APPENDIX A

Rolling Knolls Landfill Settling Parties

Quality Assurance Project Plan for the Data Gaps Sampling and Analysis Plan

Rolling Knolls Landfill Superfund Site

Chatham, New Jersey

October 2014

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Quality Assurance Project Plan for the Data Gaps Sampling and Analysis Plan

Rolling Knolls Landfill Superfund Site
Chatham, New Jersey

Prepared for:
Rolling Knolls Landfill Settling Parties

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Our Ref.:
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Date:
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2014 Quality Assurance Project Plan (QAPP) Worksheets

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QAPP Worksheet #1 & 2: Title and Approval Page

1. **Project Identifying Information**

    a. **Site name/project name**: Rolling Knolls Landfill Superfund Site

    b. **Site location/number**: The site is located at the southern end of Britten Road south of Green Village in Chatham Township, Morris County, New Jersey

    c. **Contract/Work assignment number**: Index No. II-CERCLA-02-2005-2034

2. **Federal Regulatory Agency**: Tanya Mitchell, Remedial Project Manager, United States Environmental Protection Agency (USEPA) Region

    _____ (Signature/Date)

3. **State Regulatory Agency**: Gwen Zervas, Case Manager, New Jersey Department of Environmental Protection (NJDEP)

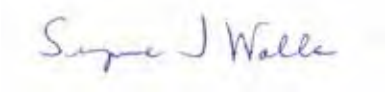
    _____ (Signature/Date)

4. **Lead Organization**: ARCADIS US, Inc.

    a. **Lead Organization Project Coordinator**: John Persico, Designated Project Coordinator, ARCADIS

    ___ _____10/29/2014_____ (Signature/Date)

    b. **Lead Organization Project Manager**: Suzanne J. Walls, Project Manager, ARCADIS

    ____  _____10/29/2014_____ (Signature/Date)

    c. **Lead Organization Quality Manager**: Dennis K. Capria, Quality Assurance Manager, ARCADIS

    _____ _____10/29/2014_____ (Signature/Date)

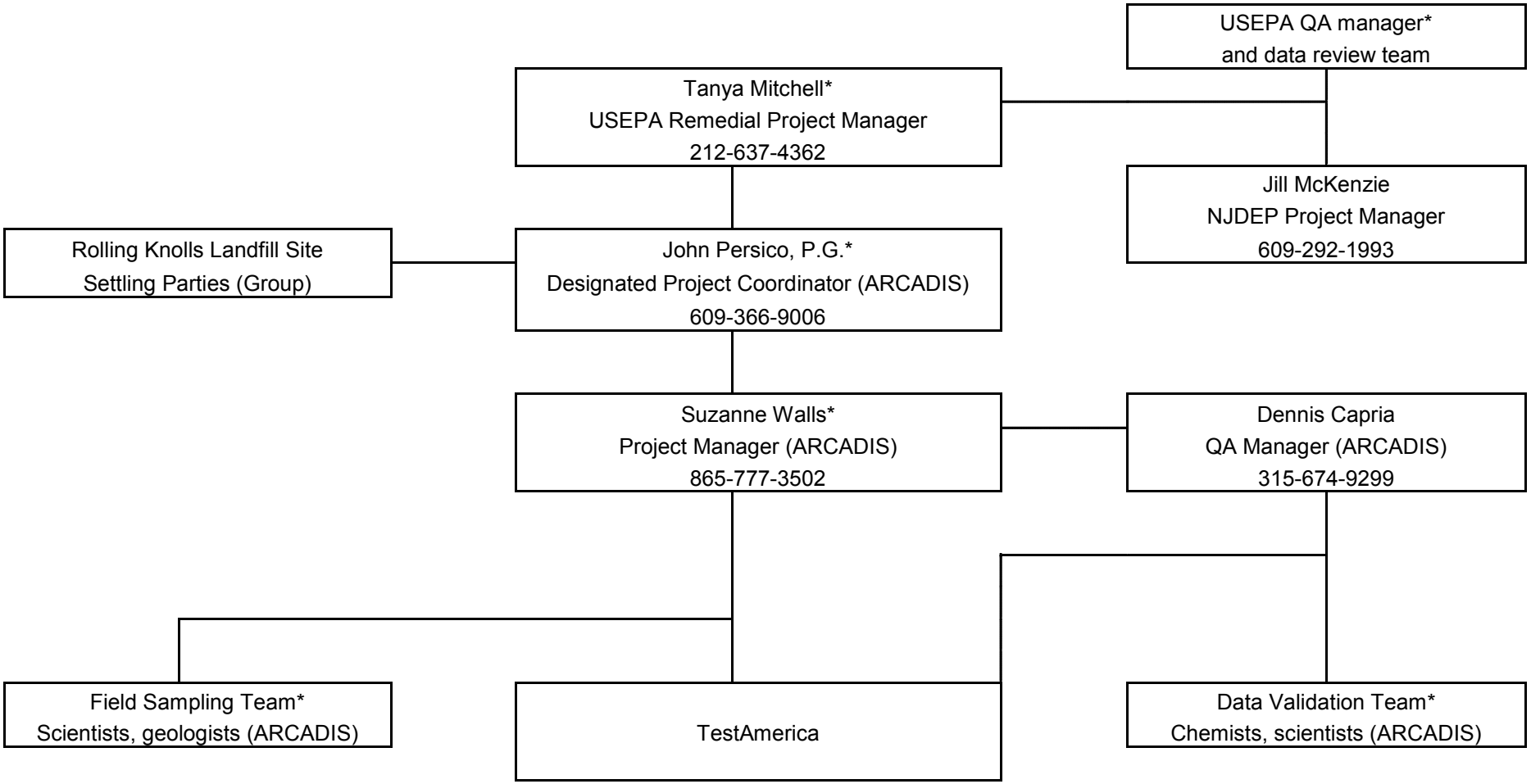
5. **Other Stakeholders**: United States Fish and Wildlife Service (USFWS), Robert J. Miele as Trustee for the Trust created by the Last Will and Testament of Angelo J. Miele and the Green Village Fire Department

6. **Plans and reports from previous investigations relevant to this project**:

    Site Characterization Summary Report (ARCADIS US Inc., February 2012) and the Baseline Human Health Risk Assessment (CDM, June 2014)

QAPP Worksheet #3 & 5: Project Organization and QAPP Distribution

*QAPP recipient Lines of authority _____ Lines of Communication - - - - - - - - - - - - - -



* - QAPP recipient

QAPP Worksheet #4, 7 & 8: Personnel Qualifications and Sign-off Sheet

Name	Project Title/Role	Education/Experience	Specialized Training/Certifications	Signature/Date
John Persico	Designated Project Coordinator (ARCADIS)	B.A. Geology, M.S. Geology/Geochemistry, 26 years of experience RIFS	P.G.	
Suzanne Walls	Project Manager (ARCADIS)	B.S. Biology, Environmental Politics, M.S. Entomology (in progress), 9 years of ecological risk experience	Certified Ecologist	
Dennis Capria	Quality Assurance (QA) Manager (ARCADIS)	B.S. Biology, minor Chemistry; 26 years of experience		
Kathryn Kelly	Project Manager (TestAmerica)	B.A. English		
Sara Goff	Laboratory QA Manager (TestAmerica)	B.S. Health Sciences		

*Signatures indicate personnel have read and agree to implement this QAPP as written

All ARCADIS personnel collecting samples have DOT/IATA Hazardous Materials Shipping and Transportation Training (HazMat #1). This training is for filling containers, and preparing, packaging and/or shipping HazMat ground and/or air. Training certificates are available upon request.

QAPP Worksheet #6: Communication Pathways

Communication Driver	Organization	Name	Contact Information	Procedure (timing, pathway, documentation, etc.)
Regulatory agency interface	USEPA	Tanya Mitchell	212.637.4362	To be contacted as needed.
Field progress reports	ARCADIS	Suzanne Walls, Project Manager	865.777.3502	To be provided daily field progress reports (through email or phone calls). Will provide complete sets of daily field progress reports, sampling logs, chains-of-custody forms, and other information to the Remedial Investigation (RI) Field Program Coordinator.
Coordinate Field Program	ARCADIS	Suzanne Walls, Project Manager	865.777.3502	To be notified of field related questions or problems by phone or email.
Stop work due to safety issues	ARCADIS	Any employee		Any employees who feel the workplace is unsafe can stop work until the safety issue is resolved.
QAPP changes prior to field work and during project executions	ARCADIS	Dennis Capria, QA Manager	315.671.9299	Any major changes to the QAPP must be approved by Dennis Capria and the Project Coordinator and USEPA before the changes can be implemented.
Unfulfilled or changes to bottle orders	TestAmerica	Kathryn Kelly, Project Manager	802.923.1021	To be notified of any problems or changes related to bottle orders.
Field equipment	Pine Environmental Services	Pine Environmental Services Staff	800.301.9663	To be notified of any problems or changes to field equipment rentals.
Sample receipt or chain of custody variances	ARCADIS	Suzanne Walls, Project Manager	865.777.3502	To be notified of any sample receipt or chain of custody variances.

Communication Driver	Organization	Name	Contact Information	Procedure (timing, pathway, documentation, etc.)
Laboratory quality control variances	ARCADIS	Dennis Capria, QA Manager	315.671.9299	To be notified of any laboratory control variances.
Analytical corrective actions	ARCADIS	Dennis Capria, QA Manager	315.671.9299	The need for corrective action for analytical issues will be determined by Dennis Capria in conjunction with the Project Coordinator, the Field Program Coordinator or the Laboratory QA Manager, as appropriate.
Field corrective actions	ARCADIS	Suzanne Walls, Project Manager	865.777.3502	The need for corrective action for field issues will be determined by Suzanne Walls with the Project Coordinator, the Field Program Coordinator or the Laboratory QA Manager, as appropriate.
Reporting Lab Data Quality Issues	TestAmerica	Kathryn Kelly, Project Manager	802.923.1021	All QA/QC issues with project field samples will be reported by contact person from TestAmerica to Suzanne Walls and Dennis Capria within 2 business days.
Data validation issues, e.g., non-compliance with procedures	TestAmerica	Kathryn Kelly, Project Manager	802.923.1021	All data validation concerns will be reported to Dennis Capria and TestAmerica.
Data review corrective actions	ARCADIS	Dennis Capria, QA Manager	315.671.9299	The need for corrective action during data review will be determined by John Persico in conjunction with Suzanne Walls.

QAPP Worksheet #9: Project Planning Session Summary

Date of planning session: August 13, 2014
Location: Fair Lawn, NJ and conference call
Purpose: Discuss progress on the Data Gaps Sampling and Analysis Plan and QAPP
Participants:

Name	Organization	Title/Role	Email/Phone
John Persico	ARCADIS	Designated Project Coordinator	John.Persico@arcadis-us.com
Suzanne Walls	ARCADIS	Project Manager	Suzy.Walls@arcadis-us.com
Dana Drew	ARCADIS	Geologist	Dana.Drew@arcadis-us.com

Notes/Comments:

- Discussion of the USEPA comments on the Baseline Ecological Risk Assessment (BERA) Work Plan and Data Gaps Memo.
- Discussion of the revised sampling locations and analyses in the Data Gaps Memo and BERA Work Plan.
- Discussion of the Baseline Human Health Risk Assessment (BHHRA) results from CDM Smith (CDM).

Date of planning session: August 14, 2014
Location: Conference call
Purpose: Discuss USEPA comments on the Data Gaps Memo
Participants:

Name	Organization	Title/Role	Email/Phone
John Persico	ARCADIS	Designated Project Coordinator	John.Persico@arcadis-us.com
Suzanne Walls	ARCADIS	Project Manager	Suzy.Walls@arcadis-us.com
Andrew Gutherz	ARCADIS	Task Manager	Andrew.Gutherz@arcadis-us.com
Dana Drew	ARCADIS	Geologist	Dana.Drew@arcadis-us.com

Notes/Comments:

- Discussion of the Data Gaps Sampling and Analysis Plan.
- Review of additional sampling locations and analyses requested by the USEPA.
- Discussion of well X-7, which was previously not sampled due to the lack of water and recharge during sampling.
- Discussion of the pattern of the previously proposed temporary well locations.

Date of planning session: August 14, 2014
Location: Conference call
Purpose: Discuss USEPA comments on the Data Gaps Memo
Participants:

Name	Organization	Title/Role	Email/Phone
John Persico	ARCADIS	Designated Project Coordinator	John.Persico@arcadis-us.com
Suzanne Walls	ARCADIS	Project Manager	Suzy.Walls@arcadis-us.com
Andrew Gutherz	ARCADIS	Task Manager	Andrew.Gutherz@arcadis-us.com
Dana Drew	ARCADIS	Geologist	Dana.Drew@arcadis-us.com
Gary Fisher	Alcatel-Lucent	Remedial Project Manager	gary.fisher@alcatel-lucent.com
Michael Draikiwicz	Novartis	Remediation Project Manager	michael.draikiwicz@novartis.com
Richard Hughes	Jackson Walker LLP	Counsel to Chevron	rhughes@jw.com
Rich Ricci	Lowenstein Sandler LLP	Counsel to Group	rricci@lowenstein.com
Mark Stella	Chevron	Remediation Project Manager	MarkStella@Chevron.com
Mickey Faigen	Issues Management LLC	Consultant to Group	Mfaigen@issuesllc.com

Notes/Comments:

- Discussion of the USEPA comments on the Data Gaps Memo and proposed responses.

Date of planning session: August 19, 2014
Location: 290 Broadway New York, NY and conference call
Purpose: Discuss comments on the Data Gaps Memo with USEPA
Participants:

Name	Organization	Title/Role	Email/Phone
John Persico	ARCADIS	Designated Project Coordinator	John.Persico@arcadis-us.com
Andrew Gutherz	ARCADIS	Task Manager	Andrew.Gutherz@arcadis-us.com
Tanya Mitchell	USEPA	Remedial Project	Mitchell.Tanya@epa.gov

Name	Organization	Title/Role	Email/Phone
		Manager	
Michael Sivak	USEPA	Chief, Mega Projects Section	Sivak.Michael@epa.gov
Michael Clemetson	USEPA	Ecological Risk Assessor	Clemetson.Michael@epa.gov
Katherine Mishkin	USEPA	Geologist	Mishkin.Katherine@epa.gov
Juan Fajardo	USEPA	Counsel at USEPA	Fajardo.Juan@epa.gov
George Molnar	CDM Smith	Consultant to USEPA	MolnarGC@cdmsmith.com
John Dougherty	CDM Smith	Consultant to USEPA	DoughertyJ@cdmsmith.com
Mark Stella	Chevron	Remediation Project Manager	MarkStella@Chevron.com
Gary Fisher	Alcatel-Lucent	Remediation Project Manager	gary.fisher@alcatel-lucent.com
Michael Draikiwicz	Novartis	Remediation Project Manager	michael.draikiwicz@novartis.com
Mickey Faigen	Issues Management LLC	Consultant	mfaigen@issuesllc.com
Rich Ricci	Lowenstein Sandler LLP	Counsel to Group	rricci@lowenstein.com

Notes/Comments:

- Discussion of the EPA comments on the Data Gaps Memo.
- Consensus decisions made on sampling locations and analyses for the Data Gaps Sampling and Analysis Plan.
- Action Items:

Action	Responsible Party	Due Date
ARCADIS will prepare the Data Gaps Sampling and Analysis Plan and Quality Assurance Project Plan and send to USEPA for approval.	ARCADIS	Week of September 15, 2014
USEPA will review Data Gaps Sampling and Analysis Plan within 3 weeks and 2 days after receipt, and the Quality Assurance Project Plan within 3 weeks after receipt.	USEPA	October 2014

QAPP Worksheet #10: Conceptual Site Model

Background Information

1. Site Description

The Rolling Knolls Landfill Superfund Site consists of a former privately operated municipal waste landfill located at the southern end of Britten Road, south of Green Village in Chatham Township, Morris County, New Jersey (Figure 1). The landfill covers 141 acres and consists of a relatively thin (18 feet or less) layer of waste material directly overlying native soil and/or wetlands. An area of surface debris was identified on 29 acres west of the landfill. The central and western portions of the landfill are owned by Robert J. Miele as Trustee of the Trust created by the Last Will and Testament of Angelo J. Miele, the former landfill operator. Eastern and southern portions are located within the Great Swamp National Wildlife Refuge (GSNWR) and owned by the United States Fish & Wildlife Service (USFWS). A northeastern portion of the landfill occurs on a parcel owned by the Green Village Fire Department.

2. Site History

The former privately operated municipal waste landfill located at the southern end of Britten Road reportedly operated from the 1930s to 1968. During this period, materials disposed at the landfill consisted primarily of municipal solid waste, but also included other waste such as industrial waste.

During the RI, an extensive characterization was implemented to evaluate the extent and composition of the landfill and potential landfill-related impacts to environmental media (Site Characterization Summary Report, February 2012). The RI efforts consisted of test pits, drum investigations, surface and subsurface soil collection, soil borings, monitoring well installations, sub slab vapor intrusion sampling, and surface water and sediment sampling.

Nature and Extent of Constituents

1. Constituent Sources

Sources of constituents detected in environmental media during RI activities can be considered as point sources and non-point sources. The largest potential source is the landfill itself. It is broad (141 acres) and relatively thin (18 feet or less) and directly overlies native soil. Because it consists almost entirely of municipal solid waste, the landfill is a diffuse source of organic and inorganic constituents. Limited areas of various waste materials that likely serve as individual point sources have been observed, but are a minor component of the total waste volume. Other potential sources of constituents are precipitation (e.g., mercury), natural background concentrations in soil and groundwater (i.e., inorganics), and/or current human activities such as hunting, skeet shooting, activities at the landscaping areas (e.g., vehicle/equipment storage and maintenance, storage of mulch, rocks and other landscaping supplies, storage of fertilizers and/or pesticides), activities during landfill operations, or uncontrolled disposal by trespassers. Based on the conditions within the landfill boundary, historical information regarding landfill disposal and maintenance activities, and the nature and extent of constituents in environmental media, it is probable that the amount of industrial waste that has been disposed of at the landfill is less than the municipal waste.

2. Constituent Detections in Soil and Groundwater

a. Soil

Surface soil samples were collected from known human use areas, both on and adjacent to the landfill, (baseball field, shooting range, landscape areas and near the Hunt Club building) as well as throughout the landfill. These samples exhibited detections of volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), pesticides, dioxins, furans, and/or inorganic constituents. The most commonly detected constituents in surface soil were polycyclic aromatic hydrocarbons (PAHs), phthalates, PCBs, pesticides and inorganic constituents. Concentrations of some of these constituents exceed New Jersey Residential and/or Nonresidential Soil Remediation Standards (SRSs) and ecologically based screening levels (EBSLs).

Fewer exceedances of the Residential and Nonresidential SRSs are noted in the human use areas, in particular the baseball field, shooting range, and Landscape Area 2 and Hunt Club building. The baseball field and shooting range are located north of the landfill. Test pits excavated in this area did not identify waste at the ground surface or at depth and analytical results do not suggest that soil in this area has been impacted by the landfill. Landscape Area 2 and the Hunt Club building occur within the surface debris area located in the western portion of the landfill. Exceedances of SRSs from surface soil in these three areas were limited to certain PAHs and vanadium (at one location in the shooting range). Landscape Area 1 occurs near the center of the landfill and directly abuts landfilled materials. Higher exceedances of Residential and Nonresidential SRSs in these samples, relative to the other human use areas, identify potential impacts from the landfill and/or the ongoing activities at the landscaping area (e.g., maintenance and storage of equipment and vehicles).

Surface soil samples collected across the entire landfill (inclusive of the landscaping and Hunt Club areas) exhibit exceedances of Residential and/or Nonresidential SRSs for PAHs, phthalates, PCBs, certain pesticides and inorganic constituents. Few VOCs were detected at concentrations greater than SRSs, and exceedances were limited to isolated locations. Few exceedances are noted in the surface debris area in the western portion of the landfill and along the western and southwestern perimeter of the landfill.

Subsurface soil samples collected within the potentially developable portion of the landfill exhibited detections of VOCs, SVOCs, PCBs, pesticides and/or inorganic constituents. The most commonly detected constituents in subsurface soil were PAHs, phthalates, PCBs, pesticides and inorganic constituents. Concentrations of some of these constituents exceed Residential and/or Nonresidential SRSs, including certain PAHs, bis(2-ethylhexyl) phthalate, PCBs, pesticides and inorganic constituents.

b. Groundwater

Sources of contamination to groundwater, within the landfill, include groundwater infiltration through the impacted waste materials and soil, as well as some potential sources upgradient of the landfill, particularly inorganic constituents.

Groundwater sampling results indicate that a variety of constituents were detected in groundwater. In general, detections of organic constituents in samples collected from groundwater monitoring wells during both the December 2007 and February 2008 sampling events were limited to a subset of VOCs, SVOCs and pesticides. Inorganic constituents were ubiquitously detected in groundwater samples. PCBs were not detected in groundwater samples collected during either sampling event. Detected VOCs included chlorinated solvents (e.g., cis-1,2-dichloroethene [cis-1,2-DCE], trichloroethylene [TCE] and tetrachloroethylene [PCE]), benzene, toluene, ethylbenzene, and xylene (BTEX) compounds and chlorofluorocarbons (CFCs), among others. Exceedances of New Jersey (NJ) Groundwater Quality Criteria (GWQC) were limited to a small subset of these organic and inorganic constituents and occurred most frequently in three monitoring wells: MW-3, MW-7 and MW-10.

Exceedances of NJ GWQC at MW-7 were limited to iron and manganese in December 2008 and aluminum, iron, lead, manganese, thallium and indeno(1,2,3-cd) pyrene in February 2008. The monitoring well installation log for MW-7 indicates that minor amounts of brick and glass were observed in the upper 5 feet of the boring. Approximately one-half of the screen interval was not logged due to a lack of sample recovery, with the other half noted as screened in a silty/organic material. The nearest test pit to MW-7 is TP-33 (approximately 350 feet to the north); waste materials noted at this location included concrete, rubber, bricks and plastic scraps. No potential industrial waste was observed during the excavation of TP-33 and PID readings recorded during excavation were all less than 10 ppm. The nearest soil sampling location to MW-7 is SS-66, located approximately 50 feet south of MW-7. The surface soil sample collected at SS-66 exhibited exceedances of Nonresidential SRSs for benzo(a)pyrene, arsenic, lead and PCBs. The nearest upgradient soil sampling location to MW-7 is SS-58. The surface soil sample collected at SS-58 exhibited exceedances of Nonresidential SRSs for aldrin, lead and PCBs. Based on these results, the source of indeno(1,2,3-cd)pyrene to groundwater at MW-7 is localized in groundwater at this location.

Exceedances of NJ GWQC at MW-10 were limited to one VOC (dichlorodifluoromethane), aluminum, arsenic, iron and manganese. The monitoring well installation log for MW-10 does not identify waste materials in the boring log and indicates that most of the material in the screened interval was clay. Dichlorodifluoromethane is a component of Freon and its presence in groundwater at monitoring well MW-10 appears to be related to old refrigerators, which are present on the ground nearby at POI-10. Low concentrations of CFCs were also observed in a surface soil sample collected at POI-10, but these concentrations did not exceed Residential or Nonresidential SRSs.

The highest concentrations of constituents exceeding NJ GWQC were generally observed in groundwater collected from MW-3. Organic constituents detected at concentrations greater than NJ GWQC in MW-3 include benzene (both sampling events), bis(2-chloroethyl)ether (both sampling events) and three BHC pesticides (December 2007 sampling event). Inorganic constituents detected at concentrations greater than NJ GWQC in MW-3 include aluminum, arsenic, manganese and sodium during both sampling events. The monitoring well installation log for MW-3 indicates that waste materials were not observed in the boring and that the screened interval is completed in clay, silt and sand. Test pit TP-09 was excavated immediately adjacent to MW-3 and was identified as wet at the ground surface, which is consistent with the observations of water levels observed above the ground surface elevation at MW-3. Rusted drums and an oil boom were observed in TP-09 and a sheen and high PID reading were observed at the interval from 4 to 6 feet below ground surface (bgs). One sample of potential industrial

waste collected from TP-09 identified the presence of benzene at 20 mg/kg. The source of organic impacts in groundwater at MW-3 is likely the materials observed at TP-09.

Groundwater from MW-3 has the most constituents in excess of NJ GWQC. Exceedances of the NJ GWQC down gradient from MW-3 (at monitoring well MW-4) were limited to aluminum, iron and manganese. Only aluminum was detected at concentrations greater than the NJ GWQC during both sampling events at MW-4. This indicates that the extent of organic impacts in groundwater at MW-3 is localized. The impacts at MW-3 are related to the presence of potential industrial waste in nearby test pit TP-09. Based on the results of groundwater sampling at other monitoring well locations, the organic impacts in groundwater at MW-7 and MW-10 are also localized.

While shallow groundwater that flows through the landfill has the potential to flow into low-lying areas and/or surface water bodies, water quality results from the ponds and the downstream portions of the Loantaka Brook and Black Brook indicate that the concentrations of VOCs, SVOCs and inorganic constituents are consistent with concentrations measured in surface water samples upstream of the potential influence of the landfill. PCBs and pesticides were either not detected or were detected at concentrations lower than those observed in upstream portions of the surface water bodies. This indicates that water from the landfill has not degraded the water quality in the surface water bodies adjacent to the landfill.

Impacted groundwater in the materials overlying the clay likely flows laterally (the dominant direction of flow) at very low rates until reaching areas of discharge (low-lying areas or surface water bodies). Vertical transport through the materials beneath the landfill is anticipated to be limited due to the presence of the glaciolacustrine clay that underlies the entire landfill. The presence of the clay means that lateral transport is the more significant transport direction instead of vertical.

c. Fate and Transport of Constituents

Fate and transport processes that describe the migration and attenuation of dissolved constituents in groundwater include advection, diffusion, sorption and degradation. Additionally, the fate and transport of inorganic constituents is a function of geochemical conditions that can create environments that limit or enhance their mobility. Likewise, different degradation reactions will occur under different geochemical conditions.

Advection refers to the bulk movement of constituents with groundwater. Diffusion is a mass transfer mechanism that refers to the movement of mass from the advective, flow-focusing features such as sands and gravels into less permeable clays and silts that act as storage reservoirs. This mass transfer occurs as a function of concentration gradients between the two types of materials, as well as physical characteristics of the units.

Sorption refers to the processes of absorption and adsorption, in which the organic matter provides specific binding sites that immobilize (adsorb) the dissolved molecules. Absorbed solute molecules partition between the aqueous and organic matter phase under assumed equilibrium conditions, and this serves to slow the velocity of a solute relative to the groundwater flow velocity. Adsorbed solute

molecules are effectively pinned in place and do not move freely through the binding matrix (Payne et al. 2008) and therefore represent a reduction in the mobile mass of solutes in groundwater.

At the landfill, estimates of groundwater velocity in the shallow water-bearing zone are fairly low with a range of 0.001 to 0.3 foot/day. It is important to note that the groundwater velocity is taken from the equivalent hydraulic conductivity, meaning that it represents the average behavior. As indicated above, groundwater and solute migration will occur in the more permeable sands and gravels and the silt and clay materials will not transmit significant volumes of water or solutes to any significant degree. Most of the VOCs detected in groundwater at the landfill will tend to sorb and be slowed via that mechanism, or will be diffused into and out of the low-permeability storage reservoirs as a function of concentration gradients. It is likely that constituents are not significantly migrating away from the landfill via advection.

The geochemical conditions can be either aerobic (oxidizing) or anaerobic (reducing) and each condition could be present within the landfill. Depending on which geochemical condition(s) are present within the groundwater, the mobility of certain dissolved-phase inorganics will be inhibited or enhanced. Likewise, degradation pathways (biological or chemical transformation of solutes) will be enhanced or inhibited based on geochemical conditions. For example, low concentrations of TCE detected in the December 2007 sampling event but not in the February 2008 sampling event, along with the presence of TCE degradation products (primarily cis-1,2-DCE and vinyl chloride) in both sampling events, is one line of evidence that the geochemical conditions within groundwater beneath the landfill are anaerobic or reducing because the transformation of TCE to these degradation products is favored under reducing conditions.

Due to the importance and relevance of geochemical conditions within landfills as related to the fate and transport of COCs, the following summary is provided to enhance the understanding of the mobility of inorganic constituents that exceed the NJ GWQC.

d. Groundwater Geochemical Conditions and Mobility of Inorganic Constituents

Inorganic constituents detected at concentrations greater than NJ GWQC during the most recent sampling event (i.e., February 2008) include the following:

- Aluminum (MW-3, MW-4, MW-5, MW-7, MW-8, X-2, X-3, X-4)
- Arsenic (MW-3, MW-10)
- Iron (MW-1, MW-2, MW-3, MW-4, MW-5, MW-6, MW-7, MW-8, MW-10, X-1, X-2, X-3, X-4, X-6)
- Lead (MW-7)
- Manganese (MW-1, MW-2, MW-3, MW-4, MW-5, MW-6, MW-7, MW-8, MW-9, MW-10, X-1, X-2)
- Sodium (MW-3, X-1)

- Thallium (MW-7).

Groundwater samples were unfiltered and represent total recoverable inorganic concentrations. The lowest concentrations of iron and manganese and generally higher concentrations of dissolved oxygen were identified at wells along the periphery of the landfill area (e.g., MW-4, MW-5, MW-8, X-2 through X-6). Higher concentrations of manganese and/or iron and generally lower concentrations of dissolved oxygen at wells were identified in the interior of the landfill area (e.g., MW-1, MW-2, MW-3, MW-6, MW-7). This may indicate suboxic groundwater conditions in the periphery of the landfill area and more reducing conditions in the interior of the landfill area. Because the samples were unfiltered, the results can also correlate to turbidity, with inorganic concentrations due to particles in the groundwater samples. For example, groundwater from monitoring well MW-3 exhibited the highest turbidity and relatively higher concentrations of iron, manganese and arsenic. Conversely, groundwater from monitoring well X-5 exhibited the lowest turbidity, low concentrations of iron and manganese and no detections of other inorganic constituents.

The mobility of inorganic constituents in groundwater may be controlled by many processes, including precipitation, sorption, complexation and redox reactions, and can be affected by pH, organic carbon and microbial processes (Violante et al. 2010). Reducing groundwater conditions may be created through microbial activity that results in the consumption of dissolved oxygen and nitrate, and the dissolution of iron and manganese minerals present in soil. Organic carbon serves as a source of electrons in these environments, and a series of electron acceptors (oxygen, nitrate, manganese, iron, sulfate) is used for microbial growth. Soil data indicate the presence of organic carbon at >10 to 20 percent TOC in the solid phase in many locations. Soil pH measured at the site ranged between 3.75 and 8.29 standard units, and groundwater pH ranged from 5.04 to 7.08 standard units.

Iron, Manganese and Aluminum

The concentrations of iron, manganese and aluminum exceeded NJ GWQC in groundwater samples collected during the February 2008 sampling event. Iron and manganese are abundant, naturally occurring elements in soil, with aluminum a major component of clay minerals and sand, and the groundwater samples were unfiltered. Geochemical conditions that can lead to the dissolution of iron and manganese minerals include a decrease in redox potential, as well as a change in ionic strength in groundwater. Natural organic carbon stimulates anaerobic microbial processes that result in reductive iron and manganese dissolution (Donahoe and Liu 1998). The iron and manganese are used as electron acceptors by naturally occurring microorganisms that metabolize the organic carbon. This natural process transforms insoluble ferric iron [Fe(III)] and Mn(IV) in solid phases to soluble ferrous iron Fe(II) and Mn(II). Organic carbon may be provided by hydrocarbons or VOCs, or natural organic matter present in the aquifer. High ionic strength in groundwater can lead to the dissolution of iron minerals, and some hydroxide minerals (aluminum, iron, manganese) and clay minerals are soluble under acidic conditions.

Arsenic

The concentration of arsenic exceeded the NJ GWQC in groundwater samples collected from monitoring wells MW-3 and MW-10 during the February 2008 sampling event. These locations are also associated with relatively high concentrations of manganese and iron and relatively high turbidity at MW-3. Arsenic

occurs naturally in soil as a trace element and is usually incorporated into iron minerals or sorbed to iron mineral surfaces. In this form, it is generally insoluble in groundwater at neutral pH, at moderate ionic strengths (e.g., sodium concentrations from 10 to 100 milligrams per liter) and under oxidizing conditions.

Certain geochemical conditions in groundwater can result in the mobilization of naturally occurring arsenic. These conditions include a decrease in redox potential (i.e., reducing conditions) generally associated with biogeochemical processes, and an increase in ionic strength (Smedley and Kinniburgh 2002). Microbial activity, stimulated by the presence of natural organic matter in groundwater, results in the dissolution of iron and release of arsenic incorporated into iron minerals or sorbed onto iron mineral surfaces. Reductive iron dissolution, with the transformation of insoluble Fe(III) to soluble Fe(II), is caused by the use of iron minerals by microorganisms for the metabolism of organic carbon. Electrons provided by the organic carbon are transferred to the iron minerals, resulting in reductive iron dissolution (Lovley and Phillips 1988). This promotes a decrease in the redox potential in the aquifer, and arsenic that is released from the iron is stabilized in a dissolved form. High groundwater ionic strength can also result in the release of naturally occurring arsenic that may be sorbed to iron minerals.

