North Boeing Field/ Georgetown Steam Plant Site Remedial Investigation/Feasibility Study

Final
Sampling and Analysis Plan and Quality Assurance Project Plan

Prepared for

DEPARTMENT OF
ECOLOGY
State of Washington

Toxics Cleanup Program
Northwest Regional Office
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List of Acronyms

AM	anthropogenic media
AOC	area of concern
ARI	Analytical Resources, Inc.
ASTM	American Society for Testing and Materials
bgs	below ground surface
CB	catch basin
CFA	Central Flightline Area
CJM	concrete joint material
COC	chain of custody
COPC	contaminant of potential concern
cVOC	chlorinated volatile organic compound
DOT	U.S. Department of Transportation
EDD	electronic data deliverable
EPH	extractable petroleum hydrocarbons
EYA	East Yard Area
FM	field manager
FOD	foreign object debris
FTA	Fuel Tank Area
GIS	Geographic Information System
GPS	global positioning system
GTSP	Georgetown Steam Plant
GW	groundwater
HSP	Health and Safety Plan
ICP-MS	inductively coupled plasma mass spectrometry
IDW	investigation-derived waste
KC	King County
KCIA	King County International Airport
LCS/LCSD	laboratory control sample / laboratory control sample duplicate
LDW	Lower Duwamish Waterway
LLA	Low-Lying Area
LTST	long-term stormwater treatment
MDL	method detection limit
mg/kg	milligrams per kilogram
MH	manhole
MS/MSD	matrix spike / matrix spike duplicate
MTCA	Model Toxics Control Act
NAPL	Non-aqueous phase liquid
NBF	North Boeing Field
NFA	North Flightline Area
ng/kg	nanograms per kilogram
NGW	North Boeing Field groundwater well
NWTPH	Northwest Total Petroleum Hydrocarbons

NYA	North Yard Area
OEM	other exterior materials
OWS	oil/water separator
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PEL	Propulsion Engineering Laboratory
PID	photo-ionization detector
PLP	Potentially Liable Person
PM	project manager
PPE	personal protective equipment
PQL	practical quantitation limit
PSEP	Puget Sound Estuary Program
PVC	polyvinyl chloride
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RI/FS	remedial investigation / feasibility study
RISL	remedial investigation screening level
RL	reporting limit
SAP	Sampling and Analysis Plan
SCL	Seattle City Light
SD	storm drain
SDS	storm drain solids
SDW	storm drain water
SFA	South Flightline Area
SFD	surface debris
SIM	selected ion monitoring
SL	screening level
SMS	Washington State Sediment Management Standards
SOP	standard operating procedure
SPU	Seattle Public Utilities
SVOC	semivolatile organic compound
SYA	South Yard Area
TCLP	Toxicity Characteristic Leaching Procedure
TEF	toxicity equivalency factors
TEQ	toxicity equivalent
TPH	total petroleum hydrocarbons
ug/L	micrograms per liter
USEPA	U.S. Environmental Protection Agency (or EPA)
VISL	vapor intrusion screening level
VOA	volatile organic analysis
VOC	volatile organic compound
VPH	volatile petroleum hydrocarbons
WAC	Washington Administrative Code

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1.0 Introduction

1.1 Purpose and Objectives

Pursuant to the Model Toxics Control Act (MTCA),[1] the Washington State Department of Ecology (Ecology) has signed Agreed Order DE 5685 with The Boeing Company (Boeing), King County, and the City of Seattle to facilitate remedial action at the North Boeing Field/ Georgetown Steam Plant Site (referred to in this document as the NBF-GTSP Site, or the Site). The Agreed Order, effective August 14, 2008, describes the process by which Ecology will conduct a remedial investigation/feasibility study (RI/FS) and one or more interim actions, if appropriate, at the Site to protect human health and the environment. The three potentially liable persons (PLPs) and Ecology have agreed that the RI/FS will be performed by Ecology. As part of this effort, Ecology has requested Leidos[2] to prepare this RI/FS Sampling and Analysis Plan/ Quality Assurance Project Plan (SAP/QAPP) and to conduct the RI/FS.

The U.S. Environmental Protection Agency (USEPA) is leading the effort to determine the most effective cleanup strategies for sediments in the nearby Lower Duwamish Waterway (LDW). Ecology is leading the effort to investigate adjacent and upland sources of contamination and to develop plans to control these sources that may impact the LDW. The NBF-GTSP Site constitutes part of this LDW upland cleanup. Ecology's source control efforts include the process of finding and eliminating or reducing releases of contaminants to LDW sediments, to the extent practicable. The goal of source control is to prevent sediments from being recontaminated after LDW cleanup has been undertaken. The NBF-GTSP Site RI/FS process is intended not only to identify potential sources of contamination transported through the storm drain system to sediments in Slip 4 of the LDW Superfund site, but also to conduct an assessment of upland environmental media (soil and groundwater) affected by Site contaminants. The RI/FS process will be performed in accordance with the MTCA regulation.

According to MTCA, the purpose of an RI/FS is to collect, develop, and evaluate sufficient information regarding a site to select a cleanup action [WAC 173-340-350(1)]. The specific purpose of the remedial investigation is to collect data and information necessary to define the extent of contamination and to characterize the site. The specific purpose of the feasibility study is to develop and evaluate alternative cleanup actions [WAC 173-340-120(4)(a) and (b)] (Ecology 2007).

Environmental investigations and cleanups at the NBF-GTSP Site have identified releases of polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs) and other semivolatile organic compounds (SVOCs), metals, petroleum hydrocarbons, and/or volatile organic compounds (VOCs) to soil, groundwater, stormwater, and other media at the Site. The RI will characterize the nature and extent of contamination in soil, groundwater, and outdoor building materials at the Site and will identify sources of contaminants to the storm drain system. Stormwater from the NBF-GTSP Site discharges to Slip 4 (Figure 1). PCBs, dioxins/furans, metals, PAHs, and phthalates were detected at concentrations above the Washington State

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[1] The MTCA Cleanup Regulation is included as Chapter 173-340 of the Washington Administrative Code (WAC).
[2] On September 30, 2013, a majority portion of Science Applications International Corporation (SAIC) changed its corporate name to Leidos. All references to SAIC within this document now refer to Leidos.

Sediment Management Standards (SMS) and other criteria in Slip 4 sediments and are identified as contaminants of potential concern (COPCs) (SAIC 2011).

Slip 4 was identified as an Early Action Area for sediment cleanup as part of the LDW Superfund site RI/FS. Due to the long time frame associated with the RI/FS process, Ecology expedited certain RI/FS activities to support implementation of interim actions and to allow cleanup of Slip 4 sediments to proceed. Some portions of the RI were begun in advance of the Slip 4 cleanup. These activities included: stormwater sampling; development of a project chemical database, a Geographic Information System (GIS) database, and a document database/library; an infiltration and inflow study to the storm drain system; and modeling of contaminant transport from stormwater to Slip 4 sediments. Selected sampling of soil, groundwater, stormwater, and various anthropogenic materials has recently been conducted at the NBF-GTSP Site. Available results from these and other relevant activities were incorporated into the final RI/FS Work Plan (Leidos 2013), which forms the basis for this SAP/QAPP document.

Cleanup of sediments in Slip 4 was formally completed in February 2012. Boeing also constructed a long-term stormwater treatment (LTST) system at NBF, which became operational in October 2011. This system treats approximately two-thirds (annual average) of the stormwater discharged through NBF to Slip 4. The system was designed primarily for treatment of PCBs. In addition, a number of other interim actions have been completed on the NBF and GTSP properties in recent years. Most notably, a large soil excavation recently took place on both sides of the fenceline separating these two properties. Currently, Boeing continues to operate the LTST system. Seattle City Light (SCL) has conducted the Slip 4 cleanup and ongoing monitoring. King County International Airport (KCIA) also is involved with investigations on the adjacent KCIA property. Boeing, SCL, and KCIA together participate in RI/FS project decision-making with Ecology.

As treatment of much of the Site stormwater continues, this RI/FS will focus on source identification and defining the extent of contamination in soil and groundwater at the Site, leading to future remediation. One of the eventual goals is to improve the quality of stormwater that does not pass through the treatment system, and to reduce contaminants entrained in stormwater that is currently treated due to the possible future termination of the treatment system.

In an effort to adequately characterize the Site, various environmental and anthropogenic media will be sampled as part of a phased field activity process. The RI/FS Work Plan and this SAP/QAPP describes a two-phase sampling/analysis approach for the following two major groups of sample media: (1) soil, groundwater, and soil vapor; and (2) storm drain media and anthropogenic media. For this second group, the individual sampled media include storm drain solids, surface debris, concrete joint material (CJM), paint, roof material, and other materials on the exterior of buildings and small structures. During development of the RI/FS Work Plan, screening levels were developed and applied to chemical results from samples of these various media (Leidos 2013). These include RI screening levels (RISLs) for most media, and vapor intrusion screening levels (VISLs) for soil vapor (Appendix A).

This SAP/QAPP is being prepared pursuant to WAC 173-340-350(7)(c)(iv) and 173-340-820. Leidos and its subcontractors will implement the SAP/QAPP under the direction of Ecology. The following sections describe the key roles and responsibilities of the project team during the RI.

1.2 Project Planning and Coordination

Mark Edens of Ecology serves as the Ecology project manager (PM) who will conduct overall project coordination, supply Ecology-furnished services, review reports, and coordinate with PLPs. Thomas Dubé will serve as the Leidos PM and be responsible for executing this SAP/QAPP, overseeing the collection and analysis of field samples in conjunction with the field manager(s), and reporting analytical results to Ecology and PLPs. Contact information for the Ecology and PLP project managers is listed below.

Ecology – Bellevue, WA
Mark Edens, Ecology Project Manager
Phone: (425) 649-7070
mede461@ecy.wa.gov

Boeing – Seattle, WA
Carl Bach, NBF Environmental Project Manager
Phone: (206) 898-0438
carl.m.bach@boeing.com

City of Seattle – Seattle, WA
Allison Crowley, SCL GTSP Environmental Project Manager
Phone: (206) 684-3167
allison.crowley@seattle.gov

King County – Seattle, WA
Peter Dumaliang, KCIA Environmental Project Manager
Phone: (206) 296-7597
peter.dumaliang@kingcounty.gov

Leidos – Bothell, WA
Thomas Dubé, RI/FS Project Manager
Phone: (425) 422-0480
dubet@leidos.com

1.3 Field Coordination

Corey Wilson and Aaron Wisher of Leidos will serve as field managers (FMs) responsible for collecting and processing samples in accordance with the SAP/QAPP, and transporting samples to the analytical laboratories for analysis. The FMs will oversee field preparation to ensure all sampling equipment meets sampling guidelines. If an FM is unavailable, the Leidos PM will designate his replacement.

Corey Wilson and Aaron Wisher of Leidos will also serve as the designated Leidos Health and Safety Managers (HSMs). The HSMs are responsible for ensuring that all personnel are properly trained, fully aware of potential site hazards, conduct all work in a safe manner, wear appropriate personal protective equipment (PPE), and abide by the conditions set forth in the site-specific Health and Safety Plan (HSP). If an HSM is unavailable, the Leidos PM will designate his replacement.

1.4 Laboratory Coordination and Data Management

Thomas Dubé of Leidos will serve as the primary laboratory coordinator responsible for subcontracting state-certified laboratories and the independent data validator, and ensuring that the field crew observes established protocols for field decontamination, sampling procedures, and chain-of-custody (COC) documentation.

Marina Mitchell of Leidos will serve as the project chemist and laboratory quality assurance/ quality control (QA/QC) manager. Ms. Mitchell will provide quality assurance oversight for the laboratory programs, including laboratory reporting and holding times, oversight of the data validation subcontractor to ensure that the laboratory analytical and QA/QC data are considered valid, and that procedures meet the analytical requirements.

Patrick Gibbons of Leidos will serve as the data manager for this project. Mr. Gibbons is responsible for following the data management procedures described in Appendix B, reporting data to the project team as scheduled, project database management, and submission of data to the Ecology ftp site and analytical database. If the data manager or project chemist is unavailable, Amber Kennedy of Leidos will be the replacement.

1.5 Subcontractor Support

The Leidos project team will consist of the following subcontractors and equipment vendors to support the data collection activities and laboratory analytical services:

- Analytical chemistry (all samples excluding soil vapor):
  Analytical Resources Incorporated (ARI)
  Cheronne Oreiro
  4611 South 134th Place
  Tukwila, WA 98166
  Phone: (206) 695-6214
  cheronneo@arilabs.com

- Analytical chemistry (for soil vapor):
  Eurofins Air Toxics, Inc.
  Kelly Buettner
  180 Blue Ravine Road, Suite B
  Folsom, CA 95630
  Phone: (916) 605-3378
  kellybuettner@eurofinsus.com

- Data validation and review of RI QAPP:
  EcoChem, Inc.
  Christine Ransom
  1011 Western Avenue, Suite 1011
  Seattle, WA 98104
  Phone: (206) 233-9332 ext. 109
  cransom@ecochem.net

- Drilling and concrete coring:

  Cascade Drilling
  Jaymen Lauer
  19404 Woodinville Snohomish Road
  Woodinville, WA 98072
  Phone: (425) 485-8908
  JLauer@cascadedrilling.com

- Confined space entry for storm drains (if needed):

  Herrera Environmental Consultants
  Alex Svendsen
  2200 6th Avenue, Suite 1100
  Seattle, WA 98121
  Phone: (206) 226-6297
  asvendsen@herrerainc.com

- Utility location:

  ULS Services Corp / Geomarkout
  Mike Benedict
  P.O. Box 724
  Pocatello, ID 83204
  Phone: 1-866-804-5734

- Equipment supply:

  Instrumentation Northwest
  Tyler Messer
  8902 122nd Avenue NE
  Kirkland, WA 98033
  Phone: (425) 822-4434
  Tyler.messer@inw.com

  Environmental Equipment & Supply
  491L Blue Eagle Avenue
  Harrisburg, PA 17112
  Phone: (717) 901-8891

1.6 Project Schedule and Organization

Field preparation is anticipated to begin in May 2014, following approval of this SAP/QAPP. Mobilization, sampling, and analysis is expected to begin in June 2014, and will last intermittently for approximately five months, in at least two phases. During this time period, Ecology and Leidos will coordinate with Boeing and SCL for scheduling, Site access, logistics, utility location, and plane stall access. A detailed schedule is presented in Section 10 of the final RI/FS Work Plan (Leidos 2013).

Environmental samples will be transported by Leidos to the ARI laboratory for analysis at the end of each day, or as early as possible after sampling. Soil vapor samples will be shipped overnight to the Air Toxics laboratory. All project analytical results will be independently validated by EcoChem as the data become available.

This RI/FS will be conducted in three steps:

- Initial survey of potential sampling locations to focus the sampling activities
- Phase I sampling
- Phase II sampling, based on Phase I results

An initial field survey will be conducted of the areas surrounding storm drain structures and buildings proposed for sampling, as well as adjacent buildings, surface debris areas, and downspouts (note that the term “buildings” in this document also includes large structures such as tanks or blast fences). The initial survey will also include a visual confirmation of the proposed locations for soil borings, installation of new monitoring wells, and soil vapor points. Phase I consists of initial sampling of soil, groundwater, soil vapor, storm drain solids, and surface debris. Upon review of analytical results, additional sampling of all or some of these media, as well as anthropogenic materials, is anticipated and will be proposed and conducted as part of Phase II. Phase II sampling determination and locations for anthropogenic media will follow the logic presented in flowchart format in Figure 2. Further information on phasing is presented in the final NBF-GTSP RI/FS Work Plan (Leidos 2013).

This RI will be performed with activities separated into two major media/pathway categories:

- Soil, groundwater, and soil vapor
- Storm drain solids, surface debris, and anthropogenic media

Phases I and II for these two media/pathway categories will not occur simultaneously. Although Phase I for each category is expected to begin about the same time, the scheduled timing will not be synchronized for completion of Phase I and commencement of Phase II.

Phase I analytical results for each category will be presented in interim data reports and submitted to Ecology and PLPs within three weeks of receipt of unvalidated data for all samples in each media category from each major area of the Site (e.g., each drainage basin). The interim data reports will consist primarily of tables and figures, with a brief text, which includes proposed locations and analyses of Phase II samples for each media. These reports will be reviewed by Ecology and PLPs to provide input and agreement prior to proceeding with completing SAP addenda and Phase II field work. SAP addenda will not be produced until validated data are evaluated. Further information on reporting and phasing is included in Section 4.3.

2.0 Field Sampling Plan

The purpose of the field sampling plan is to describe the procedure and methodology utilized in sample collection at the NBF-GTSP Site. This sampling plan addresses the Phase I and Phase II field work, during which soil, groundwater, soil vapor, storm drain solids, surface debris, and anthropogenic media samples will be collected at the Site (Figure 2). The anticipated number of samples for each sampled medium proposed for Phase I and II is outlined in Table 1, although numbers may vary depending on site-specific conditions. Table 1 presents anticipated number of environmental samples and field quality assurance / quality control (QA/QC) samples; the latter include field duplicates, equipment rinse blanks, and trip blanks (see Section 3.2.1). The number of samples for Phase II is dependent on review of Phase I analytical data along with historical Site data, as described in the project RI/FS Work Plan (Leidos 2013). Proposed sample locations and analyses are presented in Tables 2 through 4, by media. Sample locations for Phase II are not specifically discussed or depicted in this plan. Ecology, Leidos, and the PLPs will collaborate to identify Phase II sampling locations.

Leidos will notify Ecology of any notable changes to procedures outlined in this SAP/QAPP caused by access issues or any other limitations or problems. Ecology will then provide e-mail authorization for changes to the approved procedures outlined in this SAP/QAPP.

Sections 2.1 through 2.6 include discussion of sampling various environmental and anthropogenic media at the Site. Sections 2.7 and 2.8 include field and laboratory documentation and procedures. An index listing of Leidos standard operating procedures (SOPs) to be followed for field work is included in Appendix C.

2.1 Soil Sampling

This section discusses soil boring sampling locations, sampling collection and handling methods, and sample containers and labels. Planned analyses for soil samples are presented in Section 2.8, and specific analytes are listed in Appendix A.

For soil and groundwater investigation purposes, the NBF-GTSP Site has been divided into five major subdivisions (Figure 3), which were defined based on areas of past investigations, source area distribution, groundwater flow, and site usage. The Site subdivisions for soil and groundwater activities include the GTSP property and four NBF areas: PEL area, North Flightline area, Central Flightline area, and South Flightline area. These five Site subdivisions each contain a number of “areas of concern” (or AOCs) (Figure 3). These AOCs are based on findings of past environmental investigations and largely derived and modified from the synthesis included in the NBF-GTSP Supplemental Data Gaps Report (SAIC 2009). The GTSP and PEL areas are each evaluated essentially over the full extent of each subdivision; however, the other three flightline subdivisions are only evaluated with regard to locally identified AOCs.

2.1.1 Sampling Locations

Anticipated sampling locations for Phase I are listed in Table 2 and shown on Figures 4 through 21. Approximately 90 borings will be completed in Phase I, including those for the installation of groundwater monitoring wells and soil vapor points. The final number of borings is dependent on accessibility and subsurface conditions at the Site. The coordinates for each soil boring will be determined using GPS.

2.1.2 Sampling Collection and Handling Methods

This section describes specifications of the equipment being used and the methodology for collecting soil samples at the Site. Sampling collection, handling, and analysis information is provided in Table 5.

Soil drilling and related activities will be performed by Cascade Drilling, of Woodinville, Washington. Soil boring depths for locations without wells or vapor points are generally expected to continue to at least the depth of the water table or to the base of contamination as identified in the field or previous investigations, whichever is deeper. Depth to the water table varies seasonally at the Site, ranging from 2 to 11.5 feet below ground surface (bgs) for onsite wells. Borings for monitoring wells are expected to reach an approximate depth of 10 feet below the water table (for well completion) or until field or previous indications of contamination are no longer present, whichever is deeper. Borings for soil vapor points will be completed to approximately 5 to 6 feet bgs.

Soil borings will be completed using one or more of the following three methods: direct push (“geoprobe”), vacuum truck air-knife, and hand auger. Where asphalt or concrete is present, the pavement will first be removed with a circular concrete saw, or other method, by Cascade Drilling or their subcontractor.

Prior to subsurface investigations, Leidos will coordinate logistics with Ecology, Boeing, SCL, and any subcontractors to schedule and discuss field work logistics. This will include an evaluation of subsurface utilities, overhead obstacles, access considerations, field schedule, onsite vehicle usage, flightline activities, foreign object debris (FOD) concerns, and other logistical matters (see Appendix C for Subsurface Asset and Hazard Avoidance Checklist). Flightline drilling activities will conform with Federal Aviation Administration regulations for work with tall equipment near an active airport.

Underground utilities will be located and marked by a utility location service provided by Ecology/Leidos within 30 days prior to any drilling or other intrusive activities. Utility maps, including storm drain drawings, will first be consulted for refining the locations of any subsurface intrusive sampling activities. Boeing or Seattle City Light representatives will provide assistance in locating utilities, shifting proposed sampling locations, and approving all final drilling locations, prior to any intrusive activities taking place.

In the field, all drilling/direct push locations will first be cleared using a low-impact utility-clearance process. This includes the use of a hand auger and/or vacuum truck air-knife to a depth of 5 feet bgs, in order to avoid damaging any subsurface utilities or other structures. Depending on utility information provided by the facility, some locations may require deeper utility clearance activities. If soil sampling is required in this upper 5 feet (or more) bgs, soil will be sampled with a hand auger.

Soil at depths greater than 5 feet will be continuously sampled with a direct push (“geoprobe”) rig and a 2-inch diameter rod to the total depth of the boring. The anticipated minimum number of analytical soil samples submitted per boring is two; an overall average number of approximately 2.5 samples per boring is assumed. However, for soil vapor points, only one soil sample, collected at the base of the hand auger boring near the probe screen depth, is anticipated for analysis. For all borings, the soil samples will be examined and the following items will be noted in the borehole log (Appendix C):

- Sample identification
- Sample depth, date, and time
- Recovery
- Color
- Moisture content (dry, damp, moist, or wet)
- Lithology (using the modified Unified Soil Classification system)
- Geological interpretation, if possible (e.g., fill, topsoil, alluvium, etc.)
- Presence of sheen or NAPL
- Presence of contaminant odor
- Other indications of contamination (e.g., discoloration)
- Volatile field screening results (see below)

A portion of each soil sample will be field screened to obtain a relative estimate of its organic vapor concentration. This field screening will be performed by measuring the concentration of vapor in the headspace above the soil in a closed container using a photo-ionization detector (PID). The field screening will be performed by placing an extra portion of soil into a Ziploc bag, allowing the sample to equilibrate for at least 5 minutes, shaking the bag to disaggregate the soil, then opening the bag slightly, inserting the PID probe, and measuring the vapor concentration in the headspace. If the ambient temperature is below approximately 65ºF, the soil will be consistently warmed (e.g., in a heated vehicle) before the headspace measurement is made. The bagged soil will not be used for further analysis.

Determination of which soil samples are to undergo analytical testing will be based on PID field screening of indicators listed above, location of the water table, historical information, and other field information. Samples will be collected and analyzed for the parameters listed in Table 2. Samples that will be analyzed for VOCs and total petroleum hydrocarbons (TPH, gasoline range) will be collected using the Encore™ (or equivalent) hand-held coring device, in order to maintain the integrity of the soil volatile constituents prior to analysis.

Waste soil will be containerized in 55-gallon drums and staged onsite at NBF or GTSP, pending results of chemical analysis. All drums will meet the transport standards of the U.S. Department of Transportation (DOT). Geoprobe boreholes will be backfilled with bentonite, and the surface will be patched to match the surrounding pavement.

Equipment Decontamination

Portions of non-disposable sampling equipment that contact the sample will be decontaminated by drillers between boring locations by removing all visible adhering soil and product using tap water, a non-phosphate detergent solution (Alconox or Liquinox™), and a distilled-water rinse. No additional solvents or acids will be used during equipment decontamination in the field.

Four equipment rinse blank samples (two per RI phase) associated with soil samples will be analyzed for PCBs, metals, TPH, SVOCs, and VOCs. The equipment rinse blank samples are expected to be collected on the geoprobe rod with liner and on the hand auger.

All sampling will be conducted using phthalate-free, nitrile disposable gloves, which will be changed frequently, as appropriate, and between sampling depths and locations to prevent cross-contamination between samples.

2.1.3 Sample Containers and Labels

Soil samples will be labeled according to whether the borings are for purposes of soil samples only or also for installation of groundwater monitoring wells or soil vapor points.

Sample identifiers will be defined by location type, location identifier, and upper sample depth. Soil borings not used for the installation of monitoring wells or vapor points will also include the Site subdivision abbreviation (GTSP, PEL, NFA, CFA, SFA). All samples collected during the investigation will be labeled clearly and legibly using partially pre-printed labels. Each sample will be labeled with a unique alphanumeric sample identification number that identifies the Location Name followed by the top depth of each sample in feet bgs, as follows:

Soil Sample Identification Number for Soil Borings, Groundwater Monitoring Wells, and Soil Vapor Points

Boring Type	Sample ID	Example
Soil Borings	Site Subdivision - SB## - Upper Depth	PEL-SB01-12
		Field Duplicate: PEL-SB99-12
Groundwater Monitoring Wells	NGW### - Upper Depth	NGW601-10
		Field Duplicate: NGW699-10
Soil Vapor Points	VP## - Upper Depth	VP01-5
		Field Duplicate: VP99-5

Where:

- *Location Name* is a unique location-based identifier consisting of Location Type and Location Identifier; for soil borings, Site Subdivision precedes Location Type and Identifier.
    - *Site Subdivision* consists of the abbreviation for the five subdivisions of the Site:
        - GTSP – Georgetown Steam Plant property
        - PEL – Propulsion Engineering Laboratory area
        - NFA – North Flightline area
        - CFA – Central Flightline area
        - SFA – South Flightline area
    - *Location Type* consists of the structure abbreviation:
        - SB – soil boring (where boring is used only for soil sampling)
        - NGW – NBF groundwater monitoring well
        - VP – vapor point

    - *Location Identifier* (## or ###) consists of sequential numbers identifying the sample location within each subdivision for soil borings (e.g., “01-”, “02-”). The naming sequence for monitoring wells to be installed will begin with NGW601 at NBF. For field duplicate samples, numbers will follow a descending sequence starting with “99” for soil borings and vapor points, and “699” for monitoring wells.
- *Upper Depth* is the top depth of the soil sample measured in feet bgs.

All sample containers will be labeled appropriately when delivered to the laboratory. The procedure for sample storage and delivery is provided in Section 2.7.4.

Sample labels will be self-adhering, waterproof material. Indelible ink will be used to complete each sample label. Each label will contain the project name (NBF-GTSP RI), sample identification, date and time of collection, analysis and method to be conducted, preservation, and the initials of the person preparing the sample. Labels will be affixed to sample jars and bottles containing samples.

Table 5 lists the analytical methods, sample containers, holding times, and preservation requirements for all targeted analyses. Modifications to the sampling containers may be made during sample collection based on available sample volume. Soil sample volumes are anticipated to be adequate in most cases; however, in the event of low recovery, the priority of analyses for each sample will be determined in consultation with Ecology, taking into account the minimum sample volume required as presented in Table 5; this will be communicated to the laboratory by Leidos when samples are delivered.

2.2 Groundwater Sampling

This section discusses groundwater monitoring well sampling locations, sampling collection and handling methods, and sample containers and labels. Planned analyses for groundwater samples are presented in Section 2.8, and specific analytes are listed in Appendix A.

One year of quarterly groundwater sampling of up to 60 wells (new and existing) will be conducted as Phase I of this investigation (Table 2); subsequent rounds may be collected depending on initial results. Boeing and SCL have begun incorporation of final RI/FS Work Plan sampling recommendations into their regular monitoring schedule. Currently, up to two rounds of sampling have been completed for most existing monitoring wells recommended in the RI/FS work plan. If all recommended sampling and analysis of existing wells is completed by the beginning of the formal RI field work, then only the 25 new RI wells will be sampled.

During the RI, the sampling analysis plan for groundwater will be modified upon review of analytical results of the first two rounds of RI sampling. Chemical classes (or SVOC subclasses) will be removed from the sampling plan on a well-by-well basis for cases where all chemicals within the class or subclass are non-detect or detected below respective RISLs, or as approved by Ecology and the PLPs.

In addition, an investigation of approximately three upgradient wells for background groundwater and aquifer potability concerns is being considered by Ecology as part of the RI. However, the components of this task are not yet fully defined. Leidos would collect groundwater samples from these wells, which will be on the upgradient or cross-gradient side of the King County International Airport (KCIA) property. Ecology will provide further information on this sampling event when plans are finalized, and this portion of the investigation is not included in the remainder of this report.

2.2.1 Well Installation

Monitoring wells will be installed using direct-push (geoprobe) drilling with 3.5-inch diameter rods. As described in Section 2.1.2, standard 2-inch diameter rods will first be advanced to final depths for the purpose of soil sample collection. The borehole will then be reamed with the use of 3.5-inch diameter rods for the installation of the monitoring well. Well construction will follow the standards in WAC 173-160-420 and -451. Each well will consist of 2-inch diameter, flush-thread PVC risers and 5- or 10-foot long screens with 0.010-inch slots and prepacked filters of 20/40 Colorado silica sand. Well screens will generally be set so that the water table intersects the well screen. Silica sand will also be poured around the well screen interval. Borings will be sealed from the top of the sand pack to the ground surface with cement/bentonite grout as required in WAC 173-160-450. Water-tight locking plugs will protect the well, and traffic-rated flush-mount vaults will complete the housing.

The new monitoring wells will be developed in order to stabilize the sand pack and removed entrained silt from the well. This will be accomplished by surging the well with a steel bailer or surge block and then pumping with an electric down-well pump. Development will continue until at least ten well-volumes of groundwater have been removed and the turbidity amounts (either measured or visual) have stabilized. A minimum of 24 hours will lapse between the completion of well development and sampling of the new well. Development water will be stored in 55-gallon, DOT-approved drums and staged onsite. All well materials (screen, riser, etc.) will be delivered from the manufacturer pre-cleaned and sealed.

The top-of-casing elevations for all new monitoring wells at NBF will be surveyed by a professional land surveyor. Elevations will be determined to the nearest 0.01 foot relative to the North American Vertical Datum of 1988 (NAVD88). Elevations will also be calculated and presented in the National Geodetic Vertical Datum of 1929 (NGVD29), so that the water-table elevation can be readily compared across the Site (NBF uses NGVD29, and GTSP uses NAVD88).

2.2.2 Sampling Locations

Sample locations for Phase I are listed in Table 2 and shown on Figures 4 through 21. Approximately 25 borings will be advanced as described above and completed as monitoring wells. This number depends on accessibility and subsurface conditions. A total of up to 60 monitoring wells (35 existing wells and 25 new wells) will be sampled on a quarterly basis for one year as part of Phase I. Boeing and SCL will continue to monitor existing wells, and Leidos will monitor the newly installed wells. The coordinates for each new well will be determined using GPS.

2.2.3 Sampling Collection and Handling Methods

This section describes specifications of the equipment to be used and the methodology for collecting groundwater samples at the Site. Sampling collection, handling, and analysis information is provided in Table 5. As part of this RI, the PLPs are conducting groundwater sampling of existing wells using their own methods (peristaltic pump or bladder pump). The following methods apply to Ecology/Leidos sampling of new wells, and any existing wells if necessary.

