus. Days Same Day
DATE DUE

RESULTS BY: [✓ E-MAIL] FAX PHONE CALL PHONE/FAX# IF DIFFERENT FROM ABOVE

⑥ The sample temperature will be measured upon receipt at the lab. By initialing this area, you request that the lab notify you, before proceeding with analysis, if the sample temperature is outside of the range of 0.1-6.0°C. By not initialing this area, you allow the lab to proceed with analytical testing regardless of the sample temperature. ______

⑦	DATE	TIME	RECEIVED BY:	DATE	TIME
RELINQUISHED BY: (SIGNATURE)	11/3/2015	15:10	Heather Carlson	11/3/15	15:10
RELINQUISHED BY: (SIGNATURE)					
RELINQUISHED BY: (SIGNATURE)					
RELINQUISHED BY: (SIGNATURE)					

⑧ COMMENTS:(FOR LAB USE ONLY)

SAMPLE TEMPERATURE UPON RECEIPT 14.7°C
CHILL PROCESS STARTED PRIOR TO RECEIPT [✓ Y] OR N
SAMPLES(S) RECEIVED ON ICE [✓ Y] OR N
PROPER BOTTLES RECEIVED IN GOOD CONDITION [✓ Y] OR N
BOTTLES FILLED WITH ADEQUATE VOLUME [✓ Y] OR N
SAMPLES RECEIVED WITHIN HOLD TIME(S) (EXCLUDES TYPICAL FIELD PARAMETERS) [✓ Y] OR N
DATE AND TME TAKEN FROM SAMPLE BOTTLE ______

Thank you for using PDC Laboratories, Inc. Locations in Peoria, IL; St. Louis, MO; and Springfield, MO

PAGE ____ OF ____

SUBCONTRACT ORDER

Transfer Chain of Custody

PDC Laboratories, Inc.

5110421

SENDING LABORATORY

PDC Laboratories, Inc.
3278 N Highway 67
Florissant, MO 63033
(800) 333-3278

RECEIVING LABORATORY

PDC Laboratories, Inc.
2231 W Altorfer Dr
Peoria, IL 61615
(309) 692-9688

Sample: 5110421-01
Name: SW-COMP

Sampled: 11/03/15 14:00
Matrix: Water

Analysis	**Due**	**Expires**	**Comments**
Ag 6020 Tot	11/13/15 16:00	05/01/16 14:00	ALL 6020 METALS REPORT TO MDL
As 6020 Tot	11/13/15 16:00	05/01/16 14:00	
Be 6020 Tot	11/13/15 16:00	05/01/16 14:00	
Cd 6020 Tot	11/13/15 16:00	05/01/16 14:00	
Cr 6020 Tot	11/13/15 16:00	05/01/16 14:00	
Cu 6020 Tot	11/13/15 16:00	05/01/16 14:00	
Ni 6020 Tot	11/13/15 16:00	05/01/16 14:00	
Pb 6020 Tot	11/13/15 16:00	05/01/16 14:00	
Sb 6020 Tot	11/13/15 16:00	05/01/16 14:00	
Se 6020 Tot	11/13/15 16:00	05/01/16 14:00	
Tl 6020 Tot	11/13/15 16:00	05/01/16 14:00	
Zn 6020 Tot	11/13/15 16:00	05/01/16 14:00	

Please email results to Roxann Shull at rshull@pdclab.com

Date Shipped: 11/4/15 Total # of Containers: 1 Sample Origin (State): ____ PO #: ____________

Turn-Around Time Requested ☑ NORMAL ☐ RUSH Date Results Needed: ____________

Relinquished By	Date/Time	Received By	Date/Time
Heather Earhart	11/3/15		
			11/5/15 9:10a

Sample Temperature Upon Receipt 6 °C
Sample(s) Received on Ice [✓ Y] or N
Proper Bottles Received in Good Condition [✓ Y] or N
Bottles Filled with Adequate Volume [✓ Y] or N
Samples Received Within Hold Time [✓ Y] or N
Date/Time Taken From Sample Bottle Y or [✓ N]

Appendix G

DRET Analytical Results (6-Hour Aeration Tests) - Data Sheets

PDC Laboratories, Inc.

PROFESSIONAL ŁDEPENDABLE ŁCOMMITTED

November 18, 2015

Paul Smith
TETRA TECH
1634 Eport Plaza Dr
Collinsville, IL 62234

Dear Paul Smith:

Please find enclosed the analytical results for the sample(s) the laboratory received on **11/5/15 4:30 pm** and logged in under work order **5111267**. All testing is performed according to our current TNI certifications unless otherwise noted. This report cannot be reproduced, except in full, without the written permission of PDC Laboratories, Inc.

If you have any questions regarding your report, please contact your project manager. Quality and timely data is of the utmost importance to us.

PDC Laboratories, Inc. appreciates the opportunity to provide you with analytical expertise. We are always trying to improve our customer service and we welcome you to contact the Vice President , John LaPayne with any feedback you have about your experience with our laboratory.

Sincerely,

Roxann Shull

Roxann Shull
Client Services Supervisor
(314) 432-0550
rshull@pdclab.com

ANALYTICAL RESULTS

Sample: **5111267-01**
Name: LUFP-6H-1.0%
Matrix: Ground Water - Grab

Sampled: 11/05/15 14:40
Received: 11/05/15 16:30
PO #: 2015 Dedged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
General Chemistry - STL								
Solids - total suspended solids (TSS)	3000	mg/L		0.50	10	11/10/15 14:45	KMN	SM 2540D
Semivolatile Organics - SIM - STL								
Naphthalene	< 0.03	ug/L		0.03	0.10	11/17/15 19:19	BP	SW 8270C
Acenaphthylene	< 0.03	ug/L		0.03	0.10	11/17/15 19:19	BP	SW 8270C
Acenaphthene	< 0.03	ug/L		0.03	0.10	11/17/15 19:19	BP	SW 8270C
Fluorene	< 0.04	ug/L		0.04	0.10	11/17/15 19:19	BP	SW 8270C
Phenanthrene	< 0.04	ug/L		0.04	0.10	11/17/15 19:19	BP	SW 8270C
Anthracene	< 0.03	ug/L		0.03	0.10	11/17/15 19:19	BP	SW 8270C
Fluoranthene	< 0.05	ug/L		0.05	0.10	11/17/15 19:19	BP	SW 8270C
Pyrene	< 0.04	ug/L		0.04	0.10	11/17/15 19:19	BP	SW 8270C
Benzo(a)anthracene	< 0.05	ug/L		0.05	0.10	11/17/15 19:19	BP	SW 8270C
Chrysene	< 0.03	ug/L		0.03	0.10	11/17/15 19:19	BP	SW 8270C
Benzo(b)fluoranthene	< 0.08	ug/L		0.08	0.10	11/17/15 19:19	BP	SW 8270C
Benzo(k)fluoranthene	< 0.10	ug/L		0.10	0.10	11/17/15 19:19	BP	SW 8270C
Benzo(a)pyrene	< 0.04	ug/L		0.04	0.10	11/17/15 19:19	BP	SW 8270C
Indeno(1,2,3-cd)pyrene	< 0.04	ug/L		0.04	0.10	11/17/15 19:19	BP	SW 8270C
Dibenzo(a,h)anthracene	< 0.04	ug/L		0.04	0.10	11/17/15 19:19	BP	SW 8270C
Benzo(g,h,i)perylene	< 0.04	ug/L		0.04	0.10	11/17/15 19:19	BP	SW 8270C
Total Metals - PIA								
Antimony	13	ug/L		0.036	3.0	11/13/15 16:13	JMW	SW 6020
Arsenic	6.9	ug/L		0.13	1.0	11/16/15 12:05	JMW	SW 6020
Beryllium	1.2	ug/L		0.017	1.0	11/13/15 16:13	JMW	SW 6020
Cadmium	2.8	ug/L		0.042	1.0	11/13/15 16:13	JMW	SW 6020
Chromium	24	ug/L		0.27	4.0	11/16/15 12:05	JMW	SW 6020
Copper	34	ug/L		0.025	3.0	11/16/15 12:05	JMW	SW 6020
Lead	130	ug/L		0.025	1.0	11/13/15 16:13	JMW	SW 6020
Nickel	17	ug/L		0.075	5.0	11/16/15 12:05	JMW	SW 6020
Selenium	3.9	ug/L		0.32	1.0	11/16/15 12:05	JMW	SW 6020
Silver	1.5	ug/L	J	0.028	5.0	11/16/15 12:05	JMW	SW 6020
Thallium	0.23	ug/L	J	0.062	1.0	11/13/15 16:13	JMW	SW 6020
Zinc	230	ug/L		0.50	6.0	11/16/15 12:05	JMW	SW 6020
Total Metals - STL								
Mercury	35	ug/L		2.0	2.0	11/17/15 13:51	WPS	SW 7470

ANALYTICAL RESULTS

Sample: **5111267-01RE1**
Name: LUFP-6H-1.0%
Matrix: Ground Water - Grab

Sampled: 11/05/15 14:40
Received: 11/05/15 16:30
PO #: 2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
Polychlorinated Biphenyls (PCBs) - STL								
Aroclor 1016	< 0.1	ug/L		0.1	0.5	11/13/15 22:22	BP	SW 8082*
Aroclor 1221	< 0.1	ug/L		0.1	0.5	11/13/15 22:22	BP	SW 8082*
Aroclor 1232	< 0.1	ug/L		0.1	0.5	11/13/15 22:22	BP	SW 8082*
Aroclor 1242	< 0.1	ug/L		0.1	0.5	11/13/15 22:22	BP	SW 8082*
Aroclor 1248	< 0.1	ug/L		0.1	0.5	11/13/15 22:22	BP	SW 8082*
Aroclor 1254	< 0.1	ug/L		0.1	0.5	11/13/15 22:22	BP	SW 8082*
Aroclor 1260	< 0.1	ug/L		0.1	0.5	11/13/15 22:22	BP	SW 8082*
Aroclors - Total	< 0.1	ug/L		0.1	0.5	11/13/15 22:22	BP	SW 8082*
Surrogate: TCMX	*92 %*	*41-135*				*11/13/15 22:22*	*BP*	*SW 8082**
Surrogate: Decachlorobiphenyl	*102 %*	*36-148*				*11/13/15 22:22*	*BP*	*SW 8082**

ANALYTICAL RESULTS

Sample: **5111267-02**
Name: MLFP-6H-1.0%
Matrix: Ground Water - Grab

Sampled: 11/05/15 14:50
Received: 11/05/15 16:30
PO #: 2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
General Chemistry - STL								
Solids - total suspended solids (TSS)	1600	mg/L		0.50	10	11/10/15 14:45	KMN	SM 2540D
Polychlorinated Biphenyls (PCBs) - STL								
Aroclor 1016	< 0.1	ug/L		0.1	0.5	11/10/15 02:22	BP	SW 8082*
Aroclor 1221	< 0.1	ug/L		0.1	0.5	11/10/15 02:22	BP	SW 8082*
Aroclor 1232	< 0.1	ug/L		0.1	0.5	11/10/15 02:22	BP	SW 8082*
Aroclor 1242	< 0.1	ug/L		0.1	0.5	11/10/15 02:22	BP	SW 8082*
Aroclor 1248	< 0.1	ug/L		0.1	0.5	11/10/15 02:22	BP	SW 8082*
Aroclor 1254	< 0.1	ug/L		0.1	0.5	11/10/15 02:22	BP	SW 8082*
Aroclor 1260	< 0.1	ug/L		0.1	0.5	11/10/15 02:22	BP	SW 8082*
Aroclors - Total	< 0.1	ug/L		0.1	0.5	11/10/15 02:22	BP	SW 8082*
Surrogate: TCMX	*86 %*	*41-135*				*11/10/15 02:22*	*BP*	*SW 8082**
Surrogate: Decachlorobiphenyl	*104 %*	*36-148*				*11/10/15 02:22*	*BP*	*SW 8082**
Semivolatile Organics - SIM - STL								
Naphthalene	0.06	ug/L	J	0.03	0.10	11/17/15 19:46	BP	SW 8270C
Acenaphthylene	< 0.03	ug/L		0.03	0.10	11/17/15 19:46	BP	SW 8270C
Acenaphthene	< 0.03	ug/L		0.03	0.10	11/17/15 19:46	BP	SW 8270C
Fluorene	< 0.04	ug/L		0.04	0.10	11/17/15 19:46	BP	SW 8270C
Phenanthrene	< 0.04	ug/L		0.04	0.10	11/17/15 19:46	BP	SW 8270C
Anthracene	< 0.03	ug/L		0.03	0.10	11/17/15 19:46	BP	SW 8270C
Fluoranthene	< 0.05	ug/L		0.05	0.10	11/17/15 19:46	BP	SW 8270C
Pyrene	< 0.04	ug/L		0.04	0.10	11/17/15 19:46	BP	SW 8270C
Benzo(a)anthracene	< 0.05	ug/L		0.05	0.10	11/17/15 19:46	BP	SW 8270C
Chrysene	< 0.03	ug/L		0.03	0.10	11/17/15 19:46	BP	SW 8270C
Benzo(b)fluoranthene	< 0.08	ug/L		0.08	0.10	11/17/15 19:46	BP	SW 8270C
Benzo(k)fluoranthene	< 0.10	ug/L		0.10	0.10	11/17/15 19:46	BP	SW 8270C
Benzo(a)pyrene	< 0.04	ug/L		0.04	0.10	11/17/15 19:46	BP	SW 8270C
Indeno(1,2,3-cd)pyrene	< 0.04	ug/L		0.04	0.10	11/17/15 19:46	BP	SW 8270C
Dibenzo(a,h)anthracene	< 0.04	ug/L		0.04	0.10	11/17/15 19:46	BP	SW 8270C
Benzo(g,h,i)perylene	< 0.04	ug/L		0.04	0.10	11/17/15 19:46	BP	SW 8270C
Total Metals - PIA								
Antimony	4.2	ug/L		0.036	3.0	11/13/15 16:17	JMW	SW 6020
Arsenic	11	ug/L		0.13	1.0	11/16/15 12:09	JMW	SW 6020
Beryllium	1.1	ug/L		0.017	1.0	11/13/15 16:17	JMW	SW 6020
Cadmium	1.1	ug/L		0.042	1.0	11/13/15 16:17	JMW	SW 6020
Chromium	22	ug/L		0.27	4.0	11/16/15 12:09	JMW	SW 6020
Copper	21	ug/L		0.025	3.0	11/16/15 12:09	JMW	SW 6020
Lead	87	ug/L		0.025	1.0	11/13/15 16:17	JMW	SW 6020
Nickel	14	ug/L		0.075	5.0	11/16/15 12:09	JMW	SW 6020
Selenium	3.4	ug/L		0.32	1.0	11/16/15 12:09	JMW	SW 6020

ANALYTICAL RESULTS

Sample: **5111267-02**
Name: MLFP-6H-1.0%
Matrix: Ground Water - Grab

Sampled: 11/05/15 14:50
Received: 11/05/15 16:30
PO #: 2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
Silver	0.74	ug/L	J	0.028	5.0	11/16/15 12:09	JMW	SW 6020
Thallium	0.23	ug/L	J	0.062	1.0	11/13/15 16:17	JMW	SW 6020
Zinc	120	ug/L		0.50	6.0	11/16/15 12:09	JMW	SW 6020
Total Metals - STL								
Mercury	19	ug/L		0.2	0.2	11/17/15 13:51	WPS	SW 7470

ANALYTICAL RESULTS

Sample: **5111267-03**
Name: ECCS-6H-1.0%
Matrix: Ground Water - Grab

Sampled: 11/05/15 15:00
Received: 11/05/15 16:30
PO #: 2015 Dedged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
General Chemistry - STL								
Solids - total suspended solids (TSS)	340	mg/L		0.50	10	11/10/15 14:45	KMN	SM 2540D
Polychlorinated Biphenyls (PCBs) - STL								
Aroclor 1016	< 0.1	ug/L		0.1	0.5	11/10/15 02:48	BP	SW 8082*
Aroclor 1221	< 0.1	ug/L		0.1	0.5	11/10/15 02:48	BP	SW 8082*
Aroclor 1232	< 0.1	ug/L		0.1	0.5	11/10/15 02:48	BP	SW 8082*
Aroclor 1242	< 0.1	ug/L		0.1	0.5	11/10/15 02:48	BP	SW 8082*
Aroclor 1248	< 0.1	ug/L		0.1	0.5	11/10/15 02:48	BP	SW 8082*
Aroclor 1254	< 0.1	ug/L		0.1	0.5	11/10/15 02:48	BP	SW 8082*
Aroclor 1260	< 0.1	ug/L		0.1	0.5	11/10/15 02:48	BP	SW 8082*
Aroclors - Total	< 0.1	ug/L		0.1	0.5	11/10/15 02:48	BP	SW 8082*
Surrogate: TCMX	*76 %*	*41-135*				*11/10/15 02:48*	*BP*	*SW 8082**
Surrogate: Decachlorobiphenyl	*92 %*	*36-148*				*11/10/15 02:48*	*BP*	*SW 8082**
Semivolatile Organics - SIM - STL								
Naphthalene	0.16	ug/L		0.03	0.10	11/17/15 20:12	BP	SW 8270C
Acenaphthylene	0.15	ug/L		0.03	0.10	11/17/15 20:12	BP	SW 8270C
Acenaphthene	< 0.03	ug/L		0.03	0.10	11/17/15 20:12	BP	SW 8270C
Fluorene	0.06	ug/L	J	0.04	0.10	11/17/15 20:12	BP	SW 8270C
Phenanthrene	0.42	ug/L		0.04	0.10	11/17/15 20:12	BP	SW 8270C
Anthracene	0.06	ug/L	J	0.03	0.10	11/17/15 20:12	BP	SW 8270C
Fluoranthene	0.73	ug/L		0.05	0.10	11/17/15 20:12	BP	SW 8270C
Pyrene	0.74	ug/L		0.04	0.10	11/17/15 20:12	BP	SW 8270C
Benzo(a)anthracene	0.26	ug/L		0.05	0.10	11/17/15 20:12	BP	SW 8270C
Chrysene	0.45	ug/L		0.03	0.10	11/17/15 20:12	BP	SW 8270C
Benzo(b)fluoranthene	0.38	ug/L		0.08	0.10	11/17/15 20:12	BP	SW 8270C
Benzo(k)fluoranthene	0.38	ug/L		0.10	0.10	11/17/15 20:12	BP	SW 8270C
Benzo(a)pyrene	0.38	ug/L		0.04	0.10	11/17/15 20:12	BP	SW 8270C
Indeno(1,2,3-cd)pyrene	0.23	ug/L		0.04	0.10	11/17/15 20:12	BP	SW 8270C
Dibenzo(a,h)anthracene	0.08	ug/L	J	0.04	0.10	11/17/15 20:12	BP	SW 8270C
Benzo(g,h,i)perylene	0.25	ug/L		0.04	0.10	11/17/15 20:12	BP	SW 8270C
Total Metals - PIA								
Antimony	1200	ug/L		0.036	3.0	11/13/15 16:21	JMW	SW 6020
Arsenic	19	ug/L		0.13	1.0	11/16/15 12:13	JMW	SW 6020
Beryllium	0.58	ug/L	J	0.017	1.0	11/13/15 16:21	JMW	SW 6020
Cadmium	3.3	ug/L		0.042	1.0	11/13/15 16:21	JMW	SW 6020
Chromium	18	ug/L		0.27	4.0	11/16/15 12:13	JMW	SW 6020
Copper	74	ug/L		0.025	3.0	11/16/15 12:13	JMW	SW 6020
Lead	200	ug/L		0.025	1.0	11/13/15 16:21	JMW	SW 6020
Nickel	22	ug/L		0.075	5.0	11/16/15 12:13	JMW	SW 6020
Selenium	2.4	ug/L		0.32	1.0	11/16/15 12:13	JMW	SW 6020

ANALYTICAL RESULTS

Sample:	**5111267-03**	**Sampled:**	11/05/15 15:00
Name:	ECCS-6H-1.0%	**Received:**	11/05/15 16:30
Matrix:	Ground Water - Grab	**PO #:**	2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
Silver	2.4	ug/L	J	0.028	5.0	11/16/15 12:13	JMW	SW 6020
Thallium	0.076	ug/L	J	0.062	1.0	11/13/15 16:21	JMW	SW 6020
Zinc	340	ug/L		0.50	6.0	11/16/15 12:13	JMW	SW 6020
Total Metals - STL								
Mercury	600	ug/L		20	20	11/17/15 13:51	WPS	SW 7470

ANALYTICAL RESULTS

Sample: **5111267-04**
Name: LUFP-6H-1.0%F
Matrix: Ground Water - Grab

Sampled: 11/05/15 15:15
Received: 11/05/15 16:30
PO #: 2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
General Chemistry - STL								
Solids - total suspended solids (TSS)	< 0.10	mg/L		0.10	2.0	11/11/15 12:39	KLA	SM 2540D
Polychlorinated Biphenyls (PCBs) - STL								
Aroclor 1016	< 0.1	ug/L		0.1	0.5	11/10/15 03:14	BP	SW 8082*
Aroclor 1221	< 0.1	ug/L		0.1	0.5	11/10/15 03:14	BP	SW 8082*
Aroclor 1232	< 0.1	ug/L		0.1	0.5	11/10/15 03:14	BP	SW 8082*
Aroclor 1242	< 0.1	ug/L		0.1	0.5	11/10/15 03:14	BP	SW 8082*
Aroclor 1248	< 0.1	ug/L		0.1	0.5	11/10/15 03:14	BP	SW 8082*
Aroclor 1254	< 0.1	ug/L		0.1	0.5	11/10/15 03:14	BP	SW 8082*
Aroclor 1260	< 0.1	ug/L		0.1	0.5	11/10/15 03:14	BP	SW 8082*
Aroclors - Total	< 0.1	ug/L		0.1	0.5	11/10/15 03:14	BP	SW 8082*
Surrogate: TCMX	*88 %*	*41-135*				*11/10/15 03:14*	*BP*	*SW 8082**
Surrogate: Decachlorobiphenyl	*107 %*	*36-148*				*11/10/15 03:14*	*BP*	*SW 8082**
Semivolatile Organics - SIM - STL								
Naphthalene	0.14	ug/L		0.03	0.10	11/17/15 20:39	BP	SW 8270C
Acenaphthylene	< 0.03	ug/L		0.03	0.10	11/17/15 20:39	BP	SW 8270C
Acenaphthene	< 0.03	ug/L		0.03	0.10	11/17/15 20:39	BP	SW 8270C
Fluorene	< 0.04	ug/L		0.04	0.10	11/17/15 20:39	BP	SW 8270C
Phenanthrene	< 0.04	ug/L		0.04	0.10	11/17/15 20:39	BP	SW 8270C
Anthracene	< 0.03	ug/L		0.03	0.10	11/17/15 20:39	BP	SW 8270C
Fluoranthene	< 0.05	ug/L		0.05	0.10	11/17/15 20:39	BP	SW 8270C
Pyrene	< 0.04	ug/L		0.04	0.10	11/17/15 20:39	BP	SW 8270C
Benzo(a)anthracene	< 0.05	ug/L		0.05	0.10	11/17/15 20:39	BP	SW 8270C
Chrysene	< 0.03	ug/L		0.03	0.10	11/17/15 20:39	BP	SW 8270C
Benzo(b)fluoranthene	< 0.08	ug/L		0.08	0.10	11/17/15 20:39	BP	SW 8270C
Benzo(k)fluoranthene	< 0.10	ug/L		0.10	0.10	11/17/15 20:39	BP	SW 8270C
Benzo(a)pyrene	< 0.04	ug/L		0.04	0.10	11/17/15 20:39	BP	SW 8270C
Indeno(1,2,3-cd)pyrene	< 0.04	ug/L		0.04	0.10	11/17/15 20:39	BP	SW 8270C
Dibenzo(a,h)anthracene	< 0.04	ug/L		0.04	0.10	11/17/15 20:39	BP	SW 8270C
Benzo(g,h,i)perylene	< 0.04	ug/L		0.04	0.10	11/17/15 20:39	BP	SW 8270C
Total Metals - PIA								
Antimony	10	ug/L		0.036	3.0	11/13/15 16:25	JMW	SW 6020
Arsenic	1.4	ug/L		0.13	1.0	11/16/15 12:28	JMW	SW 6020
Beryllium	< 0.017	ug/L		0.017	1.0	11/13/15 16:25	JMW	SW 6020
Cadmium	< 0.042	ug/L		0.042	1.0	11/13/15 16:25	JMW	SW 6020
Chromium	< 0.27	ug/L		0.27	4.0	11/16/15 12:28	JMW	SW 6020
Copper	0.43	ug/L	J	0.025	3.0	11/16/15 12:28	JMW	SW 6020
Lead	0.80	ug/L	J	0.025	1.0	11/13/15 16:25	JMW	SW 6020
Nickel	1.0	ug/L	J	0.075	5.0	11/16/15 12:28	JMW	SW 6020
Selenium	< 0.32	ug/L		0.32	1.0	11/16/15 12:28	JMW	SW 6020

ANALYTICAL RESULTS

Sample:	**5111267-04**	**Sampled:**	11/05/15 15:15
Name:	LUFP-6H-1.0%F	**Received:**	11/05/15 16:30
Matrix:	Ground Water - Grab	**PO #:**	2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
Silver	< 0.028	ug/L		0.028	5.0	11/16/15 12:28	JMW	SW 6020
Thallium	< 0.062	ug/L		0.062	1.0	11/13/15 16:25	JMW	SW 6020
Zinc	< 0.50	ug/L		0.50	6.0	11/16/15 12:28	JMW	SW 6020
Total Metals - STL								
Mercury	< 0.2	ug/L		0.2	0.2	11/17/15 13:51	WPS	SW 7470