Lead

The concentration of lead exceeded the NJ GWQC in the groundwater sample collected from monitoring well MW-7, a location that exhibited potentially more reducing conditions, during the February 2008 sampling event. In general, the mobility of lead is not directly related to redox conditions; however, because lead may form stable precipitates with redox-sensitive elements such as sulfur, lead mobility may be indirectly related to redox conditions. In sulfate-reducing systems, lead is expected to form insoluble lead sulfide precipitates. In moderately reducing systems, reductive dissolution of iron oxides that contain adsorbed lead could result in lead mobilization. Under oxidizing conditions, lead solubility in aqueous solutions is highly pH dependent. In general, lead mineral solubility is low at near neutral to moderately alkaline pH, and higher at low pH or very high pH. Lead mobility is controlled primarily by adsorption, precipitation and complexation with organic matter. Lead is strongly adsorbed onto ferric oxides, hydrous oxides, aluminum oxides, oxyhydroxides and clay minerals in soil. Exceptions to this behavior are low-pH systems or environments with high concentrations of dissolved organic carbon, which may form stable, highly soluble complexes with lead.

Thallium

The concentration of thallium exceeded the NJ GWQC in the groundwater sample collected from monitoring well MW-7 during the February 2008 sampling event. Thallium sorbs to clay, organic matter, and iron and manganese oxides in soil, and is more mobile at low pH (WHO 1996). In highly reducing environments, thallium may precipitate as a sulfide.

3. Overview of the Landfill, Constituent Transport Processes and Constituent Distribution

As discussed above, the landfill consists of municipal solid waste. Some potential industrial wastes have been identified, but they are small in area and do not comprise a significant portion of the volume of the waste. This is expected based on the historical use of the landfill for disposal of municipal waste from Chatham Township and nearby municipalities. The surface of the landfill in some areas is covered by a thin soil layer and/or vegetation; in other areas, municipal waste is visible at the ground surface.

VOCs, SVOCs, PCBs, pesticides and inorganic constituents are found in surface and subsurface soil collected from the landfill. Many of these constituents are likely components of the municipal waste. Some of the current uses of the landfill (hunting and the maintenance activities at the landscape areas) and the areas north of the landfill (shooting range) may also contribute to the constituents observed in environmental media. The pesticides at the landfill likely come from historical pesticide use to combat mosquitoes and rodents. Inorganic constituents, such as arsenic, lead, vanadium and others, are naturally occurring and their presence in the soil samples is at least partially due to their natural occurrence.

Precipitation that falls on the landfill transpires back to the atmosphere, recharges groundwater or runs off to the neighboring wetlands or surface water bodies (i.e., the ponds, Loantaka Brook and Black Brook). The shallow groundwater beneath the site occurs in a thin, sandy and silty material that extends to 20 to 25 feet bgs. New Jersey regulation (N.J.A.C. 7:9D-2.3[a]) prohibits installation of potable wells with casings less than 50 feet in depth; therefore, no potable wells would be expected in the shallow water-bearing zone.

Two areas of impacted groundwater are observed in the shallow water-bearing zone (monitoring wells MW-3 and MW-10). Constituents observed at monitoring well MW-3 include VOCs such as benzene and may be related to VOC-impacted soil and drums located at nearby test pit TP-09. The VOC dichlorodifluoromethane, a component of Freon, was present in groundwater at monitoring well MW-10 and its presence appears to be related to old refrigerators, which are present on the ground nearby.

The landfill and shallow water-bearing zone are underlain by a thick, continuous, plastic clay unit. RI soil borings indicate that this unit is at least 25 feet thick and literature values indicate that it is more than 100 feet thick and locally as much as 128 feet thick at the east end of the GSNWR (Minard 1967). This clay unit is a barrier to vertical groundwater flow and constituent migration, protecting the underlying water-bearing material. Given the relatively low levels of constituents in the shallow water-bearing zone beneath the landfill, the nearby availability of surface discharge areas, and the thickness and lack of permeability of the clay, impacts to groundwater beneath the clay unit are not expected.

Surface water and sediment in the ponds and streams (Loantaka Brook and Black Brook) on or adjacent to the landfill exhibit some constituents that are found at the landfill. Many of these constituents are also found in surface water and sediment upstream of the landfill. Therefore, their presence in the streams is at least in part due to sources upgradient of the landfill. The results of the semiquantitative comparison of upstream and downstream data and the distribution of exceedances of ARARs or EBSLs downstream of the landfill indicate that the downstream extent of constituents related to the landfill, if any, has been defined.

Key Physical Aspects of the Site

Summary of Hydrogeologic Conditions

The hydrostratigraphy underlying the landfill consists of a shallow water table saturated zone, comprising silt and sand deposits underlain by a layer of glaciolacustrine clay that serves as a confining unit to the geologic formations below. Ten new monitoring wells were installed in 2007 to characterize the hydrogeologic conditions in this shallow water-bearing zone. Monitoring well screens cross silt, sand and clay deposits, and in some cases, the landfilled materials.

The depth and extent of saturation of waste material varied widely across the landfill, based on observations during test pit excavation, soil boring advancement and monitoring well installation activities. In most of the soil borings and monitoring wells, the waste material was dry and the native material beneath the waste was saturated. Test pit excavation logs indicated that the depth to saturation ranged from the ground surface to beneath the waste material (if present) and in some instances saturation was not observed for the entire test pit depth. In areas where the waste material was observed to be saturated at the surface, saturation was likely from precipitation and/or overland flow.

Water likely flows vertically through the unsaturated waste materials with some small horizontal component, and upon reaching the saturated material, flows laterally with the natural groundwater flow patterns. Groundwater flow is expected to occur laterally through the sand and/or silty sand units. The groundwater flow in the shallow water-bearing zone above the clay is expected to be horizontal until reaching areas of discharge.

The presence of clay at the base of the soil borings and monitoring wells is evidence of the remnant glacial lake. The clay is grey in color with some brown or reddish brown intervals, cohesive, and plastic, with only a small proportion of silt or fine sand. At the deepest boring (SB-8), the top of the clay was 25 feet bgs and the clay continued to the bottom of the boring at 50 feet bgs with little to no change in its properties. This clay is continuous beneath the landfill, reported to be more than 100 feet thick and locally as much as 128 feet thick at the east end of the GSNWR (Minard 1967), and will restrict vertical flow and constituent migration into the aquifer below, and confines the underlying groundwater.

Identification of Data Gaps and Uncertainty

Data gaps in the understanding of site conditions are summarized below:

- The extent of certain constituents at concentrations above the New Jersey SRSs in soil in portions of the site is not fully delineated.

- The extent of certain constituents in groundwater at monitoring wells MW-3 and MW-10 is not fully delineated.

- Surface water and sediment in ponds on the landfill that were not previously sampled has not been characterized.

- The potential presence of certain VOCs in sediment pore-water downgradient of monitoring well MW-10 has not been evaluated.

- Current constituent concentrations in groundwater are not known.

- The connection between groundwater and surface water in the small ponds at the northern boundary of the landfill has not been evaluated.

- Conditions at the existing Hunt Club well HC-1 have not been fully assessed.

QAPP Worksheet #11: Project/Data Quality Objectives

1. *State the Problem*

a. **Conceptual Site Model**: The Rolling Knolls Landfill Superfund Site is located in Chatham, New Jersey and was formerly a privately operated municipal waste landfill. The landfill was in use from the 1930s to 1966 and contains municipal and industrial waste. A more complete conceptual site model is provided in Worksheet #10.

b. **Description of the Problem**: Data gaps sampling has been proposed to complete the delineation of contamination across the site. The main goals of this sampling are 1) to delineate the extent of certain constituents (VOCs, SVOCs, pesticides, PCB Aroclors, PCB congeners, dioxins and furans, and metals and cyanide) in soil, sediment, groundwater, pore-water, and surface water, 2) to measure the current concentrations of constituents in groundwater, 3) to investigate the connection between surface water and groundwater, and 4) to assess conditions at the Hunt Club well. These data gaps were identified by the USEPA following the completion of the Site Characterization Summary Report (SCSR). Additional data collected during this sampling will be used to further characterize the site and will be included in the evaluation of potential risk to ecological receptors that will be investigated in the BERA.

<u>Planning Team Members and Decision Makers</u>

Planning team members and decision makers include the following:

- existing project team members who are familiar with the site and the results of previous investigations;
- geologists, environmental scientists, and engineers;
- representatives of the Settling Parties who have agreed to conduct the Remedial Investigation and Feasibility Study at the site; and
- representatives of the USEPA.

<u>Available Resources and Relevant Deadlines</u>

The Settling Parties will ensure that adequate resources are available for sample collection, sample analysis, data evaluation, and report preparation. Relevant deadlines are:

- Samples will be collected in two phases. The first phase, including surface water, sediment, pore-water, and temporary groundwater well data, will be completed in November 2014. The second phase, including permanent groundwater well data, will be completed in May 2015.

- The Scope of Work in the Administrative Settlement Agreement and Order on Consent between the Settling Parties and USEPA (September 30, 2005) allows 60 days for report preparation and submittal of the Data Gaps SAP report after receipt of the validated data.

2. *Identify the Goals of the Study*

The goal of this study is to address all remaining data gaps identified by the USEPA following the approval of the SCSR and to constrain the fate and transport of chemical constituents (see Worksheet #10 for greater detail on chemical constituents). This will allow for evaluation of potential risks to ecological receptors.

- Further delineate the extent of constituents that were present at concentrations above the New Jersey SRSs in soil in portions of the site.

- Delineate the extent (downgradient) of VOCs observed in the shallow water-bearing zone in the western and southwestern portions of the site (monitoring wells MW-3 and MW-10), which is likely related to VOC-impacted soil and drums.

- Characterize surface water and sediment in ponds on the landfill that were not previously sampled.

- Investigate the potential presence of VOCs in pore-water downgradient of well MW-10.

- Obtain a full round of groundwater samples from all monitoring wells to characterize the current constituent concentrations in groundwater.

- Investigate the connection between groundwater and surface water in the small ponds at the northern landfill boundary.

- Assess conditions at the existing Hunt Club well HC-1.

Principle study question: What is the extent of chemical constituents in the Rolling Knolls Landfill and how are groundwater, surface water and soil communicating in different areas of the site to produce the observed contamination?

Alternative Actions

Results of Comparison to the Site Characterization Summary Report	Alternative Action
Contaminants are consistent with concentrations reported in the Site Characterization Summary Report and those used in the Human Health Risk Assessment.	Complete the Data Gaps report, and implement the BERA. Reevaluate the results of the Human Health Risk Assessment.
Contaminants exceed concentrations of the SRS, Site Characterization Summary Report and those used in the Human Health Risk Assessment.	Complete the Data Gaps report, and implement the BERA. Reevaluate the results of the Human Health Risk Assessment. Consider additional sampling to be incorporated with any necessary BERA sampling or in a pre-design investigation.
Contaminant concentrations are inconsistent with previous sampling and conceptual site model.	Recommend additional sampling.

Decision Statement

Determine whether concentrations in soil, sediment, surface water, groundwater, and pore-water indicate concentrations above regulatory limits and/or acceptable risk levels for human and ecological exposures.

If soil, groundwater, pore-water, surface water and/or sediment constituents exceed concentrations determined for the SCSR and changes to the Human Health Risk Assessment (CDM, June 2014) are suspected, then the Human Health Risk Assessment may be re-evaluated. These data will also be used to update the Screening-Level Ecological Risk Assessment refinements that will be evaluated prior to conducting the BERA.

3. *Identify Information Inputs*

Type of information needed:

Analytical results for environmental samples

- Soil samples: will be used to delineate the extent of constituents associated with the landfill that are present at levels above their SRS.
- Groundwater samples from temporary monitoring wells: will be used to identify potential sources of VOCs around permanent monitoring wells MW-10 and MW-3.
- Groundwater samples from permanent wells: will be used to characterize current constituent concentrations.

- Pore-water samples: delineate constituents in groundwater that are migrating to surface water downgradient of well MW-10.

- Groundwater level measurements in permanent and temporary well: will be used to constrain the local hydrogeology and groundwater flow directions.

- Surface water and sediment samples: will be used to characterize small bodies of water that have not previously been sampled.

Field observations

During sample collection, the field teams will observe and make note of the conditions at the Site and observe the presence of surface water bodies, the terrain, and the wildlife present. The field teams will also take PID readings during drilling and well cap removal.

Source of information:

The required information will be obtained by sample collection and analysis, and will be supported by existing information on the site.

Information Needed to Meet Performance Criteria

Performance Criteria	Information Need to Meet Performance Criteria
Use of approved sampling procedures	Field notes and sample logs
Collecting an adequate sample volume	Field notes and laboratory notes
Collecting an adequate number of samples	Field notes; comparison of laboratory results report to work plan
Proper sample packing, shipping, and handling	Field notes and laboratory notes
Appropriate analytical procedures	Laboratory notes in analytical results report; all data will be validated.

4. Define the Boundaries of the Study

Geographic Area

The geographic area of the study is the Rolling Knolls Landfill and adjacent areas, including areas in the GSNWR. The depth of the study is to approximately 15 feet bgs, which is anticipated to be the approximate depth of temporary and permanent monitoring wells. In addition, the study includes evaluation of the existing Hunt Club supply well, the depth of which is unknown.

Time Frame for Collecting the Data

This study includes collection of soil, sediment, groundwater, surface water and pore-water. Sampling is proposed to begin in October when the temperatures will be moderate but the brush will begin to die back increasing visibility and site accessibility. The initial phase of field investigation should be completed in November 2014. Data will be evaluated over the winter, and the second phase of investigation (installation and sampling of permanent monitoring wells) will be implemented in April and May 2015, before vegetation has reached its full size.

The data will provide a current picture of site conditions, suitable for the risk assessments and feasibility study which will be completed when this investigation is complete.

Appropriate Scale for Decision Making

The purpose of the data gaps sampling is to target specific areas of the site that need further evaluation (See Data Gaps Sampling and Analysis Plan and Worksheets # 17 and 18). Soil, and sediment results represent the local area of the sample. Surface water, pore-water, and groundwater results represent the area local to the sampling point, but because the water flows, the results also represent upgradient areas and can be used to estimate potential future impacts to downgradient areas.

5. Develop the Analytic Approach

Population Parameters

For delineation, individual soil, sediment, groundwater, pore-water, and surface water sample results will be compared to state regulatory standards.

For risk assessments, the data will be segregated by exposure pathway (for example, surface water). Maximum and 95 percent upper confidence limit concentrations of the data will be compared to the appropriate risk screening level.

Action Levels

The action levels for soil, sediment, surface water, pore-water, and groundwater data are contained in N.J.A.C. 7:26D, Remediation Standards. In addition, the data will be used in risk assessments for comparison to the appropriate risk screening levels.

6. Specify Performance or Acceptance Criteria.

The sampling program covered by this QAPP has been developed to address certain data gaps in the investigation previously described in the SCSR, which was approved by the USEPA. This sampling is not the only or entire effort to characterize the site. The scope of sampling and analysis was determined by the Settling Parties and the USEPA project team to answer specific

and limited questions about the site. Therefore, the statistical analysis proposed in the USEPA guidance (USEPA, February 2006) is not applicable to this scope of sampling.

For acceptance criteria, it is expected that representative, valid data will be obtained from at least 90% of the proposed sample locations. Field conditions, such as a lack of groundwater in certain monitoring wells, access restrictions, or other conditions, may limit the completion of sampling at certain proposed sample locations. To the extent practical, sample locations will be relocated as needed to ensure completion of the proposed sampling. However, at some locations, an alternative location may not be available.

7. Develop the Detailed Plan for Obtaining Data.

In its letter of March 7, 2013, the USEPA identified several data gaps related to the delineation of constituents in environmental media (USEPA 2013). To address these data gaps, ARCADIS prepared a Preliminary Plan to Address Data Gaps (April 30, 2013; ARCADIS 2013). The work proposed in this Preliminary Plan was to be conducted during the design of the site remedy. However, during subsequent scoping of the BERA, USEPA offered the Group the option of assessing the data gaps before implementing the BERA so that the additional data could be used in scoping the BERA (USEPA letter of July 30, 2014; USEPA 2014). The objectives of the data gaps sampling, as described in item 3 above and in Worksheet #17, were to further characterize constituents in soil, groundwater, pore-water, surface water, and sediment.

A complete Data Gaps Sampling and Analysis Plan (SAP) developed in conjunction with USEPA has been prepared to detail the sampling and analyses proposed to for the data gaps investigation. This SAP has been submitted to the USEPA and is currently under review.

QAPP Worksheet #12: Measurement Performance Criteria

Quality Assurance Project Plan Worksheet #12-1 – Measurement Performance Criteria (Semivolatile Organic Compounds in Water by SOM01.2 and SOM01.2-SIM)

Matrix	Water
Analytical Group	SVOCs
Concentration Level	All

Sampling Procedure[1]	Analytical Method/Standard Operating Procedure (SOP)[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
SOP 2, SOP 7, SOP 8, SOP 20	SOM01.2/SOM01.2-SIM/TAB-3	Precision – Overall	Relative percent difference (RPD) < 35%	Field duplicate	S&A
		Accuracy/Bias	% Relative abundance, see SOM01.2 – Exhibit D Semivolatiles Table 1	Instrument performance check: decafluorotriphenylphosphine (DFTPP)	A
		Accuracy/Bias Contamination	All target compounds < Contract Required Quantitation Limit (CRQL)	Blanks (field, equipment, method)	S&A
		Accuracy/Bias	Percent recovery (%R), see see SOM01.2 – Exhibit D Semivolatiles Tables 6 (%),7 (associated target compounds), and 8 (associated target compounds, SIM)	Deuterated monitoring compounds (DMC)	A
		Accuracy/Bias	%R, see see SOM01.2 – Exhibit D Semivolatiles Table 5	Matrix spike (MS)[3]	A
		Accuracy/Bias	%R, see see SOM01.2 – Exhibit D Semivolatiles Table 5	Matrix spike duplicate (MSD)[3]	A
		Precision	%RPD, see see SOM01.2 – Exhibit D Semivolatiles Table 5	MS/MSD[3]	A

Quality Assurance Project Plan Worksheet #12-1 – Measurement Performance Criteria (Semivolatile Organic Compounds in Water by SOM01.2 and SOM01.2-SIM)

Matrix	Water
Analytical Group	SVOCs
Concentration Level	All

Sampling Procedure[1]	Analytical Method/Standard Operating Procedure (SOP)[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
		Precision	Area response 50.0% to 200% and retention time (RT) ±30.0 seconds from associated 12-hour calibration standard; see SOM01.2 – Exhibit D Semivolatiles Table 2 (associated target compounds)	Internal standard	A

Notes:
[1] Reference number from Quality Assurance Project Plan Worksheet #21.
[2] Reference number from Quality Assurance Project Plan Worksheet #23.
[3] MS and MSD must be client-provided.

Quality Assurance Project Plan Worksheet #12-2 – Measurement Performance Criteria (Volatile Organic Compounds in Water by SOM01.2)

Matrix	Water
Analytical Group	VOCs
Concentration Level	All

Sampling Procedure[1]	Analytical Method/Standard Operating Procedure (SOP)[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
SOP 2, SOP 7, SOP 8, SOP 20	SOM01.2/TAB-11	Precision – Overall	Relative percent difference (RPD) < 35%	Field duplicate	S&A
		Accuracy/Bias	% Relative abundance, see SOM01.2 – Exhibit D Low/Medium Volatiles Table 1	Instrument performance check: bromofluorobenzene (BFB)	A
		Accuracy/Bias Contamination	All target compounds < Contract Required Quantitation Limit (CRQL)	Blanks (trip, field, equipment, method)	S&A
		Accuracy/Bias	Percent recovery (%R), see SOM01.2 – Exhibit D Low/Medium Volatiles Table 5 (%R) and Table 7 (associated target compounds)	Deuterated monitoring compounds (DMC)	A
		Accuracy/Bias	%R, see SOM01.2 – Exhibit D Low/Medium Volatiles Table 6	Matrix spike (MS)[3]	A
		Accuracy/Bias	%R, see SOM01.2 – Exhibit D Low/Medium Volatiles Table 6	Matrix spike duplicate (MSD)[3]	A
		Precision	%RPD, see SOM01.2 – Exhibit D Low/Medium Volatiles Table 6	MS/MSD[3]	A
		Precision	Area response 50.0% to 200% and retention time (RT) ±30.0 seconds from associated 12-hour calibration standard; see SOM01.2 – Exhibit D Low/Medium Volatiles Table 3 (associated target compounds)	Internal standard	A

Notes:
[1] Reference number from Quality Assurance Project Plan Worksheet #21.
[2] Reference number from Quality Assurance Project Plan Worksheet #23.
[3] MS and MSD must be client-provided.

Quality Assurance Project Plan Worksheet #12-3 – Measurement Performance Criteria (Pesticides in Water by SOM01.2)

Matrix	Water
Analytical Group	Pesticides
Concentration Level	All

Sampling Procedure[1]	Analytical Method/SOP[2]	DQIs	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
SOP 2, SOP 7, SOP 8, SOP 20	SOM01.2/TAB-2	Precision – Overall	RPD < 35%	Field duplicate	S&A
		Accuracy/Bias Contamination	< CRQL	Blanks (field, equipment, method, instrument)	S&A
		Accuracy/Bias	%R: 30-150%	Surrogate spikes: tetrachloro-m-xylene (TCX) and decachlorobiphenyl (DCB)	A
		Accuracy/Bias	%R, see SOM01.2 – Exhibit D Pesticides Table 3	MS[3]	A
		Accuracy/Bias	%R, see SOM01.2 – Exhibit D Pesticides Table 3	MSD[3]	A
		Precision	%RPD, see SOM01.2 – Exhibit D Pesticides Table 3	MS/MSD[3]	A
		Accuracy/Bias	%R, see SOM01.2 – Exhibit D Pesticides Table 2	LCS	A
		Accuracy/Bias and Precision	Retention times, see SOM01.2 – Exhibit D Pesticides Table 1	Retention time windows	A

Notes:

[1] Reference number from Quality Assurance Project Plan Worksheet #21.

[2] Reference number from Quality Assurance Project Plan Worksheet #23.

[3] MS and MSD analysis must be client-provided.

Quality Assurance Project Plan Worksheet #12-4 – Measurement Performance Criteria (Polychlorinated Biphenyls (PCBs) in Water by SOM01.2)

Matrix	Water
Analytical Group	PCBs
Concentration Level	All

Sampling Procedure[1]	Analytical Method/SOP[2]	DQIs	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
SOP 2, SOP 7, SOP 8, SOP 20	SOM01.2/TAB-1	Precision – Overall	RPD < 35%	Field duplicate	S&A
		Accuracy/Bias Contamination	< CRQL	Blanks (field, equipment, method, instrument)	S&A
		Accuracy/Bias	%R: 30-150%	Surrogate spikes: tetrachloro-m-xylene (TCX) and decachlorobiphenyl (DCB)	A
		Accuracy/Bias	%R, see SOM01.2 – Exhibit D Aroclors Table 1	MS[3]	A
		Accuracy/Bias	%R, see SOM01.2 – Exhibit D Aroclors Table 1	MSD[3]	A
		Precision	%RPD, see SOM01.2 – Exhibit D Aroclors Table 1	MS/MSD[3]	A
		Accuracy/Bias	%R, see SOM01.2 – Exhibit D Aroclors Table 2	LCS	A
		Accuracy/Bias and Precision	Retention times, see analytical SOP	Retention time windows	A

Notes:

[1] Reference number from Quality Assurance Project Plan Worksheet #21.

[2] Reference number from Quality Assurance Project Plan Worksheet #23.

[3] MS and MSD analysis must be client-provided.

Quality Assurance Project Plan Worksheet #12-5 – Measurement Performance Criteria (Metals, Mercury, and Cyanide in Water by ISM01.3)

Matrix	Water
Analytical Group	Metals/Mercury/Cyanide
Concentration Level	All

Sampling Procedure[1]	Analytical Method/SOP[2]	DQIs	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
SOP 2, SOP 7, SOP 8, SOP 20	ISM01.3[5]/TAB-5, TAB-6, TAB-7	Precision – Overall	RPD < 35%	Field duplicate	S&A
		Accuracy/Bias Contamination	< CRQL	Blanks (field, equipment, calibration, method)	S&A
		Precision	RPD < 20% for original and duplicate sample values ≥5x the CRQL; control limit of the CRQL used if either the sample or duplicate value is <5x the CRQL	Matrix duplicate (MD)[3]	A
		Accuracy/Bias	%R: 75-125%; does not apply when the sample concentration is ≥4x the spike added	MS[3]	A
		Precision – lab	Percent recovery (%R) ±20% of true value or ±1 times the CRQL of the analyte's true value, whichever is greater	Interference check sample (A and AB) (ICP-AES metals analysis only)	A
		Accuracy/Bias	%R 70-130% (50-150% for antimony and silver)	Laboratory control sample (LCS) (ICP-AES metals analysis only)	A
		Precision	Percent difference (%D) < 10% for original samples >50x the MDL	Serial dilution (ICP-AES metals analysis only)[4]	A

Notes:

[1] Reference number from Quality Assurance Project Plan Worksheet #21.
[2] Reference number from Quality Assurance Project Plan Worksheet #23.
[3] MD and MS must be client-provided.
[4] Performed as needed only for analytes with concentration > 50 times the method detection limit (MDL).
[5] Metals analysis will be performed using Inductively Coupled Plasma-Atomic Emission Spectroscopy.

Quality Assurance Project Plan Worksheet #12-6 – Measurement Performance Criteria (Mercury in Water by EPA 1631E)

Matrix	Water
Analytical Group	Mercury
Concentration Level	Low

Sampling Procedure[1]	Analytical Method/SOP[2]	DQIs	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
SOP 2, SOP 7, SOP 8, SOP 20	EPA 1631E/TANC-12	Precision – Overall	RPD < 35%	Field duplicate	S&A
		Accuracy/Bias Contamination	< RL	Blanks (field, equipment, calibration, method)	S&A
		Precision	RPD < method specified limit	Matrix duplicate (MD)[3]	A
		Accuracy/Bias	%R, method specified limit	MS[4]	A
		Accuracy/Bias	%R, method specified limit	Continuing calibration verification	A
		Accuracy/Bias	%R, method specified limit	Ongoing precision and recovery (OPR) sample	A
		Accuracy/Bias	%R, method specified limit	Quality control sample (QCS)	A

Notes:

[1] Reference number from Quality Assurance Project Plan Worksheet #21.

[2] Reference number from Quality Assurance Project Plan Worksheet #23.

[3] MD and MS must be client-provided.

Quality Assurance Project Plan Worksheet #12-7 – Measurement Performance Criteria (Semivolatile Organic Compounds in Soil and Sediment by SOM01.2 and SOM01.2-SIM)

Matrix	Soil/Sediment
Analytical Group	SVOCs
Concentration Level	All

Sampling Procedure[1]	Analytical Method/Standard Operating Procedure (SOP)[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
SOP 5, SOP 14	SOM01.2/SOM01.2-SIM/TAB-3	Precision – Overall	Relative percent difference (RPD) < 50%	Field duplicate	S&A
		Accuracy/Bias	% Relative abundance, see SOM01.2 – Exhibit D Semivolatiles Table 1	Instrument performance check: decafluorotriphenylphosphine (DFTPP)	A
		Accuracy/Bias Contamination	All target compounds < Contract Required Quantitation Limit (CRQL)	Blanks (field, equipment, method)	S&A
		Accuracy/Bias	Percent recovery (%R), see see SOM01.2 – Exhibit D Semivolatiles Tables 6 (%),7 (associated target compounds), and 8 (associated target compounds, SIM)	Deuterated monitoring compounds (DMC)	A
		Accuracy/Bias	%R, see see SOM01.2 – Exhibit D Semivolatiles Table 5	Matrix spike (MS)[3]	A
		Accuracy/Bias	%R, see see SOM01.2 – Exhibit D Semivolatiles Table 5	Matrix spike duplicate (MSD)[3]	A
		Precision	%RPD, see see SOM01.2 – Exhibit D Semivolatiles Table 5	MS/MSD[3]	A
		Precision	Area response 50.0% to 200% and retention time (RT) ±30.0 seconds from associated 12-hour calibration standard; see SOM01.2 – Exhibit D Semivolatiles Table 2 (associated target compounds)	Internal standard	A

Notes:
[1] Reference number from Quality Assurance Project Plan Worksheet #21.
[2] Reference number from Quality Assurance Project Plan Worksheet #23.
[3] MS and MSD must be client-provided.

Quality Assurance Project Plan Worksheet #12-8 – Measurement Performance Criteria (Volatile Organic Compounds in Soil and Sediment by SOM01.2)

Matrix	Soil/Sediment
Analytical Group	VOCs
Concentration Level	All

Sampling Procedure[1]	Analytical Method/Standard Operating Procedure (SOP)[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
SOP 5, SOP 14	SOM01.2/TAB-4	Precision – Overall	Relative percent difference (RPD) < 50%	Field duplicate	S&A
		Accuracy/Bias	% Relative abundance, see SOM01.2 – Exhibit D Low/Medium Volatiles Table 1	Instrument performance check: bromofluorobenzene (BFB)	A
		Accuracy/Bias Contamination	All target compounds < Contract Required Quantitation Limit (CRQL)	Blanks (trip, field, equipment, method)	S&A
		Accuracy/Bias	Percent recovery (%R), see SOM01.2 – Exhibit D Low/Medium Volatiles Table 5 (%R) and Table 7 (associated target compounds)	Deuterated monitoring compounds (DMC)	A
		Accuracy/Bias	%R, see SOM01.2 – Exhibit D Low/Medium Volatiles Table 6	Matrix spike (MS)[3]	A
		Accuracy/Bias	%R, see SOM01.2 – Exhibit D Low/Medium Volatiles Table 6	Matrix spike duplicate (MSD)[3]	A
		Precision	%RPD, see SOM01.2 – Exhibit D Low/Medium Volatiles Table 6	MS/MSD[3]	A
		Precision	Area response 50.0% to 200% and retention time (RT) ±30.0 seconds from associated 12-hour calibration standard; see SOM01.2 – Exhibit D Low/Medium Volatiles Table 3	Internal standard	A

Quality Assurance Project Plan Worksheet #12-8 – Measurement Performance Criteria (Volatile Organic Compounds in Soil and Sediment by SOM01.2)

Matrix	Soil/Sediment
Analytical Group	VOCs
Concentration Level	All

Sampling Procedure[1]	Analytical Method/Standard Operating Procedure (SOP)[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
			(associated target compounds)		

Notes:
[1] Reference number from Quality Assurance Project Plan Worksheet #21.
[2] Reference number from Quality Assurance Project Plan Worksheet #23.
[3] MS and MSD must be client-provided.

Quality Assurance Project Plan Worksheet #12-9 – Measurement Performance Criteria (Pesticides in Soil and Sediment by SOM01.2)

Matrix	Soil/Sediment
Analytical Group	Pesticides
Concentration Level	All

Sampling Procedure[1]	Analytical Method/SOP[2]	DQIs	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
SOP 5, SOP 14	SOM01.2/TAB-2	Precision – Overall	RPD < 50%	Field duplicate	S&A
		Accuracy/Bias Contamination	< CRQL	Blanks (field, equipment, method, instrument)	S&A
		Accuracy/Bias	%R: 30-150%	Surrogate spikes: tetrachloro-m-xylene (TCX) and decachlorobiphenyl (DCB)	A
		Accuracy/Bias	%R, see SOM01.2 – Exhibit D Pesticides Table 3	MS[3]	A
		Accuracy/Bias	%R, see SOM01.2 – Exhibit D Pesticides Table 3	MSD[3]	A
		Precision	%RPD, see SOM01.2 – Exhibit D Pesticides Table 3	MS/MSD[3]	A
		Accuracy/Bias	%R, see SOM01.2 – Exhibit D Pesticides Table 2	LCS	A
		Accuracy/Bias and Precision	Retention times, see SOM01.2 – Exhibit D Pesticides Table 1	Retention time windows	A

Notes:
[1] Reference number from Quality Assurance Project Plan Worksheet #21.
[2] Reference number from Quality Assurance Project Plan Worksheet #23.
[3] MS and MSD analysis must be client-provided.