Prior to each round of sampling, the water level depth of each monitoring well will be measured in order to determine the hydraulic gradient at the Site. Water levels will be measured in each well prior to purging in that area and levels will be recorded on a groundwater sample collection form (Appendix C).Water levels in the wells will be determined by sounding with an electric water level meter. If any NAPL is encountered, its depth will be measured using an electric interface probe.

Groundwater purging and sampling will be conducted using low-flow techniques with a peristaltic pump and dedicated Teflon®-lined polyethylene tubing that will remain in the well during the RI period. During sampling, the polyethylene tubing will be extended down to beyond the middle of the well screen. The opposite end of the tubing will be connected to the peristaltic pump via the end of a disposable silicon tube designated for inflow. Wells will be purged at a low flow rate to minimize depression of the water level within the well. During purging, field measurements on the removed groundwater will be recorded approximately every 3 to 5 minutes, until values attain relative stability for three successive readings. Goals for field measurement stability are: temperature to ±0.5°C, pH to ±0.1 standard unit, and specific conductance or turbidity to ±10 percent.

Sampling will immediately follow purging and will continue with a similar or slower flow rate, until all sample containers are full. Both total and dissolved metals analyses will be performed. Samples for dissolved metals analysis will be filtered in the field using a 0.45-micron, in-line filter affixed to the outlet tubing of the peristaltic pump. Prior to filling the sample container with filtered groundwater, the filter will be purged with sample water for approximately three filter volumes.

All field data will be recorded on a groundwater sample collection form (Appendix C), and final values prior to sampling will be reported with RI analytical data. Groundwater samples will be analyzed for the parameters listed in Table 2. Purge water will be collected in 55-gallon, DOT-approved drums provided by the PLPs and staged onsite.

Equipment Decontamination

Decontamination will be necessary for well development equipment and water level meters prior to use in each well. All tubing will be kept in factory bags or other clean containers until time of use. Teflon-lined polyethylene tubing will be dedicated and kept in the well for the duration of the RI and reused for each sampling event. Silicon tubing will be discarded after each use. Development equipment and water level meter or interface probe that are placed in the well will be decontaminated by using tap water, a non-phosphate detergent solution (Alconox or Liquinox™), and a distilled-water rinse.

Four equipment rinse blank samples (two per RI phase) associated with groundwater sampling will be analyzed for PCBs, total metals, TPH, SVOCs, and VOCs. This rinse will be performed using both types of sample tubing and the water-level meter probe. Lab-grade distilled water will be pumped through the tubing with a peristaltic pump, and then poured over the water level probe.

All sampling will be conducted using phthalate-free, nitrile disposable gloves, which will be changed frequently, as appropriate, and between sampling locations to prevent potential cross-contamination between samples.

2.2.4 Sample Containers and Labels

Sample identifiers will be defined by location name and sample collection date. All samples collected during the investigation will be labeled clearly and legibly using partially pre-printed labels. Each sample will be labeled with a unique alphanumeric sample identification number as follows:

Groundwater Sample Identification Number

Monitoring Well Type	Sample ID	Example
Existing well	Location Name - ## - Date	GTSP-7-050614
Newly installed well	NGW### - Date	NGW601-061214
		Field Duplicate: NGW699-061214

Where:

- *Location Name* consists of a unique identification name for existing and newly installed monitoring wells. The naming sequence for monitoring wells to be installed will begin with NGW (NBF groundwater well). New monitoring wells are not proposed at GTSP.
- *Location Identifier* (###) consists of a sequential numbers identifying the sample location. The numbering sequence for monitoring wells to be installed will begin with “601” at NBF. For field duplicate samples, numbers will follow a descending sequence starting with “699”.
- *Date* is the sample collection date in *mmddyy* format.

All sample containers will be labeled appropriately when delivered to the laboratory. The procedure for sample storage and delivery is provided in Section 2.7.4.

Sample labels will be self-adhering, waterproof material. Indelible ink will be used to complete each sample label. Each label will contain the project name (NBF-GTSP RI), sample identification, date and time of collection, analysis and method to be conducted, preservation, and the initials of the person preparing the sample. Labels will be affixed to sample bottles and vials containing samples.

Table 5 lists the analytical methods, sample containers, holding times, and preservation requirements for all targeted analyses. Modifications to the sampling containers may be made during sample collection based on available sample volume. Groundwater sample volumes are anticipated to be adequate in most cases; however, in the event of low recharge volume, the priority of analyses for each sample will be determined in consultation with Ecology, taking into account the minimum sample volume required as presented in Table 5; this will be communicated to the laboratory by Leidos when samples are delivered.

2.3 Soil Vapor Sampling

This section discusses soil vapor sampling locations, sampling collection and handling methods, and sample containers and labels. Planned analyses for soil vapor samples are presented in Section 2.8, and specific analytes are listed in Appendix A.

Two seasonal soil vapor sampling events (warm and cool seasons) will be conducted at each of the proposed monitoring points as part of Phase I. Procedures will closely follow the recommendations in the Ecology draft guidance on vapor intrusion evaluation (Ecology 2009). Subsequent rounds of sampling may be conducted depending on results for the first two rounds, potentially including sub-slab vapor points or indoor air sampling.

2.3.1 Soil Vapor Point Installation

Soil vapor points will be installed using hand augering, with approximately 3.5-inch diameter borings. Air-knife techniques will only be used if hand augering is not possible. Vapor points will consist of 0.25-inch diameter nylon tubing with a probe screen on the bottom. Nylon tubing will extend to approximately 5 feet bgs, depending on the water table depth. The bottom probe of the vapor point will consist of a 6-inch long stainless steel screen, generally positioned at or below 5 feet bgs. Vapor points will be set so that the water table will not intersect the probe screen during seasonal high water levels. Sand will be placed around the probe interval to depths of at least 6 inches above and below the probe. Borings will be sealed from the top of the sand pack to the ground surface with cement/bentonite grout. Vapor points will be equipped with a dedicated Swagelok® valve and completed within traffic-rated flush-mount vaults. All vapor point materials (tubing, probe screen, valve) will be delivered from the manufacturer pre-cleaned and sealed.

2.3.2 Sampling Locations

Sample locations for Phase I vapor samples are listed in Table 2 and shown on Figures 4 through 21 (vapor points are not present on all figures). Ten borings will be hand augered as described in Section 2.1 and then completed as soil vapor points. The final number depends on accessibility and subsurface conditions. These vapor monitoring points will be sampled on a biannual basis for one year as part of Phase I. The coordinates for each vapor point will be determined using GPS.

2.3.3 Sampling Collection and Handling Methods

This section describes specifications of the equipment being used and the detailed methodology for collecting soil vapor samples at the Site. Sampling collection, handling, and analysis information is provided in Table 5.

Installation of the soil vapor sampling monitoring points may result in a disturbance of equilibrium soil vapor concentrations in the immediate vicinity of the monitoring points. Therefore, Leidos will allow an equilibration period of at least 48 hours to allow soil vapor conditions to return to steady-state prior to sample collection. Also, per Ecology's recommendation (Ecology 2009), soil vapor sampling will not be performed during or immediately following a heavy rain event, and scheduling will also take into account significant barometric pressure changes.

Vapor sampling will take place within 1-liter Summa canisters that come from the laboratory under vacuum. Prior to sample collection, the initial vacuum of each Summa canister will be measured to verify that the canister has not leaked or been inadvertently opened. The initial vacuum, which should be approximately 29 inches of mercury, will be recorded on the canister's identification tag and the soil vapor sampling form (Appendix C).

Following the initial vacuum check, the 1-liter sampling canister will be connected by a sampling manifold to a 6-liter Summa canister that will be used solely for purging the sample collection train. The manifold will also be equipped with a filter and a flow restrictor calibrated to provide a sampling flow rate of approximately 170 milliliters per minute, which equates to a sampling interval of approximately 6 minutes.

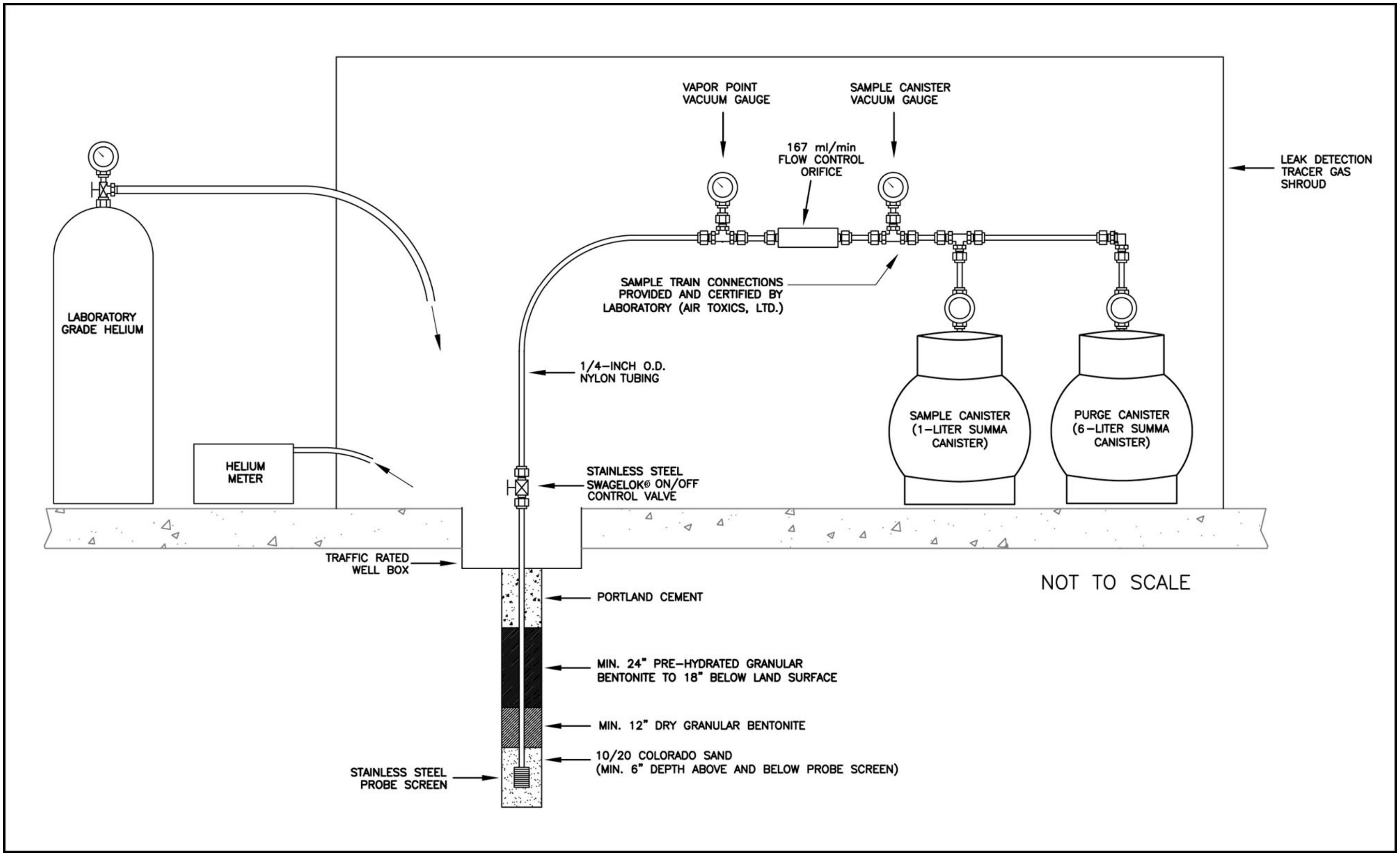
After connecting the purge canister, a preliminary leak check of the system will be performed. If the vacuum readings between the initial and final reading differ, the manifold will be reconnected to the canisters and checked again until the system is leak free. If, after a third attempt, a leak-free connection cannot be maintained, the sampling manifold will be removed from service and not used for sample collection.

Following completion of the preliminary leak check, the sampling manifold will be connected to the vapor point. Rigid-wall 0.25–inch outside-diameter nylon tubing will be used to connect the vapor point control valve to the inlet of the sampling manifold with Swagelok® fittings.

As a secondary check for leaks or short-circuiting, helium will be used as a tracer gas to test for ambient air leakage into the sampling system. To accomplish this, the entire soil vapor sampling train (vapor point, sampling manifold, sampling canister, and purge canister) will be contained in a shroud in which a helium-rich environment will be maintained throughout the duration of the sample collection, as recommended in Ecology's guidance (Ecology 2009). The figure on the following page shows a typical sampling train configuration. For the duration of sampling, the concentration of helium inside the shroud will be monitored using a helium detector, attempting to maintain a concentration of approximately 10 percent helium by volume.

Prior to collecting a soil vapor sample, each vapor point will be purged to remove stagnant air from the sample collection train. Purge volume will be based on the calculated volume of air contained within the vapor point and all tubing connected to the inlet of the sampling canister; three volumes will be purged. The sand pack volume of the vapor point will not be included in the purge volume calculation, as it is assumed that the vapor concentration in the sand pack will be in equilibrium with the surrounding soil.

Following purging, the valve on the sampling canister will be opened to begin sample collection. The start time and initial canister vacuum will be recorded on a soil vapor sampling form (Appendix C). During the time of sample collection (about 6 minutes), the sampling technician will periodically check the canister vacuum to verify that the canister is filling at the expected rate. Sample collection will be stopped when the vacuum gauge on the sampling canister indicates that between 3 to 5 inches of mercury is remaining. After sample collection is done, the final canister vacuum will be recorded on the canister identification tag and also on the soil vapor sampling form. All field data will be recorded on the soil vapor sampling form (Appendix C).



Soil Vapor Sampling Train Configuration

In order to evaluate sample variability and laboratory QA/QC concerns, one field duplicate soil vapor sample will be collected during each of the two phases. The duplicate sample will be collected using a duplicate-sampling manifold, which will allow two sample collection canisters to be filled simultaneously in a parallel configuration.

2.3.4 Sample Containers and Labels

Soil vapor samples will be collected in 1-liter Summa vapor-sampling canisters, provided by Air Toxics Ltd. (Air Toxics) laboratory in Folsom, California. Each Summa canister used for sample collection will be individually certified (100-percent certified) to contain less than the reporting limit for each of the target compounds.

Samples will be identified by location type and identifier and sample collection date. All samples collected during the investigation will be labeled clearly and legibly using partially pre-printed labels. Each sample will be labeled with a unique alphanumeric sample identification number as follows:

Soil Vapor Sample Identification Number

Sample ID	Example
VP## - Date	VP01-062514
	Field Duplicate: VP99-062514

Where:

- *Location Type* consists of the structure abbreviation (“VP” for vapor point).
- *Location Identifier* (##) consists of sequential numbers identifying the sample location (e.g., “01-”, “02-”). For field duplicate samples, numbers will follow a descending sequence starting with “99”.
- *Date* is the sample collection date in *mmddyy* format.

All sample containers will be labeled appropriately when shipped overnight to the laboratory. The procedure for sample storage and delivery is provided in Section 2.7.4.

Sample labels will be self-adhering, waterproof material. Indelible ink will be used to complete each sample label. Each label will contain the project name (NBF-GTSP RI), sample identification, date and time of collection, analysis and method to be conducted, and the initials of the person preparing the sample. Labels will be affixed to sample Summa canisters.

Table 5 lists the analytical methods, sample containers, holding times, and preservation requirements for all targeted analyses.

2.4 Storm Drain Solids Sampling

This section discusses storm drain solids sampling locations, sampling collection and handling methods, and sample containers and labels. Planned analyses for storm drain solids grab samples are presented in Section 2.8, and specific analytes are listed in Appendix A.

2.4.1 Sampling Locations

The storm drain system at NBF is divided into six main drainage basins (Figure 22): north lateral, north-central lateral, south-central lateral, south lateral, Building 3-380 area, and the parking lot drainage areas. The five Site subdivisions used for soil and groundwater investigations (Section 2.1) are distinct from these drainage areas identified for the storm drain, surface debris, and anthropogenic media, which primarily have transport pathways through the storm drain system.

A total of 53 storm drain structures are identified for storm drain solids sampling as part of RI Phase I, presented in Table 3 and Figures 23 and 24. Table 3 also includes the rationale for sampling storm drain solids as presented in Figure 2a. Storm drain structure locations include catch basins, manholes, drains, and oil/water separators. Actual sampling locations will be dependent upon storm drain structure accessibility, available sample material volume, and results of the initial survey (Section 1.6). Depending on results of RI Phase I, up to 15 samples may be collected during Phase II (Table 1).

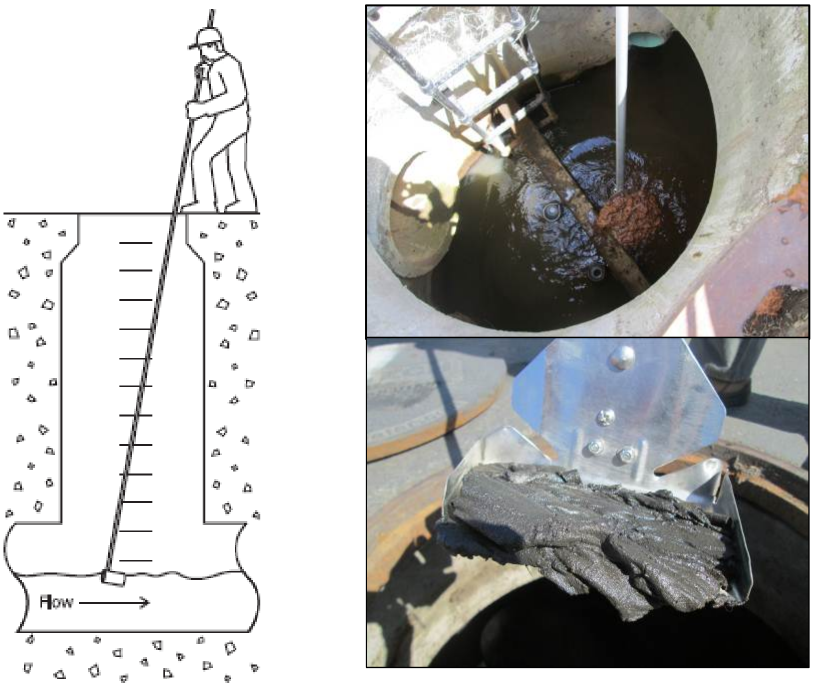
In some cases, it will be necessary to take samples at upstream locations to aid in identification of a potential source. Leidos will also identify alternate sampling locations in the event that primary sampling locations are inaccessible. Potential accessibility issues include confined space requirements, storm structure blockage, and facility operations. In the event that confined space entry is necessary, Leidos will subcontract with Herrera Environmental Consultants to conduct below-grade sample collection. If available sample volumes are insufficient to meet all analytical requirements, then other storm structure locations may be sampled instead or the list of analytes will be prioritized based on local contaminant concerns. Adherence with sample volume quantities listed in Table 5 will allow the laboratory to meet project-specific reporting limits.

2.4.2 Sampling Collection and Handling Methods

This section describes specifications of the equipment being used and the methodology for collecting storm drain solids grab samples. Sampling collection, handling, and analysis information is provided in Table 5.

Leidos will conduct sampling activities during dry periods, if weather permits, to provide an opportunity to maximize the volume of storm drain solids available for collection. A manhole hook will be used to remove catch basin, oil/water separator, and manhole covers. The field crew will use a flashlight to inspect the storm drain structure and determine the sample collection approach. Leidos will collect storm drain solids samples with similar methods to those described in Ecology's *How to Do Stormwater Sampling: A Guide For Industrial Facilities* (Ecology 2010). Leidos will use a decontaminated stainless steel scoop, spoon, or similar device attached to the base of a pole (when necessary) to collect solids from each storm drain structure.

Grab sample material will be collected and placed in a decontaminated, foil-lined stainless steel bowl, and any material greater than approximately 2 millimeters diameter (e.g., rocks, twigs, or foreign objects) will be removed from the sample. The sampling team will homogenize the storm drain solids material and then transfer this material to pre-labeled sample containers. If necessary, any liquids remaining over the solids will be decanted.



**Storm Drain Solids Grab Sampler and
Sample Collection Method (Ecology 2010)**

Equipment Decontamination

All sampling equipment will be decontaminated using tap water, a non-phosphate detergent solution (Alconox or Liquinox™), and a distilled-water rinse. Decontaminated sample processing equipment (spoons and bowls) will be wrapped or covered with aluminum foil.

Two equipment rinse blank samples associated with storm drain solids samples will be analyzed for PCBs, metals, and SVOCs during RI Phase I. The equipment rinse blank samples are expected to be collected on the sample scoop and stainless steel bowl (or foil-lined bowl).

All sampling will be conducted using phthalate-free, nitrile disposable gloves, which will be changed frequently, as appropriate, and between sampling locations to prevent cross-contamination between samples.

2.4.3 Sample Containers and Labels

Samples will be identified by the RI drainage basin, location type, location identifier, sample date, and sample matrix. All samples collected during the investigation will be labeled clearly and legibly. Each sample will be labeled with a unique alphanumeric sample identification number as follows:

Storm Drain Solids Sample Identification Number

Sample ID	Example
Location Name### - Date - Sample Matrix	MH130-050614-S
	Field Duplicate: MH999-050614-S

Where:

- *Location Name* consists of the structure abbreviation (e.g., CB = catch basin, MH = manhole, OWS = oil/water separator) and a unique identification number (###). For field duplicate samples, the identification number will follow a descending sequence starting with “999”.
- *Date* is the sample collection date in *mmddyy* format.
- *Sample Matrix* consists of the sample type, where S = storm drain solids.

All sample containers will be labeled appropriately when delivered to the laboratory. The procedure for sample storage and delivery is provided in Section 2.7.4.

Sample labels will be self-adhering, waterproof material. Indelible ink will be used to complete each sample label. Each label will contain the project name (NBF-GTSP RI), sample identification, date and time of collection, analysis and method to be conducted, preservation, and the initials of the person preparing the sample. Labels will be affixed to sample jars containing samples.

Table 5 lists the analytical methods, samples containers, holding times, and preservation requirements for all targeted analyses. Modifications to the sampling containers may be made during sample collection based on available sample volume and will be communicated to the laboratory by Leidos when samples are delivered.

2.5 Surface Debris Sampling

This section discusses surface debris sampling locations, sampling collection and handling methods, and sample containers and labels. Planned analyses for surface debris samples are presented in Section 2.8, and specific analytes are listed in Appendix A.

2.5.1 Sampling Locations

Sample locations for Phase I are listed in Table 4 and shown on Figures 23 and 24. Table 4 also includes the rationale for sampling surface debris as described in Figure 2a. Approximately 91 surface debris samples will be collected. This number depends on accessibility and sampleable volumes available. Nearby areas may be sampled in lieu of selected locations for cases where sampleable volumes or accessibility prevent collection. The coordinates for each sample location will be determined using GPS.

2.5.2 Sampling Collection and Handling Methods

This section describes specifications of the equipment to be used and the methodology for collecting surface debris samples at the Site. Sampling collection, handling, and analysis information is provided in Table 5.

Leidos will define the perimeter of the polygon area from which each surface debris sample will be collected, based on the volume of material present, the proximity to storm drain structures or target buildings/structures, and the presence of sampled or similarly sampled anthropogenic material. The perimeter will then be mapped using GPS or marked manually on the aerial photo base.

Surface debris samples will collected by sweeping together loose debris with a new broom and collecting the debris in a stainless steel dust pan or on aluminum foil. Each broom will have a 24-inch wide replaceable broom head with 4-inch palmyra bristles. Each surface debris sample will be collected with a new broom head. Surface debris material may include fragments of pavement, vehicle debris (such as tire or paint fragments), soil, gravel, other fine particulate debris, refuse, and organic matter. The sample material will be placed in a pre-labeled 8-oz. sample jars with a clean stainless steel spoon. Material greater than approximately ¼-inch diameter will be removed by the sampler prior to placing the solids material in the sample jar. Detailed sample material descriptions will be recorded on the surface debris sampling form (Appendix C).

Equipment Decontamination

Prior to field operations, all sampling equipment will be thoroughly decontaminated. Portions of non-disposable sampling equipment that contact the sample will be decontaminated by removing all visible adhering debris, using tap water, a non-phosphate detergent solution (Alconox or Liquinox™), and a distilled-water rinse. Decontaminated sample processing equipment (spoons, bowls, etc.) will be wrapped or covered with aluminum foil. A new, clean broom head and decontaminated stainless steel dust pan or foil will be used to gather each sample.

Two equipment rinse blank samples associated with surface debris samples will be analyzed for PCBs, metals, and SVOCs during RI Phase I. The equipment rinse samples are expected to be collected on the broom head and stainless steel dust pan or aluminum foil.

All sampling will be conducted using phthalate-free, nitrile disposable gloves, which will be changed frequently, as appropriate, and between sampling locations to prevent cross-contamination between samples.

2.5.3 Sample Containers and Labels

Samples will be identified by RI drainage basin, location name, location type, location identifier, sample date. All samples collected during the investigation will be labeled clearly and legibly using partially pre-printed labels. Each sample will be labeled with a unique alphanumeric sample identification number as follows:

Surface Debris Sample Identification Number

Sample ID	Example
Drainage Basin - SFD## - Date	NL-SFD01-070214
	Field Duplicate: NL-SFD99-070214

Where:

- *Drainage Basin* indicates the stormwater drainage basin from which the sample is collected (surface debris samples are not proposed for GTSP, the Building 3-380 drainage area, or the Parking Lot drainage area):
    - NL – north lateral
    - NCL – north-central lateral
    - SCL – south-central lateral
    - SL – south lateral
- *Location Name* is a unique location-based identifier consisting of Sample Type and Location Identifier:
    - *Sample Type* consists of a three letter abbreviation for surface debris (SFD).
    - *Location Identifier Number* (##) consists of sequential numbers identifying the sample location (e.g., “01-”, “02-”). For field duplicate samples, the identification number will follow a descending sequence starting with “99”.
- *Date* is the sample collection date in *mmddyy* format.

All sample containers will be labeled appropriately when delivered to the appropriate laboratory. The procedure for sample storage and delivery is provided in Section 2.7.4.

Sample labels will be self-adhering, waterproof material. Indelible ink will be used to complete each sample label. Each label will contain the project name (NBF-GTSP RI), sample identification, date and time of collection, analysis and method to be conducted, preservation, and the initials of the person preparing the sample. Labels will be affixed to sample jars containing samples.

Table 5 lists the analytical methods, sample containers, holding times, and preservation requirements for all targeted analyses. Modifications to the sampling containers may be made during sample collection based on available sample volume. Sample volumes are anticipated to be limited at some locations; therefore, the list of analytes will be prioritized based on local contaminant concerns, taking into account the minimum sample volume required as presented in Table 5, and will be communicated to the laboratory by Leidos when samples are delivered. Additional surface debris may be collected and archived for additional analyses during Phase II of sampling and analysis.

2.6 Anthropogenic Media Sampling

Sampling of anthropogenic media will be conducted as part of Phase II (Figure 2b). The sampling plan for anthropogenic media is dependent upon review of analytical results from the first round of sampling per drainage area. Chemical classes will be removed from the sampling plan on an area-by-area basis for cases where all chemicals within the class for a given medium are routinely non-detect or detected below respective RISLs. Planned analyses for anthropogenic media samples are presented in Section 2.8, and specific analytes are listed in Appendix A.

2.6.1 Sampling Locations

Ecology and Leidos will coordinate with Boeing and SCL personnel for scheduling and logistics for access.

For planning purposes, sampling locations for each anthropogenic media were initially estimated as follows: 20 CJM, 56 paint, 11 caulk, 18 roof material (including downspout solids), and 4 other exterior materials sampling locations. A visual inspection of paint, caulking, and other exterior materials will be conducted prior to sampling and will include inspecting the color, condition, elasticity, and brittleness. Leidos personnel will attempt to collect the paint and caulk samples in areas with already damaged or weathered materials. In addition, it may be necessary to make test cuts into the paint or caulk to determine the extent of layers present. The coordinates for each sample location will be determined using GPS.

2.6.2 Sampling Collection and Handling Methods

This section describes specifications of the equipment being used and the methodology for collecting anthropogenic material samples at the Site. Sampling collection, handling, and analysis information is provided in Table 5.

Concrete Joint Material

Sampling of CJM will be performed similar to previous sampling events at NBF (Landau 2001). A disposable, single-edged stainless-steel razor blade in a retractable utility knife will be used to collect representative samples of CJM from predetermined sample locations. The CJM will be extracted from the joints in sections of 5 to 10 centimeters (cm) in length and 1 to 3 cm in width. The CJM will be placed in a decontaminated stainless steel bowl, lined with aluminum foil, and cut into fragments 0.25 inch (0.6 cm) or less in size, and preferably as fine as possible, for improved effectiveness of the laboratory extraction process. The fragments will be placed into a pre-labeled wide-mouth glass jar. If it is practicable to sample directly into the jar, that will be done instead. Sample locations will be marked with spray paint immediately following sampling collection.

Paint

The sampling team will use a step ladder (if necessary) to collect paint samples at up to 10 feet above ground surface. A disposable, single-edged stainless steel razor blade in a utility knife or stainless steel scraper will be used to collect paint samples from areas of a building where paint is chipping and/or deteriorating. An area of at least 10 square cm will be collected for analysis, depending on necessary sample volumes. The paint chips will be collected into a decontaminated stainless steel bowl lined with foil. Large paint chips will be broken into smaller pieces with the stainless steel razor and placed into a pre-labeled wide mouth glass jar. Fragments will be 0.25 inch or less in size, and preferably as fine as possible, for improved effectiveness of the laboratory extraction process. If it is practicable to sample directly into the jar, that will be done instead.

Building Caulk and Other Exterior Building Materials

The sampling team will use a step ladder to collect caulk and other exterior materials samples at up to 10 feet above ground surface. A disposable, single-edged stainless steel razor blade in a utility knife will be used to collect caulk material, plastics, and rubber from predetermined sample locations. Sample locations will be selected to limit damage caused by the removal of the building material. The building materials will be extracted in sections of at least 5 cm in length and 1 to 3 cm in width, depending on necessary sample volumes. The building materials will be placed in a decontaminated stainless steel bowl, lined with foil, and cut into fragments 0.25 inch or less in size, and preferably as fine as possible, for improved effectiveness of the laboratory extraction process. The fragments will be homogenized and placed into a pre-labeled wide-mouth glass jar. If it is practicable to sample directly into the jar, that will be done instead.

Roof Material and Debris

The sampling team will work with Boeing to safely access building roofs to collect roof material and debris samples. Preference will be given to sampling rooftop loose debris located in proximity to downspout inlets. If sufficient sampleable quantities are not present, downspout solids/debris will be sampled instead. If the latter material is not available, then solid roof material located near downspout inlets will be sampled.

Roof debris samples will be collected by sweeping together loose debris with a new broom and a stainless steel dust pan or aluminum foil. This will be performed with a disposable whisk broom or a larger push broom with a 24-inch wide replaceable broom head with palmyra bristles. The sample material will be placed in pre-labeled sample jars with a clean stainless steel spoon.

Downspout solids (essentially surface debris) will be sampled within or immediately adjacent to the downspout drain outlet, where downspout material is concentrated. This material will be collected similar to roof debris sampling.

Roof material samples will be collected using a disposable, single-edged stainless steel razor blade in a utility knife or a stainless steel scraper in areas where large amounts of sampleable roof material are available. Roof material will be placed into a stainless steel bowl lined with foil and cut into fragments 0.25 inch or less in size, and preferably as fine as possible, for improved effectiveness of the laboratory extraction process. The sample material will be homogenized and transferred to pre-labeled sample jars with a clean stainless steel spoon. If it is practicable to sample directly into the jar, that will be done instead.