ANALYTICAL RESULTS

Sample: **5111267-05**
Name: MLFP-6H-1.0%F
Matrix: Ground Water - Grab

Sampled: 11/05/15 15:25
Received: 11/05/15 16:30
PO #: 2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
General Chemistry - STL								
Solids - total suspended solids (TSS)	1.2	mg/L	J	0.10	2.0	11/11/15 12:39	KLA	SM 2540D
Polychlorinated Biphenyls (PCBs) - STL								
Aroclor 1016	< 0.1	ug/L		0.1	0.5	11/10/15 03:39	BP	SW 8082*
Aroclor 1221	< 0.1	ug/L		0.1	0.5	11/10/15 03:39	BP	SW 8082*
Aroclor 1232	< 0.1	ug/L		0.1	0.5	11/10/15 03:39	BP	SW 8082*
Aroclor 1242	< 0.1	ug/L		0.1	0.5	11/10/15 03:39	BP	SW 8082*
Aroclor 1248	< 0.1	ug/L		0.1	0.5	11/10/15 03:39	BP	SW 8082*
Aroclor 1254	< 0.1	ug/L		0.1	0.5	11/10/15 03:39	BP	SW 8082*
Aroclor 1260	< 0.1	ug/L		0.1	0.5	11/10/15 03:39	BP	SW 8082*
Aroclors - Total	< 0.1	ug/L		0.1	0.5	11/10/15 03:39	BP	SW 8082*
Surrogate: TCMX	*88 %*	*41-135*				*11/10/15 03:39*	*BP*	*SW 8082**
Surrogate: Decachlorobiphenyl	*109 %*	*36-148*				*11/10/15 03:39*	*BP*	*SW 8082**
Semivolatile Organics - SIM - STL								
Naphthalene	0.30	ug/L		0.03	0.10	11/17/15 21:05	BP	SW 8270C
Acenaphthylene	< 0.03	ug/L		0.03	0.10	11/17/15 21:05	BP	SW 8270C
Acenaphthene	< 0.03	ug/L		0.03	0.10	11/17/15 21:05	BP	SW 8270C
Fluorene	< 0.04	ug/L		0.04	0.10	11/17/15 21:05	BP	SW 8270C
Phenanthrene	< 0.04	ug/L		0.04	0.10	11/17/15 21:05	BP	SW 8270C
Anthracene	< 0.03	ug/L		0.03	0.10	11/17/15 21:05	BP	SW 8270C
Fluoranthene	< 0.05	ug/L		0.05	0.10	11/17/15 21:05	BP	SW 8270C
Pyrene	< 0.04	ug/L		0.04	0.10	11/17/15 21:05	BP	SW 8270C
Benzo(a)anthracene	< 0.05	ug/L		0.05	0.10	11/17/15 21:05	BP	SW 8270C
Chrysene	< 0.03	ug/L		0.03	0.10	11/17/15 21:05	BP	SW 8270C
Benzo(b)fluoranthene	< 0.08	ug/L		0.08	0.10	11/17/15 21:05	BP	SW 8270C
Benzo(k)fluoranthene	< 0.10	ug/L		0.10	0.10	11/17/15 21:05	BP	SW 8270C
Benzo(a)pyrene	< 0.04	ug/L		0.04	0.10	11/17/15 21:05	BP	SW 8270C
Indeno(1,2,3-cd)pyrene	< 0.04	ug/L		0.04	0.10	11/17/15 21:05	BP	SW 8270C
Dibenzo(a,h)anthracene	< 0.04	ug/L		0.04	0.10	11/17/15 21:05	BP	SW 8270C
Benzo(g,h,i)perylene	< 0.04	ug/L		0.04	0.10	11/17/15 21:05	BP	SW 8270C
Total Metals - PIA								
Antimony	3.8	ug/L		0.036	3.0	11/13/15 16:29	JMW	SW 6020
Arsenic	1.6	ug/L		0.13	1.0	11/16/15 12:32	JMW	SW 6020
Beryllium	< 0.017	ug/L		0.017	1.0	11/13/15 16:29	JMW	SW 6020
Cadmium	< 0.042	ug/L		0.042	1.0	11/13/15 16:29	JMW	SW 6020
Chromium	< 0.27	ug/L		0.27	4.0	11/16/15 12:32	JMW	SW 6020
Copper	0.56	ug/L	J	0.025	3.0	11/16/15 12:32	JMW	SW 6020
Lead	0.31	ug/L	J	0.025	1.0	11/13/15 16:29	JMW	SW 6020
Nickel	1.0	ug/L	J	0.075	5.0	11/16/15 12:32	JMW	SW 6020
Selenium	< 0.32	ug/L		0.32	1.0	11/16/15 12:32	JMW	SW 6020

ANALYTICAL RESULTS

Sample: **5111267-05**
Name: MLFP-6H-1.0%F
Matrix: Ground Water - Grab

Sampled: 11/05/15 15:25
Received: 11/05/15 16:30
PO #: 2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
Silver	< 0.028	ug/L		0.028	5.0	11/16/15 12:32	JMW	SW 6020
Thallium	< 0.062	ug/L		0.062	1.0	11/13/15 16:29	JMW	SW 6020
Zinc	< 0.50	ug/L		0.50	6.0	11/16/15 12:32	JMW	SW 6020
Total Metals - STL								
Mercury	< 0.2	ug/L		0.2	0.2	11/17/15 13:51	WPS	SW 7470

ANALYTICAL RESULTS

Sample: **5111267-06**
Name: ECCS-6H-1.0%F
Matrix: Ground Water - Grab

Sampled: 11/05/15 15:35
Received: 11/05/15 16:30
PO #: 2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
General Chemistry - STL								
Solids - total suspended solids (TSS)	< 0.10	mg/L		0.10	2.0	11/11/15 12:39	KLA	SM 2540D
Polychlorinated Biphenyls (PCBs) - STL								
Aroclor 1016	< 0.1	ug/L		0.1	0.5	11/10/15 04:05	BP	SW 8082*
Aroclor 1221	< 0.1	ug/L		0.1	0.5	11/10/15 04:05	BP	SW 8082*
Aroclor 1232	< 0.1	ug/L		0.1	0.5	11/10/15 04:05	BP	SW 8082*
Aroclor 1242	< 0.1	ug/L		0.1	0.5	11/10/15 04:05	BP	SW 8082*
Aroclor 1248	< 0.1	ug/L		0.1	0.5	11/10/15 04:05	BP	SW 8082*
Aroclor 1254	< 0.1	ug/L		0.1	0.5	11/10/15 04:05	BP	SW 8082*
Aroclor 1260	< 0.1	ug/L		0.1	0.5	11/10/15 04:05	BP	SW 8082*
Aroclors - Total	< 0.1	ug/L		0.1	0.5	11/10/15 04:05	BP	SW 8082*
Surrogate: TCMX	*87 %*	*41-135*				*11/10/15 04:05*	*BP*	*SW 8082**
Surrogate: Decachlorobiphenyl	*105 %*	*36-148*				*11/10/15 04:05*	*BP*	*SW 8082**
Semivolatile Organics - SIM - STL								
Naphthalene	0.47	ug/L		0.03	0.10	11/17/15 21:31	BP	SW 8270C
Acenaphthylene	< 0.03	ug/L		0.03	0.10	11/17/15 21:31	BP	SW 8270C
Acenaphthene	< 0.03	ug/L		0.03	0.10	11/17/15 21:31	BP	SW 8270C
Fluorene	< 0.04	ug/L		0.04	0.10	11/17/15 21:31	BP	SW 8270C
Phenanthrene	< 0.04	ug/L		0.04	0.10	11/17/15 21:31	BP	SW 8270C
Anthracene	< 0.03	ug/L		0.03	0.10	11/17/15 21:31	BP	SW 8270C
Fluoranthene	< 0.05	ug/L		0.05	0.10	11/17/15 21:31	BP	SW 8270C
Pyrene	< 0.04	ug/L		0.04	0.10	11/17/15 21:31	BP	SW 8270C
Benzo(a)anthracene	< 0.05	ug/L		0.05	0.10	11/17/15 21:31	BP	SW 8270C
Chrysene	< 0.03	ug/L		0.03	0.10	11/17/15 21:31	BP	SW 8270C
Benzo(b)fluoranthene	< 0.08	ug/L		0.08	0.10	11/17/15 21:31	BP	SW 8270C
Benzo(k)fluoranthene	< 0.10	ug/L		0.10	0.10	11/17/15 21:31	BP	SW 8270C
Benzo(a)pyrene	< 0.04	ug/L		0.04	0.10	11/17/15 21:31	BP	SW 8270C
Indeno(1,2,3-cd)pyrene	< 0.04	ug/L		0.04	0.10	11/17/15 21:31	BP	SW 8270C
Dibenzo(a,h)anthracene	< 0.04	ug/L		0.04	0.10	11/17/15 21:31	BP	SW 8270C
Benzo(g,h,i)perylene	< 0.04	ug/L		0.04	0.10	11/17/15 21:31	BP	SW 8270C
Total Metals - PIA								
Antimony	170	ug/L		0.036	3.0	11/13/15 16:34	JMW	SW 6020
Arsenic	3.6	ug/L		0.13	1.0	11/16/15 12:36	JMW	SW 6020
Beryllium	< 0.017	ug/L		0.017	1.0	11/13/15 16:34	JMW	SW 6020
Cadmium	< 0.042	ug/L		0.042	1.0	11/13/15 16:34	JMW	SW 6020
Chromium	< 0.27	ug/L		0.27	4.0	11/16/15 12:36	JMW	SW 6020
Copper	0.57	ug/L	J	0.025	3.0	11/16/15 12:36	JMW	SW 6020
Lead	0.66	ug/L	J	0.025	1.0	11/13/15 16:34	JMW	SW 6020
Nickel	2.2	ug/L	J	0.075	5.0	11/16/15 12:36	JMW	SW 6020
Selenium	< 0.32	ug/L		0.32	1.0	11/16/15 12:36	JMW	SW 6020

ANALYTICAL RESULTS

Sample: **5111267-06**
Name: ECCS-6H-1.0%F
Matrix: Ground Water - Grab

Sampled: 11/05/15 15:35
Received: 11/05/15 16:30
PO #: 2015 Dredged Study

Parameter	Result	Unit	Qualifier	MDL	RDL	Analyzed	Analyst	Method
Silver	< 0.028	ug/L		0.028	5.0	11/16/15 12:36	JMW	SW 6020
Thallium	< 0.062	ug/L		0.062	1.0	11/13/15 16:34	JMW	SW 6020
Zinc	1.7	ug/L	J	0.50	6.0	11/16/15 12:36	JMW	SW 6020
Total Metals - STL								
Mercury	0.5	ug/L		0.2	0.2	11/17/15 13:51	WPS	SW 7470

QC SAMPLE RESULTS

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch B518864 - 04 SW 3510 (608/8081/8082) - SW 8082									
Blank (B518864-BLK1)				Prepared & Analyzed: 11/09/15					
Aroclor 1016	< 0.1	ug/L							
Aroclor 1221	< 0.1	ug/L							
Aroclor 1232	< 0.1	ug/L							
Aroclor 1242	< 0.1	ug/L							
Aroclor 1248	< 0.1	ug/L							
Aroclor 1254	< 0.1	ug/L							
Aroclor 1260	< 0.1	ug/L							
Aroclors - Total	< 0.1	ug/L							
Surrogate: TCMX	*0.16*	*ug/L*		*0.2000*		*80*	*41-135*		
Surrogate: Decachlorobiphenyl	*0.18*	*ug/L*		*0.2000*		*88*	*36-148*		
LCS (B518864-BS1)				Prepared & Analyzed: 11/09/15					
Aroclor 1016	3	ug/L		5.000		68	43.1-112		
Aroclor 1260	3	ug/L		5.000		58	44.6-107		
Surrogate: TCMX	*0.15*	*ug/L*		*0.2000*		*73*	*41-135*		
Surrogate: Decachlorobiphenyl	*0.16*	*ug/L*		*0.2000*		*80*	*36-148*		
Matrix Spike (B518864-MS1)	**Sample: 5111254-04**			Prepared: 11/09/15 Analyzed: 11/10/15					
Aroclor 1016	4	ug/L	Q1	5.000	ND	71	77.2-124		
Aroclor 1260	3	ug/L		5.000	ND	61	52.6-137		
Surrogate: TCMX	*0.15*	*ug/L*		*0.2000*		*76*	*41-135*		
Surrogate: Decachlorobiphenyl	*0.18*	*ug/L*		*0.2000*		*88*	*36-148*		
Batch B518865 - 04 SW 3510 (625/8270) - SW 8270C									
Blank (B518865-BLK1)				Prepared: 11/12/15 Analyzed: 11/13/15					
Naphthalene	< 0.03	ug/L							
Acenaphthylene	< 0.03	ug/L							
Acenaphthene	< 0.03	ug/L							
Fluorene	< 0.04	ug/L							
Phenanthrene	< 0.04	ug/L							
Anthracene	< 0.03	ug/L							
Fluoranthene	< 0.05	ug/L							
Pyrene	< 0.04	ug/L							
Benzo(a)anthracene	< 0.05	ug/L							
Chrysene	< 0.03	ug/L							
Benzo(b)fluoranthene	< 0.08	ug/L							
Benzo(k)fluoranthene	< 0.10	ug/L							
Benzo(a)pyrene	< 0.04	ug/L							
Indeno(1,2,3-cd)pyrene	< 0.04	ug/L							
Dibenzo(a,h)anthracene	< 0.04	ug/L							
Benzo(g,h,i)perylene	< 0.04	ug/L							
Surrogate: Nitrobenzene-d5	*45*	*ug/L*		*80.00*		*57*	*18.5-97.5*		
Surrogate: 2-Fluorobiphenyl	*41*	*ug/L*		*80.00*		*52*	*13.9-97.2*		
Surrogate: p-Terphenyl-d14	*48*	*ug/L*		*80.00*		*59*	*17.5-104*		
LCS (B518865-BS1)				Prepared & Analyzed: 11/12/15					
Naphthalene	48.1	ug/L		80.00		60	51-87.6		
Acenaphthylene	45.9	ug/L		80.00		57	46.5-86.8		

QC SAMPLE RESULTS

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch B518865 - 04 SW 3510 (625/8270) - SW 8270C									
LCS (B518865-BS1)				Prepared & Analyzed: 11/12/15					
Acenaphthene	49.7	ug/L		80.00		62	49.1-89.7		
Fluorene	45.5	ug/L		80.00		57	53.5-88.1		
Phenanthrene	48.1	ug/L		80.00		60	50.4-94.4		
Anthracene	47.8	ug/L		80.00		60	49.6-92.1		
Fluoranthene	43.3	ug/L		80.00		54	49-93.6		
Pyrene	42.6	ug/L		80.00		53	44.5-88.4		
Benzo(a)anthracene	41.2	ug/L		80.00		51	43.8-90.5		
Chrysene	46.4	ug/L		80.00		58	46.5-92.3		
Benzo(b)fluoranthene	47.2	ug/L		80.00		59	50.4-93.5		
Benzo(k)fluoranthene	44.9	ug/L		80.00		56	50.2-91.1		
Benzo(a)pyrene	49.0	ug/L		80.00		61	50.6-89.8		
Indeno(1,2,3-cd)pyrene	49.3	ug/L		80.00		62	46-90.3		
Dibenzo(a,h)anthracene	46.1	ug/L		80.00		58	46.1-91.3		
Benzo(g,h,i)perylene	46.6	ug/L		80.00		58	36.7-107		
Surrogate: Nitrobenzene-d5	*43*	*ug/L*		*80.00*		*53*	*18.5-97.5*		
Surrogate: 2-Fluorobiphenyl	*40*	*ug/L*		*80.00*		*50*	*13.9-97.2*		
Surrogate: p-Terphenyl-d14	*40*	*ug/L*		*80.00*		*50*	*17.5-104*		
Matrix Spike (B518865-MS1)	**Sample: 5111254-06**			Prepared: 11/12/15 Analyzed: 11/14/15					
Naphthalene	45.4	ug/L		80.00	0.16	57	25.5-91.4		
Acenaphthylene	42.3	ug/L		80.00	ND	53	20-91.3		
Acenaphthene	46.1	ug/L		80.00	ND	58	22.1-95.9		
Fluorene	42.9	ug/L		80.00	ND	54	21.9-97.6		
Phenanthrene	44.4	ug/L		80.00	ND	56	27.7-96.7		
Anthracene	43.7	ug/L		80.00	ND	55	23.5-95.9		
Fluoranthene	39.9	ug/L		80.00	ND	50	24.8-97.1		
Pyrene	38.7	ug/L		80.00	ND	48	25.5-92.4		
Benzo(a)anthracene	37.0	ug/L		80.00	ND	46	25.1-92		
Chrysene	42.1	ug/L		80.00	ND	53	27-95.1		
Benzo(b)fluoranthene	45.5	ug/L		80.00	ND	57	28-100		
Benzo(k)fluoranthene	42.2	ug/L		80.00	ND	53	21.1-98.1		
Benzo(a)pyrene	44.3	ug/L		80.00	ND	55	16.9-98.8		
Indeno(1,2,3-cd)pyrene	47.8	ug/L		80.00	ND	60	25-92.2		
Dibenzo(a,h)anthracene	44.3	ug/L		80.00	ND	55	27.2-91.2		
Benzo(g,h,i)perylene	45.4	ug/L		80.00	ND	57	13.6-110		
Surrogate: Nitrobenzene-d5	*42*	*ug/L*		*80.00*		*52*	*18.5-97.5*		
Surrogate: 2-Fluorobiphenyl	*40*	*ug/L*		*80.00*		*50*	*13.9-97.2*		
Surrogate: p-Terphenyl-d14	*38*	*ug/L*		*80.00*		*48*	*17.5-104*		
Batch B518945 - 04-No Prep WC - SM 2540D									
Blank (B518945-BLK1)				Prepared & Analyzed: 11/10/15					
Solids - total suspended solids (TSS)	0.400	mg/L	J						
LCS (B518945-BS1)				Prepared & Analyzed: 11/10/15					
Solids - total suspended solids (TSS)	99.0	mg/L		100.0		99	82.9-110		
Duplicate (B518945-DUP1)	**Sample: 5111254-05**			Prepared & Analyzed: 11/10/15					
Solids - total suspended solids (TSS)	0.641	mg/L	J		1.20			61	5

QC SAMPLE RESULTS

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch B518945 - 04-No Prep WC - SM 2540D									
Duplicate (B518945-DUP2)	**Sample: 5111278-01**			Prepared & Analyzed: 11/10/15					
Solids - total suspended solids (TSS)	1710	mg/L			1710			0	5
Batch B519030 - 04-No Prep WC - SM 2540D									
Blank (B519030-BLK1)				Prepared & Analyzed: 11/11/15					
Solids - total suspended solids (TSS)	< 0.10	mg/L							
LCS (B519030-BS1)				Prepared & Analyzed: 11/11/15					
Solids - total suspended solids (TSS)	97.0	mg/L		100.0		97	82.9-110		
Duplicate (B519030-DUP1)	**Sample: 5111309-01**			Prepared & Analyzed: 11/11/15					
Solids - total suspended solids (TSS)	0.800	mg/L	X, J		0.400			67	5
Duplicate (B519030-DUP2)	**Sample: 5111572-01**			Prepared & Analyzed: 11/11/15					
Solids - total suspended solids (TSS)	1620	mg/L			1540			5	5
Batch B519071 - 04 SW 3510 (608/8081/8082) - SW 8082									
Blank (B519071-BLK1)				Prepared: 11/12/15 Analyzed: 11/13/15					
Aroclor 1016	< 0.1	ug/L							
Aroclor 1221	< 0.1	ug/L							
Aroclor 1232	< 0.1	ug/L							
Aroclor 1242	< 0.1	ug/L							
Aroclor 1248	< 0.1	ug/L							
Aroclor 1254	< 0.1	ug/L							
Aroclor 1260	< 0.1	ug/L							
Aroclors - Total	< 0.1	ug/L							
Surrogate: TCMX	*0.17*	*ug/L*		*0.2000*		*84*	*41-135*		
Surrogate: Decachlorobiphenyl	*0.20*	*ug/L*		*0.2000*		*99*	*36-148*		
LCS (B519071-BS1)				Prepared: 11/12/15 Analyzed: 11/13/15					
Aroclor 1016	4	ug/L		5.000		77	43.1-112		
Aroclor 1260	3	ug/L		5.000		68	44.6-107		
Surrogate: TCMX	*0.17*	*ug/L*		*0.2000*		*86*	*41-135*		
Surrogate: Decachlorobiphenyl	*0.20*	*ug/L*		*0.2000*		*100*	*36-148*		
LCS Dup (B519071-BSD1)				Prepared: 11/12/15 Analyzed: 11/13/15					
Aroclor 1016	4	ug/L		5.000		78	43.1-112	1	40
Aroclor 1260	3	ug/L		5.000		62	44.6-107	9	40
Surrogate: TCMX	*0.16*	*ug/L*		*0.2000*		*79*	*41-135*		
Surrogate: Decachlorobiphenyl	*0.17*	*ug/L*		*0.2000*		*86*	*36-148*		
Batch B519147 - SW 3015 - SW 6020									
Blank (B519147-BLK1)				Prepared: 11/12/15 Analyzed: 11/13/15					
Antimony	< 0.036	ug/L							
Arsenic	< 0.13	ug/L							
Beryllium	< 0.017	ug/L							
Cadmium	< 0.042	ug/L							
Chromium	< 0.27	ug/L							
Copper	< 0.025	ug/L							
Lead	< 0.025	ug/L							
Nickel	< 0.075	ug/L							

QC SAMPLE RESULTS

Batch B519147 - SW 3015 - SW 6020

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Blank (B519147-BLK1)				Prepared: 11/12/15 Analyzed: 11/13/15					
Selenium	< 0.32	ug/L							
Silver	< 0.028	ug/L							
Thallium	< 0.062	ug/L							
Zinc	< 0.50	ug/L							
LCS (B519147-BS1)				Prepared: 11/12/15 Analyzed: 11/13/15					
Antimony	517	ug/L		555.6		93	80-120		
Arsenic	564	ug/L		555.6		102	80-120		
Beryllium	563	ug/L		555.6		101	80-120		
Cadmium	586	ug/L		555.6		106	80-120		
Chromium	584	ug/L		555.6		105	80-120		
Copper	584	ug/L		555.6		105	80-120		
Lead	574	ug/L		555.6		103	80-120		
Nickel	585	ug/L		555.6		105	80-120		
Selenium	595	ug/L		555.6		107	80-120		
Silver	583	ug/L		555.6		105	80-120		
Thallium	537	ug/L		555.6		97	80-120		
Zinc	581	ug/L		555.6		105	80-120		
Matrix Spike (B519147-MS1)	**Sample: 5111753-02**			Prepared: 11/12/15 Analyzed: 11/13/15					
Antimony	570	ug/L		555.6	0.143	103	75-125		
Arsenic	636	ug/L		555.6	4.34	114	75-125		
Beryllium	637	ug/L		555.6	ND	115	75-125		
Cadmium	567	ug/L		555.6	ND	102	75-125		
Chromium	641	ug/L		555.6	0.768	115	75-125		
Copper	591	ug/L		555.6	0.613	106	75-125		
Lead	502	ug/L		555.6	0.232	90	75-125		
Nickel	626	ug/L		555.6	11.5	111	75-125		
Selenium	652	ug/L		555.6	1.12	117	75-125		
Silver	603	ug/L		555.6	ND	109	75-125		
Thallium	< 0.062	ug/L			ND		75-125		
Zinc	595	ug/L		555.6	7.14	106	75-125		
Matrix Spike Dup (B519147-MSD1)	**Sample: 5111753-02**			Prepared: 11/12/15 Analyzed: 11/13/15					
Antimony	595	ug/L		555.6	0.143	107	75-125	4	20
Arsenic	649	ug/L		555.6	4.34	116	75-125	2	20
Beryllium	639	ug/L		555.6	ND	115	75-125	0.2	20
Cadmium	579	ug/L		555.6	ND	104	75-125	2	20
Chromium	659	ug/L		555.6	0.768	118	75-125	3	20
Copper	606	ug/L		555.6	0.613	109	75-125	3	20
Lead	517	ug/L		555.6	0.232	93	75-125	3	20
Nickel	640	ug/L		555.6	11.5	113	75-125	2	20
Selenium	657	ug/L		555.6	1.12	118	75-125	0.8	20
Silver	632	ug/L		555.6	ND	114	75-125	5	20
Thallium	< 0.062	ug/L			ND		75-125		20
Zinc	608	ug/L		555.6	7.14	108	75-125	2	20

Batch B519368 - 04-SW 7470A/245.1 - SW 7470

QC SAMPLE RESULTS

Parameter	Result	Unit	Qual	Spike Level	Source Result	%REC	%REC Limits	RPD	RPD Limit
Batch B519368 - 04-SW 7470A/245.1 - SW 7470									
Blank (B519368-BLK1)				Prepared & Analyzed: 11/17/15					
Mercury	< 0.2	ug/L							
LCS (B519368-BS1)				Prepared & Analyzed: 11/17/15					
Mercury	2.15	ug/L		2.000		108	85-115		
Matrix Spike (B519368-MS1)	**Sample: 5111254-03**			Prepared & Analyzed: 11/17/15					
Mercury	< 0.2	ug/L	NA, Q4, R	2.000	117	NR	50-150		
Matrix Spike (B519368-MS2)	**Sample: 5111652-01**			Prepared & Analyzed: 11/17/15					
Mercury	20.8	ug/L		20.00	ND	104	50-150		
Matrix Spike Dup (B519368-MSD1)	**Sample: 5111254-03**			Prepared & Analyzed: 11/17/15					
Mercury	< 0.2	ug/L	NA, Q4, R	2.000	117	NR	50-150		20
Matrix Spike Dup (B519368-MSD2)	**Sample: 5111652-01**			Prepared & Analyzed: 11/17/15					
Mercury	20.6	ug/L		20.00	ND	103	50-150	1	20

NOTES

Specific method revisions used for analysis are available upon request.

Certifications

PIA - Peoria, IL
TNI Accreditation for Drinking Water, Wastewater, Hazardous and Solid Wastes Fields of Testing through IL EPA Lab No. 100230
Illinois Department of Public Health Bacteriological Analysis in Drinking Water Approved Laboratory Registry No. 17553
Missouri Department of Natural Resources Certificate of Approval for Microbiological Laboratory Service No. 870
Drinking Water Certifications: Iowa (240); Kansas (E-10338); Missouri (870)
Wastewater Certifications: Arkansas (88-0677); Iowa (240); Kansas (E-10338)
Hazardous/Solid Waste Certifications: Arkansas (88-0677); Iowa (240); Kansas (E-10338)

SPMO - Springfield, MO
USEPA DMR-QA Program

STL - St. Louis, MO
TNI Accreditation for Wastewater, Hazardous and Solid Wastes Fields of Testing through KS Lab No. E-10389
Illinois Department of Public Health Bacteriological Analysis in Drinking Water Approved Laboratory Registry No. 171050
Drinking Water Certifications: Missouri (1050)
Missouri Department of Natural Resources

* Not a TNI accredited analyte

Qualifiers

J	Estimated value; value between the Method Detection Limit and Method Reporting Limit.
NA	Not Analyzed.
Q1	Matrix Spike failed % Recovery
Q4	The matrix spike recovery result is unusable since the analyte concentration in the sample is greater than four times the spike level. The associated blank spike was acceptable.
R	Matrix Spike/Matrix Spike Duplicate Failed %Relative Percent Difference
X	Values are both under 25 mg/L and within one method reporting limit of each other.