Quality Assurance Project Plan Worksheet #12-10 – Measurement Performance Criteria (Polychlorinated Biphenyls (PCBs) in Soil and Sediment by SOM01.2)

Matrix	Soil/Sediment
Analytical Group	PCBs
Concentration Level	All

Sampling Procedure[1]	Analytical Method/SOP[2]	DQIs	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
SOP 5, SOP 14	SOM01.2/TAB-1	Precision – Overall	RPD < 50%	Field duplicate	S&A
		Accuracy/Bias Contamination	< CRQL	Blanks (field, equipment, method, instrument)	S&A
		Accuracy/Bias	%R: 30-150%	Surrogate spikes: tetrachloro-m-xylene (TCX) and decachlorobiphenyl (DCB)	A
		Accuracy/Bias	%R, see SOM01.2 – Exhibit D Aroclors Table 1	MS[3]	A
		Accuracy/Bias	%R, see SOM01.2 – Exhibit D Aroclors Table 1	MSD[3]	A
		Precision	%RPD, see SOM01.2 – Exhibit D Aroclors Table 1	MS/MSD[3]	A
		Accuracy/Bias	%R, see SOM01.2 – Exhibit D Aroclors Table 2	LCS	A
		Accuracy/Bias and Precision	Retention times, see analytical SOP	Retention time windows	A

Notes:
[1] Reference number from Quality Assurance Project Plan Worksheet #21.
[2] Reference number from Quality Assurance Project Plan Worksheet #23.
[3] MS and MSD analysis must be client-provided.

Quality Assurance Project Plan Worksheet #12-11 – Measurement Performance Criteria (Metals, Mercury, and Cyanide in Soil and Sediment by ISM01.3)

Matrix	Soil/Sediment
Analytical Group	Metals/Mercury/Cyanide
Concentration Level	All

Sampling Procedure[1]	Analytical Method/SOP[2]	DQIs	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
SOP 5, SOP 14	ISM01.3[5]/TAB-5, TAB-6, TAB-7	Precision – Overall	RPD < 50%	Field duplicate	S&A
		Accuracy/Bias Contamination	< CRQL	Blanks (field, equipment, calibration, method)	S&A
		Precision	RPD < 20% for original and duplicate sample values ≥5x the CRQL; control limit of the CRQL used if either the sample or duplicate value is <5x the CRQL	Matrix duplicate (MD)[3]	A
		Accuracy/Bias	%R: 75-125%; does not apply when the sample concentration is ≥4x the spike added	MS[3]	A
		Precision – lab	Percent recovery (%R) ±20% of true value or ±1 times the CRQL of the analyte's true value, whichever is greater	Interference check sample (A and AB) (ICP-AES metals analysis only)	A
		Accuracy/Bias	%R 70-130% (50-150% for antimony and silver)	Laboratory control sample (LCS) (ICP-AES metals analysis only)	A
		Precision	Percent difference (%D) < 10% for original samples >50x the MDL	Serial dilution (ICP-AES metals analysis only)[4]	A

Notes:

[1] Reference number from Quality Assurance Project Plan Worksheet #21.
[2] Reference number from Quality Assurance Project Plan Worksheet #23.
[3] MD and MS must be client-provided.
[4] Performed as needed only for analytes with concentration > 50 times the method detection limit (MDL).
[5] Metals analysis will be performed using Inductively Coupled Plasma-Atomic Emission Spectroscopy.

QAPP Worksheet #12-12 Measurement Performance Criteria (Total Organic Carbon in Soil and Sediment by Lloyd Kahn)

Matrix	Soil/Sediment
Analytical Group	TOC
Concentration Level	All

Sampling Procedure[1]	Analytical Method/SOP[2]	DQIs	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
SOP 5, SOP 14	Lloyd Kahn/TAB-9	Precision — Overall	RPD < 50%	Field duplicate	S&A
		Accuracy/Bias	%R, laboratory generated limits	LCS	A
		Accuracy/Bias Contamination	< RL	Blanks (field, equipment, method)	S&A
		Accuracy/Bias	%R, laboratory generated limits	Matrix Spike (MS)[3]	A
		Precision	RPD, laboratory generated limits	MS/MSD or Laboratory Duplicate[3]	A

Notes:

[1] Reference number from QAPP Worksheet #21.

[2] Reference number from QAPP Worksheet #23.

[3] Sufficient sample size for MS and laboratory duplicate analysis must be client-provided.

Quality Assurance Project Plan Worksheet #12-13 – Measurement Performance Criteria (PCB Congeners in Soil and Sediment by EPA 1668A)

Matrix	Soil/Sediment
Analytical Group	PCB Congeners
Concentration Level	All

Sampling Procedure[1]	Analytical Method/SOP[2]	DQIs	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
SOP 5, SOP 14	EPA 1668A/TAWS-1	Precision – Overall	RPD < 50%	Field duplicate	S&A
		Accuracy/Bias	%R, method specified limit	Labeled Compounds/Internal Standard	A
		Accuracy/Bias Contamination	< RL	Blanks (field, equipment, method)	S&A
		Accuracy/Bias	%R, method specified limit	OPR/LCS	A
		Accuracy/Bias	%R, method specified limit	MS[3]	A
		Accuracy/Bias	%R, method specified limit	MSD or LCSD[3]	A
		Precision	RPD, method specified limit	MS/MSD or LCS/LCSD [3]	A

Notes:
[1]Reference number from Quality Assurance Project Plan Worksheet #21.
[2]Reference number from Quality Assurance Project Plan Worksheet #23.
[3]Sufficient sample size for MS and MSD analysis must be client-provided. LCS/LCSD performed when no MS/MSD are supplied.

Quality Assurance Project Plan Worksheet #12-14 – Measurement Performance Criteria (Dioxins and Furans in Soil and Sediment by EPA 1613)

Matrix	Soil/Sediment
Analytical Group	Dioxins and Furans
Concentration Level	All

Sampling Procedure[1]	Analytical Method/ Standard Operating Procedure (SOP)[2]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	Quality Control (QC) Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
SOP 5, SOP 14	EPA 1613/TAWS-2	Precision – Overall	Relative percent difference (RPD) < 50%	Field duplicate	S&A
		Precision	Percent recovery (%R), method specified limit	Labeled Compounds/Internal Standard	A
		Accuracy/Bias Contamination	< RL	Blanks (field, equipment, method)	S&A
		Accuracy/Bias	%R, method specified limit	Laboratory control sample (LCS) and laboratory control sample duplicate (LCSD)[3]	A
		Accuracy/Bias and Precision	Method specified limit	Instrument performance check: Perfluorokerosene (PKF)	A
		Precision	%RPD method specified limit	LCS/LCSD	A

Notes:
[1]Reference number from Quality Assurance Project Plan Worksheet #21.
[2]Reference number from Quality Assurance Project Plan Worksheet #23.

QAPP Worksheet #13: Secondary Data Uses and Limitations

Data type	Source	Data uses relative to current project	Factors affecting the reliability of data and limitations on data use
Concentrations of constituents of concern at the site	ARCADIS U.S., Inc. 2012. Site Characterization Summary Report.	Determine data gaps	None. Data had been validated.
Historical data	ARCADIS U.S. Inc. 2013. Preliminary Plan to Address Data Gaps Technical Memorandum	Determine data gaps	None
Historical data	ARCADIS BBL. 2007. Remedial Investigation/Feasibility Study Work Plan	Determine data gaps	None
Past site uses, potential ecological and human receptors.	Blasland, Bouck & Lee, Inc. 2006. Preliminary Conceptual Site Model.	Determine constituents of concern, and potential ecological and/or human receptors	None
Constituents of concern at the site	Foster Wheeler. 2000. Expanded Site Inspection Report: Rolling Knolls Landfill, Green Village, Chatham Township, Morris County, New	Determine data gaps	None

Data type	Source	Data uses relative to current project	Factors affecting the reliability of data and limitations on data use
	Jersey.		
Constituents of concern at the site	NUS Corporation. 1986. Report of Soil Sampling and Drilling Program at the Green Village Disposal Site.	Determine data gaps	None.
Historical data	United States Fish & Wildlife Service. 1991. Contaminants in Fish and Sediments of the Great Swamp National Wildlife Refuge, Morris County, New Jersey. New Jersey Field Office, Pleasantville, NJ. United States Fish & Wildlife Service. 2005. Contaminants in Fish and Sediments of the Great Swamp National Wildlife Refuge, Morris County, New Jersey: A 10-Year Follow-Up Investigation.	Determine potential migration	None

Data type	Source	Data uses relative to current project	Factors affecting the reliability of data and limitations on data use
Constituents of concern at the site	Weston Solutions Inc. 2003a. CLP Analytical Data of Soil and Sediment Samples; Rolling Knolls Landfill, Green Village, Chatham Township, Morris County, New Jersey.	Determine data gaps	None.
Constituents of concern at the site	Weston Solutions Inc. 2003b. PCB Field Screening Analytical Data of Soil and Sediment Samples; Rolling Knolls Landfill, Green Village, Chatham, Morris County, New Jersey.	Determine data gaps	None.

QAPP Worksheet #14/16: Project Tasks & Schedule

Activity	Responsible party	Planned start date	Planned completion date	Deliverable(s)	Deliverable due date
Mobilization	ARCADIS	17 November 2014	17 November 2014	Field notes	17 October 2014
Underground utility clearing	ARCADIS	17 November 2014	17 November 2014	Field notes of New Jersey One-Call utility mark outs	17 November 2014
Sample collection – soil	ARCADIS	17 November 2014	2 December 2014	Field notes, map of boring locations, and soil logs	9 December 2014
Installation and sampling of temporary monitoring wells	ARCADIS	1 December 2014	5 December 2014	Field notes, map of well locations, soil logs, groundwater purge logs, and chain of custodies	8 December 2014
First Groundwater Sampling Event - Redevelopment and Sampling of permanent wells	ARCADIS	8 December 2014	19 December 2014	Field notes, groundwater purge logs, and chain of custodies	22 December 2014
Installation of pore water samplers	ARCADIS	18 November 2014	18 November 2014	Field notes and chain of custodies	18 November 2014
Sample collection – pore-water	ARCADIS	3 December 2014	3 December 2014	Field notes and chain of custodies	2 December 2014
Sample collection – surface water and sediment	ARCADIS	2 December 2014	11 December 2014	Field notes and chain of custodies	12 December 2014

Activity	Responsible party	Planned start date	Planned completion date	Deliverable(s)	Deliverable due date
Assess Hunt Club Well HC-1	ARCADIS	5 December 2014	5 December 2014	Field notes, groundwater purge logs, and chain of custodies	6 December 2014
Analysis of Phase One samples	TestAmerica	18 November 2014	19 January 2015	Report of Analyses/Data package	19 January 2015
Validation of Phase One data	ARCADIS	13 January 2015	12 February 2015	Validation Summary report	12 February 2015
Usability assessment	Project Team	January 2015	January 2015	Meeting minutes/Usability assessment summary report	January 2015
Preparation of Interim Technical Memo	ARCADIS	12 December 2014	12 February 2015	Interim Technical Memorandum	12 February 2015
USEPA review and approval of Interim Technical Memorandum	USEPA	16 February 2015	6 March 2015	Approval of proposed permanent monitoring well locations	6 March 2015
Obtain well permits	ARCADIS	9 Mach 2015	27 March 2015	Permit approvals	27 March 2015
Install and develop permanent wells	ARCADIS	30 March 2015	10 April 2015	Field notes and well logs	17 April 2015
Second groundwater sampling event (all new monitoring wells, and selected existing monitoring wells based on the results of the first groundwater sampling even)	ARCADIS	27 April 2015	7 May 2015	Field notes and purge logs	8 May 2015
Third groundwater	ARCADIS	27 July 2015	7 August 2015	Field notes and purge	8 August 2015

Activity	Responsible party	Planned start date	Planned completion date	Deliverable(s)	Deliverable due date
sampling event (all new wells)				logs	
Groundwater sample analysis	TestAmerica	28 April 2015	7 September 2015	Laboratory data packages	7 September 2015
Data validation	ARCADIS	7 June 2015	21 September 2015	Validation summary report	21 September 2015
Final report	ARCADIS	22 September 2015	30 October 2015	Final report	30 October 2015

Analysis Tasks

- Soil and sediment samples will be processed, prepared and analyzed by:
  - i. TestAmerica Burlington for volatile organic compounds (VOCs) by SOM01.2, semivolatile organic compounds (SVOCs) by SOM01.2, polynuclear aromatic hydrocarbons (PAHs) by SIM by SOM01.2, polychlorinated biphenyls (PCBs) Aroclors by SOM01.2, pesticides by SOM01.2, metals by ISM01.3, mercury by ISM01.3, cyanide by ISM01.3, total organic carbon (TOC) by Lloyd Kahn, and pH by SW-846 9045C.
  - ii. TestAmerica West Sacramento for polychlorinated biphenyl (PCB) congeners by EPA 1668A, and dioxins and furans by EPA 1613B.
- Surface water and groundwater samples will be processed, prepared and analyzed by:
  - i. TestAmerica Burlington for VOCs by SOM01.2, SVOCs by SOM01.2, PAHs by SIM by SOM01.2, PCB Aroclors by SOM01.2, pesticides by SOM01.2, metals by ISM01.3, mercury by ISM01.3, low level mercury by EPA 1631E, cyanide by ISM01.3, TOC by EPA SW846 9060, and pH by SW-846 9045C.
  - ii. TestAmerica West Sacramento for polychlorinated biphenyl (PCB) congeners by EPA 1668A, and dioxins and furans by EPA 1613B.

Quality Control Tasks

The samples will be collected and processed, and waste will be disposed of as documented in the field Standard Operating Procedures (SOPs). The quality assurance (QA) samples are described in Worksheet #20.

Secondary Data

See Worksheet #13.

Data Management Tasks

The purpose of data management is to confirm that the necessary data are accurate and readily accessible to meet the analytical and reporting objectives of the project. The field investigations will include a significant number of samples that require a structured, comprehensive and efficient program for management of data.

The data management program established for the project includes field documentation and sample QA/quality control (QC) procedures, methods for tracking and managing the data, and a system for filing all site-related information. More specifically, data management procedures will be employed to efficiently process the information collected, such that the data are readily accessible and accurate. These procedures are described in detail in the following section.

The data management plan has five elements: 1) sample designation system, 2) field activities, 3) sample tracking and management, 4) data management system, and 5) document control and inventory.

Sample Designation System

A concise and easily understandable sample designation system is an important part of project sampling activities. It provides a unique sample number that will facilitate both sample tracking and easy resampling of select locations to evaluate data gaps, if necessary. The sample designation system to be employed during the sampling activities will be consistent, yet flexible enough to accommodate unforeseen sampling events or conditions. A combination of letters and numbers will be used to yield a unique sample number for each field sample collected, as outlined below.

Sample Codes

Each sample will be identified by a unique identification number in the logbook, sampling log, and chain-of-custody (COC) record using an alphanumeric code. Field samples will be linked to geographic location via location codes. All field samples will be identified using the following convention in the order presented below:

The alphanumeric sample designation code prefix will indicate the sampling method and/or sample matrix, subarea from which the sample was collected, and a numeric code corresponding to the location number. The sample depth interval, in feet, will follow the location number, and provide unique identification for that sample. Location numbering will be designated using the following codes:

- Soil Sample – “SS”
- Surface Water Sample – “SW”
- Sediment Sample – “SD”

- Groundwater Sample – “TW” if from a temporary monitoring well, or “MW” if from a permanent monitoring well
- Pore-Water Sample – “PW”
- Trip Blank Sample – “TB”
- Field Duplicate Sample – “DUP”
- Equipment Blank Sample – “EB”
- Matrix Spike and Matrix Spike Duplicate – “MS” and MSD”

The location code, consisting of a two to five digit designation, will follow the sample type code. For subsurface soil samples, the designation will also consist of the sample depth in feet. For example, a subsurface soil sample collected from a depth of 2 to 4 ft from SB02 would be designated SS-SB02 (2-4). For groundwater, surface water, and pore-water samples, the sample code will also include a six-digit number indicating the month, day, and year the sample was obtained. For example, a groundwater sample collected from temporary monitoring well TW-2 on October 30, 2014 will be designated GW-TW-2(103014).

QA/QC samples will be designated by a three-letter code followed by the six-digit sample collection date. For field and equipment blanks, a two-letter sample type code will precede the blank designation to indicate which medium the blank was intended to represent. For example, a field blank collected on October 30, 2014 during surface soil samples collection would be designated SS-FB1-103014. The sampling point associations for field duplicates must be recorded in the field log.

Sample identification and labeling procedures may be modified as needed to supplement specific investigation objectives and any deviations identified in site-specific work plans.

Field Activities

Field activities require consistent documentation and accurate record keeping. During site activities, standardized procedures will be used for documentation of field activities, data security and QA. These procedures are described in further detail in the following subsections.

Field Documentation

Complete and accurate record keeping is a critical component of the field investigation activities. When interpreting analytical results and identifying data trends, investigators realize that field notes are an important part of the review and validation process. To confirm that the field investigation is thoroughly documented, several different information records, each with its own specific reporting requirements, will be maintained, including:

- field logs
- chain-of-custody (COC) forms
- instrument calibration records

Each of these types of field documentation is described below.

Field Logs

Personnel performing the field activities will keep field logs that detail observations and measurements made during the site work. Data will be recorded directly into site-dedicated, bound notebooks, with each entry dated and signed. To determine, at a future date, that notebook pages are not missing, each page will be sequentially numbered. Erroneous entries will be corrected by crossing out the original entry, initialing it and then documenting the proper information. In addition, certain media sample locations will be surveyed to accurately record their locations. The survey crew will use its own field logs and will supply the sampling location coordinates to the Database Administrator.

Chain-of-Custody Forms

COC forms are used to document and track sample possession from time of collection to the time of disposal. A COC form will accompany each field sample collected, and one copy of the form will be filed in the field office. Field personnel will be briefed on the proper use of the COC procedure.

Instrument Calibration Records

As part of data QA procedures, field monitoring and detection equipment will be routinely calibrated. Instrument calibration confirms that equipment used is of the proper type, range, accuracy and precision to provide data compatible with the specified requirements and desired results. Calibration procedures for the various types of field instrumentation are described in Worksheet 22. To demonstrate that established calibration procedures have been followed, calibration records will be prepared and maintained to include, as appropriate, the following:

- calibration date and time
- type and identification number of equipment
- calibration frequency and acceptable tolerances
- identification of individual(s) performing calibration
- reference standards used
- calibration data
- information on calibration success or failure

The calibration record will serve as a written account of monitoring or detection equipment QA. Erratic behavior or failures of field equipment will be subsequently recorded in the calibration log.

Data Security

Measures will be taken during the field investigation to confirm that samples and records are not lost, damaged or altered. When not in use, field notebooks will be stored at the field office or locked in the field vehicle. Access to these files will be limited to the field personnel who use them.

Sample Management and Tracking

A record of all field documentation will be maintained to confirm the validity of data used in the site analysis. To effectively execute such documentation, specific sample tracking and data management procedures will be used throughout the sampling program.

Sample tracking will begin with the completion of COC forms. The completed COC forms will be faxed to the ARCADIS Project Manager or their designee Copies of all completed COC forms will be maintained in the project file. The laboratory will verify receipt of the samples electronically (via e-mail) on the following day.

When analytical data are received from the laboratory, the Project QA Manager or designee will review the incoming analytical data packages against the information on the COCs to confirm that the correct analyses were performed for each sample and that results for all samples

submitted for analysis were received. Any discrepancies noted will be promptly followed up by the Project QA Manager or designee.

Data Management System

In addition to the sample tracking system, a data management system will be implemented. The central focus of the data management system will be the development of a personal computer-based project database. The project database, to be maintained by the Project Database Manager, will combine pertinent geographical, field and analytical data. Information that will be used to populate the database will be derived from three primary sources: surveying of sampling locations, field observations and analytical results. Each of these sources is discussed in the following sections.

Computer Hardware

The database will be constructed on personal computer work stations connected through a network server. The network will provide access to various hardware peripherals, such as laser printers, backup storage devices, image scanners and modems. Computer hardware will be upgraded to industrial and corporate standards, as necessary, in the future.

Computer Software

The individual electronic data deliverables (EDDs), supplied by the laboratory in either an ASCII comma separated value (CSV) format or in a Microsoft® Excel worksheet, will be loaded into the appropriate database table via a custom-designed user interface Visual Basic program. Any analytical data that cannot be provided by the laboratory in electronic format will be entered manually. After entry into the database, the EDD data will be compared to the field information previously entered into the database to confirm that all requested analytical data have been received.

Survey Information

In general, each location sampled as part of the work plan will be surveyed to confirm accurate documentation of sample locations for mapping and GIS purposes (if appropriate), to facilitate resampling of select sample locations during future monitoring programs, if needed, and for any potential remediation activities. Field books associated with the surveying activities will be stored as a record of the project activities. The collection and reporting of locational data must include the GPS accuracy.

Field Observations

An important part of the information that will ultimately reside in the data management system for use during the project will originate in the observations that are recorded in the field.

Following each sampling event, a status memorandum may be prepared by the field personnel who performed the sampling activities. The purpose of the status memo is to summarize and provide a record of the sampling event. Topics to be discussed include the locations sampled, blind duplicate and MS/MSD sample identification numbers, personnel involved in the activity, and any other noteworthy events or observations that occurred.

Tables are typically attached to the memorandum and are used to summarize measurements that were recorded in the field books. It is anticipated that these tables will be developed using a personal computer spreadsheet program to reduce possible transcription error and to facilitate the transfer of information to the data management system.

All pertinent field data will be manually entered into the appropriate database tables from the COC forms and field notebooks.

Analytical Results

Analytical results will be provided by the laboratory in a digital (pdf) or a hard copy format. The data packages will be examined to confirm that the correct analyses were performed for each sample submitted and that all of the analyses requested on the COC form were performed. If discrepancies are noted, the Project QA Manager will be notified and will promptly follow up with the laboratory to resolve any issues.

Each data package will be validated in accordance with procedures outlined in Worksheet #37. Data that do not meet the specified standards will be flagged pending resolution of the issue. The flag will not be removed from the data until the issue associated with the sample results is resolved. Although flags may remain for certain data, the use of the data may not necessarily be restricted.

Following completion of the data validation, the digital files will be used to populate the appropriate database tables. This format specifies one data record for each constituent for each sample analyzed. Specific fields include:

- sample identification number
- date sampled
- date analyzed
- parameter name
- analytical result

- units
- detection limit
- qualifier(s)

The individual EDDs, supplied by the laboratory in a Microsoft Excel worksheet, will be loaded into the appropriate database table. If dilutions or re-analyses are included in the EDD, the laboratory must designate which set of results are considered reportable. The data will be evaluated by the data validator, and will make the final determination of which data is reportable. Any analytical data that cannot be provided by the laboratory in electronic format will be entered manually. After entry into the database, the EDD data will be compared to the field information previously entered into the database to confirm that all requested analytical data have been received.

Data Analysis and Reporting

The database management system will have several functions to facilitate the review and analysis of project data. Data entry screens will be developed to assist in the keypunching of field observations. Routines will also be developed to permit the user to scan analytical data from a given site for a given medium. Several output functions that have been developed by ARCADIS will be appropriately modified for use in the data management system.

A valuable function of the data management system will be the generation of tables of analytical results from the project database. The capability of the data management system to directly produce tables reduces the redundant manual entry of analytical results during report preparation and precludes transcription errors that may occur otherwise. This data management system function has the ability to process the data and generate tables. Tables of analytical data will be produced as part of data interpretation, data reporting, and generation of the Final Report.

For certain comparisons, PCB Aroclors may be summed to obtain a total PCB concentration for each sample location. Undetected Aroclors will be considered to be zero during this summation.

Some sample locations will be submitted for analysis of PCB congeners. These methods may have congeners that co-elute. The co-elution scheme for these analyses will be as described in the laboratory SOP. In the instance where co-eluting congener values may be reported multiple times, the result was included only once in the sum.

Another function of the data management system will be to create digital files of analytical results and qualifiers suitable for transfer to mapping/ presentation software. A function has been created by ARCADIS that creates a digital file consisting of sample location number, state plane coordinates, sampling date and detected constituents, and associated concentrations and analytical qualifiers. The file is then transferred to an

AutoCAD work station, where another program has been developed to plot a location's analytical data in a "box" format at the sample location (represented by the state plane coordinates). This routine greatly reduces the redundant keypunching of analytical results and facilitates the efficient production of interpretative and presentation graphics.

The data management system also has the capability of producing a digital file of select parameters that exists in one or more of the databases. This type of custom function is accomplished on an interactive basis and is best used for transferring select information into a number of analysis tools, such as statistical or graphing programs.

ARCADIS will provided with an Electronic Data Deliverable (EDD) submittal of all recent validated data following the step-by-step instructions provided in the EPA Region 2 EDD webpage. http://www.epa.gov/region2/superfund/medd.htm.

Documentation and Records

Field Documentation. Field personnel will provide comprehensive documentation covering all aspects of field sampling, field analysis and sample COC. This documentation constitutes a record that allows reconstruction of all field events to aid in the data review and interpretation process. All documents, records and information relating to the performance of the field work will be retained in the project file.

The various forms of documentation to be maintained throughout the action include:

- *Daily Production Documentation*. A field notebook consisting of a waterproof, bound notebook that will contain a record of all activities performed at the site.

- *Sampling Information*. Sampling locations, physical observations and weather conditions (as appropriate) will be described in the field notes.

- *Sample COC*. COC forms will provide the record of responsibility for sample collection, transport and submittal to the laboratory. COC forms will be filled out at each sampling site, at a group of sampling sites or at the end of each day of sampling by ARCADIS' field personnel designated to be responsible for sample custody. If the samples are relinquished by the designated sampling person to other sampling or field personnel, the COC form will be signed and dated by the appropriate personnel to document the sample transfer. The original COC form will accompany the samples to the laboratory, and copies will be forwarded to the project files.

  Persons will have custody of samples when the samples are in their physical possession, in their view after being in their possession, or in their physical possession and secured so they cannot be tampered with. In addition, when samples are secured in a restricted area

accessible only to authorized personnel, they will be deemed to be in the custody of such authorized personnel.

- *Field Equipment, Calibration and Maintenance Logs*. To document the calibration and maintenance of field instrumentation, calibration and maintenance logs will be maintained for each piece of field equipment that is not factory-calibrated.

Laboratory Project Files. The laboratory will establish a file for pertinent data. The file will include correspondence, faxed information, phone logs and COC forms. The laboratory will retain project files and data packages for a period to be determined by the Settling Parties.

Laboratory Logbooks. Workbooks, bench sheets, instrument logbooks and instrument printouts will be used to trace the history of samples through the analytical process and to document important aspects of the work, including the associated QCs. As such, logbooks, bench sheets, instrument logs and instrument printouts will be part of the permanent record of the laboratory. Each page or entry will be dated and initialed by the analyst at the time of entry. Errors in entry will be crossed out in indelible ink with one stroke, corrected without the use of white-out or by obliterating or writing directly over the erroneous entry, and initialed and dated by the individual making the correction. Pages of logbooks that are not used will be completed by lining out unused portions. Information regarding the sample, analytical procedures performed and results of the testing will be recorded on laboratory forms or personal notebook pages by the analyst. These notes will be dated and will also identify the analyst, instrument used and instrument conditions. Laboratory notebooks will be periodically reviewed by the laboratory group leaders for accuracy, completeness and compliance with this QAPP. All entries and calculations will be verified by the laboratory group leader. If all entries on the pages are correct, the laboratory group leader will initial and date the pages. Corrective action will be taken for incorrect entries before the laboratory group leader signs.

Computer and Hard Copy Storage. All electronic files and deliverables and hard copy data packages (or electronic copies) will be retained for a period to be determined by the Settling Parties.

Field Data Reporting. Information collected in the field through visual observation, manual measurement and/or field instrumentation will be recorded in field notebooks or data sheets and/or on forms. Such data will be reviewed by the ARCADIS Project Manager or their designee for adherence to the Work Plan and for consistency. Concerns identified as a result of this review will be discussed with the field personnel, corrected if possible and (as necessary) incorporated into the data evaluation process. If applicable, field data forms and calculations will be processed and included in appendices to the appropriate reports (when generated). The original field logs documents and data reductions will be kept in the project file at the ARCADIS office in Cranbury, New Jersey.

Laboratory Data Reporting. Data reports for all parameters will include, at a minimum, the following items:

Narrative: Summary of activities that took place during sample analysis, including the following information:

- laboratory name and address
- date of sample receipt
- cross reference of laboratory identification number to contractor sample identification
- analytical methods used
- deviations from specified protocol
- corrective actions taken

Included with the narrative will be any sample handling documents, including field and internal COC forms, air bills, and shipping tags.

Analytical Results: These will be reported according to analysis type and include the following information, as applicable:

- sample identification (ID)
- laboratory ID
- date of collection
- date of receipt
- date of extraction
- date of analysis
- method detection and reporting limits

Sample results on the report forms will be corrected for dilutions. Sediment and soil data will be reported on a dry weight basis. Unless otherwise specified, all results will be reported uncorrected for blank contamination.

The analyses performed will be reported as Contract Laboratory Program (CLP)-equivalent Level 4 data package which will include supporting documentation. This additional documentation will include, but not be limited to, raw data required to recalculate any result, including instrument printouts and quantitation reports. The report also will include standards used in calibration and calculation of analytical results; sample extraction,

digestion and other preparation logs; standard preparation logs; instrument run logs; and moisture content calculations.

Data reporting levels are as follows:

- **Level 4 — Full Reporting**: Full CLP or CLP-type reporting is used for those analyses that, based on the intended data use, require full documentation.

Laboratory reporting for all parameter groups in soil, sediment, groundwater, surface water and pore-water will be Level 4.

Assessment/Audit Tasks

Performance and systems audits will be completed in the field and laboratory during the data gap investigations, as described below and in Worksheets #31 and #32.

1. ***Field Audits***. The following field performance and systems audits will be completed during this project.
   The ARCADIS Project Manager or their designee will monitor field performance. Field performance audit summaries will contain an evaluation of field activities to verify that the activities are performed according to established procedures as described in field SOPs. Field performance audits may be performed by the ARCADIS Project Manager (or her designee). The auditor(s) will review field reports and communicate concerns to the ARCADIS Project Manager and/or Field Task Manager, as appropriate.

   The ARCADIS Project Manager will administer a readiness review one week prior to mobilization and the ARCADIS Task Manager will conduct field performance audits the first day of soil and temporary well groundwater sampling and at a frequency of approximately one per month during field activities. The number and frequency of additional field performance audits conducted will be determined independently by the Field Task Manager. The observations made during field performance audits and any recommended changes/deviations to the field procedures will be recorded and documented.

   The Project QA Manager will review the rinse and trip blank data to identify potential deficiencies in field sampling and cleaning procedures. In addition, systems audits comparing scheduled QA/QC activities from this QAPP with actual QA/QC activities completed will be performed. The Field Task Manager and Project QA Manager will periodically confirm that work is being performed consistent with this QAPP. The ARCADIS Project Manager will conduct an interim management review following site mobilization and a final management review upon completion of field work.

2. Laboratory Audits

Internal laboratory audits are conducted periodically by the Laboratory QA Manager. As part of the audit, the overall performance of the laboratory staff is evaluated and compared to the performance criteria outlined in the laboratory QA manual and SOPs. Results of the audits are summarized and issued to each department supervisor, Laboratory Manager and Laboratory Director. A systems audit of each laboratory is also performed by the Project QA Manager to determine whether the procedures implemented by each laboratory comply with the QA manual and SOPs.

As a participant in state and federal certification programs, the laboratory is audited by representatives of the regulatory agency issuing certification, in addition to the laboratory's internal audits. Audits are usually conducted annually and focus on laboratory conformance to the specific program protocols for which the laboratory is seeking certification. The auditor reviews sample handling and tracking documentation, analytical methodologies, analytical supportive documentation and final reports. The audit findings are formally documented and submitted to the laboratory for corrective action, if necessary.

ARCADIS reserves the right to conduct an on-site audit of the laboratory prior to the start of analyses for the project. Additional audits may be performed during the project, as deemed necessary.

3. Corrective Action

Corrective actions are required when field or analytical data are not within the objectives specified in this QAPP. Corrective actions include procedures to promptly investigate, document, evaluate and correct data collection and/or analytical procedures. Field and laboratory corrective action procedures for the actions are described below.

a. Field Procedures

If, during field work, a condition is noted by the field crew that would have an adverse effect on data quality, corrective action will be taken so as not to repeat this condition. Condition identification, cause and corrective action implemented by the Field Task Manager or a designee will be documented on a Corrective Action Form and reported to the appropriate ARCADIS Project QA Manager and Project Manager.

Examples of situations that would require corrective actions are provided below:

- protocols as defined by the QAPP and/or field SOPs have not been followed

- equipment is not in proper working order or is not properly calibrated
- QC requirements have not been met
- issues resulting from performance or systems audits have not been resolved

Project personnel will continuously monitor ongoing work performance as part of daily responsibilities.

b. Laboratory Procedures

In the laboratory, when a condition is noted to have an adverse effect on data quality, corrective action will be taken so as not to repeat this condition. Condition identification, cause and corrective action taken will be documented and reported to the Project Manager and Project QA Manager.