Sample Area Repair

In general, anthropogenic material sampling locations will be selected to minimize impacts to sampled areas. Leidos will coordinate with Boeing, SCL, or an Ecology subcontractor to repair areas where CJM, window or door caulk, paint, or other building materials have been removed. The repair work will be conducted soon after sampling to avoid compromising the integrity of the seals around the windows, doors, and exterior of a building.

Equipment Decontamination

Following each individual sample collection, razor blades will be discarded into a sealed, hard plastic container. The stainless steel bowl used to process a sample will be decontaminated using tap water, a non-phosphate detergent solution (Alconox or Liquinox™), and a distilled-water rinse. Decontaminated sample processing equipment (spoons and bowls) will be wrapped or covered with aluminum foil.

For roof material and surface debris sampling, the sample contacting portions of non-disposable sampling equipment will be decontaminated by removing all visible adhering debris and using tap water, a non-phosphate detergent solution (Alconox or Liquinox™), and a distilled-water rinse. A new, clean broom head or decontaminated stainless steel scraper and decontaminated stainless steel dust pan will be used to gather each sample.

Approximately four equipment rinse blank samples associated with anthropogenic media samples are anticipated to be analyzed for PCBs, metals, and SVOCs during RI Phase II. The equipment rinse samples are expected to be collected on decontaminated reused materials, such as spoons and bowls.

All sampling will be conducted using disposable nitrile gloves, which will be removed and changed after handling each individual sample. The used gloves will be disposed of as municipal waste.

2.6.3 Sample Containers and Labels

Samples will be identified by building number or drainage basin where the samples were collected, sample type, identification number, and sample collection date. All samples collected during the investigation will be labeled clearly and legibly using partially pre-printed labels. Each sample will be labeled with a unique alphanumeric sample identification number that identifies characteristics of the sample as follows:

Anthropogenic Media Sample Identification Number

Sample ID	Example
Building Number - Sample Type - ## - Date	3-626-RD-01-042614
	Field Duplicate: 3-626-RD-99-042614
Drainage Basin - Sample Type - ## - Date	NL-Paint-01-080214
	Field Duplicate: NL-Paint-99-080214

Where:

- *Building Number* indicates the building from which the sample is collected. If the sample is not collected from a building, the drainage basin will be used instead.
- *Drainage Basin* indicates the stormwater drainage basin from which the sample is collected:
    - NL – north lateral
    - NCL – north-central lateral
    - SCL – south-central lateral
    - SL – south lateral

- *Sample Type* consists of the anthropogenic medium sampled:
  - CJM
  - Paint
  - Caulk
  - Roof:
    - Roof debris (“RD”)
    - Downspout solids (“DS”)
    - Solid roof materials (“RS”)
  - OEM (other exterior material)
- *Location Identifier Number* (##) consists of a sequential numbers identifying the sample location (e.g., “01-”, “02-”). For field duplicate samples, the identification number will follow a descending sequence starting with “99”.
- *Date* is the sample collection date in *mmddyy* format.

All sample containers will be labeled appropriately when delivered to laboratory. The procedure for sample storage and delivery is provided in Section 2.7.4.

Sample labels will be self-adhering, waterproof material. Indelible ink will be used to complete each sample label. Each label will contain the project name (NBF-GTSP RI), sample identification, date and time of collection, analysis and method to be conducted, preservation, and the initials of the person preparing the sample. Labels will be affixed to sample jars containing samples.

Table 5 lists the analytical methods, holding time and preservation requirements for all targeted analyses. Modifications to the sampling containers may be made during sample collection based on available sample volume. Sample volumes may be limited at some locations; therefore, the list of analytes will be prioritized based on local contaminant concerns, taking into account the minimum sample volume required as presented in Table 5, and will be communicated to the laboratory by Leidos when samples are delivered.

A field laboratory or similar space will be established to provide a secure and clean area for equipment storage.

2.7 Field Documentation and Procedures

2.7.1 Field Documentation

A complete record of field activities will be maintained by the field crew. Documentation necessary to meet QA objectives for this project includes field notes and field forms, sample container labels, and chain-of-custody (COC) forms (Appendix C). The field documentation will include:

- Date, time, place, and location of sampling
- Onsite personnel and visitors
- Daily safety discussion and any safety issues
- Quality assurance/quality control samples collected (duplicate samples, rinse blanks, trip blanks)

- Field measurements (such as water levels) and their units
- Observations about site, location, and samples (weather, odors, appearance, etc.)
- Any modifications, decisions, and/or corrective actions to the study design and procedures identified in this SAP
- Equipment decontamination verification
- Photographs of each sample location, as appropriate, including notation of location ID

One or more field logbooks will be kept onsite during field operations. Daily activities will be recorded in a bound field logbook with water-resistant paper. All entries will be made legibly and will be signed and dated daily. Field logbooks and other field documents are intended to provide sufficient data and observations to enable participants to reconstruct events that occur during project field activities. Unless restricted by weather conditions, all original data recorded in field logbooks and on sample labels, COC records, and field forms will be written in waterproof ink. If an error is made, the individual responsible will make corrections simply by crossing out the error and adjacently recording the correct information, along with initials and date. All documentation, including voided entries, must be maintained within project files.

2.7.2 Waste Disposal and Handling Procedures

Investigation-derived waste (IDW) generated during field activities covered by this SAP may include drummed soil and groundwater, decontamination fluids, PPE, and miscellaneous solid waste generated during sample collection activities. All IDW will be properly managed for appropriate disposal. The following waste handling procedures will be used during RI field activities:

- IDW generated during field activities (soil cuttings, purged groundwater, decontamination water, and other remnant sampled material) will be stored in PLP-provided 55-gallon, DOT-approved drums. Following sampling at each area, the drums will be transported to a secure onsite staging location at NBF or GTSP. Each drum will be labeled and dated with information appropriate for accurate tracking and identification of the containers and their contents. IDW containers will be labeled as “Pending Analysis” until the results of analytical testing are received and a hazardous/ non-hazardous determination is made.
- Final drummed waste determinations will be based on knowledge of where and how the waste was generated and on analytical results from the sampling locations. PCB analyses may be added for soil waste characterization if not already included in results. In addition, one composite waste soil sample and one composite waste water sample will be analyzed for TCLP metals for each area of concern (or other appropriate compositing combination, not to exceed four drums per composite sample). Waste water samples will also be field-measured for pH and lab-analyzed for flash point.
- Disposable PPE and other non-drummed wastes that may be generated during field sampling activities (including gloves, foil, paper, plastic bags, disposable sampling equipment, and other miscellaneous types of debris) will be placed in plastic garbage bags for disposal in standard municipal waste receptacles.

Drums will be properly labeled and the appropriate placards affixed, with the generator’s contact name and phone number. Following receipt of laboratory analytical data, Boeing, will coordinate storage and disposal of this material. Transport and disposal of waste soil and water will be coordinated by Boeing and SCL. The PLPs are considered the generators and will sign all manifests, bill of lading, profile sheets, and any other shipping documents.

2.7.3 Field Equipment Calibration

Field instruments include PIDs, water quality meters (pH, conductivity, turbidity), and helium meters. These instruments will be calibrated prior to each day's use according to the manufacturer's recommended procedure, using the appropriate calibration standards. The calibration of such instruments will be noted in the equipment calibration form in Appendix C.

2.7.4 Sample Storage and Delivery

With the exception of soil vapor, all samples will be stored in a cooler chest, on ice, while at the Site and during transportation to the ARI laboratory in Tukwila, Washington. A temperature compliance vial (if provided by laboratory) will accompany each cooler to verify that proper holding temperatures (≤ 6°C) were maintained during transport. Summa canisters of soil vapor samples will be stored at ambient temperature while at the Site and waiting for shipment to the Air Toxics laboratory in Folsom, California.

Each shipping container or sample cooler (or batch of coolers) containing laboratory samples will contain a fully completed COC form. The field personnel will retain a copy of the COC form, and the original will be sent with the samples to the laboratory. Samples will be transported via vehicle by a Leidos field technician or shipped overnight to the laboratory under proper chain-of-custody.

Preparation of sample containers for delivery will be performed in the following manner:

- Sample containers will be placed inside the laboratory-provided bubble wrap Ziploc bag (or other protection packaging) and labeled.
- An empty cooler will be prepared by lining the cooler with insulation/packaging materials, and surrounding the wrapped sampling containers with bagged ice.
- Summa sample canisters will be packaged securely in a cardboard box lined with foam padding.
- Prior to transporting or shipping the sample containers to the appropriate laboratory for analysis, the headspace in the cooler and/or shipping container will be packed with bubble wrap.
- COC forms will be enclosed in a plastic bag and taped to the inside lid of the cooler. The cooler or other shipping container will be wrapped with strapping tape. Custody seals will be signed and dates and affixed to the outside of the cooler or other shipping container.
- The COC will be signed by the individual who is relinquishing samples to the laboratory or courier service. Upon receipt of samples at the laboratory, the condition of the samples will be recorded by the receiver. Leidos field personnel will be responsible for the following:
  - Packaging the samples
  - Signing the COC before placing inside the cooler or shipping container
  - Notifying the laboratory of when the samples are being delivered

Table 5 summarizes the requirements for sample containers and preservation, as well as the maximum time that samples can be held prior to being analyzed.

2.7.5 Chain-of-Custody Procedures

The field crew will retain samples at all times until Leidos personnel deliver samples to the appropriate laboratory or courier service. Chain-of-custody forms will be initiated at the time of sample collection to ensure that all collected samples are properly documented and traceable through storage, transport, and analysis. When all line items on the form are completed or when the samples are relinquished, the sample collection custodian will sign and date the form, list the time, and confirm the completeness of all descriptive information contained on the form. Each individual who subsequently assumes responsibility for the sample will sign the COC form. The field COC terminates after the laboratory receives the samples. The field manager will retain a copy of the completed, signed COC forms for project files. An example form can be found in Appendix C.

2.8 Laboratory Analyses

All of the analytical procedures used in this program will be performed by subcontracted laboratories in accordance with U.S. Environmental Protection Agency (USEPA 1986) and Ecology guidelines. The laboratory analysis for storm drain solids will be consistent with Ecology's Sediment Sampling and Analysis Plan Appendix (Ecology 2008). Each laboratory participating in this investigation will be accredited by Ecology and have an internal QA/QC plan. Analyses will be required to conform to referenced test methods and the laboratory's written QA plan and standard operating procedures.

Samples will be collected and analyzed using the procedures specified in Tables 5 and 6 for all media. Target analytes, practical quantitation limits (PQLs) or reporting limits, and method detection limits (MDLs) are presented in Appendix A. The laboratories will report analytical results down to the MDL as J-qualified data. For virtually all COPCs in all media, the PQLs are lower than or equal to the RISLs or VISLs; the only exceptions include two chemicals for soil vapor, where the VISLs are between the PQL and MDL (Appendix A).

The target chemical classes for analysis are summarized in the table on the following page. Based on the final RI/FS Work Plan, samples of each medium will be analyzed for all or some of the chemical classes listed. In addition, MTCA Method B TPH cleanup levels will be calculated for soil in AOCs with previously identified significant petroleum contamination. This includes volatile and extractable petroleum hydrocarbon (VPH/EPH) fractions. Required testing is identified in MTCA Table 830-1 and is also based on the COPCs present at the Site. Approximately two petroleum suite of samples for Method B cleanup level calculations will be analyzed in each significant petroleum-contaminated area (Table 2).

For storm drain and anthropogenic media samples, variations in analytical suites result in the following combinations, with final sample selection being made in the field:

- All storm drain solids samples will be analyzed for PCBs, metals, and SVOCs (full suite); dioxins/furans will be analyzed in selected samples (approximately 10) at locations with known elevated concentrations of PCBs in storm drain solids or nearby surface debris.

- All surface debris and anthropogenic media samples will be analyzed for PCBs and metals; approximately one-third of these samples will be analyzed for SVOCs (PAHs, phthalates, and phenols). Dioxins/furans will be analyzed in selected surface debris samples (approximately 15) at locations with known elevated concentrations of PCBs in storm drain solids or nearby anthropogenic media (excluding paint). Anthropogenic media, with the exception of paint, will be analyzed for dioxins/furans in approximately one-fifth of samples.

The need for continuation of analysis of all chemical classes for groundwater and anthropogenic media will be evaluated early in the RI process, on a well or local basis, as described in Sections 2.2 and 2.6.

Target Chemical Classes for Analysis by Media

Chemical Class	Soil	Groundwater	Soil Vapor	Storm Drain Solids	Surface Debris	Anthropogenic Media
PCBs	●	●		●	●	●
Dioxins/Furans	●			●	●	●
Metals	●	●		●	●	●
TPH	●	●				
SVOCs	●	●	●	●	●	●
VOCs	●	●	●			

Notes:
- SVOCs include the full EPA 8270 analytical suite for soil and groundwater. However, for storm drain solids, surface debris, and anthromedia, they only include PAHs, phthalates, and phenols.
- Groundwater samples will be analyzed for both total and dissolved metals.
- All PCB analyses are for aroclors (EPA 8082).

Analytical Resources, Inc. (ARI) of Tukwila, Washington, will analyze samples for most media and analytes. Eurofin Air Toxics, Ltd., of Folsom, California, will be subcontracted to analyze soil vapor samples. Analytical data will be formally validated by an independent third-party firm, EcoChem, Inc., of Seattle, Washington.

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Quality Assurance Project Plan
Signature Page

Site: North Boeing Field / Georgetown Steam Plant

Document Name: North Boeing Field / Georgetown Steam Plant Site Remedial Investigation/ Feasibility Study, Sampling and Analysis Plan and Quality Assurance Project Plan

Document Date: April 16, 2014

Signature below indicates review and approval of the Quality Assurance Project Plan and agreement that the anticipated sampling and analytical methods are sufficient to meet the quality objectives of the NBF-GTSP Remedial Investigation.

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3.0 Quality Assurance Project Plan

The purpose of the project QAPP is to provide confidence in the quality of the analytical results through a system of QA/QC performance checks with respect to data collection methods, laboratory analysis, data reporting, and appropriate corrective actions to achieve compliance with established performance and data quality criteria. This section presents the QA/QC protocols used to ensure that the data obtained during the investigation are legally defensible and usable for their intended purpose.

3.1 Measurements of Data Quality

The quality of the project data reported by the laboratories will be evaluated using accuracy, precision, representativeness, completeness, and comparability as described below.

Precision is a measure of mutual agreement among individual measurements of the same property under prescribed conditions. Precision will be assessed by the analysis of MS/MSD samples, field duplicate samples, and LCS/LCSD samples. The calculated relative percent differences (RPDs) for field and MS/MSD pairs will provide information on the precision of sampling and analytical procedures, and the RPDs for LCS/LCSD pairs will provide information on precision of the analytical procedures. The performance-based (or method defined) laboratory control limits for precision will be used for laboratory and field duplicate evaluation for the project.

Accuracy is the degree to which an observed measurement agrees with an accepted reference or true value. Accuracy is a measure of the bias in the system and is expressed as the percent recoveries of spiked analytes in MS/MSD and LCS/LCSD samples. Accuracy will also be evaluated through the surrogate spikes in each sample for the organic chemistry analyses. The performance-based (or method defined) laboratory control limits for accuracy will be used for the project.

Representativeness expresses the degree to which data accurately and precisely represent an actual condition or characteristic at a particular sampling point. Representativeness is achieved by collecting samples representative of the matrix at the time of collection. Representativeness will be evaluated using replicate samples and blanks.

Completeness refers to the amount of acceptable data points collected relative to the amount needed to achieve the project's technical objectives. Completeness is calculated as the number of valid data points achieved divided by the total number of data points expected for all requested analyses. For this project, the overall completeness objective is 95 percent; at least 95 percent of proposed samples should be collected and successfully analyzed, excluding sample locations where lack of material precluded sample collection.

Comparability is based on the use of established USEPA-approved methods for the analysis of the selected parameters. The quantification of the analytical parameters is based on published methods, supplemented with well-documented procedures used in the laboratory to ensure reproducibility of the data.

3.2 Quality Assurance and Quality Control

Field and laboratory QA/QC samples will be used to evaluate the data precision, accuracy, representativeness, and comparability of the analytical results. The field QA/QC samples to be collected are described in Section 3.2.1. The laboratory QA/QC samples are discussed in Section 3.2.2.

3.2.1 Field QA/QC Samples

Field QA/QC samples will be collected during sampling to evaluate the quality of the sampling procedures and the analytical data. Field QA/QC samples include field duplicate samples and water blank samples (equipment rinse blanks and trip blanks). Field QA/QC samples will be handled in the same or similar manner as the environmental samples collected. Descriptions of the field QC samples are provided below.

Field Duplicate Samples

Field duplicate samples will be collected at a rate of approximately one per twenty samples (5 percent) for analysis for all environmental sample types, at locations where sufficient sample volume is available. Field duplicate samples will be collected at the same time and analyzed for the same chemicals as the original sample. Field duplicate sample results are used to assess the precision of the sample collection process and to help determine the representativeness of the sample. Some material and locations with inherent variability may require a higher frequency of duplicate sampling, such as paint chips. If the results of the field duplicate samples exceed QA/QC criteria for precision, this information will be discussed in the data validation report, but data qualifiers will not be applied to the associated results.

Field duplicate samples will be presented “blind” to the analytical laboratory (i.e., the laboratory will not know which environmental sample is matched to the duplicate). The total number of samples, including field duplicate samples, is estimated in Table 1.

Equipment Rinse Blanks

Equipment rinse blank samples provide a QC check on the potential for cross contamination by measuring the effectiveness of the decontamination procedures on the sampling equipment. The equipment rinse blank samples consist of reagent-grade water provided by ARI, as applicable, rinsed across sample collection and processing equipment. A total of eight rinse blank samples will be collected for soil and groundwater sampling, and analyzed for PCBs, metals, TPH, SVOCs, and VOCs. A total of four rinse blank samples will also be collected for storm drain solids and surface debris sampling, and analyzed for PCBs, metals, and SVOCs. If chemicals are detected in the equipment rinse blank samples, the detected concentrations will be compared to the associated sample results to evaluate the potential for contamination. The blank results will be discussed in the data validation report, and data qualifiers may be applied to the associated sample results using USEPA Functional Guidelines for data validation (USEPA 2008, 2009, 2010, 2011).

The total number of equipment rinse blank samples is estimated in Table 1. Equipment rinse blank samples will be identified by sample type, sample media type, and sample collection date, as follows:

Equipment Rinse Blank Sample Identification Number

Sample ID	Example
Equipment Rinse - Sample Type - Date	ER-GW-062414

Where:

- *Equipment Rinse* (ER) indicates the sample is an equipment rinse blank sample.
- *Sample Type* consists of the medium sampled:
  - Soil – SO
  - Groundwater – GW
  - Storm Drain Solids – SDS
  - Surface Debris – SFD
- *Date* is the sample collection date in *mmddyy* format.

Trip Blanks

Trip blank samples provide a QC check on the potential for cross contamination by volatile constituents within a batch of environmental samples (e.g., a cooler chest) by measuring the volatile concentrations accumulated in a water blank sample. Trip blanks will be submitted with every soil and groundwater sample shipment in which these samples are being analyzed for VOCs and/or NWTPH-Gx. One trip blank, consisting of laboratory-supplied organic-free water, will be included in each cooler and analyzed upon receipt for the same volatile constituents as the environmental samples. Soil and groundwater samples analyzed for VOCs and NWTPH-Gx will be consolidated into respective coolers (approximately one cooler for soil and one cooler for groundwater) at the end of each field day to minimize the number of trip blanks required.

The total number of trip blank samples is estimated in Table 1. Trip blank samples will be identified by sample type, sample media type, and sample collection date, as follows:

Trip Blank Sample Identification Number

Sample ID	Example
Trip Blank - Sample Type - Date	TB-SO-051214

Where:

- *Trip Blank* (TB) indicates the sample is a trip blank sample for that batch of samples.
- *Sample Type* consists of the medium sampled:
  - Soil – SO
  - Groundwater – GW
- *Date* is the sample collection date in *mmddyy* format.

Temperature Blanks

Temperature blanks will be used to confirm that collected environmental samples are stored and transported at the required temperature as listed in Table 5. One temperature water blank, provided by the laboratory, will be included in each cooler of environmental samples with a preserved temperature requirement. Upon receipt, ARI will measure the temperature of the water blank and record the results. Any measurement not meeting requirements (received at >6°C) will be noted by ARI in the laboratory report. Temperature blanks are not given sample numbers and are not analyzed.

3.2.2 Laboratory QA/QC Samples

Instrument calibration and laboratory QA/QC sample requirements are defined in the test methods and the laboratory's written standard operating procedures. A laboratory control sample duplicate (LCSD) should be analyzed if the laboratory does not have sufficient sample volume to prepare a project-specific matrix spike/matrix spike duplicate (MS/MSD) or organic test methods, and/or laboratory duplicate sample for inorganic test methods. The results of these samples will provide information on the accuracy and precision of the chemical analysis and will be used to qualify data, as necessary, during data validation using USEPA Functional Guidelines (USEPA 2008, 2010, 2011). The frequencies of analysis for laboratory QA/QC samples are summarized in Table 6. It is possible that the planned analyses of laboratory duplicate and matrix spike samples may not be possible due to limited sample volume.

3.2.3 Analytical Laboratory Reports

Analytical laboratory reports will be accompanied by sufficient raw data and QC results to enable independent reviewers to evaluate the quality of the data and to recalculate the results. The analytical laboratory deliverables will include, but are not limited to, the following:

- MDLs and RLs for each sample (adjusted for weights, volumes, dilution factors and total solids)
- Laboratory qualifiers reported with analyte concentrations and a summary of qualifier definitions
- Case narrative including any problems encountered, protocol modifications, and/or corrective actions taken
- Sample analytical and QA/QC results with units and control limits
- All method references used during analyses
- Surrogate recovery results and control limits
- MS/MSD results and control limits
- Laboratory duplicate results and control limits
- Method blank results
- Laboratory control sample/laboratory control sample duplicate (LCS/LCSD) results and control limits
- Initial and continuing calibration results and control limits
- Sample custody records (including original COC forms)
- Sample and QC results in the electronic data deliverable (EDD) format specified in Appendix D
- All raw data (instrument printouts, runlogs, sample preparation bench sheets, sample analysis bench sheets)

3.2.4 Data Validation

All analytical results obtained during this investigation will undergo independent data validation by EcoChem, Inc. of Seattle, Washington. Data validation will be performed following USEPA guidance (USEPA 2008, 2009, 2010, 2011) and requirements for the analytical methods. A summary-level (EPA Stage 2b) data validation will be performed for all standard chemistry. A full-level (EPA Stage 4) data validation will be performed for dioxins/furans. A compliance-level (EPA Stage 2a) screening, including a comparison of detected results to associated sample concentrations, will be performed for all rinse blank, trip blank, and waste characterization samples. If data quality concerns are noted, the laboratory will be contacted, as necessary, and the samples will be reanalyzed, data qualified, and/or the issue discussed in the data validation report. As part of the validation process, 100 percent of field sample results and 10 percent of QC results in the EDD will be verified against the data package. Any transcription errors will be verified with the laboratory. The results of the data validation will be summarized in a data validation report, which will be included as an appendix to the RI Report. The verified EDD with added data validation qualifiers and reason codes will be included as part of the data validation deliverables.

The analytical laboratories will provide electronic copies of the data packages to Leidos and EcoChem (hardcopies are not required). The data packages will contain sufficient information to allow for a full-level data validation and review of all sample and laboratory QC sample results (calibration, method blanks, LCS/LCSD, and MS/MSD), including all raw data needed to recalculate reported results. Results for waste characterization samples will not undergo data validation.

4.0 Data Analysis, Recordkeeping, and Reporting Requirements

4.1 Analysis of Chemistry Data

The chemical results for all media will be processed using the data management rules presented in Appendix B. Data tables will indicate sample locations, chemical concentrations, and final data qualifiers, and will also include a comparison of the results to RISLs, cleanup levels, or other criteria.

4.2 Recordkeeping

At the conclusion of the RI, all records, including field notes, laboratory data reports, data validation reports, and other relevant documentation, will be archived and provided to Ecology in electronic format, as requested.

4.3 Interim Data Reports / SAP Addenda

Interim data reports will be submitted during and following Phase I of the RI, as analytical results are received and evaluated. These reports will be produced for each major area (Site subdivision or drainage basin) and for each of the two major categories of media, as data become available for review. The reports will include an evaluation of analytical data for sampled media to determine the nature and extent of contamination, as well as any identified data gaps leading to RI Phase II activities. Components will include tables and figures, a brief write-up summarizing results and any identified data gaps, and proposed sampling locations and analyses for Phase II media, along with sampling rationale.

Each interim data report will be submitted to Ecology and PLPs for review approximately three weeks after all unvalidated data are received for that media and major area. Data reports are anticipated to be separated out by designated areas (Site subdivisions or drainage area), depending on batching of data, timing of data receipt, and amount of data in each area. It is likely that the PEL area (soil) and north lateral drainage area (storm drain and anthropogenic media) will require their own reports, and that other areas of the Site will be combined, in order to reduce the number of data reports. Upon review of validated data, any changes that might result from the validation process and affect Phase II work will be incorporated into SAP addenda and be submitted to Ecology and the PLPs, prior to commencing with Phase II field work. The SAP addenda will present proposed sampling locations, sampling methods, and planned analyses; the addenda represent simple modifications to the components of the final SAP/QAPP.

All deliverables, consisting of interim data reports and SAP addenda, will be provided in hard copy (five copies unless otherwise requested) and/or electronically as Microsoft Word documents and Adobe pdf files. The format decisions will be made prior to each submittal, via discussions between Ecology and the PLPs.

4.4 Remedial Investigation Report

Following RI field and analytical activities, an RI Report will be prepared to compile, evaluate, and present data leading to the feasibility study. The RI Report will include and expand upon portions of the RI/FS Work Plan that summarized Site information to date. The structure of the RI Report is described in the final RI/FS Work Plan (Leidos 2013).

During the RI phase and beginning early in the production of the RI Report, MTCA cleanup levels or other criteria will be developed and refined, for comparison of Site data to determine exceedances and the extent of contamination. This process includes evaluating background/ upgradient concentrations. Historical data and locations will be included, where appropriate, to define the type and extent of contamination. Tables will be compiled to present key analytical and physical data. Concentrations and/or exceedance factors for cleanup levels or other criteria will be presented. Bulk data will be compiled in appendices, which may be distributed solely in electronic format.

Leidos will provide all deliverables to Ecology electronically in Microsoft Word, Excel, and/or Adobe pdf formats for all documents, as appropriate. Additionally, five hard copies will be submitted. Leidos will provide georeferenced data files in the appropriate format specified by Ecology for all figures created with GIS software.

In addition, the validated chemistry data from this investigation will be uploaded into Ecology’s Environmental Information Management (EIM) database. Information for entering data into EIM can be found on Ecology’s website: http://www.ecy.wa.gov/eim/.

5.0 References

Ecology (Washington State Department of Ecology). 2007. Model Toxics Control Act Cleanup regulation, Chapter 173-340, as amended October 12, 2007. Washington State Department of Ecology, Lacey, WA. November 2007.

Ecology. 2008. Sediment Sampling and Analysis Plan Appendix. Guidance on the Development of Sediment Sampling and Analysis Plans Meeting the Requirements of the Sediment Management Standards (Chapter 173-204 WAC). Washington State Department of Ecology. Publication No. 03-09-043. Revised February 2008.

Ecology. 2009. Draft Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action. Washington State Department of Ecology. October 9, 2009.

Ecology. 2010. How to Do Stormwater Sampling: A Guide for Industrial Facilities. Washington State Department of Ecology. Publication No. 02-10-071. Revised March 2010.

Landau. 2001. Report: Sampling and Analysis, Concrete Joint Material, North Boeing Field, Seattle, Washington. Prepared for The Boeing Company by Landau. March 22, 2001. [N1460]

Leidos. 2013. North Boeing Field/Georgetown Steam Plant Remedial Investigation/Feasibility Study, Final Work Plan. Prepared for Washington State Department of Ecology by Leidos. November 11, 2013. [N0199]

PSEP (Puget Sound Estuary Program). 1986. Recommended Protocols for Measuring Conventional Sediment Variables in Puget Sound. U.S. Environmental Protection Agency, Region 10, Seattle, WA, for Puget Sound Estuary Program. March 1986.

SAIC. 2009. North Boeing Field and Georgetown Steam Plant, Supplemental Report: Summary of Existing Information and Identification of Data Gaps. Prepared for Washington State Department of Ecology by SAIC. August 2009. [N1739]

SAIC. 2011. North Boeing Field/Georgetown Steam Plant Site Remedial Investigation/ Feasibility Study, Assessment of Infiltration and Inflow to North Boeing Field Storm Drain System. Prepared for Washington State Department of Ecology by SAIC. February 2011. [N0231]

USEPA (U.S. Environmental Protection Agency). 1986 and updates. SW-846 Manual. Test methods for evaluating solid waste, physical/chemical methods. U.S. Environmental Protection Agency. http://www.epa.gov/epaoswer/hazwaste/test/sw846.html

USEPA. 2008. Office of Emergency and Remedial Response. June 2008. *USEPA Contract Laboratory Program, National Functional Guidelines for Superfund Organic Methods Data Review*. EPA-540-R-08-01. Washington, DC.

USEPA. 2009. Office of Emergency and Remedial Response. January 2009. *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use.* EPA-540-R-08-005. Washington, DC.

USEPA. 2010. Office of Emergency and Remedial Response. January 2010. *USEPA Contract Laboratory Program, National Functional Guidelines for Superfund Inorganic Data Review*. EPA 540-R-10-011. Washington, DC.

USEPA. 2011. Office of Emergency and Remedial Response. September 2011. *USEPA Contract Laboratory Program, National Functional Guidelines for Chlorinated Dioxin/Furan Data Review*. EPA 540-R-11-016. Washington, DC.

Van den Berg, M., L.S. Birnbaum, M. Denison, M. De Vito, W. Farland, M. Feeley, H. Fiedler, H. Hakansson, A. Hanberg, L. Haws, M. Rose, S. Safe, D. Schrenk, C. Tohyama, A. Tritscher, J. Tuomisto, M. Tysklind, N. Walker, and R. Peterson. 2006. The 2005 World Health Organization Reevaluation of Human and Mammalian Toxic Equivalency Factors for Dioxins and Dioxin-Like Compounds. Prepared for the World Health Organization (WHO). Toxicological Sciences, v. 93 (2), p. 223-241; ToxSci Advance Access, published July 7, 2006.