Roxann Shull

Certified by: Roxann Shull, Client Services Supervisor

PDC Laboratories, Inc. – St. Louis
3278 N. Highway 67 (Lindbergh)
Florissant, MO 63033
www.pdclab.com

CHAIN OF CUSTODY RECORD

Phone (314) 432-0550 or (314) 921-4488
Fax (314) 432-4977

State where samples collected MA

(Instructions/Sample Acceptance Policy on Reverse)

ALL SHADED AREAS MUST BE COMPLETED BY CLIENT (PLEASE PRINT)

① CLIENT TETRA TECH
ADDRESS 1634 EASTPORT PLAZA
CITY STATE ZIP COLLINSVILLE, IL 62234
CONTACT PERSON P. SMITH

PROJECT NUMBER 11/5/2015
P.O. NUMBER
MEANS SHIPPED
PHONE NUMBER
FAX NUMBER
EMAIL ADDRESS
SAMPLER P. SMITH
SAMPLER'S SIGNATURE

MATRIX TYPES:
WW-WASTEWATER
DW-DRINKING WATER
GW-GROUND WATER
WWSL-SLUDGE
NAS-SOLID
L'CHT-LEACHATE
NAL-NONAQUEOUS
SOIL-SOILS

④ (FOR LAB USE ONLY)
LOGIN # 511267
LOGGED BY: HE
LAB PROJ. #
TEMPLATE:
PROJ. MGR.:

② SAMPLE DESCRIPTION AS YOU WANT ON REPORT	DATE COLLECTED	TIME COLLECTED	SAMPLE TYPE GRAB	SAMPLE TYPE COMP	MATRIX TYPE	Bottle Count	③ ANALYSIS REQUESTED PAHs	PCBs	METALS	TSS			REMARKS
LVFP-6H-1.0%	11/5/2015	1440	✓		WAT	5	X	X	X	X			SEE EMAIL
MLFP-6H-1.0%		1450	✓		WAT	5	X	X	X	X			"NEW TREATABILITY
ECCS-6H-1.0%		1500	✓		WAT	5	X	X	X	X			STUDY", 11/28/2015
LVFP-6H-1.0% F		1515	✓		WAT	5	X	X	X	X			FOR PROJECT
MLFP-6H-1.0% F		1525	✓		WAT	5	X	X	X	X			DETAILS &
ECCS-6H-1.0% F		1535	✓		WAT	5	X	X	X	X			SPECIFICATIONS

11/5/2015

⑤ TURNAROUND TIME (RUSH TAT IS SUBJECT TO PDC LABS APPROVAL AND SURCHARGE)
[✓ NORMAL (8-10 Bus. Days)] RUSH (5 Bus. Days) *Fastrak*™ (3 Bus. Days) 1-2 Bus. Days Same Day
DATE DUE

RESULTS BY: [✓ E-MAIL] FAX / PHONE CALL PHONE/FAX# IF DIFFERENT FROM ABOVE

⑥ The sample temperature will be measured upon receipt at the lab. By initialing this area, you request that the lab notify you, before proceeding with analysis, if the sample temperature is outside of the range of 0.1-6.0°C. By not initialing this area, you allow the lab to proceed with analytical testing regardless of the sample temperature. ______

⑦ RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY:	DATE	TIME
	11/5/2015	16:30	Heather Earhart	11/5/15	16:30
RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY:	DATE	TIME
RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY:	DATE	TIME
RELINQUISHED BY: (SIGNATURE)	DATE	TIME	RECEIVED BY:	DATE	TIME

⑧ COMMENTS:(FOR LAB USE ONLY)

SAMPLE TEMPERATURE UPON RECEIPT 18.6 °C
CHILL PROCESS STARTED PRIOR TO RECEIPT [✓ Y] OR N
SAMPLES(S) RECEIVED ON ICE [✓ Y] OR N
PROPER BOTTLES RECEIVED IN GOOD CONDITION [✓ Y] OR N
BOTTLES FILLED WITH ADEQUATE VOLUME [✓ Y] OR N
SAMPLES RECEIVED WITHIN HOLD TIME(S) [✓ Y] OR N
(EXCLUDES TYPICAL FIELD PARAMETERS)
DATE AND TME TAKEN FROM SAMPLE BOTTLE ______

Thank you for using PDC Laboratories, Inc. Locations in Peoria, IL; St. Louis, MO; and Springfield, MO

PAGE 1 OF 1

SUBCONTRACT ORDER
Transfer Chain of Custody

PDC Laboratories, Inc.
5111267

SENDING LABORATORY

PDC Laboratories, Inc.
3278 N Highway 67
Florissant, MO 63033
(800) 333-3278

RECEIVING LABORATORY

PDC Laboratories, Inc.
2231 W Altorfer Dr
Peoria, IL 61615
(309) 692-9688

Sample: **5111267-01**
Name: LUFP-6H-1.0%

Sampled: 11/05/15 14:40
Matrix: Water

Analysis	Due	Expires	Comments
Ag 6020 Tot	11/17/15 16:00	05/03/16 14:40	ALL 6020 METALS REPORT TO MDL
As 6020 Tot	11/17/15 16:00	05/03/16 14:40	
Be 6020 Tot	11/17/15 16:00	05/03/16 14:40	
Cd 6020 Tot	11/17/15 16:00	05/03/16 14:40	
Cr 6020 Tot	11/17/15 16:00	05/03/16 14:40	
Cu 6020 Tot	11/17/15 16:00	05/03/16 14:40	
Ni 6020 Tot	11/17/15 16:00	05/03/16 14:40	
Pb 6020 Tot	11/17/15 16:00	05/03/16 14:40	
Sb 6020 Tot	11/17/15 16:00	05/03/16 14:40	
Se 6020 Tot	11/17/15 16:00	05/03/16 14:40	
Tl 6020 Tot	11/17/15 16:00	05/03/16 14:40	
Zn 6020 Tot	11/17/15 16:00	05/03/16 14:40	

SUBCONTRACT ORDER
Transfer Chain of Custody

PDC Laboratories, Inc.

5111267

SENDING LABORATORY

PDC Laboratories, Inc.
3278 N Highway 67
Florissant, MO 63033
(800) 333-3278

RECEIVING LABORATORY

PDC Laboratories, Inc.
2231 W Altorfer Dr
Peoria, IL 61615
(309) 692-9688

Sample: 5111267-02
Name: MLFP-6H-1.0%

Sampled: 11/05/15 14:50
Matrix: Water

Analysis	Due	Expires	Comments
Ag 6020 Tot	11/17/15 16:00	05/03/16 14:50	ALL 6020 METALS REPORT TO MDL
As 6020 Tot	11/17/15 16:00	05/03/16 14:50	
Be 6020 Tot	11/17/15 16:00	05/03/16 14:50	
Cd 6020 Tot	11/17/15 16:00	05/03/16 14:50	
Cr 6020 Tot	11/17/15 16:00	05/03/16 14:50	
Cu 6020 Tot	11/17/15 16:00	05/03/16 14:50	
Ni 6020 Tot	11/17/15 16:00	05/03/16 14:50	
Pb 6020 Tot	11/17/15 16:00	05/03/16 14:50	
Sb 6020 Tot	11/17/15 16:00	05/03/16 14:50	
Se 6020 Tot	11/17/15 16:00	05/03/16 14:50	
Tl 6020 Tot	11/17/15 16:00	05/03/16 14:50	
Zn 6020 Tot	11/17/15 16:00	05/03/16 14:50	

SUBCONTRACT ORDER
Transfer Chain of Custody

PDC Laboratories, Inc.

5111267

SENDING LABORATORY

PDC Laboratories, Inc.
3278 N Highway 67
Florissant, MO 63033
(800) 333-3278

RECEIVING LABORATORY

PDC Laboratories, Inc.
2231 W Altorfer Dr
Peoria, IL 61615
(309) 692-9688

Sample: **5111267-03**
Name: ECCS-6H-1.0%

Sampled: 11/05/15 15:00
Matrix: Water

Analysis	Due	Expires	Comments
Ag 6020 Tot	11/17/15 16:00	05/03/16 15:00	ALL 6020 METALS REPORT TO MDL
As 6020 Tot	11/17/15 16:00	05/03/16 15:00	
Be 6020 Tot	11/17/15 16:00	05/03/16 15:00	
Cd 6020 Tot	11/17/15 16:00	05/03/16 15:00	
Cr 6020 Tot	11/17/15 16:00	05/03/16 15:00	
Cu 6020 Tot	11/17/15 16:00	05/03/16 15:00	
Ni 6020 Tot	11/17/15 16:00	05/03/16 15:00	
Pb 6020 Tot	11/17/15 16:00	05/03/16 15:00	
Sb 6020 Tot	11/17/15 16:00	05/03/16 15:00	
Se 6020 Tot	11/17/15 16:00	05/03/16 15:00	
Tl 6020 Tot	11/17/15 16:00	05/03/16 15:00	
Zn 6020 Tot	11/17/15 16:00	05/03/16 15:00	

SUBCONTRACT ORDER
Transfer Chain of Custody

PDC Laboratories, Inc.

5111267

SENDING LABORATORY

PDC Laboratories, Inc.
3278 N Highway 67
Florissant, MO 63033
(800) 333-3278

RECEIVING LABORATORY

PDC Laboratories, Inc.
2231 W Altorfer Dr
Peoria, IL 61615
(309) 692-9688

Sample: 5111267-04
Name: LUFP-6H-1.0%F

Sampled: 11/05/15 15:15
Matrix: Water

Analysis	Due	Expires	Comments
Ag 6020 Tot	11/17/15 16:00	05/03/16 15:15	ALL 6020 METALS REPORT TO MDL
As 6020 Tot	11/17/15 16:00	05/03/16 15:15	
Be 6020 Tot	11/17/15 16:00	05/03/16 15:15	
Cd 6020 Tot	11/17/15 16:00	05/03/16 15:15	
Cr 6020 Tot	11/17/15 16:00	05/03/16 15:15	
Cu 6020 Tot	11/17/15 16:00	05/03/16 15:15	
Ni 6020 Tot	11/17/15 16:00	05/03/16 15:15	
Pb 6020 Tot	11/17/15 16:00	05/03/16 15:15	
Sb 6020 Tot	11/17/15 16:00	05/03/16 15:15	
Se 6020 Tot	11/17/15 16:00	05/03/16 15:15	
Tl 6020 Tot	11/17/15 16:00	05/03/16 15:15	
Zn 6020 Tot	11/17/15 16:00	05/03/16 15:15	

SUBCONTRACT ORDER
Transfer Chain of Custody

PDC Laboratories, Inc.

5111267

SENDING LABORATORY

PDC Laboratories, Inc.
3278 N Highway 67
Florissant, MO 63033
(800) 333-3278

RECEIVING LABORATORY

PDC Laboratories, Inc.
2231 W Altorfer Dr
Peoria, IL 61615
(309) 692-9688

Sample: 5111267-05
Name: MLFP-6H-1.0%F

Sampled: 11/05/15 15:25
Matrix: Water

Analysis	Due	Expires	Comments
Ag 6020 Tot	11/17/15 16:00	05/03/16 15:25	ALL 6020 METALS REPORT TO MDL
As 6020 Tot	11/17/15 16:00	05/03/16 15:25	
Be 6020 Tot	11/17/15 16:00	05/03/16 15:25	
Cd 6020 Tot	11/17/15 16:00	05/03/16 15:25	
Cr 6020 Tot	11/17/15 16:00	05/03/16 15:25	
Cu 6020 Tot	11/17/15 16:00	05/03/16 15:25	
Ni 6020 Tot	11/17/15 16:00	05/03/16 15:25	
Pb 6020 Tot	11/17/15 16:00	05/03/16 15:25	
Sb 6020 Tot	11/17/15 16:00	05/03/16 15:25	
Se 6020 Tot	11/17/15 16:00	05/03/16 15:25	
Tl 6020 Tot	11/17/15 16:00	05/03/16 15:25	
Zn 6020 Tot	11/17/15 16:00	05/03/16 15:25	

SUBCONTRACT ORDER

Transfer Chain of Custody

PDC Laboratories, Inc.

5111267

SENDING LABORATORY

PDC Laboratories, Inc.
3278 N Highway 67
Florissant, MO 63033
(800) 333-3278

RECEIVING LABORATORY

PDC Laboratories, Inc.
2231 W Altorfer Dr
Peoria, IL 61615
(309) 692-9688

Sample: 5111267-06
Name: ECCS-6H-1.0%F

Sampled: 11/05/15 15:35
Matrix: Water

Analysis	Due	Expires	Comments
Ag 6020 Tot	11/17/15 16:00	05/03/16 15:35	ALL 6020 METALS REPORT TO MDL
As 6020 Tot	11/17/15 16:00	05/03/16 15:35	
Be 6020 Tot	11/17/15 16:00	05/03/16 15:35	
Cd 6020 Tot	11/17/15 16:00	05/03/16 15:35	
Cr 6020 Tot	11/17/15 16:00	05/03/16 15:35	
Cu 6020 Tot	11/17/15 16:00	05/03/16 15:35	
Ni 6020 Tot	11/17/15 16:00	05/03/16 15:35	
Pb 6020 Tot	11/17/15 16:00	05/03/16 15:35	
Sb 6020 Tot	11/17/15 16:00	05/03/16 15:35	
Se 6020 Tot	11/17/15 16:00	05/03/16 15:35	
Tl 6020 Tot	11/17/15 16:00	05/03/16 15:35	
Zn 6020 Tot	11/17/15 16:00	05/03/16 15:35	

Please email results to Roxann Shull at rshull@pdclab.com

Date Shipped: 11/9/15 Total # of Containers: 6 Sample Origin (State): _____ PO #: __________

Turn-Around Time Requested ☑ NORMAL ☐ RUSH Date Results Needed: __________

Heather Carlant	11/9/15		
Relinquished By	Date/Time	Received By	Date/Time
			11/10/15 1010
Relinquished By	Date/Time	Received By	Date/Time

Sample Temperature Upon Receipt 5 °C
Sample(s) Received on Ice [✓ Y] or N
Proper Bottles Received in Good Condition [✓ Y] or N
Bottles Filled with Adequate Volume [✓ Y] or N
Samples Received Within Hold Time [✓ Y] or N
Date/Time Taken From Sample Bottle Y or [✓ N]

APPENDIX 8A

October 2015 Fireworks Single Beam Bathymetric Survey Technical Memorandum

October 2015 Fireworks Single Beam Bathymetric Survey

Technical Memorandum

October 27, 2015

Submitted to:
Tetra Tech
160 Federal Street, 3rd Floor
Boston, MA 02110

Prepared by:

Tetra Tech
19803 North Creek Parkway
Bothell, WA 98208

Table of Contents

List of Appendices

List of Figures

List of Tables

Acronyms and Abbreviations

CTD	conductivity, temperature, depth
GPS	Global Positioning System
MSL	mean sea level
NAD83	North American Datum 1983
QC	quality control
RTK	real-time kinematic
Tt	Tetra Tech
UTC	Coordinated Universal Time

1 Overview

Tetra Tech, Inc. (Tetra Tech) conducted a single beam bathymetric survey on Lily and Factory Ponds in Hanover, MA on October 2nd through 4th, 2015. The primary survey equipment consisted of a single beam echosounder (SBE) sweep system and vessel positioning equipment. These systems were used to map bathymetry in these ponds, to the extents accessible by vessel and the sonars ability to capture valid data. The charted results of the bathymetric survey are provided in Appendix A.

2 System Setup

The SBE system and support sensors were installed on a small vessel in the Factory Pond (Figure 1). One sonar head was installed with the head approximately one foot below the waterline and directly below the positioning and elevation sensors. The other sonar, that was collecting data simultaneously, was fixed to the hull of the vessel. These ponds were observed to have significant aquatic vegetation during the time of survey and extra measures were taken to ensure data collection and reduce stand-down time due to packed vegetation covering the sonar (Figure 2). However it is likely that bathymetry in numerous areas have impacted by the presence of aquatic vegetation resulted in shoal biased data. Additionally due to the presence of heavy aquatic vegetation some areas were not able to be surveyed.

Figure 1. Single Beam Survey Vessel (sonar pole stored on angle, not survey ready)

Figure 2. Onsite Aquatic Vegetation

The equipment used for the survey are listed in Table 1. Data collection and navigation software for the bathymetry survey was HYPACK® v.2014.

Table 1. **Survey Equipment**

Sensor Type	Manufacturer and Model
Single Beam Sonar	Ross 875-X Single Beam Sweep System w/ two 3º 200Khz sonars
Elevation	Leica 1230 RTK GPS
Position	Trimble SPS 651 / Leica 1230 RTK GPS
Sound Speed Sensors	YSI CastAway CTD

2.1 Geodesy Settings

Horizontal (X, Y) positioning data for the survey were collected in North American Datum 1983 (NAD83) U.S. State Plane Massachusetts Mainland. Elevation data were collected in Mean Sea Level (MSL) based on project monitoring well DP-MW1 top of riser elevation. Halnon Land Surveying Inc provided control verification and additional monuments for this and potential future survey work. Appendix B contains the Halnon submission. Table 2 presents the geodesy settings used for the survey.

Table 2. Survey Geodesy Settings

Parameter	Setting
Horizontal Datum	NAD-83
Zone	Massachusetts Mainland State Plane Zone 2001
Vertical Datum	MSL (Derived from DP-MW1 TOR)
Distance Unit	US Survey feet
Depth Unit	US Survey feet

2.2 GPS Control and Validation

Horizontal and vertical positioning and quality control were achieved using a monuments DP-MW1 TOR, BM6 and DH-SET. Vessel positioning was achieved via real-time kinematic (RTK) corrections from a base station set up near the survey area to tie into local control. The historic control points specified for the survey were unrecoverable or under dense tree canopy, this drove the monument establishment effort. The Halnon Land Surveying, Inc report is provided in Appendix B.

The Leica 1230 RTK global positioning system (GPS) used on the boat was placed on control points for the purposes of comparison and position verification. The results are presented in Table 3.

Table 3. GPS Positioning Quality Control (all units in feet, all time local)

PID	Control Monument - Halnon	Date/Time	Observed Easting	Observed Northing	Observed Elevation	Delta Easting	Delta Northing	Delta Elevation
QC-100215-BM1A	No. 5 – BM1	10/2/2015 8:46	825932.146	2858452.480	53.028	0.053	0.054	0.017
QC-BM6-100315B	No. 6	10/3/2015 16:40	825912.508	2858451.286	54.820	0.026	0.003	0.031
QC-BM6-100315A	No. 6	10/3/2015 16:39	825912.512	2858451.290	54.791	0.030	0.001	0.060
QC-BM1-100315A	No. 5 – BM1	10/3/2015 16:41	825932.182	2858452.459	53.003	0.016	0.033	0.042
QC-BM6-100415A	No. 6	10/4/2015 7:15	825912.531	2858451.280	54.788	0.049	0.009	0.062
QC-BM1-100415A	No. 5 – BM1	10/4/2015 7:19	825932.212	2858452.436	53.031	0.014	0.010	0.014

3 Survey Procedures

The goal of the survey was to map the elevation of the pond bottom within the Lily and Factory Ponds at the site in Hanover, MA.

Figure 3. Project Survey Area (outline in red)

3.1 Daily Quality Control Procedures

Daily bar checks and GPS waterline checks were conducted as a QC procedure to confirm the sonar's ability to record accurate depth measurements.

The bar check QC uses a reflective target at known depth below the water surface to verify the sonar depth measurements, including the application of sound speed and the operator input sonar head draft. This QC check verifies that the sonar system, as installed and configured, will provide accurate water surface relative depth measurements within defined tolerances.

The waterline QC compares water surface elevation measurements done using a RTK GPS rover and the vessel survey system. This verifies the accuracy of RTK GPS vertical measurements and offset values on the survey vessel. This QC check also documents any variation or error between shore and vessel GPS units and serves as an elevation baseline reference for the measurements taken throughout the survey.

The combination of the two QC tests provides validation of the sonar depth measurement accuracy relative to the survey vertical datum. The results are presented in Tables 4 and 5.

Table 4. Bar Check Quality Control (all units in feet, all time UTC)

Date/Time	Bar Depth	Sonar Draft	Observed Depth	Total Depth	Delta Depth
10/2/2015 14:38	2.00	0.67	1.4	2.07	0.07
10/3/2015 13:21	2.80	0.70	2.20	2.90	0.10
10/4/2015 12:43	5.00	0.70	4.35	5.05	0.05

Table 5. Waterline Quality Control (all units in feet, all time local)

Date/Time	Rover Height	Tidal Draft	Boat Tide	Total Tide	Delta Tide
10/2/2015 8:48	49.05	0.67	48.38	49.05	0.00
10/2/2015 16:54	49.15	0.67	48.53	49.20	0.05
10/3/2015 9:27*	49.04	0.70	48.40	49.10	0.06
10/4/2015 8:48	49.35	0.70	48.61	49.31	0.04

*10/03/2015 Tide required post processing, elevation shift of -0.854ft

.

4 Bathymetry Results

The charts from the single beam bathymetry survey of the Lily and Factory Ponds are provided in Appendix A. Charts are provide with the bathymetry presented as a digital terrain model (DTM) and sounding in each cell for a 3 foot cell size grid.

5 Deliverables

Project Deliverables, all of which were provided electronically and within this memorandum, include the following.

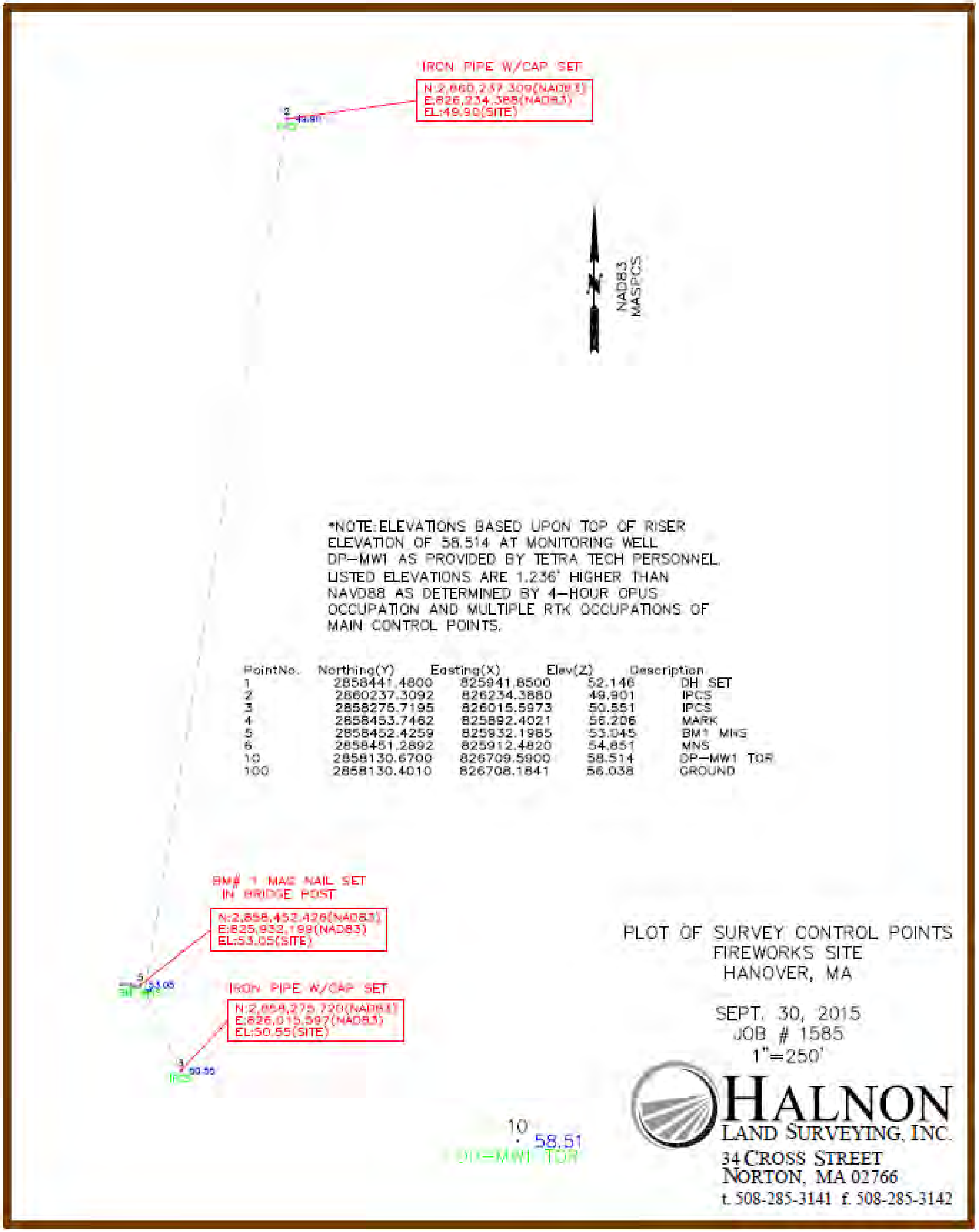
1. Data collection technical memorandum documenting survey collection, processing methods and deliverables.
2. SBE – cleaned surface (outliers/noise removed), attitude and tidally corrected, and gridded XYZ file (Appendix C),
3. The final charts from the single beam bathymetry survey are provided in Appendix A. Charts are provided with the bathymetry presented as a digital terrain model (DTM) and soundings in each grid cell.

Appendix A

Fireworks Bathymetry Charts for Lily and Factory Ponds October 2015 (submitted electronically)

Appendix B

Halnon PLS Control Monument Report



*NOTE: ELEVATIONS BASED UPON TOP OF RISER ELEVATION OF 58.514 AT MONITORING WELL DP-MW1 AS PROVIDED BY TETRA TECH PERSONNEL. LISTED ELEVATIONS ARE 1.236' HIGHER THAN NAVD88 AS DETERMINED BY 4-HOUR OPUS OCCUPATION AND MULTIPLE RTK OCCUPATIONS OF MAIN CONTROL POINTS.

PointNo.	Northing(Y)	Easting(X)	Elev(Z)	Description
1	2858441.4800	825941.8500	52.146	DH SET
2	2860237.3092	826234.3880	49.901	IPCS
3	2858275.7195	826015.5973	50.551	IPCS
4	2858453.7462	825892.4021	56.206	MARK
5	2858452.4259	825932.1985	53.045	BM1 MNG
6	2858451.2892	825912.4820	54.851	MNS
10	2858130.6700	826709.5900	58.514	DP-MW1 TOR
100	2858130.4010	826708.1841	56.038	GROUND

PLOT OF SURVEY CONTROL POINTS
FIREWORKS SITE
HANOVER, MA

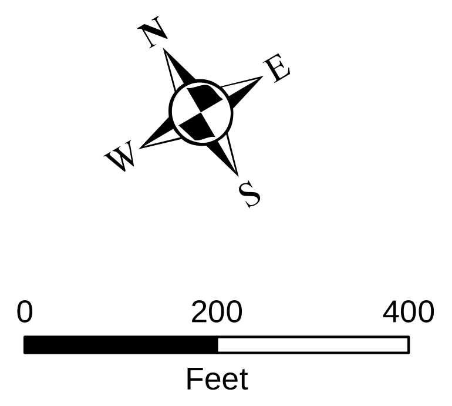
SEPT. 30, 2015
JOB # 1585
1"=250'

HALNON
LAND SURVEYING, INC.
34 CROSS STREET
NORTON, MA 02766
t. 508-285-3141 f. 508-285-3142

Appendix C

ASCII ENZ Data Set of the Single Beam Data (submitted electronically)

Document Path: X:\2015_Tt_Fireworks\ArcGIS\maps\Soundings.mxd



NOTE: The data is based on a 3ft uncertainty grid.