Corrective action may be initiated, at a minimum, under the following conditions:

- protocols as defined by this QAPP have not been followed
- predetermined data acceptance standards are not obtained
- equipment is not in proper working order or calibrated
- sample and test results are not completely traceable
- QC requirements have not been met
- issues resulting from performance or systems audits have not been resolved

Laboratory personnel will continuously monitor ongoing work performance as part of daily responsibilities. Corrective action will be initiated at the point where the problem has been identified. At whatever level this occurs (analyst, supervisor, data review, or quality control), it will be brought to the attention of the Laboratory QA Manager and, ultimately, the Laboratory Director. Final approval of any action deemed necessary is subject to the approval of the Laboratory Director.

Any corrective action deemed necessary based on system or performance audits, the analytical results of split samples, or the results of data review will be implemented. The corrective action may include sample re-extraction, re-preparation, re-analysis, cleanup, dilution, matrix

modification or other activities.
Data Review Tasks
See Worksheets #36 and #37.

QAPP Worksheet #15: Project Action Limits and Laboratory-Specific Detection/Quantitation Limits

Project action limits and laboratory-specific detection/quantitation limits are provided in Table 1 (attached).

QAPP Worksheet #17: Sampling Design and Rationale

Physical boundaries for the area under study

- Figure 1 depicts the estimated boundaries of the landfill and surface debris area based on observations during test pit activities. Eastern and southern portions of the landfill are located within the GSNWR.

Time period being represented by the collected data

- Sampling will occur in two phases, beginning in October 2014 and ending in May 2015. Data can be compared to the previous sampling event to constrain annual and seasonal variations. All data will represent current conditions.

Description of the sampling area

- The sampling areas were selected to address specific data gaps in the previous investigation.

- They include soil near northern, eastern, southern, and western estimated landfill boundary, groundwater across the landfill and adjacent areas, surface water and sediment in ponds both on and near the landfill, and pore-water in wetlands on the west side of the landfill.

Sample locations

Sample locations are shown on Figures 2a and 2b.

Soil samples (20 samples, with 20 additional samples contingent on the results)

a. Basis for the number and placement of samples: Soil sampling will be conducted in a step-out manner. Soil samples will be collected in two lines: an inner line approximately 25 feet from the edge of the estimated landfill boundary, and an outer line approximately 50 feet from the edge of the estimated landfill boundary. The inner samples will be analyzed for the full TCL/TAL parameters. If the results of these analyses exceed the SRSs, samples from the outer line will be analyzed for the same parameters. If the results from the outer line also exceed the SRSs, additional sampling may be needed to complete delineation.

b. How sample positions will be located: Sample locations were selected in consultation with USEPA. They will be located using site landmarks (e.g, monitoring wells or other permanent features) and global positioning system (GPS).

c. If a soil sample cannot be collected then the location may be moved to another location within 10 feet of the proposed location.

Groundwater samples (9 samples total) from temporary monitoring wells

a. Basis for the number and placement of samples: Temporary wells were placed upgradient and downgradient of well MW-3 and MW-10 to help identify potential sources of VOCs and to help delineate their downgradient extent.

b. How sample positions will be located: Sample locations were selected in consultation with USEPA. They will be located using site landmarks (e.g, monitoring wells or other permanent features) and GPS.

c. If a sample cannot be collected where planned, the temporary wells may be relocated.

Groundwater samples (31 samples total) from permanent monitoring wells

a. Basis for the number and placement of samples: The locations of wells include 17 historical permanent wells and 7 new wells. All 24 wells will be sampled once. The 7 new wells will be sampled a second time, resulting in a total of 31 samples.

b. How sample positions will be located: Sample locations were selected in consultation with USEPA. Locations for the new permanent wells will be selected in consultation with USEPA based on the results of soil samples and temporary monitoring wells.

c. If a sample cannot be collected (e.g., the well is dry) then the field staff will return later during the sampling event to check the conditions and collect the sample if possible.

Pore-water samples (2 samples total)

a. Basis for the number and placement of samples: Pore-water sample locations were selected to delineate potential migration of VOCs in groundwater from the area of monitoring well MW-10 to the southwest.

b. How sample positions will be located: Sample locations were selected in consultation with USEPA. They will be located using site landmarks (e.g, monitoring wells or other permanent features) and GPS.

c. If a sample cannot be collected where planned, the locations may be relocated within 10 feet of the proposed location.

Surface water samples (11 samples total)

a. Basis for the number and placement of samples: Surface water samples will be collected from surface water bodies on the landfill that were not sampled during the previous investigations.

b. How sample positions will be located: Sample locations were selected in consultation with USEPA. They will be located using site landmarks (e.g, monitoring wells or other permanent features) and GPS.

c. If a sample cannot be collected where planned, the location may be adjusted. Some of the water bodies where sampling is proposed are small and have not been directly observed during previous activities. They may be ephemeral or smaller than shown in Figures 2a and 2b. Surface water and sediment samples will be collected if any standing water is observed at the proposed sampling locations.

Sediment samples (11 samples total)

a. Basis for the number and placement of samples: Sediment samples will be collected from surface water bodies on the landfill that were not sampled during the previous investigations.

b. How sample positions will be located: Sample locations were selected in consultation with USEPA. They will be located using site landmarks (e.g, monitoring wells or other permanent features) and GPS.

c. If a sample cannot be collected where planned, the location may be adjusted. Some of the water bodies where sampling is proposed are small and have not been directly observed during previous activities. They may be ephemeral or smaller than shown in Figures 2a and 2b. In such cases, the samples may be collected elsewhere or eliminated.

QAPP Worksheet #18: Sampling Locations and Methods

Sample ID	Matrix	Depth (ft bgs)	Type	Analyte/Analytical Group	Sampling SOP	Comments
SS-125	Soil	0.0-1.0	Macrocore	Full TCL/TAL, SVOCs SIM	SOP 5	
SS-126	Soil	0.0-1.0	Macrocore	Full TCL/TAL, SVOCs SIM	SOP 5	Contingent sample
SS-127	Soil	0.0-1.0	Macrocore	Full TCL/TAL, SVOCs SIM, PCBs (as Congeners), Dioxins, Furans	SOP 5	
SS-128	Soil	0.0-1.0	Macrocore	Full TCL/TAL, SVOCs SIM, PCBs (as Congeners), Dioxins, Furans	SOP 5	Contingent sample
SS-129	Soil	0.0-1.0	Macrocore	Full TCL/TAL, SVOCs SIM, PCBs (as Congeners), Dioxins, Furans	SOP 5	
SS-130	Soil	0.0-1.0	Macrocore	Full TCL/TAL, SVOCs SIM, PCBs (as Congeners), Dioxins, Furans	SOP 5	Contingent sample
SS-131	Soil	0.0-1.0	Macrocore	Full TCL/TAL, SVOCs SIM	SOP 5	
SS-132	Soil	0.0-1.0	Macrocore	Full TCL/TAL, SVOCs SIM	SOP 5	Contingent sample

Sample ID	Matrix	Depth (ft bgs)	Type	Analyte/Analytical Group	Sampling SOP	Comments
SS-133	Soil	0.0-1.0	Macrocore	Full TCL/TAL, SVOCs SIM	SOP 5	
SS-134	Soil	0.0-1.0	Macrocore	Full TCL/TAL, SVOCs SIM	SOP 5	Contingent sample
SS-135	Soil	0.0-1.0	Macrocore	Full TCL/TAL, SVOCs SIM	SOP 5	
SS-136	Soil	0.0-1.0	Macrocore	Full TCL/TAL, SVOCs SIM	SOP 5	Contingent sample
SS-137	Soil	0.0-1.0	Macrocore	Full TCL/TAL, SVOCs SIM, PCBs (as Congeners), Dioxins, Furans	SOP 5	
SS-138	Soil	0.0-1.0	Macrocore	Full TCL/TAL, SVOCs SIM, PCBs (as Congeners), Dioxins, Furans	SOP 5	Contingent sample
SS-139	Soil	0.0-1.0	Macrocore	Full TCL/TAL, SVOCs SIM, PCBs (as Congeners), Dioxins, Furans	SOP 5	
SS-140	Soil	0.0-1.0	Macrocore	Full TCL/TAL, SVOCs SIM, PCBs (as Congeners), Dioxins, Furans	SOP 5	Contingent sample
SS-141	Soil	0.0-1.0	Macrocore	Full TCL/TAL, SVOCs SIM	SOP 5	

Sample ID	Matrix	Depth (ft bgs)	Type	Analyte/Analytical Group	Sampling SOP	Comments
SS-142	Soil	0.0-1.0	Macrocore	Full TCL/TAL, SVOCs SIM	SOP 5	Contingent sample
SS-143	Soil	0.0-1.0	Macrocore	Full TCL/TAL, SVOCs SIM	SOP 5	
SS-144	Soil	0.0-1.0	Macrocore	Full TCL/TAL, SVOCs SIM	SOP 5	Contingent sample
SS-145	Soil	0.0-1.0	Macrocore	Full TCL/TAL, SVOCs SIM	SOP 5	
SS-146	Soil	0.0-1.0	Macrocore	Full TCL/TAL, SVOCs SIM	SOP 5	Contingent sample
SS-147	Soil	0.0-1.0	Macrocore	Full TCL/TAL, SVOCs SIM	SOP 5	
SS-148	Soil	0.0-1.0	Macrocore	Full TCL/TAL, SVOCs SIM	SOP 5	Contingent sample
SS-149	Soil	0.0-1.0	Macrocore	Full TCL/TAL, SVOCs SIM	SOP 5	
SS-150	Soil	0.0-1.0	Macrocore	Full TCL/TAL, SVOCs SIM	SOP 5	Contingent sample
SS-151	Soil	0.0-1.0	Macrocore	Full TCL/TAL, SVOCs SIM	SOP 5	

Sample ID	Matrix	Depth (ft bgs)	Type	Analyte/Analytical Group	Sampling SOP	Comments
SS-152	Soil	0.0-1.0	Macrocore	Full TCL/TAL, SVOCs SIM	SOP 5	Contingent sample
SS-153	Soil	0.0-1.0	Macrocore	Full TCL/TAL, SVOCs SIM	SOP 5	
SS-154	Soil	0.0-1.0	Macrocore	Full TCL/TAL, SVOCs SIM	SOP 5	Contingent sample
SS-155	Soil	0.0-1.0	Macrocore	Full TCL/TAL, SVOCs SIM	SOP 5	
SS-156	Soil	0.0-1.0	Macrocore	Full TCL/TAL, SVOCs SIM	SOP 5	Contingent sample
SS-157	Soil	0.0-1.0	Macrocore	Full TCL/TAL, SVOCs SIM	SOP 5	
SS-158	Soil	0.0-1.0	Macrocore	Full TCL/TAL, SVOCs SIM	SOP 5	Contingent sample
SS-159	Soil	0.0-1.0	Macrocore	Full TCL/TAL, SVOCs SIM, PCBs (as Congeners), Dioxins, Furans	SOP 5	

Sample ID	Matrix	Depth (ft bgs)	Type	Analyte/Analytical Group	Sampling SOP	Comments
SS-160	Soil	0.0-1.0	Macrocore	Full TCL/TAL, SVOCs SIM, PCBs (as Congeners), Dioxins, Furans	SOP 5	Contingent sample
SS-161	Soil	0.0-1.0	Macrocore	Full TCL/TAL, SVOCs SIM, PCBs (as Congeners), Dioxins, Furans	SOP 5	
SS-162	Soil	0.0-1.0	Macrocore	Full TCL/TAL, SVOCs SIM, PCBs (as Congeners), Dioxins, Furans	SOP 5	Contingent sample
SS-163	Soil	0.0-1.0	Macrocore	Full TCL/TAL, SVOCs SIM, PCBs (as Congeners), Dioxins, Furans	SOP 5	
SS-164	Soil	0.0-1.0	Macrocore	Full TCL/TAL, SVOCs SIM, PCBs (as Congeners), Dioxins, Furans	SOP 5	Contingent sample
MW-1	Groundwater	TBD	Low flow	Full TCL/TAL, SVOCs SIM, TAL Metals & Cyanide (filtered)	SOP 7	Existing well
MW-2	Groundwater	TBD	Low flow	Full TCL/TAL, SVOCs SIM, TAL Metals & Cyanide (filtered)	SOP 7	Existing well

Sample ID	Matrix	Depth (ft bgs)	Type	Analyte/Analytical Group	Sampling SOP	Comments
MW-3	Groundwater	TBD	Low flow	Full TCL/TAL, SVOCs SIM, TAL Metals & Cyanide (filtered)	SOP 7	Existing well
MW-4	Groundwater	TBD	Low flow	Full TCL/TAL, SVOCs SIM, TAL Metals & Cyanide (filtered)	SOP 7	Existing well
MW-5	Groundwater	TBD	Low flow	Full TCL/TAL, SVOCs SIM, TAL Metals & Cyanide (filtered)	SOP 7	Existing well
MW-6	Groundwater	TBD	Low flow	Full TCL/TAL, SVOCs SIM, TAL Metals & Cyanide (filtered)	SOP 7	Existing well
MW-7	Groundwater	TBD	Low flow	Full TCL/TAL, SVOCs SIM, TAL Metals & Cyanide (filtered)	SOP 7	Existing well
MW-8	Groundwater	TBD	Low flow	Full TCL/TAL, SVOCs SIM, TAL Metals & Cyanide (filtered)	SOP 7	Existing well
MW-9	Groundwater	TBD	Low flow	Full TCL/TAL, SVOCs SIM, TAL Metals & Cyanide (filtered)	SOP 7	Existing well

Sample ID	Matrix	Depth (ft bgs)	Type	Analyte/Analytical Group	Sampling SOP	Comments
MW-10	Groundwater	TBD	Low flow	Full TCL/TAL, SVOCs SIM, TAL Metals & Cyanide (filtered)	SOP 7	Existing well
MW-11	Groundwater	TBD	Low flow	Full TCL/TAL, SVOCs SIM, TAL Metals & Cyanide (filtered)	SOP 7	Proposed new well
MW-12	Groundwater	TBD	Low flow	Full TCL/TAL, SVOCs SIM, TAL Metals & Cyanide (filtered)	SOP 7	Proposed new well
MW-13	Groundwater	TBD	Low flow	Full TCL/TAL, SVOCs SIM, TAL Metals & Cyanide (filtered)	SOP 7	Proposed new well
MW-14	Groundwater	TBD	Low flow	Full TCL/TAL, SVOCs SIM, TAL Metals & Cyanide (filtered)	SOP 7	Proposed new well
MW-15	Groundwater	TBD	Low flow	Full TCL/TAL, SVOCs SIM, TAL Metals & Cyanide (filtered)	SOP 7	Proposed new well
MW-16	Groundwater	TBD	Low flow	Full TCL/TAL, SVOCs SIM, TAL Metals & Cyanide (filtered)	SOP 7	Proposed new well
MW-17	Groundwater	TBD	Low flow	Full TCL/TAL, SVOCs SIM, TAL Metals & Cyanide (filtered)	SOP 7	Proposed new well

Sample ID	Matrix	Depth (ft bgs)	Type	Analyte/Analytical Group	Sampling SOP	Comments
X-1	Groundwater	TBD	Low flow	Full TCL/TAL, SVOCs SIM, TAL Metals & Cyanide (filtered)	SOP 7	Existing well
X-2	Groundwater	TBD	Low flow	Full TCL/TAL, SVOCs SIM, TAL Metals & Cyanide (filtered)	SOP 7	Existing well
X-3	Groundwater	TBD	Low flow	Full TCL/TAL, SVOCs SIM, TAL Metals & Cyanide (filtered)	SOP 7	Existing well
X-4	Groundwater	TBD	Low flow	Full TCL/TAL, SVOCs SIM, TAL Metals & Cyanide (filtered)	SOP 7	Existing well
X-5	Groundwater	TBD	Low flow	Full TCL/TAL, SVOCs SIM, TAL Metals & Cyanide (filtered)	SOP 7	Existing well
X-6	Groundwater	TBD	Low flow	Full TCL/TAL, SVOCs SIM, TAL Metals & Cyanide (filtered)	SOP 7	Existing well
X-7	Groundwater	TBD	Low flow	Full TCL/TAL, SVOCs SIM, TAL Metals & Cyanide (filtered)	SOP 7	Existing well

Sample ID	Matrix	Depth (ft bgs)	Type	Analyte/Analytical Group	Sampling SOP	Comments
TWP-1	Groundwater	TBD	Macrocore	Full TCL/TAL, SVOCs SIM, TAL Metals & Cyanide (filtered)	SOP 2	Temporary well
TWP-2	Groundwater	TBD	Macrocore	Full TCL/TAL, SVOCs SIM, TAL Metals & Cyanide (filtered)	SOP 2	Temporary well
TWP-3	Groundwater	TBD	Macrocore	Full TCL/TAL, SVOCs SIM, TAL Metals & Cyanide (filtered)	SOP 2	Temporary well
TWP-4	Groundwater	TBD	Macrocore	Full TCL/TAL, SVOCs SIM, TAL Metals & Cyanide (filtered)	SOP 2	Temporary well
TWP-5	Groundwater	TBD	Macrocore	Full TCL/TAL, SVOCs SIM, TAL Metals & Cyanide (filtered)	SOP 2	Temporary well
TWP-6	Groundwater	TBD	Macrocore	Full TCL/TAL, SVOCs SIM, TAL Metals & Cyanide (filtered)	SOP 2	Temporary well
TWP-7	Groundwater	TBD	Macrocore	Full TCL/TAL, SVOCs SIM, TAL Metals & Cyanide (filtered)	SOP 2	Temporary well
TWP-8	Groundwater	TBD	Macrocore	Full TCL/TAL, SVOCs SIM, TAL Metals & Cyanide (filtered)	SOP 2	Temporary well

Sample ID	Matrix	Depth (ft bgs)	Type	Analyte/Analytical Group	Sampling SOP	Comments
TWP-9	Groundwater	TBD	Macrocore	Full TCL/TAL, SVOCs SIM, TAL Metals & Cyanide (filtered)	SOP 2	Temporary well
PWS -1	Pore-Water	TBD	PDB	Full TCL/TAL, SVOCs SIM, TAL Metals & Cyanide (filtered)	SOP 20	Passive Sampler
PWS-2	Pore-Water	TBD	PDB	Full TCL/TAL, SVOCs SIM, TAL Metals & Cyanide (filtered)	SOP 20	Passive Sampler
SW-34	Surface Water	TBD	Bailer/direct dip	Full TCL/TAL, SVOCs SIM, TAL Metals & Cyanide (filtered), Low-Level Mercury, Hardness, pH, TOC	SOP 8	Teflon-lined bailer
SW-35	Surface Water	TBD	Bailer/direct dip	Full TCL/TAL, SVOCs SIM, TAL Metals & Cyanide (filtered), Low-Level Mercury, Hardness, pH, TOC	SOP 8	Teflon-lined bailer
SW-36	Surface Water	TBD	Bailer/direct dip	Full TCL/TAL, SVOCs SIM, TAL Metals & Cyanide (filtered), Low-Level Mercury, Hardness, pH, TOC	SOP 8	Teflon-lined bailer

Sample ID	Matrix	Depth (ft bgs)	Type	Analyte/Analytical Group	Sampling SOP	Comments
SW-37	Surface Water	TBD	Bailer/direct dip	Full TCL/TAL, SVOCs SIM, TAL Metals & Cyanide (filtered), Low-Level Mercury, Hardness, pH, TOC	SOP 8	Teflon-lined bailer
SW-38	Surface Water	TBD	Bailer/direct dip	Full TCL/TAL, SVOCs SIM, TAL Metals & Cyanide (filtered), Low-Level Mercury, Hardness, pH, TOC	SOP 8	Teflon-lined bailer
SW-39	Surface Water	TBD	Bailer/direct dip	Full TCL/TAL, SVOCs SIM, TAL Metals & Cyanide (filtered), Low-Level Mercury, Hardness, pH, TOC	SOP 8	Teflon-lined bailer
SW-40	Surface Water	TBD	Bailer/direct dip	Full TCL/TAL, SVOCs SIM, TAL Metals & Cyanide (filtered), Low-Level Mercury, Hardness, pH, TOC	SOP 8	Teflon-lined bailer
SW-41	Surface Water	TBD	Bailer/direct dip	Full TCL/TAL, SVOCs SIM, TAL Metals & Cyanide (filtered), Low-Level Mercury, Hardness, pH, TOC	SOP 8	Teflon-lined bailer

Sample ID	Matrix	Depth (ft bgs)	Type	Analyte/Analytical Group	Sampling SOP	Comments
SW-42	Surface Water	TBD	Bailer/direct dip	Full TCL/TAL, SVOCs SIM, TAL Metals & Cyanide (filtered), Low-Level Mercury, Hardness, pH, TOC	SOP 8	Teflon-lined bailer
SW-43	Surface Water	TBD	Bailer/direct dip	Full TCL/TAL, SVOCs SIM, TAL Metals & Cyanide (filtered), Low-Level Mercury, Hardness, pH, TOC	SOP 8	Teflon-lined bailer
SW-44	Surface Water	TBD	Bailer/direct dip	Full TCL/TAL, SVOCs SIM, TAL Metals & Cyanide (filtered), Low-Level Mercury, Hardness, pH, TOC	SOP 8	Teflon-lined bailer
SD-34	Sediment	TBD	Grab sample	Full TCL/TAL, SVOCs SIM, pH, TOC, Grain size	SOP 14	
SD-35	Sediment	TBD	Grab sample	Full TCL/TAL, SVOCs SIM, pH, TOC, Grain size	SOP 14	
SD-36	Sediment	TBD	Grab sample	Full TCL/TAL, SVOCs SIM, pH, TOC, Grain size	SOP 14	

Sample ID	Matrix	Depth (ft bgs)	Type	Analyte/Analytical Group	Sampling SOP	Comments
SD-37	Sediment	TBD	Grab sample	Full TCL/TAL, SVOCs SIM, pH, TOC, Grain size	SOP 14	
SD-38	Sediment	TBD	Grab sample	Full TCL/TAL, SVOCs SIM, pH, TOC, Grain size	SOP 14	
SD-39	Sediment	TBD	Grab sample	Full TCL/TAL, SVOCs SIM, pH, TOC, Grain size	SOP 14	
SD-40	Sediment	TBD	Grab sample	Full TCL/TAL, SVOCs SIM, pH, TOC, Grain size	SOP 14	
SD-41	Sediment	TBD	Grab sample	Full TCL/TAL, SVOCs SIM, pH, TOC, Grain size	SOP 14	
SD-42	Sediment	TBD	Grab sample	Full TCL/TAL, SVOCs SIM, pH, TOC, Grain size	SOP 14	
SD-43	Sediment	TBD	Grab sample	Full TCL/TAL, SVOCs SIM, pH, TOC, Grain size	SOP 14	
SD-44	Sediment	TBD	Grab sample	Full TCL/TAL, SVOCs SIM, pH, TOC, Grain size	SOP 14	

QAPP Worksheet #19 & 30: Sample Containers, Preservation, and Hold Times

Laboratory: TestAmerica, Inc. 30 Community Dr, Suite 11 S. Burlington, VT 05403 Attn: Sample Receiving

List any required accreditations/certifications: Active CLP Routine Analytical Services Laboratory with contract number EPW11036 (Organic Multi - SOM01.2) and EPW09044 (Inorganic - ISM01.3); NJ NELAP VT972 Expires 06/30/15

Back-up Laboratory: Not identified

Sample Delivery Method: FedEx Overnight

Analyte/ Analyte Group	Matrix	Method/ SOP	Container (number, size & type per sample)	Preservation	Preparation Holding Time	Analytical Holding Time	Data Package Turnaround
Pesticides	Soil/sediment	SOM01.2/TAB-2	1x 4-ounce (oz) glass jar with Teflon®-lined lid	Cool to ≤6°C	10 days from verified time of sample receipt (VTSR)	40 days from extraction date	4 weeks
PCB Aroclors	Soil/sediment	SOM01.2/TAB-1	1x 4-oz glass jar with Teflon®-lined lid	Cool to ≤6°C	10 days from VTSR	40 days from extraction date	4 weeks
PCB Congeners	Soil/sediment	EPA 1668/TAWS-1	1x 4-oz glass jar with Teflon®-lined lid	Stored in the dark at <-10°C	1 year from VTSR	40 days from extraction date	4 weeks
Metals/Cyanide	Soil/sediment	ISM01.3/TAB-5, TAB-6, TAB-7	1x 4-oz glass jar with Teflon®-lined lid	Cool to ≤6°C	NA	180 days VTSR – ICP, 26 days VTSR – Hg, 12 days VTSR	4 weeks

Analyte/ Analyte Group	Matrix	Method/ SOP	Container (number, size & type per sample)	Preservation	Preparation Holding Time	Analytical Holding Time	Data Package Turnaround
						- CN	
VOCs	Soil/Sediment	SOM01.2/TAB -4	2 x 40-milliliter (mL) vial 5ml DI water & 1 40mL vial 5mL MeOH 1 -2oz glass jar for moisture determination	Cool to ≤6°C	NA	10 day VTSR (vials must be frozen with 48 hours)	4 weeks
SVOCs/ SVOC SIM	Soil/Sediment	SOM01.2/ SOM01.2-SIM/TAB-3	1 – 4oz amber glass	Cool to ≤6°C	10 days from VTSR	40 days from extraction date	4 weeks
Dioxins, furans	Soil/sediment	EPA 1613/TAWS-14	1x 8-ounce glass jar with Teflon®-lined lid or stainless steel liner	Cool to ≤6°C	1 year from VTSR	40 days	4 weeks
TOC	Soil/sediment	Lloyd Kahn/TAB-9	1x 2-oz glass jar with Teflon®-lined lid	Cool to ≤6°C	NA	28 days from collection date	4 weeks

Analyte/ Analyte Group	Matrix	Method/ SOP	Container (number, size & type per sample)	Preservation	Preparation Holding Time	Analytical Holding Time	Data Package Turnaround
VOCs	Water	SOM01.2/TAB-11	3 x 40-mL vials	No headspace; HCl to pH <2; Cool to ≤6°C	NA	10 days VTSR	4 weeks
SVOCs/ SVOC SIM	Water	SOM01.2/SOM01.2-SIM/TAB-3	2 x 1-liter (L) amber bottles	Cool to ≤6°C	5 days VTSR	40 days from extraction date	4 weeks
TAL Metals	Water	ISM01.3/TAB-5, TAB-6	1 x 500-mL high density polyethylene (HDPE)	HNO_3 to pH <2; Cool to ≤6°C	NA	180 days VTSR – ICP, 26 days VTSR - Hg	4 weeks
Cyanide	Water	ISM01.3/TAB-7	1 x 250-mL HDPE	NaOH to pH >12; Cool to ≤6°C	NA	12 days VTSR	4 weeks
Pesticides	Water	SOM01.2/TAB-2	2 x 1-L amber bottles	Cool to ≤6°C	5 days VTSR	40 days from extraction date	4 weeks
PCB Aroclors	Water	SOM01.2/TAB-1	2 x 1-L amber bottles	Cool to ≤6°C	5 days VTSR	40 days from extraction date	4 weeks
Mercury LL	Water	1631E/TANC-12	4 – 40 mL Vials	Cool to ≤6°C	Unpreserved sample – preserve or analyze within 48 hours of collection;	28 days from collection	4 weeks

Analyte/ Analyte Group	Matrix	Method/ SOP	Container (number, size & type per sample)	Preservation	Preparation Holding Time	Analytical Holding Time	Data Package Turnaround
					Preserved sample – 28 days		

QAPP Worksheet #20: Field QC Summary

Matrix	Analyte/Analytical Group	Method/ SOP	Field Samples	Field Duplicates	Matrix Spikes	Matrix Spike Duplicates	Equipment Blanks	Trip Blanks	Total # analyses
Soil	VOCs	SOM01.2/TAB-4	40	2	1	1	2	2	48
Soil	SVOCs	SOM01.2/TAB-3	40	2	1	1	2	0	46
Soil	SVOCs SIM	SOM01.2-SIM/TAB-3	40	2	1	1	2	0	46
Soil	Pesticides	SOM01.2/TAB-2	40	2	1	1	2	0	46
Soil	PCBs Aroclors	SOM01.2/TAB-1	40	2	1	1	2	0	46
Soil	TAL Metals, Mercury, Cyanide	ISM01.3/TAB-5, TAB-6, TAB-7	40	2	1	1	2	0	46
Soil	PCB Congeners	EPA 1668/ TAWS-1	14	1	1	1	1	0	18
Soil	Dioxins and Furans	EPA 1613/ TAWS-2	14	1	1	1	1	0	18
Groundwater (temporary wells)	VOCs	SOM01.2/TAB-4, TAB-11	9	1	1	1	1	2	15
Groundwater (temporary wells)	SVOCs	SOM01.2/TAB-3	9	1	1	1	1	0	13
Groundwater (temporary wells)	SVOCs SIM	SOM01.2-SIM/TAB-3	9	1	1	1	1	0	13
Groundwater (temporary wells)	Pesticides	SOM01.2/TAB-2	9	1	1	1	1	0	13

Matrix	Analyte/Analytical Group	Method/ SOP	Field Samples	Field Duplicates	Matrix Spikes	Matrix Spike Duplicates	Equipment Blanks	Trip Blanks	Total # analyses
Groundwater (temporary wells)	PCBs Aroclors	SOM01.2/TAB-1	9	1	1	1	1	0	13
Groundwater (temporary wells)	TAL Metals, Mercury and Cyanide (unfiltered)	ISM01.3/TAB-5, TAB-6, TAB-7	9	1	1	1	1	0	13
Groundwater (temporary wells)	TAL Metals, Mercury and Cyanide (filtered)	ISM01.3/TAB-5, TAB-6, TAB-7	9	1	1	1	1	0	13
Groundwater (permanent wells)	VOCs	SOM01.2/TAB-4, TAB-11	48	3[a]	2[b]	2[b]	3	5	63
Groundwater (permanent wells)	SVOCs	SOM01.2/TAB-3	48	3[a]	2[b]	2[b]	3	0	58
Groundwater (permanent wells)	SVOCs SIM	SOM01.2-SIM/TAB-3	48	3[a]	2[b]	2[b]	3	0	58
Groundwater (permanent wells)	Pesticides	SOM01.2/TAB-2	48	3[a]	2[b]	2[b]	3	0	58
Groundwater (permanent wells)	PCB Aroclors	SOM01.2/TAB-1	48	3[a]	2[b]	2[b]	3	0	58
Groundwater (permanent wells)	TAL Metals, Mercury and Cyanide (unfiltered)	ISM01.3/TAB-5, TAB-6, TAB-7	48	3[a]	2[b]	2[b]	3	0	58

Matrix	Analyte/Analytical Group	Method/ SOP	Field Samples	Field Duplicates	Matrix Spikes	Matrix Spike Duplicates	Equipment Blanks	Trip Blanks	Total # analyses
Groundwater (permanent wells)	TAL Metals, Mercury and Cyanide (filtered)	ISM01.3/TAB-5, TAB-6, TAB-7	48	3[a]	2[b]	2[b]	3	0	58
Pore-Water	VOCs	SOM01.2/TAB-4, TAB-11	2	1	0[c]	0[c]	0[c]	1	4
Pore-Water	SVOCs	SOM01.2/TAB-3	2	1	0[c]	0[c]	0[c]	0	3
Pore-Water	SVOCs SIM	SOM01.2-SIM/TAB-3	2	1	0[c]	0[c]	0[c]	0	3
Pore-Water	Pesticides	SOM01.2/TAB-2	2	1	0[c]	0[c]	0[c]	0	3
Pore-Water	PCBs Aroclors	SOM01.2/TAB-1	2	1	0[c]	0[c]	0[c]	0	3
Pore-Water	TAL Metals, Mercury and Cyanide (unfiltered)	ISM01.3/TAB-5, TAB-6, TAB-7	2	1	0[c]	0[c]	0[c]	0	3
Pore-Water	TAL Metals, Mercury and Cyanide (unfiltered)	ISM01.3/TAB-5, TAB-6, TAB-7	2	1	0[c]	0[c]	0[c]	0	3
Surface Water	VOCs	SOM01.2/TAB-4, TAB-11	11	1	1	1	1	2	17
Surface Water	SVOCs	SOM01.2/TAB-3	11	1	1	1	1	0	15
Surface Water	SVOCs SIM	SOM01.2-SIM/TAB-3	11	1	1	1	1	0	15
Surface Water	Pesticides	SOM01.2-TAB-2	11	1	1	1	1	0	15
Surface Water	PCBs Aroclors	SOM01.2/TAB-1	11	1	1	1	1	0	15

Matrix	Analyte/Analytical Group	Method/ SOP	Field Samples	Field Duplicates	Matrix Spikes	Matrix Spike Duplicates	Equipment Blanks	Trip Blanks	Total # analyses
Surface Water	TAL Metals and Cyanide (unfiltered)	ISM01.3/TAB-5, TAB-7	11	1	1	1	1	0	15
Surface Water	TAL Metals and Cyanide (Filtered)	ISM01.3/TAB-5, TAB-7	11	1	1	1	1	0	15
Surface Water	Low-Level Mercury	EPA 1631E/ TANC-12	11	1	1	1	1	0	15
Surface Water	Hardness	Calculation	11	0	0	0	0	0	11
Sediment	VOCs	SOM01.2/TAB-4, TAB-11	11	1	1	1	1	2	17
Sediment	SVOCs	SOM01.2/TAB-3	11	1	1	1	1	0	15
Sediment	SVOCs SIM	SOM01.2-SIM/TAB-3	11	1	1	1	1	0	15
Sediment	Pesticides	SOM01.2-TAB-2	11	1	1	1	1	0	15
Sediment	PCBs Aroclors	SOM01.2/TAB-1	11	1	1	1	1	0	15
Sediment	TAL Metals, Mercury and Cyanide	ISM01.3/TAB-5, TAB-6, TAB-7	11	1	1	1	1	0	15
Sediment	pH, TOC, grain size	Lloyd Kahn/TAB-9	11	0	0	0	0	0	11

[a] Two field duplicate samples will be collected during the first groundwater event and one field duplicate sample will be collected during the second groundwater event.