Tables

Table 1
Summary of Proposed RI Sampling [1]

Media	Phase I				Phase II (estimated numbers)				Notes
	Sampling Locations	Environ-mental Samples	Field Duplicate Samples	Water Blank Samples[2]	Sampling Locations	Environ-mental Samples	Field Duplicate Samples	Water Blank Samples[2]	
Soil, Groundwater, and Vapor Investigations									
Soil	90	210	10	20+2	32	74	4	7+2	● Sampling locations include borings for the installation of monitoring wells and soil vapor points ● Sample number represents an estimated quantity, based on an average of 2.5 soil samples per boring ● Phase II sampling assumes 30% of Phase I sampling
Groundwater	25	100	5	9+2	8	32	2	3+2	● Phase I sampling includes samples from proposed wells only ● Phase II sampling assumes 30% of Phase I sampling
Soil Vapor	10	20[3]	2	0	4	8	2	0	● Soil vapor points will be monitored for two seasonal rounds ● Phase II soil vapor sampling assumes 30% of Phase I sampling
Storm Drain Inflow Investigations									
Storm Drain Solids	53	53	3	0+2	15	15	1	0+1	● Phase II storm drain solids sampling assumes approximately 30% of Phase I sampling
Surface Debris	91	91	5	0+2	--	--	--	--	● Phase II sampling currently not proposed, but will be evaluated after review of Phase I results
CJM	0	0	0	0	20	20	1	0+1	● Estimated sample numbers; final quantities will be determined after review of Phase I results
Paint	0	0	0	0	56	56	3	0+2	
Caulk	0	0	0	0	11	11	1	0	
Roof Material[4]	0	0	0	0	18	18	1	0+1	
Other Exterior Material	0	0	0	0	4	4	0	0	

1. Sample locations and numbers are approximate and may vary depending on field conditions and findings
2. Estimated numbers of water blank samples include trip blanks + equipment rinses, respectively
3. Note that the final RI/FS Work Plan inadvertently listed 24 samples for soil vapor
4. Roof material samples include roof debris and downspout solids

Table 2
Summary of Proposed RI Phase I Activities for Soil, Groundwater, and Soil Vapor

Area of Concern	Individual Sampling Locations				Total Number of Boring Locations[1]	Number of Samples			Analyses
	Proposed Soil Borings for Soil Sampling	Proposed GW Monitoring Wells	Existing GW Monitoring Wells for RI Sampling	Proposed Soil Vapor Points		Minimum Number of Soil Samples[1]	Minimum Number of GW Samples[2]	Minimum Number of Soil Vapor Samples[3]	
GTSP									
North Yard Area (Figure 5)	GTSP-SB01	--	--	--	1	2	--	--	PCBs, Dioxins/Furans
East Yard Area (Figure 5)	GTSP-SB02	--	--	--	1	2	--	--	PCBs, Metals, SVOC, VOCs, Dioxins/Furans
Fuel Tank Area (Figures 5 and 6)	--	--	GTSP-8	--	--	--	--	--	TPH
South Yard Area and Low-Lying Area (Figures 5 and 6)	--	--	GTSP-2, GTSP-7	--	--	--	--	--	PCBs, Metals, SVOC, cVOCs
NBF -- PEL Area									
NBF Fenceline Area (Figure 6)	--	--	NGW521, NGW522, NGW523	--	--	--	--	--	PCBs, cVOCs
Building 3-323 Area**:**									
● Soil Borings, Vapor Points (Figure 6)	PEL-SB01 through PEL-SB06	--	--	VP01, VP02	8	14	--	4	PCBs, Metals, PAHs (Soil); VOCs (VP)
● Existing Monitoring Well (Figure 6)	--	--	NGW511	--	--	--	--	--	PCBs, TPH, SVOCs, VOCs
Buildings 3-302 and 3-322 Area (Figure 6)	PEL-SB07, PEL-SB08	--	--	--	2	4	--	--	PCBs, Metals
Buildings 3-329, 3-333, 3-335 Area**:**									
● Building 3-329 area (Figure 8)	--	NGW601, NGW602	--	--	2	4	8	--	PCBs, VOCs
● North end of Building 3-335 (Figures 7 and 8)	PEL-SB09	NGW603	NGW520	--	2	4	4	--	PCBs, TPH[4], VOCs
● West of Building 3-335 (Figure 8)	--	--	NGW516	--	--	--	--	--	PCBs, TPH, SVOCs, VOCs
● SE of Building 3-335, and near Test Building (Figure 7)	PEL-SB10 through PEL-SB14	--	--	--	5	10	--	--	PCBs, TPH[4], three borings for VOCs
	--	--	NGW514, NGW515	--	--	--	--	--	PCBs, TPH, VOCs, and one well for Metals
● Soil Vapor Points (Figures 7 and 8)	--	--	--	VP03, VP04, VP05	3	3	--	6	VOCs, TPH[4]
Building 3-324 Area**:**									
● Soil Borings, Vapor Point (Figure 8)	PEL-SB15 through PEL-SB18	--	--	VP06	5	9	--	2	PCBs, TPH, PAHs, BTEX; VOCs (vapor)
● Monitoring Wells (Figure 8)	--	NGW604	NGW519	--	1	2	4	--	PCBs, Metals, TPH, PAHs, BTEX
Buildings 3-315 and 3-626 Area (Figure 7)	PEL-SB19, PEL-SB20, PEL-SB21	--	--	--	3	6	--	--	PCBs, PAHs

Table 2
Summary of Proposed RI Phase I Activities for Soil, Groundwater, and Soil Vapor

Area of Concern	Individual Sampling Locations				Total Number of Boring Locations[1]	Number of Samples			Analyses
	Proposed Soil Borings for Soil Sampling	Proposed GW Monitoring Wells	Existing GW Monitoring Wells for RI Sampling	Proposed Soil Vapor Points		Minimum Number of Soil Samples[1]	Minimum Number of GW Samples[2]	Minimum Number of Soil Vapor Samples[3]	
Building 3-353 Area:									
• Soil Boring, Vapor Point (Figures 7 and 9)	PEL-SB22	--	--	VP07	2	3	--	2	PCBs, TPH, PAHs, BTEX; VOCs (vapor)
• Monitoring Wells (Figure 7)	--	NGW605	GT-1114-2	--	1	2	4	--	PCBs, Metals, TPH, SVOCs, BTEX
Green Hornet Area (Figure 9)	PEL-SB23 through PEL-SB29	NGW606	NGW101 through NGW106	--	8	16	4	--	TPH[4], SVOCs, BTEX; PCBs, VOCs (soil only)
NBF -- North Flightline									
Former Buildings 3-360 and 3-361 Area (Figure 11)	--	NGW607	--	--	1	2	4	--	VOCs
Building 3-380 Storm Drain Area:									
• Near Building 3-350 (Figure 11)	NFA-SB01, NFA-SB02	--	--	--	2	4	--	--	PCBs, Metals
• South end, north Markov area (Figure 12)	NFL-SB03, NFL-SB04	--	--	--	2	4	--	--	PCBs, TPH, SVOCs, VOCs
Building 7-27-1 Area (Figure 12)	--	--	NGW252, NGW253	--	--	--	--	--	PCBs, TPH, cVOCs
Building 3-380 Area (Figures 13 and 14)	--	NGW608, NGW609	--	--	2	4	8	--	PCBs, Metals, SVOCs
Buildings 3-369 and 3-374 Area (Figure 13)	--	--	GT88-1, DW-1-370	--	--	--	--	--	PCBs, Metals, TPH, SVOCs
Building 3-390 Area (Figure 14)	--	NGW610	--	--	1	2	4	--	PCBs, Metals, TPH, SVOCs, VOCs
Concourse A Area (Figures 7, 9, 14 and 15)	NFA-SB05 through NFA-SB09	NGW611, NGW612	--	--	7	14	8	--	PCBs, Metals, TPH[4], SVOCs, VOCs
NBF -- Central Flightline									
Building 3-801 Area:									
• Soil Borings, Vapor Point (Figures 18 and 19)	CFA-SB01, CFA-SB02	--	--	VP08	3	5	--	2	TPH[4], VOCs (2 borings); VOCs only (VP)
• Monitoring Well (Figure 19)	--	NGW613	--	--	1	2	4	--	Metals, VOCs, SVOCs (soil only)
Building 3-800 Area:									
• Vapor Point (Figures 18 and 19)	--	--	--	VP09	1	1	--	2	VOCs
• Monitoring Wells (Figure 18)	--	NGW614	NGW307, NGW309[5]	--	1	2	4	--	Metals, SVOCs, VOCs
Main Fuel Farm Area (Figure 20)	CFA-SB03, CFA-SB04, CFA-SB05	NGW615, NGW616, NGW617	NGW351 through NGW359	VP10	7	13	12	2	TPH[4], PAHs, BTEX; VOCs (vapor only)
Concourse B Area:									

Table 2
Summary of Proposed RI Phase I Activities for Soil, Groundwater, and Soil Vapor

Area of Concern	Individual Sampling Locations				Total Number of Boring Locations[1]	Number of Samples			Analyses
	Proposed Soil Borings for Soil Sampling	Proposed GW Monitoring Wells	Existing GW Monitoring Wells for RI Sampling	Proposed Soil Vapor Points		Minimum Number of Soil Samples[1]	Minimum Number of GW Samples[2]	Minimum Number of Soil Vapor Samples[3]	
● Near MH249 and MH461 (Figure 17)	--	NGW618, NGW619	--	--	2	4	8	--	PCBs, Metals, SVOCs, VOCs
● Near MH249 (Figure 17)	CFA-SB06	--	--	--	1	2	--	--	PCBs, Metals
Central Flightline Transformer Areas[6] (Figure 19)	CFA-SB07 through CFA-SB15	--	--	--	9	18	--	--	PCBs, Metals
NBF -- South Flightline									
Buildings 3-830, 3-831, and 3-832 Area (Figure 21)	--	NGW620	--	--	1	2	4	--	PCBs, TPH
Site-Wide Groundwater Investigation (monitoring wells not located within an AOC boundary)									
● Monitoring Wells (Figures 12, 17, 19, and 21)	--	NGW621 through NGW625	--	--	5	0 (TBD)	20	--	PCBs, Metals, TPH, SVOCs
Estimated Total Number of RI Locations/Samples:	**55**	**25**	**35[2]**	**10**	**90**	**160**	**100**	**20**	

-- = Not applicable
PCBs = polychlorinated biphenyls (aroclors)
TBD = To be determined
GW = Groundwater
SVOCs = semivolatile organic compounds
VOCs = volatile organic compounds
VP = Vapor point for soil vapor
BTEX = benzene, toluene, ethylbenzene, and xylenes
cVOCs = chlorinated volatile organic compounds (PCE, TCE, DCE isomers, and vinyl chloride)

1. Includes all borings for soil samples, for proposed monitoring wells, and for vapor points. Sample numbers represent minimum quantities, based on two samples per soil boring.
2. PLPs are currently sampling the RI proposed existing wells; therefore, Ecology will not sample these. Sample numbers represent minimum quantities for proposed (new) monitoring wells.
3. Soil vapor samples include two samples per vapor point.
4. Volatile and extractable petroleum hydrocarbon (VPH/EPH) fractions will be analyzed on one or more samples in areas with petroleum contamination, to be determined in the field. The following borings have been tentatively identified for VPH/EPH analyses: NGW603, PEL-SB10, PEL-SB11, VP05, PEL-SB24, PEL-SB25, NFA-SB08, CFA-SB01, CFA-SB02, CFA-SB03, and CFA-SB04.
5. Existing monitoring wells NGW307 and NGW309 are sampled semi-annually.
6. Substation Vault 94 is currently undergoing remediation by Boeing. The need for four proposed soil borings in this area will be determined upon review of confirmation sampling in the V-94 removal report.

Note: The sample numbers in this table apply to Phase I of the RI activities, which will likely be followed by an additional phase of RI activities, depending on the findings of Phase I.

Table 3
Summary of Proposed RI Sampling and Rationale for Storm Drain Solids

Sample Locations and Analyses			Rationale for Sampling Storm Drain Solids (Figure 2a)				
Storm Drain Structure To Be Sampled	Adjacent Buildings	Analyses[1]	Phase I, Part 1a	Phase I, Part 1b Elevated Levels in SDS Samples Collected Between 2004 and 2009		Phase I, Part 1c SD Structures Not Sampled Since 2004	
			Structures Potentially Affected by Recent Interim Actions	Near or Downgradient of AM Not Adequately Characterized	Near or Downgradient of AM Samples with Elevated Levels	Located on Lateral Line at Main Tributary	Near or Downgradient of AM Samples with Elevated Levels
Georgetown Steam Plant							
MH12	GTSP Powerhouse	PCBs, Metals, SVOCs, Dioxins/Furans				●[2]	
North Lateral Drainage Area							
CB147	3-368	PCBs, Metals, SVOCs, Dioxins/Furans	●				
CB159	3-626	PCBs, Metals, SVOCs	●				
CB173	3-323	PCBs, Metals, SVOCs	●[3]				
CB179	3-323	PCBs, Metals, SVOCs, Dioxins/Furans	●	●			
CB185	3-332	PCBs, Metals, SVOCs	●				
CB187A	3-322, 3-326	PCBs, Metals, SVOCs	●		●		
CB188A	3-326	PCBs, Metals, SVOCs	●				●
CB193	3-322	PCBs, Metals, SVOCs	●				
CB193A	3-322	PCBs, Metals, SVOCs	●				
D133C	3-315	PCBs, Metals, SVOCs	●				
MH112	3-350	PCBs, Metals, SVOCs				●	●
MH130	--	PCBs, Metals, SVOCs, Dioxins/Furans	●			●	
MH152	3-321	PCBs, Metals, SVOCs	●	●			
MH166A	3-331, 3-334	PCBs, Metals, SVOCs	●	●			
MH169	3-310	PCBs, Metals, SVOCs, Dioxins/Furans	●	●			
MH179A	3-323	PCBs, Metals, SVOCs	●	●			
MH179B	3-323	PCBs, Metals, SVOCs	●				
MH181A	3-323	PCBs, Metals, SVOCs, Dioxins/Furans	●[3]				
MH187	3-326	PCBs, Metals, SVOCs	●		●		
MH193	3-326	PCBs, Metals, SVOCs, Dioxins/Furans	●	●			
MH652	3-626	PCBs, Metals, SVOCs		●[3]			
OWS132	--	PCBs, Metals, SVOCs		●			
OWS137	3-368	PCBs, Metals, SVOCs		●			
OWS612-2	3-315	PCBs, Metals, SVOCs	●				
UNKCB23	3-315	PCBs, Metals, SVOCs					●

Table 3
Summary of Proposed RI Sampling and Rationale for Storm Drain Solids

Sample Locations and Analyses			Rationale for Sampling Storm Drain Solids (Figure 2a)				
Storm Drain Structure To Be Sampled	Adjacent Buildings	Analyses[1]	Phase I, Part 1a	Phase I, Part 1b Elevated Levels in SDS Samples Collected Between 2004 and 2009		Phase I, Part 1c SD Structures Not Sampled Since 2004	
			Structures Potentially Affected by Recent Interim Actions	Near or Downgradient of AM Not Adequately Characterized	Near or Downgradient of AM Samples with Elevated Levels	Located on Lateral Line at Main Tributary	Near or Downgradient of AM Samples with Elevated Levels
North-Central Lateral Drainage Area							
CB227C	--	PCBs, Metals, SVOCs					●
MH223	A-3	PCBs, Metals, SVOCs					●
MH228B	--	PCBs, Metals, SVOCs				●	
MH228D	--	PCBs, Metals, SVOCs		●			
MH247	--	PCBs, Metals, SVOCs, Dioxins/Furans		●			
MH248	--	PCBs, Metals, SVOCs					●
MH249	--	PCBs, Metals, SVOCs	●				
MH358	3-369	PCBs, Metals, SVOCs				●	
MH363A	--	PCBs, Metals, SVOCs				●	
OWS226A	--	PCBs, Metals, SVOCs		●			
South-Central Lateral Drainage Area							
CB373	3-390	PCBs, Metals, SVOCs				●	
MH361	3-369	PCBs, Metals, SVOCs				●	
MH410	3-800	PCBs, Metals, SVOCs				●	
MH864	--	PCBs, Metals, SVOCs				●	
South Lateral Drainage Area							
CB261	--	PCBs, Metals, SVOCs, Dioxins/Furans	●[3]	●[3]			
CB352	3-390	PCBs, Metals, SVOCs					●
CB384	3-369	PCBs, Metals, SVOCs		●			
MH263	3-818	PCBs, Metals, SVOCs				●	
MH271B	3-390/3-800	PCBs, Metals, SVOCs				●	
MH353	--	PCBs, Metals, SVOCs				●	
MH401	3-390	PCBs, Metals, SVOCs					●
MH481	--	PCBs, Metals, SVOCs				●	
MH482	--	PCBs, Metals, SVOCs		●			
OWS1-C	3-374	PCBs, Metals, SVOCs		●			
OWS483B/C	--	PCBs, Metals, SVOCs		●			
OWS483E/D	--	PCBs, Metals, SVOCs, Dioxins/Furans	●	●			

Table 3
Summary of Proposed RI Sampling and Rationale for Storm Drain Solids

Sample Locations and Analyses			Rationale for Sampling Storm Drain Solids (Figure 2a)				
			Phase I, Part 1a	Phase I, Part 1b Elevated Levels in SDS Samples Collected Between 2004 and 2009		Phase I, Part 1c SD Structures Not Sampled Since 2004	
Storm Drain Structure To Be Sampled	Adjacent Buildings	Analyses[1]	Structures Potentially Affected by Recent Interim Actions	Near or Downgradient of AM Not Adequately Characterized	Near or Downgradient of AM Samples with Elevated Levels	Located on Lateral Line at Main Tributary	Near or Downgradient of AM Samples with Elevated Levels
Building 3-380 Drainage Area							
No storm drain solids sampling proposed							
Parking Lot Drainage Area							
CB433	--	PCBs, Metals, SVOCs				●	
All Areas for NBF-GTSP Site							
Total number of structures to be sampled:		*53*					
PCBs, metals, and SVOCs analyses:		*53*					
Dioxins/furans analyses:		*10*					

AM = Anthropogenic media

1. Analyses for dioxins/furans, and possibly other analytes, to be confirmed in the field based on available sampleable material at each location.
2. First SD structure downstream of Powerhouse roof drains (but not at a tributary) is to be sampled.
3. SD structures CB173, CB261, MH181A, and MH652 are included for SD solids sampling due to significantly elevated levels of PCBs or mercury during 2012 sampling. If volumes of SD solids are limited, alternative sampling locations will be identified at downstream or adjacent structures: for CB173 → MH172 or MH170; for CB261 → MH842 or MH844; for MH181A → MH181; for MH652 → MH651.

Notes:
- SVOCs include PAHs, phthalates, and phenols.
- RI samples of SD solids will be collected from the SD structure listed or from adjacent/downstream structures, depending on field determination of drainage direction and the availability of sampleable SD solids.
- The total number of proposed samples excludes field duplicates, which will be collected at an approximate rate of 1 in 20 samples (5%).

Table 4
Summary of Proposed RI Sampling and Rationale for Surface Debris

Sample Locations and Analyses			Rationale for Sampling Surface Debris (Figure 2a)			
			Phase I, Part 2a Surface Debris Near SD Structures		Phase I, Part 2b[2] Surface Debris Near Buildings[3]	
Drainage Area (SD polygons and surrounding areas)	**Adjacent Buildings**	**Analyses[1]**	**Elevated Levels in SDS Samples, Surface Debris Not Adequately Characterized**	**No SDS Samples, Nearby AM Samples with Elevated Levels**	**Building[3] is Near SDS Samples with Elevated Levels, Surface Debris Not Adequately Characterized**	**AM Samples from Building[3] have Elevated Levels or Not Adequately Characterized, No SDS Samples**
Georgetown Steam Plant						
No proposed samples						
North Lateral Drainage Area						
CB136	--	PCBs, Metals	●			
CB141	3-315	PCBs, Metals	●			
CB142B	3-353	PCBs, Metals	●			
CB147	3-368	PCBs, Metals, Dioxins/Furans	●			
CB159	3-626	PCBs, Metals, Dioxins/Furans	●			
CB173	3-323	PCBs, Metals, Dioxins/Furans	●			
CB174B	3-323	PCBs, Metals		●		
CB175	3-323	PCBs, Metals	●			
CB185	3-332	PCBs, Metals	●			
CB188A	3-326	PCBs, Metals		●		
CB192	3-322	PCBs, Metals	●			
CB193	3-322	PCBs, Metals, SVOCs, Dioxins/Furans	●			
CB193A	3-322	PCBs, Metals	●			
CB194	3-322	PCBs, Metals	●			
CB363	3-380	PCBs, Metals, SVOCs	●			
D153B	3-333	PCBs, Metals, SVOCs	●			
D153C	3-310	PCBs, Metals	●			
MH112	--	PCBs, Metals, SVOCs		●		
MH130	--	PCBs, Metals, Dioxins/Furans	●			
MH133D	3-341	PCBs, Metals, SVOCs	●			
MH138	3-626	PCBs, Metals, SVOCs	●			
MH152	3-626	PCBs, Metals, SVOCs	●			
MH166A	3-323/3-331/3-334	PCBs, Metals, Dioxins/Furans	●			
MH169	3-310	PCBs, Metals, Dioxins/Furans	●			

Table 4
Summary of Proposed RI Sampling and Rationale for Surface Debris

Sample Locations and Analyses			Rationale for Sampling Surface Debris (Figure 2a)			
Drainage Area (SD polygons and surrounding areas)	**Adjacent Buildings**	**Analyses[1]**	**Phase I, Part 2a Surface Debris Near SD Structures**		**Phase I, Part 2b[2] Surface Debris Near Buildings[3]**	
			Elevated Levels in SDS Samples, Surface Debris Not Adequately Characterized	**No SDS Samples, Nearby AM Samples with Elevated Levels**	**Building[3] is Near SDS Samples with Elevated Levels, Surface Debris Not Adequately Characterized**	**AM Samples from Building[3] have Elevated Levels or Not Adequately Characterized, No SDS Samples**
MH172	3-323	PCBs, Metals, SVOCs	●			
MH179B	3-323	PCBs, Metals	●			
MH181A	3-323/3-334	PCBs, Metals, SVOCs	●			
MH193	--	PCBs, Metals, Dioxins/Furans	●			
MH651	3-626	PCBs, Metals	●			
MH652	3-626	PCBs, Metals	●			
OWS132	--	PCBs, Metals	●			
OWS137	Wind Tunnel	PCBs, Metals	●			
UNKCB23	3-315	PCBs, Metals		●		
Tank Area of Building 3-310	3-310	(2) PCBs, Metals			●-2	
Building 3-323	--	(4) PCBs, Metals, SVOCs			●-4	
Tank Area of Building 3-323	3-323	(2) PCBs, Metals			●-2	
Northern half of Building 3-326	--	(2) PCBs, Metals, SVOCs				●-2
Building 3-368	--	PCBs, Metals, SVOCs	●		●-1	
Building 3-626	--	(4) PCBs, Metals; (1) Dioxins/Furans			●-4	
North-Central Lateral Drainage Area						
CB227C	--	PCBs, Metals		●		
CB229A	--	PCBs, Metals, SVOCs	●			
CB364A	--	PCBs, Metals	●			
MH221A	--	PCBs, Metals, SVOCs	●			
MH223	--	PCBs, Metals		●		
MH226	--	PCBs, Metals, SVOCs	●			
MH228	--	PCBs, Metals		●		
MH228D	--	PCBs, Metals	●			
MH247	--	PCBs, Metals, Dioxins/Furans	●			
MH248	--	PCBs, Metals		●		
MH249	--	PCBs, Metals	●			
MH362	3-380	PCBs, Metals, SVOCs	●			

Table 4
Summary of Proposed RI Sampling and Rationale for Surface Debris

Sample Locations and Analyses			Rationale for Sampling Surface Debris (Figure 2a)			
			Phase I, Part 2a Surface Debris Near SD Structures		Phase I, Part 2b[2] Surface Debris Near Buildings[3]	
Drainage Area (SD polygons and surrounding areas)	**Adjacent Buildings**	**Analyses[1]**	**Elevated Levels in SDS Samples, Surface Debris Not Adequately Characterized**	**No SDS Samples, Nearby AM Samples with Elevated Levels**	**Building[3] is Near SDS Samples with Elevated Levels, Surface Debris Not Adequately Characterized**	**AM Samples from Building[3] have Elevated Levels or Not Adequately Characterized, No SDS Samples**
OWS226A	--	PCBs, Metals	●			
Blast Fence near CB224, CB225	--	(2) PCBs, Metals; (1) SVOCs, Dioxins/Furans	●		●-2	
South-Central Lateral Drainage Area						
MH471	--	PCBs, Metals, Dioxins/Furans	●			
Building 3-390 (NW side, S of Boiler Room)	--	PCBs, Metals, SVOCs		●		
Building 3-390 (NW side, N of Boiler Room)	--	PCBs, Metals				●-1
South Lateral Drainage Area						
CB261	--	PCBs, Metals, SVOCs, Dioxins/Furans	●			
CB384	3-369	PCBs, Metals, Dioxins/Furans	●			
MH356	3-369	PCBs, Metals, SVOCs	●			
MH401	3-390	PCBs, Metals		●		
MH482	--	PCBs, Metals, SVOCs	●			
OWS1-C	3-374	PCBs, Metals	●			
OWS443B/446B	--	PCBs, Metals		●		
OWS483B/C, E/D	--	PCBs, Metals, SVOCs Dioxins/Furans	●			
Buildings 3-369, 3-374	3-370, 3-390	(4) PCBs, Metals; (2) SVOCs			●-4	
Building 3-390 (S side)	--	(3) PCBs, Metals				●-3
Building 3-397	--	(2) PCBs, Metals				●-2
Building 3-825	--	(4) PCBs, Metals; (1) SVOCs				●-4
Building 8-834	3-811	(4) PCBs, Metals				●-4

Table 4
Summary of Proposed RI Sampling and Rationale for Surface Debris

Sample Locations and Analyses			Rationale for Sampling Surface Debris (Figure 2a)			
Drainage Area (SD polygons and surrounding areas)	**Adjacent Buildings**	**Analyses[1]**	**Phase I, Part 2a Surface Debris Near SD Structures**		**Phase I, Part 2b[2] Surface Debris Near Buildings[3]**	
			Elevated Levels in SDS Samples, Surface Debris Not Adequately Characterized	**No SDS Samples, Nearby AM Samples with Elevated Levels**	**Building[3] is Near SDS Samples with Elevated Levels, Surface Debris Not Adequately Characterized**	**AM Samples from Building[3] have Elevated Levels or Not Adequately Characterized, No SDS Samples**
Building 3-380 Drainage Area and Parking Lot Drainage Area						
No proposed samples						
All Areas for NBF-GTSP Site						
Approximate total number of samples:		*91*				
PCBs and metals analyses:		*91*				
SVOCs analyses:		*29*				
Dioxins/furans analyses:		*15*				

AM = Anthropogenic media (paint, caulk, surface debris, CJM, pavement, other building materials)
SDS = Storm drain solids
SVOCs include PAHs, phthalates, and phenols

1. Analyses for preliminary selected locations to be confirmed in the field based on available sampleable material.
2. The number of proposed surface debris samples per building or structure area is indicated after each bullet in Part 2b. More than one sample may be needed to spatially cover large buildings or multiple structures.
3. Buildings considered were constructed or renovated during or before 1985.

The data set for storm drain solids includes results from 2004 to 2012.

Notes:
- Samples will be collected from the SD polygon area listed and possibly also from the surrounding areas, depending on field determination of drainage direction.
- The total number of proposed samples excludes field duplicates, which will be collected at a rate of approximately 1 in 20 samples (5%).

Table 5
Analytical Methods, Sample Container, Minimum Sample Volume, Preservation, and Holding Time Requirements

Chemical Class	Analytical Method	Minimum Sample Volume[1]	Sample Container	Preservation	Holding Time
Solid Samples (soil, storm drain solids, surface debris, anthropogenic media)					
Dioxins/Furans	EPA 1613B	10 g dry	8-oz amber glass widemouth with Teflon-lined lid	Cool (0-6°C)/ Freeze (-20°C)	1 year to extract, 40 days to analyze
PCB Aroclors[4]	EPA 8082	5 g dry	8-oz glass widemouth with Teflon-lined lid	Cool (0-6°C)	14 days to extract, 40 days to analyze (1 year to extract if frozen)
SVOCs (including phthalates and PAHs)	EPA 8270D or EPA 8270D-SIM	10 g dry			
VOCs, TPH-gasoline range	EPA 8260C, or NWTPH-Gx	20 g wet	(4) 40-mL VOA vials with Teflon septa	Sodium bisulfate (low conc.) or methanol (high conc.), Cool (0-6°C)	14 days
TPH-diesel/oil range	NWTPH-Dx (extended)	10 g dry	4-oz glass widemouth with Teflon-lined lid	Cool (0-6°C)	14 days to extract, 40 days to analyze
TPH fractions	VPH	10 g wet	(2) 40-mL amber VOA vials with Teflon septa	Methanol, Cool (0-6°C)	14 days
TPH fractions	EPH	10 g dry	4-oz glass widemouth with Teflon-lined lid	Cool (0-6°C)	14 days to extract, 40 days to analyze
Metals, total (excluding mercury)	EPA 6010C/200.7	5 g dry for metals (15 g wet)	4-oz glass widemouth with Teflon-lined lid	Cool (0-6°C)	6 months (2 years if frozen)
Mercury	EPA 7471A				28 days (6 months if frozen)
Total organic carbon	PSEP (1986)				14 days (6 months if frozen)
Total solids	EPA 160.3	10 g wet			
Grain size	PSEP (1986)	40 g wet	16-oz glass widemouth with Teflon-lined lid	Cool (0-6°C)	6 months
Aqueous Samples (groundwater, rinse blank and trip blank samples)					
Dioxins/Furans	EPA 1613B	1 L	(2) 1-L glass amber bottles	Cool (0-6°C)	1 year to extract, 40 days to analyze
PCB Aroclors[4]	Modified EPA 8082	1 L	(2) 1-L glass amber bottles	Cool (0-6°C)	7 days to extract, 40 days to analyze
SVOCs (including phthalates and PAHs)	EPA 8270D or EPA 8270D-SIM	1 L	(4) 0.5-L glass amber bottles	Cool (0-6°C)	7 days to extract, 40 days to analyze
VOCs, TPH-gasoline range	EPA 8260C, or NWTPH-Gx	40 mL	(3) 40-mL VOA vials with Teflon septa	HCl, Cool (0-6°C)	14 days (pres.) 7 days (unpres.)
TPH-diesel/oil range	NWTPH-Dx (extended)	500 mL	(2) 0.5-L glass amber bottles	Cool (0-6°C)	7 days to extract, 40 days to analyze
Metals, total or filtered (including mercury)	EPA 6020A/200.8/7470A	150 mL	0.5-L HDPE bottle	Nitric acid	28 days for mercury, 6 months for other metals
Total Dissolved Solids	SM2540C	500 mL	1-L HDPE bottle	Cool (0-6°C)	7 days

Table 5
Analytical Methods, Sample Container, Minimum Sample Volume, Preservation, and Holding Time Requirements

Chemical Class	Analytical Method	Minimum Sample Volume[1]	Sample Container	Preservation	Holding Time
Vapor Samples (soil vapor)					
VOCs	EPA TO-15	1 L	1-L Summa canister	Ambient	30 days
Atmospheric gases	Modified ASTM D-1946	1 L	1-L Summa canister	Ambient	30 days
Waste Disposal Characterization Samples (soil and water)					
TCLP metals (soil and water)[2]	EPA 1311	Varies	Widemouth glass jar	Cool (0-6°C)	28 days
Flash point (water only)	ASTM D-93 PMCC	100 mL	500-mL HDPE bottle	Cool (0-6°C)	None
pH[3] (water only)	9040C/4500 H+B/9045D	500 mL	500-mL HDPE bottle	--	Immediate upon receipt in laboratory

ASTM = American Society for Testing and Materials
conc. = concentration
EPH = Extractable Petroleum Hydrocarbons
HDPE = high-density polyethylene
NWTPH = Northwest Total Petroleum Hydrocarbons
PMCC = Pensky-Martens Closed Cup
pres. = preserved
PSEP = Puget Sound Estuary Program
SIM = selected ion monitoring
unpres. = unpreserved
VOA = volatile organic analyses
VPH = Volatile Petroleum Hydrocarbons

1. Anthropogenic materials may require larger volumes.
2. TCLP metals for water is performed on solids when water has >0.5% solids; otherwise total metals applies.
3. Each drum of waste water produced will be measured for pH in the field. Laboratory measurements of pH will be made in corresponding disposal samples for cases where field pH is 12 or greater.
4. Method 8082 for PCB Aroclor analysis does not specify any holding times for sample extraction of solids or waters.