Geodetic Settings		Survey Equipment	
Horizontal Datum	North American Datum 1983	**Bathymetry Sensor**	Ross 875-X Singlebeam Sweep System
Projection	Massachusetts Mainland State Plane Zone 2001	**Positioning System**	Leica 1230 RTK GPS/ Trimble SPS 651
Horizontal Units	U.S. Survey Feet	**Sound Speed Profilers**	YSI Castaway
Vertical Units	U.S. Survey Feet		
Vertical Datum	MSL		
Base Station PID(s):	BM6 and DH Set, Halnon Land Surveying Inc.	**Dates Surveyed**	10/2/2015 - 10/4/2015

2015 Fireworks Soundings

Tetra Tech
19803 North Creek Parkway
Bothell, WA 98012

TETRA TECH

Collection/Processing:	Kyle Enright	
Drafted by:	MJ Watson	SHEET
Reviewed by:	B. Bridge	2 of 2

APPENDIX 9A

Risk Characterization Bridging for the Fireworks Site

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ATTACHMENTS

ACRONYMS AND ABBREVIATIONS

AVS	acid volatile sulfide
bgs	below ground surface
CCA	Central Commercial Area
cm	centimeter
CMR	Code of Massachusetts Regulations
COC	chemical of concern
COEC	chemical of environmental concern
Con Com	Town of Hanover Conservation Commission
COPC	chemical of potential concern
COPEC	chemical of potential environmental concern
CSA	Comprehensive Site Assessment
CSM	conceptual site model
CUG	cleanup goal
CWA	Cold Waste Area
CY	cubic yard
DCE	1,1-dichloroethylene
DPW	Town of Hanover Department of Public Works
ECC	Eastern Channel Corridor
ELCR	excess lifetime cancer risk
ERC	Environmental Risk Characterization
FTRBA	Former Test Range Berm Area
HI	hazard index
HMX	octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
IHRC	Indian Head River Corridor
Kg	kilogram
LDRC	Lower Drinkwater River Corridor
LMB	largemouth bass
LNA	Lower North Area
LOAEL	lowest observable adverse effect level
LUFP	Lily Pond and Upper Factory Pond
MassDEP	Massachusetts Department of Environmental Protection
MCP	Massachusetts Contingency Plan
MD	munitions debris
MEC	munitions and explosives of concern
MeHg	methylmercury
mg	milligram
MLFP	Middle and Lower Factory Pond

MUA	Marsh Upland Area
NOAEL	no observable adverse effect level
NSR	No Significant Risk
OHM	oil and hazardous material
PGA	Potential Greenway Area
PQL	practical quantitation limit
PRG	Preliminary Remediation Goals
RAM	Release Abatement Measure
RAO	Remedial Action Objective [Note: Does not refer to a “Response Action Outcome”]
RAP	Remedial Action Plan
RDX	hexahydro-1,3,5-trinitro-1,3,5-triazine
RfC	reference concentration
RfD	reference dose
RRD	range-related debris
RSL	USEPA Regional Screening Level
SCCA	Southern Conservation Commission Area
SDA	Southern Disposal Area
SEM	simultaneously extracted metals
Site	Fireworks Site
SVOC	semi-volatile organic compound
TAL	target analyte list
TCLP	toxicity characteristic leaching procedure
THg	total mercury
UCL	upper concentration limit
UDRC	Upper Drinkwater River Corridor
UNA	Upper North Area
UXO	unexploded ordnance
VOC	volatile organic compound

1. Introduction

1.1. Bridging the Gap Since the Last Risk Characterization

The risk characterization prepared as part of the 2005 Phase II Comprehensive Site Assessment (CSA) presented the approach and results of a Method 3 risk characterization performed for the soil, groundwater, sediment, surface water, and fish tissue at the Fireworks Site ("Site"). The conceptual site model (CSM) for potential human and ecological exposures that was developed in 2005 reflected the current and the reasonably foreseeable future exposure pathways for the Site receptors to the impacted environmental media in each potential exposure area based on the information available at that time. Since then, this CSM and the content of the 2005 risk characterization have become out of date in some ways to different degrees and are now not in complete accordance with the risk characterization components of the current Massachusetts Contingency Plan (MCP). Therefore, a risk characterization "bridging" effort was designed to update the CSM for the Site, reassess the chemicals of potential concern, and develop proposed preliminary remediation goals (PRGs) for those constituents in the identified exposure media at the Site. This appendix describes this risk characterization "bridging" effort and its findings. This set of risk characterization activities was performed to provide a linkage between the last formal risk characterization work performed for the Site and the updated PRGs required to revise the Phase III Remedial Action Plan (RAP). An updated CSM, updated remedial action objectives (RAOs) (Note: This acronym does not stand for "Response Action Outcome" that is commonly abbreviated as "RAO" in the MCP), and associated soil and sediment PRGs will be incorporated into the revised Phase III RAP analysis of remediation options. The Phase III RAP will be revised to incorporate the additional site characterization data collected since 2009 and consider updated remediation costs and performance.

To revise the Phase III RAP, a surficial sediment mercury PRG for the ponds and streams and revised risk-based PRGs for the impacted upland soil and accessible shoreline sediments must be established to design and compare the anticipated effectiveness of the remedial action alternatives being considered. A technically defensible and protective sediment mercury PRG is proposed in Appendix 3D. This proposed PRG was designed to achieve a condition of "No Significant Risk" (NSR) and justify a Permanent Solution relative to the Site's pond and stream sediments. This proposed PRG represents an average surficial sediment mercury concentration to be applied to a water body that would be projected to eventually result in a largemouth bass (LMB) fish tissue concentration distribution in that pond or reach that would be consistent with the statewide "background" LMB fillet tissue mercury concentration distribution.

Updated soil PRGs for the protection of human health and the environment also are needed that are tailored to the updated CSM for potential exposures and are in accordance with current MCP risk characterization guidance. The soil PRGs that were applied in the 2009 draft of the Phase III RAP were developed to support the Phase II CSA that was completed in 2005 and the initial draft of the Phase III RAP that was prepared in 2007. After this analysis, the MCP amendments of 2014 included additional risk characterization tools and protocols, including updates to several toxicity values recommended for use under the MCP and the Method 1 Soil Standards used to identify the oil and/or hazardous material (OHM) of potential significance at the Site. Collectively, the collection of the additional site characterization data and the significant 2014 MCP regulatory updates required the CSM for potential human and ecological exposures to the soil and sediment to be reviewed and updated. After the CSM was updated, updated PRGs were developed and proposed for those soil and accessible sediment exposure pathways that were indicated to be complete or potentially complete for the current or future Site users. Soil and accessible sediment PRGs were calculated for the identified chemicals of concern that were identified using the updated MCP screening criteria. The PRGs were calculated for each receptor using a "reverse" Method 3 approach and were based on achieving individual chemical target excess cancer risks or non-cancer hazard thresholds for multi-pathway cumulative carcinogenic and/or non-carcinogenic health effects associated with the identified chemicals of concern in an exposure medium. As these soil and accessible sediment PRGs primarily apply to the conservation/recreation area in the southern part of the Site (i.e., the Southern Conservation Commission Area (SCCA)) and the Eastern Channel Corridor (ECC) Over Bank Areas in the northern part of the Site, site-specific exposure factors were utilized as appropriate.

The updated soil and sediment PRGs will be applied in the revised Phase III RAP for the direct comparison of chemical concentrations in soil and sediment to identify areas of the Site that pose NSR. Similarly, the updated PRGs will be used to identify any soil or sediment in areas of the Site that may pose a potential risk to the receptors identified in the updated CSM and, therefore, potentially warrant a remedial response. Focused remediation strategies will then be developed and evaluated for the areas found to pose potential unacceptable risks.

The following section presents the chronology of events that have occurred since the development of the CSM and the performance of the risk characterizations that were presented in the 2005 Phase II CSA that affected the subsequent site characterization and risk characterization activities. Each event is briefly described with a focus on its significance to the Site's CSM, risk characterization, RAOs, or PRGs. Using this summary as a foundation, the current conditions at the Site were reviewed and updated CSMs for human health and environmental exposure were developed. Updated human health soil and accessible sediment PRGs were then calculated for the identified current and future site users. Soil and accessible sediment PRGs were developed for contaminants determined to contribute most significantly to the cumulative receptor human health risks. These PRGs were developed for the protection of human health and the documentation supporting their development will be included in the Phase III RAP or in a separate prior document. The potential risks to environmental receptors also were re-considered. The results of the 2005 Environmental Risk Characterization (ERC) were reviewed relative to current site conditions.

1.2. Chronology of Events Affecting Site Characterization and Risk Characterization

The following chronology lists the events that occurred since the Phase II risk characterization work that have contributed to the need for the current risk characterization "bridging" activities:

- Phase II Comprehensive Site Assessment Report. November 2005 (Tetra Tech 2005) – Samples of the Site soil, groundwater, sediment and surface water were collected during the Phases IIA, IIB, IIC and IID sampling programs that took place between 1998 and 2003. The analytical results from these sampling events were used to characterize the nature and extent of contamination at the Site. Comprehensive human health and ecological risk characterizations were performed to assess the potential risks associated with each identified "risk characterization area".

- Phase III Supplemental Sampling and Revised Phase III RAP. June 2009 (Tetra Tech 2009) – Additional Phase III sampling was performed to increase the sediment mercury sampling density for the ponds, streams and wetlands. These results were evaluated in a Supplemental Phase III Sampling Report that was submitted to the Massachusetts Department of Environmental Protection (MassDEP) in March of 2009. The Revised Phase III RAP presented RAOs for human health and environmental health outcomes based on the results of the Phase II CSA and the combined original and supplemental Phase III sampling results. PRGs were developed based on these objectives and remedial options were designed and evaluated.

- MCP Updates and Amendments – Since the Phase II CSA was completed in 2005, there have been several updates to the MCP human health and environmental risk characterization guidance that affect the way risk characterizations must be performed to be compliant with MCP. The most recent and broadest changes to the MCP and the risk characterization guidance and protocols took effect in April 2014.

- Extreme Storm Events – The Site experienced two 100-year storm events in succession in 2010 that roughly tripled the flow of water through the Site's river and ponds for the period. Extensive flooding at the Site was observed, and sediment from the stream channels that was contaminated with mercury was deposited onto the adjacent stream banks and low-lying areas. It was also suspected that the high flows may have transported mercury-contaminated sediment down-stream to adjacent areas within the watershed with concurrent scouring or deposition at various locations and changed the spatial distribution of the mercury contamination. This movement of sediment caused the existing sampling results to no longer be representative of the current Site conditions. Soil characterization in areas adjacent to the shorelines also was determined to be incomplete due to the sediment redistribution caused by these flooding events. A sampling program to re-baseline these conditions and to conduct some benchtop testing of the sediments to support the evaluation of alternatives in the Phase III was begun in January 2015.

- <u>Supplemental Phase II Re-Baselining sampling</u> – Sediment and soil samples were collected in areas potentially affected by the flooding in 2010. Additionally, a few areas associated with the Former Test Range that had not been previously sampled during investigation Phases IIA through IID were determined to need better characterization. Accordingly, a focused supplemental sampling and site characterization effort was implemented to identify the presence and extent of this contamination. Limited groundwater sampling also was performed since no groundwater sampling had been performed at the Site since late 2008/early 2009.

- <u>Release Abatement Measure (RAM) Plan for the Former Test Range Berm Area (FTRBA) and the Cold Waste Area (CWA) (Tetra Tech - Ongoing)</u> – The scope of work and work plans were finalized in May 2017. Field activities started in May of 2017 and work at the FTRBA and the Area in Front of the Berm (AIFB) is now nearing completion in March 2018. The RAM (and the Immediate Response Action (IRA) that it has evolved into) involves the excavation, sifting and off-site removal of munitions, metallic debris, construction debris and contaminated soil associated with the historical operations at the FTRBA and the CWA. This RAM/IRA has resulted in the destruction or removal of munitions and explosives of concern (MEC), unexploded ordnance (UXO), munitions debris (MD), range-related debris (RRD), and soil not meeting the MCP Method 1 S-1 Soil Standards. Following the completion of the RAM/IRA, the FTRBA and the CWA will be either stabilized or stabilized and restored.

1.3. Organization of this Document

The remainder of this Risk Characterization Bridging Document addresses the following topics:

- Section 2: A review of the Phase II CSA Human Health Risk Characterization, highlighting the CSM for potential human exposures and identifying the areas of the Site that were found to pose NSR and those that were found to pose a significant human health risk.

- Section 3: A review of the Phase II CSA Environmental Risk Characterization, highlighting the CSM for potential ecological exposures and identifying the areas of the Site that were found to pose NSR and those that were found to pose a significant ecological risk.

- Section 4: A review of the PRGs for human health and ecological protection that were applied in the 2009 Phase III RAP.

- Section 5: A review of the changes in the MCP and associated risk characterization provisions that occurred since the 2005 Phase II CSA risk characterizations were completed, including the 2014 MCP Amendments, the risk characterization-related Technical Updates, and the development of the MCP ShortForms.

- Section 6: A summary of the sampling and remedial actions that have been performed at the Site since the 2005 Phase II CSA risk characterizations were completed.
- Section 7: The development of updated CSMs for human health and environmental exposures.
- Section 8: The development of updated human health and environmental PRGs for soil and accessible sediment.
- Section 9: References cited in the document.

2. Review of the Phase II CSA Human Health Risk Characterization

2.1. Conceptual Site Model for Human Health from the 2005 Phase II CSA

The Phase II CSA presented the approach and results of a risk characterization performed for the soil, groundwater, sediment, surface water and fish tissue at the Site. A summary of the 2005 CSA risk characterization results for the current and reasonably foreseeable future receptors is presented in Table 2-1. The CSM developed in 2005 reflected the current and the reasonably foreseeable future uses of each potential exposure area at the Site at that time:

- In the Upper North Area (UNA) and Lower North Area (LNA) (See Figure 2-1), the current receptors at that time were identified as commercial workers, commercial customers, utility workers, construction workers, trespassers, recreational users and recreational fisherman. Trespassers or recreational users / members of the public using the Greenway were expected to continue to use these areas in a comparable manner in the future. Recreational fishermen also were anticipated to continue to access and utilize these areas for catch-and-release fishing and boating in the future, even though there is currently a ban on the consumption of fish caught in the Site's ponds and streams. Additionally, the municipal garage for the Town of Hanover Department of Public Works (DPW) is in the LNA off of Ames Way and utilizes portions of this area.
- The Town of Hanover Conservation Commission (Con Com) maintains and manages a conservation area within the central portion of the Site. The current potential receptors in the central portion of the Site were identified as commercial workers, commercial customers, utility workers, construction workers and trespassers. This area also includes the Greenway Trail (previously referred to in the 2005 CSA as the Potential Greenway Area (PGA)) which is a path running adjacent to the ponds and streams on several of the former access and perimeter roads of the Fireworks facility. This trail is currently used for hiking and dog walking. Adult and child recreational users and fishermen are known to canoe, kayak, fish, and occasionally wade and swim in Lily Pond and Upper Factory Pond.

- The southern portion of the Site consists of open fields, areas of dense foliage, areas cleared for remediation activities, and wetlands. The current receptors were identified as conservation managers and recreational users and fishermen who canoe, kayak, wade and fish in the ponds. These activities were likely to continue in the foreseeable future. Additionally, utility workers and construction workers were anticipated to potentially work in the Southern Conservation Commission Area (SCCA), Marsh Upland Area (MUA), or the Southern Disposal Area (SDA) should structures or utilities associated with the recreational or conservation activities performed in this area be constructed in the future.

Not all the Site's current or future receptors are associated with each identified potential exposure area at the Site. In addition, the environmental media to which a receptor could be exposed and the OHM they could be exposed to depend on the specific risk characterization area. Even within a particular risk characterization area, not all receptor behaviors may occur at the same points of exposure for that medium. Therefore, once receptors were identified for each risk characterization area, the projected points of exposure within each exposure medium for each receptor were identified. The exposure points considered in the 2005 CSA were as follows:

- Since there were no preferential exposure areas identified in relation to the soil within any of the risk characterization areas at the Site, the potential soil exposure points were identified to be the entire risk characterization area for accessible (surficial) soil (0-3 feet below ground surface (bgs)) and the combined accessible and upper potentially accessible soil (0-6 feet bgs). The risk characterization areas evaluated for soil exposure were the UNA, LNA, Central Commercial Area (CCA), SCCA, MUA, SDA, CWA and the PGA (see Figure 2-1).
- Similarly, particulates from the surface soil that may be resuspended and entrained into the ambient air were assumed to originate from any point within each risk characterization area. As such, the concentrations of OHM in the ambient air were calculated for each risk characterization area using area-wide soil characteristics.
- It was assumed that people would be more likely to come into contact with bank sediments along the pond and stream shorelines than the submerged sediments in the middle of the ponds or streams. Therefore, the exposure points relative to sediment in the ponds and streams were identified as only including the bank sediment. Bank sediment exposure points were identified for Lily Pond/Upper Factory Pond (LUFP) and Middle/Lower Factory Pond (MLFP). Potential exposure points relative to the sediment in a shallow stream or river reach potentially accessible to people were identified for the ECC, the Lower Drinkwater River Corridor (LDRC) and the Upper Drinkwater River Corridor (UDRC). A wetland sediment exposure point was identified for the MUA sediment area.

- Each surface water body or reach of connected streams was identified as a separate potential exposure point. Surface water exposure points were established for the ECC, the LDRC, the UDRC, LUFP and MLFP.
- No routine exposure to the local groundwater was occurring or assumed to be reasonably anticipated to occur in the future.

Human receptors were assumed to come into contact with the OHM at these exposure points via one or more of the following exposure routes identified in accordance with 310 CMR 40.0925 for soil or exposed sediment:

- Incidental ingestion;
- Dermal absorption (through dermal contact);
- Inhalation of particulates or volatile OHM in the air; and
- Inhalation and subsequent ingestion of particulates in air (for the construction worker or utility worker exposure scenarios only).

2.2. Human Health Risk Characterization Results from the 2005 Phase II CSA

The Method 3 risk characterization results from the 2005 Phase II CSA for the identified risk characterization areas (see Figure 2-1), receptors and CSM exposure pathways judged to be complete or potentially complete are summarized below. This summary is broken into two groups: characterization areas and exposure media where a finding of NSR was achieved and those risk characterization areas and exposure media where a significant risk was found to exist. Significant risk to human health was identified if the projected cumulative chemical and pathway risk to a receptor exceeded an excess lifetime cancer risk (ELCR) of $1x10^{-5}$ or a hazard Index (HI) of one.

2.2.1. Risk Characterization Areas and Exposure Media Associated with a Finding of "No Significant Risk"

- No significant carcinogenic or non-carcinogenic risks were associated with exposure to the accessible soil (0-3 feet bgs), the upper potentially accessible soil (0-6 feet bgs), or the upper overburden groundwater associated with the UNA, LNA, CCA and SCCA.
- No significant carcinogenic or non-carcinogenic risks were associated with exposure to the accessible soil (0-3 feet bgs) of the PGA.
- No significant carcinogenic or non-carcinogenic risks were associated with exposure to the upper overburden groundwater associated with the SDA.
- No significant carcinogenic or non-carcinogenic risks were associated with exposure to the surface water or direct exposure to sediment of MLFP or the UDRC.

- No significant carcinogenic or non-carcinogenic risks were associated with exposure to the surface water of the ECC, LDRC, and LUFP.
- The Phase II CSA did not identify any significant risks to human health associated with exposures to the groundwater or surface water at the Site.

2.2.2. Risk Characterization Areas and Exposure Media with a Finding of "Significant Risk"

- Significant non-carcinogenic risk was associated with exposure to mercury in the accessible soil (0-3 feet bgs) and upper potentially accessible soil (0-6 feet bgs) of the MUA for a hypothetical future construction worker through the incidental ingestion and dermal absorption of soil.
- Significant carcinogenic and non-carcinogenic risks were associated with exposure to 1,1-dichloroethene, chromium, trichloroethene, lead, cis-1,2-dichloroethene, and trans-1,2-dichloroethene in the accessible soil (0-3 feet bgs) and upper potentially accessible soil (0-6 feet bgs) of the SDA for a hypothetical future construction or utility worker through incidental ingestion of soil and the inhalation of particulates and volatiles released from the soil. However, including the contributions of Class C carcinogens in the carcinogenic risk calculations (as was done in the CSA risk characterization of 2005) was not required at the time by MassDEP guidance. The ELCRs for the Class C carcinogens were included in the Phase II CSA human health risk characterization as a conservative measure and, as a result, the ELCR results slightly over-estimate the carcinogenic risks that would otherwise be viewed as compliant with the MCP. The 2005 Phase II CSA stated that 1,1-dichlorethene was a Class C carcinogen and was determined to appreciably increase the projected risks for some of the risk characterization areas. A PRG was developed for 1,1-dichlorethene and applied in the 2007 Phase III RAP noting that a future risk management decision may be warranted should future remediation be required solely because of the presence of this Class C carcinogen.
- Significant carcinogenic risk from the "worst case scenario" evaluated for hypothetical adult and child recreational users was associated with exposure to 1,1-dichloroethene in the accessible soil of the SDA due primarily to the inhalation of surficial soil particulates. Since the significant ELCR for this area was calculated to include the risk contributions from 1,1-dichloroethene (which is classified as a "possible" human Class C carcinogen), the Phase II CSA again indicated that a future risk management decision may be warranted should future remediation be required solely because of the presence of this Class C carcinogenic compound.
- The adult and child recreational users were assumed to be exposed to accessible soil (0-3 feet bgs) in the SCCA, CWA, MUA, SDA, and the PGA, and to surface water and sediment in the UDRC, LDRC, LUFP, and MLFP. Since these receptors would not

realistically spend all of their time in one particular area or water body (given their limited size or lack of unique features), cumulative ELCRs and HIs were calculated assuming a "worst case" exposure scenario where the highest projected ELCR or HI from each exposure medium was identified and then summed to reach a total cumulative "worst case scenario" ELCR and HI for the recreational users. For example, even if the highest calculated ELCRs for a child recreational user exposed to soil, sediment, and surface water media were associated with different areas of the Site, these highest medium-specific risk contributions for this receptor were summed to calculate the total cumulative "worst case scenario" ELCR for that child recreational user regardless of the area.

- Significant non-carcinogenic risk from the "worst case scenario" of a hypothetical child recreational user was associated with exposure to antimony in soil (via incidental ingestion and dermal absorption), lead (via incidental ingestion), and barium (via the inhalation of soil particulates) in the CWA.
- Significant carcinogenic and non-carcinogenic risks were associated with exposure to benzo(a)pyrene and mercury in the ECC sediment for a hypothetical trespasser and fisherman through dermal absorption. In addition, dibenz(a,h)anthracene in the ECC sediment contributed to the risks for a hypothetical fisherman through dermal absorption.
- Significant carcinogenic risk was associated with exposure to benzo(a)pyrene and vinyl chloride in the LDRC sediment for a hypothetical fisherman through dermal absorption.
- Significant carcinogenic risk also was associated with exposure to benzo(a)pyrene in the LUFP sediment for a hypothetical fisherman through dermal absorption.
- Significant non-carcinogenic risk was associated with exposure to mercury and methylmercury in the ECC, LDRC, LUFP and MLFP fish tissue for a hypothetical fisherman by ingestion.

3. Review of the Phase II CSA Environmental Risk Characterization

3.1. Conceptual Site Model for Environmental Exposures from the 2005 Phase II CSA

3.1.1. Descriptions of the Various Areas of the Site

3.1.1.1. *Northern Area*

The northern portion of the Site was divided into the UNA and the LNA as part of the overall risk characterization design. The UNA encompasses the former research and development buildings of the former Fireworks facility and current light industrial and commercial developments that are occupied daily and subject to both human access and vehicular traffic. The remaining portions of the UNA consist of abandoned buildings and structures in various stages of disrepair with areas of asphalt roadways connecting the abandoned structures. Fragmented areas of vegetation are present throughout the UNA and LNA, with more opportunistic vegetative growth occurring around the former roads and buildings. The fragmented areas of vegetation consist of a mixture of deciduous and coniferous trees with a shrub layer in the understory mostly associated with the riparian areas of the Drinkwater River. The area has evidence of trespasser activity, and the dumping of building debris and trash was observed. The remaining portions of the UNA are occupied by active commercial and industrial developments including a saw mill, automotive/auto body shops, light manufacturing, equipment storage yards, landscaping companies and construction companies. These areas are occupied during daylight hours and the access roads carry vehicular traffic to and from these places of business. Each of these properties was estimated to be approximately 2 to 6 acres in size. The current land use designation in this portion of the Site is industrial development. The developed properties afford little to no significant habitat for aquatic or wildlife species. The ECC constitutes the boundary between the UNA and the LNA and provides some aquatic and riparian habitat for fish and semi-aquatic wildlife.

The LNA borders on the ECC and encompasses the developed property and equipment storage yard for the Town of Hanover DPW Garage. This area consists of maintenance buildings, an equipment refueling area, and an open equipment yard with a surface comprised of concrete slab, crushed gravel and disturbed soils. The equipment yard is the location of daily human and vehicular traffic and is estimated to be less than 6 acres in size. The current maintenance facility and equipment yard affords little value as habitat for fish and wildlife species. The DPW facility is bounded on the west by the riparian and riverine habitats of the LDRC (not part of the LNA). A narrow margin of mixed coniferous/deciduous vegetation separates the maintenance facility and equipment yard from the riverine wetlands and channel of the LDRC. The riparian habitat and aquatic habitat of the ECC and the nearby LDRC are used by fish and wildlife species.

The environmental screening of the surface soil sampling results for the UNA and LNA indicated that OHM was present in the soils at levels exceeding some environmental screening values. However, the developed nature of the properties and their small size limit the potential exposure of semi-aquatic and terrestrial wildlife to these contaminants. Therefore, the exposure pathway for environmental receptors was judged to be incomplete in the developed areas. The wetland and aquatic habitats of the ECC and LDRC afford significant value as fish and wildlife habitat and were evaluated as part of the ERC for the Site.

The outlet from Forge Pond (located north and west of the Site) discharges to the Drinkwater River at the northwest corner of the Site. A water flow control structure below the outlet diverts water between the UDRC and the ECC. The aquatic habitats of the two channel corridors are highly divergent in environmental character. The UDRC is a linear feature running north-to-south, with bottom substrates consisting of cobble and gravel substrates. The flow in this channel can form microhabitats consisting of riffles and runs along its length. During the Phase IIC and IID sampling events, flow within the UDRC was highly variable with water levels ranging from significant flowing water volumes to near negligible water being present. The overhanging tree canopy creates a highly shaded stream channel with little or no submergent aquatic vegetation being present in the stream bed. The banks of the channel are moderately vegetated given the highly shaded environment. The UDRC and its riparian habitat does support significant habitat for fish and semi-aquatic wildlife. No evidence of historical release or disposal activities related to the Site were indicated in the Site records or observed along the banks of the UDRC.

In contrast to the UDRC, the ECC is an elongated, meandering channel with densely vegetated banks and a sporadically broken overhead canopy above the river channel. The breaks in the canopy allow for opportunistic growth of submergent aquatic macrophytes to grow in the stream channel. Benthic substrates in the ECC consisted of fine grain sands and silt with areas of mixed gravel. The deposited layers are intermittent in places. The flow is non-turbulent with riparian emergent vegetation and remnant bridge abutments from abandoned roads create scattered eddies of circulation throughout the channel length. The ECC bounds the UNA, which contains both historical Fireworks structures and the current industrial and commercial facilities. Debris (including glassware, piping, metal debris, tires, building debris and other cultural debris) are apparent throughout the length of the ECC. Even with the presence of this debris and the existing developments, the ECC affords riparian and aquatic habitat for fish and semi-aquatic wildlife.

The Phase IIC sampling of the surface water and sediments revealed elevated concentrations of mercury and lead to be present in the ECC. Sampling of the UDRC revealed concentrations of metals to be comparable to the concentrations observed in background surface water and sediment samples of the Northern Drinkwater River north of Forge Pond. Given the comparability of the concentrations, the lack of historical Fireworks discharge or disposal and the natural setting, the UDRC was determined to not be impacted by OHM related to the Site. Focused investigations were directed towards the ECC and LDRC and its impoundments where Site-related OHM has been detected above background concentrations.