[b] One matrix spike and matrix spike duplicate sample will be collected during the first groundwater event and one matrix spike and matrix spike duplicate sample will be collected during the second groundwater event.

[c] No matrix spike or matrix spike duplicate samples will be collected as the sample matrix consists of deionized water. No equipment blank is required because the samples will be transferred directly from the pore-water Permeable Diffusion Bag to the sample bottles.

QAPP Worksheet #21: Field SOPs

SOP # or reference	Title, Revision, Date, and URL (if available)	Originating Organization	SOP option or Equipment Type (if SOP provides different options)	Modified for Project? Y/N	Comments
SOP 1	Water Level Measurement	ARCADIS		N	
SOP 2	Standard GW Sampling for Monitoring Wells	ARCADIS		N	
SOP 3	Monitoring Well Installation	ARCADIS		N	
SOP 4	Monitoring Well Development	ARCADIS		N	
SOP 5	Drilling Procedures for Collecting and Screening of Soil Samples	ARCADIS		N	
SOP 6	Soil Description	ARCADIS		N	
SOP 7	Low-Flow Groundwater Purging and Sampling Procedures for Monitoring Wells	ARCADIS		N	
SOP 8	Surface Water Sampling	ARCADIS		N	
SOP 9	Chain-of-Custody, Handling, Packing and Shipping	ARCADIS		N	
SOP 10	Investigation-Derived Waste Handling and Storage	ARCADIS		N	
SOP 11	Field Equipment Decontamination	ARCADIS		N	

SOP # or reference	Title, Revision, Date, and URL (if available)	Originating Organization	SOP option or Equipment Type (if SOP provides different options)	Modified for Project? Y/N	Comments
SOP 12	Measuring Basic Water Quality Parameters In-situ	ARCADIS		N	
SOP 13	Sediment Core Collection	ARCADIS		N	
SOP 14	Sediment Sampling	ARCADIS		N	
SOP 15	Extraction/Preservation of Soil/ Sediment Samples for VOCs	ARCADIS		N	
SOP 16	Compositing or Homogenizing Samples	ARCADIS		N	
SOP 17	Surface and Subsurface Soil Sampling Using Manual Methods	ARCADIS		N	
SOP 18	Soil Drilling and Sample Collection	ARCADIS		N	
SOP 19	Field Log Book Entries	ARCADIS		N	
SOP 20	Pore-Water Sampling using *in-situ* dialysis membrane sampling apparatus	ARCADIS		N	

QAPP Worksheet #22: Field Equipment Calibration, Maintenance, Testing, and Inspection

Field Equipment	Activity	SOP Reference	Title or position of responsible person	Frequency	Acceptance Criteria	Corrective Action
Water Quality meter	Check all membranes and sensors, cable and check battery charge	SOP 12	Field Staff	See SOP 12	See SOP 12	See SOP 12
Photoionization Detector (PID)	Calibrate	SOP 5	Field Staff	See SOP 5	See SOP 5	See SOP 5
Water-Level Meter	Check battery	SOP 1	Field Staff	See SOP 1	See SOP 1	See SOP 1
GPS	As required by manufacturer specification	NA	Field Staff	NA	NA	NA

QAPP Worksheet #23: Analytical SOP's

SOP #	Title, Date, and URL (if available)	Definitive or Screening Data	Matrix/Analytical Group	SOP Option or Equipment Type	Modified for Project? Y/N
F-4	FSP – Water Column Sampling Procedures	Definitive	Temperature, pH, turbidity, conductivity, dissolved oxygen (DO)	Water quality meter	N
F-3	FSP – Sediment Sampling Procedures	Screening	Water surface elevation	Water level meter	N
F-3	FSP – Sediment Sampling Procedures	Screening	Core characterization	Unified Soil Classification System (USCS) or United States Department of Agriculture (USDA) soil classification system	N
TAWS-1	'PCB Analysis by HRGC/HRMS',WS-ID-0013, Rev 4.4, 5/07/14 and 'PCB Preparation for Analysis by HRGC/HRMS' WS-IDP-0013, Rev 3.0, 9/12/14	Definitive	PCB Congeners in Water, Soil and Sediment	High Resolution Gas Chromatography/ High Resolution/Mass Spectrometry (HRGC/HRMS)	N
TAWS-2	'Analysis of Tetra- through Octa Chlorinated Dioxins and Furans by Isotope Dilution HRGC/HRMS by Method 1613B', WS-ID-0007, Rev 3.7, 2/07/14 and 'Preparation of Samples for Tetra- through Octa Chlorinated Dioxins and Furans by Isotope Dilution HRGC/HRMS by Method 1613B' WS-IDP-0007, Rev 1.9, 4/11/2014	Definitive	Dioxins and Furans in Water, Soil and Sediment	HRGC/HRMS	N
TAB-1	'Determination of Aroclors by GC/ECD (CLP SOW SOM01.2)', BR-GC-010, Rev 1, 6/02/08 and 'Extraction and Cleanup Procedure for the Determination of Aroclors (CLP SOW SOM01.2)', BR-EX-013, Rev 2, 2/21/14	Definitive	PCB Aroclors in Water, Soil and Sediment	Gas Chromatography/ Electron Capture Dectector (GC/ECD)	N

TAB-2	'Determination of Pesticides by GC/ECD (CLP SOW SOM01.2)', BR-GC-011, Rev 1, 6/02/08 and 'Sample Preparation and Cleanup Procedure for Pesticides (CLP SOW SOM01.2)', BR-EX-014, Rev 2, 02/24/14	Definitive	Pesticides in Water, Soil and Sediment	GC/ECD	N
TAB-3	'SVOCs by GC/MS and GC/MS SIM (CLP SOM01.2)', BR-MS-006, Rev 1, 11/10/10 and 'Sample Preparation and Cleanup Procedure for SVOCs (CLP SOW SOM01.2)',BR-EX-015 Rev 2, 02/24/14	Definitive	SVOCs in Water, Soil and Sediment	Gas Chromatography/ Mass Spectrometry (GC/MS)	N
TAB-4	'Analytical Method for Low/Medium Volatiles (CLP SOW SOM01.2)', BR-MV-009 Rev 0, 1/01/08	Definitive	VOCs in Water, Soil and Sediment	GC/MS	N
TAB-5	'Determination of Trace Metals by ICP-OES (CLP SOW ISM01.3)', BR-ME-019, Rev 1, 10/29/12	Definitive	Metals, except mercury in Water, Soil and Sediment	Inductively coupled atomic plasma-optical emission spectroscopy (ICP-OES)	N
TAB-6	'Determination of Mercury by Cold Vapor Analysis (CLP SOW ISM01.2)', BR-ME-018, Rev 0, 08/06/10	Definitive	Mercury in Water, Soil, and Sediment	Mercury autoanalyzer	N
TAB-7	'Determination of Total Cyanide'(CLP SOW ISM01.3), BR-WC-023, Rev 0, 08/06/10		Cyanide in Water, Soil, and Sediment		
TAB-9	'Total Organic Carbon in Soils & Sediments (Lloyd Kahn)', BR-WC-008, Rev 14, 03/18/14	Definitive	TOC	TOC analyzer	N
TAB-11	'Analytical Method for Trace Volatiles (CLP SOW SOM01.2)', BR-MV-010, Rev 0, 1/1/2008	Definitive	VOCs in Water	GC/MS	N
TANC-12	'Preparation and Analysis of Mercury in Aqueous and Solid Samples by Cold Vapor Atomic Fluorescence Method 1631E', NC-MT-001, Rev 6, 9/27/13	Definitive	Low level Mercury in Surface Water	Cold Vapor Atomic Fluorescence Spectroscopy (CVAFS)	N

QAPP Worksheet #24: Analytical Instrument Calibration

Instrument	Calibration Procedure	Frequency	Acceptance Criteria	Corrective Action (CA)	Title/position responsible for CA	SOP Reference
GC/MS for VOCs by SOM01.2	Instrument performance check: Bromofluorobenzene (BFB)	Once at the beginning of each 12-hour period during which samples or standards are analyzed.	% Relative abundance, see SOM01.2 Exhibit D Low/Medium Volatiles Section 17 Table 1	Retune instrument.	Analyst	See TAB-4 and TAB-11
	Initial calibration (ICAL) – minimum of five concentrations	Prior to sample analysis, after instrument performance check acceptance criteria have been met.	Relative standard deviation (RSD) and RRF, see SOM01.2 Exhibit D Low/Medium Volatiles Section 17 Table 4	Inspect system, correct problem, rerun calibration and affected samples.		
	Continuing calibration verification (CCV) – opening	Prior to sample analysis and after instrument performance check and ICAL acceptance criteria and have been met.	Percent difference (%D) and RRF, see SOM01.2 Exhibit D Low/Medium Volatiles Section 17 Table 4	Inspect system, correct problem, rerun calibration and affected samples.		

Instrument	Calibration Procedure	Frequency	Acceptance Criteria	Corrective Action (CA)	Title/position responsible for CA	SOP Reference
GC/MS for VOCs by SOM01.2	CCV – closing	After all samples and blanks have been analyzed, and before the end of the 12-hour time period. May be used as the opening CCV for a new 12-hour analytical sequence.	%D ±50% for all compounds and RRF ≥ 0.010 for all compounds.	Inspect system, correct problem, rerun calibration and affected samples.	Analyst	See TAB-4 and TAB-11
GC/MS for SVOCs by SOM01.2 and SOM01.2 SIM (PAHs)	Instrument performance check: Decafluorotriphenylphosphine (DFTPP)	Once at the beginning of each 12-hour period during which samples or standards are analyzed.	% Relative abundance, see SOM01.2 Exhibit D Semivolatiles Section 17 Table 1	Retune instrument.	Analyst	See TAB-3
	Initial calibration (ICAL) – minimum of five concentrations	Prior to sample analysis, after instrument performance check acceptance criteria have been met.	Relative standard deviation (RSD) and RRF, see SOM01.2 Exhibit D Semivolatiles Section 17 Table 4	Inspect system, correct problem, rerun calibration and affected samples.		

Instrument	Calibration Procedure	Frequency	Acceptance Criteria	Corrective Action (CA)	Title/position responsible for CA	SOP Reference
	Continuing calibration verification (CCV) – opening	Prior to sample analysis and after instrument performance check and ICAL acceptance criteria and have been met.	Percent difference (%D) and RRF, see SOM01.2 Exhibit D Semivolatiles Section 17 Table 4	Inspect system, correct problem, rerun calibration and affected samples.		
GC/MS for SVOCs by SOM01.2 and SOM01.2 SIM (PAHs)	CCV - closing	After all samples and blanks have been analyzed, and before the end of the 12-hour time period. May be used as the opening CCV for a new 12-hour analytical sequence.	%D ±50% for all compounds and RRF ≥ 0.010 for all compounds.	Inspect system, correct problem, rerun calibration and affected samples.	Analyst	See TAB-3
HRGC/HRMS for EPA 1668 and 1613	Instrument performance check (tune).	Prior to initial and continuing calibration.	As per method.	Retune instrument.	Analyst	See TAWS-1 and TAWS-2
	Initial calibration — a minimum of five concentration levels for all	Prior to sample analysis;	Each compound RRF RSD <	Inspect system, correct problem, rerun calibration and		

Instrument	Calibration Procedure	Frequency	Acceptance Criteria	Corrective Action (CA)	Title/position responsible for CA	SOP Reference
	compounds.	minimum of annually.	35% for all compounds and RF RSD < 20%.	affected samples if RSD > 50%.		
	Continuing calibration — before sample analysis; one midpoint standard.	Before sample analysis and every 12 hours.	Each compound RRF %D < 35% and RF %D <20%.	Inspect system, correct problem, rerun calibration and affected samples if %D > 80%.		
GC/ECD for PCB Aroclors by SOM01.2	ICAL – minimum of five concentrations for Aroclors 1016 and 1260; single mid-point calibration for other Aroclors	Prior to sample analysis. If any Aroclors other than 1016 and 1260 are detected in a sample, a five-point initial calibration is required for the detected Aroclor.	RSD ≤ 20% for any Aroclor analyzed at a five-point calibration.	Inspect system, correct problem, rerun calibration and affected samples.	Analyst	See TAB-1
	CCV – opening; mid-point concentration for Aroclor 1016/1260 and any other Aroclor detected in a sample	At the beginning of the analytical sequence.	Retention time (RT) within the RT window established for the ICAL. %D within ±15.0%.	Inspect system, correct problem, rerun calibration and affected samples.		

Instrument	Calibration Procedure	Frequency	Acceptance Criteria	Corrective Action (CA)	Title/position responsible for CA	SOP Reference
GC/ECD for PCB Aroclors by SOM01.2	CCV – closing; mid-point concentration for Aroclor 1016/1260 and any other Aroclor detected in a sample	At the beginning of the analytical sequence.	RT within the RT window established for the ICAL. %D within ±50.0%.	Inspect system, correct problem, rerun calibration and affected samples.	Analyst	See TAB-1
GC/ECD for Pesticides by SOM01.2	ICAL – single-component compounds – minimum of five concentrations	Prior to sample analysis.	Initial Calibration RSD ≤ 20% for compounds or linear $r^2 \geq 0.99$, except for alpha-BHC and delta-BHC must be ≤ 25.0%, %RSD of the two surrogates must be ≤ 30.0%.	Inspect system, correct problem, and rerun calibration.	Analyst	See TAB-2
	ICAL – Toxaphene (multi-component compound) – minimum of five concentrations	Prior to sample analysis.	The %RSD of the CFs for each Toxaphene peak and surrogates must be ≤ 30.0%	Inspect system, correct problem, and rerun calibration.		
	Opening CCV – before sample analysis; one midpoint standard. Toxaphene CCV analyzed if detected in sample.	Prior to sample analysis.	The %D for compounds and surrogates in the PEM ± 25.0%; %D in the calibration verification standard (CS)	Inspect system, correct problem, and rerun calibration.		

Instrument	Calibration Procedure	Frequency	Acceptance Criteria	Corrective Action (CA)	Title/position responsible for CA	SOP Reference
			± 20.0%			
	Closing CCV	After 12 hours.	Same as Opening CCV	Inspect system, correct problem, rerun calibration and affected samples.		
ICP-AES for ISM01.3	ICAL: blank and at least five standards; one standard shall be at or below	Daily, prior to sample analysis.	Correlation coefficient r ≥ 0.995.	Terminate analysis, correct problem, and re-verify calibration	Analyst	See TAB-5
	Initial calibration verification (ICV)	Following each instrument calibration.	Within +10% of the true value.			
	CCV	Every 2 hours of analytical run, and at the beginning and end of each run.	Within +10% of the true value.	Terminate analysis, correct problem, re-verify calibration, and reanalyze all samples analyzed since the last compliant CCV.		
ICP-AES for ISM01.3	Initial and continuing calibration blank (ICB/CCB)	ICB: Following each instrument calibration, immediately after the ICV. CCB: Every 2 hours of a run, and at the beginning and end of each run. Performed immediately after the	< CRQL	Terminate analysis, correct problem, recalibrate instrument, re-verify calibration, and reanalyze all samples analyzed since the lab compliant CCB.	Analyst	See TAB-5

Instrument	Calibration Procedure	Frequency	Acceptance Criteria	Corrective Action (CA)	Title/position responsible for CA	SOP Reference
		CCV.				
CVAA for ISM01.3 (mercury)	ICAL: blank and at least five standards; one standard shall be at or below	Daily or each time instrument is set up, after ICV or CCV failures, and after major instrument adjustment.	Correlation coefficient r ≥ 0.995.	Terminate analysis, correct problem, and re-verify calibration.	Analyst	See TAB-6
	Initial calibration verification (ICV)	Following each instrument calibration.	Within +15% of the true value.	Terminate analysis, correct problem, and re-verify calibration.		
	CCV	Every hour of a run, and at the beginning and end of each run.	Within +15% of the true value.	Terminate analysis, correct problem, re-verify calibration, and reanalyze all samples analyzed since the last compliant CCV.		
	Initial and continuing calibration blank (ICB/CCB)	ICB: Following each instrument calibration, immediately after the ICV. CCB: Every 2 hours of a run, and at the beginning and end of each run. Performed	< CRQL	Terminate analysis, correct problem, recalibrate instrument, re-verify calibration, and reanalyze all samples analyzed since the lab compliant CCB.		

Instrument	Calibration Procedure	Frequency	Acceptance Criteria	Corrective Action (CA)	Title/position responsible for CA	SOP Reference
		immediately after the CCV.				
CVAFS for Low Level Mercury Analysis by EPA 1631E	Initial calibration (ICAL) per manufacturer's instructions, with a minimum of six standards and three calibration blanks.	Daily initial calibration prior to sample analysis	Calibration factors must have < 15% RSD, and the low standard must calculate back to + 25% of the true value.	Evaluate standard and instrument response. Repeat ICAL.	Analyst	See TANC-12
	Second-source ICV (QCS)	Beginning of every analytical sequence.	80% - 120% Recovery	Terminate analysis, correct the problem, recalibrate, or re-prep with calibration curve.		
	Continuing calibration verification (CCV or OPR)	Following ICV/ICB, after every 10 samples and the end of the sequence	77% - 123% recovery	Evaluate standard and instrument response. If problem with instrument (autosampler failure, response poor, etc.) or standards, correct as appropriate, then repeat. If still fails, repeat initial calibration. Re-analyze all samples since the last successful calibration verification.		
	Calibration blank (ICB/CCB)	After ICAL, after CCV	No target analytes > RL	Terminate analysis, correct problem,		

Instrument	Calibration Procedure	Frequency	Acceptance Criteria	Corrective Action (CA)	Title/position responsible for CA	SOP Reference
		calibration, after every 10 samples, and at the end of the sequence	in accordance with requirements	recalibrate instrument, re-verify calibration, and reanalyze all samples analyzed since the lab compliant CCB.		
Total Organic Carbon Analyzer	Initial calibration — minimum three concentration levels.	Daily, or on continuing calibration failure.	Initial calibration — correlation coefficient ≥ 0.995.	Inspect system, correct problem, rerun calibration and affected samples.	Analyst	TAB-9
	Continuing calibration verification standard – midpoint standard	After every 10 samples and the end of the sequence	85-115% recovery			
pH Meter	Initial calibration with two buffers that bracket pH of samples at room temperature.	Daily.	Slope reading after calibration should be between 94-102%.	If slope falls out of range of slope reading, troubleshoot and fix problem according to user's manual.	Analyst	See laboratory QAM
Analytical Balance	See laboratory Quality Assurance Manual (QAM)	Daily.	Not applicable	Inspect system, correct problem, rerun calibration and affected samples.	Analyst	See laboratory QAM

Note: the analytical laboratory, TestAmerica, has a SOP review cycle related to the CLP SOW methods. This review cycle only occurs as the EPA CLP SOW methods are updated and promulgated.

Worksheet #25: Analytical Instrument and Equipment Maintenance, Testing, and Inspection

Instrument /Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action (CA)	Title/ position responsible for CA	Reference
CVAFS	· Check argon flow, pump tubing, drain, soda lime drying tube. · Check Hg lamp intensity. · Change Hg lamp, liquid/ gas separator, Nafion dryer	Low level mercury	Instrument performance and sensitivity	Daily Lamp Semi-annually As needed	CCV pass criteria	Troubleshoot and correct problem	Analyst	TANC-12
GC/MS	· Clean Injection Port and Liner · Change Septa · Replace or clip Guard Column and or Analytical Column · Fill Autosampler rinse vials	VOCs, SVOCs	Check Injection Port and Liner, Check Septa, Check Guard Column and or Analytical Column, and Check Autosampler rinse vials	As required	Passing calibration	Perform maintenance, check standards, recalibrate	Analyst	SOP TAB-3, TAB-4, and BR-QAM
GC/ECD	· Replace Septa · Clean and replace Injection Port Liner	PCBs and Pesticides	Instrument performance and sensitivity	As required	Passing calibration	Perform maintenance, check standards, recalibrate	Analyst	SOP TAB-1, TAB-2, and BR-QAM

Instrument /Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action (CA)	Title/ position responsible for CA	Reference
	· Replace or clip Guard Column · Replace or clip Analytical Column · Bake, Re-foil, Refurbish Detector							

Instrument /Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action (CA)	Title/ position responsible for CA	Reference
ICP-AES	· Replace Peristaltic Pump tubing · Clean Torch and Cones · Fill Rinse, Internal Standard, and Standards Vessels · Empty Waste Vessels	All metals except mercury	Check Peristaltic Pump tubing, Check Torch and Cones, Check Level of Rinse, Internal Standard, and Standards Vessels, Check Waste Vessels	As required	Passing calibration	Perform maintenance, check standards, recalibrate	Analyst	SOP TAB-5 and BR-QAM
CVAA	· Lubricate Autosampler rods · Clean Autosampler · Fill Rinse Vessel · Fill Stannous Chloride · Empty Waste Vessel	Mercury	Check Peristaltic Pump tubing, Check/ Rinse Vessel, Check Stannous Chloride, and Check Waste Vessel	As required	Passing calibration	Perform maintenance, check standards, recalibrate	Analyst	SOP TAB-6 and BR-QAM

Instrument /Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action (CA)	Title/ position responsible for CA	Reference
GC/HRMS	Parameter Setup	PCB Congeners, Dioxins/ Furans	Physical check	Initially; prior to DCC	Correct Parameters	Reset if incorrect	Analyst	TAWS-1, TAWS-2
	Tune Check		Conformance to instrument tuning.		Compliance to ion abundance criteria	Correct the problem and repeat tune check		
TOC Analyzer	Change column	TOC	Per Manufac-turer's Instructions	As required	Passing calibration	Perform maintenance, check standards, recalibrate	Analyst	TAB-9 and BR-QAM

Worksheet #26 & 27: Sample Handling, Custody, and Disposal

Worksheet #26 – Sample Handling System

Sample Collection, Packaging and Shipment
Sample Collection (Personnel/Organization): Field Personnel/ARCADIS
Sample Packaging (Personnel/Organization): Field Personnel/ARCADIS
Coordination of Shipment (Personnel/Organization): Field Personnel/ARCADIS
Type of Shipment/Carrier: pick-up at site by TestAmerica courier, or Federal Express to TestAmerica
Sample Receipt and Analysis
Sample Receipt (Personnel/Organization): Sample Custodian/TestAmerica
Sample Custody and Storage (Personnel/Organization): Sample Custodian/TestAmerica
Sample Preparation (Personnel/Organization): Lab Analysts/TestAmerica
Sample Determinative Analysis (Personnel/Organization): Lab Analysts/TestAmerica
Sample Archiving
Field Sample Storage: 30 days from submittal of laboratory final report
Sample Extract/Digestate Storage (number of days from extraction/digestion): 60 days
Sample Disposal
Personnel/Organization: Sample Custodian/TestAmerica
Number of Days from Analysis: 30-day minimum from submittal of laboratory final report

Worksheet #27 – Sample Custody Requirements

Sample Handling and Custody Requirements
At all times, field and laboratory personnel will be aware of the need to maintain all samples, whether in the field or in the laboratory, under strict chain-of-custody and in a manner to retain physical properties and chemical composition. This Worksheet details sample handling and custody requirements from collection to ultimate disposal.
Sample Handling
Sample packaging and shipment procedures are designed so that the samples will arrive at the laboratory, with the chain-of-custody, intact. Samples will be packaged for shipment as outlined below: · Securely affix the sample label to the container with clear packing tape. · Check the cap on the sample container to confirm that it is properly sealed. · Wrap the sample container cap with clear packing tape to prevent the label from becoming loose. · Complete the chain-of-custody form with the required sampling information and confirm that the recorded information matches the sample labels. **Note:** If the designated sampler relinquishes the samples to other sampling or field personnel for packing or other purposes, the sampler will complete the chain-of-custody prior to this transfer. The appropriate personnel will sign and date the chain-of-custody form to document the sample custody transfer. · Using duct tape, secure the outside drain plug at the bottom of the cooler. · Wrap sample containers in bubble wrap or other cushioning material. · Place 1 to 2 inches of cushioning material at the bottom of the cooler. · Place the sealed sample containers into the cooler. · Place ice in plastic bags and seal. Place loosely in the cooler. · Fill the remaining space in the cooler with cushioning material. · Place chain-of-custody forms in a plastic bag and seal. Tape the forms to the inside of the cooler lid. · Close the lid of the cooler, lock and secure with duct tape. · Wrap strapping tape around both ends of the cooler at least twice. · Mark the cooler on the outside with the shipping address and return address, affix “Fragile” labels and draw (or affix) arrows indicating “this side up.” Cover the labels with clear plastic tape. · Place a signed custody seal over the sample cooler lid.
Shipping Procedures
Samples will be packaged by field personnel and transported as low-concentration environmental samples. Samples will be hand delivered or delivered by an express carrier within 48 hours of the time of collection. Shipments will be accompanied by the chain-of-custody form identifying the contents. The original form will accompany the shipment; copies will be retained by the sampler for the sampling office records. If the

Worksheet #27 – Sample Custody Requirements

samples are sent by common carrier, a bill of lading will be used. Receipts or bills of lading will be retained as part of the permanent project documentation. Commercial carriers are not required to sign off on the chain-of-custody form as long as the forms are sealed inside the sample cooler and the custody seals remain intact.

Sample custody seals and packing materials for filled sample containers will be provided by the analytical laboratory. The filled, labeled and sealed containers will be placed in a cooler on ice and carefully packed to eliminate the possibility of container breakage.

Field Custody Procedures

The objective of field sample custody is to protect samples from tampering from the time of sample collection through time of transport to the analytical laboratory. Persons will have custody of samples when the samples are in their physical possession, in their view after being in their possession, or in their physical possession and secured so they cannot be tampered with. In addition, when samples are secured in a restricted area accessible only to authorized personnel, they will be deemed to be in the custody of such authorized personnel.

Field custody documentation consists of both field logbooks and field chain-of-custody forms.

Field logbooks will provide the means of recording the data collecting activities that are performed. As such, entries will be described in as much detail as possible so that persons going to the site could reconstruct a particular situation without reliance on memory.

Field logbooks will be bound field survey books or notebooks. Logbooks will be assigned to field personnel, but will be stored in a secure location when not in use. Each logbook will be identified by the project-specific document number. The title page of each logbook will contain the following:

- person to whom the logbook is assigned
- logbook number
- project name
- project start date
- end date

Entries into the logbook will contain a variety of information. At the beginning of each entry, the date, start time, weather conditions, names of all sampling team members present, level of personal protection being used, and signature of the person making the entry will be provided. The names of visitors to the site and field sampling or investigation team personnel, as well as the purpose of their visit, will also be recorded in the field logbook.

Measurements made and samples collected will be recorded. Entries will be made in ink, with no erasures. If an incorrect entry is made, the information will be crossed out with one strike mark. Whenever a sample is collected or a measurement is made, a detailed description of the location of the station will be recorded. The number of the photographs taken, if any, will also be noted. All equipment used to make

Worksheet #27 – Sample Custody Requirements

measurements will be identified, along with the date of calibration.

Samples will be collected following the sampling procedures documented in the Standard Operating Procedures in Appendix A and Worksheet #14. The equipment used to collect samples will be noted, along with the time of sampling, sample description, depth at which the sample was collected, volume and number of containers. Sample identification numbers will be assigned prior to sample collection. Field duplicate samples, which will receive an entirely separate sample identification number, will be noted under sample description.

Sample Labels

Sample labels will be affixed to sample bottles prior to delivery at the sampling site. The following information is required on each sample label:

- project name
- date collected
- time collected
- location
- name of sampler
- analysis to be performed
- preservative
- sample number

Chain-of-Custody Record

Completed chain-of-custody forms will be required for all samples to be analyzed. Chain-of-custody forms will be initiated by the sampling crew in the field. The chain-of-custody forms will contain the unique sample identification number, sample date and time, sample description, sample type, preservation (if any) and analyses required. The original chain-of-custody form will accompany the samples to the laboratory. Copies of the chain-of-custody will be made prior to shipment (or multiple copy forms will be used) for field documentation. The chain-of-custody forms will remain with the samples at all times. The samples and signed chain-of-custody forms will remain in the possession of the sampling crew until the samples are delivered to the express carrier (e.g., Federal Express), hand delivered to a mobile or permanent laboratory, or placed in secure storage.

Sample labels will be completed for each sample using waterproof ink. The labels will include the information listed in the previous section (Sample Labels). The completed sample labels will be affixed to each sample bottle and covered with clear tape.

Whenever samples are split with a government agency or other party, a separate chain-of-custody will be prepared for those samples and marked to identify the party with whom the samples are being split. The person relinquishing the samples to the facility or agency should request the representative's signature acknowledging sample receipt. If the representative is unavailable or refuses, note this in the "Received By" space.

Worksheet #27 – Sample Custody Requirements

Laboratory Custody Procedures
Upon sample receipt, laboratory personnel will be responsible for sample custody. The original field chain-of-custody form will accompany all samples requiring laboratory analysis. The laboratory will use chain-of-custody guidelines described in the United States Environmental Protection Agency guidance documents. Samples will be kept secured in the laboratory until all stages of analysis are complete. All laboratory personnel having samples in their custody will be responsible for documenting and maintaining sample integrity. Immediately upon sample receipt, the laboratory sample custodian will verify the integrity of the cooler seal, open the cooler, and compare the contents against the field chain-of-custody. If a sample container is missing, a sample container is received broken, the sample is in an inappropriate container, or the sample has not been preserved by appropriate means, ARCADIS will be notified. The laboratory sample custodian will be responsible for logging the samples in, assigning a unique laboratory identification number to each sample, labeling the sample bottle with the laboratory identification number, and moving the sample to an appropriate storage location to await analysis. The project name, field sample code, date sampled, date received, analysis required, storage location and date, and action for final disposition will be recorded in the laboratory tracking system. Relevant custody documentation will be placed in the project file.