Table 6
Laboratory QA/QC Sample Requirements

Analysis	Initial Calibration	CCV	LCS/OPR and Method Blank	Lab Duplicate	MS/MSD	Surrogates/ Labeled Compounds	Accuracy and Precision Control Limits[1]
Dioxins/Furans	Prior to analysis	Start of batch, every 12 hours	One per prep batch (max 20 samples per batch)	--	--	Every sample	Laboratory limits
PCB Aroclors		Start of batch, every 12 hours and end of batch			MS/MSD at rate of 5% of samples per matrix		
SVOCs and selected SVOCs by SIM		Start of 12-hour batch					
VOCs							
Metals (including mercury)	Daily, prior to analysis	Start of batch, every 10 samples and end of batch		One per prep batch (max 20 samples per batch)	One per prep batch (max 20 samples per batch)	--	
NWTPH-Dx and NWTPH-Gx	Prior to analysis	Start of batch and end of batch		--	MS/MSD at rate of 5% of samples per matrix[2]	Every sample	
TPH fractions (VPH)		Start of batch and every 10 samples					
TPH fractions (EPH)							
Total Organic Carbon		Start of batch, every 10 samples and end of batch		One per prep batch (max 20 samples per batch)	One MS per prep batch (max 20 samples per batch)	--	
Total Solids	--	--	--		--		
Grain Size							
Total Dissolved Solids			One per prep batch (max 20 samples per batch)				
Atmospheric Gases	Prior to analysis	Start of batch	One per prep batch (max 20 samples per batch)	One at rate of 5% of samples			

CCV = continuing calibration verification
LCS = laboratory control sample; an ongoing precision and recovery (OPR) sample may be substituted for an LCS for analysis of dioxins/furans
MS/MSD = matrix spike / matrix spike duplicate
-- = not applicable

Note:
1. The current laboratory control limits at the time of analysis will be used to evaluate precision and accuracy. Laboratory limits for precision will also be used to evaluate field duplicate precision. Control limits will be provided in the laboratory data packages.
2. Laboratory may also analyze MS and laboratory duplicate in lieu of MS/MSD.

Appendix A

Target Analytes, Laboratory Methods, and Analytical Limits

Appendix Table A-1
Target Analytes, Laboratory Methods, and Analytical Limits

Analyte	Soil							Groundwater							Soil Vapor						
	Analytical Method	MDL	LOD	LOQ	LCS	RPD	RISL	Analytical Method	MDL	LOD	LOQ	LCS	RPD	RISL	Analytical Method	MDL	LOD	LOQ*	LCS	RPD	VISL
		(mg/kg)			(%)		(mg/kg)		(ug/L)			(%)		(ug/L)		(ug/m^3)			(%)		(ug/m^3)
Polychlorinated Aromatic Compounds																					
PCB Aroclors																					
Aroclor 1016	EPA 8082A/3546	0.011	0.017	0.033	62 - 111	≤ 40	0.033	EPA 8082A/3510C	0.003	0.005	0.01	44 - 117	≤ 40	0.44	Not analyzed for in soil vapor samples						
Aroclor 1221	EPA 8082A/3546	0.011	0.017	0.033	--	--	0.14	EPA 8082A/3510C	0.003	0.005	0.01	--	--	--							
Aroclor 1232	EPA 8082A/3546	0.011	0.017	0.033	--	--	0.14	EPA 8082A/3510C	0.003	0.005	0.01	--	--	--							
Aroclor 1242	EPA 8082A/3546	0.011	0.017	0.033	--	--	0.033	EPA 8082A/3510C	0.003	0.005	0.01	--	--	--							
Aroclor 1248	EPA 8082A/3546	0.014	0.017	0.033	--	--	0.033	EPA 8082A/3510C	0.003	0.005	0.01	--	--	--							
Aroclor 1254	EPA 8082A/3546	0.014	0.017	0.033	--	--	0.033	EPA 8082A/3510C	0.003	0.005	0.01	--	--	0.044							
Aroclor 1260	EPA 8082A/3546	0.014	0.017	0.033	59 - 118	≤ 40	0.033	EPA 8082A/3510C	0.003	0.005	0.01	46 - 131	≤ 40	0.044							
Aroclor 1262	EPA 8082A/3546	0.014	0.017	0.033	--	--	--	EPA 8082A/3510C	0.003	0.005	0.01	--	--	--							
Aroclor 1268	EPA 8082A/3546	0.014	0.017	0.033	--	--	--	EPA 8082A/3510C	0.003	0.005	0.01	--	--	--							
Total PCBs	EPA 8082A/3546	--	--	**0.033**	--	--	**0.033**	EPA 8082A/3510C	--	--	**0.01**	--	--	**0.044**							
Dioxins/Furans (ng/kg) #																					
2,3,7,8-TCDF	EPA 1613B	0.24	0.50	1.0	75 - 158	≤ 25	--	Not analyzed for in groundwater samples							Not analyzed for in soil vapor samples						
2,3,7,8-TCDD	EPA 1613B	0.17	0.50	1.0	67 - 158	≤ 25	11														
1,2,3,7,8-PeCDF	EPA 1613B	0.52	1.25	2.5	80 - 134	≤ 25	--														
2,3,4,7,8-PeCDF	EPA 1613B	0.67	1.0	1.0	68 - 160	≤ 25	--														
1,2,3,7,8-PeCDD	EPA 1613B	0.38	1.0	1.0	70 - 142	≤ 25	--														
1,2,3,4,7,8-HxCDF	EPA 1613B	0.71	1.25	2.5	72 - 134	≤ 25	--														
1,2,3,6,7,8-HxCDF	EPA 1613B	0.27	1.25	2.5	84 - 130	≤ 25	--														
2,3,4,6,7,8-HxCDF	EPA 1613B	0.70	1.25	2.5	70 - 156	≤ 25	--														
1,2,3,7,8,9-HxCDF	EPA 1613B	0.89	1.25	2.5	78 - 130	≤ 25	--														
1,2,3,4,7,8-HxCDD	EPA 1613B	0.77	1.25	2.5	70 - 164	≤ 25	--														
1,2,3,6,7,8-HxCDD	EPA 1613B	0.66	1.25	2.5	76 - 134	≤ 25	--														
1,2,3,7,8,9-HxCDD	EPA 1613B	0.48	1.25	2.5	64 - 162	≤ 25	--														
1,2,3,4,6,7,8-HpCDF	EPA 1613B	1.11	1.25	2.5	82 - 122	≤ 25	--														
1,2,3,4,7,8,9-HpCDF	EPA 1613B	0.88	1.25	2.5	78 - 138	≤ 25	--														
1,2,3,4,6,7,8-HpCDD	EPA 1613B	0.75	1.25	2.5	70 - 140	≤ 25	--														
OCDF	EPA 1613B	1.52	2.5	5.0	63 - 170	≤ 25	--														
OCDD	EPA 1613B	1.73	2.5	5.0	78 - 144	≤ 25	--														
Total Dioxins/Furans (TEQ, ng/kg)#	EPA 1613B	--	--	**4.0**	--	--	**11**														
Metals																					
Aluminum	EPA 6010C/200.7	0.76	5	5	80 - 120	≤ 20	5.0	EPA 6020A/200.8	**1.6**	**10**	**20**	**80 - 120**	**≤ 20**	**16,000**	Not analyzed for in soil vapor samples						
Antimony	EPA 6010C/200.7	0.63	5	5	80 - 120	≤ 20	5.0	EPA 6020A/200.8	**0.011**	**0.1**	**0.2**	**80 - 120**	**≤ 20**	**6.0**							
Arsenic	EPA 6010C/200.7	**0.33**	**5**	**5**	**80 - 120**	**≤ 20**	**7.0**	EPA 6020A/200.8	**0.092**	**0.25**	**0.5**	**80 - 120**	**≤ 20**	**5.0**							
Barium	EPA 6010C/200.7	**0.13**	**0.3**	**0.3**	**80 - 120**	**≤ 20**	**83**	EPA 6020A/200.8	**0.020**	**0.25**	**0.5**	**80 - 120**	**≤ 20**	**2,000**							
Beryllium	EPA 6010C/200.7	0.016	0.1	0.1	80 - 120	≤ 20	3.2	EPA 6020A/200.8	**0.021**	**0.1**	**0.2**	**80 - 120**	**≤ 20**	**4.0**							
Cadmium	EPA 6010C/200.7	**0.018**	**0.2**	**0.2**	**80 - 120**	**≤ 20**	**1.0**	EPA 6020A/200.8	**0.010**	**0.05**	**0.1**	**80 - 120**	**≤ 20**	**2.6**							
Chromium	EPA 6010C/200.7	**0.12**	**0.5**	**0.5**	**80 - 120**	**≤ 20**	**120**	EPA 6020A/200.8	**0.045**	**0.25**	**0.5**	**80 - 120**	**≤ 20**	**100**							
Cobalt	EPA 6010C/200.7	0.027	0.3	0.3	80 - 120	≤ 20	23	EPA 6020A/200.8	0.011	0.1	0.2	80 - 120	≤ 20	--							
Copper ^	EPA 6010C/200.7	**0.092**	**0.2**	**0.2**	**80 - 120**	**≤ 20**	**36**	EPA 6020A/200.8	**0.24**	**0.25**	**0.5**	**80 - 120**	**≤ 20**	**120**							
Iron	EPA 6010C/200.7	0.75	5	5	80 - 120	≤ 20	5.0	EPA 6020A/200.8	**3.9**	**10**	**20**	**80 - 120**	**≤ 20**	**11,000**							
Lead	EPA 6010C/200.7	**0.16**	**2**	**2**	**80 - 120**	**≤ 20**	**57**	EPA 6020A/200.8	**0.046**	**0.05**	**0.1**	**80 - 120**	**≤ 20**	**11**							
Manganese	EPA 6010C/200.7	0.028	0.1	0.1	80 - 120	≤ 20	0.10	EPA 6020A/200.8	**0.022**	**0.25**	**0.5**	**80 - 120**	**≤ 20**	**2,200**							
Mercury	EPA 7471B or 245.5	**0.002**	**0.0125**	**0.025**	**75 - 125**	≤ 20	**0.070**	EPA 7470 or 245.1 (Low)	**0.003**	**0.01**	**0.02**	**75 - 125**	≤ 20	**0.020**							
Molybdenum	EPA 6010C/200.7	0.079	0.5	0.5	80 - 120	≤ 20	400	EPA 6020A/200.8	0.013	0.1	0.2	80 - 120	≤ 20	--							
Nickel	EPA 6010C/200.7	**0.39**	**1**	**1**	**80 - 120**	**≤ 20**	**38**	EPA 6020A/200.8	**0.079**	**0.25**	**0.5**	**80 - 120**	**≤ 20**	**100**							
Selenium	EPA 6010C/200.7	0.50	5	5	80 - 120	≤ 20	5.0	EPA 6020A/200.8	**0.13**	**0.25**	**0.5**	**80 - 120**	**≤ 20**	**50**							
Silver ^	EPA 6010C/200.7	**0.043**	**0.3**	**0.3**	**80 - 120**	**≤ 20**	**0.30**	EPA 6020A/200.8	**0.008**	**0.1**	**0.2**	**80 - 120**	**≤ 20**	**1.5**							
Thallium	EPA 6010C/200.7	0.31	5	5	80 - 120	≤ 20	5.0	EPA 6020A/200.8	**0.004**	**0.1**	**0.2**	**80 - 120**	**≤ 20**	**0.50**							
Tin	EPA 6010C/200.7	0.14	1	1	80 - 120	≤ 20	48,000	EPA 6010C/200.7	1.4	5	10	80 - 120	≤ 20	9,600							
Vanadium	EPA 6010C/200.7	0.027	0.3	0.3	80 - 120	≤ 20	--	EPA 6020A/200.8	**0.043**	**0.1**	**0.2**	**80 - 120**	**≤ 20**	**3.0**							
Zinc	EPA 6010C/200.7	**0.14**	**1**	**1**	**80 - 120**	**≤ 20**	**86**	EPA 6020A/200.8	**0.052**	**2**	**4**	**80 - 120**	**≤ 20**	**33**							
Petroleum Hydrocarbons																					
Gasoline Range Hydrocarbons	NWTPH-Gx	**1.7**	**2.5**	**5.0**	**80 - 120**	**≤ 30**	**30/100**	NWTPH-Gx	**57**	**130**	**250**	**80 - 120**	**≤ 30**	**800/1,000**	Not analyzed for in soil vapor samples						
Diesel Range Hydrocarbons	NWTPH-Dx	**1.4**	**2.5**	**5.0**	**62 - 119**	**≤ 30**	**2,000**	NWTPH-Dx	**22**	**50**	**100**	**61 - 120**	**≤ 30**	**500**							
Oil Range Hydrocarbons	NWTPH-Dx	**2.5**	--	**10**	--	--	**2,000**	NWTPH-Dx	44	100	200	--	≤ 30	500							
n-Hexane	VPH	0.45	--	0.45	--	--	--	VPH	5.0	--	5.0	--	--	--							

Appendix Table A-1
Target Analytes, Laboratory Methods, and Analytical Limits

Analyte	Soil							Groundwater							Soil Vapor						
	Analytical Method	MDL	LOD	LOQ	LCS	RPD	RISL	Analytical Method	MDL	LOD	LOQ	LCS	RPD	RISL	Analytical Method	MDL	LOD	LOQ*	LCS	RPD	VISL
		(mg/kg)			(%)		(mg/kg)		(ug/L)			(%)		(ug/L)		(ug/m^3)			(%)		(ug/m^3)
Semivolatile Organic Compounds																					
Phenols																					
2-Chlorophenol	EPA 8270D/3546	0.0065	0.01	0.02	34 - 120	≤ 30	400	EPA 8270D/3520C	0.22	0.5	1	48 - 120	≤ 30	--	Not analyzed for in soil vapor samples						
4-Chloro-3-methylphenol	EPA 8270D/3546	0.029	0.05	0.1	32 - 120	≤ 30	--	EPA 8270D/3520C	1.1	1.5	3	59 - 120	≤ 30	--							
2,4-Dichlorophenol	EPA 8270D/3546	0.032	0.05	0.1	28 - 120	≤ 30	240	EPA 8270D/3520C	1.1	1.5	3	54 - 120	≤ 30	24							
2,4-Dimethylphenol	EPA 8270D/3546	0.027	0.05	0.1	10 - 120	≤ 30	1,600	EPA 8270D/3520C	1.1	1.5	3	37 - 120	≤ 30	3.0							
4,6-Dinitro-2-methylphenol	EPA 8270D/3546	0.051	0.1	0.2	24 - 120	≤ 30	--	EPA 8270D/3520C	3.6	5	10	40 - 131	≤ 30	--							
2,4-Dinitrophenol	EPA 8270D/3546	0.041	0.1	0.2	10 - 120	≤ 30	160	EPA 8270D/3520C	3.4	10	20	40 - 120	≤ 30	--	Not analyzed for in soil vapor samples						
o-Cresol (2-Methylphenol)	EPA 8270D/3546	0.0078	0.01	0.02	28 - 120	≤ 30	4,000	EPA 8270D/3520C	0.21	0.5	1	44 - 120	≤ 30	400							
p-Cresol (4-Methylphenol)	EPA 8270D/3546	0.015	0.015	0.02	29 - 120	≤ 30	400	EPA 8270D/3520C	0.47	1	2	48 - 120	≤ 30	40							
2-Nitrophenol	EPA 8270D/3546	0.0069	0.01	0.02	30 - 120	≤ 30	--	EPA 8270D/3520C	0.26	1.5	3	37 - 120	≤ 30	--							
4-Nitrophenol	EPA 8270D/3546	0.044	0.05	0.1	35 - 127	≤ 30	--	EPA 8270D/3520C	1.8	5	10	44 - 129	≤ 30	--							
Pentachlorophenol	EPA 8270D/3546	0.031	0.05	0.1	16 - 120	≤ 30	2.5	EPA 8270D/3520C	1.9	5	10	40 - 131	≤ 30	10							
Phenol	EPA 8270D/3546	0.0082	0.01	0.02	34 - 120	≤ 30	24,000	EPA 8270D/3520C	0.27	0.5	1	48 - 120	≤ 30	78							
2,4,5-Trichlorophenol	EPA 8270D/3546	0.027	0.05	0.1	28 - 120	≤ 30	8,000	EPA 8270D/3520C	1.1	2.5	5	58 - 120	≤ 30	800							
2,4,6-Trichlorophenol	EPA 8270D/3546	0.025	0.05	0.1	30 - 120	≤ 30	80	EPA 8270D/3520C	1.0	1.5	3	53 - 120	≤ 30	5.0							
Phthalates																					
Bis(2-ethylhexyl) phthalate	EPA 8270D/3546	**0.029**	**0.04**	**0.05**	**34 - 130**	**≤ 30**	**0.067**	EPA 8270D/3520C	**2.1**	**3**	**3**	**58 - 120**	**≤ 30**	**3.0**	Not analyzed for in soil vapor samples						
Butyl benzyl phthalate	EPA 8270D/3546	0.0080	0.01	0.02	45 - 132	≤ 30	530	EPA 8270D/3520C	0.30	0.5	1	54 - 120	≤ 30	1.0							
Dibutyl phthalate	EPA 8270D/3546	0.0053	0.01	0.02	48 - 126	≤ 30	8,000	EPA 8270D/3520C	0.29	0.5	1	65 - 120	≤ 30	1,600							
Diethyl phthalate	EPA 8270D/3546	0.0177	0.02	0.02	55 - 120	≤ 30	64,000	EPA 8270D/3520C	0.27	0.5	1	60 - 120	≤ 30	13,000							
Dimethyl phthalate	EPA 8270D/3546	0.0064	0.01	0.02	43 - 120	≤ 30	--	EPA 8270D/3520C	0.26	0.5	1	61 - 120	≤ 30	140							
Di-n-octyl phthalate	EPA 8270D/3546	0.0087	0.01	0.02	28 - 124	≤ 30	0.067	EPA 8270D/3520C	0.27	0.5	1	62 - 120	≤ 30	1.0							
Polycyclic Aromatic Hydrocarbons																					
Acenaphthene	EPA 8270D-SIM/3546	0.0015	0.0025	0.005	35 - 120	≤ 30	4,800	EPA 8270D-SIM/3510C	0.0031	0.005	0.01	41 - 120	≤ 30	2.6	--	--	--	--	--	--	--
Acenaphthylene	EPA 8270D-SIM/3546	0.0016	0.0025	0.005	39 - 120	≤ 30	--	EPA 8270D-SIM/3510C	0.0032	0.005	0.01	41 - 120	≤ 30	11	--	--	--	--	--	--	--
Anthracene	EPA 8270D-SIM/3546	0.0018	0.0025	0.005	36 - 120	≤ 30	24,000	EPA 8270D-SIM/3510C	0.0025	0.005	0.01	40 - 120	≤ 30	11	--	--	--	--	--	--	--
Benzo(a)anthracene	EPA 8270D-SIM/3546	**0.0022**	**0.0025**	**0.005**	**42 - 120**	**≤ 30**	**1.4**	EPA 8270D-SIM/3510C	0.0035	0.005	0.01	42 - 120	≤ 30	0.12	--	--	--	--	--	--	--
Benzo(b)fluoranthene	EPA 8270D-SIM/3546	**0.0021**	**0.0025**	**0.005**	**35 - 127**	**≤ 30**	**1.4**	EPA 8270D-SIM/3510C	0.0036	0.005	0.02	44 - 120	≤ 30	0.12	--	--	--	--	--	--	--
Benzo(k)fluoranthene	EPA 8270D-SIM/3546	**0.0023**	**0.0025**	**0.005**	**37 - 129**	**≤ 30**	**14**	EPA 8270D-SIM/3510C	0.0035	0.005	0.02	50 - 120	≤ 30	0.29	--	--	--	--	--	--	--
Total Benzofluoranthenes	EPA 8270D-SIM/3546	**0.0023**	**0.0025**	**0.005**	**35 - 127**	**≤ 30**	**--**	EPA 8270D-SIM/3510C	0.0099	0.005	0.02	50 - 120	≤ 30	--	--	--	--	--	--	--	--
Benzo(a)pyrene	EPA 8270D-SIM/3546	**0.0024**	**0.0025**	**0.005**	**36 - 120**	**≤ 30**	**0.0094**	EPA 8270D-SIM/3510C	0.0024	0.005	0.01	35 - 120	≤ 30	0.012	--	--	--	--	--	--	--
Benzo(g,h,i)perylene	EPA 8270D-SIM/3546	**0.0028**	**0.0040**	**0.005**	**38 - 120**	**≤ 30**	**0.031**	EPA 8270D-SIM/3510C	0.0031	0.005	0.01	38 - 120	≤ 30	0.012	--	--	--	--	--	--	--
Chrysene	EPA 8270D-SIM/3546	**0.0019**	**0.0025**	**0.005**	**48 - 120**	**≤ 30**	**140**	EPA 8270D-SIM/3510C	0.0031	0.005	0.01	44 - 120	≤ 30	0.47	--	--	--	--	--	--	--
Dibenz(a,h)anthracene	EPA 8270D-SIM/3546	0.0026	0.0040	0.005	38 - 120	≤ 30	0.14	EPA 8270D-SIM/3510C	0.0030	0.005	0.01	34 - 120	≤ 30	0.010	--	--	--	--	--	--	--
Dibenzofuran	EPA 8270D-SIM/3546	0.0014	0.0025	0.005	38 - 120	≤ 30	80	EPA 8270D-SIM/3510C	0.0035	0.005	0.01	38 - 120	≤ 30	1.3	--	--	--	--	--	--	--
Fluoranthene	EPA 8270D-SIM/3546	**0.0019**	**0.0040**	**0.005**	**46 - 120**	**≤ 30**	**0.16**	EPA 8270D-SIM/3510C	0.0034	0.005	0.01	45 - 120	≤ 30	2.3	--	--	--	--	--	--	--
Fluorene	EPA 8270D-SIM/3546	0.0015	0.0025	0.005	41 - 120	≤ 30	3,200	EPA 8270D-SIM/3510C	0.0032	0.005	0.01	43 - 120	≤ 30	2.0	--	--	--	--	--	--	--
Indeno(1,2,3-cd)pyrene	EPA 8270D-SIM/3546	**0.0030**	**0.0040**	**0.005**	**40 - 120**	**≤ 30**	**1.4**	EPA 8270D-SIM/3510C	0.0033	0.005	0.01	37 - 120	≤ 30	0.013	--	--	--	--	--	--	--
1-Methylnaphthalene	EPA 8270D-SIM/3546	0.0016	0.0025	0.005	39 - 120	≤ 30	35	EPA 8270D-SIM/3510C	0.0031	0.005	0.01	39 - 120	≤ 30	--	--	--	--	--	--	--	--
2-Methylnaphthalene	EPA 8270D-SIM/3546	**0.0017**	**0.0025**	**0.005**	**35 - 120**	**≤ 30**	**0.043**	EPA 8270D-SIM/3510C	**0.0038**	**0.005**	**0.01**	**37 - 120**	**≤ 30**	**18**	--	--	--	--	--	--	--
Naphthalene	EPA 8270D-SIM/3546	0.0023	0.0050	0.005	36 - 120	≤ 30	1,600	EPA 8270D-SIM/3510C	0.0074	0.010	0.01	37 - 120	≤ 30	54	EPA TO-15 (Low)	2.3	5.5	6.8	60 - 140	≤ 25	14
Phenanthrene	EPA 8270D-SIM/3546	0.0016	0.0025	0.005	46 - 120	≤ 30	--	EPA 8270D-SIM/3510C	0.0030	0.005	0.01	41 - 120	≤ 30	4.8	--	--	--	--	--	--	--
Pyrene	EPA 8270D-SIM/3546	0.0023	0.0040	0.005	49 - 120	≤ 30	2,400	EPA 8270D-SIM/3510C	0.0042	0.005	0.01	41 - 120	≤ 30	14	--	--	--	--	--	--	--
Other SVOCs																					
Aniline	EPA 8270D/3546	0.017	0.05	0.1	10 - 134	≤ 30	--	EPA 8270D/3520C	0.97	1	1	21 - 120	≤ 30	56	--	--	--	--	--	--	--
Azobenzene	EPA 8270D/3546	0.0046	0.01	0.02	35 - 120	≤ 30	9.1	EPA 8270D/3520C	0.23	0.5	2	55 - 120	≤ 30	2.0	--	--	--	--	--	--	--
Benzoic acid	EPA 8270D/3546	0.059	0.1	0.2	10 - 120	≤ 30	320,000	EPA 8270D/3520C	3.9	10	20	37 - 120	≤ 30	2,200	--	--	--	--	--	--	--
Benzyl alcohol	EPA 8270D/3546	0.015	0.02	0.02	19 - 120	≤ 30	8,000	EPA 8270D/3520C	0.55	1	2	26 - 120	≤ 30	180	--	--	--	--	--	--	--
4-Bromophenyl phenyl ether	EPA 8270D/3546	0.0061	0.01	0.02	39 - 120	≤ 30	--	EPA 8270D/3520C	0.24	0.5	1	56 - 120	≤ 30	--	--	--	--	--	--	--	--
Carbazole	EPA 8270D/3546	0.0074	0.01	0.02	43 - 135	≤ 30	--	EPA 8270D/3520C	0.31	0.5	1	57 - 120	≤ 30	--	--	--	--	--	--	--	--
4-Chloroaniline	EPA 8270D/3546	0.034	0.05	0.1	11 - 120	≤ 30	--	EPA 8270D/3520C	1.7	2.5	5	10 - 132	≤ 30	5.0	--	--	--	--	--	--	--
Bis(2-chloroethoxy) methane	EPA 8270D/3546	0.0063	0.01	0.02	39 - 120	≤ 30	--	EPA 8270D/3520C	0.24	0.5	1	48 - 120	≤ 30	--	--	--	--	--	--	--	--
Bis(2-chloroethyl) ether	EPA 8270D/3546	0.0068	0.01	0.02	36 - 120	≤ 30	0.91	EPA 8270D/3520C	0.25	0.5	1	50 - 120	≤ 30	--	--	--	--	--	--	--	--
2-Chloronaphthalene	EPA 8270D/3546	0.0044	0.01	0.02	40 - 120	≤ 30	--	EPA 8270D/3520C	0.25	0.5	1	42 - 120	≤ 30	640	--	--	--	--	--	--	--
4-Chlorophenyl-phenylether	EPA 8270D/3546	0.0070	0.01	0.02	32 - 120	≤ 30	--	EPA 8270D/3520C	0.27	0.5	1	54 - 100	≤ 30	--	--	--	--	--	--	--	--
1,2-Dichlorobenzene	EPA 8270D/3546	0.0047	0.01	0.02	40 - 120	≤ 30	7,200	EPA 8270D/3520C	0.25	0.35	1	28 - 120	≤ 30	5.2	EPA TO-15 (Low)	0.66	0.78	1.6	70 - 130	≤ 25	910
1,3-Dichlorobenzene	EPA 8270D/3546	0.0051	0.01	0.02	40 - 120	≤ 30	--	EPA 8270D/3520C	0.27	0.5	1	24 - 120	≤ 30	--	EPA TO-15 (Low)	0.50	0.78	1.6	70 - 130	≤ 25	--
1,4-Dichlorobenzene	EPA 8270D/3546	0.0044	0.01	0.02	39 - 120	≤ 30	2.4	EPA 8270D/3520C	0.27	0.5	1	24 - 120	≤ 30	7.1	EPA TO-15 (Low)	0.20	0.78	1.6	70 - 130	≤ 25	3,700
3,3'-Dichlorobenzidine	EPA 8270D/3546	0.031	0.05	0.1	10 - 120	≤ 30	2.2	EPA 8270D/3520C	1.8	2.5	5	44 - 120	≤ 30	--	--	--	--	--	--	--	--