3.1.1.2. *Central Area*

The central portion of the Site was the primary magazine area for the storage of manufactured munitions and pyrotechnics during facility operation. The level of development within this area was much less than in the northern area and is limited to widely scattered, deteriorated structures formerly used to store munitions. In addition, there are scattered structures that functioned as storage facilities and temporary lay down areas for equipment. All access roads in this area were unimproved dirt roads. Construction debris and tires have been observed along the roadways. The Central Area remains largely forested with the primary tree canopy dominated by white pine and red pine with a more limited representation by deciduous species. Canopy coverage within this area is largely continuous with pine tree diameter and height appearing very similar across the area. This continuous, consistent vegetation cover type suggests that little disturbance to the area has occurred during historical Site activities. Understory vegetation is sparse with slightly greater density occurring along the dirt access roads. In these areas, the understory shrubs included multiflora rose and pine, oak, birch and alder saplings. The Drinkwater River enters its first impounded area, Lily Pond, in the Central Area. Flow velocity slows at the inlet and the surface area of the channel expands to form the basin of Lily Pond. The Drinkwater River channel is reformed as the outlet from Lily Pond for a short distance before forming the inlet to Factory Pond. Lily Pond remains shallow throughout. Bottom substrates along the shoreline are largely fine grained with leaf packs. Observed emergent vegetation includes rushes, bur reeds, and cattails. Arrowhead and duckweed are the dominant floating aquatic plants.

3.1.1.3. *Southern Area*

The southern portion of the Site was used historically for the disposal of Site-related wastes and the testing of munitions and pyrotechnics. Pockets of garbage and municipal debris, building debris, tires, household refuse, cans, rusty vehicles, and appliances are scattered throughout the Southern Area. Spent shotgun shells from trespassing and target shooting also are present. The Southern Area is crossed by dirt roads that connect various past disposal and operations areas. These areas include the Waste Burn Pit Area, the Former Test Range Area, the CWA, and the Demolition Pit Area. In addition to the above areas, a perched scrub-shrub and emergent upland marsh is located down-slope from the Demolition Pit Area (i.e., now referred to as the MUA Sediment Area). The CWA adjacent to the eastern shoreline of Factory Pond was where scrap metal was deposited. The CWA has now been largely remediated as part of the on-going RAM. The former disposal and testing areas in the southern area have exposed soils and are clear of vegetation to some degree with secondary re-growth beginning to infringe along the periphery of these areas. The individual waste disposal areas remained separated by more mature, continuous stands of secondary growth, deciduous forest with scattered conifer stands similar in composition to those described in the northern area. A detectable current from the Drinkwater River is not apparent in Factory Pond and the impoundment basin remains fully within the Site boundary. Factory Pond is divided into two sub-basins by a constriction in the shore that supports a wooden foot bridge just south of the CWA. The areas surrounding the Waste Burn Pit, Factory Pond Drum Area and CWA appear to be draining into the upper and middle Factory Pond basin. Surface water run-off from the Demolition Pit Area drains into the marsh uplands adjacent to the lower basin of Factory Pond. The basin is characterized by a diverse assemblage of riparian vegetation cover types, including emergent wetland plants, scrub-shrub species and areas of palustrine wetlands composed of cedar, aspen and sycamore saplings. Water coloration within the Factory Pond basin is generally tea colored suggesting a high humic acid content.Drainages from surrounding swamps form an unnamed tributary which discharges along the eastern shoreline of Factory Pond. The upper basin shoreline remains very complex with regard to riparian and wetland vegetation types.

Based on the observed features and measured conditions in these areas, the environmental CSM summary shown in Table 3-1 was presented in the ERC performed for the 2005 CSA.

3.2. Environmental Risk Characterization Results from the 2005 Phase II CSA

The ERC performed as part of the 2005 Phase II CSA concluded that some environmental receptors associated with terrestrial, aquatic and wetland habitats at the Site were exposed to chemicals of potential environmental concern (COPECs) (see Table 3-1). COPECs were identified in surface soils, surface water, freshwater, sediments and groundwater through comparisons of the sampling results to conservative environmental screening level benchmarks developed to be protective of a broad base group of species at the community level. The initial benchmark screening evaluation revealed maximum concentrations of preliminary COPECs exceeded their corresponding benchmarks.

Following this initial screening, an environmental CSM was developed to facilitate the evaluation of the possible exposure pathways and routes for environmental receptors to Site-related contaminants via various transport and food chain pathways. The primary pathways of exposure to environmental receptors included direct contact with contaminated environmental media (e.g., soil or sediment), dietary ingestion of contaminated prey, and incidental ingestion of contaminated abiotic media during feeding or grooming. For higher trophic level receptors, bioaccumulation of certain COPECs (such as mercury and methylmercury) were projected to result in exposure via transfer up the food chain. Aquatic communities such as plankton, benthic, pelagic invertebrates and fish also were determined to be potentially at risk from direct exposure to COPECs. The pathways of exposure were through direct contact with abiotic media, the consumption of contaminated prey (such as soil invertebrates, fish, terrestrial or aquatic invertebrates, and terrestrial or aquatic plants) and incidental exposure to abiotic environmental media. The following habitats were reflected in the environmental CSM:

- Terrestrial habitats included upland communities represented by broad-leafed forests and conifer dominated upland forest areas.
- Wetland habitats included smaller areas of palustrine, forested corridor wetlands along the Drinkwater River lacustrine, emergent wetlands along Lily and Factory Ponds, and perched, scrub-shrub wetland area in the southern area.
- Aquatic habitats included lotic habitats of the Drinkwater River and lacustrine, lentic habitats of Lily Pond and Factory Pond.

Environmental receptors associated with the above habitats included plant, soil invertebrates, sediment benthic communities and mammal, bird, reptile and amphibian species.

Representative receptor species were selected to represent a trophic level or feeding guild to assess local food chain effects. A simple food chain model that incorporated a variety of environmental receptors deemed representative of the ecology and habitats of the Site was developed and refined. Risks to candidate environmental receptors were assessed to determine if the identified COPECs posed a potential risk to lower and/or higher trophic level receptors. Environmental receptors included representative terrestrial/aquatic plants, benthic macroinvertebrates, soil invertebrates, avian, mammalian, reptilian, amphibian, and fish species. Each species was chosen based on its diet, suitability of the habitats found on the Site, and the bioaccumulating characteristics of mercury, a COPEC of primary concern found in all media on-Site.

The 2005 ERC applied a weight-of-evidence approach to the assessment of potential environmental risks to a range of environmental receptors representing 15 assessment endpoints. These assessment endpoints were discrete natural resource values or functions that were indicated to be important to the local ecology or natural communities. The 15 assessment endpoints considered were specific to the areas of the Site where these endpoints/species were indicated to be potentially at risk. The ERC used population and community-level survey techniques as lines of evidence for the assessment endpoints that were evaluated. Modeled food chain intakes were used to characterize risks to the upper trophic wildlife receptors.

A toxicity quotient approach (i.e., the comparison of a daily exposure level to a no observable adverse effect level (NOAEL) or a lowest observable adverse effect level (LOAEL)) was used to assess risk for a specific toxicological endpoint. Population level biota surveys were used to assess risks to terrestrial plants and soil invertebrates. Exceedance of a LOAEL dosage was considered as an indication of the potential for biologically significant harm. Other receptors such as benthic communities, fish communities, amphibians, and reptiles were evaluated with Site-specific studies using toxicological testing and population level investigations.

The MCP provided the following criteria for the determination of risks to environmental assessment endpoints in an ERC:

- No Significant Risk of Harm;
- No Substantial Hazard;
- Evidence of Biologically Significant Harm; and
- Indications of Potential for Biologically Significant Harm.

The summary of results for potential environmental risks from the ERC are presented in Table 2-1. For terrestrial habitats, metals in surface soil were found to be the primary chemicals of environmental concern (COECs). For aquatic habitats, mercury was the primary COEC. The chemistry of mercury in the environment is complex given that the chemical form of mercury varies by environmental medium and the bioaccumulation potential of each form varies significantly. Methylmercury (MeHg) and total mercury (THg) are both present at the Site. MeHg is the primary form of mercury that is bioaccumulated by biota. MeHg accounts for >98 percent of the mercury in fish and other aquatic biota, and generally represents the most significant form of mercury contributing to risks to upper trophic levels of the aquatic food chain. Site-specific sediment data showed that MeHg constitutes less than 1.5 percent of the THg present in the sediment at the Site. The majority of the mercury present in the sediment is likely to be in inorganic forms (i.e., mercuric salts) and, to a lesser degree, as complex organomercury compounds. The Phase II ERC did not identify any risks to environmental receptors as a result of exposures to the Site's surface water or groundwater.

4. Preliminary Remedial Goals for Both Human Health and Environmental Health in the 2009 Revised Phase III RAP

The Revised Phase III RAP (which updated and refined the initial draft Phase III RAP that was prepared in 2007 but was never finalized) was developed to evaluate comprehensive remedial action alternatives in accordance with the MCP. The draft Revised Phase III RAP incorporated the sampling and field investigation results collected in the fall of 2008 and in February of 2009. The process of identifying, evaluating and selecting Site-wide remedial action alternatives began with the development of Site-specific RAOs. The RAOs contained the narrative requirements that the remedial actions that were being evaluated for the Site needed to meet to address the identified risks to human health, the environment, safety or public welfare and to comply with regulatory requirements. Once the RAOs were established, numerical PRGs to support the evaluation of the effectiveness of the remedial alternatives with respect to protectiveness were developed. These PRGs defined the concentrations of contaminants in the affected exposure media (e.g., sediment or soil) that had to be met to achieve the RAOs.

Preliminary medium-specific RAOs were developed and presented in the draft Revised Phase III RAP Report. Revised RAOs were then developed based on an overall Site-wide risk management perspective. Given the size and complexity of the Site, it was anticipated that some RAOs would suggest remedial responses that conflicted in their desired outcome with other identified RAOs. Consequently, a "fatal flaw" incompatibility analysis was conducted by collectively comparing the preliminary RAOs to the PRGs and evaluating the impacts of each in the context of overall Site remediation. This analysis took into consideration such factors as the nature and extent of the disturbance to the Site required to implement the remedy, the relative degree of risk reduction to be achieved, and the magnitude of the Site-specific background concentrations relative to the calculated PRGs. Following this "fatal flaw" evaluation, the preliminary RAOs were revised. Building on these RAOs, the human health and environmental PRGs were developed.

4.1. Human Health PRGs for Soil

The calculation of risk-based PRGs involved first considering the chemical-specific risk contribution associated with each chemical of potential concern (COPC) assessed in the Phase II CSA human health risk characterization (HHRC). Thresholds were established to identify the chemicals of concern (COCs) that were judged to be making a significant contribution to the overall risk or hazard to the identified receptors. These "risk driver" COCs were defined as the chemicals that individually contributed a projected ELCR contribution to a particular receptor greater than 1×10^{-6} or a potential non-carcinogenic HI contribution greater than 0.2. Using these thresholds, COCs were identified for which PRGs were developed. Human health-related PRGs were developed for the soil associated with two depth intervals (0 to 3 feet bgs and 0 to 6 feet bgs). PRGs for accessible surficial sediment to which recreational users may be exposed also were developed in the same manner as the soil PRGs. For each potentially exposed receptor associated with the CSM as it was then, risk-based PRGs were back-calculated to meet the specified individual chemical target risk goals for carcinogenic risk and/or non-carcinogenic health effects, as appropriate for the chemical. The risk-based soil and exposed sediment PRGs were derived through consideration of Site-specific exposure scenarios, the background concentrations of the chemicals in the exposure media, practical quantitation limits (PQLs) for the compound, and pertinent chemical-specific policy criteria. No human health-based PRGs were needed for groundwater or surface water, as no unacceptable risks were identified relative to these media.

Final PRGs were then selected based on the following steps:

- Step A The lowest (most stringent) PRG was identified for every significant “risk driver” for each medium at the Site to which the identified target receptors were assumed to be exposed.
- Step B The value identified in Step A was then compared to background concentration(s) if the “risk driver” was a naturally occurring or ubiquitous chemical in the vicinity of the Site. For soil, the value in Step A was compared to the MassDEP-published background value for “natural” soil. For sediment, the value in Step A was compared to the mean of the Site-specific background concentration from the river and pond background locations. If the value identified in Step A was lower than the applicable background value, the value was adjusted upward to match the respective background level. Otherwise, the value from Step A was carried forward in the process.
- Step C The value identified in Step B was then compared to the PQL for that “risk driver” in that environmental medium. If the value identified in Step B was lower than the PQL, the value was adjusted upward to match the PQL. Otherwise, the value from Step B was carried forward in the process.
- Step D Policy criteria or regulatory action levels established for that chemical in a similar exposure setting (e.g., lead) were then considered. The policy criteria were applied, where appropriate. Otherwise, the value from Step C was carried forward in the process.
- Step E The value identified in Step D for each “risk driver” in each medium was considered the PRG to be used in the Phase III evaluations.

4.2. Environmental PRGs for Soil

The environmental PRGs were developed using the results of both field studies and predictive modeling for the receptors and assessment endpoints that were evaluated in the Stage II ERC. The environmental PRG development focused on the primary exposure routes and source media identified for each COEC or assessment endpoint combination considered. The environmental source media were the sediment and surface soils for the assessment endpoints associated with significant risks in the ERC.

Under the MCP, exceedance of a NOAEL alone did not constitute a basis for a finding of potential environmental harm. Other lines of evidence were considered as part of a weight-of-evidence evaluation. Exceedance of a LOAEL value may, however, support a finding of potential risk of environmental harm. Consequently, this value was used in the development of the corresponding environmental PRGs.

The environmental PRGs were selected by identifying the lowest assessment endpoint-specific PRG calculated for each COEC. For semi-aquatic and terrestrial wildlife receptors, the selected environmental PRG was the lowest available LOAEL or LOAEL-equivalent concentration, consistent with MCP guidance. Semi-aquatic environmental receptors were defined as receptors that depend partially on the aquatic habitat or resource for protection or nutrition. The environmental PRGs did not consider the background concentration as a basis for the PRG.

4.3. Human Health and Environmental PRGs for Sediment

The human health and environmental PRGs were then reviewed relative to the identified RAOs established to recognize potential inconsistencies and the possibility of requiring mutually exclusive outcomes. Results from the Phase II CSA showed that THg in sediment and MeHg in the upper trophic levels of local food chains were the key environmental risk drivers and should be a primary focus of any sediment remediation strategy. Previously, an RAO identified for sediment was proposed to reduce risks to acceptable levels for each of the nine environmental endpoints identified in the ERC as having potential risk of biologically significant harm. However, review of the sediment PRGs for each endpoint showed that the THg PRGs for two endpoints (i.e., those associated with piscivorous birds and piscivorous mammals - 0.02 and 0.32 mg/Kg, respectively) were lower than the lowest measured Site-specific sediment background concentration for THg (0.34 mg/Kg for the river). The Phase II CSA concluded that a residual risk to both endpoints existed at the background THg concentration. Since it is impractical to remediate the THg concentration in the sediment to less than its background level, it was acknowledged that it would not be feasible to fully protect the piscivorous bird and piscivorous mammal endpoints, even if background concentrations were achieved. The next lowest THg environmental sediment PRG that was greater than background was the herbivorous waterfowl (27 mg/Kg). However, the human health PRG that had been calculated for THg in sediment (22.2 mg/Kg) was lower than the THg PRG for herbivorous waterfowl in sediment. Therefore, the human health PRG value for THg in sediments was used in the draft Revised Phase III RAP as the criteria to determine whether this revised RAO had been met.

5. MCP Amendments and Risk Characterization Revisions Since the 2005 Phase II CSA

5.1. MCP 2014 Amendments

MassDEP adopted a broad set of amendments to the MCP in April 2014. Many of these amendments and associated changes could impact the results of risk characterizations performed for the Site and the PRGs that were developed. A few of these changes related to removal of Tier 1 classifications, updated Method 1 Standards, considerations relating to RAOs, guidance on CSMs, and the use of modeling in risk characterization. More complete summaries of these amendments are posted on the MassDEP website.

5.2. MCP Risk Characterization Technical Updates

Since the performance of the human health and environmental risk characterizations as part of the 2005 CSA, several Technical Updates to the guidance for human health and environmental risk characterizations under the MCP have been published. Technical Updates to the Guidance for Human Health Risk Assessment published after 2005 include the following:

- “Calculation of an Enhanced Soil Ingestion Rate”, June 2014;
- “Weighted Skin-Soil Adherence Factors”, June 2014;
- “Expressing the Precision of Exposure Point Concentrations and Risk Estimates in MCP Risk Characterizations”, December 2009;
- “Default Fish Ingestion Rates and Exposure Assumptions for Human Health Risk Assessments”, December 2008; and
- “Characterization of Risks Due to Inhalation of Particulates by Construction Workers”, July 2008.

Technical updates to the Guidance for Ecological Risk Assessment published after 2005 include the following:

- “Averaging Area for Benthic Invertebrate Assessments”, January 2006
- “Assessment Endpoints for Benthic Invertebrates”, January 2006
- “Assessing Risk of Harm to Benthic Invertebrates”, January 2006
- “Freshwater Sediment Toxicity Tests”, January 2006
- “Revised Sediment Screening Values”, January 2006
- “Ecological Value of Surface Water Features”, January 2006
- “Area-Based Screening for Sediment Contamination”, January 2006

To remain compliant with the MCP, these technical updates must be applied where appropriate in future risk characterizations performed relative to the Site.

5.3. MassDEP ShortForms

In addition to the above-referenced updates, the MassDEP ShortForms were first published in March of 2006 (subsequent to the Phase II CSA human health risk characterization). Refinements, additions, and updates were made 14 more times since the initial publication of the ShortForms. The current set of available ShortForms are significantly different from the original ShortForms in that they are not limited to residential scenarios, but rather include additional receptors such as construction workers, trespassers, recreational children, and office workers. These additions have increased the applicability of the revised ShortForms relative to the risk characterizations applicable to the Site. A summary of the ShortForms developed since the Phase II CSA is presented in Table 5-1.

The ShortForms now address a number of current or potential future receptors relative to soil or exposed sediment at the Site, and allow for facilitated multi-chemical, multi-pathway forward Method 3 risk calculations and or single-chemical, multi-pathway reverse multi-pathway risk calculations to identify risk-based PRGs consistent with specified excess cancer risk or non-cancer hazard index targets. These ShortForms also incorporate the current MassDEP default exposure assumptions and toxicity values to be applied, as appropriate, in MCP human health risk characterizations.

6. Sampling and Remedial Actions Performed Since the 2005 Phase II CSA

6.1. Supplemental Phase II Re-Baselining Sampling (2015)

Since the development of the original CSM in 2005, a series of record high precipitation events occurred in 2010 that resulted in the subsequent flooding of portions of the Site adjacent to the river and stream reaches. This flooding deposited mercury-contaminated sediment from the ECC over the channel banks onto the soil in the adjacent low-lying areas. The high flows also were suspected to have transported some mercury-contaminated sediment down-stream within the watershed with concurrent scouring and re-deposition at other locations. As mercury is the contaminant of most concern in the Site sediments, additional sampling was warranted to assess the extent of sediment deposition onto the surface soil in the UNA and LNA and to re-define the distribution of mercury-contaminated sediment in the Site’s ponds and streams. Areas where the sediment was sampled during the re-baselining investigation were the ECC, LUFP, MLFP and the Indian Head River Corridor (IHRC) below the Factory Pond Dam. Areas where the soil was sampled to assess the impact of the flooding were the ECC Over Bank Areas and the 100-Year Floodplain Areas associated with Factory Pond. In addition, a few areas associated with the Former Test Range that had yet to be sufficiently characterized during Phases IIA through IID also were sampled to identify the presence and extent of explosives-related compounds and munitions-related metals (including lead). Finally, additional soil sampling was performed in the SDA where a soil upper concentration limit (UCL) exceedance had been previously identified and in the MUA to better delineate the depth distribution of soil contamination there.

The results of the re-baselining soil sampling in 2015 were as follows (see the main report to which this appendix is attached for more details of this sampling):

- The ECC Over Bank Areas soil sampling indicated that the stream had overflowed its banks during the 2010 precipitation events or previously/subsequently and had deposited mercury-contaminated sediment on the northeastern bank of the ECC, the eastern near-bank areas, and the interior lowlands of the serpentine reach of the ECC.
- The soil sampling at the Former Test Range Area revealed concentrations of lead greater than the MCP Method 1 S-1 and/or S-2 Standards throughout all subareas associated with the FTRBA (i.e., the Test Range Floor, all four quadrants of the Test Range Berm, and the Area Behind the Berm). The mercury results did not exceed the mercury MCP S-1 Standard at any sampling location within the Former Test Range. Explosives compounds were detected at relatively low concentrations (except for nitroglycerin) in the surface soil (from the Far-Range Firing Position, Heavy Steel Plate Area, Test Range Floor and the Area behind the Berm) and the subsurface soil (from each quadrant of the Test Range Berm). Perchlorate was the only explosive compound that was detected in all subareas of the Former Test Range, but its concentrations were consistently less than its MCP Method 1 S-1 standard. The number of explosives detected in the Former Test Range soils ranged from one (in two of four quadrants sampled at the Test Range Berm) to nine (at the Front of the Near Range Firing Position). Nitroglycerin was found in exceedance of its USEPA RSL residential standard in surface soil in the Heavy Steel Plate Area, the Near-Range Firing Position, and Area behind the Berm, and greater than its MCP S-2 standard in the Heavy Steel Plate Area.
- The soil sampling at the SDA UCL Exceedance Area revealed lead and mercury concentrations less than the current MassDEP UCLs for both metals, indicating that there is no longer evidence of a soil UCL exceedance in this area. The lead results exceeded the MCP Method 1 S-1 Standard for lead, but the mercury results did not exceed the MCP Method 1 S-1 Standard for mercury. There also were MCP Method 1 S-1 exceedances of antimony, barium, chromium, and zinc in this area. Explosives were not analyzed for in 2009, but the explosives detected at low concentrations during the re-baselining sampling in 2015 included 1,3,5-trinitrobenzene, 1,3-dintrobenzene, 2,4,6-trinitrotoluene, 2,4-dintrotoluene, 2,6-dinitrotoluene, 2-amino-4,6-dinitrotoluene, 4-amino-2,6-dinitrotoluene, 4-nitrotoluene, octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX), nitrobenzene, picric acid, and hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX). None of the measured explosive concentrations exceeded the published MCP Method 1 S-1 standards or residential RSLs.

- Mercury was the only metal that was analyzed for in the surface soil at the two 100-Year Floodplain Areas. The sampling results did not exceed the MCP Method 1 S-1 Standard for mercury, indicating that there was little or no apparent flood deposition of mercury-contaminated sediment on the western shoreline of MLFP.

- The soil sampling at the PZ-24 Groundwater UCL Exceedance Area resulted in barium, chromium and lead concentrations that exceeded their respective MCP Method 1 S-1 Standards, but did not exceed their respective MCP Method 1 S-2 standards. The mercury results did not exceed the MCP Method 1 S-1 Standard for mercury. The lead and mercury concentrations were less than their respective UCLs for both metals, indicating that there is no longer evidence of a soil UCL exceedance in this area. The explosives detected in this area at low concentrations were 1,3-dintrobenzene, 2-amino-4,6-dinitrotoluene, 3-nitrotoluene, HMX, RDX and Tetryl. None of the measured explosive concentrations exceeded the MCP Method 1 S-1 or residential RSLs.

- The soil sampling at the MUA indicated that there were elevated lead and mercury levels at several sampling locations. The concentrations of lead and mercury that exceeded their respective MCP Method 1 S-1 Standards (i.e., 200 mg/Kg for lead and 20 mg/Kg for mercury, respectively) extended down to a depth of 4 feet bgs at a number of the sampled locations. Samples in the 12”-24” bgs depth range showed mercury concentrations exceeding its UCL value of 300 mg/Kg. In many cases, this depth coincides with the beginning of the layer of dense glacial till underlying the looser surficial material. No other metals exceeded their respective MCP S-1 standards. These sampling results indicate the area of highest soil metals contamination is in the south-central portion of this subarea adjacent to the boundary with the MUA Sediment Area. Soil in the MUA was previously tested for explosives as part of the 2002 Phase IIC Site Investigation. During the 2002 Phase IIC sampling event, fifteen soil samples were collected across the area from the depth interval of 0 to 3.0 feet (or refusal). All 15 samples were analyzed for volatile organic compounds (VOCs), chromium (VI), total mercury, methyl mercury, target analyte list (TAL) metals, toxicity characteristic leaching procedure (TCLP) metals, semi-volatile organic compounds (SVOCs), and acid volatile sulfide (AVS) and simultaneously extracted metals (SEM) (AVS/SEM). Eight of the 15 samples (those located nearest the adjacent sediment area) also were analyzed for explosives. Tetryl was detected in one of the eight samples at 150 ug/Kg in sample S-MUA16. There is no MCP Method 1 Soil Standard for Tetryl, however, this result is below the USEPA residential RSL of 32,000 ug/Kg (based off a non-cancer HI of 0.2). Nitroglycerin was reported in two of the soil samples, 2,700 ug/Kg at S-MUA16 and 3,800 ug/Kg at S-MUA19. There is no MCP Method 1 Soil Standard for nitroglycerin. These two soil results exceed the USEPA Resident Soil RSL of 1,260 ug/Kg (based on a non-cancer HI of 0.2), however, both results are below the USEPA Industrial Soil RSL of 8,200 ug/Kg. One MUA sediment sample was previously tested for explosives in the 2002 Phase IID Site Investigation. Nitroglycerin was the only detected explosive reported as 2,700 ug/kg which is consistent with the detected concentrations in the 2015 MUA soil samples. As such, it was demonstrated previously that explosives are not of concern in the Marsh Upland Area and additional sampling for explosives during the 2015 re-baselining sampling event was not warranted.

The results of the re-baselining sediment sampling in 2015 were as follows:

- The ECC re-baselining sediment sampling revealed mercury concentrations at locations throughout the ECC that exceeded 4 mg/Kg. The concentrations were generally highest in the eastern reach of the ECC, with the possible exception of the three sampling stations nearest the southern confluence of the ECC with the LDRC.

- The LDRC sediment sampling revealed mercury concentrations that exceeded 4 mg/Kg in the two northern most sampling locations where the detected mercury levels were found to be similar to those measured in the lower reaches of the ECC. The third sampling location at the boundary between this area and Lily Pond had the lowest detected concentration of mercury in the Site’s river and pond sediments from this sampling.

- The measured LUFP sediment mercury concentrations exceeded 4 mg/Kg at various depths throughout LUFP. In LUFP, mercury concentrations greater than 4 mg/Kg were generally found to extend to 6 inches bgs, with pockets of deeper sediment contamination greater than 4 mg/Kg in the northern portion of Lily Pond (i.e., to depths of 12-24 inches). In Middle Factory Pond north of the Greenway Trail foot bridge, the sediment mercury contamination greater than 4 mg/Kg extended 12-18 inches bgs on the eastern shoreline and only somewhat below 6 inches on the western shoreline at a tributary inlet. These areas of deeper mercury contamination may be indicative of recirculation/depositions zones that are located along the eastern shore above the foot bridge flow constriction, at the inlet delta along the western shore, and within the northernmost portion of Lily Pond where the flow velocity drops quickly. Mercury contamination in the Lower Factory Pond sediment is mostly within the top 6 inches except for deeper pockets of contamination directly behind the Factory Pond Dam and in the inlet on the eastern shoreline where contamination was detected down to a depth of 24 inches.