QAPP Worksheet #28: Analytical Quality Control and Corrective Action

Quality Assurance Project Plan Worksheet #28-1 – Quality Control Samples (Semivolatile Organic Compounds in Water by SOM01.2 and SOM01.2-SIM)

Matrix	Water	**Analytical Method/ SOP Reference**	SOM01.2/SOM01.2-SIM/TAB-3	**No. of Sample Locations**	Numerous	
Analytical Group	SVOCs	**Sampler's Name**	NA			
Concentration Level	All	**Field Sampling Organization**	ARCADIS Sampling Personnel			
Sampling SOP	SOP 2, SOP 7, SOP 8, SOP 20	**Analytical Organization**	Test America			
Quality Control (QC) Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Field duplicate	One per 10 field samples of similar matrix	RPD < 35%	Qualify data as needed.	Data validator	Precision – overall	RPD < 35%
DMC	Added to all samples and blanks	%R, see SOM01.2 – Exhibit D Semivolatiles Tables 6 (%R) 7 (associated target compounds), and 8 (associated target compounds – SIM)	Check calculations, sample preparation logs, DMC standard spiking solution, and instrument operation. Re-extract/reanalyze samples. Qualify data as needed.	Laboratory analyst and/or data validator	Accuracy/bias	%R, see SOM01.2 – Exhibit D Semivolatiles Tables 6 (%R) 7 (associated target compounds), and 8 (associated target compounds – SIM)
Method blanks	One per analytical batch	< CRQL	Investigate source of contamination and re-extract/reanalyze associated samples. Qualify data as needed.	Laboratory analyst and/or data validator	Accuracy/bias contamination	< CRQL

Quality Assurance Project Plan Worksheet #28-1 – Quality Control Samples (Semivolatile Organic Compounds in Water by SOM01.2 and SOM01.2-SIM)

Matrix	Water	**Analytical Method/ SOP Reference**	SOM01.2/SOM01.2-SIM/TAB-3	**No. of Sample Locations**	Numerous	
Analytical Group	SVOCs	**Sampler's Name**	NA			
Concentration Level	All	**Field Sampling Organization**	ARCADIS Sampling Personnel			
Sampling SOP	SOP 2, SOP 7, SOP 8, SOP 20	**Analytical Organization**	Test America			
Quality Control (QC) Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Equipment blanks	One per 20 field samples	< CRQL	Qualify data as needed.	Data validator	Accuracy/bias contamination	< CRQL
Instrument check: DFTPP	One per calibration	%R, see SOM01.2 – Exhibit D Semivolatiles Table 1	Re-tune the instrument and reanalyze associated samples.	Laboratory analyst	Accuracy/bias	%R, see SOM01.2 – Exhibit D Semivolatiles Table 1
Internal standard	Added to all samples and blanks	Area response 50.0% to 200% and retention time (RT) ±30.0 seconds from associated 12-hour calibration standard, see SOM01.2 – Exhibit D Semivolatiles Table 2 (associated target compounds)	Check calculations, internal standard solutions, and instrument operation. Re-extract/reanalyze samples. Qualify data as needed.	Laboratory analyst and/or data validator	Precision	Area response 50.0% to 200% and retention time (RT) ±30.0 seconds from associated 12-hour calibration standard, see SOM01.2 – Exhibit D Semivolatiles Table 2 (associated target compounds)

Quality Assurance Project Plan Worksheet #28-1 – Quality Control Samples (Semivolatile Organic Compounds in Water by SOM01.2 and SOM01.2-SIM)

Matrix	Water	**Analytical Method/ SOP Reference**	SOM01.2/SOM01.2-SIM/TAB-3	**No. of Sample Locations**	Numerous	
Analytical Group	SVOCs	**Sampler's Name**	NA			
Concentration Level	All	**Field Sampling Organization**	ARCADIS Sampling Personnel			
Sampling SOP	SOP 2, SOP 7, SOP 8, SOP 20	**Analytical Organization**	Test America			
Quality Control (QC) Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
MS[2]	One per batch	%R, see SOM01.2 - Exhibit D Semivolatile Table 5	Re-extract/reanalyze samples. Qualify data as needed	Laboratory analyst and/or data validator	Accuracy/bias	%R, see SOM01.2 - Exhibit D Semivolatile Table 5
MSD[2]	One per batch	%R, see SOM01.2 - Exhibit D Semivolatile Table 5	Re-extract/reanalyze samples. Qualify data as needed	Laboratory analyst and/or data validator	Accuracy/bias	%R, see SOM01.2 - Exhibit D Semivolatile Table 5
MS/MSD[2]	One per batch	%R, see SOM01.2 - Exhibit D Semivolatile Table 5	Re-extract/reanalyze samples. Qualify data as needed	Laboratory analyst and/or data validator	Precision	%R, see SOM01.2 - Exhibit D Semivolatile Table 5

Note:

[1] An analytical batch is defined as no more than 20 analytical samples including field samples and field blanks.

[2] MS and MSD must be client-provided.

Quality Assurance Project Plan Worksheet #28-2 – Quality Control Samples (Volatile Organic Compounds in Water by SOM01.2)

Matrix	Water	**Analytical Method/ SOP Reference**	SOM01.2/TAB-11	**No. of Sample Locations**	Numerous	
Analytical Group	VOCs	**Sampler's Name**	NA			
Concentration Level	All	**Field Sampling Organization**	ARCADIS Sampling Personnel			
Sampling SOP	SOP 2, SOP 7, SOP 8, SOP 20	**Analytical Organization**	Test America			
Quality Control (QC) Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Field duplicate	One per 10 field samples of similar matrix	RPD < 35%	Qualify data as needed.	Data validator	Precision – overall	RPD < 35%
DMC	Added to all samples and blanks	%R, see SOM01.2 – Exhibit D Low/Medium Volatiles Tables 5 (%R) and 7 (associated target compounds)	Check calculations, sample preparation logs, DMC standard spiking solution, and instrument operation. Re-extract/reanalyze samples. Qualify data as needed.	Laboratory analyst and/or data validator	Accuracy/bias	%R, see SOM01.2 – Exhibit D Low/Medium Volatiles Tables 5 (%R) and 7 (associated target compounds)
Method blanks	One per analytical batch	< CRQL	Investigate source of contamination and re-extract/reanalyze associated samples. Qualify data as needed.	Laboratory analyst and/or data validator	Accuracy/bias contamination	< CRQL
Equipment blanks	One per 20 field samples	< CRQL	Qualify data as needed.	Data validator	Accuracy/bias contamination	< CRQL

Quality Assurance Project Plan Worksheet #28-2 – Quality Control Samples (Volatile Organic Compounds in Water by SOM01.2)

Matrix	Water	**Analytical Method/ SOP Reference**	SOM01.2/TAB-11	**No. of Sample Locations**	Numerous	
Analytical Group	VOCs	**Sampler's Name**	NA			
Concentration Level	All	**Field Sampling Organization**	ARCADIS Sampling Personnel			
Sampling SOP	SOP 2, SOP 7, SOP 8, SOP 20	**Analytical Organization**	Test America			
Quality Control (QC) Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Instrument check: BFB	One per calibration	%R, see SOM01.2 – Exhibit D Low/Medium Volatiles Table 1	Re-tune the instrument and reanalyze associated samples.	Laboratory analyst	Accuracy/bias	%R, see SOM01.2 – Exhibit D Low/Medium Volatiles Table 1
Internal standard	Added to all samples and blanks	Area response 50.0% to 200% and retention time (RT) ±30.0 seconds from associated 12-hour calibration standard, see SOM01.2 – Exhibit D Low/Medium Volatiles Table 3 (associated target compounds)	Check calculations, internal standard solutions, and instrument operation. Re-extract/reanalyze samples. Qualify data as needed.	Laboratory analyst and/or data validator	Precision	Area response 50.0% to 200% and retention time (RT) ±30.0 seconds from associated 12-hour calibration standard, see SOM01.2 – Exhibit D Semivolatiles Table 2 (associated target compounds)
MS[2]	One per batch	%R, see SOM01.2 - Exhibit D Low/Medium Volatiles Table 6	Re-extract/reanalyze samples. Qualify data as needed	Laboratory analyst and/or data validator	Accuracy/bias	%R, see SOM01.2 - Exhibit D Low/Medium Volatiles Table 6

Quality Assurance Project Plan Worksheet #28-2 – Quality Control Samples (Volatile Organic Compounds in Water by SOM01.2)

Matrix	Water	**Analytical Method/ SOP Reference**	SOM01.2/TAB-11	**No. of Sample Locations**	Numerous	
Analytical Group	VOCs	**Sampler's Name**	NA			
Concentration Level	All	**Field Sampling Organization**	ARCADIS Sampling Personnel			
Sampling SOP	SOP 2, SOP 7, SOP 8, SOP 20	**Analytical Organization**	Test America			
Quality Control (QC) Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
MSD[2]	One per batch	%R, see SOM01.2 - Exhibit D Low/Medium Volatiles Table 6	Re-extract/reanalyze samples. Qualify data as needed	Laboratory analyst and/or data validator	Accuracy/bias	%R, see SOM01.2 - Exhibit D Low/Medium Volatiles Table 6
MS/MSD[2]	One per batch	%R, see SOM01.2 - Exhibit D Low/Medium Volatiles Table 6	Re-extract/reanalyze samples. Qualify data as needed	Laboratory analyst and/or data validator	Precision	%R, see SOM01.2 - Exhibit D Low/Medium Volatiles Table 6

Note:

[1] An analytical batch is defined as no more than 20 analytical samples including field samples and field blanks.

[2] MS and MSD must be client-provided.

Quality Assurance Project Plan Worksheet #28-3 – Quality Control Samples (Pesticides in Water by SOM01.2)

Matrix	Water	**Analytical Method/ SOP Reference**	SOM01.2/TAB-2	**No. of Sample Locations**	Numerous	
Analytical Group	Pesticides	**Sampler's Name**	NA			
Concentration Level	All	**Field Sampling Organization**	ARCADIS Sampling Personnel			
Sampling SOP	SOP 2, SOP 7, SOP 8, SOP 20	**Analytical Organization**	Test America			
QC Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits[3]**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**DQI**	**Measurement Performance Criteria**
Field duplicate	One per 10 field samples of similar matrix	RPD < 35%	Qualify data as needed	Data validator	Precision – overall	RPD < 35%
Surrogate spikes	Added to all samples and blanks	%R: 30-150%	Check calculations, sample preparation logs, surrogate spiking solution, and instrument operation. Re-extract/reanalyze samples. Qualify data as needed.	Laboratory analyst and/or data validator	Accuracy/bias	%R: 30-150%
Method blanks	One per analytical batch	< CRQL	Investigate source of contamination and re-extract/reanalyze associated samples. Qualify data as needed.	Laboratory analyst and/or data validator	Accuracy/bias contamination	< CRQL
Equipment blanks	One per 20 field samples	< CRQL	Qualify data as needed	Data validator	Accuracy/bias contamination	< CRQL

Quality Assurance Project Plan Worksheet #28-3 – Quality Control Samples (Pesticides in Water by SOM01.2)

Matrix	Water	**Analytical Method/ SOP Reference**	SOM01.2/TAB-2	**No. of Sample Locations**	Numerous	
Analytical Group	Pesticides	**Sampler's Name**	NA			
Concentration Level	All	**Field Sampling Organization**	ARCADIS Sampling Personnel			
Sampling SOP	SOP 2, SOP 7, SOP 8, SOP 20	**Analytical Organization**	Test America			
QC Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits[3]**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**DQI**	**Measurement Performance Criteria**
LCS	One per analytical batch	%R, see SOM01.2 - Exhibit D Pesticides Table 2	Re-extract/reanalyze associated samples. Qualify data as needed	Laboratory analyst and/or data validator	Accuracy/bias	%R, see SOM01.2 - Exhibit D Pesticides Table 2
MS[2]	One per analytical batch	%R, see SOM01.2 - Exhibit D Pesticides Table 3	Re-extract/reanalyze samples. Qualify data as needed	Laboratory analyst and/or data validator	Accuracy/bias	%R, see SOM01.2 - Exhibit D Pesticides Table 3
MSD[2]	One per analytical batch	%R, see SOM01.2 - Exhibit D Pesticides Table 3	Re-extract/reanalyze samples. Qualify data as needed	Laboratory analyst and/or data validator	Accuracy/bias	%R, see SOM01.2 - Exhibit D Pesticides Table 3
MS/MSD[2]	One per analytical batch	%R, see SOM01.2 - Exhibit D Pesticides Table 3	Re-extract/reanalyze samples. Qualify data as needed	Laboratory analyst and/or data validator	Precision	%R, see SOM01.2 - Exhibit D Pesticides Table 3

Note:
[1] An analytical batch is defined as no more than 20 analytical samples including field samples and field blanks.
[2] MS and MSD must be client-provided.

Quality Assurance Project Plan Worksheet #28-4 – Quality Control Samples (PCBs in Water by SOM01.2)

Matrix	Water	**Analytical Method/ SOP Reference**	SOM01.2/TAB-1	**No. of Sample Locations**	Numerous	
Analytical Group	PCBs	**Sampler's Name**	NA			
Concentration Level	All	**Field Sampling Organization**	ARCADIS Sampling Personnel			
Sampling SOP	SOP 2, SOP 7, SOP 8, SOP 20	**Analytical Organization**	Test America			
QC Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits[3]**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**DQI**	**Measurement Performance Criteria**
Field duplicate	One per 10 field samples of similar matrix	RPD < 35%	Qualify data as needed	Data validator	Precision – overall	RPD < 35%
Surrogate spikes	Added to all samples and blanks	%R: 30-150%	Check calculations, sample preparation logs, surrogate spiking solution, and instrument operation. Re-extract/reanalyze samples. Qualify data as needed.	Laboratory analyst and/or data validator	Accuracy/bias	%R: 30-150%
Method blanks	One per analytical batch	< CRQL	Investigate source of contamination and re-extract/reanalyze associated samples. Qualify data as needed.	Laboratory analyst and/or data validator	Accuracy/bias contamination	< CRQL
Equipment blanks	One per 20 field samples	< CRQL	Qualify data as needed	Data validator	Accuracy/bias contamination	< CRQL
LCS	One per analytical batch	%R, see SOM01.2 - Exhibit D Aroclors Table 2	Re-extract/reanalyze associated samples. Qualify data as needed	Laboratory analyst and/or data validator	Accuracy/bias	%R, see SOM01.2 - Exhibit D Aroclors Table 2
MS[2]	One per analytical batch	%R, see SOM01.2 - Exhibit D Aroclors Table 1	Re-extract/reanalyze samples. Qualify data as needed	Laboratory analyst and/or data validator	Accuracy/bias	%R, see SOM01.2 - Exhibit D Aroclors Table 1

Quality Assurance Project Plan Worksheet #28-4 – Quality Control Samples (PCBs in Water by SOM01.2)

Matrix	Water	**Analytical Method/ SOP Reference**	SOM01.2/TAB-1	**No. of Sample Locations**	Numerous	
Analytical Group	PCBs	**Sampler's Name**	NA			
Concentration Level	All	**Field Sampling Organization**	ARCADIS Sampling Personnel			
Sampling SOP	SOP 2, SOP 7, SOP 8, SOP 20	**Analytical Organization**	Test America			
QC Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits[3]**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**DQI**	**Measurement Performance Criteria**
MSD[2]	One per analytical batch	%R, see SOM01.2 - Exhibit D Aroclors Table 1	Re-extract/reanalyze samples. Qualify data as needed	Laboratory analyst and/or data validator	Accuracy/bias	%R, see SOM01.2 - Exhibit D Aroclors Table 1
MS/MSD[2]	One per analytical batch	%R, see SOM01.2 - Exhibit D Aroclors Table 1	Re-extract/reanalyze samples. Qualify data as needed	Laboratory analyst and/or data validator	Precision	%R, see SOM01.2 - Exhibit D Aroclors Table 1

Note:
[1] An analytical batch is defined as no more than 20 analytical samples including field samples and field blanks.
[2] MS and MSD must be client-provided.

Quality Assurance Project Plan Worksheet #28-5 – Quality Control Samples (Metals. Mercury, and Cyanide in Water by ISM01.3)

Matrix	Water	**Analytical Method/ SOP Reference**	ISM01.3[3]/TAB-5, TAB-6, TAB-7	**No. of Sample Locations**	Numerous	
Analytical Group	Metals, Mercury, and Cyanide	**Sampler's Name**	To be determined			
Concentration Level	All	**Field Sampling Organization**	ARCADIS Sampling Personnel			
Sampling Standard Operating Procedure (SOP)	SOP 2, SOP 7, SOP 8, SOP 20	**Analytical Organization**	Test America			
Quality Control (QC) Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator**	**Measurement Performance Criteria**
Field duplicate	One per 10 field samples of similar matrix	Relative percent difference (RPD) < 35%	Qualify data as needed	Data Validator	Precision – overall	RPD < 35%
Method blanks	One per analytical batch	< CRQL	Qualify data as needed or reanalyze batch	Lab personnel and/or Data Validator	Accuracy/bias contamination	< CRQL
Equipment blanks	One per 20 field samples	< CRQL	Qualify data as needed	Data Validator	Accuracy/bias contamination	< CRQL
Calibration verification standards	Every 10 field samples and at the end of the analysis sequence	Percent recovery (%R) 85-115%	Reanalysis of batch	Lab personnel	Accuracy/bias contamination	%R 85-115%
Interference check sample (A and AB) (ICP-AES metals analysis only)	Two per run	%R ±20% of true value or ±1 times the CRQL of the analyte's true value, whichever is greater	Qualify data as needed or reanalysis of batch	Lab personnel	Precision – lab	%R ±20% of true value or ±1 times the CRQL of the analyte's true value, whichever is greater

Quality Assurance Project Plan Worksheet #28-5 – Quality Control Samples (Metals. Mercury, and Cyanide in Water by ISM01.3)

Matrix	Water	**Analytical Method/ SOP Reference**	ISM01.3[3]/TAB-5, TAB-6, TAB-7	**No. of Sample Locations**	Numerous	
Analytical Group	Metals, Mercury, and Cyanide	**Sampler's Name**	To be determined			
Concentration Level	All	**Field Sampling Organization**	ARCADIS Sampling Personnel			
Sampling Standard Operating Procedure (SOP)	SOP 2, SOP 7, SOP 8, SOP 20	**Analytical Organization**	Test America			
Quality Control (QC) Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator**	**Measurement Performance Criteria**
Laboratory control sample (LCS) (ICP-AES metals analysis only)	One per batch	%R 70-130% (50-150% for antimony and silver)	Qualify data as needed or reanalyze batch	Lab personnel and/or Data Validator	Precision	%R 70-130% (50-150% for antimony and silver)
Matrix spike (MS)[2]	One per batch	%R: 75-125%; does not apply when the sample concentration is ≥4x the spike added	Qualify data as needed	Lab personnel and/or Data Validator	Accuracy/bias	%R: 75-125%; does not apply when the sample concentration is ≥4x the spike added
Matrix duplicate (MD)[2]	One per batch	RPD < 20% for original and duplicate sample values ≥5x the CRQL; control limit of the CRQL used if either the sample or duplicate value is <5x the CRQL	Qualify data as needed	Lab personnel and/or Data Validator	Precision	RPD < 20% for original and duplicate sample values ≥5x the CRQL; control limit of the CRQL used if either the sample or duplicate value is <5x the CRQL
Serial dilution (ICP-AES metals analysis only)	One per batch	Percent difference (%D) < 10% for original samples >50x the MDL	Qualify data as needed	Lab personnel	Precision	Percent difference (%D) < 10%

Notes:
[1]An analytical batch is defined as no more than 20 analytical samples including field samples and field blanks.
[2] MS/MD must be client-supplied.
[3] Metals analysis will be performed using Inductively Coupled Plasma-Atomic Emission Spectroscopy.

Quality Assurance Project Plan Worksheet #28-6 – Quality Control Samples (Mercury in Water by EPA 1631E)

Matrix	Water	**Analytical Method/ SOP Reference**	EPA 1631E/TANC-12	**No. of Sample Locations**	Numerous	
Analytical Group	Mercury	**Sampler's Name**	To be determined			
Concentration Level	Low	**Field Sampling Organization**	ARCADIS Sampling Personnel			
Sampling Standard Operating Procedure (SOP)	SOP 2, SOP 7, SOP 8, SOP 20	**Analytical Organization**	Test America			
Quality Control (QC) Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator**	**Measurement Performance Criteria**
Field duplicate	One per 10 field samples of similar matrix	Relative percent difference (RPD) < 35%	Qualify data as needed	Data Validator	Precision – overall	RPD < 35%
Method blanks	One per analytical batch	< RL	Qualify data as needed or reanalyze batch	Lab personnel and/or Data Validator	Accuracy/bias contamination	< RL
Equipment blanks	One per 20 field samples	< RL	Qualify data as needed	Data Validator	Accuracy/bias contamination	< RL
Calibration verification standards	Every 10 field samples and at the end of the analysis sequence	Percent recovery (%R), method specified limit	Reanalysis of batch	Lab personnel	Accuracy/bias contamination	%R 85-115%
Ongoing precision and recovery (OPR) sample	One per batch	%R, method specified limit	Qualify data as needed or reanalyze batch	Lab personnel and/or Data Validator	Precision	%R, method specified limit
Quality control sample (QCS)	One per batch	%R, method specified limit	Qualify data as needed or reanalyze batch	Lab personnel and/or Data Validator	Precision	%R, method specified limit

Quality Assurance Project Plan Worksheet #28-6 – Quality Control Samples (Mercury in Water by EPA 1631E)

Matrix	Water	**Analytical Method/ SOP Reference**	EPA 1631E/TANC-12	**No. of Sample Locations**	Numerous	
Analytical Group	Mercury	**Sampler's Name**	To be determined			
Concentration Level	Low	**Field Sampling Organization**	ARCADIS Sampling Personnel			
Sampling Standard Operating Procedure (SOP)	SOP 2, SOP 7, SOP 8, SOP 20	**Analytical Organization**	Test America			
Quality Control (QC) Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator**	**Measurement Performance Criteria**
Matrix spike (MS)[2]	One per batch	%R, method specified limit	Qualify data as needed	Lab personnel and/or Data Validator	Accuracy/bias	%R, method specified limit
Matrix duplicate (MD)[2]	One per batch	RPD, method specified limit	Qualify data as needed	Lab personnel and/or Data Validator	Precision	RPD, method specified limit

Notes:
[1]An analytical batch is defined as no more than 20 analytical samples including field samples and field blanks.
[2] MS/MD must be client-supplied.

Quality Assurance Project Plan Worksheet #28-7 – Quality Control Samples (Semivolatile Organic Compounds in Soil and Sediment by SOM01.2 and SOM01.2-SIM)

Matrix	Soil/Sediment	**Analytical Method/ SOP Reference**	SOM01.2/SOM01.2-SIM/TAB-3	**No. of Sample Locations**	Numerous	
Analytical Group	SVOCs	**Sampler's Name**	NA			
Concentration Level	All	**Field Sampling Organization**	ARCADIS Sampling Personnel			
Sampling SOP	SOP 5, SOP 14	**Analytical Organization**	Test America			
Quality Control (QC) Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Field duplicate	One per 10 field samples of similar matrix	RPD < 50%	Qualify data as needed.	Data validator	Precision – overall	RPD < 50%
DMC	Added to all samples and blanks	%R, see SOM01.2 – Exhibit D Semivolatiles Tables 6 (%R) 7 (associated target compounds), and 8 (associated target compounds – SIM)	Check calculations, sample preparation logs, DMC standard spiking solution, and instrument operation. Re-extract/reanalyze samples. Qualify data as needed.	Laboratory analyst and/or data validator	Accuracy/bias	%R, see SOM01.2 – Exhibit D Semivolatiles Tables 6 (%R) 7 (associated target compounds), and 8 (associated target compounds – SIM)
Method blanks	One per analytical batch	< CRQL	Investigate source of contamination and re-extract/reanalyze associated samples. Qualify data as needed.	Laboratory analyst and/or data validator	Accuracy/bias contamination	< CRQL
Equipment blanks	One per 20 field samples	< CRQL	Qualify data as needed.	Data validator	Accuracy/bias contamination	< CRQL
Instrument check: DFTPP	One per calibration	%R, see SOM01.2 – Exhibit D Semivolatiles Table 1	Re-tune the instrument and reanalyze associated samples.	Laboratory analyst	Accuracy/bias	%R, see SOM01.2 – Exhibit D Semivolatiles Table 1

Quality Assurance Project Plan Worksheet #28-7 – Quality Control Samples (Semivolatile Organic Compounds in Soil and Sediment by SOM01.2 and SOM01.2-SIM)

Matrix	Soil/Sediment	**Analytical Method/ SOP Reference**	SOM01.2/SOM01.2-SIM/TAB-3	**No. of Sample Locations**	Numerous	
Analytical Group	SVOCs	**Sampler's Name**	NA			
Concentration Level	All	**Field Sampling Organization**	ARCADIS Sampling Personnel			
Sampling SOP	SOP 5, SOP 14	**Analytical Organization**	Test America			
Quality Control (QC) Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Internal standard	Added to all samples and blanks	Area response 50.0% to 200% and retention time (RT) ±30.0 seconds from associated 12-hour calibration standard, see SOM01.2 – Exhibit D Semivolatiles Table 2 (associated target compounds)	Check calculations, internal standard solutions, and instrument operation. Re-extract/reanalyze samples. Qualify data as needed.	Laboratory analyst and/or data validator	Precision	Area response 50.0% to 200% and retention time (RT) ±30.0 seconds from associated 12-hour calibration standard, see SOM01.2 – Exhibit D Semivolatiles Table 2 (associated target compounds)
MS[2]	One per batch	%R, see SOM01.2 - Exhibit D Semivolatile Table 5	Re-extract/reanalyze samples. Qualify data as needed	Laboratory analyst and/or data validator	Accuracy/bias	%R, see SOM01.2 - Exhibit D Semivolatile Table 5
MSD[2]	One per batch	%R, see SOM01.2 - Exhibit D Semivolatile Table 5	Re-extract/reanalyze samples. Qualify data as needed	Laboratory analyst and/or data validator	Accuracy/bias	%R, see SOM01.2 - Exhibit D Semivolatile Table 5
MS/MSD[2]	One per batch	%R, see SOM01.2 - Exhibit D Semivolatile Table 5	Re-extract/reanalyze samples. Qualify data as needed	Laboratory analyst and/or data validator	Precision	%R, see SOM01.2 - Exhibit D Semivolatile Table 5

Note:

[1] An analytical batch is defined as no more than 20 analytical samples including field samples and field blanks.

[2] MS and MSD must be client-provided.

Quality Assurance Project Plan Worksheet #28-8 – Quality Control Samples (Volatile Organic Compounds in Soil and Sediment by SOM01.2)

Matrix	Soil/Sediment	**Analytical Method/ SOP Reference**	SOM01.2-TAB-4	**No. of Sample Locations**	Numerous	
Analytical Group	VOCs	**Sampler's Name**	NA			
Concentration Level	All	**Field Sampling Organization**	ARCADIS Sampling Personnel			
Sampling SOP	SOP 5, SOP 14	**Analytical Organization**	Test America			
Quality Control (QC) Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Field duplicate	One per 10 field samples of similar matrix	RPD < 50%	Qualify data as needed.	Data validator	Precision – overall	RPD < 50%
DMC	Added to all samples and blanks	%R, see SOM01.2 – Exhibit D Low/Medium Volatiles Tables 5 (%R) and 7 (associated target compounds)	Check calculations, sample preparation logs, DMC standard spiking solution, and instrument operation. Re-extract/reanalyze samples. Qualify data as needed.	Laboratory analyst and/or data validator	Accuracy/bias	%R, see SOM01.2 – Exhibit D Low/Medium Volatiles Tables 5 (%R) and 7 (associated target compounds)
Method blanks	One per analytical batch	< CRQL	Investigate source of contamination and re-extract/reanalyze associated samples. Qualify data as needed.	Laboratory analyst and/or data validator	Accuracy/bias contamination	< CRQL
Equipment blanks	One per 20 field samples	< CRQL	Qualify data as needed.	Data validator	Accuracy/bias contamination	< CRQL

Quality Assurance Project Plan Worksheet #28-8 – Quality Control Samples (Volatile Organic Compounds in Soil and Sediment by SOM01.2)

Matrix	Soil/Sediment	**Analytical Method/ SOP Reference**	SOM01.2-TAB-4	**No. of Sample Locations**	Numerous	
Analytical Group	VOCs	**Sampler's Name**	NA			
Concentration Level	All	**Field Sampling Organization**	ARCADIS Sampling Personnel			
Sampling SOP	SOP 5, SOP 14	**Analytical Organization**	Test America			
Quality Control (QC) Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Instrument check: BFB	One per calibration	%R, see SOM01.2 – Exhibit D Low/Medium Volatiles Table 1	Re-tune the instrument and reanalyze associated samples.	Laboratory analyst	Accuracy/bias	%R, see SOM01.2 – Exhibit D Low/Medium Volatiles Table 1
Internal standard	Added to all samples and blanks	Area response 50.0% to 200% and retention time (RT) ±30.0 seconds from associated 12-hour calibration standard, see SOM01.2 – Exhibit D Low/Medium Volatiles Table 3 (associated target compounds)	Check calculations, internal standard solutions, and instrument operation. Re-extract/reanalyze samples. Qualify data as needed.	Laboratory analyst and/or data validator	Precision	Area response 50.0% to 200% and retention time (RT) ±30.0 seconds from associated 12-hour calibration standard, see SOM01.2 – Exhibit D Semivolatiles Table 2 (associated target compounds)
MS[2]	One per batch	%R, see SOM01.2 - Exhibit D Low/Medium Volatiles Table 6	Re-extract/reanalyze samples. Qualify data as needed	Laboratory analyst and/or data validator	Accuracy/bias	%R, see SOM01.2 - Exhibit D Low/Medium Volatiles Table 6
MSD[2]	One per batch	%R, see SOM01.2 - Exhibit D Low/Medium Volatiles Table 6	Re-extract/reanalyze samples. Qualify data as needed	Laboratory analyst and/or data validator	Accuracy/bias	%R, see SOM01.2 - Exhibit D Low/Medium Volatiles Table 6

Quality Assurance Project Plan Worksheet #28-8 – Quality Control Samples (Volatile Organic Compounds in Soil and Sediment by SOM01.2)

Matrix	Soil/Sediment	**Analytical Method/ SOP Reference**	SOM01.2-TAB-4	**No. of Sample Locations**	Numerous	
Analytical Group	VOCs	**Sampler's Name**	NA			
Concentration Level	All	**Field Sampling Organization**	ARCADIS Sampling Personnel			
Sampling SOP	SOP 5, SOP 14	**Analytical Organization**	Test America			
Quality Control (QC) Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
MS/MSD[2]	One per batch	%R, see SOM01.2 - Exhibit D Low/Medium Volatiles Table 6	Re-extract/reanalyze samples. Qualify data as needed	Laboratory analyst and/or data validator	Precision	%R, see SOM01.2 - Exhibit D Low/Medium Volatiles Table 6

Note:

[1] An analytical batch is defined as no more than 20 analytical samples including field samples and field blanks.

[2] MS and MSD must be client-provided.

Quality Assurance Project Plan Worksheet #28-9 – Quality Control Samples (Pesticides in Soil and Sediment by SOM01.2)

Matrix	Soil/Sediment	**Analytical Method/ SOP Reference**	SOM01.2/TAB-2	**No. of Sample Locations**	Numerous	
Analytical Group	Pesticides	**Sampler's Name**	NA			
Concentration Level	All	**Field Sampling Organization**	ARCADIS Sampling Personnel			
Sampling SOP	SOP 5, SOP 14	**Analytical Organization**	Test America			
QC Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits[3]**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**DQI**	**Measurement Performance Criteria**
Field duplicate	One per 10 field samples of similar matrix	RPD < 50%	Qualify data as needed	Data validator	Precision – overall	RPD < 50%
Surrogate spikes	Added to all samples and blanks	%R: 30-150%	Check calculations, sample preparation logs, surrogate spiking solution, and instrument operation. Re-extract/reanalyze samples. Qualify data as needed.	Laboratory analyst and/or data validator	Accuracy/bias	%R: 30-150%
Method blanks	One per analytical batch	< CRQL	Investigate source of contamination and re-extract/reanalyze associated samples. Qualify data as needed.	Laboratory analyst and/or data validator	Accuracy/bias contamination	< CRQL
Equipment blanks	One per 20 field samples	< CRQL	Qualify data as needed	Data validator	Accuracy/bias contamination	< CRQL
LCS	One per analytical batch	%R, see SOM01.2 - Exhibit D Pesticides Table 2	Re-extract/reanalyze associated samples. Qualify data as needed	Laboratory analyst and/or data validator	Accuracy/bias	%R, see SOM01.2 - Exhibit D Pesticides Table 2
MS[2]	One per analytical batch	%R, see SOM01.2 - Exhibit D Pesticides Table 3	Re-extract/reanalyze samples. Qualify data as needed	Laboratory analyst and/or data validator	Accuracy/bias	%R, see SOM01.2 - Exhibit D Pesticides Table 3

Quality Assurance Project Plan Worksheet #28-9 – Quality Control Samples (Pesticides in Soil and Sediment by SOM01.2)

Matrix	Soil/Sediment	**Analytical Method/ SOP Reference**	SOM01.2/TAB-2	**No. of Sample Locations**	Numerous	
Analytical Group	Pesticides	**Sampler's Name**	NA			
Concentration Level	All	**Field Sampling Organization**	ARCADIS Sampling Personnel			
Sampling SOP	SOP 5, SOP 14	**Analytical Organization**	Test America			
QC Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits[3]**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**DQI**	**Measurement Performance Criteria**
MSD[2]	One per analytical batch	%R, see SOM01.2 - Exhibit D Pesticides Table 3	Re-extract/reanalyze samples. Qualify data as needed	Laboratory analyst and/or data validator	Accuracy/bias	%R, see SOM01.2 - Exhibit D Pesticides Table 3
MS/MSD[2]	One per analytical batch	%R, see SOM01.2 - Exhibit D Pesticides Table 3	Re-extract/reanalyze samples. Qualify data as needed	Laboratory analyst and/or data validator	Precision	%R, see SOM01.2 - Exhibit D Pesticides Table 3

Note:
[1] An analytical batch is defined as no more than 20 analytical samples including field samples and field blanks.
[2] MS and MSD must be client-provided.