Appendix Table A-1
Target Analytes, Laboratory Methods, and Analytical Limits

Analyte	Soil							Groundwater							Soil Vapor						
	Analytical Method	MDL	LOD	LOQ	LCS	RPD	RISL	Analytical Method	MDL	LOD	LOQ	LCS	RPD	RISL	Analytical Method	MDL	LOD	LOQ*	LCS	RPD	VISL
		(mg/kg)			(%)		(mg/kg)		(ug/L)			(%)		(ug/L)		(ug/m^3)			(%)		(ug/m^3)
2,4-Dinitrotoluene	EPA 8270D/3546	0.023	0.05	0.1	35 - 127	≤ 30	160	EPA 8270D/3520C	1.1	1.5	3	51 - 120	≤ 30	32	--	--	--	--	--	--	--
2,6-Dinitrotoluene	EPA 8270D/3546	0.027	0.05	0.1	33 - 123	≤ 30	8.0	EPA 8270D/3520C	1.1	1.5	3	52 - 120	≤ 30	16	--	--	--	--	--	--	--
Hexachlorobenzene	EPA 8270D/3546	0.0047	0.01	0.02	33 - 120	≤ 30	0.63	EPA 8270D/3520C	0.28	0.5	1	54 - 120	≤ 30	1.0	--	--	--	--	--	--	--
Hexachlorobutadiene	EPA 8270D/3546	0.0050	0.01	0.02	37 - 120	≤ 30	13	EPA 8270D/3520C	0.34	1.5	3	18 - 120	≤ 30	3.0	EPA TO-15 (Low)	2.5	1.4	14	70 - 130	≤ 25	1.1
Hexachlorocyclopentadiene	EPA 8270D/3546	0.041	0.05	0.1	10 - 120	≤ 30	480	EPA 8270D/3520C	1.1	2.5	5	16 - 120	≤ 30	48	--	--	--	--	--	--	--
Hexachloroethane	EPA 8270D/3546	0.0057	0.01	0.02	38 - 120	≤ 30	71	EPA 8270D/3520C	0.30	1	2	18 - 120	≤ 30	3.1	--	--	--	--	--	--	--
Isophorone	EPA 8270D/3546	0.0078	0.01	0.02	37 - 120	≤ 30	1,100	EPA 8270D/3520C	0.42	0.5	1	57 - 120	≤ 30	46	--	--	--	--	--	--	--
2-Nitroaniline	EPA 8270D/3546	0.030	0.05	0.1	31 - 126	≤ 30	800	EPA 8270D/3520C	1.5	1.5	3	31 - 120	≤ 30	160	--	--	--	--	--	--	--
3-Nitroaniline	EPA 8270D/3546	0.038	0.05	0.1	22 - 120	≤ 30	--	EPA 8270D/3520C	1.5	3	3	36 - 120	≤ 30	--	--	--	--	--	--	--	--
4-Nitroaniline	EPA 8270D/3546	0.035	0.05	0.1	24 - 125	≤ 30	--	EPA 8270D/3520C	2.0	3	3	25 - 132	≤ 30	--	--	--	--	--	--	--	--
Nitrobenzene	EPA 8270D/3546	0.0080	0.01	0.02	36 - 120	≤ 30	160	EPA 8270D/3520C	0.25	0.5	1	57 - 120	≤ 30	16	--	--	--	--	--	--	--
n-Nitrosodimethylamine	EPA 8270D/3546	0.022	0.03	0.04	17 - 120	≤ 30	0.040	EPA 8270D/3520C	1.3	1.5	3	41 - 120	≤ 30	5.0	--	--	--	--	--	--	--
n-Nitrosodiphenylamine	EPA 8270D/3546	0.0096	0.01	0.02	36 - 120	≤ 30	200	EPA 8270D/3520C	0.30	0.5	1	48 - 120	≤ 30	2.0	--	--	--	--	--	--	--
n-Nitrosodi-n-propylamine	EPA 8270D/3546	0.011	0.015	0.02	34 - 120	≤ 30	0.14	EPA 8270D/3520C	0.27	0.5	1	49 - 120	≤ 30	--	--	--	--	--	--	--	--
1,2,4-Trichlorobenzene	EPA 8270D/3546	0.0060	0.01	0.02	35 - 120	≤ 30	35	EPA 8270D/3520C	0.25	0.5	1	28 - 120	≤ 30	1.1	EPA TO-15 (Low)	4.0	6.8	9.6	--	--	910
Volatile Organic Compounds																					
Acetone	EPA 8260C (Low)	0.00048	0.0025	0.005	48 - 132	≤ 40	72,000	EPA 8260C (Medium)	2.1	2.5	5	64 - 125	≤ 40	7,200	EPA TO-15 (Low)	0.61	1.2	3.1	70 - 130	≤ 25	--
Acrolein	EPA 8260C (Low)	0.0038	0.025	0.05	60 - 130	≤ 40	40.00	EPA 8260C (Medium)	2.5	2.5	5	60 - 124	≤ 40	10	--	--	--	--	--	--	--
Acrylonitrile	EPA 8260C (Low)	0.0010	0.0025	0.005	59 - 124	≤ 40	1.9	EPA 8260C (Medium)	0.60	1	1	76 - 123	≤ 40	5.0	--	--	--	--	--	--	--
Benzene	EPA 8260C (Low)	**0.00030**	**0.0005**	**0.001**	**80 - 120**	**≤ 40**	**0.0010**	EPA 8260C (Low)	**0.027**	**0.1**	**0.2**	**80 - 120**	**≤ 40**	**0.80**	EPA TO-15 (Low)	**0.27**	**0.42**	**0.83**	**70 - 130**	**≤ 25**	**3.2**
Bromobenzene	EPA 8260C (Low)	0.00020	0.0005	0.001	75 - 120	≤ 40	--	EPA 8260C (Medium)	0.061	0.1	0.2	80 - 120	≤ 40	--	--	--	--	--	--	--	--
Bromochloromethane	EPA 8260C (Low)	0.00032	0.0005	0.001	69 - 133	≤ 40	--	EPA 8260C (Medium)	0.061	0.1	0.2	80 - 120	≤ 40	--	--	--	--	--	--	--	--
Bromoethane	EPA 8260C (Low)	0.00044	0.0010	0.002	74 - 132	≤ 40	--	EPA 8260C (Medium)	0.041	0.1	0.2	77 - 122	≤ 40	--	--	--	--	--	--	--	--
Bromoform	EPA 8260C (Low)	0.00030	0.0005	0.001	63 - 120	≤ 40	130	EPA 8260C (Medium)	0.062	0.1	0.2	62 - 149	≤ 40	5.5	EPA TO-15 (Low)	0.38	1.3	2.7	70 - 130	≤ 25	23
Bromomethane	EPA 8260C (Low)	0.00019	0.0005	0.001	40 - 172	≤ 40	110	EPA 8260C (Medium)	0.252	0.5	1	68 - 130	≤ 40	--	EPA TO-15 (Low)	0.95	2.0	1.0	70 - 130	≤ 25	23
n-Butylbenzene	EPA 8260C (Low)	0.00026	0.0005	0.001	75 - 134	≤ 40	--	EPA 8260C (Medium)	0.025	0.1	0.2	80 - 125	≤ 40	--	--	--	--	--	--	--	--
sec-Butylbenzene	EPA 8260C (Low)	0.00024	0.0005	0.001	77 - 127	≤ 40	--	EPA 8260C (Medium)	0.024	0.1	0.2	80 - 121	≤ 40	--	--	--	--	--	--	--	--
tert-Butylbenzene	EPA 8260C (Low)	0.00031	0.0005	0.001	77 - 125	≤ 40	--	EPA 8260C (Medium)	0.026	0.1	0.2	80 - 121	≤ 40	--	--	--	--	--	--	--	--
Carbon disulfide	EPA 8260C (Low)	0.00056	0.0010	0.001	72 - 146	≤ 40	8,000	EPA 8260C (Medium)	0.037	0.1	0.2	77 - 124	≤ 40	800	EPA TO-15 (Low)	0.40	1.6	4.2	70 - 130	≤ 25	3,200
Carbon tetrachloride	EPA 8260C (Low)	0.00021	0.0005	0.001	76 - 136	≤ 40	14	EPA 8260C (Medium)	0.044	0.1	0.2	71 - 139	≤ 40	1.0	EPA TO-15 (Low)	0.54	0.82	1.6	70 - 130	≤ 25	4.2
CFC-11 (Trichlorofluoromethane)	EPA 8260C (Low)	0.00027	0.0005	0.001	57 - 161	≤ 40	24,000	EPA 8260C (Medium)	0.037	0.1	0.2	74 - 135	≤ 40	2,400	EPA TO-15 (Low)	0.41	0.73	1.5	70 - 130	≤ 25	3,200
CFC-12 (Dichlorodifluoromethane)	EPA 8260C (Low)	0.00021	0.0005	0.001	67 - 142	≤ 40	16,000	EPA 8260C (Medium)	0.052	0.1	0.2	68 - 133	≤ 40	--	EPA TO-15 (Low)	0.48	0.64	1.3	70 - 130	≤ 25	800
CFC-113 (Trichlorotrifluoroethane)	EPA 8260C (Low)	0.00029	0.0010	0.002	72 - 142	≤ 40	1,000,000	EPA 8260C (Medium)	0.043	0.1	0.2	76 - 124	≤ 40	240,000	EPA TO-15 (Low)	0.40	1.0	2.0	70 - 130	≤ 25	140,000
Chlorobenzene	EPA 8260C (Low)	0.00022	0.0005	0.001	80 - 120	≤ 40	1,600	EPA 8260C (Medium)	0.023	0.1	0.2	80 - 120	≤ 40	100	EPA TO-15 (Low)	0.16	0.60	1.2	70 - 130	≤ 25	230
Chlorodibromomethane	EPA 8260C (Low)	0.00027	0.0005	0.001	77 - 123	≤ 40	--	EPA 8260C (Medium)	0.048	0.1	0.2	80 - 120	≤ 40	1.0	EPA TO-15 (Low)	0.47	1.1	2.2	70 - 130	≤ 25	0.045
Chloroethane (Ethyl chloride)	EPA 8260C (Low)	0.00046	0.0005	0.001	53 - 154	≤ 40	15,000	EPA 8260C (Medium)	0.086	0.1	0.2	68 - 133	≤ 40	--	EPA TO-15 (Low)	0.95	1.4	3.4	70 - 130	≤ 25	46,000
Chloroform	EPA 8260C (Low)	0.00023	0.0005	0.001	75 - 126	≤ 40	800	EPA 8260C (Medium)	0.027	0.1	0.2	80 - 120	≤ 40	80	EPA TO-15 (Low)	**0.24**	**0.63**	**1.3***	**70 - 130**	**≤ 25**	**1.1**
Chloromethane (Methyl chloride)	EPA 8260C (Low)	0.00026	0.0005	0.001	67 - 142	≤ 40	120	EPA 8260C (Medium)	0.095	0.25	0.5	77 - 122	≤ 40	--	EPA TO-15 (Low)	0.44	0.27	0.55	70 - 130	≤ 25	41
2-Chlorotoluene	EPA 8260C (Low)	0.00030	0.0005	0.001	76 - 120	≤ 40	--	EPA 8260C (Medium)	0.024	0.1	0.2	80 - 120	≤ 40	--	--	--	--	--	--	--	--
4-Chlorotoluene	EPA 8260C (Low)	0.00028	0.0005	0.001	75 - 121	≤ 40	--	EPA 8260C (Medium)	0.016	0.1	0.2	80 - 120	≤ 40	--	--	--	--	--	--	--	--
Cumene (Isopropylbenzene)	EPA 8260C (Low)	0.00023	0.0005	0.001	77 - 127	≤ 40	8,000	EPA 8260C (Medium)	0.021	0.1	0.2	80 - 120	≤ 40	800	EPA TO-15 (Low)	0.28	0.64	1.3	70 - 130	≤ 25	1,800
1,2-Dibromo-3-chloropropane	EPA 8260C (Low)	0.00059	0.0025	0.005	61 - 128	≤ 40	1.3	EPA 8260C (Medium)	0.37	0.5	0.5	79 - 129	≤ 40	4.4	--	--	--	--	--	--	--
Dibromomethane	EPA 8260C (Low)	0.00015	0.0005	0.001	80 - 120	≤ 40	--	EPA 8260C (Medium)	0.145	0.2	0.2	80 - 120	≤ 40	--	--	--	--	--	--	--	--
Dichlorobromomethane	EPA 8260C (Low)	0.00025	0.0005	0.001	80 - 122	≤ 40	--	EPA 8260C (Medium)	0.048	0.1	0.2	80 - 122	≤ 40	1.0	EPA TO-15 (Low)	0.70	0.87	1.7	70 - 130	≤ 25	0.033
trans-1,4-Dichloro-2-butene	EPA 8260C (Low)	0.00044	0.0025	0.005	62 - 127	≤ 40	--	EPA 8260C (Medium)	0.32	0.5	1	47 - 147	≤ 40	--	--	--	--	--	--	--	--
1,1-Dichloroethane	EPA 8260C (Low)	0.00020	0.0005	0.001	65 - 139	≤ 40	16,000	EPA 8260C (Medium)	0.053	0.1	0.2	80 - 120	≤ 40	1,600	EPA TO-15 (Low)	0.28	0.53	1.0	70 - 130	≤ 25	3,200
1,2-Dichloroethane (EDC)	EPA 8260C (Low)	0.00019	0.0005	0.001	77 - 120	≤ 40	11	EPA 8260C (Medium)	0.072	0.1	0.2	80 - 121	≤ 40	1.0	EPA TO-15 (Low)	0.44	0.53	1.0	70 - 130	≤ 25	0.96
1,1-Dichloroethene	EPA 8260C (Low)	0.00034	0.0005	0.001	73 - 138	≤ 40	0.0023	EPA 8260C (Medium)	**0.054**	**0.1**	**0.2**	**74 - 120**	**≤ 40**	**7.0**	EPA TO-15 (Low)	0.40	0.52	1.0	70 - 130	≤ 25	910
cis-1,2-Dichloroethene	EPA 8260C (Low)	**0.00024**	**0.0005**	**0.001**	**75 - 124**	**≤ 40**	**0.0052**	EPA 8260C (Medium)	**0.043**	**0.1**	**0.2**	**78 - 120**	**≤ 40**	**16**	EPA TO-15 (Low)	**0.54**	**0.52**	**1.0**	**70 - 130**	**≤ 25**	**160**
trans-1,2-Dichloroethene	EPA 8260C (Low)	0.00027	0.0005	0.001	73 - 131	≤ 40	1,600	EPA 8260C (Medium)	0.048	0.1	0.2	75 - 120	≤ 40	100	EPA TO-15 (Low)	0.28	0.52	1.0	70 - 130	≤ 25	320
1,2-Dichloropropane	EPA 8260C (Low)	0.00016	0.0005	0.001	74 - 120	≤ 40	--	EPA 8260C (Medium)	0.035	0.1	0.2	80 - 120	≤ 40	5.0	EPA TO-15 (Low)	0.34	0.60	1.2	70 - 130	≤ 25	18
1,3-Dichloropropane	EPA 8260C (Low)	0.00021	0.0005	0.001	77 - 120	≤ 40	--	EPA 8260C (Medium)	0.062	0.1	0.2	80 - 120	≤ 40	--	--	--	--	--	--	--	--
2,2-Dichloropropane	EPA 8260C (Low)	0.00029	0.0005	0.001	77 - 137	≤ 40	--	EPA 8260C (Medium)	0.052	0.1	0.2	72 - 133	≤ 40	--	--	--	--	--	--	--	--
1,1-Dichloropropene	EPA 8260C (Low)	0.00031	0.0005	0.001	80 - 123	≤ 40	--	EPA 8260C (Medium)	0.034	0.1	0.2	80 - 120	≤ 40	--	--	--	--	--	--	--	--
cis-1,3-Dichloropropene	EPA 8260C (Low)	0.00023	0.0005	0.001	80 - 124	≤ 40	10	EPA 8260C (Medium)	0.061	0.1	0.2	80 - 127	≤ 40	1.0	EPA TO-15 (Low)	0.29	0.59	1.2	70 - 130	≤ 25	6.3
trans-1,3-Dichloropropene	EPA 8260C (Low)	0.00022	0.0005	0.001	80 - 126	≤ 40	10	EPA 8260C (Medium)	0.081	0.1	0.2	79 - 132	≤ 40	1.0	EPA TO-15 (Low)	0.54	0.59	1.2	70 - 130	≤ 25	6.3
Ethylbenzene	EPA 8260C (Low)	0.00020	0.0005	0.001	80 - 120	≤ 40	8,000	EPA 8260C (Medium)	0.037	0.1	0.2	80 - 120	≤ 40	700	EPA TO-15 (Low)	0.26	0.56	1.1	70 - 130	≤ 25	4,600
Ethylene dibromide (EDB)	EPA 8260C (Low)	0.00018	0.0005	0.001	79 - 120	≤ 40	0.50	EPA 8260C (Medium)	0.075	0.1	0.2	80 - 120	≤ 40	1.0	EPA TO-15 (Low)	0.52	1.0	2.0	70 - 130	≤ 25	0.11
2-Hexanone	EPA 8260C (Low)	0.00044	0.0025	0.005	62 - 128	≤ 40	--	EPA 8260C (Medium)	0.90	2.5	5	80 - 129	≤ 40	--	EPA TO-15 (Low)	0.82	2.1	5.3	70 - 130	≤ 25	--
p-Isopropyltoluene	EPA 8260C (Low)	0.00024	0.0005	0.001	78 - 131	≤ 40	--	EPA 8260C (Medium)	0.026	0.1	0.2	80 - 124	≤ 40	--	--	--	--	--	--	--	--
Methyl ethyl ketone (MEK)	EPA 8260C (Low)	0.00051	0.0005	0.005	64 - 120	≤ 40	--	EPA 8260C (Medium)	0.81	2.5	5	73 - 123	≤ 40	4,800	EPA TO-15 (Low)	0.91	1.5	3.1	70 - 130	≤ 25	4,600
Methyl iodide	EPA 8260C (Low)	0.00022	0.0005	0.001	34 - 181	≤ 40	--	EPA 8260C (Medium)	0.23	0.5	1	76 - 123	≤ 40	--	--	--	--	--	--	--	--
Methyl isobutyl ketone (MIBK)	EPA 8260C (Low)	0.00042	0.0025	0.005	20 - 157	≤ 40	--	EPA 8260C (Medium)	0.97	2.5	5	80 - 125	≤ 40	640	EPA TO-15 (Low)	0.36	0.53	1.1	70 - 130	≤ 25	320
Methyl tert-butyl ether (MTBE)	EPA 8260C (Low)	0.00023	0.0005	0.001	68 - 124	≤ 40	--	EPA 8260C (Medium)	0.073	0.25	0.5	79 - 121	≤ 40	--	EPA TO-15 (Low)	0.40	0.47	0.94	70 - 130	≤ 25	96

Appendix Table A-1
Target Analytes, Laboratory Methods, and Analytical Limits

Analyte	Soil							Groundwater							Soil Vapor						
	Analytical Method	MDL	LOD	LOQ	LCS	RPD	RISL	Analytical Method	MDL	LOD	LOQ	LCS	RPD	RISL	Analytical Method	MDL	LOD	LOQ*	LCS	RPD	VISL
		(mg/kg)			(%)		(mg/kg)		(ug/L)			(%)		(ug/L)		(ug/m^3)			(%)		(ug/m^3)
Methylene chloride	EPA 8260C (Low)	0.00064	0.0010	0.002	61 - 128	≤ 40	--	EPA 8260C (Medium)	0.49	0.5	1	71 - 125	≤ 40	5.0	EPA TO-15 (Low)	0.31	0.45	1.8	70 - 130	≤ 25	53
n-Propylbenzene	EPA 8260C (Low)	0.00027	0.0005	0.001	76 - 126	≤ 40	--	EPA 8260C (Medium)	0.023	0.1	0.2	80 - 120	≤ 40	800	EPA TO-15 (Low)	0.27	0.64	1.3	70 - 130	≤ 25	4,600
Styrene	EPA 8260C (Low)	0.00014	0.0005	0.001	80 - 122	≤ 40	--	EPA 8260C (Medium)	0.045	0.1	0.2	80 - 121	≤ 40	100	EPA TO-15 (Low)	0.20	0.55	1.1	70 - 130	≤ 25	4,600
1,1,1,2-Tetrachloroethane	EPA 8260C (Low)	0.00023	0.0005	0.001	80 - 120	≤ 40	--	EPA 8260C (Medium)	0.040	0.1	0.2	80 - 128	≤ 40	1.7	--	--	--	--	--	--	--
1,1,2,2-Tetrachloroethane	EPA 8260C (Low)	0.00025	0.0005	0.001	71 - 120	≤ 40	--	EPA 8260C (Medium)	0.060	0.1	0.2	80 - 120	≤ 40	1.0	EPA TO-15 (Low)	0.47	0.89	1.8	70 - 130	≤ 25	0.43
Tetrachloroethene (PCE)	EPA 8260C (Low)	**0.00026**	**0.0005**	**0.001**	**76 - 131**	**≤ 40**	**0.0018**	EPA 8260C (Medium)	**0.047**	**0.1**	**0.2**	**80 - 120**	**≤ 40**	**5.0**	EPA TO-15 (Low)	**0.32**	**0.88**	**1.8**	**70 - 130**	**≤ 25**	**96**
Toluene	EPA 8260C (Low)	0.00015	0.0005	0.001	78 - 120	≤ 40	6,400	EPA 8260C (Medium)	0.040	0.1	0.2	80 - 120	≤ 40	640	EPA TO-15 (Low)	0.21	0.49	0.99	70 - 130	≤ 25	23,000
1,2,3-Trichlorobenzene	EPA 8260C (Low)	0.00031	0.0025	0.005	76 - 122	≤ 40	--	EPA 8260C (Medium)	0.11	0.25	0.5	80 - 125	≤ 40	--	--	--	--	--	--	--	--
1,1,1-Trichloroethane	EPA 8260C (Low)	0.00023	0.0005	0.001	78 - 133	≤ 40	160,000	EPA 8260C (Medium)	0.041	0.1	0.2	79 - 124	≤ 40	200	EPA TO-15 (Low)	0.57	0.71	1.4	70 - 130	≤ 25	23,000
1,1,2-Trichloroethane	EPA 8260C (Low)	0.00029	0.0005	0.001	77 - 120	≤ 40	18	EPA 8260C (Medium)	0.13	0.2	0.2	80 - 120	≤ 40	1.0	--	--	--	--	--	--	--
Trichloroethene (TCE)	EPA 8260C (Low)	**0.00021**	**0.0005**	**0.001**	**76 - 131**	**≤ 40**	**0.0015**	EPA 8260C (Medium)	**0.049**	**0.1**	**0.2**	**80 - 120**	**≤ 40**	**4.0**	EPA TO-15 (Low)	**0.34**	**0.70**	**1.4***	**70 - 130**	**≤ 25**	**3.7**
1,2,3-Trichloropropane	EPA 8260C (Low)	0.00052	0.0010	0.002	75 - 120	≤ 40	0.033	EPA 8260C (Medium)	0.13	0.25	0.5	80 - 120	≤ 40	2.0	--	--	--	--	--	--	--
1,2,4-Trimethylbenzene	EPA 8260C (Low)	0.00023	0.0005	0.001	77 - 125	≤ 40	--	EPA 8260C (Medium)	0.024	0.1	0.2	80 - 122	≤ 40	--	EPA TO-15 (Low)	0.45	0.64	1.3	70 - 130	≤ 25	32
1,3,5-Trimethylbenzene	EPA 8260C (Low)	0.00025	0.0005	0.001	77 - 126	≤ 40	800	EPA 8260C (Medium)	0.015	0.1	0.2	80 - 120	≤ 40	80	EPA TO-15 (Low)	0.54	0.64	1.3	70 - 130	≤ 25	27
Vinyl acetate	EPA 8260C (Low)	0.00038	0.0005	0.005	54 - 138	≤ 40	--	EPA 8260C (Medium)	0.069	0.1	0.2	74 - 120	≤ 40	--	--	--	--	--	--	--	--
Vinyl chloride	EPA 8260C (Low)	**0.00024**	**0.0005**	**0.001**	**74 - 134**	**≤ 40**	**0.0010**	EPA 8260C (Low)	**0.057**	**0.1**	**0.2**	**74 - 123**	**≤ 40**	**0.20**	EPA TO-15 (Low)	**0.19**	**0.33**	**0.68**	**70 - 130**	**≤ 25**	**2.8**
m,p-Xylene	EPA 8260C (Low)	0.00039	0.0005	0.001	80 - 123	≤ 40	16,000	EPA 8260C (Medium)	0.052	0.2	0.4	80 - 120	≤ 40	1,600	EPA TO-15 (Low)	0.28	0.56	1.1	70 - 130	≤ 25	460
o-Xylene	EPA 8260C (Low)	0.00022	0.0005	0.001	80 - 120	≤ 40	16,000	EPA 8260C (Medium)	0.035	0.1	0.2	80 - 120	≤ 40	1,600	EPA TO-15 (Low)	0.27	0.56	1.1	70 - 130	≤ 25	460
Total Xylenes	EPA 8260C (Low)	0.00061	0.0005	0.002	80 - 120	≤ 40	16,000	EPA 8260C (Medium)	0.090	0.2	0.6	80 - 120	≤ 40	1,600	--	--	--	--	--	--	--
Atmospheric Gases (%)																					
Carbon dioxide	Not analyzed for in soil samples							Not analyzed for in groundwater samples							ASTM D-1946 modified	--	--	0.01	--	--	--
Helium															ASTM D-1946 modified	--	--	0.05	--	--	--
Methane															ASTM D-1946 modified	--	--	0.0001	--	--	--
Nitrogen															ASTM D-1946 modified	--	--	0.01	--	--	--
Oxygen															ASTM D-1946 modified	--	--	0.01	--	--	--

ARI = Analytical Resources, Inc.
LCS = laboratory control sample (supplied by ARI and Air Toxics)
LOD = limit of detection (supplied by two labs)
LOQ = limit of quantitation (supplied by two labs; equivalent to PQLs or RLs)
MDL = method detection limit (supplied by two labs)
RISL = remedial investigation screening level (Final RI/FS Work Plan 2013)
RPD = relative percent difference (supplied by two labs)
VISL = vapor intrusion screening level , for soil vapor (applying Ecology 2009 guidance; soil vapor VISL is equal to 10x the most stringent Method B Air Cleanup Level)

Notes:
Bold values indicate an RI chemical of potential concern (COPC) for the associated media.
Low or Medium refer to low-level or medium-level quantitation limits.
* LOQs for soil vapor are considered approximate; LOQs for chloroform and TCE (COPCs) are greater than VISLs, but MDLs are lower than VISLs. LOQs for atmospheric gases are in percent.
# Concentrations for dioxins/furans are in ng/kg.
-- Not applicable or not available

Appendix Table A-2
Target Analytes, Laboratory Methods, and Analytical Limits

Analyte	Storm Drain Solids							Surface Debris							CJM and Building Materials^						
	Analytical Method	MDL	LOD	LOQ	LCS	RPD	RISL	Analytical Method	MDL	LOD	LOQ	LCS	RPD	RISL	Analytical Method	MDL	LOD	LOQ	LCS	RPD	RISL
		(mg/kg)			(%)		(mg/kg)		(mg/kg)			(%)		(mg/kg)		(mg/kg)			(%)		(mg/kg)
Polychlorinated Aromatic Compounds																					
PCB Aroclors																					
Aroclor 1016	EPA 8082A/3546	0.008	0.01	0.02	56 - 120	≤ 40	--	EPA 8082A/3546	0.008	0.01	0.02	56 - 120	≤ 40	--	EPA 8082B/3580A	0.038	0.4	0.8	59 - 120	≤ 40	--
Aroclor 1221	EPA 8082A/3546	0.008	0.01	0.02	--	--	--	EPA 8082A/3546	0.008	0.01	0.02	--	--	--	EPA 8082B/3580A	0.038	0.4	0.8	--	--	--
Aroclor 1232	EPA 8082A/3546	0.008	0.01	0.02	--	--	--	EPA 8082A/3546	0.008	0.01	0.02	--	--	--	EPA 8082B/3580A	0.038	0.4	0.8	--	--	--
Aroclor 1242	EPA 8082A/3546	0.009	0.01	0.02	--	--	--	EPA 8082A/3546	0.009	0.01	0.02	--	--	--	EPA 8082B/3580A	0.073	0.4	0.8	--	--	--
Aroclor 1248	EPA 8082A/3546	0.009	0.01	0.02	--	--	--	EPA 8082A/3546	0.009	0.01	0.02	--	--	--	EPA 8082B/3580A	0.073	0.4	0.8	--	--	--
Aroclor 1254	EPA 8082A/3546	0.009	0.01	0.02	--	--	--	EPA 8082A/3546	0.009	0.01	0.02	--	--	--	EPA 8082B/3580A	0.073	0.4	0.8	--	--	--
Aroclor 1260	EPA 8082A/3546	0.009	0.01	0.02	58 - 120	≤ 40	--	EPA 8082A/3546	0.009	0.01	0.02	58 - 120	≤ 40	--	EPA 8082B/3580A	0.073	0.4	0.8	43 - 177	≤ 40	--
Aroclor 1262	EPA 8082A/3546	0.009	0.01	0.02	--	--	--	EPA 8082A/3546	0.009	0.01	0.02	--	--	--	EPA 8082B/3580A	0.073	0.4	0.8	--	--	--
Aroclor 1268	EPA 8082A/3546	0.009	0.01	0.02	--	--	--	EPA 8082A/3546	0.009	0.01	0.02	--	--	--	EPA 8082B/3580A	0.073	0.4	0.8	--	--	--
Total PCBs	EPA 8082A/3546	--	--	**0.02**	--	--	**0.13**	EPA 8082A/3546	--	--	**0.02**	--	--	**0.13**	EPA 8082B/3580A	--	--	**0.8**	--	--	**1.3**
Dioxins/Furans (ng/kg)#																					
2,3,7,8-TCDF	EPA 1613B	0.24	0.50	1.0	75 - 158	≤ 25	--	EPA 1613B	0.24	0.5	1.0	75 - 158	≤ 25	--	EPA 1613B	0.24	0.5	1.0	75 - 158	≤ 25	--
2,3,7,8-TCDD	EPA 1613B	0.17	0.50	1.0	67 - 158	≤ 25	13	EPA 1613B	0.17	0.5	1.0	67 - 158	≤ 25	13	EPA 1613B	0.17	0.5	1.0	67 - 158	≤ 25	130
1,2,3,7,8-PeCDF	EPA 1613B	0.52	1.25	2.5	80 - 134	≤ 25	--	EPA 1613B	0.52	1.25	2.5	80 - 134	≤ 25	--	EPA 1613B	0.52	1.25	2.5	80 - 134	≤ 25	--
2,3,4,7,8-PeCDF	EPA 1613B	0.67	1.0	1.0	68 - 160	≤ 25	--	EPA 1613B	0.67	1.0	1.0	68 - 160	≤ 25	--	EPA 1613B	0.67	1.0	1.0	68 - 160	≤ 25	--
1,2,3,7,8-PeCDD	EPA 1613B	0.38	1.0	1.0	70 - 142	≤ 25	--	EPA 1613B	0.38	1.0	1.0	70 - 142	≤ 25	--	EPA 1613B	0.38	1.0	1.0	70 - 142	≤ 25	--
1,2,3,4,7,8-HxCDF	EPA 1613B	0.71	1.25	2.5	72 - 134	≤ 25	--	EPA 1613B	0.71	1.25	2.5	72 - 134	≤ 25	--	EPA 1613B	0.71	1.25	2.5	72 - 134	≤ 25	--
1,2,3,6,7,8-HxCDF	EPA 1613B	0.27	1.25	2.5	84 - 130	≤ 25	--	EPA 1613B	0.27	1.25	2.5	84 - 130	≤ 25	--	EPA 1613B	0.27	1.25	2.5	84 - 130	≤ 25	--
2,3,4,6,7,8-HxCDF	EPA 1613B	0.70	1.25	2.5	70 - 156	≤ 25	--	EPA 1613B	0.70	1.25	2.5	70 - 156	≤ 25	--	EPA 1613B	0.70	1.25	2.5	70 - 156	≤ 25	--
1,2,3,7,8,9-HxCDF	EPA 1613B	0.89	1.25	2.5	78 - 130	≤ 25	--	EPA 1613B	0.89	1.25	2.5	78 - 130	≤ 25	--	EPA 1613B	0.89	1.25	2.5	78 - 130	≤ 25	--
1,2,3,4,7,8-HxCDD	EPA 1613B	0.77	1.25	2.5	70 - 164	≤ 25	--	EPA 1613B	0.77	1.25	2.5	70 - 164	≤ 25	--	EPA 1613B	0.77	1.25	2.5	70 - 164	≤ 25	--
1,2,3,6,7,8-HxCDD	EPA 1613B	0.66	1.25	2.5	76 - 134	≤ 25	--	EPA 1613B	0.66	1.25	2.5	76 - 134	≤ 25	--	EPA 1613B	0.66	1.25	2.5	76 - 134	≤ 25	--
1,2,3,7,8,9-HxCDD	EPA 1613B	0.48	1.25	2.5	64 - 162	≤ 25	--	EPA 1613B	0.48	1.25	2.5	64 - 162	≤ 25	--	EPA 1613B	0.48	1.25	2.5	64 - 162	≤ 25	--
1,2,3,4,6,7,8-HpCDF	EPA 1613B	1.11	1.25	2.5	82 - 122	≤ 25	--	EPA 1613B	1.11	1.25	2.5	82 - 122	≤ 25	--	EPA 1613B	1.11	1.25	2.5	82 - 122	≤ 25	--
1,2,3,4,7,8,9-HpCDF	EPA 1613B	0.88	1.25	2.5	78 - 138	≤ 25	--	EPA 1613B	0.88	1.25	2.5	78 - 138	≤ 25	--	EPA 1613B	0.88	1.25	2.5	78 - 138	≤ 25	--
1,2,3,4,6,7,8-HpCDD	EPA 1613B	0.75	1.25	2.5	70 - 140	≤ 25	--	EPA 1613B	0.75	1.25	2.5	70 - 140	≤ 25	--	EPA 1613B	0.75	1.25	2.5	70 - 140	≤ 25	--
OCDF	EPA 1613B	1.52	2.5	5.0	63 - 170	≤ 25	--	EPA 1613B	1.52	2.5	5.0	63 - 170	≤ 25	--	EPA 1613B	1.52	2.5	5.0	63 - 170	≤ 25	--
OCDD	EPA 1613B	1.73	2.5	5.0	78 - 144	≤ 25	--	EPA 1613B	1.73	2.5	5.0	78 - 144	≤ 25	--	EPA 1613B	1.73	2.5	5.0	78 - 144	≤ 25	--
Total Dioxins/Furans (TEQ, ng/kg)#	EPA 1613B	--	--	**4.0**	--	--	**13**	EPA 1613B	--	--	**4.0**	--	--	**13**	EPA 1613B	--	--	**4.0**	--	--	**130**
Metals																					
Aluminum	EPA 6010C/200.7	0.76	5	5	80 - 120	≤ 20	--	EPA 6010C/200.7	0.76	5	5	80 - 120	≤ 20	--	EPA 6010C/200.7	0.76	5	5	80 - 120	≤ 20	--
Antimony	EPA 6010C/200.7	0.63	5	5	80 - 120	≤ 20	--	EPA 6010C/200.7	0.63	5	5	80 - 120	≤ 20	--	EPA 6010C/200.7	0.63	5	5	80 - 120	≤ 20	--
Arsenic	EPA 6010C/200.7	**0.33**	**5**	**5**	**80 - 120**	**≤ 20**	7.3	EPA 6010C/200.7	**0.33**	**5**	**5**	**80 - 120**	**≤ 20**	7.3	EPA 6010C/200.7	**0.33**	**5**	**5**	**80 - 120**	**≤ 20**	**73**
Barium	EPA 6010C/200.7	0.13	0.3	0.3	80 - 120	≤ 20	--	EPA 6010C/200.7	0.13	0.3	0.3	80 - 120	≤ 20	--	EPA 6010C/200.7	0.13	0.3	0.3	80 - 120	≤ 20	--
Beryllium	EPA 6010C/200.7	0.016	0.1	0.1	80 - 120	≤ 20	--	EPA 6010C/200.7	0.016	0.1	0.1	80 - 120	≤ 20	--	EPA 6010C/200.7	0.016	0.1	0.1	80 - 120	≤ 20	--
Cadmium	EPA 6010C/200.7	**0.018**	**0.2**	**0.2**	**80 - 120**	**≤ 20**	**5.1**	EPA 6010C/200.7	**0.018**	**0.2**	**0.2**	**80 - 120**	**≤ 20**	**5.1**	EPA 6010C/200.7	**0.018**	**0.2**	**0.2**	**80 - 120**	**≤ 20**	**51**
Chromium	EPA 6010C/200.7	**0.12**	**0.5**	**0.5**	**80 - 120**	**≤ 20**	**260**	EPA 6010C/200.7	**0.12**	**0.5**	**0.5**	**80 - 120**	**≤ 20**	**260**	EPA 6010C/200.7	**0.12**	**0.5**	**0.5**	**80 - 120**	**≤ 20**	**2,600**
Cobalt	EPA 6010C/200.7	0.027	0.3	0.3	80 - 120	≤ 20	--	EPA 6010C/200.7	0.027	0.3	0.3	80 - 120	≤ 20	--	EPA 6010C/200.7	0.027	0.3	0.3	80 - 120	≤ 20	--
Copper ^	EPA 6010C/200.7	**0.092**	**0.2**	**0.2**	**80 - 120**	**≤ 20**	**390**	EPA 6010C/200.7	**0.092**	**0.2**	**0.2**	**80 - 120**	**≤ 20**	**390**	EPA 6010C/200.7	**0.092**	**0.2**	**0.2**	**80 - 120**	**≤ 20**	**3,900**
Iron	EPA 6010C/200.7	0.75	5	5	80 - 120	≤ 20	--	EPA 6010C/200.7	0.75	5	5	80 - 120	≤ 20	--	EPA 6010C/200.7	0.75	5	5	80 - 120	≤ 20	--
Lead	EPA 6010C/200.7	**0.16**	**2**	**2**	**80 - 120**	**≤ 20**	**450**	EPA 6010C/200.7	**0.16**	**2**	**2**	**80 - 120**	**≤ 20**	**450**	EPA 6010C/200.7	**0.16**	**2**	**2**	**80 - 120**	**≤ 20**	**4,500**
Manganese	EPA 6010C/200.7	0.028	0.1	0.1	80 - 120	≤ 20	--	EPA 6010C/200.7	0.028	0.1	0.1	80 - 120	≤ 20	--	EPA 6010C/200.7	0.028	0.1	0.1	80 - 120	≤ 20	--
Mercury	EPA 7471B or 245.5	**0.002**	**0.013**	**0.025**	**75 - 125**	**≤ 20**	**0.41**	EPA 7471B or 245.5	**0.002**	**0.013**	**0.025**	**75 - 125**	**≤ 20**	**0.41**	EPA 7471B or 245.5	**0.002**	**0.013**	**0.025**	**75 - 125**	**≤ 20**	**4.1**
Molybdenum	EPA 6010C/200.7	0.079	0.5	0.5	80 - 120	≤ 20	--	EPA 6010C/200.7	0.079	0.5	0.5	80 - 120	≤ 20	--	EPA 6010C/200.7	0.079	0.5	0.5	80 - 120	≤ 20	--
Nickel	EPA 6010C/200.7	0.39	1	1	80 - 120	≤ 20	370	EPA 6010C/200.7	0.39	1	1	80 - 120	≤ 20	370	EPA 6010C/200.7	0.39	1	1	80 - 120	≤ 20	--
Selenium	EPA 6010C/200.7	0.50	5	5	80 - 120	≤ 20	--	EPA 6010C/200.7	0.50	5	5	80 - 120	≤ 20	--	EPA 6010C/200.7	0.50	5	5	80 - 120	≤ 20	--
Silver ^	EPA 6010C/200.7	**0.043**	**0.3**	**0.3**	**80 - 120**	**≤ 20**	**6.1**	EPA 6010C/200.7	**0.043**	**0.3**	**0.3**	**80 - 120**	**≤ 20**	**6.1**	EPA 6010C/200.7	**0.043**	**0.3**	**0.3**	**80 - 120**	**≤ 20**	**61**
Thallium	EPA 6010C/200.7	0.31	5	5	80 - 120	≤ 20	--	EPA 6010C/200.7	0.31	5	5	80 - 120	≤ 20	--	EPA 6010C/200.7	0.31	5	5	80 - 120	≤ 20	--
Tin	EPA 6010C/200.7	0.14	1	1	80 - 120	≤ 20	--	EPA 6010C/200.7	0.14	1	1	80 - 120	≤ 20	--	EPA 6010C/200.7	0.14	1	1	80 - 120	≤ 20	--
Vanadium	EPA 6010C/200.7	0.027	0.3	0.3	80 - 120	≤ 20	--	EPA 6010C/200.7	0.027	0.3	0.3	80 - 120	≤ 20	--	EPA 6010C/200.7	0.027	0.3	0.3	80 - 120	≤ 20	--
Zinc	EPA 6010C/200.7	**0.14**	**1**	**1**	**80 - 120**	**≤ 20**	**410**	EPA 6010C/200.7	**0.14**	**1**	**1**	**80 - 120**	**≤ 20**	**410**	EPA 6010C/200.7	**0.14**	**1**	**1**	**80 - 120**	**≤ 20**	**4,100**