- Mercury concentrations in the MUA sediments were somewhat higher than in the MLFP sediments, and were the highest at the boundary with the MUA Soil Area. These observations suggested that the mercury in the MUA sediment may have been from a different source than the MLFP sediment. The mercury contamination in this area extended down more than 6 inches to at least 12 inches, and possibly to the shallow bedrock.

- Within the IHRC, the mercury concentrations detected in the depositional areas downstream and within 1200 feet of the Factory Pond Dam ranged from 0.084 to 0.78

mg/Kg. Within an intermediate reach of the IHRC between 1.0 and 1.6 miles downstream of the Factory Pond Dam, the average mercury concentration at sampling station 5 was 3.45 mg/Kg and at sampling station 7 was 3.1 mg/Kg. Farther downstream at sampling station 8 (i.e., 2.5 miles below Factory Pond Dam), the surficial sediment mercury concentration was 4.2 mg/Kg. Sampling station 8 was located approximately 1000 feet above the Luddam's Ford Dam, a major impoundment and sediment deposition area. The source of the mercury in the sediment between Factory Pond Dam and the Luddam's Ford Dam is uncertain but is not believed to be from the Site. Further discussion on potential sources of mercury in this area is contained in Appendix 3F of the Final Supplemental Phase II Report.

6.2. RAM/IRA for the Cold Waste Area and the Former Test Range Berm Area (2017-Ongoing)

This RAM involves the excavation and off-site removal of UXO, MD, RRD, metallic debris, construction debris, and any contaminated soil associated with the historical operations at the CWA and the FTRBA. The CWA is a fenced area approximately 130 feet by 70 feet in size that is located on the eastern shoreline of Factory Pond north of the foot bridge. Removal of the metallic debris in this area was performed by excavating soil down to the groundwater table which was at an average depth of 18 inches bgs. This excavation generated roughly 500 cubic yards (CY) of excavated debris and soil. The FTRBA is part of a natural hillside and is approximately 300 feet wide by 100 feet long along the berm face. The AIFB lies directly in front of the berm. The FTRBA is within a wooded area in the southeastern portion of the Site. Removal of the embedded munitions and RRD was estimated to require excavation into the berm to a depth of approximately 36 inches (generating roughly 3,300 CY of excavated debris and soil). Excavation to date in the FTRBA and the AIFB has had to go deeper at certain locations to ensure removal of the metal detected. Completion of this RAM will remove any soil exceeding the MCP Method 1 S-1 Soil Standards from these two areas of the Site. As such, no future exposures to trace explosives contamination or munitions-related metals at these two areas are anticipated.

7. Updated Conceptual Site Models

7.1. Updated Conceptual Site Model for Human Health Exposures

The 2005 CSM was reviewed to determine if the results from the subsequent soil and sediment sampling or changes that have occurred at the Site since 2005 required adjustments to be made to the CSM. This review especially focused on the mercury sampling results from the banks of the ECC and the adjacent low-lying over bank soil areas where mercury-containing sediment was found to have been deposited, and the metals and explosives detections in some locations associated with the FTRBA. Updating the previous CSM from 2005 also included the identification of any potential new receptors that were not previously identified, as well as any additional exposure points to an impacted environmental medium. Figures 7-1 through 7-3 present the updated CSMs for human health exposures to soil and sediment in the northern, central, and southern portions of the Site, respectively.

Northern Portion of the Site

As was previously noted, the PGA was further developed since 2005 and is now part of the "Greenway Trail" that runs on both the eastern and western sides of the ponds north of the foot bridge and incorporates the foot bridge itself. In addition, the CSM was updated to include users of the UNA who may be potentially exposed to the mercury-contaminated sediment on the ground surface in the ECC Over Bank Areas, since accessible soil exposures were not previously highlighted for these areas. Previously, the 2005 CSA identified mercury as the direct contact sediment "risk driver" for a trespasser in the ECC sediments, and mercury, benzo(a)pyrene and benzo(a)anthracene as the "risk drivers" for a recreational fisherman. Therefore, the potential risk to these receptors from direct contact exposure to the accessible soil containing the recent sediment deposits will be assessed for these receptors and chemicals.

The additional sediment samples that were collected in the ECC, LUFP and MLFP during the 2015 re-baselining sampling event were only analyzed for mercury. As sediment mercury concentrations were the only new data collected, there were no changes to the CSM for these areas.

The current and reasonably foreseeable future receptors for the northern portion of the Site were identified in the updated CSM as commercial workers, commercial customers, utility workers, construction workers, trespassers, recreational users and recreational fisherman (see Figure 7-1).

Central Portion of the Site

The updated CSM for this area is similar to the one developed in the 2005 CSA (see Figure 7-2). However, since the development of this 2005, there is a better understanding of the extent of contamination in this portion of the Site, which is now known to be limited to the land owned by the Con Com. As such, commercial workers and commercial customers are no longer potential receptors in this area. In addition, because this portion of the Site encompasses conservation land, potential exposure to a conservation manager is now considered in the updated CSM.

Southern Portion of the Site

The detection of metals and explosives in the area in front of the Test Range Berm, the Test Range Berm itself, and the Area Behind the Test Range Berm during the 2015 re-baselining sampling suggested that this area also needed to be explicitly incorporated in the updated CSM relative to potential exposure to these chemicals. The current and reasonably foreseeable future receptors for this area are construction workers and utility workers who may interact with the soil in the future to build structures associated with the recreational and conservation uses of this area and any associated buried utilities. Adult and child recreational users also may be potentially exposed to the eventual surficial soil that will be present in this area in the future. However, as stated previously, the Former Test Range Berm has undergone extensive soil removal activities along the berm face as part of the ongoing RAM/IRA in 2017. The removal of this soil and the restoration with clean material will make the direct contact exposure pathway incomplete for the FTRBA. Accordingly, soil PRGs were not developed for these chemicals for the FTRBA.

An assessment of the current status and condition of each of the risk characterization areas identified in the 2005 CSA was performed since the subsequent site characterization and remediation activities have altered the conditions in these areas relative to the conditions that were reflected in the original CSM:

- There has been no change in the current or anticipated future land use or associated receptors for the SDA since 2005 relative to the soil. As stated previously, the top 18 inches of soil in the CWA was excavated and removed. This remediation significantly reduced the concentrations of metals in the accessible soil in this area, especially those metals that had previously exhibited UCL exceedances (i.e., antimony, barium, zinc, and lead). Post-excavation confirmatory sampling of the remaining soil below the RAM excavation horizon yielded metals concentrations that did not exceed their MCP Method 1 S-1 Standards. Sidewall sampling in the CWA excavation at the fence line indicated that two of four sidewall samples showed exceedances of the MCP Method 1 S-1 and S-2 Standards for total chromium and one sidewall sample result exceeded the MCP Method 1 S-1 and S-2 Standards for antimony. The only current or reasonably foreseeable future use of this area following site remediation is for conservation or recreation. As activities associated with recreational or conservation land use are not typically intrusive into the soil past 18" (especially in this area with a relatively high groundwater table), the pathway for recreational exposure to contaminated soil is now considered to be incomplete within the CWA fencing. Therefore, updated direct contact soil PRGs were not developed for the CWA.

- Additional delineation soil sampling also took place in the MUA during the 2015 re-baselining sampling event where soil was tested for the presence of metals. There were no indicated changes to the potential receptors for this area.

The 2015 re-baselining sampling of the sediments in the IHRC for mercury was the first such sampling for most of this reach of the river. For reasons set forth in Appendix 3F, this area is not considered to be part of the Site.

The current and reasonably foreseeable future receptors for the subareas within the southern portion of the Site were identified in the updated CSM as utility workers, construction workers, trespassers, recreational users, recreational fisherman and conservation managers (see Figure 7-3). As noted above, there are now incomplete pathways for some of these receptors in different subareas within the southern portion of the Site.

7.2. Updated Conceptual Site Model for Environmental Exposures

The 2005 environmental CSM presented in the ERC Report also was reviewed to determine if the results from the 2015 re-baselining sampling events or changes that have occurred at the Site since 2005 warranted any changes or adjustments to the environmental CSM. Figures 7-1 through 7-3 present the updated CSMs for ecological exposures to soil and sediment in the northern, central, and southern portions of the Site, respectively.

The soil in the UNA now includes soil in the ECC Over Bank Areas that has been impacted by the deposition of mercury-contaminated sediment. As such, the environmental CSM was updated to include these potential soil exposures. However, as the re-baselining only analyzed for mercury and mercury had already been identified as a COEC for the UNA in the 2005 ERC, no change to the COEC list was required for this area. Mercury was identified as a COEC for soil invertebrates, terrestrial plants, and microbial communities in the UNA in the 2005 ERC.

The detection of metals and explosives at the FTRBA during the 2015 re-baselining sampling suggests that this area should be included in an updated environmental CSM. However, as stated previously, soil removal and restoration efforts at the berm ultimately will eliminate potential direct contact exposures of environmental receptors to impacted soil in this area. This will be confirmed through post-excavation confirmatory sampling at the final excavation face and the use of demonstrated clean backfill to restore the site. As such, there are no complete environmental exposure pathways included in the updated environmental CSM for this area.

8. Updated Human Health and Environmental PRGs

The following sections describe the development of updated soil and sediment PRGs for the protection of human health at the Site. The updated values are presented in Table 8-1.

8.1. Updated Human Health Soil PRG Development

For efficiency and consistency, the updated soil PRGs associated with the exposure media and receptors highlighted by the updated CSM were developed using the current MassDEP ShortForms using a single chemical modified “reverse” MCP Method 3 approach. This approach is when a single chemical excess lifetime cancer risk (ELCR) or non-cancer hazard index (HI) risk goal is specified, receptor-specific exposure parameters are chosen, the MCP toxicity values are applied, and the exposure point concentration in soil is iteratively adjusted using the ShortForm for that receptor until the target cancer or noncancer risk target is achieved. To take into consideration the potential cumulative carcinogenic and noncarcinogenic effects of exposure to multiple chemicals that may be present in the soil, PRGs were calculated corresponding to an individual chemical target ELCR of $1x10^{-6}$ and an individual chemical HI of 0.2. It should be noted that the MCP target multi-chemical, multi-pathway cancer risk is $1x10^{-5}$ and the target multi-chemical, multi-pathway noncancer hazard index is one (1.0). Updated PRGs were calculated for the chemicals previously identified as direct contact “risk drivers” for the various receptors based on the Phase II HHRC results. The use of the current MassDEP ShortForms automatically factored into the PRG calculations several of the required changes and updates to the PRG development process that were previously outlined. These changes included the use of updated toxicity factors for chemicals, updated chemical and physical properties for chemicals, and the use of MassDEP default exposure factors for many of the common receptors of interest, when appropriate. These updates also reflected the elimination of calculated cancer risks for Class C carcinogens that no longer have published cancer toxicity values (such as 1,1-DCE) since the current MassDEP policy is to not estimate a carcinogenic risk for these chemicals. Accordingly, an updated soil PRG was not calculated for 1,1,-DCE since there was no significant non-cancer risk found relative to 1,1-DCE in the 2005 CSA.

Currently, relevant ShortForms have been published for soil exposures only for a construction worker and a park visitor. As no ShortForm has been published specifically for a utility worker, it is assumed that PRGs designed to be protective of the construction worker with appropriate exposure parameter inputs also would be protective of the utility worker who is typically assumed to have a shorter exposure duration (i.e., exposure during fewer days per event) but longer exposure period (i.e., exposure during events over multiple years) than the construction worker. Although the utility worker may have a longer exposure period, the longer exposure duration and greater intensity of exposures to soil for a construction worker are anticipated to result in greater overall exposure and a risk-based PRG that is protective of a utility worker. Similarly, since no ShortForm has been published specifically for a recreational user or intermittent conservation worker, the ShortForm published for the park visitor was used to calculate the PRGs for the recreational user and intermittent conservation worker receptors using appropriate exposure parameter inputs. The particular surrogate receptor ShortForms were selected because they accounted for the appropriate combination of soil exposure pathways that would be expected for the actual Site receptor.

The PRG ShortForm calculations for each receptor are presented in Attachment A. In the upper portion of each receptor-specific ShortForm output, PRGs were first calculated to achieve a contaminant-specific HI of 0.2 relative to potential non-carcinogenic health effects from exposure to the “risk drivers” associated with that receptor, as applicable. In the lower portion of each receptor-specific ShortForm output, PRGs were then calculated to achieve a contaminant-specific ELCR of 1x10-6 relative to potential carcinogenic risks from exposure to the “risk drivers” associated with that receptor, as applicable. If a “risk driver” has the potential to produce both non-carcinogenic health effects and carcinogenic risks, that contaminant appears twice on the ShortForm and the lower of the two PRGs was selected to be the risk-based PRG protective of that receptor.

8.1.1. Construction Worker / Utility Worker Soil PRGs

The construction worker ShortForm was used to calculate the updated soil PRGs for a construction worker and to conservatively address the potential risks to a utility worker. Updated PRGs were calculated in consideration of the direct exposure of each receptor to the identified “risk drivers” associated with each potential risk characterization area. Routes of exposure were assumed to be incidental ingestion, dermal absorption and particulate inhalation (with gastrointestinal absorption and pulmonary absorption). The updated PRGs correspond to a target individual chemical, multi-pathway ELCR of $1x10^{-6}$ and/or an individual chemical, multi-pathway HI of 0.2 to account for potential cumulative effects from multiple co-located contaminants. Carcinogenic effects were projected over the lifetime of a construction worker and non-carcinogenic health effects were projected over the assumed exposure period. Updated PRGs for non-carcinogenic health effects were calculated for subchronic exposures utilizing subchronic reference doses (RfDs) and reference concentrations (RfCs) when available. If a subchronic toxicity factor was not available, the chronic RfDs and RfCs were automatically used as in the ShortForm (i.e., the default MCP approach). The toxicity data and the default exposure parameters published with the ShortForms were used to develop the updated PRGs. The construction worker was assumed to have a soil ingestion rate of 100 mg/day and a body weight of 58 kg. The exposure frequency was assumed to be 0.714 events/day (i.e., a construction worker was assumed to be exposed to soil for five events (or days) over a period of a seven-day week) for eight hours a day over an exposure period of 182 days (i.e., 130 work days over a six-month period).

The construction worker receptor is assumed to be potentially exposed to soil within the depth range of 0 to 15 feet bgs, which is typically the range applicable to exposures associated with excavation scenarios and building construction (including utility installation and repair). The areas of the Site in which the construction worker (utility worker) updated soil PRGs would be applied in the Revised Phase III RAP are: UNA; LNA; SCCA; SDA; and the MUA. The “risk drivers” for which updated PRGs were potentially necessary for one or more areas relative to the construction worker were:

Metals:	Aluminum, Arsenic, Barium, Cadmium, Chromium (Total), Lead, Manganese, Mercury and Zinc (Note: Aluminum and Manganese are not included in the ShortForms).
Volatile Organics:	Benzene, cis-1,2-Dichloroethene, trans-1,2-Dichloroethene, Trichloroethylene and Vinyl Chloride.

Background concentrations also were considered in the development of these updated soil PRGs. In accordance with MCP policy and guidance, only inorganics, metals and PAHs were considered to be potentially present in the accessible soil as potential background chemicals. Site-specific soil background values for each soil interval (i.e., accessible soil and potentially accessible soil) were compared to the updated PRGs calculated using the ShortForms. If the constituent’s background concentration was higher than the updated risk-based PRG, the background concentration was identified as the updated soil PRG for that constituent.

8.1.2. Recreational User Soil PRGs

The park visitor ShortForm was used to calculate updated soil PRGs for the child and adult recreational user exposed to accessible soil or exposed shoreline sediment, a trespasser exposed to accessible soil, and a recreational fisherman exposed to accessible soil or exposed shoreline sediment. Updated PRGs were calculated in consideration of the direct exposure of each receptor to the identified “risk drivers” associated with each risk characterization area. Routes of potential exposure were assumed to be incidental ingestion and dermal absorption (i.e., no inhalation of particulates or volatiles was assumed consistent with the ShortForm default formulation). The updated PRGs correspond to a target individual chemical, multi-pathway ELCR of $1x10^{-6}$ and/or an individual chemical, multi-pathway HI of 0.2 to account for potential cumulative effects from multiple co-located contaminants. As the park visitor ShortForm does not consider the inhalation route of exposure significant for this receptor (or the similar surrogate receptors), updated PRGs were not calculated for those “risk drivers” identified from the 2005 CSA that contributed risks above the thresholds only via the inhalation pathway. If a chemical was associated with significant risk through the incidental ingestion and/or dermal absorption pathways, an updated soil PRG was calculated.

Carcinogenic exposures were calculated over the lifetime of the child and adult recreational receptors, as appropriate (i.e., the lifetime additional daily dose for ages 1-8, 8-15, and 15-31 years were combined and averaged over 70 years). Non-carcinogenic health effects were projected conservatively for a child receptor for both a chronic and subchronic exposure period, as appropriate. The default recreational exposure parameters within the ShortForm were used to calculate updated PRGs where the chronic exposure period was assumed to be 7 years (i.e., a child ages 1-8 years) and the subchronic exposure period was assumed to be 1 year (i.e., a child ages 1-2 years). The updated PRGs for non-carcinogenic effects were calculated for chronic exposures using chronic RfDs and RfCs contained in the ShortForms. For subchronic exposures, a subchronic RfD and RfC were used when available. If a subchronic toxicity factor was not available, the chronic RfDs and RfCs contained within the ShortForm were applied.

- The young child recreational site user (aged 1-2 years) was assumed to have a soil ingestion rate of 100 mg/day and a body weight of 10.7 kg. The exposure frequency was assumed to be 0.428 events/day over a period of 0.577 years (i.e., a child was assumed to be exposed to soil for approximately 3 days a week for 52 weeks of the single year of age). A recreational user in this age range was the receptor for which the updated PRGs for the protection of subchronic non-cancer health effects were calculated.
- A child recreational site user (aged 1-8 years) was assumed to have a soil ingestion rate of 100 mg/day and a body weight of 17 kg. The exposure frequency was assumed to be 0.247 events/day (i.e., a child was assumed to be exposed to soil for approximately 3 days per week for 30 weeks) over an exposure duration of 7 years. A recreational user in this age range was the receptor for which the updated PRGs for the protection of chronic non-cancer health effects was calculated.
- An adolescent recreational site user (aged 8-15 years) was assumed to have a soil ingestion rate of 50 mg/day and a body weight of 39.9 kg. The exposure duration for this

age group was 7 years. The exposure frequency was assumed to be 0.247 events/days (i.e., assumed to be exposed to soil for approximately 3 days per week for 30 weeks).

- An adult recreational site user (aged 15-31 years) was assumed to have a soil ingestion rate of 50 mg/day and a body weight of 58.7 kg. The exposure duration for this age group was 16 years. The exposure frequency was assumed to be 0.247 events/days (i.e., assumed to be exposed to soil for approximately 3 days per week for 30 weeks).
- A recreational user in the age range of 1-31 was the receptor for which the updated PRGs for the protection of lifetime cancer health effects was calculated.

To ensure that updated PRGs were calculated for all soil contaminants that may be significant contributors to risk for each receptor scenario, the site characterization data collected during the 2015 re-baselining sampling event was used in addition to the data previously collected from an area to identify chemicals that may require an updated PRG. Updated soil PRGs were developed for those chemicals that were identified as “risk drivers” for their respective areas in the 2005 CSA summary and which were indicated to remain a potential concern at the Site in consideration of the more recent sampling data. In addition, chemicals requiring an updated PRG were identified for the areas of the Site that were newly sampled as part of the 2015 re-baselining sampling event or that were re-sampled during that event. For instance:

- Mercury was found at concentrations exceeding the MCP Method 1 S-1 Standard for mercury in the accessible soil in the ECC Over Bank Areas. As such, mercury was identified as a “risk driver” for the soil in this area and applicable updated soil PRGs were calculated for mercury.
- The 2015 re-baselining sampling in the 100-Year Floodplain Areas revealed only very low mercury concentrations in the accessible soil, which were less than the MCP Method 1 S-1 Standard for mercury. As such, no updated mercury PRGs were warranted for these areas.
- The metals concentrations reported for the soil in the MUA Soil Area from the 2015 re-baselining sampling event were compared to the prior metals results to determine if any additional metals should be added to the COC list for that area and should have an updated PRG calculated for the potential exposure scenarios for that area. No new “risk drivers” were identified.
- No updated PRGs will be established for the FTRBA (including the Area in Front of the Berm) or the CWA since those areas were remediated during the RAM to remove any soil not meeting the unrestricted MCP Method 1 S-1 Standards.
- Method 3 forward cumulative risk calculations for the current or reasonably foreseeable future receptors identified for the other subareas of the Former Test Range (i.e., the Far-Range Firing Position, the Heavy Steel Plate Area, the Near-Range Firing Position, and

the Area Behind The Berm) were performed using the appropriate receptor ShortForms and the recently collected soil sampling results for metals and explosives. No updated soil PRGs needed to be developed as the result of this sampling.

The recreational user receptor was assumed to be potentially exposed to soil within the depth range of zero to 3 feet bgs, which is typically the soil disturbance range applicable to exposures associated with incidental surficial activity. The areas of the Site in which the recreational user updated soil PRGs would be applied in the Revised Phase III RAP are: SDA; the MUA; and the ECC Over Bank Soil Areas. The "risk drivers" for which updated PRGs were potentially necessary for one or more areas relative to the recreational user were:

Metals:	Lead and Mercury.

Background concentrations also were considered in the development of the updated soil PRGs. In accordance with MCP policy and guidance, only inorganics, metals and PAHs were considered to be potentially present in the accessible soil as potential background chemicals. Site-specific soil background values for each soil interval (accessible soil and potentially accessible soil) were compared to the updated PRGs developed using the ShortForms. If a background concentration was greater than the updated risk-based PRG derived using the ShortForm, the background concentration was identified as the updated soil PRG for that constituent.

8.1.3. Trespasser Soil PRGs

No "risk drivers" were identified for the trespasser in the 2005 Phase II CSA risk characterization. However, mercury was identified as a "risk driver" for the accessible soil in the ECC Over Bank Soil Areas in the depth range of zero to 3 feet bgs (i.e., the soil depth range applicable to exposures associated with surficial activity). An updated soil PRG was calculated for this potential exposure scenario for use in the Revised Phase III RAP.

8.1.4. Commercial Worker Soil PRGs

Benzo(a)pyrene was identified as a "risk driver" via the incidental ingestion exposure pathway for a commercial worker in the 2005 Phase II CSA risk characterization. However, the multi-chemical, multi-pathway receptor risks for this receptor were less than the cumulative ELCR and HI targets. As such, an updated soil PRG was not calculated for this potential exposure scenario.

8.2. Updated Human Health Sediment Direct Contact PRG Development

To address the human health risks associated with exposure to accessible sediment at the Site, surficial shoreline sediment will be treated as accessible soil for purposes of calculating and applying an updated PRG in the Revised Phase III Report. The 2005 CSA identified a recreational fisherman and a trespasser as potentially being at risk from direct exposure to accessible sediment or shallow submerged sediment along the shoreline. As noted above, updated PRGs were calculated for a target individual chemical, multi-pathway direct contact

ELCR of $1x10^{-6}$ and/or an individual chemical, multi-pathway HI of 0.2 to account for potential cumulative effects from multiple co-located contaminants. As ShortForms have not been published specifically for either of these two receptors, updated PRGs were calculated using a modified park visitor ShortForm for soil. Exposure parameters were selected that would be protective of a recreational fisherman or trespasser who would only infrequently be exposed to these surficial accessible sediments at the Site.

8.2.1. Recreational Fisherman Exposed to Accessible Shoreline Sediment PRGs

A recreational fisherman was assumed to be exposed to accessible shoreline sediment in accordance with the following scenario:

- A child recreational fisherman (aged 1-8 years) was assumed to have an accessible sediment ingestion rate of 100 mg/day and a body weight of 17 kg. The exposure frequency was assumed to be 0.214 events/day (i.e., a child fisherman was assumed to be exposed to the accessible shoreline sediment for approximately 2 days per week for 39 weeks each year) over an exposure duration of 7 years. A child recreational fisherman in this age range was the receptor for which the updated PRGs for the protection of chronic noncancer health effects were calculated.
- An adolescent recreational fisherman (aged 8-15 years) was assumed to have an accessible sediment ingestion rate of 50 mg/day and a body weight of 39.9 kg. The exposure duration for this age group was 7 years. The exposure frequency was assumed to be 0.214 events/days (i.e., assumed to be exposed to the accessible shoreline sediment for approximately 2 days per week for 39 weeks each year).
- An adult recreational fisherman (aged 15-31 years) was assumed to have an accessible sediment ingestion rate of 50 mg/day and a body weight of 58.7 kg. The exposure duration for this age group was 16 years. The exposure frequency was assumed to be 0.214 events/days (i.e., assumed to be exposed to the accessible shoreline sediment for approximately 2 days per week for 39 weeks each year).
- A recreational fisherman in the age range of 1-31 was the receptor for which the updated PRGs for the protection of lifetime cancer health effects were calculated.

The recreational fisherman receptor was assumed to be potentially exposed to sediment within a depth range of 0-3 feet bgs, which is the range applicable to exposures associated with incidental surficial activity. The areas of the Site in which the recreational fisherman updated PRGs would be applied to the accessible sediment in the Revised Phase III RAP are: LUFP; MLFP; LDRC; the ECC Over Bank Soil Areas; and the IHRC. The “risk drivers” for which updated PRGs were necessary for one or more areas relative to the recreational fisherman were:

Metals:	Antimony, Arsenic, Lead and Mercury.

PAHs: Benzo(a)pyrene, Benzo(b)fluoranthene, Dibenz(a,h)anthracene and Indeno(1,2,3-c,d)pyrene.

Volatile Organics: Vinyl Chloride.

The current ShortForm toxicity values for benzo(a)pyrene were applied in the calculations (i.e., not the updated values used to calculate the USEPA Regional Screening Levels (RSLs)). The background concentration of mercury in soil also was considered in the development of these accessible sediment updated PRGs for mercury. If the background sediment (soil) mercury concentration was greater than the risk–based direct contact updated PRG derived using the ShortForm, the background sediment concentration was identified as the updated PRG for that receptor-medium combination.

8.2.2. Trespasser Exposed to Accessible Shoreline Sediment PRGs

A trespasser was assumed to be exposed to accessible shoreline sediment in accordance with the following scenario:

- An adolescent trespasser (aged 11-18 years) was assumed to have an accessible sediment ingestion rate of 50 mg/day and a body weight of 50.7 kg. The exposure frequency was assumed to be 0.286 events/day (i.e., an adolescent trespasser was assumed to be exposed to the accessible shoreline sediment for approximately 2 days per week for 30 weeks each year) over an exposure duration of 7 years. An adolescent trespasser in this age range was the receptor for which the updated PRGs for the protection of lifetime cancer health effects and chronic non-cancer health effects were calculated.