Quality Assurance Project Plan Worksheet #28-10 – Quality Control Samples (PCBs in Soil and Sediment by SOM01.2)

Matrix	Soil/Sediment	**Analytical Method/ SOP Reference**	SOM01.2/TAB-1	**No. of Sample Locations**	Numerous	
Analytical Group	PCBs	**Sampler's Name**	NA			
Concentration Level	All	**Field Sampling Organization**	ARCADIS Sampling Personnel			
Sampling SOP	SOP 5, SOP 14	**Analytical Organization**	Test America			
QC Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits[3]**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**DQI**	**Measurement Performance Criteria**
Field duplicate	One per 10 field samples of similar matrix	RPD < 50%	Qualify data as needed	Data validator	Precision – overall	RPD < 50%
Surrogate spikes	Added to all samples and blanks	%R: 30-150%	Check calculations, sample preparation logs, surrogate spiking solution, and instrument operation. Re-extract/reanalyze samples. Qualify data as needed.	Laboratory analyst and/or data validator	Accuracy/bias	%R: 30-150%
Method blanks	One per analytical batch	< CRQL	Investigate source of contamination and re-extract/reanalyze associated samples. Qualify data as needed.	Laboratory analyst and/or data validator	Accuracy/bias contamination	< CRQL
Equipment blanks	One per 20 field samples	< CRQL	Qualify data as needed	Data validator	Accuracy/bias contamination	< CRQL
LCS	One per analytical batch	%R, see SOM01.2 - Exhibit D Aroclors Table 2	Re-extract/reanalyze associated samples. Qualify data as needed	Laboratory analyst and/or data validator	Accuracy/bias	%R, see SOM01.2 - Exhibit D Aroclors Table 2
MS[2]	One per analytical batch	%R, see SOM01.2 - Exhibit D Aroclors Table 1	Re-extract/reanalyze samples. Qualify data as needed	Laboratory analyst and/or data validator	Accuracy/bias	%R, see SOM01.2 - Exhibit D Aroclors Table 1

Quality Assurance Project Plan Worksheet #28-10 – Quality Control Samples (PCBs in Soil and Sediment by SOM01.2)

Matrix	Soil/Sediment	**Analytical Method/ SOP Reference**	SOM01.2/TAB-1	**No. of Sample Locations**	Numerous	
Analytical Group	PCBs	**Sampler's Name**	NA			
Concentration Level	All	**Field Sampling Organization**	ARCADIS Sampling Personnel			
Sampling SOP	SOP 5, SOP 14	**Analytical Organization**	Test America			
QC Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits[3]**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**DQI**	**Measurement Performance Criteria**
MSD[2]	One per analytical batch	%R, see SOM01.2 - Exhibit D Aroclors Table 1	Re-extract/reanalyze samples. Qualify data as needed	Laboratory analyst and/or data validator	Accuracy/bias	%R, see SOM01.2 - Exhibit D Aroclors Table 1
MS/MSD[2]	One per analytical batch	%R, see SOM01.2 - Exhibit D Aroclors Table 1	Re-extract/reanalyze samples. Qualify data as needed	Laboratory analyst and/or data validator	Precision	%R, see SOM01.2 - Exhibit D Aroclors Table 1

Note:
[1] An analytical batch is defined as no more than 20 analytical samples including field samples and field blanks.
[2] MS and MSD must be client-provided.

Quality Assurance Project Plan Worksheet #28-11 – Quality Control Samples (Metals. Mercury, and Cyanide in Soil and Sediment by ISM01.3)

Matrix	Soil/Sediment	**Analytical Method/ SOP Reference**	ISM01.3[3]/TAB-5, TAB-6, TAB-7	**No. of Sample Locations**	Numerous	
Analytical Group	Metals, Mercury, and Cyanide	**Sampler's Name**	To be determined			
Concentration Level	All	**Field Sampling Organization**	ARCADIS Sampling Personnel			
Sampling Standard Operating Procedure (SOP)	SOP 5, SOP 14	**Analytical Organization**	Test America			
Quality Control (QC) Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator**	**Measurement Performance Criteria**
Field duplicate	One per 10 field samples of similar matrix	Relative percent difference (RPD) < 50%	Qualify data as needed	Data Validator	Precision – overall	RPD < 50%
Method blanks	One per analytical batch	< CRQL	Qualify data as needed or reanalyze batch	Lab personnel and/or Data Validator	Accuracy/bias contamination	< CRQL
Equipment blanks	One per 20 field samples	< CRQL	Qualify data as needed	Data Validator	Accuracy/bias contamination	< CRQL
Calibration verification standards	Every 10 field samples and at the end of the analysis sequence	Percent recovery (%R) 85-115%	Reanalysis of batch	Lab personnel	Accuracy/bias contamination	%R 85-115%
Interference check sample (A and AB) (ICP-AES metals analysis only)	Two per run	%R ±20% of true value or ±1 times the CRQL of the analyte's true value, whichever is greater	Qualify data as needed or reanalysis of batch	Lab personnel	Precision – lab	%R ±20% of true value or ±1 times the CRQL of the analyte's true value, whichever is greater

Quality Assurance Project Plan Worksheet #28-11 – Quality Control Samples (Metals. Mercury, and Cyanide in Soil and Sediment by ISM01.3)

Matrix	Soil/Sediment	**Analytical Method/ SOP Reference**	ISM01.3[3]/TAB-5, TAB-6, TAB-7	**No. of Sample Locations**	Numerous	
Analytical Group	Metals, Mercury, and Cyanide	**Sampler's Name**	To be determined			
Concentration Level	All	**Field Sampling Organization**	ARCADIS Sampling Personnel			
Sampling Standard Operating Procedure (SOP)	SOP 5, SOP 14	**Analytical Organization**	Test America			
Quality Control (QC) Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator**	**Measurement Performance Criteria**
Laboratory control sample (LCS) (ICP-AES metals analysis only)	One per batch	%R 70-130% (50-150% for antimony and silver)	Qualify data as needed or reanalyze batch	Lab personnel and/or Data Validator	Precision	%R 70-130% (50-150% for antimony and silver)
Matrix spike (MS)[2]	One per batch	%R: 75-125%; does not apply when the sample concentration is ≥4x the spike added	Qualify data as needed	Lab personnel and/or Data Validator	Accuracy/bias	%R: 75-125%; does not apply when the sample concentration is ≥4x the spike added
Matrix duplicate (MD)[2]	One per batch	RPD < 20% for original and duplicate sample values ≥5x the CRQL; control limit of the CRQL used if either the sample or duplicate value is <5x the CRQL	Qualify data as needed	Lab personnel and/or Data Validator	Precision	RPD < 20% for original and duplicate sample values ≥5x the CRQL; control limit of the CRQL used if either the sample or duplicate value is <5x the CRQL
Serial dilution (ICP-AES metals analysis only)	One per batch	Percent difference (%D) < 10% for original samples >50x the MDL	Qualify data as needed	Lab personnel	Precision	Percent difference (%D) < 10%

Notes:

[1]An analytical batch is defined as no more than 20 analytical samples including field samples and field blanks.

[2] MS/MD must be client-supplied.

[3] Metals analysis will be performed using Inductively Coupled Plasma-Atomic Emission Spectroscopy.

Quality Assurance Project Plan Worksheet #28-12 Quality Control Samples (Total Organic Carbon in Soil and Sediment by Lloyd Kahn)

Matrix	Soil/Sediment	**Analytical Method/ SOP Reference**	Lloyd Kahn/TAB-12	**No. of Sample Locations**	Numerous	
Analytical Group	TOC	**Sampler's Name**	Not Available			
Concentration Level	All	**Field Sampling Organization**	ARCADIS Sampling Personnel			
Sampling SOP	SOP 5, SOP 14	**Analytical Organization**	Test America			
QC Sample	**Frequency/Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**DQI**	**Measurement Performance Criteria**
Field duplicate	One per 10 field samples of similar matrix	RPD < 50%	Qualify data as needed	Data validator	Precision – overall	RPD < 50%
LCS	One per analytical batch	%R, laboratory specific limits	Re-prepare/reanalyze samples. Qualify data as needed.	Laboratory analyst and/or data validator	Accuracy/bias	%R, laboratory specific limits
Laboratory duplicate[2]	One per analytical batch	RPD, laboratory specific limits	Re-prepare/reanalyze samples. Qualify data as needed.	Laboratory analyst and/or data validator	Precision – overall	RPD, laboratory specific limits
MS[2]	One per analytical batch	%R, laboratory specific limits	Re-prepare/reanalyze samples. Qualify data as needed.	Laboratory analyst and/or data validator	Accuracy/bias	%R, laboratory specific limits

Note:
[1] An analytical batch is defined as no more than 20 analytical samples including field samples and field blanks.
[2] Sufficient sample size for MS and laboratory duplicate analysis must be client-provided.

Quality Assurance Project Plan Worksheet #28-13 – Quality Control Samples (PCB Congeners in Soil and Sediment by EPA 1668A)

Matrix	Soil/Sediment	**Analytical Method/ SOP Reference**	EPA 1668A/TAWS-1	**No. of Sample Locations**	Numerous	
Analytical Group	PCB Congeners	**Sampler's Name**	NA			
Concentration Level	All	**Field Sampling Organization**	ARCADIS Sampling Personnel			
Sampling SOP	SOP 5, SOP 14	**Analytical Organization**	Test America			
QC Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**DQI**	**Measurement Performance Criteria**
Field duplicate	One per 10 field samples of similar matrix	RPD < 50%	Qualify data as needed	Data validator	Precision – overall	RPD < 50%
Ongoing precision and recovery (OPR)	One per analytical batch	%R, method specified limits	Correct the problem. Re-prepare, extract, and clean-up the sample batch and repeat the OPR.	Laboratory analyst and/or data validator	Accuracy/bias	%R, method specified limits
Method blanks	One per analytical batch	< RL	Investigate source of contamination and re-extract/reanalyze associated samples. Qualify data as needed.	Laboratory analyst and/or data validator	Accuracy/bias contamination	< RL
Equipment blanks	One per 20 field samples	< RL	Qualify data as needed.	Data validator	Accuracy/bias contamination	< RL
Internal standards	Added to all samples	%R, method specified limits	Reanalyze sample. Qualify data as needed.	Laboratory analyst and/or data validator	Accuracy/bias	%R, method specified limits
MS[2]	One per analytical batch	%R, method specified limits	Re-extract/reanalyze associated samples. Qualify data as needed.	Laboratory analyst and/or data validator	Accuracy/bias	%R, method specified limits

Quality Assurance Project Plan Worksheet #28-13 – Quality Control Samples (PCB Congeners in Soil and Sediment by EPA 1668A)

Matrix	Soil/Sediment	**Analytical Method/ SOP Reference**	EPA 1668A/TAWS-1	**No. of Sample Locations**	Numerous	
Analytical Group	PCB Congeners	**Sampler's Name**	NA			
Concentration Level	All	**Field Sampling Organization**	ARCADIS Sampling Personnel			
Sampling SOP	SOP 5, SOP 14	**Analytical Organization**	Test America			
QC Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**DQI**	**Measurement Performance Criteria**
MSD or LCSD[2]	One per analytical batch	%R, method specified limits	Re-extract/reanalyze samples. Qualify data as needed.	Laboratory analyst and/or data validator	Accuracy/bias	%R, method specified limits
MS/MSD and LCS/LCSD[2]	One per analytical batch	RPD, method specified limits	Re-extract/reanalyze samples. Qualify data as needed.	Laboratory analyst and/or data validator	Precision	RPD, method specified limits

Note:
[1] An analytical batch is defined as no more than 20 analytical samples including field samples and field blanks.
[2] LCS/LCSD used when MS/MSD are not client-supplied.

Quality Assurance Project Plan Worksheet #28-14 – Quality Control Samples (Dioxins and Furans in Soil and Sediment by EPA 1613)

Matrix	Soil	**Analytical Method/ SOP Reference**	EPA 1613/TAWS-2	**No. of Sample Locations**	Numerous	
Analytical Group	Dioxins and Furans	**Sampler's Name**	TBD			
Concentration Level	All	**Field Sampling Organization**	ARCADIS Sampling Personnel			
Sampling Standard Operating Procedure (SOP)	SOP 5, SOP 14	**Analytical Organization**	Test America			
Quality Control (QC) Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Field duplicate	One per 10 field samples of similar matrix	Relative percent difference (RPD) < 50%	Qualify data as needed	Data Validator	Precision – overall	RPD < 50%
Internal standards/ recovery standards	9 IS/2 RS per sample and lab QC samples	Percent recovery (%R), method specified limit	Reanalysis or re-extraction/reanalysis of sample	Lab personnel	Accuracy/bias	%R, method specified limit
Method blanks	One per analytical batch	< RL	Qualify data as needed or re-extraction/reanalysis of batch	Lab personnel and/or Data Validator	Accuracy/bias contamination	< RL
Equipment blanks	One per 20 field samples	< RL	Qualify data as needed	Data Validator	Accuracy/bias contamination	< RL
Laboratory control sample/laboratory control sample duplicate (LCS/LCSD)[2]	One per analytical batch	%R, method specified limit	Reanalysis or re-extraction/ reanalysis of batch	Lab personnel and/or Data Validator	Accuracy/bias	%R, method specified limit
Instrument performance check: Perfluorokerosene (PKF)	One per calibration	Method specified limit	Reanalyze batch	Lab personnel	Accuracy/bias	%R, method specified limit

Quality Assurance Project Plan Worksheet #28-14 – Quality Control Samples (Dioxins and Furans in Soil and Sediment by EPA 1613)

Matrix	Soil	**Analytical Method/ SOP Reference**	EPA 1613/TAWS-2	**No. of Sample Locations**	Numerous	
Analytical Group	Dioxins and Furans	**Sampler's Name**	TBD			
Concentration Level	All	**Field Sampling Organization**	ARCADIS Sampling Personnel			
Sampling Standard Operating Procedure (SOP)	SOP 5, SOP 14	**Analytical Organization**	Test America			
Quality Control (QC) Sample	**Frequency/Number[1]**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**Data Quality Indicator (DQI)**	**Measurement Performance Criteria**
Matrix spike/matrix spike duplicate (MS/MSD)[2]	One per batch	%R, method specified limit	Qualify data as needed	Lab personnel and/or Data Validator	Accuracy/bias	%R, method specified limit
MS/MSD and LCS/LCSD[2]	One per batch	%RPD, method specified limit	Qualify data as needed	Lab personnel and/or Data Validator	Precision	%RPD, method specified limit

Note: [1]An analytical batch is defined as no more than 20 analytical samples including field samples and field blanks.
[2]LCS/LCSD used when MS/MSD are not client-supplied.

QAPP Worksheet #29: Project Documents and Records

Sample Collection Documents and Records	On-Site Analysis Documents and Records	Off-Site Analysis Documents and Records	Data Assessment Documents and Records	Other
- Field Notes - Sampling Logs - Chain-of-Custody Records - Air Bills - Custody Seals	- Equipment Calibration Logs - Field Data Records - Field Instrument Maintenance Logs	- Sample Receipt, Custody and Tracking Records - Standard Traceability Logs - Equipment Calibration Logs - Sample Prep Logs - Run Logs - Equipment Maintenance, Testing and Inspection Logs - Corrective Action Forms - Reported Field Sample Results - Reported Results for Standards, Quality Control (QC) Checks and QC Samples - Instrument PDF of (raw data) for Field Samples, Standards, QC Checks and QC Samples - Data Package Completeness Checklists - Sample Disposal Records - Extraction/Cleanup Records - Raw Data (stored on disk or CD-R) - Analytical Reports to ARCADIS	- Data Validation Checklists - Data Quality Assessments	Site-specific Work Plans as needed Site-specific Safety and Health Plan

QAPP Worksheet #31, 32 & 33: Assessments and Corrective Action

Assessments:

Assessment Type	Responsible Party & Organization	Number/Frequency	Estimated Dates	Assessment Deliverable	Deliverable due date
Readiness Review	Suzanne Walls, ARCADIS	One assessment one week prior to mobilization	Approximately 15 October 2014	Readiness Review Memorandum	24 hours following assessment
Field Sampling TSA	Andrew Gutherz, ARCADIS	One the first day of soil and temporary well groundwater sampling and at a frequency of approximately one per month during field activities. The number and frequency of additional field performance audits conducted will be determined independently by the Field Task Manager.	Approximately 22 October 2014	TSA Memorandum	24 hours following assessment
Management Review	John Persico, ARCADIS	Interim Management Review following site mobilization. Final management review upon completion of field work.	Interim review – approximately 10 November 2014. Final review – approximately 1 February 2015	QA Management Report	48 hours following Management Review

Assessment Response and Corrective Action:

Assessment Type	Responsibility for responding to assessment findings	Assessment Response Documentation	Timeframe for Response	Responsibility for Implementing Corrective Action	Responsible for monitoring Corrective Action implementation
Readiness Review	John Persico, ARCADIS	Readiness Review Corrective Action Response	24 hours from receipt of Readiness Review Memorandum	As directed by PM	As directed by PM
Field Sampling TSA	Suzanne Walls, ARCADIS	Field Sampling Corrective Action Response	24 hours from receipt of Memorandum	Field Task Leader	Field Task Leader
Management Reviews	Suzanne Walls, ARCADIS	QA Management Response	48 hours from receipt of QA Management Report	As assigned in QA Management Response	As assigned in QA Management Response

QAPP Worksheet #34: Data Verification and Validation Inputs

Item	Description	Verification (completeness)	Validation (conformance to specifications)
Planning Documents/Records			
1	Approved QAPP	X	
2	Contract	X	
4	Field SOPs	X	
5	Laboratory SOPs	X	
Field Records			
6	Field logbooks	X	
7	Equipment calibration records	X	
8	Chain-of-Custody Forms	X	
9	Sampling logs	X	
10	Drilling logs	X	
13	Change orders/deviations	X	
14	Field audit reports	X	
15	Field corrective action reports	X	
Analytical Data Package			
16	Cover sheet (laboratory identifying information)	X	X
17	Case narrative	X	X
18	Internal laboratory chain-of-custody	X	X
19	Sample receipt records	X	X
20	Sample chronology (i.e. dates and times of receipt, preparation, & analysis)	X	X
21	Communication records	X	X
22	Project-specific PT sample results	X	X
23	LOD/LOQ establishment and verification	X	X
24	Standards Traceability	X	X
25	Instrument calibration records	X	X
26	Definition of laboratory qualifiers	X	X
27	Results reporting forms	X	X
28	QC sample results	X	X
29	Corrective action reports	X	X
30	Raw data	X	X
31	Electronic data deliverable	X	

QAPP Worksheet #35: Data Verification Procedures

Records Reviewed	Requirement Documents	Process Description	Responsible Person, Organization
Field logbook and purge forms	QAPP	Verify that records are present and complete for each day of field activities. Verify that all planned samples including field QC samples were collected and that sample collection locations are documented. Verify that changes/exceptions are documented and were reported in accordance with requirements. Verify that any required field monitoring was performed and results are documented.	Weekly – Project Manager
Chain-of-custody forms	QAPP	Verify the completeness of chain-of-custody records. Check that appropriate methods and sample preservation have been recorded. Verify that the required volume of sample has been collected and that sufficient sample volume is available for QC samples (e.g., field duplicates, surrogates, blanks, and MS/MSD). Verify that all required signatures and dates are present. Check for transcription errors.	Daily – Field Crew Chief At conclusion of field activities – Project Manager
Laboratory Deliverable		Verify that the laboratory deliverable contains all records specified in the QAPP. Check sample receipt records to ensure sample condition upon receipt was noted, and any missing/broken sample containers were noted and reported according to plan. Compare the data package with the CoCs to verify that results were provided for all collected samples. Review the narrative to ensure all QC exceptions are described. Check for evidence that any required notifications were provided to project personnel as specified in the QAPP. Verify that necessary signatures and dates are present.	Before release – Laboratory QAM Upon receipt – Project Manager

QAPP Worksheet #36
Data Validation Procedures

Quality Assurance Project Plan Worksheet #36 – Validation (Steps IIa and IIb) Summary

Steps IIa and IIb	Matrix	Analytical Group	Data Purpose	Concentration Level	Validation Criteria[1]	Data Validator (title and organizational affiliation)
IIa and IIb	Sediments and Soil	Volatile Organic Compounds (VOCs), Semi-Volatile Organic Compounds (SVOCs) TCL/SIM, Polychlorinated Biphenyls (PCBs), Pesticides, PCBs Congener, Dioxins/Furans, TAL Metals, pH, TOC	Data Gaps	All	USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review SOM 1.2 June 2008, and USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review ISM 1.2 January 2010; EPA Region II Data Validation SOP for Dioxins EPA method 1613 HW-25 September 2008, EPA Region II Data Validation SOP for PCB congeners EPA method 1668 August 2003; Quality Assurance Project Plan (QAPP) criteria; associated analytical methodology, and professional judgment	Lyndi Mott Project Chemist, ARCADIS
IIa and IIb	Water	Volatile Organic Compounds (VOCs), Semi-Volatile Organic Compounds (SVOCs) TCL/SIM, Polychlorinated Biphenyls (PCBs), Pesticides, TAL Metals, LL Mercury, pH, TOC	Data Gaps	All	USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review SOM 1.2 June 2008, and USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review ISM 1.2 January 2010; Quality Assurance Project Plan (QAPP) criteria, associated analytical methodology; and professional judgment	Lyndi Mott Project Chemist, ARCADIS

QAPP Worksheet #37: Data Usability Assessment

Identify personnel (organization and position/title) responsible for participating in the data usability assessment:

4. John Persico, ARCADIS Project Coordinator
5. Suzanne Walls, ARCADIS Project Manager
6. Dennis Capria, ARCADIS QA Manager

The data usability assessment will be performed by the ARCADIS project management staff. Data verification will involve assessing whether analytical data meet the QC objectives and whether the necessary quality control steps were performed during field and laboratory tasks. The key data that will be assessed during data verification include:

- Sample collection, handling and analysis procedures in the field and laboratory
- Laboratory data (laboratory-qualified)
- Data package deliverable completeness
- QC sample data summaries

Quality Assurance Project Plan Worksheet #37 – Usability Assessment

The Data Usability Assessment will be performed by ARCADIS for data associated with the Data QAP Work Plan at the Rolling Knolls site. Documentation generated during the Data Usability Assessment will consist of data validation checklists with a brief summary of overall data usability.

The Data Usability Assessment process involves data verification and validation. Data verification is the process by which laboratory results are checked to provide that the proper quality control (QC) steps were performed and key items have met QC objectives (both analytical and contractual). Key steps of an ARCADIS data verification include:

- identifying sample collection, handling and analysis procedures
- documenting handling and analysis activities (e.g., , QC checklist)
- verifying (internally, at the data generator level) all sampling, handling, on-site analytical laboratory data

Quality Assurance Project Plan Worksheet #37 – Usability Assessment

- verifying laboratory data (e.g., laboratory-qualified data)
- verifying sampling, on-site analytical laboratory data
- verifying data package deliverable completeness
- reviewing the case narrative
- presenting all analytical results
- summarizing QC sample data
- evaluating applicable raw data

All required data deliverables must be present in the data package in order to proceed to the next step of data validation.

Data validation entails a review of the sample collection, handling, QC data, and the raw data to verify that the laboratory was operating within required limits, analytical results were correctly transcribed from the instrument read-outs and which (if any) environmental samples were related to out-of-control QC samples. The objective of data validation is to identify any questionable or invalid laboratory measurements.

The data quality indicators (DQIs) used to evaluate conformance with the project data quality objectives (DQOs) are presented below.

DQIs are generally defined in terms of six parameters:

1. representativeness
2. comparability
3. completeness
4. precision
5. accuracy
6. sensitivity

Quality Assurance Project Plan Worksheet #37 – Usability Assessment

Each parameter is defined below. Specific objectives for the site actions are presented in other sections of this QAPP, as referenced below.

Representativeness

Representativeness is the degree to which sampling data accurately and precisely represent site conditions, and is dependent on sampling and analytical variability and the variability of environmental media at the site. Actions have been designed to assess the presence of chemical constituents at the time of sampling. The QAPP presents the rationale for sample quantities and location. This QAPP presents field sampling and laboratory analytical methodologies. Use of the prescribed field and laboratory analytical methods with associated holding times and preservation requirements are intended to provide representative data.

Comparability

Comparability is the degree of confidence with which one data set can be compared to another. Comparability between phases of the actions (if additional phases are required) will be maintained through consistent use of the sampling and analytical methodologies set forth in this QAPP, established quality assurance/quality control (QA/QC) procedures and use of appropriately trained personnel.

Completeness

Completeness is defined as a measure of the amount of valid data obtained from an event and/or investigation compared to the total amount that was obtained. This will be determined upon final assessment of the analytical results. Completeness of a field or laboratory data set will be calculated by comparing the number of valid sample results generated to the total number of results generated.

$$\text{Completeness} = \frac{\text{Number valid results}}{\text{Total number of results generated}} \times 100$$

As a general guideline, overall project completeness is expected to be at least 90 percent. The assessment of completeness will require professional judgment to determine data usability for intended purposes.

Quality Assurance Project Plan Worksheet #37 – Usability Assessment

Precision

Precision is a measure of the reproducibility of sample results. The goal is to maintain a level of analytical precision consistent with the objectives of the action. To maximize precision, sampling and analytical procedures will be followed. All work for the site actions will adhere to established protocols presented in the QAPP. Checks for analytical precision will include the analysis of matrix spike/matrix spike duplicates (MS/MSDs), laboratory duplicates and field duplicates. Checks for field measurement precision will include duplicate field measurements.

The precision of data will be measured by calculating the Relative Percent Difference (RPD) by the following equation:

$$RPD = \frac{(A-B)}{(A+B)/2} \times 100$$

Where:

A = Analytical result from one of two duplicate measurements.

B = Analytical result from the second measurement.

Accuracy

Accuracy is a measure of how close a measured result is to the true value. Both field and analytical accuracy will be monitored through initial and continuing calibration of instruments. In addition, reference standards, MSs, blank spikes and surrogate standards will be used to assess the accuracy of the analytical data.

Accuracy will be calculated in terms of percent recovery as follows:

$$\% \text{ Recovery} = \frac{A-X}{} \times 100$$

Quality Assurance Project Plan Worksheet #37 – Usability Assessment

B

Where:

A = Value measured in spiked sample or standard.

X = Value measured in original sample.

B = True value of amount added to sample or true value of standard.

Sensitivity

Sensitivity is a quantitative measurement to determine if the analytical laboratory's procedures/methodologies and their associated detection limits can satisfy the project requirements as they relate to the project action limits. DLs are updated annually by the laboratory. The current DLs for the analytical laboratories are presented in Worksheet #15.

1. Data Validation and Usability

ARCADIS will validate data generated using the United States Environmental Protection Agency's (USEPA's) National Functional Guidelines (Organics October 1999 and Inorganics October 2004), USEPA Contract Laboratory Program National Functional Guidelines for Chlorinated Dibenzo-p-Dioxins (CDDs) and Chlorinated Dibenzofurans (CDFs) Data Review, (September 2011), and USEPA Region 2 SOP HW-31, Rev. 6 Analysis of Volatile Organic Compounds in Air Contained in Canisters by Method TO-15, (June 2014) for data validation, available at the time of project initiation. These procedures and criteria may be modified, as necessary, to address project-specific and method-specific criteria. Data validation will consist of data screening, checking, reviewing, editing and interpretation to document analytical data quality and to determine whether the quality is sufficient to meet the DQOs.

The data validator will verify that reduction of laboratory measurements and laboratory reporting of analytical parameters is in accordance with the procedures specified for each analytical method and/or as specified in this QAPP. Any deviations from the analytical method or any special reporting requirements apart from those specified in this QAPP will be detailed on chain-of-custody (COC) forms.

Quality Assurance Project Plan Worksheet #37 – Usability Assessment

Upon receipt of laboratory data, the following procedures will be executed by the data validator:

- Evaluate completeness of data package.
- Verify that field COC forms were completed and that samples were handled properly.
- Verify that holding times were met for each parameter. Holding time exceedances, should they occur, will be documented. Data for all samples exceeding holding time requirements will be flagged as either estimated or rejected. The decision as to which qualifier is more appropriate will be made on a case-by-case basis.
- Verify that parameters were analyzed according to the methods specified.
- Review QA/QC data (i.e., confirm that duplicates, blanks and spikes were analyzed on the required number of samples, as specified in the method and verify that duplicate and MS recoveries are acceptable).
- Investigate anomalies identified during review. When anomalies are identified, they will be discussed with the Project Manager and/or Laboratory Manager, as appropriate.
- If data appear suspect, investigate the specific data of concern. Calculations will be traced back to raw data. If calculations do not agree, the cause will be determined and corrected.

Deficiencies discovered as a result of the data review, as well as the corrective actions implemented in response, will be documented and submitted in the form of a written report addressing the following topics, as applicable to each method:

- assessment of the data package
- description of any protocol deviations
- failures to reconcile reported and/or raw data
- assessment of any compromised data
- overall appraisal of the analytical data

Quality Assurance Project Plan Worksheet #37 – Usability Assessment

· table of site name, sample quantities, matrix and fractions analyzed

It should be noted that qualified results do not necessarily invalidate data. The goal to produce the best possible data does not necessarily mean that data must be produced without QC qualifiers. Qualified data can provide useful information.

During the review process, laboratory qualified and unqualified data are verified against the supporting documentation. Based on this evaluation, qualifier codes may be added, deleted or modified by the data reviewer. Results will be qualified with the following codes in accordance with the USEPA National Functional Guidelines:

Laboratory Data Qualifiers:

J Estimated: The compound was positively identified; however, the associated numerical value is an estimated concentration greater than the DL but less than the LOQ.

B Blank contamination: The analyte was found in an associated blank above one half the LOQ, as well as in the sample.

U Undetected: The analyte/compound was analyzed for, but not detected.

Usability Assessment Data Qualifiers:

R The data are rejected due to deficiencies in meeting QC criteria and may not be used for decision making.

J Estimated: The analyte was positively identified, the quantitation is an estimation due to discrepancies in meeting certain analyte-specific quality control criteria.

UB Blank contamination: The analyte was found in an associated blank above one half the LOQ, as well as in the sample.

UJ The analyte was not detected; however, the result is estimated due to discrepancies in meeting certain analyte-specific quality control criteria.

Two facts will be noted to all data users. First, the "R" flag means that the associated value is unusable. In other words, due to significant QC problems, the analysis is invalid and provides no information as to whether the compound is present or not. Analytes with "R" values should not

Quality Assurance Project Plan Worksheet #37 – Usability Assessment

appear on data tables because they cannot be relied upon for any reason. The second fact is that no compound concentration, even if it has passed all QC tests, is guaranteed to be accurate. Strict QC serves to increase confidence in data, but any value potentially contains error.

Resolution of any issues regarding laboratory performance or deliverables will be handled between the laboratory and the data validator. Suggestions for reanalysis may be made by the Project Chemist at this point.

Validation Reports

The data validation reports will identify all deficiencies and the potential impact on the results. The ARCADIS Project Chemist or designee will amend qualifiers generated during the validation process to the database. The validation checklists and the database will be the primary location of all applicable data qualifiers. Qualifiers will be applied to the hard copy analytical reports.

Field Data Review

Field data are generated from in-field measurement, which may include a geophysical survey, well development and groundwater sampling. The quality objective for the in-field measurement activities is to obtain accurate measurements of sample characteristics, including aqueous pH, conductivity, temperature, turbidity and dissolved oxygen, using appropriate equipment. Data are recorded in field logbooks or on field sampling sheets and calibration logs. Calibration logs will be reviewed by ARCADIS Field Managers with other field documentation to identify any potential impacts to data quality and usability. Field logbooks are reviewed as part of the QC inspections.

Reconciliation with Data Usability Requirements

Data results will be examined to determine the performance that was achieved for each data usability criterion. The performance will then be compared with the project objectives and DQOs. Deviations from objectives will be noted. Data that has been rejected will not be used. Data that has been qualified but not rejected will be considered useable (i.e., qualified as estimated) and definitive data. If there is an instance where further limitations must be placed on qualified data, the data will be additionally qualified with “X.” This would indicate that the associated data is non-definitive data and should be used for screening purposes only.

Additional action may be warranted when performance does not meet performance objectives for critical data. Options for corrective action relating

Quality Assurance Project Plan Worksheet #37 – Usability Assessment

to incomplete information, questionable results or inconsistent data may include any or all of the following:

- retrieval of missing information
- request for additional explanation or clarification
- reanalysis of sample from extract (when appropriate)
- recalculation or reinterpretation of results by the laboratory

These actions may improve the data quality, reduce uncertainty and eliminate the need to qualify or reject data. If these actions do not improve the data quality to an acceptable level, the following additional actions may be taken:

- extrapolation of missing data from existing data points
- use of historical data
- evaluation of the critical/noncritical nature of the sample

If the data gap cannot be resolved by these actions, the data bias and potential for false negatives and positives can be evaluated. If the resultant uncertainty level is unacceptable, the following action must be taken:

- additional sample collection and analysis

Therefore the usability of the analytical data will be assessed based on the quality controls, field and laboratory documentation, and data comparison. The data will be analyzed in the context of the sampling location, groundwater flow patterns, geology, and previous data from the Site Characterization Summary Report. All data acquired will also be reviewed to ensure that sampling was consistent with the pre-designed sampling plan. Any deviations from the sampling plan and any anomalous data will be further examined to constrain what the usability of this data is.