Appendix Table A-2
Target Analytes, Laboratory Methods, and Analytical Limits

Analyte	Storm Drain Solids							Surface Debris							CJM and Building Materials^						
	Analytical Method	MDL	LOD	LOQ	LCS	RPD	RISL	Analytical Method	MDL	LOD	LOQ	LCS	RPD	RISL	Analytical Method	MDL	LOD	LOQ	LCS	RPD	RISL
		(mg/kg)			(%)		(mg/kg)		(mg/kg)			(%)		(mg/kg)		(mg/kg)			(%)		(mg/kg)
Semivolatile Organic Compounds																					
Phenols																					
2-Chlorophenol	EPA 8270D (Soil/Sed)	0.014	0.034	0.067	45 - 120	≤ 30	--	EPA 8270D (Soil/Sed)	0.014	0.034	0.067	45 - 120	≤ 30	--	EPA 8270D (Soil/Sed)	0.014	0.034	0.067	45 - 120	≤ 30	--
4-Chloro-3-methylphenol	EPA 8270D (Soil/Sed)	0.12	0.17	0.33	54 - 120	≤ 30	--	EPA 8270D (Soil/Sed)	0.12	0.17	0.33	54 - 120	≤ 30	--	EPA 8270D (Soil/Sed)	0.12	0.17	0.33	54 - 120	≤ 30	--
2,4-Dichlorophenol	EPA 8270D (Soil/Sed)	0.075	0.17	0.33	51 - 120	≤ 30	--	EPA 8270D (Soil/Sed)	0.075	0.17	0.33	51 - 120	≤ 30	--	EPA 8270D (Soil/Sed)	0.075	0.17	0.33	51 - 120	≤ 30	--
2,4-Dimethylphenol	EPA 8270D (Soil/Sed)	0.016	0.034	0.067	40 - 120	≤ 30	0.067	EPA 8270D (Soil/Sed)	0.016	0.034	0.067	40 - 120	≤ 30	--	EPA 8270D (Soil/Sed)	0.016	0.034	0.067	40 - 120	≤ 30	--
4,6-Dinitro-2-methylphenol	EPA 8270D (Soil/Sed)	0.12	0.34	0.67	10 - 157	≤ 30	--	EPA 8270D (Soil/Sed)	0.12	0.34	0.67	10 - 157	≤ 30	--	EPA 8270D (Soil/Sed)	0.12	0.34	0.67	10 - 157	≤ 30	--
2,4-Dinitrophenol	EPA 8270D (Soil/Sed)	0.077	0.34	0.67	15 - 169	≤ 30	--	EPA 8270D (Soil/Sed)	0.077	0.34	0.67	15 - 169	≤ 30	--	EPA 8270D (Soil/Sed)	0.077	0.34	0.67	15 - 169	≤ 30	--
o-Cresol (2-Methylphenol)	EPA 8270D (Soil/Sed)	0.023	0.034	0.067	45 - 120	≤ 30	0.067	EPA 8270D (Soil/Sed)	0.023	0.034	0.067	45 - 120	≤ 30	--	EPA 8270D (Soil/Sed)	0.023	0.034	0.067	45 - 120	≤ 30	--
p-Cresol (4-Methylphenol)	EPA 8270D (Soil/Sed)	**0.022**	**0.034**	**0.067**	**47 - 120**	**≤ 30**	**0.67**	EPA 8270D (Soil/Sed)	**0.022**	**0.034**	**0.067**	**47 - 120**	**≤ 30**	**0.67**	EPA 8270D (Soil/Sed)	**0.022**	**0.034**	**0.067**	**47 - 120**	**≤ 30**	**6.7**
2-Nitrophenol	EPA 8270D (Soil/Sed)	0.063	0.067	0.067	50 - 120	≤ 30	--	EPA 8270D (Soil/Sed)	0.063	0.067	0.067	50 - 120	≤ 30	--	EPA 8270D (Soil/Sed)	0.063	0.067	0.067	50 - 120	≤ 30	--
4-Nitrophenol	EPA 8270D (Soil/Sed)	0.048	0.17	0.33	23 - 130	≤ 30	--	EPA 8270D (Soil/Sed)	0.048	0.17	0.33	23 - 130	≤ 30	--	EPA 8270D (Soil/Sed)	0.048	0.17	0.33	23 - 130	≤ 30	--
Pentachlorophenol	EPA 8270D (Soil/Sed)	0.096	0.17	0.33	40 - 123	≤ 30	0.36	EPA 8270D (Soil/Sed)	0.096	0.17	0.33	40 - 123	≤ 30	--	EPA 8270D (Soil/Sed)	0.096	0.17	0.33	40 - 123	≤ 30	--
Phenol	EPA 8270D (Soil/Sed)	**0.016**	**0.03**	**0.067**	**37 - 120**	**≤ 30**	**0.42**	EPA 8270D (Soil/Sed)	**0.016**	**0.034**	**0.067**	**37 - 120**	**≤ 30**	**0.42**	EPA 8270D (Soil/Sed)	**0.016**	**0.034**	**0.067**	**37 - 120**	**≤ 30**	**4.2**
2,4,5-Trichlorophenol	EPA 8270D (Soil/Sed)	0.15	0.17	0.33	52 - 120	≤ 30	--	EPA 8270D (Soil/Sed)	0.15	0.17	0.33	52 - 120	≤ 30	--	EPA 8270D (Soil/Sed)	0.15	0.17	0.33	52 - 120	≤ 30	--
2,4,6-Trichlorophenol	EPA 8270D (Soil/Sed)	0.14	0.17	0.33	51 - 120	≤ 30	--	EPA 8270D (Soil/Sed)	0.14	0.17	0.33	51 - 120	≤ 30	--	EPA 8270D (Soil/Sed)	0.14	0.17	0.33	51 - 120	≤ 30	--
Phthalates																					
Bis(2-ethylhexyl) phthalate	EPA 8270D (Soil/Sed)	**0.024**	**0.034**	**0.067**	**63 - 128**	**≤ 30**	**1.3**	EPA 8270D (Soil/Sed)	**0.024**	**0.034**	**0.067**	**63 - 128**	**≤ 30**	**1.3**	EPA 8270D (Soil/Sed)	**0.024**	**0.034**	**0.067**	**63 - 128**	**≤ 30**	**13**
Butyl benzyl phthalate	EPA 8270D (Soil/Sed)	**0.025**	**0.034**	**0.067**	**44 - 144**	**≤ 30**	**0.067**	EPA 8270D (Soil/Sed)	**0.025**	**0.034**	**0.067**	**44 - 144**	**≤ 30**	**0.067**	EPA 8270D (Soil/Sed)	**0.025**	**0.034**	**0.067**	**44 - 144**	**≤ 30**	**0.67**
Dibutyl phthalate	EPA 8270D (Soil/Sed)	0.033	0.034	0.067	60 - 120	≤ 30	1.4	EPA 8270D (Soil/Sed)	0.033	0.034	0.067	60 - 120	≤ 30	--	EPA 8270D (Soil/Sed)	0.033	0.034	0.067	60 - 120	≤ 30	--
Diethyl phthalate	EPA 8270D (Soil/Sed)	0.021	0.034	0.067	54 - 120	≤ 30	0.20	EPA 8270D (Soil/Sed)	0.021	0.034	0.067	54 - 120	≤ 30	--	EPA 8270D (Soil/Sed)	0.021	0.034	0.067	54 - 120	≤ 30	--
Dimethyl phthalate	EPA 8270D (Soil/Sed)	0.027	0.034	0.067	56 - 120	≤ 30	0.071	EPA 8270D (Soil/Sed)	0.027	0.034	0.067	56 - 120	≤ 30	--	EPA 8270D (Soil/Sed)	0.027	0.034	0.067	56 - 120	≤ 30	--
Di-n-octyl phthalate	EPA 8270D (Soil/Sed)	0.019	0.034	0.067	59 - 120	≤ 30	6.2	EPA 8270D (Soil/Sed)	0.019	0.034	0.067	59 - 120	≤ 30	--	EPA 8270D (Soil/Sed)	0.019	0.034	0.067	59 - 120	≤ 30	--
Polycyclic Aromatic Hydrocarbons																					
Acenaphthene	EPA 8270D/3546	**0.016**	**0.034**	**0.067**	**48 - 120**	**≤ 30**	**0.50**	EPA 8270D/3546	**0.016**	**0.034**	**0.067**	**48 - 120**	**≤ 30**	**0.50**	EPA 8270D/3546	**0.016**	**0.034**	**0.067**	**48 - 120**	**≤ 30**	**5.0**
Acenaphthylene	EPA 8270D/3546	0.021	0.034	0.067	56 - 120	≤ 30	1.3	EPA 8270D/3546	0.021	0.034	0.067	56 - 120	≤ 30	1.3	EPA 8270D/3546	0.021	0.034	0.067	56 - 120	≤ 30	--
Anthracene	EPA 8270D/3546	**0.020**	**0.034**	**0.067**	**57 - 120**	**≤ 30**	**0.96**	EPA 8270D/3546	**0.020**	**0.034**	**0.067**	**57 - 120**	**≤ 30**	**0.96**	EPA 8270D/3546	**0.020**	**0.034**	**0.067**	**57 - 120**	**≤ 30**	**9.6**
Benzo(a)anthracene	EPA 8270D/3546	**0.019**	**0.034**	**0.067**	**56 - 124**	**≤ 30**	**1.3**	EPA 8270D/3546	**0.019**	**0.034**	**0.067**	**56 - 124**	**≤ 30**	**1.3**	EPA 8270D/3546	**0.019**	**0.034**	**0.067**	**56 - 124**	**≤ 30**	**13**
Benzo(b)fluoranthene	EPA 8270D/3546	0.033	--	0.067	42 - 132	≤ 30	--	EPA 8270D/3546	0.033	--	0.067	42 - 132	≤ 30	--	EPA 8270D/3546	0.033	--	0.067	42 - 132	≤ 30	--
Benzo(k)fluoranthene	EPA 8270D/3546	0.033	--	0.067	39 - 129	≤ 30	--	EPA 8270D/3546	0.033	--	0.067	39 - 129	≤ 30	--	EPA 8270D/3546	0.033	--	0.067	39 - 129	≤ 30	--
Total Benzofluoranthenes	EPA 8270D/3546	**0.033**	--	**0.067**	**39 - 129**	**≤ 30**	**3.2**	EPA 8270D/3546	**0.033**	--	**0.067**	**39 - 129**	**≤ 30**	**3.2**	EPA 8270D/3546	**0.033**	--	**0.067**	**39 - 129**	**≤ 30**	**32**
Benzo(a)pyrene	EPA 8270D/3546	**0.021**	**0.034**	**0.067**	**53 - 120**	**≤ 30**	**0.15**	EPA 8270D/3546	**0.021**	**0.034**	**0.067**	**53 - 120**	**≤ 30**	**0.15**	EPA 8270D/3546	**0.021**	**0.034**	**0.067**	**53 - 120**	**≤ 30**	**1.5**
Benzo(g,h,i)perylene	EPA 8270D/3546	**0.026**	**0.034**	**0.067**	**44 - 125**	**≤ 30**	**0.67**	EPA 8270D/3546	**0.026**	**0.034**	**0.067**	**44 - 125**	**≤ 30**	**0.67**	EPA 8270D/3546	**0.026**	**0.034**	**0.067**	**44 - 125**	**≤ 30**	**6.7**
Chrysene	EPA 8270D/3546	**0.021**	**0.034**	**0.067**	**53 - 124**	**≤ 30**	**1.4**	EPA 8270D/3546	**0.021**	**0.034**	**0.067**	**53 - 124**	**≤ 30**	**1.4**	EPA 8270D/3546	**0.021**	**0.034**	**0.067**	**53 - 124**	**≤ 30**	**14**
Dibenz(a,h)anthracene	EPA 8270D/3546	**0.025**	**0.034**	**0.067**	**47 - 123**	**≤ 30**	**0.23**	EPA 8270D/3546	**0.025**	**0.034**	**0.067**	**47 - 123**	**≤ 30**	**0.23**	EPA 8270D/3546	**0.025**	**0.034**	**0.067**	**47 - 123**	**≤ 30**	**2.3**
Dibenzofuran	EPA 8270D/3546	**0.018**	**0.034**	**0.067**	**55 - 120**	**≤ 30**	**0.54**	EPA 8270D/3546	**0.018**	**0.034**	**0.067**	**55 - 120**	**≤ 30**	**0.54**	EPA 8270D/3546	**0.018**	**0.034**	**0.067**	**55 - 120**	**≤ 30**	**5.4**
Fluoranthene	EPA 8270D/3546	**0.042**	**0.067**	**0.067**	**52 - 129**	**≤ 30**	**1.7**	EPA 8270D/3546	**0.042**	**0.067**	**0.067**	**52 - 129**	**≤ 30**	**1.7**	EPA 8270D/3546	**0.042**	**0.067**	**0.067**	**52 - 129**	**≤ 30**	**17**
Fluorene	EPA 8270D/3546	**0.016**	**0.034**	**0.067**	**55 - 120**	**≤ 30**	**0.54**	EPA 8270D/3546	**0.016**	**0.034**	**0.067**	**55 - 120**	**≤ 30**	**0.54**	EPA 8270D/3546	**0.016**	**0.034**	**0.067**	**55 - 120**	**≤ 30**	**54**
Indeno(1,2,3-cd)pyrene	EPA 8270D/3546	**0.027**	**0.034**	**0.067**	**40 - 128**	**≤ 30**	**0.60**	EPA 8270D/3546	**0.027**	**0.034**	**0.067**	**40 - 128**	**≤ 30**	**0.60**	EPA 8270D/3546	**0.027**	**0.034**	**0.067**	**40 - 128**	**≤ 30**	**60**
1-Methylnaphthalene	EPA 8270D/3546	0.029	0.034	0.067	55 - 120	≤ 30	--	EPA 8270D/3546	0.029	0.034	0.067	55 - 120	≤ 30	--	EPA 8270D/3546	0.029	0.034	0.067	55 - 120	≤ 30	--
2-Methylnaphthalene	EPA 8270D/3546	**0.024**	**0.034**	**0.067**	**54 - 120**	**≤ 30**	**0.67**	EPA 8270D/3546	**0.024**	**0.034**	**0.067**	**54 - 120**	**≤ 30**	**0.67**	EPA 8270D/3546	**0.024**	**0.034**	**0.067**	**54 - 120**	**≤ 30**	**6.7**
Naphthalene	EPA 8270D/3546	0.015	0.034	0.067	50 - 120	≤ 30	2.1	EPA 8270D/3546	0.015	0.034	0.067	50 - 120	≤ 30	2.1	EPA 8270D/3546	0.015	0.034	0.067	50 - 120	≤ 30	--
Phenanthrene	EPA 8270D/3546	**0.020**	**0.034**	**0.067**	**55 - 120**	**≤ 30**	**1.5**	EPA 8270D/3546	**0.020**	**0.034**	**0.067**	**55 - 120**	**≤ 30**	**1.5**	EPA 8270D/3546	**0.020**	**0.034**	**0.067**	**55 - 120**	**≤ 30**	**15**
Pyrene	EPA 8270D/3546	**0.047**	**0.067**	**0.067**	**49 - 134**	**≤ 30**	**2.6**	EPA 8270D/3546	**0.047**	**0.067**	**0.067**	**49 - 134**	**≤ 30**	**2.6**	EPA 8270D/3546	**0.047**	**0.067**	**0.067**	**49 - 134**	**≤ 30**	**26**

ARI = Analytical Resources, Inc.
CJM = concrete joint material
LCS = laboratory control sample (supplied by ARI)
LOD = limit of detection (supplied by ARI)
LOQ = limit of quantitation (supplied by ARI; equivalent to PQLs or RLs)
MDL = method detection limit (supplied by ARI)
RISL = remedial investigation screening level (Final RI/FS Work Plan 2013)
RPD = relative percent difference (supplied by ARI)

Notes:

Bold values indicate an RI chemical of potential concern (COPC) for the associated media.

^ Building materials include paint and other material located on sides or tops of buildings/structures; copper and silver are not COPCs for building materials, but are COPCs for CJM. Aside from PCBs and metals, MDLs and LOQs for CJM and building materials should be considered target limits and may not be attainable, as they are based on soil and sediment studies, not unconventional matrices. MDLs and LOQs listed above for solid matrices are based on 100% solids (dry weight). Actual MDLs and LOQs for field samples may be higher.

Concentrations for dioxins/furans are in ng/kg; total dioxins/furans is not considered to be a COPC for paint, but is a COPC for other anthropogenic materials.

-- Not applicable or not available

Appendix B

Data Management Procedures

Appendix B
Data Management Procedures

1.0 Best Result Selection

When multiple results for a single chemical are available for a sample, analyte, and fraction (i.e., total and dissolved metals) one single result is often selected for reporting purposes. When working with NBF-GTSP historical analytical data (such as in the RI/FS Work Plan), where supporting information is commonly lacking, a single result is presented. For other cases, such as new RI data where full analytical information is available, multiple results may be presented, and the "best result selection" would not be applied or only partially applied.

Chemicals analyzed by the same analytical method will be qualified by EcoChem. However, if multiple analyses are involved, then the final result may be selected by Leidos. In this case, results not selected as the final result are qualified with a "DNR" to indicate "Do Not Report" in the project database. Results selected as the final result are reported without additional data qualification. The rationale used for best result selection is summarized below.

- When all results are detected, the result with the highest concentration is selected as the final result. If, however, the results are from diluted and non-diluted analyses by the same analytical method, the result from the analysis with the lowest dilution factor is selected.
- When all results are non-detected, the result with the lowest reporting limit is selected as the final result.
- If both detected and non-detected results are available, the detected result will be selected as the final result.

2.0 Reporting and Calculating Procedures

2.1 Significant Figures

Results will typically be reported by Leidos using the same number of significant figures reported by the laboratory. Values that represent total concentrations of individual analytes (e.g., total PCBs from Aroclor summation) will be reported to the maximum number of decimal places recorded in any of the individual analytes. Calculated values, including averages and toxicity equivalent (TEQ) results, will be reported by Leidos to two significant figures, with the exception of dioxins/furans TEQs that will be reported to three significant figures.

2.2 Calculated Totals

Analyte totals will be calculated as described below:

- **Total PCBs Aroclors** are calculated in accordance with the procedures described in the Washington State Sediment Management Standards (SMS) using only detected values for seven Aroclor mixtures (Aroclors 1016, 1221, 1232, 1242, 1248, 1254, and 1260).

However, if detected concentrations are reported for additional Aroclors, they will also be included in calculated totals and will be noted accordingly in any reports and data tables. For samples in which none of the Aroclor mixtures are detected, the total PCB Aroclor results will be given a value equal to the highest RL/PQL of the individual Aroclor mixtures and assigned a U-qualifier.

- **Total polycyclic aromatic hydrocarbons (PAHs), low molecular weight PAHs (LPAHs), high molecular weight PAHs (HPAHs), and total benzofluoranthenes** are calculated in accordance with the procedures described in SMS. Total LPAHs are the sum of detected concentrations of naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, and anthracene. Total HPAHs are the sum of detected concentrations of fluoranthene, pyrene, benzo(a)anthracene, chrysene, total benzofluoranthenes, benzo(a)pyrene, indeno(1,2,3,-c,d)pyrene, dibenz(a,h)anthracene, and benzo(g,h,i)perylene. Total PAHs include all chemicals listed above for LPAH and HPAH. Total benzofluoranthenes are the sum of the b, j, and k isomers when data for these individual isomers are available. Alternately, a total benzofluoranthenes result may be reported by the laboratory, depending on the analytical conditions. For samples in which all individual compounds within the groups described above are undetected, the single highest RL/PQL for the component chemical in that sample represents the associated total result.

2.3 Weighted Totals

Toxicity-weighted analyte totals will be calculated as described below:

- The TEQ concentration of dioxins/furans compounds will be normalized to the toxicity of 2,3,7,8-TCDD using toxicity equivalency factors (TEFs) updated by the World Health Organization (WHO) in 2005 (Van den Berg et al. 2006) and incorporated into the Model Toxics Control Act (MTCA) (WAC 173-340-900, Table 708-1). The TEQ is equal to the sum of the concentrations of 17 individual congeners multiplied by their TEF (potency relative to 2,3,7,8-TCDD). Non-detected values will be assessed using half the detection limit for data evaluation purposes. Dioxins/furans TEFs are listed in Table B-1 on the following page.

Table B-1. Dioxin/Furan TEFs

Analyte	TEF
Dioxin Congeners	
2,3,7,8-TCDD	1
1,2,3,7,8-PECDD	1
1,2,3,4,7,8-HXCDD	0.1
1,2,3,6,7,8-HXCDD	0.1
1,2,3,7,8,9-HXCDD	0.1
1,2,3,4,6,7,8-HPCDD	0.01
1,2,3,4,6,7,8,9-OCDD	0.0003
Furan Congeners	
2,3,7,8-TCDF	0.1
1,2,3,7,8-PECDF	0.03
2,3,4,7,8-PECDF	0.3
1,2,3,4,7,8-HXCDF	0.1
1,2,3,6,7,8-HXCDF	0.1
1,2,3,7,8,9-HXCDF	0.1
2,3,4,6,7,8-HXCDF	0.1
1,2,3,4,6,7,8-HPCDF	0.01
1,2,3,4,7,8,9-HPCDF	0.01
1,2,3,4,6,7,8,9-OCDF	0.0003

- Carcinogenic PAH (cPAH) values will be similarly calculated using TEQ values based on an individual compound’s relative toxicity to benzo(a)pyrene (WAC 173-340-900, Table 708-2). Final cPAH concentrations are equivalent to the sum of the concentrations of the seven individual cPAH compounds multiplied by their associated TEF. Non-detected values will utilize half of the PQL for data evaluation purposes.

Table B-2. cPAH TEFs

Analyte	TEF
Benzo(a)pyrene	1
Benzo(a)anthracene	0.1
Benzo(b)fluoranthene	0.1
Benzo(k)fluoranthene	0.1
Benzofluoranthenes (total)	0.1
Chrysene	0.01
Dibenz(a,h)anthracene	0.1
Indeno(1,2,3-cd)pyrene	0.1

3.0 Qualifier Mapping

Data qualifiers will be reported by the laboratories, as defined in the data packages. Additional data qualifiers may be applied during data validation using USEPA functional guidelines. Leidos will review the combination of both laboratory and validation qualifiers and report final results with a single set of interpreted qualifiers, listed in Table B-3. All data qualifiers will be stored in the project database. Results rejected for QA/QC reasons will be reported as rejected, without quantitative values.

Table B-3. Final Data Qualifiers

Final Data Qualifier	Qualifier Definition
J	estimated concentration
U	non-detect at the given reporting limit
UJ	non-detect at the given reporting limit, which is estimated
C	the result is a coelution
CJ	the result is a coelution with an estimated concentration
CU	the non-detected result is a coelution
CUJ	the non-detected result is a coelution with an estimated concentration
R	rejected

Appendix C

RI Field Forms and SOP List

FIELD EQUIPMENT CALIBRATION SHEET

CLIENT: Department of Ecology **PROJECT:** NBF-GTSP RI

COMMENTS: ____

DATE / TIME / INITIALS	INSTRUMENT (MAKE AND MODEL)	SERIAL OR ID NUMBER	CALIBRATION GAS OR SUBSTANCE	CONCENTRATION OR VALUE	INSTRUMENT READING	COMMENTS	OK ?

Subsurface Asset and Hazard Avoidance Checklist

Project Name: NBF-GTSP RI

Location:

Scheduled Field Dates:

The following checklist must be completed and signed by the Field Manager. The Field Manager must complete (initial checklist items) and sign this checklist to indicate that he/she has personally performed or verified that each applicable requirement has been or will be completed or that an item is not applicable to the planned work. If any applicable checklist items cannot be completed, then the Project Manager's approval is required to proceed. In order to approve deviating from these requirements, the Project Manager must ensure that alternate and adequate controls have been implemented.