The trespasser receptor was assumed to be potentially exposed to sediment within a depth range of 0-3 feet bgs, which is the range applicable to exposures associated with incidental surficial activity. The adolescent trespasser updated PRGs will be applied to the accessible sediment of the ECC in the Revised Phase III RAP. The “risk drivers” for which updated PRGs were necessary for one or more areas relative to the adolescent trespasser were:

Metals: Antimony and Mercury.

PAHs: Benzo(a)pyrene and Dibenz(a,h)anthracene.

The current ShortForm toxicity values for benzo(a)pyrene were applied in the calculations (i.e., not the updated values used to calculate the USEPA RSLs). The background concentration of mercury in sediment/soil also was considered in the development of these accessible sediment updated PRGs for mercury. If the background sediment (soil) mercury concentration was greater than the risk–based direct contact updated PRG derived using the ShortForm, the background sediment concentration was identified as the updated PRG for that receptor-medium combination.

8.2.3. Construction Worker Exposed to Accessible Shoreline Sediment PRGs

Mercury was identified as a “risk driver” via incidental ingestion for a construction worker in the 2005 Phase II CSA risk characterization. However, the multi-chemical, multi-pathway receptor risks for this receptor were less than the cumulative ELCR and HI targets. As such, an updated soil PRG was not calculated for this potential exposure scenario.

8.2.4. Non-Fisherman Recreational Site User Exposed to Accessible Shoreline Sediment PRGs

Mercury was identified as a “risk driver” for a non-fisherman recreational site user in the 2005 Phase II CSA risk characterization. However, the multi-chemical, multi-pathway receptor risks for this receptor were less than the cumulative ELCR and HI targets. As such, an updated soil PRG was not calculated for this potential exposure scenario.

8.2.5. Submerged Sediment PRG

In addition to direct contact exposure, receptors also were identified in the updated human health CSM as being potentially at risk from consuming fish tissue from the water bodies at the Site. As stated previously, the new PRG for submerged sediment was designed to achieve the statewide mercury background LMB fillet tissue concentration/distribution in the Site’s LMB (see Appendix 3D). LMB was the focus of the new PRG development for submerged sediment because it is a higher trophic level game fish species expected to bioaccumulate the most mercury. Given the widespread presence of mercury in the sediments of the Site’s ponds and streams, remediation of the sediments to meet this objective is expected to also reduce the concentrations of any co-located contaminants in the sediment and further reduce the risks to aquatic receptors and recreational users of the Site’s water bodies.

8.3. Updated Environmental Soil and Sediment PRG Development

An assessment of the current status and condition of each of the ecological areas of concern outlined in the 2005 CSA was performed since the subsequent site characterization and remediation activities have altered the areas relative to the conditions originally reflected in the CSM:

- In the SDA, there has been no change in the current or anticipated future land use or associated environmental receptors relative to the soil since 2005. Since the 2005 CSA was completed, the top 18 inches of soil in the CWA has been excavated and removed. The current and reasonably foreseeable future use land at the CWA is for conservation or recreation. As non-burrowing environmental receptors are not typically exposed to soil below 18 inches, the pathway for exposure to contaminated soil for these receptors is now considered to be incomplete. The short-tailed shrew typically inhabits underground nests and maintain underground runaways, usually in the top 10 cm (i.e., 3.9 inches) of soil, but sometimes as deep as 50 cm (i.e., 19.7 inches) (Hamilton, 1931; and Jameson, 1943, cited in George, et al., 1986). Although there is some potential for short tailed shrews to burrow as deep as 18 inches, this occurrence would be rare in this area given the extremely shallow water table. Therefore, in light of the completed remediation and stabilization of this area with clean material, no updated environmental soil PRGs were needed for the CWA.

- Since the 2005 CSA, additional delineation soil sampling also took place in the MUA during the 2015 re-baselining sampling event where soil was tested for the presence of metals. There are no anticipated changes to the potential environmental receptors at this location.

- The surficial sediment mercury PRG developed in Appendix 3D was designed to meet NSR under the MCP in consideration of the potential risks to human health and the environment. As such no additional or separate updated sediment PRG is required for environmental protection.

- The environmental "risk drivers" for soil from the Phase II CSA ERC were (see Table 2-1):

Metals:	Antimony, Arsenic, Barium, Cobalt, Chromium (Total), Copper, Lead, Mercury, Nickel, Selenium, Thallium and Zinc.
Volatile Organics:	Hexachlorobenzene.
SVOCs:	Di-n-octylphthalate.

- The environmental "risk drivers" for sediment from the Phase II CSA ERC were (see Table 2-1):

Metals:	Antimony, Lead, Mercury (Total and Methylmercury).

The environmental PRGs presented in the Revised Phase III RAP were updated, as needed. At this time, there has been no terrestrial update to the MCP ERC process relative to the use of screening values. As such, the Revised Phase III RAP environmental PRGs will be carried forward as the updated PRGs.

9. References

George, S. B.; Choate, J. R.; Genoways, H. H. (1986) Blarina brevicauda. American Society of Mammalogists; Mammalian Species 261.

Hamilton, W. J., Jr. (1931) Habits of the short-tailed shrew, Blarina brevicauda (Say). Ohio J. Sci. 31: 97-106.

Jameson, E. W., Jr. (1943) Notes on the habits and siphanapterous parasites of the mammals of Welland County, Ontario. J. Mammal. 24: 194-197.

MassDEP (Massachusetts Department of Environmental Protection). 1996. Massachusetts Contingency Plan (MCP). Guidance for Disposal Site Risk Characterization. Chapter 9: Method 3 Environmental Risk Characterization. Interim Final Policy, BWSC/ORS-95-141. CMR: 40.0900.1996.

MassDEP 1999. Massachusetts Contingency Plan, 310 CMR 40.0000. April 3, 2006.

Tetra Tech, Inc. (Tetra Tech) (2005) Draft Comprehensive Site Assessment Report, Former Fireworks Facility, Hanover, Massachusetts.

Tetra Tech (2009) Revised Phase III Remedial Action Plan, National Fireworks Site, Hanover Massachusetts.

USEPA (2005) U. S. Environmental Protection Agency. Guidance for Developing Ecological Soil Screening Levels. Office of Solid Waste and Emergency Response. Washington, DC.

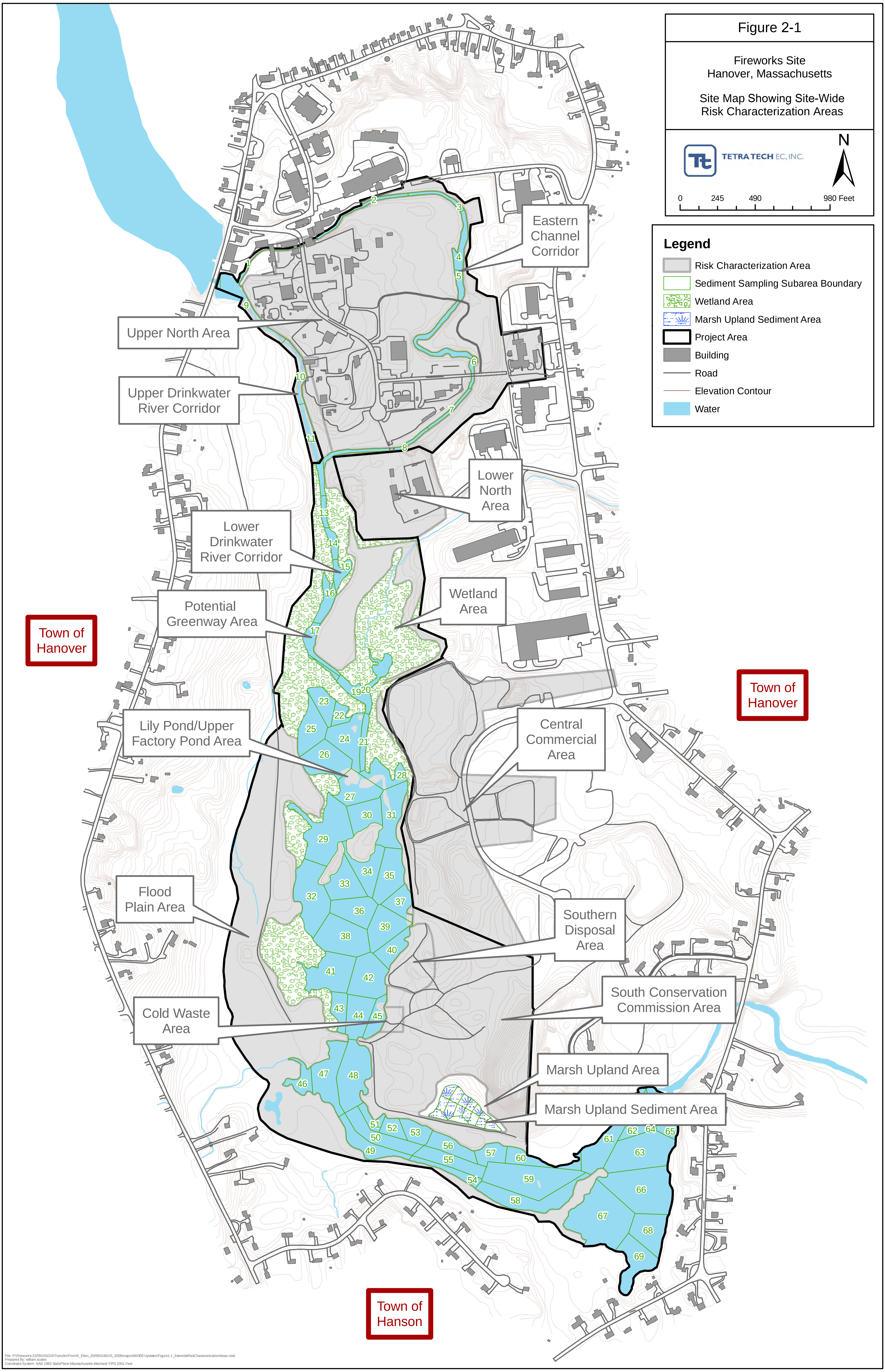
FIGURES

Figure 2-1

Fireworks Site
Hanover, Massachusetts

Site Map Showing Site-Wide
Risk Characterization Areas

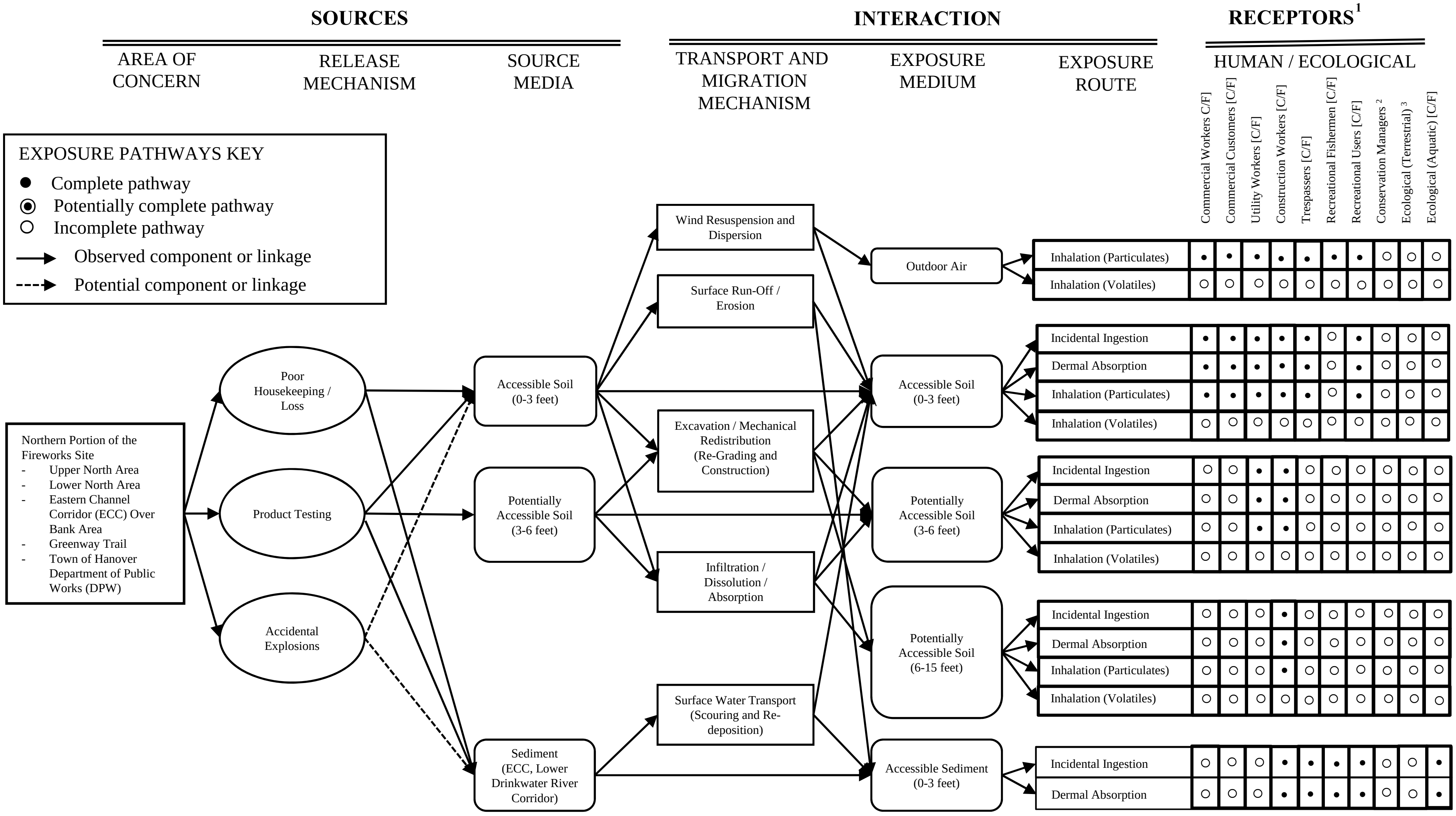
TETRA TECH EC, INC.



Legend

- Risk Characterization Area
- Sediment Sampling Subarea Boundary
- Wetland Area
- Marsh Upland Sediment Area
- Project Area
- Building
- Road
- Elevation Contour
- Water

File: P:\Fireworks-2329\GIS\GIS\Transfer\From\fr_Ellen_20090416\GIS_2008\maps\060309 Updates\Figure1-1_SitewideRiskCharacterizationAreas.mxd
Prepared By: william.scales
Coordinate System: NAD 1983 StatePlane Massachusetts Mainland FIPS 2001 Feet



EXPOSURE MEDIUM	EXPOSURE ROUTE	Commercial Workers C/F]	Commercial Customers [C/F]	Utility Workers [C/F]	Construction Workers [C/F]	Trespassers [C/F]	Recreational Fishermen [C/F]	Recreational Users [C/F]	Conservation Managers ²	Ecological (Terrestrial) ³	Ecological (Aquatic) [C/F]
Outdoor Air	Inhalation (Particulates)	●	●	●	●	●	●	●	○	○	○
	Inhalation (Volatiles)	○	○	○	○	○	○	○	○	○	○
Accessible Soil (0-3 feet)	Incidental Ingestion	●	●	●	●	●	○	●	○	○	○
	Dermal Absorption	●	●	●	●	●	○	●	○	○	○
	Inhalation (Particulates)	●	●	●	●	●	○	●	○	○	○
	Inhalation (Volatiles)	○	○	○	○	○	○	○	○	○	○
Potentially Accessible Soil (3-6 feet)	Incidental Ingestion	○	○	●	●	○	○	○	○	○	○
	Dermal Absorption	○	○	●	●	○	○	○	○	○	○
	Inhalation (Particulates)	○	○	●	●	○	○	○	○	○	○
	Inhalation (Volatiles)	○	○	○	○	○	○	○	○	○	○
Potentially Accessible Soil (6-15 feet)	Incidental Ingestion	○	○	○	●	○	○	○	○	○	○
	Dermal Absorption	○	○	○	●	○	○	○	○	○	○
	Inhalation (Particulates)	○	○	○	●	○	○	○	○	○	○
	Inhalation (Volatiles)	○	○	○	○	○	○	○	○	○	○
Accessible Sediment (0-3 feet)	Incidental Ingestion	○	○	○	●	●	●	●	○	○	●
	Dermal Absorption	○	○	○	●	●	●	●	○	○	●

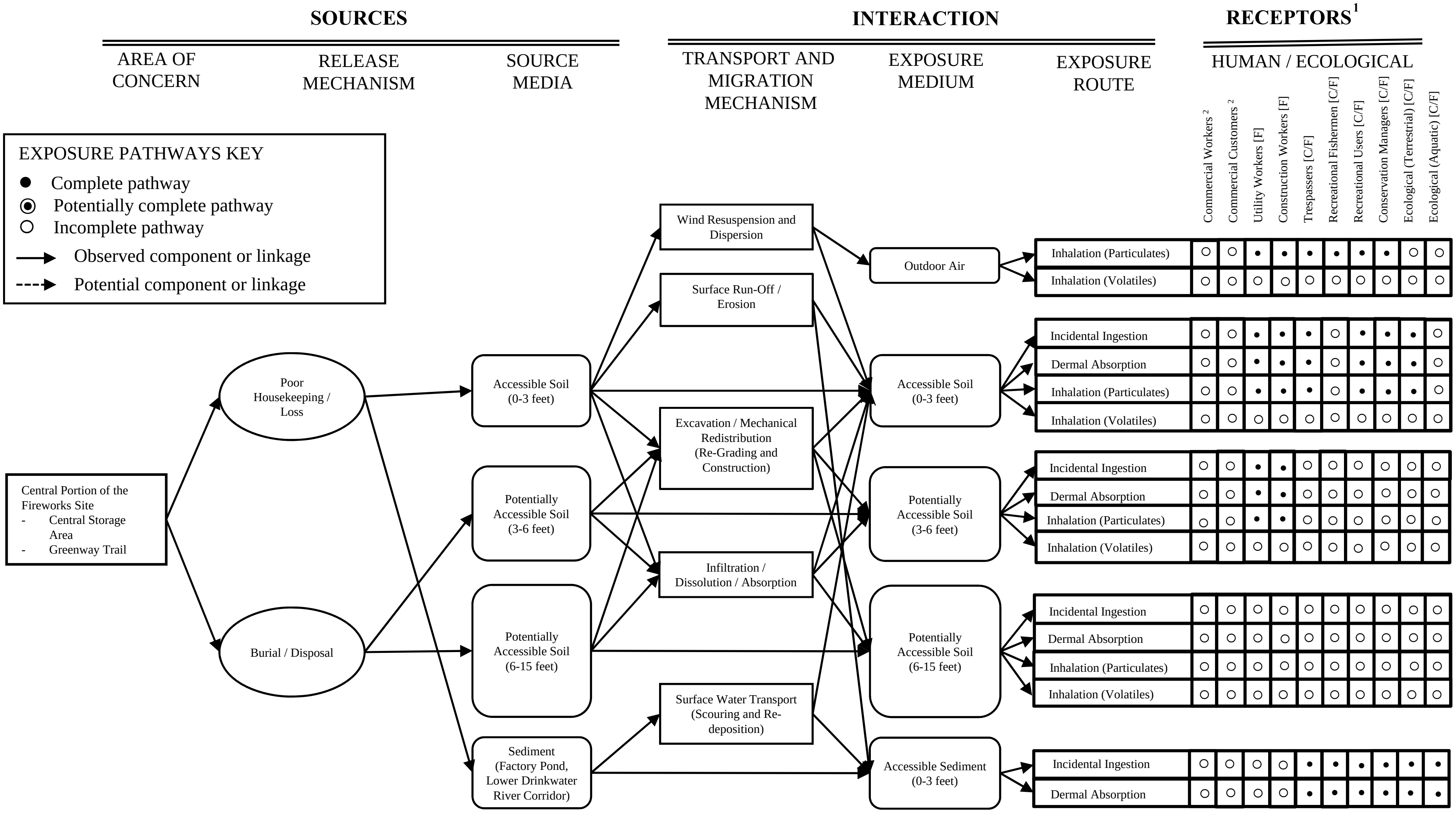
NOTES:

(1) C = Current Receptor; F = Potential Future Receptor

(2) The northern portion of the Site is mainly occupied by commercial and industrial developments and private property, therefore, conservation managers would not be present.

(3) Due to the developed and disturbed nature of the habitat in this portion of the Site, terrestrial receptors are not anticipated to be present in the northern portion of the Site.

Figure 7-1. Updated Conceptual Site Model for the Northern Portion of the Fireworks Site



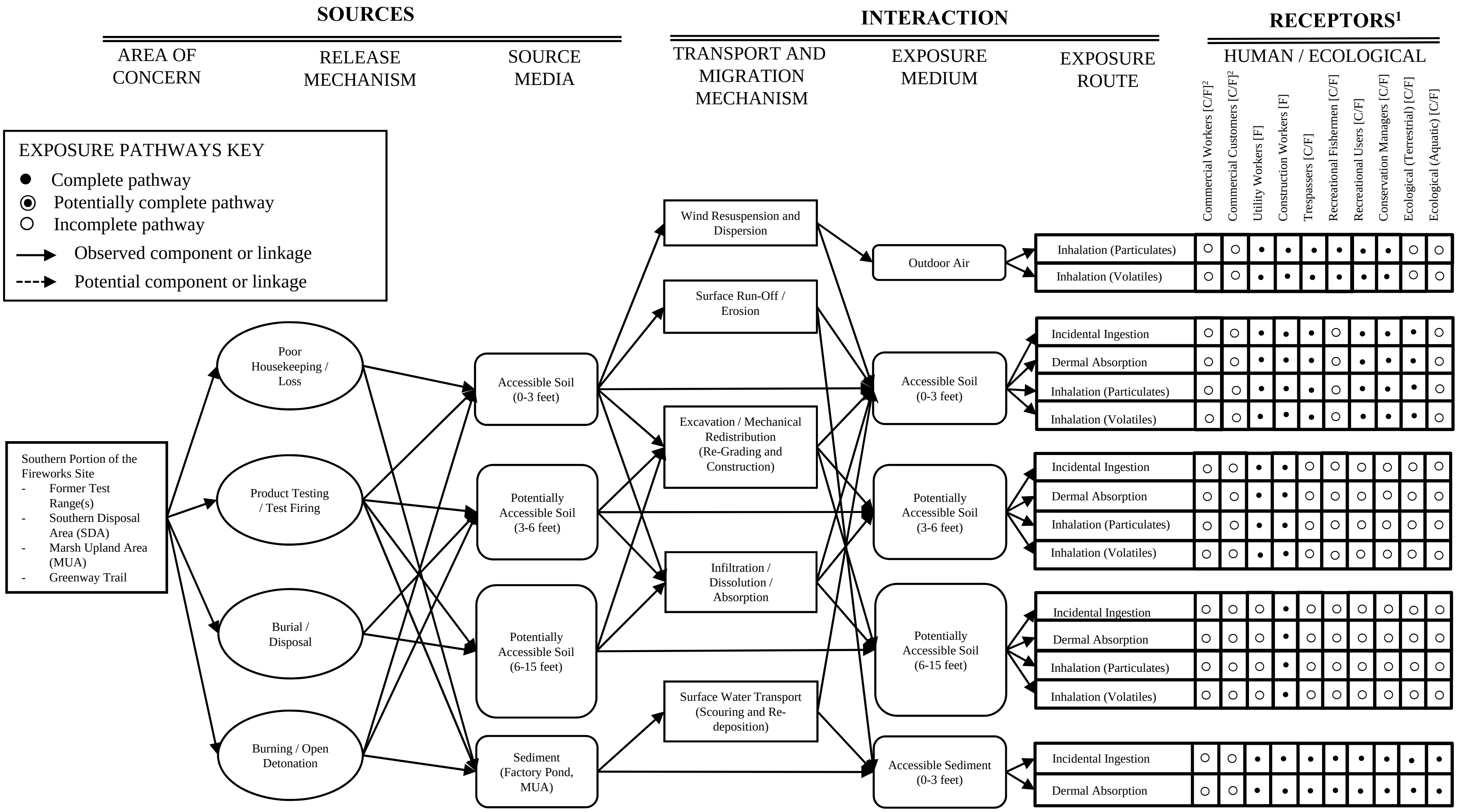
EXPOSURE MEDIUM	EXPOSURE ROUTE	Commercial Workers [2]	Commercial Customers [2]	Utility Workers [F]	Construction Workers [F]	Trespassers [C/F]	Recreational Fishermen [C/F]	Recreational Users [C/F]	Conservation Managers [C/F]	Ecological (Terrestrial) [C/F]	Ecological (Aquatic) [C/F]
Outdoor Air	Inhalation (Particulates)	○	○	●	●	●	●	●	●	○	○
	Inhalation (Volatiles)	○	○	○	○	○	○	○	○	○	○
Accessible Soil (0-3 feet)	Incidental Ingestion	○	○	●	●	●	○	●	●	●	○
	Dermal Absorption	○	○	●	●	●	○	●	●	●	○
	Inhalation (Particulates)	○	○	●	●	●	○	●	●	●	○
	Inhalation (Volatiles)	○	○	○	○	○	○	○	○	○	○
Potentially Accessible Soil (3-6 feet)	Incidental Ingestion	○	○	●	●	○	○	○	○	○	○
	Dermal Absorption	○	○	●	●	○	○	○	○	○	○
	Inhalation (Particulates)	○	○	●	●	○	○	○	○	○	○
	Inhalation (Volatiles)	○	○	○	○	○	○	○	○	○	○
Potentially Accessible Soil (6-15 feet)	Incidental Ingestion	○	○	○	○	○	○	○	○	○	○
	Dermal Absorption	○	○	○	○	○	○	○	○	○	○
	Inhalation (Particulates)	○	○	○	○	○	○	○	○	○	○
	Inhalation (Volatiles)	○	○	○	○	○	○	○	○	○	○
Accessible Sediment (0-3 feet)	Incidental Ingestion	○	○	○	○	●	●	●	●	●	●
	Dermal Absorption	○	○	○	○	●	●	●	●	●	●

NOTES:

(1) C = Current Receptor; F = Potential Future Receptor

(2) There are no current commercial activities within the central portion of the Site and future commercial redevelopment is not anticipated in the foreseeable future due to existing land use restrictions.