PRIOR TO GOING ON-SITE	
Initials and Date	**Requirement**
	Perform a detailed review of the project work plan.
	Contact the state utility one-call program or facility utility program to locate and mark subsurface assets and hazards at the worksite.
	Obtain from the client the specifications for any underground storage tanks at the site and review the proposed locations for drilling or excavation relative to the tank specifications.
	Obtain from the client the "as built" drawings for the site and review the proposed locations relative to the subsurface structures shown in the drawings.
	Verify that all of the proposed drilling or excavation locations are not; immediately between storage tanks and product dispenser systems, immediately between storage tanks and the control units (building), or immediately between dispenser systems and the control units (building).
	Verify that all of the proposed drilling or excavation locations are outside the area immediately between underground storage tanks and tank air vents.
	Plan for response to unintentional damage to utility, include information in H&S plan, and include response information in site training.
ON-SITE	
	Mark all drilling or excavation locations using spray paint or some other recognizable and durable marking.
	Review all locations with the facility owner/operator to determine if any unidentified utilities or structures are present.
	Walk the perimeter of the site and buildings in the vicinity of the planned work and verify that all known utilities have been marked. Identify if any of the following are present and verify that the associated utilities have been identified.
	Yes ☐ No ☐ water shut off valves
	Yes ☐ No ☐ sewer clean-outs
	Yes ☐ No ☐ electrical junction boxes
	Yes ☐ No ☐ cable television junction boxes
	Yes ☐ No ☐ telephone/electric poles
	Yes ☐ No ☐ manhole covers
	Yes ☐ No ☐ fire hydrants
	Yes ☐ No ☐ light poles
	Yes ☐ No ☐ storage tank vents
DRILLING	
	If planned borehole is within 25 feet of known or suspected utilities, excavate borehole to a diameter at least 3 inches wider than the diameter of drilling equipment (or bracket with smaller holes) and at least 5 feet deep without encountering evidence of utilities (exposed lines, pea-gravel, etc.).
	Planned drilling locations are at least 3 feet from known utilities.

Subsurface Asset and Hazard Avoidance Checklist

EXCAVATION

	If planned excavation will or may come within 25 feet of known or suspected utilities, excavation area surveyed using a hand held magnetic locator/metal detector (or other appropriate device) to identify utilities. Enter serial number of instrument(s).
	If excavation will cross a utility or come within 5 feet of a utility, expose the utility at the crossing point or at the nearest approach, using low-impact techniques, in order to determine its exact location.
	Requirements of E&I EC&HS Procedure 160, Excavation Safety, have been reviewed and will be met.

I have personally verified the items initialed above and believe that the planned drilling or excavation will not unintentionally contact subsurface assets or hazards.

Field Manager Signature	Printed Name	Date

I have reviewed this form because it was not possible for the field manager to complete all of the checklist items. I have verified that other sufficient controls are in place or I have taken steps to notify the client and have the client accept (in writing) the additional liability. The additional controls are as follows:

Project Manager Signature	Printed Name	Date

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MONITORING WELL/ BORING LOG

BORING/WELL No:
PAGE 1 of

PROJECT: NBF-GTSP RI	DRILLER:	WELL DIAMETER:
LOCATION:	DRILL METHOD:	WELL DEPTH:
CLIENT:	SAMPLE METHOD:	WELL CASING:
DATE:	HOLE DIAMETER:	WELL SCREEN:
LOGGED BY:	HOLE DEPTH:	FILTER PACK:
PHOTOGRAPH TAKEN?	EQUIPMENT DECONTAMINATED?	CASING ELEVATION:

Water Level	Moisture Content	PID (ppm)	BLOWS / 6"	Sample		DEPTH (ft.)	SOIL TYPE	LITHOLOGY / DESCRIPTION	Well Completion/ Backfill Material
				Recovery	Interval				
						2			
						4			
						6			
						8			
						10			
						12			
						14			
						16			
						18			
						20			

NOTES:

GROUNDWATER SAMPLE COLLECTION FORM

PROJECT: NBF-GTSP RI

DATE/TIME: ____________________

SAMPLE ID: ____________________

WEATHER: ____________________

LOCATION NAME: ____________________

ANALYSIS: ____________________

WELL PURGING DATA

Initial depth to water:____________________

Depth of well:____________________

Screened interval: ____________________

Volume of water in well:____________________

Method of purging:____________________

Purge rate:____________________

Method of decontaminating:____________________

SAMPLE CONTAINER DATA:

Type	Preservative	Volume	No. Required	No. Filled

SAMPLE METHOD: Pump Bailer Other______

FILTERED FOR METALS? Yes No

Filter for metals purged? ☐

Photograph taken? ☐

Sample entered on C.O.C.? ☐

Equipment decontaminated? ☐

SAMPLE PRESERVATION METHOD: ____________________ Iced________

Volume of water (gallons) in 2-inch PVC monitoring well = 0.174*h (h = height of water column in well, in feet)

WATER QUALITY OBSERVATIONS DURING PURGING

Date/Time	Volume Purged (gallons)	Depth to Water (feet)	Temp (°C)	pH	Conductivity (µS/cm)	D.O. (mg/L)	Redox (± mV)	Turbidity (NTU)

Comments: ____________________

Signature: ____________________

Date/Time: ____________________

SOIL VAPOR SAMPLING FORM

Project: NBF-GTSP RI

Date and Time: ______________________________

Personnel: ____

Soil Vapor Sampling Point ID	Vacuum Test		Purging				Helium		Sampling				PID	
	Time Start Vacuum Testing	Time Stop Vacuum Testing	Time Start Purging	Time Stop Purging	Purging Rate (ml/min)	Total Volume Purged (ml)	Time of Helium Reading	Helium Reading	Time Start Sampling	Time Stop Sampling	Canister Vacuum Before Sampling (in Hg)	Canister Vacuum After Sampling (in Hg)	Time of PID Reading	PID Reading (ppm)

Notes: ____

____

____

____

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STORM DRAIN SOLIDS COLLECTION FORM

Project: NBF-GTSP RI

Location ID: ______________________

Sampled By: ____________________________

Sample ID: _______________________

Date: ______/______/ 2014

Time: ______________

Structure Type:	**Dimensions:** **W_______L_______**	**Standing Water:** **Y / N**	**Flow:** **Y / N**
System Sketch ↑**N**			
Depth to Bottom: ______________**ft**	**Depth to Water:** ______________**ft**	**Depth of Solids:** ______________**in**	**Sampled: Y / N** **Discrete / Composite** *(circle one)* **Equip. Decontaminated? Y / N**
Solid type:	***Solid color:***	***Solid Odor:***	***Comments:***
Cobble Gravel Sand F M C Silt/clay Organic matter Debris	Drab olive Brown Brown surface Gray Black Tan	None Slight Moderate Strong Overwhelming H_2S Petroleum	Photo Info: ________________________ GPS Coordinates: ________________________

NOTES:

Recorded By/Date: ____________________________

Reviewed By/Date: ______________________________

SURFACE DEBRIS COLLECTION FORM

Project: NBF-GTSP RI

Location Name: ____________________

Sampled By: ____________________

Sample ID: ____________________

Date and Time: ____________________

GPS Coordinates: ____________________
(centroid location)

Sampling Area Sketch (include: approximate length and width (feet) of polygon, nearby buildings, and nearby storm drain structures)

↑N

Debris type and percent:		***Overall debris color:***	***Debris size:***	***Substrate:***
Asphalt material		Drab olive	Dusty	Concrete
Concrete material		Brown	Sandy	Asphalt
Plant debris		Gray	*Other:*	*Other:*
Soil		Black		
Paint		Tan		
Rubber		Silver		
Caulk		Orange	Photograph taken?	☐
Metal		White	Sampling polygon drawn on aerial photo?	☐
Waste & materials		*Other:*	Equipment decontaminated?	☐
Other:				

NOTES (provide detailed description of material):

Recorded By/Date: ____________________

Reviewed By/Date: ____________________

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ANTHROPOGENIC MATERIALS COLLECTION FORM

Project: NBF-GTSP RI **Date and Time:** ______________________ **Sampled By:** ___________________________

Sample ID: ____ **Location Name:** ____

Nearby Storm Drain Structure(s): ____________________ **GPS Coordinates:** ____

Side of Building	***Portion of Building/ Structure/Surface***	***Material Type***	***Substrate***	***Condition***	***Color***
North South East West Roof Not applicable *Other:*	Wall Window Door Ground *Other:* Height above ground:	CJM Paint Caulk OEM Roof debris Solid roof materials Downspout solids *Other:*	Brick Asphalt Concrete Metal siding Synthetic siding Wood Rubber Corrugated metal Foam Insulation *Other:*	New/Fresh Chipping/Flaking Peeling Cracked/Crumbling Fragmented Discolored Oxidized/Rusted Soft or Hard *Other:*	Pale or Dark or Bright Beige Gray Brown Red Tan White Black Yellow Blue Green Orange Silver *Other:*
Location/Sample Information and Comments:					

Circle/complete all sample descriptors above that are applicable to the associated sample.

Photograph taken? ☐
Location drawn on aerial photo? ☐
Equipment decontaminated? ☐

Recorded By/Date: ________________________________

Reviewed By/Date: ________________________________

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EQUIPMENT RINSE SAMPLE COLLECTION FORM

PROJECT: NBF-GTSP RI

DATE/TIME: ________________________

SAMPLE ID: ______________________________

WEATHER: _________________________

ANALYSIS: ____

EQUIPMENT RINSE DATA

Equipment rinsed:____

Environmental sample for which equipment was used:____

Method of decontaminating:____

SAMPLE CONTAINER DATA:

Type	Preservative	Volume	No. Required	No. Filled

SAMPLE METHOD: ______________

Photograph taken? ☐

Sample entered on C.O.C.? ☐

SAMPLE PRESERVATION METHOD: _____________________________________ Iced_______

Comments:____

____

____

____

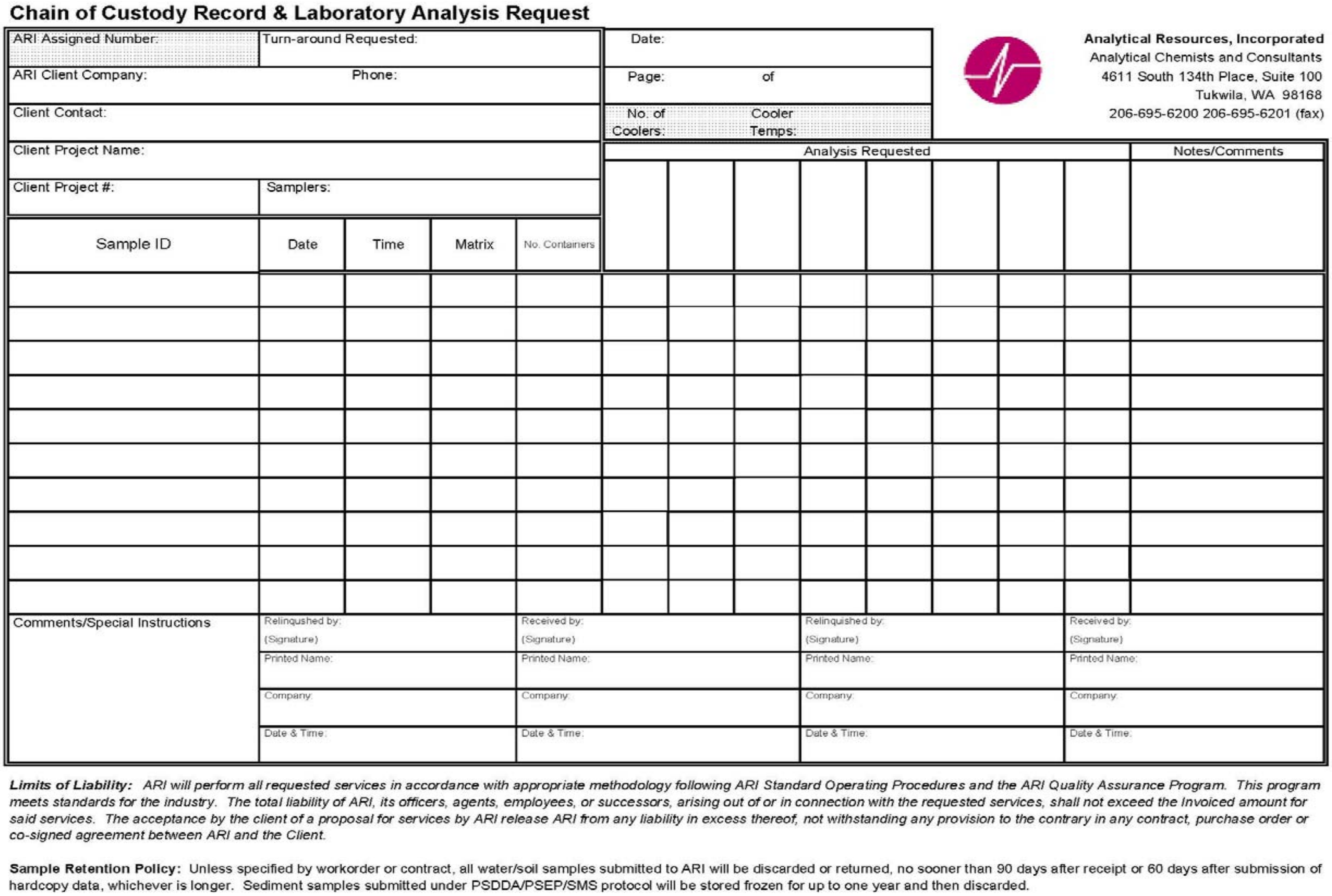
____

____

Signature: __________________________________

Date/Time: ___________________

CHAIN OF CUSTODY FORM



Chain of Custody Record & Laboratory Analysis Request

ARI Assigned Number:
Turn-around Requested:
Date:
ARI Client Company:
Phone:
Page: of
Client Contact:
No. of Coolers:
Cooler Temps:
Client Project Name:
Client Project #:
Samplers:

Analytical Resources, Incorporated
Analytical Chemists and Consultants
4611 South 134th Place, Suite 100
Tukwila, WA 98168
206-695-6200 206-695-6201 (fax)

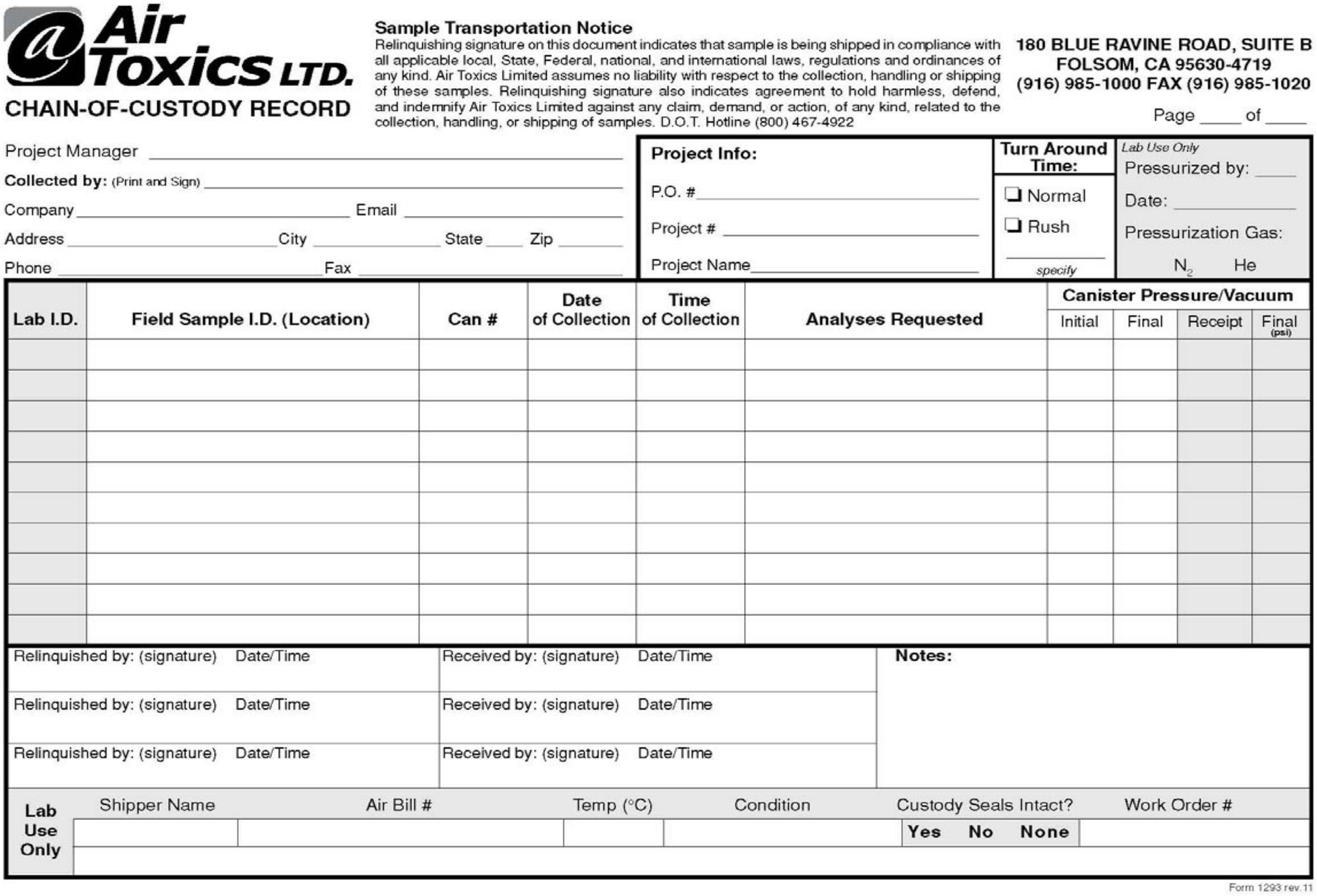
Sample ID	Date	Time	Matrix	No. Containers	Analysis Requested								Notes/Comments

Comments/Special Instructions	Relinqushed by: (Signature)	Received by: (Signature)	Relinqushed by: (Signature)	Received by: (Signature)
	Printed Name:	Printed Name:	Printed Name:	Printed Name:
	Company:	Company:	Company:	Company:
	Date & Time:	Date & Time:	Date & Time:	Date & Time:

Limits of Liability: *ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.*

Sample Retention Policy: Unless specified by workorder or contract, all water/soil samples submitted to ARI will be discarded or returned, no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer. Sediment samples submitted under PSDDA/PSEP/SMS protocol will be stored frozen for up to one year and then discarded.

CHAIN OF CUSTODY FORM



Air Toxics LTD.

CHAIN-OF-CUSTODY RECORD

Sample Transportation Notice

Relinquishing signature on this document indicates that sample is being shipped in compliance with all applicable local, State, Federal, national, and international laws, regulations and ordinances of any kind. Air Toxics Limited assumes no liability with respect to the collection, handling or shipping of these samples. Relinquishing signature also indicates agreement to hold harmless, defend, and indemnify Air Toxics Limited against any claim, demand, or action, of any kind, related to the collection, handling, or shipping of samples. D.O.T. Hotline (800) 467-4922

180 BLUE RAVINE ROAD, SUITE B
FOLSOM, CA 95630-4719
(916) 985-1000 FAX (916) 985-1020

Page _____ of _____

Project Manager ____________________

Collected by: (Print and Sign) ____________________

Company ____________________ Email ____________________

Address ____________________ City ____________ State ____ Zip ________

Phone ____________________ Fax ____________________

Project Info:

P.O. # ____________________

Project # ____________________

Project Name ____________________

Turn Around Time:

☐ Normal

☐ Rush

________ *specify*

Lab Use Only

Pressurized by: ______

Date: ____________

Pressurization Gas:

N_2 He

Lab I.D.	Field Sample I.D. (Location)	Can #	Date of Collection	Time of Collection	Analyses Requested	Canister Pressure/Vacuum			
						Initial	Final	Receipt	Final (psi)

Relinquished by: (signature) Date/Time	Received by: (signature) Date/Time	**Notes:**
Relinquished by: (signature) Date/Time	Received by: (signature) Date/Time	
Relinquished by: (signature) Date/Time	Received by: (signature) Date/Time	

Lab Use Only	Shipper Name	Air Bill #	Temp (°C)	Condition	Custody Seals Intact?	Work Order #
					Yes No None	

Form 1293 rev.11

Leidos Standard Operating Procedures List
NBF-GTSP Remedial Investigation

Procedure No.	Procedure Title
FTP-370	Groundwater Sampling Procedures: Water Level Measurements
FTP-405	Cleaning and Decontaminating Sample Containers and Sampling Equipment
FTP-525	Soil Sampling Using an Auger
FTP-605	Gauging and Sampling Light Non-Aqueous Phase Liquid in a Well
FTP-625	Sample Chain of Custody
FTP-691	Composite Procedures
FTP-750	Field Measurement Procedures: Organic Vapor Detection
FTP-880	Field Measurement Procedures: pH, Temperature, and Conductivity
FTP-910	Field Measurement Procedures: Turbidity
FTP-955	Field Measurement Procedures: Dissolved Oxygen
FTP-1215	Field Activity Documentation
FTP-1220	Documenting and Controlling Field Changes to Approved Work Plans
FTP-1225	Field Demobilization Checklist for Project-Generated Waste
SOP-1.0	Low-Flow Groundwater Sampling
EHS-4.1	Incident Reporting and Investigation
EHS-8	Hazard Communication Program
EHS-13	Personal Protective Equipment
EHS-15	Hearing Conservation and Noise Control
EHS-20	Hazardous Waste Operations
EHS-110	Vehicle Operation
EHS-130	Subsurface Asset and Hazard Avoidance
EHS-280	Investigative Derived Waste

FTP = Field Technical Procedure
SOP = Standard Operating Procedure
EHS = Environmental, Health and Safety procedure

Appendix D

Electronic Data Deliverable Format

Appendix D

Electronic Data Deliverable Format

Laboratory electronic data deliverables (EDDs) will be submitted as tab delimited text or csv files and will conform to the specifications listed below. This format provides all data required for an EIM submittal.

Field	Name	Type[1]	Data Required[2]
1	PROJID	T	No
2	STUDYID	T	No
3	FIELDID	T	No
4	LABID	T	Yes
5	LABBATCH	T	Yes
6	CAS NUMBER	T	Special
7	ANALYTE	T	Yes
8	VALUE	N	Yes
9	VALUESF	N	No
10	LABQUAL	T	Special
11	UNITS	T	Yes
12	MDL	N	Special
13	REPLIMIT	N	Yes
14	ANLGROUP	T	No
15	PREPMETHOD	T	No
16	ANLMETHOD	T	Yes
17	MATTYPE	T	Yes
18	BASIS	T	Yes
19	LEACHDATE	T	No
20	EXTRDATE	D	Special
21	ANLDATE	D	Yes
22	DILFACTOR	N	Yes
23	COLUMN	T	Yes
24	FRACTION	T	Yes
25	LABNAME	T	Yes
26	PARENTID	T	Special
27	SAMPLEQTY	N	No
28	QTYUNITS	T	No
29	MOISTURE	N	No
30	QCTYPE1	T	Special
31	QCTYPE2	T	Special
32	SURROGATE	N	Special
33	SPIKE	N	Special
34	RECOVERY	N	No
35	RPD	N	No
36	LOWLIMIT	N	No
37	UPPLIMIT	N	No
38	RPDLIMIT	N	No

Notes:

1. ***Type*** field refers to the following data types:

T	Text, preferably left justified.
N	Numeric, no decimal defined.
D	Date/time, Date must be 8 characters long for the date with the format MM/DD/YY. Time must be 6 or 8 characters long in the format of HH:MM (hours and minutes) or HH:MM:SS (hours, minutes, and seconds). The time must be presented in 24 hour clock (not 12 hour clock).

2. ***Data required*** field indicates the following:

Yes	The field must contain some information and a blank value is not acceptable.
No	The field does not require information and if left blank, is assumed to mean no information was supplied.
Special	A special case where the field may be left blank if appropriate; however, a blank field does not represent a lack of information, rather, it indicates some meaning (i.e., a blank in LABQUAL indicates a detected result).

Field Descriptions:

1. **PROJID:** Project name, provided by the client at the beginning of the work assignment and is also listed on the COC forms, sample labels, and other project documentation.
2. **STUDYID:** Unique 8 character ID to identify the study in the Washington Department of Ecology's EIM database.
3. **FIELDID:** The sample identification number as reported on the COC form and on sample labels, or the laboratory QC sample identification.

   QC samples created by the Laboratory from field samples (e.g., laboratory duplicates) must contain the exact SAMPID of the field sample. Other Laboratory QC samples (e.g., blanks, spikes, duplicates) must have unique sample identifiers which may be identical to the LABID below.
4. **LABID:** The Laboratory internal identification number. The combination of the FIELDID and LABID field should be sufficient to uniquely define either an environmental or QC sample, but may not be sufficient to distinguish reanalyses and dilutions.
5. **LABBATCH:** The laboratory identification number used to associate laboratory generated QC samples.
6. **CAS NUMBER:** A unique identifying number assigned by the Chemical Abstracts Service (CAS) Division of the American Chemical Society to each distinct chemical substance recorded in the CAS Chemical Registry System. The CAS Number is accepted nationally and internationally as an identifier for specific, definable chemical substances.
7. **ANALYTE:** Analyte or parameter reported. All compounds should be reported in upper case.
8. **VALUE:** Concentration, value, or result of the compound tested, reported to the correct number of significant figures. The reporting limit (RL) will be reported for non-detect values. Only numbers are acceptable for this field.

In the case of spiked results, the VALUE will be the spiked sample result and will not be adjusted for the original sample results. If spiked compounds are diluted beyond detection, then the reporting limit (RL) shall be reported in the VALUE field and a "U" added with other qualifiers in the LABQUAL field.

9. **VALUESF:** The number of significant figures that should be reported for the VALUE field.
10. **LABQUAL:** Lab flags or qualifiers are reported in this field.

    Qualifier codes may be used from the *Statement of Work for Organics Analysis, Multi-Media, Multi-Concentration,* and Document OLM01.0 through revision OLM01.8 (USEPA, August 1991). More than one qualifier may be used per record. If other qualifiers are used, then the Laboratory must include a list of the definitions of the codes with the electronics. The list may be present as a paper copy or an electronic text file.

    All non-detected results shall be reported with a "U" qualifier. The qualification "ND" for non-detected results is unacceptable. Blank values are acceptable and implied to mean a detected result. If a range will be reported (e.g., greater than 50) the symbol ">" shall be reported in this field.
11. **UNITS:** The units of measure for each record will be reported in this field.
12. **MDL:** Used to report the method detection limit (MDL), a value determined by MDL studies performed in accordance with 40 CFR or sample specific estimated detection limits (e.g., 2.5 x signal to noise ratio) for high resolution, isotope dilution test methods. This value is corrected for dilution, percent moisture, or related factors that affect the MDL and/or RL. MDLs are required for all results, as applicable (e.g., not applicable for total solids).
13. **REPLIMIT:** Used to report the reporting limit (RL presented in REPLIMIT field). Non-detect results reported in the VALUE field should contain the RL corrected for dilution, percent moisture, or related factors that affect the RL.
14. **ANLGROUP:** Field used to group results from various methods. For instance, an entry of ‘METALS’ may be entered to report results from methods SW-846 6010, SW-846 7041, and SW-846 7470.
15. **PREPMETHOD:** Indicate the extraction or digestion method used (e.g., SW-846 3550B).
16. **ANLMETHOD:** Indicate the analytical method used (e.g., SW-846 8270). Dissolved metals must be clearly identified versus total metals results.
17. **MATTYPE:** Indicate one of the following for the matrix analyzed: SOIL, SEDIMENT, TISSUE, and WATER. If a sample or laboratory QC material does not match one of these, indicate with a code of "X" and explain in the cover letter.
18. **BASIS:** Indicate whether results are reported on a dry weight or wet weight basis, using the terms DRY or WET. If a sample or laboratory QC material does not match one of these, indicate with a code of "X" and explain in the cover letter.
19. **LEACHDATE:** Date the sample was extracted for TCLP or SPLP test methods. If leaching extraction is not applicable, then the field must be left blank.
20. **EXTRDATE:** Date the sample was extracted or prepared. If an extraction or preparation step is not applicable, then the field may be blank.
21. **ANLDATE:** Date the sample was analyzed.

22. **DILFACTOR:** The dilution factor. This should also reflect "effective" dilutions achieved by increasing or decreasing sample or extracting solvent volumes from standard amounts. That is, pre-concentration steps will result in a dilution factor of less than 1; this is OK.

23. **COLUMN:** This field is used to identify the analytical column from which the result was reported, if applicable.

Code	Definition
1	Primary column
2	Secondary column, also known as conformational column
N	Not applicable

24. **FRACTION:** This field identifies when an aqueous sample is filtered prior to analysis to determine the "dissolved" portion of the chemical of interest. Unfiltered aqueous samples are reported as the "total" fraction. This nomenclature is typically used for metals analysis.

Code	Definition
T	Total
D	Dissolved
N	Not applicable

25. **LABNAME**: The full name (and location if appropriate) of or abbreviated name (and location) of the laboratory performing the analysis.

26. **PARENTID**: For duplicate samples only (i.e., laboratory duplicate, MSD, or LCSD). List the parent sample ID.

27. **SAMPLEQTY:** Quantity or weight of the sample aliquot used for analysis.

28. **QTYUNITS:** The units of measure for the quantity or weight of the sample used for analysis.

29. **MOISTURE:** Moisture content of solid samples, expressed as percent moisture.

30. **QCTYPE1:** This field is used to identify laboratory QC samples. A blank value is acceptable, indicating the record is not one of the sample types below. One of the following codes must be used to identify the laboratory QC sample type:

Code	Definition
RM	Reference material.
MB	Method blank.
LCS	Laboratory control sample (blank spike or ongoing precision and recovery check).
MS/MSD	Matrix spike / matrix spike duplicate samples.
DUP	Duplicate (Laboratory duplicates only; field duplicates will have a unique SAMPID).

31. **QCTYPE2:** This field is used to identify analyte types, including tentatively identified compounds (TICs), surrogate compounds, internal standards (IS), and labeled compounds (LC). A blank value is acceptable, indicating the record is not one of the analyte types below. One of the following codes must be used to identify the analyte type:

Code	Definition
SUR	Surrogate or labeled compound result.
TIC	Tentatively identified compound.
IS	Internal standard.

32. **SURROGATE:** If added, this refers to the surrogate or labeled compound concentration or amount expected, for example 100 for 100 ug/kg. Units of measure are implied from the UNITS field.
33. **SPIKE:** If added, this refers to the spike concentration or amount expected, for example 100 for 100 ug/kg. Units of measure are implied from the UNITS field.
34. **RECOVERY:** Percent (%) recovery. A blank value is acceptable, indicating a non-spiked, non-reference material result. This field should be filled in for surrogates and labeled compounds as well as spiked QC samples and reference materials.
35. **RPD:** Relative percent difference. This field should be filled in for field and laboratory duplicate, matrix spike duplicates, and laboratory control sample duplicates.
36. **LOWLIMIT:** Lower recovery control limit. This field should be filled in for surrogates, QC samples and reference materials.
37. **UPPLIMIT:** Upper recovery control limit. This field should be filled in for surrogates, QC samples and reference materials.
38. **RPDLIMIT:** Relative percent difference control limit. This field should be filled in for laboratory duplicates and spiked sample duplicates.

The EDD used for data validation will include all of the fields noted above with data populated by the laboratory, and the following additional fields populated by the data validator.

Field	Name	Type[1]	Data Required[2]
39	val_name	T	Yes
40	val_date	D	Yes
41	val_qual	T	Special
42	val_level	T	Yes
43	val_reason	T	Special
44	val_notes	T	No

39. **val_name:** The full or abbreviated name of the data validation firm.
40. **val_date:** The date on which data validation was completed.
41. **val_qual:** Any data qualifiers added during data validation.
42. **val_level:** The level of data validation (e.g., full or summary, S2AVEM).
43. **val_reason:** The reason (or reason code) for data qualification. This field is required if validation qualifiers were added.
44. **val_notes:** Any additional notes. If numeric results changed during data validation, it must be noted here.