Figure 7-2. Updated Conceptual Site Model for the Central Portion of the Fireworks Site



EXPOSURE MEDIUM	EXPOSURE ROUTE	Commercial Workers [C/F][2]	Commercial Customers [C/F][2]	Utility Workers [F]	Construction Workers [F]	Trespassers [C/F]	Recreational Fishermen [C/F]	Recreational Users [C/F]	Conservation Managers [C/F]	Ecological (Terrestrial) [C/F]	Ecological (Aquatic) [C/F]
Outdoor Air	Inhalation (Particulates)	○	○	●	●	●	●	●	●	○	○
	Inhalation (Volatiles)	○	○	●	●	●	●	●	●	○	○
Accessible Soil (0-3 feet)	Incidental Ingestion	○	○	●	●	●	○	●	●	●	○
	Dermal Absorption	○	○	●	●	●	○	●	●	●	○
	Inhalation (Particulates)	○	○	●	●	●	○	●	●	●	○
	Inhalation (Volatiles)	○	○	●	●	●	○	●	●	●	○
Potentially Accessible Soil (3-6 feet)	Incidental Ingestion	○	○	●	●	○	○	○	○	○	○
	Dermal Absorption	○	○	●	●	○	○	○	○	○	○
	Inhalation (Particulates)	○	○	●	●	○	○	○	○	○	○
	Inhalation (Volatiles)	○	○	●	●	○	○	○	○	○	○
Potentially Accessible Soil (6-15 feet)	Incidental Ingestion	○	○	○	●	○	○	○	○	○	○
	Dermal Absorption	○	○	○	●	○	○	○	○	○	○
	Inhalation (Particulates)	○	○	○	●	○	○	○	○	○	○
	Inhalation (Volatiles)	○	○	○	●	○	○	○	○	○	○
Accessible Sediment (0-3 feet)	Incidental Ingestion	○	○	●	●	●	●	●	●	●	●
	Dermal Absorption	○	○	●	●	●	●	●	●	●	●

NOTES:

(1) C = Current Receptor; F = Potential Future Receptor

(2) The only commercial activity relative to the southern portion of the Site is at the Country Ski Shop located on the southern shoreline of Lower Factory Pond. However, there is no complete exposure pathway for accessible sediment or soil (this Shop is not located on-site).

Figure 7-3. Updated Conceptual Site Model for the Southern Portion of the Fireworks Site

TABLES

Table 2-1
Summary of the 2005
Comprehensive Site Assessment
Risk Characterizations

	Human Health			**Ecological**		
	Receptor	**Media**	**COC**	**Receptor/Community**	**Media**	**COC**
Terrestrial						
North Area of No Historical Fireworks Use	No Significant Risks					
West Area of No Historical Fireworks Use	No Significant Risks					
East Area of No Historical Fireworks Use	No Significant Risks					
Central Area of No Historical Fireworks Use	No Significant Risks					
Upper North Area				Soil Invertebrate, Terrestrial Plants and Microbial Communities	Surface Soils	Cu, Hg, Ni, Zn
Lower North Area	No Significant Risks					
Floodplain Area				Insectivorous Birds – American Woodcock	Surface Soils	Pb, Se
Potential Greenway Area				Insectivorous Birds – American Woodcock	Surface Soils	Hg
				Insectivorous Small Mammals – Short-tailed Shrew	Soil Invertebrates, Surface Soils	Th
Central Commercial Area	No Significant Risks					

Table 2-1
Summary of the 2005 Comprehensive Site Assessment Risk Characterizations

Human Health				Ecological		
	Receptor	Media	COC	Receptor/Community	Media	COC
Southern Conservation Commission Area				Insectivorous Birds – American Woodcock	Surface Soils	Ba, Hg, Pb, di-n-octylphthalate
				Soil Invertebrate, Terrestrial Plants and Microbial Communities	Surface Soils	Cu, Hg, Ni, Zn
Southern Disposal Area	Construction Worker, Utility Worker	Soil (0-6 ft bgs)	Cr, Pb, 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE, TCE	Insectivorous Birds – American Woodcock	Surface Soils	As, Ba, Cr, Cu, Hg, Pb, Se, Zn
	Adult Recreational User, Child Recreational User	Surface Soil (0-3 ft bgs)	1,1-DCE	Carnivorous Bird – Red-tailed Hawk	Surface Soils	Ba, Cr, Pb, Zn
				Insectivorous Small Mammals – Short-tailed Shrew	Soil Invertebrates, Surface Soils	Cu, Sb, Zn
				Soil Invertebrate, Terrestrial Plants and Microbial Communities	Surface Soils	Cu, Hg, Ni, Zn
Cold Waste Area	Child Recreational User	Surface Soil (0-3 ft bgs)	Sb, Ba, Pb	Insectivorous Birds – American Woodcock	Surface Soils	As, Ba, Co, Cu, Hg, Pb, Se
				Insectivorous Small Mammals – Short-tailed Shrew	Soil Invertebrates, Surface Soils	As, Ba, Co, Cu, Sb, Zn, Th, hexachlorobenzene
Marsh Upland Area	Construction Worker	Soil (0-6 ft bgs)	Hg	Insectivorous Birds – American Woodcock	Surface Soils	Hg, Pb
				Carnivorous Bird – Red-tailed Hawk	Surface Soils	Ba, Cr, Pb, Zn
				Soil Invertebrate, Terrestrial Plants and Microbial Communities	Surface Soils	Cu, Hg, Ni, Zn

Table 2-1
Summary of the 2005
Comprehensive Site Assessment
Risk Characterizations

Human Health				Ecological		
	Receptor	**Media**	**COC**	**Receptor/Community**	**Media**	**COC**
Aquatic						
Upper Drinkwater River Corridor	No Significant Risks					
Eastern Channel Corridor	Trespasser	Sediment	Hg , B(a)p	Freshwater Benthic Macroinvertebrates	Sediment	Hg, MeHg
	Fisherman	Sediment	Hg, B(a)p, D(a,h)a	Warm Water Freshwater Fish	Biota	MeHg
	Fisherman	Fish Tissue	Hg, MeHg	Piscivorous Birds – Belted Kingfisher	Biota	MeHg
				Omnivorous Waterfowl – Mallard	Sediment, Biota	Hg
				Herbivorous Waterfowl – Mute Swan	Sediment	MeHg
				Piscivorous Mammal – Mink	Biota	MeHg
				Omnivorous Mammal – Raccoon	Sediment, Aquatic Biota	Sb, Hg
				Herbivorous Mammal – Muskrat	Aquatic plants, sediments	Sb, Pb, MeHg
Lower Drinkwater River Corridor	Fisherman	Sediment	B(a)p, Vinyl chloride	Freshwater Benthic Macroinvertebrates	Sediment	Hg, MeHg
	Fisherman	Fish Tissue	Hg, MeHg	Piscivorous Birds – Belted Kingfisher	Biota	MeHg
				Omnivorous Waterfowl – Mallard	Sediment, Biota	Hg
				Piscivorous Mammal – Mink	Biota	MeHg
				Herbivorous Mammal – Muskrat	Aquatic plants, sediments	Sb, Pb, MeHg
				Herbivorous Waterfowl – Mute Swan	Sediment	MeHg
				Reptile Communities – Snapping Turtles	Sediment	Hg

Table 2-1
Summary of the 2005 Comprehensive Site Assessment Risk Characterizations

Human Health				Ecological		
	Receptor	Media	COC	Receptor/Community	Media	COC
Lily Pond/Upper Factory Pond Area	Fisherman	Sediment	B(a)p	Piscivorous Birds – Belted Kingfisher	Biota	MeHg
	Fisherman	Fish Tissue	Hg, MeHg	Herbivorous Waterfowl – Mute Swan	Sediment	MeHg
				Piscivorous Mammal – Mink	Biota	MeHg
				Herbivorous Mammal – Muskrat	Aquatic plants, sediments	Sb, Pb, MeHg
				Reptile Communities – Snapping Turtles	Sediment	Hg
Middle/Lower Factory Pond Area	Fisherman	Fish Tissue	Hg, MeHg	Piscivorous Birds – Belted Kingfisher	Biota	MeHg
				Herbivorous Waterfowl – Mute Swan	Sediment	MeHg
				Piscivorous Mammal – Mink	Biota	MeHg
				Herbivorous Mammal – Muskrat	Aquatic plants, sediments	Sb, Pb, MeHg
				Reptile Communities – Snapping Turtles	Sediment	Hg
Marsh Upland Area				Freshwater Benthic Macroinvertebrates	Sediment	Hg, MeHg
				Omnivorous Waterfowl – Mallard	Sediment, Biota	Hg
				Herbivorous Mammal – Muskrat	Aquatic plants, sediments	Sb, Pb, MeHg
				Herbivorous Waterfowl – Mute Swan	Sediment	Hg, MeHg, Pb

1,1-DCE - 1,1-dichloroethene
As - arsenic
B(a)p - benzo(a)pyrene
Ba - barium
cis-1,2-DCE - cis-1,2-dichloroethene
Co - cobalt
Cr - chromium
Cu - copper
D(a,h)a - Dibenz(a,h)anthracene
Hg - mercury
MeHg - methyl mercury
Ni - nickel
Pb - lead
Sb - antimony
Se - selenium
TCE - trichloroethene
Th - thallium
trans-1,2-DCE - trans-1,2-dichloroethene
Zn - zinc

Table 3-1. Summary of the 2005 Phase II CSA Environmental Conceptual Site Model

Exposure Medium	Environmental Receptors	Exposure Pathway / Route
Soil	Terrestrial wildlife, plants, and soil invertebrates	Direct contact with soil and incidental ingestion of soils.
Sediment	Benthic organisms, freshwater fish, semi- aquatic wildlife	Contact with sediment or pore (interstitial) water, incidental ingestion of sediments
Surface Water	Aquatic organisms, terrestrial and semi- aquatic wildlife	Contact with surface water, ingestion of surface water.
Groundwater	Aquatic organisms	Contact with groundwater via surface water discharge.

Table 5-1 Chronological Summary of the MCP ShortForms Development	
Date	**Change Potentially Relevant to the Fireworks Site Risk Characterization**
2006-03-31	Initial placement of residential water (sf06rw) and residential water imminent hazard (sf06rwih) shortforms on the web.
2006-05-29	Minor adjustments and corrections.
2006-04-28	Added residential soil (sf06rs), residential soil IH (sf06rsih), residential air (sf06ra) and residential air IH (sf06raih).
2006-09-05	Added park visitor (sf06ps), park visitor IH (sf06psih) and trespasser (sf06ts) shortforms
2007-02-01	Added trespasser imminent hazard (sf06tsih) and construction worker (sf07cw) shortforms.
2007-09-13	Minor adjustments, corrections and updates.
2008-09-26	Updated *vlookup* and toxicological data.
2012-10-10	Updated *vlookup* and toxicological data.
2013-6-17	Minor adjustments, corrections and updates.
2013-10-7	Updated toxicological data.
2013-11-15	Updated toxicological data.
2014-01-27	Updated toxicological data.
2014-4-12	Minor adjustments and updates.
2014-4-18	Minor adjustments and updates.
2015-3-15	Minor adjustments and updates.

Table 8-1. Updated Human Health Soil and Sediment Preliminary Remediation Goals (PRGs)

Soil PRGs (mg/Kg)						Sediment PRGs (mg/Kg)				
Chemical of Concern	**Receptor [1]**	**Calculated Multi-Pathway ELCR**	**Calculated Multi-Pathway HI [2]**	**Maximum Site-Specific Soil Background Concentration [3]**	**Mass DEP Default Natural Soil Background Concentration [4]**	**Chemical of Concern**	**Receptor [5]**	**Calculated Multi-Pathway ELCR**	**Calculated Multi-Pathway HI [6]**	**Maximum Site-Specific Sediment Background Concentration [7]**
		Target = $1x10^{-6}$	**Target = 0.2**	**(mg/Kg)**	**(mg/Kg)**			**Target = $1x10^{-6}$**	**Target = 0.2**	**(mg/Kg)**
Arsenic	Construciton Worker	91	**39**	4.5	20	Antimony	Fisherman	NA	**35**	1.7
Barium	Construciton Worker	NA	**4620**	69	50	Arsenic	Fisherman	4.3	64	**9.2**
Benzene	Construciton Worker	1600	**1194**	NV	NV	Benzo(a)anthracene	Fisherman	**14**	10000	1.34
Cadmium	Construciton Worker	2100	**60**	0.10	2.0	Benzo(a)pyrene	Fisherman	1.4	10000	**1.76**
Chromium (Total) [8]	Construciton Worker	**314**	820	11	30	Benzo(b)fluoranthene	Fisherman	**14**	10000	2.09
cis-1,2-Dichloroethene	Construciton Worker	NA	**2400**	NV	NV	Dibenz(a,h)anthracene	Fisherman	**1.4**	10000	0.57
trans-1,2-Dichloroethene	Construciton Worker	NA	**23000**	NV	NV	Indeno(1,2,3-cd)pyrene	Fisherman	**14**	10000	1.43
Lead	Construciton Worker	NA	**204**	82	100	Lead	Fisherman	NA	**220**	204
Mercury	Construciton Worker	NA	**32**	0.28	0.3	Mercury	Fisherman	NA	**35**	0.43
Trichloroethylene	Construciton Worker	1750	**61**	NV	NV	Vinyl Chloride	Fisherman	**2.8**	380	NV
Vinyl Chloride	Construciton Worker	**64**	360	NV	NV	Antimony	Trespasser	NA	**300**	1.7
Zinc	Construciton Worker	NA	**5750**	104	100	Benzo(a)pyrene	Trespasser	**42**	910000	1.76
Lead	Recreational User	NA	70	82	**100**	Dibenz(a,h)anthracene	Trespasser	**42**	910000	0.57
Mercury	Recreational User	NA	**14**	0.28	0.30	Mercury	Trespasser	NA	**320**	0.43

Acronyms and Notes:

Bold and highlighted values indicate the selected PRG

bgs = below ground surface

ELCR = excess lifetime cancer risk

HI = hazard index

NA = Not Applicable

NV = no vlaue

[1] Source: PRGs for the construction worker were developed using default exposure assumptions and toxicity data published in the MassDEP sf12cw ShortForm. PRGs for the recreational user were developed using default exposure assumptions and toxicity data published in the the MassDEP sf12ps ShortForm.

[2] Source: Non-cancer PRGs for the construction worker were developed using sub-chronic toxicity factors published in the MassDEP sf12cw ShortForm. Non-cancer PRGs developed for the recreational user were based on the lower PRG calculated for the chronic or subchronic exposure scenario using toxicity data published by the MassDEP sf12ps ShortForm.

[3] Source: Comprehensive Site Assessment Report (Tetra Tech 2005). Maximum site-specific soil background concentrations were the same for the 0-3 and 0-6 ft bgs depth ranges.

[4] Source: Background Levels of Polycyclic Aromatic Hydrocarbons and Metals in Soil (MassDEP 2002).

[5] Source: PRGs for the fisherman were developed assuming an exposure frequency of 2 days/week for 39 weeks and using the toxicity data published in the MassDEP sf12ps ShortForm. PRGs for the recreational user were developed assuming an exposure frequency of 1 day/week for 26 weeks and using the toxicity data published in the the MassDEP sf12ts ShortForm.

[6] Non-cancer PRGs for the fisherman were conservatively developed for ages 1-8 using chronic toxicity factors published in the MassDEO sf12ps Shortform. Non-cancer PRGs for a trespasser were based on the lower PRG calculated for the chronic or subchronic exposure scenario using toxicity data published in the MassDEP sf12ts ShortForm.

[7] Source: Comprehensive Site Assessment Report (Tetra Tech 2005). Maximum site-specific sediment background concentrations for the shoreline accessible areas.

[8] Chromium (VI) limit is 200 mg/Kg due to contact dermititis.

ATTACHMENT A MCP SHORTFORM INPUTS AND OUTPUTS SUPPORTING THE UPDATED HUMAN HEALTH SOIL AND SEDIMENT PRELIMINARY REMEDIATION GOALS [NOTE: ALL SHORTFORM CALCLATIONS APPLIED DEFAULT TOXICITY VALUES AND DEFAULT EXPOSURE PARAMETERS FOR THE INDICATED RECEPTOR]

Construction Worker - Soil: Table CW-1
Exposure Point Concentration (EPC) and Risk
Based on Construction Worker 18-25 years of age

ShortForm Version 10-12
Vlookup Version v0315

ELCR (all chemicals) = 1.6E-05
HI (all chemicals) = 1.6E+01

****Do not insert or delete any rows****

Click on empty cell below and select OHM using arrow.

Oil or Hazardous Material (OHM)	EPC (mg/kg)	ELCR ingestion	ELCR dermal	ELCR inhalation GI	ELCR inhalation pulmonary	$ELCR_{total}$	Subchronic				HQ_{total}	
							HQ_{ing}	HQ_{derm}	HQ_{inh-GI}	HQ_{inh}		
Non-Carcinogenic (HQ = 0.2)												
ARSENIC	3.9E+01	2.6E-07	1.6E-07	6.7E-09	3.1E-08	4.5E-07	8.0E-02	4.8E-02	2.1E-03	7.3E-02	2.0E-01	
BARIUM	4.6E+03						8.1E-02	8.2E-02	2.1E-03	3.4E-02	2.0E-01	
BENZENE	1.2E+03	5.8E-07	1.7E-07	1.5E-08	2.5E-09	7.7E-07	1.5E-01	4.4E-02	3.8E-03	4.4E-03	2.0E-01	
CADMIUM	6.0E+01				2.9E-08	2.9E-08	7.4E-02	1.5E-02	1.9E-03	1.1E-01	2.0E-01	
CHROMIUM (TOTAL)	8.2E+02				2.6E-06	2.6E-06	5.0E-02	5.1E-02	1.3E-03	1.0E-01	2.0E-01	**Note! Cr(VI) limit is 200 mg/kg due to contact dermititis.**
DICHLOROETHYLENE, CIS-1,2-	2.4E+03						1.5E-01	4.5E-02	3.8E-03	1.5E-03	2.0E-01	
DICHLOROETHYLENE, TRANS-1,2-	2.3E+04						1.4E-01	4.3E-02	3.7E-03	1.4E-02	2.0E-01	
LEAD	2.0E+02						1.7E-01	2.0E-02	4.3E-03	7.6E-03	2.0E-01	
MERCURY	3.2E+01						6.6E-02	1.3E-01	1.7E-03	4.0E-03	2.0E-01	
TRICHLOROETHYLENE	6.1E+01	2.7E-08	8.1E-09	6.9E-10	8.1E-11	3.6E-08	1.5E-01	4.5E-02	3.9E-03	1.1E-03	2.0E-01	
VINYL CHLORIDE	3.6E+02	4.4E-06	1.3E-06	1.1E-07	8.4E-10	5.9E-06	1.5E-01	4.5E-02	3.8E-03	1.3E-04	2.0E-01	
ZINC	5.8E+03						2.4E-02	2.4E-02	6.1E-04	1.5E-01	2.0E-01	
Carcinogenic (TR = 1x10-6)												
TRICHLOROETHYLENE	1.8E+03	7.7E-07	2.3E-07	2.0E-08	2.3E-09	1.0E-06	4.3E+00	1.3E+00	1.1E-01	3.3E-02	5.76E+00	
BENZENE	1.6E+03	7.7E-07	2.3E-07	2.0E-08	3.3E-09	1.0E-06	2.0E-01	6.0E-02	5.1E-03	6.0E-03	2.68E-01	
CADMIUM	2.1E+03				1.0E-06	1.0E-06	2.6E+00	5.2E-01	6.7E-02	3.9E+00	7.08E+00	
ARSENIC	9.1E+01	6.0E-07	3.6E-07	1.6E-08	7.2E-08	1.0E-06	1.9E-01	1.1E-01	4.8E-03	1.7E-01	4.7E-01	
CHROMIUM (TOTAL)	3.14E+02				1.0E-06	1.0E-06	1.9E-02	1.9E-02	5.0E-04	3.9E-02	7.8E-02	**Note! Cr(VI) limit is 200 mg/kg due to contact dermititis.**
VINYL CHLORIDE	6.40E+01	7.9E-07	2.4E-07	2.0E-08	1.5E-10	1.0E-06	2.6E-02	7.9E-03	6.8E-04	2.4E-05	3.5E-02	

Park Visitor - Soil: Table PS-1
Exposure Point Concentration (EPC)
Based on Visitor Ages 1-31 (Cancer), 1-8 (Chronic Noncancer), and 1-2 (Subchronic Noncancer)

ShortForm Version 10-12
Vlookup Version v0315

ELCR (all chemicals) =
Chronic HI (all chemicals) = 5.7E-01
Subchronic HI (all chemicals) = 1.4E+00

****Do not insert or delete any rows****

Click on empty cell below and select OHM using arrow.

Oil or Hazardous Material	EPC (mg/kg)	ELCR$_{ingestion}$	ELCR$_{dermal}$	ELCR$_{total}$	Chronic HQ$_{ing}$	Chronic HQ$_{derm}$	Chronic HQ$_{total}$	Subchronic HQ$_{ing}$	Subchronic HQ$_{derm}$	Subchronic HQ$_{total}$	
Sub-Chronic Non-Carcinogenic (HQ = 0.2)											
LEAD	7.0E+01				6.8E-02	6.9E-03	7.5E-02	1.9E-01	1.3E-02	2.0E-01	**Note! Lead IH HQ limit is 1, not 10.**
MERCURY	1.4E+01				3.4E-02	5.8E-02	9.2E-02	9.3E-02	1.1E-01	2.0E-01	
Chronic Non-Carcinogenic (HQ = 0.2)											
LEAD	1.9E+02				1.8E-01	1.9E-02	2.0E-01	5.1E-01	3.6E-02	5.4E-01	**Note! Lead IH HQ limit is 1, not 10.**
MERCURY	3.0E+01				7.3E-02	1.2E-01	2.0E-01	2.0E-01	2.3E-01	4.3E-01	

Park Visitor - Soil: Table PS-1
Exposure Point Concentration (EPC)
Based on Visitor Ages 1-31 (Cancer), 1-8 (Chronic Noncancer), and 1-2 (Subchronic Noncancer)

ShortForm Version 10-12

Vlookup Version v0315

ELCR (all chemicals) = 1.7E-02

Chronic HI (all chemicals) = 2.0E+00

Subchronic HI (all chemicals) = 2.8E+00

****Do not insert or delete any rows****

Click on empty cell below and select OHM using arrow.

Oil or Hazardous Material	EPC (mg/kg)	$ELCR_{ingestion}$	$ELCR_{dermal}$	$ELCR_{total}$	Chronic			Subchronic			
					HQ_{ing}	HQ_{derm}	HQ_{total}	HQ_{ing}	HQ_{derm}	HQ_{total}	
Non-Carcinogenic (HQ = 0.2)											
ANTIMONY	3.5E+01				1.1E-01	9.4E-02	2.0E-01	3.0E-01	1.8E-01	4.8E-01	
ARSENIC	6.4E+01	9.3E-06	5.8E-06	1.5E-05	1.3E-01	6.9E-02	2.0E-01	3.7E-01	1.3E-01	5.0E-01	
BENZO(a)ANTHRACENE	1.0E+04	4.3E-04	2.9E-04	7.2E-04	1.3E-01	7.1E-02	2.0E-01	3.5E-02	1.4E-02	4.8E-02	
BENZO(a)PYRENE	1.0E+04	4.3E-03	2.9E-03	7.2E-03	1.3E-01	7.1E-02	2.0E-01	3.5E-02	1.4E-02	4.8E-02	
BENZO(b)FLUORANTHENE	1.0E+04	4.3E-04	2.9E-04	7.2E-04	1.3E-01	7.1E-02	2.0E-01	3.5E-02	1.4E-02	4.8E-02	
DIBENZO(a,h)ANTHRACENE	1.0E+04	4.3E-03	2.9E-03	7.2E-03	1.3E-01	7.1E-02	2.0E-01	3.5E-02	1.4E-02	4.8E-02	
INDENO(1,2,3-cd)PYRENE	1.0E+04	4.3E-04	2.9E-04	7.2E-04	1.3E-01	7.1E-02	2.0E-01	3.5E-02	1.4E-02	4.8E-02	
LEAD	2.2E+02				1.8E-01	1.9E-02	2.0E-01	5.1E-01	3.6E-02	5.5E-01	**Note! Lead IH HQ limit is 1, not 10.**
MERCURY	3.5E+01				7.3E-02	1.2E-01	2.0E-01	2.0E-01	2.4E-01	4.4E-01	
VINYL CHLORIDE	3.8E+02	1.0E-04	3.2E-05	1.4E-04	1.6E-01	4.1E-02	2.0E-01	4.4E-01	7.7E-02	5.2E-01	
Carcinogenic (TR = 1x10-6)											
ARSENIC	4.3E+00	6.3E-07	3.9E-07	1.0E-06	9.0E-03	4.6E-03	1.4E-02	2.5E-02	8.7E-03	3.4E-02	
BENZO(a)ANTHRACENE	1.4E+01	6.0E-07	4.1E-07	1.0E-06	1.8E-04	1.0E-04	2.8E-04	4.9E-05	1.9E-05	6.8E-05	
BENZO(a)PYRENE	1.4E+00	6.0E-07	4.1E-07	1.0E-06	1.8E-05	1.0E-05	2.8E-05	4.9E-06	1.9E-06	6.8E-06	
BENZO(b)FLUORANTHENE	1.4E+01	6.0E-07	4.1E-07	1.0E-06	1.8E-04	1.0E-04	2.8E-04	4.9E-05	1.9E-05	6.8E-05	
DIBENZO(a,h)ANTHRACENE	1.4E+00	6.0E-07	4.1E-07	1.0E-06	1.8E-05	1.0E-05	2.8E-05	4.9E-06	1.9E-06	6.8E-06	
INDENO(1,2,3-cd)PYRENE	1.4E+01	6.0E-07	4.1E-07	1.0E-06	1.8E-04	1.0E-04	2.8E-04	4.9E-05	1.9E-05	6.8E-05	
VINYL CHLORIDE	2.8	7.6E-07	2.4E-07	1.0E-06	1.2E-03	3.0E-04	1.5E-03	3.2E-03	5.7E-04	3.8E-03	

MassDEP ORS
Contact: Lydia Thompson
Lydia.Thompson@state.ma.us
617-556-1165

Trespasser - Soil: Table TS-1
Exposure Point Concentration (EPC)
Based on Trespasser Ages 11-18 (Cancer and Non-Cancer)

ShortForm Version 10-12

Vlookup Version v0315

ELCR (all chemicals) = 4.3E-02
Chronic HI (all chemicals) = 2.2E+00
Subchronic HI (all chemicals) = 8.0E-01

****Do not insert or delete any rows****

Click on empty cell below and select OHM using arrow.

Oil or Hazardous Material	**EPC (mg/kg)**	**ELCR$_{ingestion}$**	**ELCR$_{dermal}$**	**ELCR$_{total}$**	**Chronic**		**HQ$_{total}$**	**Subchronic**		**HQ$_{total}$**
					HQ$_{ing}$	**HQ$_{derm}$**		**HQ$_{ing}$**	**HQ$_{derm}$**	
Non-Carcinogenic (HQ = 0.2)										
ANTIMONY	3.0E+02				5.2E-02	4.3E-02	9.6E-02	1.2E-01	8.0E-02	2.0E-01
BENZO(a)PYRENE	9.1E+05	1.4E-02	7.7E-03	2.2E-02	6.4E-01	3.5E-01	9.9E-01	1.4E-01	6.5E-02	2.0E-01
DIBENZO(a,h)ANTHRACENE	9.1E+05	1.4E-02	7.7E-03	2.2E-02	6.4E-01	3.5E-01	9.9E-01	1.4E-01	6.5E-02	2.0E-01
MERCURY	3.2E+02				3.7E-02	6.1E-02	9.9E-02	8.2E-02	1.1E-01	2.0E-01
Carcinogenic (TR = 1x10-6)										
BENZO(a)PYRENE	4.2E+01	6.4E-07	3.5E-07	1.0E-06	2.9E-05	1.6E-05	4.6E-05	6.5E-06	3.0E-06	9.4E-06
DIBENZO(a,h)ANTHRACENE	4.2E+01	6.4E-07	3.5E-07	1.0E-06	2.9E-05	1.6E-05	4.6E-05	6.5E-06	3.0E-06	9.4E-06