Step 1	**Review the project's objectives and sampling design** The Project Manager and Project Coordinator will review the key outputs defined during systematic planning (i.e., DQOs) to make sure they are still applicable. Review the sampling design for consistency with stated objectives. This provides the context for interpreting the data in subsequent steps. - Verify that required sampling procedures were used

	- Verify that required analytical methods were used - Verify all required QC samples were collected and analyzed - Evaluate QC data
Step 2	**Review the data verification and data validation outputs** The Data Validator will evaluate the completeness of the data package, verify chain of custodies, verify sample holding times were met, verify analysis methods, review QA/QC data, and investigate anomalies. The Project Coordinator and Project Manager will summarize the data using graphs, maps, and tables, and will look for patterns, trends, and anomalies (i.e., unexpected results). Review deviations from planned activities (e.g., number and locations of samples, holding time exceedances, damaged samples, non-compliant PT sample results, and SOP deviations) and determine their impacts on the data usability. Evaluate implications of unacceptable QC sample results.
Step 3	**Document data usability and draw conclusions** Determine if the data can be used as intended, considering implications of deviations and corrective actions. Discuss data quality indicators. Assess the performance of the sampling design and identify limitations on data use. Update the conceptual site model and document conclusions. Prepare the data usability summary report which can be in the form of text and/or a table.

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TABLE 1
PARAMETERS, METHODS, AND TARGET REPORTING LIMITS
ROLLING KNOLLS LANDFILL SUPERFUND SITE
CHATHAM, NEW JERSEY

Analyte (method)	CAS Number	Sediment Minimum Screening Level (mg/kg)	Soil Minimum Screening Level (mg/kg)	Sample Matrix: Soil/Sediment: Laboratory MDL (mg/kg)	Sample Matrix: Soil/Sediment: Laboratory RL (mg/kg)	Surface Water Minimum Screening Level (µg/L)	Groundwater Minimum Screening Level (µg/L)	Sample Matrix: Water: Laboratory MDL (µg/L)	Sample Matrix: Water: Laboratory RL (µg/L)
TCL - Volatiles (SOM01.2)									
1,1,1-Trichloroethane	71-55-6	0.213	0.005	0.00023	0.005	76	30	0.22	5
1,1,2,2-Tetrachloroethane	79-34-5	0.850	0.127	0.00030	0.005	4.7	1.0	0.21	5
1,1,2-Trichloro-1,2,2-trifluoroetha	76-13-1	NA	NA	0.00027	0.005	NA	5500	0.25	5
1,1,2-Trichloroethane	79-00-5	0.518	2.0	0.00076	0.005	13	3.0	0.25	5
1,1-Dichloroethane	75-34-3	0.027	8.0	0.00027	0.005	0.29	50	0.2	5
1,1-Dichloroethene	75-35-4	0.019	8.3	0.00026	0.005	4.7	1.0	0.43	5
1,2,3-Trichlorobenzene	87-61-6	NA	20	0.00026	0.005	NA	0.70	0.57	5
1,2,4-Trichlorobenzene	120-82-1	5.1	20	0.00026	0.005	21	9.0	0.49	5
1,2-Dibromo-3-chloropropane	96-12-8	NA	0.080	0.00044	0.005	NA	0.02	0.39	5
1,2-Dibromoethane	106-93-4	NA	0.008	0.00022	0.005	NA	0.03	0.23	5
1,2-Dichlorobenzene	95-50-1	0.294	3.0	0.00023	0.005	14	600	0.17	5
1,2-Dichloroethane	107-06-2	0.260	0.90	0.00033	0.005	0.29	2.0	0.26	5
1,2-Dichloropropane	78-87-5	0.333	2.0	0.00039	0.005	0.50	1.0	0.46	5
1,3-Dichlorobenzene	541-73-1	1.3	38	0.00027	0.005	38	600	0.18	5
1,4-Dichlorobenzene	106-46-7	0.318	20	0.00033	0.005	9.4	75	0.39	5
1,4-Dioxane	123-91-1	NA	7.0	0.022	0.1	NA	0.78	11	100
2-Butanone	78-93-3	0.270	3100	0.00130	0.01	14000	300	0.84	10
2-Hexanone	591-78-6	0.022	20	0.00085	0.01	99	3.8	0.79	10
4-Methyl-2-pentanone	108-10-1	0.033	630	0.00067	0.01	170	120	0.25	10
Acetone	67-64-1	0.009	70000	0.00190	0.01	1500	6000	1.6	10
Benzene	71-43-2	0.142	0.26	0.00023	0.005	0.15	1.0	0.21	5
Bromochloromethane	74-97-5	NA	15	0.00031	0.005	NA	8.3	0.26	5
Bromodichloromethane	75-27-4	NA	0.54	0.00035	0.005	0.55	1.0	0.18	5
Bromoform	75-25-2	0.492	16	0.00024	0.005	4.3	4.0	0.13	5
Bromomethane	74-83-9	0.001	0.24	0.00070	0.005	16	10	0.95	5
Carbon Disulfide	75-15-0	NA	7800	0.00028	0.005	0.92	700	0.95	5
Carbon Tetrachloride	56-23-5	1.5	0.60	0.00020	0.005	0.33	1.0	0.14	5
Chlorobenzene	108-90-7	0.291	13	0.00028	0.005	47	50	0.29	5
Chloroethane	75-00-3	NA	220	0.00059	0.005	NA	NA	0.60	5
Chloroform	67-66-3	0.121	0.60	0.00031	0.005	68	70	0.22	5
Chloromethane	74-87-3	NA	4.0	0.00029	0.005	NA	19	0.34	5
cis-1,2-Dichloroethene	156-59-2	NA	230	0.00031	0.005	NA	70	0.30	5
cis-1,3-Dichloropropene	10061-01-5	NA	2.0	0.00027	0.005	0.34	1.0	0.22	5
Cyclohexane	110-82-7	NA	650	0.00021	0.005	NA	1300	0.25	5
Dibromochloromethane	124-48-1	NA	2.1	0.00026	0.005	0.40	1.0	0.19	5
Dichlorodifluoromethane	75-71-8	NA	490	0.00029	0.005	NA	1000	0.25	5
Ethylbenzene	100-41-4	0.175	5.2	0.00034	0.005	14	700	0.23	5
Isopropylbenzene	98-82-8	NA	NA	0.00021	0.005	NA	NA	0.24	5

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				Laboratory MDL (mg/kg)	Laboratory RL (mg/kg)			Laboratory MDL (µg/L)	Laboratory RL (µg/L)
m,p-Xylene	108-38-3 / 106-42-3	NA	NA	0.00019	0.005	NA	NA	0.26	5
Methyl Acetate	79-20-9	NA	78000	0.00028	0.005	NA	7000	0.26	5
Methyl tert-Butyl Ether	1634-04-4	NA	110	0.00027	0.005	70	70	0.27	5
Methylcyclohexane	108-87-2	NA	NA	0.00050	0.005	NA	NA	0.26	5
Methylene Chloride	75-09-2	0.159	4.1	0.00037	0.005	2.5	3.0	0.31	5
o-Xylene	95-47-6	NA	65	0.00026	0.005	NA	19	0.22	5
Styrene	100-42-5	0.254	4.7	0.00024	0.005	32	100	0.24	5
Tetrachloroethene	127-18-4	1.0	2.0	0.00024	0.005	0.34	1.0	0.31	5
Toluene	108-88-3	1.2	200	0.00025	0.005	253	600	0.27	5
trans-1,2-Dichloroethene	156-60-5	0.654	0.78	0.00026	0.005	590	100	0.54	5
trans-1,3-Dichloropropene	10061-02-6	NA	2.0	0.00024	0.005	0.34	1.0	0.21	5
Trichloroethene	79-01-6	0.112	7.0	0.00033	0.005	1.0	1.0	0.82	5
Trichlorofluoromethane	75-69-4	NA	23000	0.00037	0.005	NA	2000	0.21	5
Vinyl Chloride	75-01-4	0.202	0.65	0.00031	0.005	0.08	1.0	0.52	5
Xylenes (Total)	1330-20-7	0.433	10	NA	NA	27	1000	NA	NA
TCL - Semivolatiles (SOM01.2)									
1,1'-Biphenyl	92-52-4	1.1	3100	0.013	0.17	14	400	0.47	5
1,2,4,5-Tetrachlorobenzene	95-94-3	1.3	2.0	0.0088	0.17	0.97	0.24	1.0	5
2,2'-oxybis(1-Chloropropane)	108-60-1	NA	NA	0.011	0.17	NA	NA	0.7	5
2,3,4,6-Tetrachlorophenol	58-90-2	NA	180	0.009	0.17	NA	200	0.24	5
2,4,5-Trichlorophenol	95-95-4	NA	4.0	0.012	0.17	1800	700	0.53	5
2,4,6-Trichlorophenol	88-06-2	0.208	4.0	0.010	0.17	0.58	20	0.57	5
2,4-Dichlorophenol	120-83-2	0.082	88	0.017	0.17	11	20	0.41	5
2,4-Dimethylphenol	105-67-9	0.304	0.010	0.013	0.17	100	100	0.34	5
2,4-Dinitrophenol	51-28-5	0.006	0.061	0.016	0.33	19	40	7.4	10
2,4-Dinitrotoluene	121-14-2	0.014	0.700	0.015	0.17	0.11	10	0.36	5
2,6-Dinitrotoluene	606-20-2	NA	0.700	0.015	0.17	NA	10	0.39	5
2-Chloronaphthalene	91-58-7	0.417	0.012	0.012	0.17	0.40	600	0.40	5
2-Chlorophenol	95-57-8	0.032	0.243	0.013	0.17	24	40	0.47	5
2-Methylnaphthalene	91-57-6	NA	230	0.013	0.17	NA	3.6	0.40	5
2-Methylphenol	95-48-7	0.012	310	0.010	0.17	13	NA	0.39	5
2-Nitroaniline	88-74-4	NA	39	0.039	0.33	NA	19	2.1	10
2-Nitrophenol	88-75-5	NA	NA	0.014	0.17	NA	NA	0.39	5
3,3'-Dichlorobenzidine	91-94-1	0.127	0.646	0.031	0.17	0.02	30	0.26	5
3-Nitroaniline	99-09-2	NA	NA	0.038	0.33	NA	NA	2.3	10
4,6-Dinitro-2-methylphenol	534-52-1	NA	6.0	0.028	0.33	NA	NA	5	10
4-Bromophenyl-phenylether	101-55-3	1.2	NA	0.012	0.17	1.5	NA	0.58	5
4-Chloro-3-methylphenol	59-50-7	NA	NA	0.016	0.17	NA	NA	0.50	5

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TCL - Semivolatiles (SOM01.2) continued									
4-Chloroaniline	106-47-8	NA	2.7	0.020	0.17	NA	30	0.53	5
4-Chlorophenyl-phenylether	7005-72-3	NA	NA	0.014	0.17	NA	NA	0.44	5
3&4-Methylphenol	108-39-4 / 106-44-5	NA	31	0.013	0.17	NA	NA	0.73	5
4-Nitroaniline	100-01-6	NA	25	0.039	0.33	NA	3.8	3.9	10
4-Nitrophenol	100-02-7	0.013	NA	0.042	0.33	60	NA	4	10
Acenaphthene	83-32-9	0.007	20	0.010	0.17	38	400	0.54	5
Acenaphthylene	208-96-8	0.006	682	0.011	0.17	4840	NA	0.50	5
Acetophenone	98-86-2	NA	780	0.038	0.17	NA	700	0.67	5
Anthracene	120-12-7	0.220	1480	0.010	0.17	0.04	2000	0.51	5
Atrazine	1912-24-9	NA	210	0.016	0.17	NA	3.0	1	5
Benzaldehyde	100-52-7	NA	6100	0.027	0.17	NA	200	0.84	5
Benzo(a)anthracene	56-55-3	0.320	0.60	0.014	0.17	0.03	0.10	0.44	5
Benzo(a)pyrene	50-32-8	0.370	0.20	0.013	0.17	0.00	0.10	0.40	5
Benzo(b)fluoranthene	205-99-2	10	0.60	0.024	0.17	0.00	0.20	0.98	5
Benzo(g,h,i)perylene	191-24-2	0.170	119	0.019	0.17	7.64	NA	0.53	5
Benzo(k)fluoranthene	207-08-9	0.240	6	0.015	0.17	0.38	0.50	0.43	5
bis(2-Chloroethoxy) methane	111-91-1	NA	23	0.012	0.17	NA	5.9	0.57	5
bis(2-Chloroethyl) ether	111-44-4	3.5	0.40	0.011	0.17	0.03	7.0	0.76	5
bis-(2-Ethylhexyl)phthalate	117-81-7	0.182	0.93	0.043	0.17	0.30	3.0	2.9	5
Butylbenzylphthalate	85-68-7	2.0	0.24	0.018	0.17	23	100	1.6	5
Caprolactam	105-60-2	NA	31000	0.020	0.17	NA	990	1.5	5
Carbazole	86-74-8	NA	24	0.013	0.17	NA	NA	0.3	5
Chrysene	218-01-9	0.340	4.7	0.014	0.17	3.8	5.0	0.55	5
Dibenzo(a,h)anthracene	53-70-3	0.060	0.20	0.020	0.17	0.004	0.30	0.37	5
Dibenzofuran	132-64-9	0.420	7.2	0.012	0.17	3.7	0.79	0.38	5
Diethylphthalate	84-66-2	0.295	25	0.010	0.17	110	6000	0.37	5
Dimethylphthalate	131-11-3	NA	NA	0.012	0.17	NA	NA	0.47	5
Di-n-butylphthalate	84-74-2	1.1	0.150	0.013	0.17	9.7	700	0.38	5
Di-n-octylphthalate	117-84-0	NA	2400	0.015	0.17	708	100	0.61	5
Fluoranthene	206-44-0	0.750	122	0.014	0.17	1.9	300	0.41	5
Fluorene	86-73-7	0.190	122	0.015	0.17	19	300	0.42	5
Hexachlorobenzene	118-74-1	0.020	0.199	0.007	0.17	0.00028	0.02	0.52	5
Hexachlorobutadiene	87-68-3	0.027	0.040	0.011	0.17	0.05	1.0	0.32	5
Hexachlorocyclopentadiene	77-47-4	0.901	0.755	0.018	0.17	40	40	0.45	5
Hexachloroethane	67-72-1	0.584	0.596	0.007	0.17	1.4	7.0	0.36	5
Indeno(1,2,3-cd)pyrene	193-39-5	0.200	0.600	0.018	0.17	0.04	0.20	0.65	5
Isophorone	78-59-1	0.432	139	0.010	0.17	35	40	0.46	5

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TCL - Semivolatiles (SOM01.2) continued									
Naphthalene	91-20-3	0.176	0.099	0.011	0.17	13	300	0.44	5
Nitrobenzene	98-95-3	0.145	1.3	0.014	0.17	17	6	0.69	5
N-Nitroso-di-n-propylamine	86-30-6	NA	0.200	0.022	0.17	0.01	10	0.64	5
N-Nitrosodiphenylamine	621-64-7	NA	0.545	0.013	0.17	3.30	10	0.57	5
Pentachlorophenol	87-86-5	23	0.119	0.022	0.33	0.27	0.30	3.2	10
Phenanthrene	85-01-8	0.560	45.7	0.013	0.17	3.6	NA	0.43	5
Phenol	108-95-2	0.049	30.0	0.014	0.17	180	2000	0.61	5
Pyrene	129-00-0	0.490	78.5	0.023	0.17	0.30	200	0.38	5
Semivolatiles-SIM (SOM01.2)									
2-Methylnaphthalene	91-57-6	NA	230	0.00021	0.0033	NA	3.6	0.40	0.10
Acenaphthene	83-32-9	0.007	20	0.00017	0.0033	38	400	0.54	0.10
Acenaphthylene	208-96-8	0.006	682	0.00056	0.0033	4840	NA	0.50	0.10
Anthracene	120-12-7	0.220	1480	0.00011	0.0033	0.035	2000	0.51	0.10
Benzo(a)anthracene	56-55-3	0.320	0.600	0.00025	0.0033	0.025	0.10	0.44	0.10
Benzo(a)pyrene	50-32-8	0.370	0.200	0.00029	0.0033	0.0038	0.10	0.40	0.10
Benzo(b)fluoranthene	205-99-2	10	0.600	0.00017	0.0033	0.0038	0.20	0.98	0.10
Benzo(g,h,i)perylene	191-24-2	0.170	119.0	0.00021	0.0033	7.64	NA	0.53	0.10
Benzo(k)fluoranthene	207-08-9	0.240	6.0	0.00021	0.0033	0.38	0.50	0.43	0.10
Chrysene	218-01-9	0.340	4.7	0.00017	0.0033	3.8	5.0	0.55	0.10
Dibenzo(a,h)anthracene	53-70-3	0.060	0.200	0.00022	0.0033	0.0038	0.30	0.37	0.10
Fluoranthene	206-44-0	0.750	122	0.00027	0.0033	1.9	300	0.41	0.10
Fluorene	86-73-7	0.190	122	0.00015	0.0033	19	300	0.42	0.10
Indeno(1,2,3-cd)pyrene	193-39-5	0.200	0.600	0.00021	0.0033	0.038	0.20	0.65	0.10
Naphthalene	91-20-3	0.176	0.099	0.00044	0.0033	13	300	0.44	0.10
Pentachlorophenol	87-86-5	23	0.119	0.00190	0.0067	0.27	0.30	3.2	0.20
Phenanthrene	85-01-8	0.560	45.7	0.00020	0.0033	3.6	NA	0.43	0.10
Pyrene	129-00-0	0.490	78.5	0.00021	0.0033	0.30	200	0.38	0.10
TCL - PCB/Pesticides (SOM01.2)									
2,4'-DDD	53-19-0	NA	NA	NA	0.0033	NA	NA	NA	0.10
2,4'-DDE	3424-82-6	NA	NA	NA	0.0033	NA	NA	NA	0.10
2,4'-DDT	789-02-6	NA	NA	NA	0.0033	NA	NA	NA	0.10
4,4'-DDD	72-54-8	0.008	0.758	0.0001	0.0033	0.0003	0.10	0.027	0.10
4,4'-DDE	72-55-9	0.005	0.596	0.0001	0.0033	0.0002	0.10	0.03	0.10
4,4'-DDT	50-29-3	0.008	0.004	0.0001	0.0033	0.0002	0.10	0.019	0.10
Aldrin	309-00-2	0.002	0.003	0.0001	0.0017	0.0000	0.04	0.023	0.05
alpha-BHC	319-84-6	0.006	0.099	0.0001	0.0017	0.0026	0.02	0.011	0.05
alpha-Chlordane	5103-71-9	NA	NA	0.0001	0.0017	NA	NA	0.016	0.05
beta-BHC	319-85-7	0.005	0.004	0.0001	0.0017	0.009	0.04	0.011	0.05

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TCL - PCB/Pesticides (SOM01.2) continued									
delta-BHC	319-86-8	NA	NA	0.0000	0.0017	2.20	NA	0.0089	0.05
Dieldrin	60-57-1	0.002	0.002	0.0001	0.0033	0.00005	0.03	0.023	0.10
Endosulfan I	959-8-8	0.006	470	0.0002	0.0017	0.05	40	0.0099	0.05
Endosulfan II	33213-65-9	0.006	470	0.0001	0.0033	0.05	40	0.01	0.10
Endosulfan sulfate	1031-07-8	0.035	0.036	0.0001	0.0033	2.22	40	0.01	0.10
Endrin	72-20-8	0.003	0.010	0.0001	0.0033	0.036	2.0	0.02	0.10
Endrin aldehyde	7421-93-4	0.480	0.011	0.0001	0.0033	0.059	NA	0.03	0.10
Endrin ketone	53494-70-5	NA	NA	0.0001	0.0033	NA	NA	0.016	0.10
gamma-BHC (Lindane)	58-89-9	0.003	0.005	0.0000	0.0017	0.026	0.03	0.011	0.05
gamma-Chlordane	5103-74-2	NA	NA	0.0002	0.0017	NA	NA	0.018	0.05
Heptachlor	76-44-8	0.001	0.006	0.0001	0.0017	0.000079	0.05	0.015	0.05
Heptachlor epoxide	1024-57-3	0.005	0.070	0.0001	0.0017	0.000039	0.20	0.015	0.05
Methoxychlor	72-43-5	0.014	0.020	0.0005	0.017	0.03	40	0.068	0.50
Toxaphene	8001-35-2	0.000	0.119	0.0083	0.17	0.0002	2.0	5.0	5.0
Aroclor-1016	12674-11-2	0.007	0.400	0.0015	0.031	NA	0.14	0.14	1.0
Aroclor-1221	11104-28-2	0.120	0.150	0.0048	0.042	0.28	0.0046	0.11	1.0
Aroclor-1232	11141-16-5	0.600	0.150	0.0007	0.031	0.58	0.0046	0.14	1.0
Aroclor-1242	53469-21-9	0.170	0.240	0.0010	0.033	0.053	0.039	0.11	1.0
Aroclor-1248	12672-29-6	0.030	0.240	0.0012	0.021	0.081	0.039	0.25	1.0
Aroclor-1254	11097-69-1	0.060	0.110	0.0015	0.033	0.033	0.039	0.1	1.0
Aroclor-1260	11096-82-5	0.005	0.240	0.0009	0.031	94	0.039	0.098	1.0
Aroclor-1262	37324-23-5	NA	NA	0.0011	0.031	NA	NA	0.12	1.0
Aroclor-1268	11100-14-4	NA	NA	0.0016	0.031	NA	NA	0.11	1.0
PCBs (EPA 1668a)**									
2',3,4,4',5-PeCB (PCB-123)	65510-44-3	NA	0.120	NA	0.000002	NA	0.02	NA	0.00002
2,3',4,4',5-PeCB (PCB-118)	31508-00-6	NA	0.120	NA	0.000002	NA	0.02	NA	0.00002
2,3,4,4',5-PeCB (PCB-114)	74472-37-0	NA	0.120	NA	0.000002	NA	0.02	NA	0.00002
2,3,3',4,4'-PeCB (PCB-105)	32598-14-4	NA	0.120	NA	0.000002	NA	0.02	NA	0.00002
3,3',4,4',5-PeCB (PCB-126)	57465-28-8	NA	0.000037	NA	0.000002	NA	0.000014	NA	0.00002
2,3',4,4',5,5'-HxCB (PCB-167)	52663-72-6	NA	0.120	NA	0.000002	NA	0.02	NA	0.00002
2,3,3',4,4',5-HxCB (PCB-156)	38380-08-4	NA	0.120	NA	0.000004	NA	0.02	NA	0.00004
2,3,3',4,4',5'-HxCB (PCB-157)	69782-90-7	NA	0.120	NA	0.000004	NA	0.02	NA	0.00004
3,3',4,4',5,5'-HxCB (PCB-169)	32774-16-6	NA	0.00012	NA	0.000002	NA	0.00002	NA	0.00002
2,3,3',4,4',5,5'-HpCB (PCB-189)	39635-31-9	NA	NA	NA	0.000002	NA	0.02	NA	0.00002

TABLE 1
PARAMETERS, METHODS, AND TARGET REPORTING LIMITS
ROLLING KNOLLS LANDFILL SUPERFUND SITE
CHATHAM, NEW JERSEY

Analyte (method)	CAS Number	Sediment Minimum Screening Level (mg/kg)	Soil Minimum Screening Level (mg/kg)	Sample Matrix: Soil/Sediment: Laboratory MDL (mg/kg)	Sample Matrix: Soil/Sediment: Laboratory RL (mg/kg)	Surface Water Minimum Screening Level (µg/L)	Groundwater Minimum Screening Level (µg/L)	Sample Matrix: Water: Laboratory MDL (µg/L)	Sample Matrix: Water: Laboratory RL (µg/L)
Dioxins by 1613									
2,3,7,8-TCDD	1746-01-6	0.00000012	0.0000002	NA	0.000001	0.000000003	0.00001	NA	0.00001
Total TCDD	--	NA	NA	NA	0.000001	NA	NA	NA	0.00001
2,3,7,8-TCDF	51207-31-9	NA	NA	NA	0.000001	NA	NA	NA	0.00001
Total TCDF	--	NA	NA	NA	0.000001	NA	NA	NA	0.00001
1,2,3,7,8-PeCDD	40321-76-4	NA	NA	NA	0.000005	NA	NA	NA	0.00005
Total PeCDD	--	NA	NA	NA	0.000005	NA	NA	NA	0.00005
1,2,3,7,8-PeCDF	57117-41-6	NA	NA	NA	0.000005	NA	NA	NA	0.00005
2,3,4,7,8-PeCDF	57117-31-4	NA	NA	NA	0.000005	NA	NA	NA	0.00005
Total PeCDF	--	NA	NA	NA	0.000005	NA	NA	NA	0.00005
1,2,3,4,7,8-HxCDD	39227-28-6	NA	NA	NA	0.000005	NA	NA	NA	0.00005
1,2,3,6,7,8-HxCDD	57653-85-7	NA	NA	NA	0.000005	NA	NA	NA	0.00005
1,2,3,7,8,9-HxCDD	19408-74-3	NA	NA	NA	0.000005	NA	NA	NA	0.00005
Total HxCDD	--	NA	NA	NA	0.000005	NA	NA	NA	0.00005
1,2,3,4,7,8-HxCDF	70648-26-9	NA	NA	NA	0.000005	NA	NA	NA	0.00005
1,2,3,6,7,8-HxCDF	57117-44-9	NA	NA	NA	0.000005	NA	NA	NA	0.00005
1,2,3,7,8,9-HxCDF	72918-21-9	NA	NA	NA	0.000005	NA	NA	NA	0.00005
2,3,4,6,7,8-HxCDF	60851-34-5	NA	NA	NA	0.000005	NA	NA	NA	0.00005
Total HxCDF	--	NA	NA	NA	0.000005	NA	NA	NA	0.00005
1,2,3,4,6,7,8-HpCDD	35822-46-9	NA	NA	NA	0.000005	NA	NA	NA	0.00005
Total HpCDD	--	NA	NA	NA	0.000005	NA	NA	NA	0.00005
1,2,3,4,6,7,8-HpCDF	67562-39-4	NA	NA	NA	0.000005	NA	NA	NA	0.00005
1,2,3,4,7,8,9-HpCDF	55673-89-7	NA	NA	NA	0.000005	NA	NA	NA	0.00005
Total HpCDF	--	NA	NA	NA	0.000005	NA	NA	NA	0.00005
OCDD	3268-87-9	NA	NA	NA	0.000010	NA	NA	NA	0.0001
OCDF	39001-02-0	NA	NA	NA	0.000010	NA	NA	NA	0.0001
TAL - Metals (ISM01.3)									
Aluminum	7429-90-5	58030	50	2.0	20	87	200	27.2	200
Antimony	7440-36-0	12	5.0	0.23	6	5.6	6.0	3.3	60
Arsenic	7440-38-2	6	9.9	0.24	1	0.017	3.0	1.8	10
Barium	7440-39-3	NA	283	0.44	20	220	6000	1.8	200
Beryllium	7440-41-7	NA	10	0.013	0.5	3.6	1.0	0.050	5.0
Cadmium	7440-43-9	0.60	0.360	0.029	0.5	3.4	4.0	0.27	5.0
Calcium	7440-70-2	NA	NA	4.2	500	NA	NA	66.2	5000
Chromium	7440-47-3	26	0.40	0.039	1	42	70	0.26	10
Cobalt	7440-48-4	50	0.14	0.046	5	24	100	0.66	50
Copper	7440-50-8	16	5.4	0.25	2.5	1300	1300	2.5	25
Iron	7439-89-6	NA	5500	1.5	10	158	300	10.1	100
Lead	7439-92-1	31	11	0.35	1	5.0	5.0	1.3	10

TABLE 1
PARAMETERS, METHODS, AND TARGET REPORTING LIMITS
ROLLING KNOLLS LANDFILL SUPERFUND SITE
CHATHAM, NEW JERSEY

Analyte (method)	CAS Number	Sediment Minimum Screening Level (mg/kg)	Soil Minimum Screening Level (mg/kg)	Sample Matrix: Soil/Sediment: Laboratory MDL (mg/kg)	Sample Matrix: Soil/Sediment: Laboratory RL (mg/kg)	Surface Water Minimum Screening Level (µg/L)	Groundwater Minimum Screening Level (µg/L)	Sample Matrix: Water: Laboratory MDL (µg/L)	Sample Matrix: Water: Laboratory RL (µg/L)
TAL - Metals (ISM01.3) continued									
Magnesium	7439-95-4	NA	NA	3.0	500	NA	NA	50.8	5000
Manganese	7439-96-5	630	220	0.049	1.5	120	50	0.15	15
Mercury	7439-97-6	0.20	0.0005	0.024	0.1	0.05	2.0	1.2	0.20
Nickel	7440-02-0	16	13.6	0.098	4	500	100	89.1	40
Potassium	7440-09-7	NA	NA	7.3	500	NA	NA	3.5	5000
Selenium	7782-49-2	NA	0.210	0.45	3.5	5.0	40	0.57	35
Silver	7440-22-4	0.50	2.0	0.057	1	0.12	40	22.6	10
Sodium	7440-23-5	NA	NA	2.5	500	NA	50000	1.9	5000
Thallium	7440-28-0	NA	1.0	0.32	2.5	0.24	2.0	0.63	25
Vanadium	7440-62-2	NA	2.0	0.055	5	12	10	0.38	50
Zinc	7440-66-6	120	8.5	0.068	6	7400	2000	0.036	60
Cyanide	57-12-5	0.0001	1.3	0.16	2.5	5.2	100	2.06	10
Low Level Mercury by 1631									
Mercury	7439-97-6	0.20	0.0005	NA	NA	0.05	2.0	0.0002	0.0005

Notes:

Minimum screening levels for the respective medium were derived from the following EBSLs and human health criteria, in the following order:

Sediment: NJDEP Ecological Screening Criteria; ORNL Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Sediment-Associated Biota (Jones et al. 1997).

Soil: NJDEP Ecological Screening Criteria or NJ Soil Remediation Standards; USEPA (2014) Regional Screening Level (RSL) Residential Soil (Cancer Risk = $1x10^{-6}$; NonCancer Hazard = 0.1).

Surface Water: NJ GWQC (Freshwater Chronic or Human Health Criteria); ORNL Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota (Suter and Tsao 1996).

Groundwater: NJDEP Groundwater Qualtiy Standards N.J.A.C. 7:9C; USEPA (2014) Regional Screening Level (RSL) Tapwater (Cancer Risk = $1x10^{-6}$; NonCancer Hazard = 0.1).

Additional screening levels may be included based on site characterization information.

** Only congeners with a screening value available were presented; however, all 209 congeners will be analyzed and reported.

µg/L - micrograms per liter
EBSL - Ecologically-Based Screening Level
MDL - Method Detection Limit
mg/kg - milligrams per kilogram
NA - Not Available
NJDEP - New Jersey Department of Environmental Protection
NJ GWQC - New Jersey Groundwater Quality Criteria
ORNL - Oak Ridge National Laboratory
PCB - Polychlorinated Biphenyl
RL - Reporting Limit
TAL - Target Analyte List
TCL - Target Compound List

Appendix A

Standard Operating Procedures

This appendix is included in the electronic copy of the document.

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Water Level Measurement

Rev. #: 2

Rev Date: February 24, 2011

Approval Signatures

Prepared by: _____ Date: 02/24/2011

Reviewed by: _____ Date: 02/24/2011
(Technical Expert)

I. Scope and Application

The objective of this Standard Operating Procedure (SOP) is to describe procedures to measure and record groundwater and surface-water elevations. Water levels may be measured using an electronic water-level probe, oil-water level indicator, or a pressure transducer from established reference points (e.g. top of casing). Reference points will be surveyed to evaluate fluid elevations relative to mean sea level (msl). This SOP describes the equipment, field procedures, materials, and documentation procedures to measure and record groundwater and surface-water elevations using the aforementioned equipment.

This is a standard (i.e., typically applicable) operating procedure which may be varied or changed as required, dependent upon site conditions, equipment limitations, or limitations imposed by the procedure. The ultimate procedure employed will be documented in the project work plans or reports.

II. Personnel Qualifications

ARCADIS field sampling personnel will have current health and safety training including 40-hour HAZWOPER training, site supervisor training, site-specific training, first aid, and CPR, as needed. In addition, ARCADIS field sampling personnel will be versed in the relevant SOPs and posses the required skills and experience necessary to successfully complete the desired field work.

III. Equipment List

The following materials, as required, shall be available during water level measurements:

- Appropriate personal protective equipment as specified in the Site Health and Safety Plan
- Equipment decontamination supplies
- Electronic water-level indicator
- Electronic oil-water level indicator
- Mini-Troll® or Troll® pressure transducer
- In-Situ™ data logger

- Laptop computer with the Win-Situ software package installed
- Photoionization detector (PID) and/or organic vapor analyzer
- Non-phosphate laboratory soap (Alconox or equivalent)
- Deionized/distilled water
- 150-foot measuring tape
- Solvent (methanol/acetone) rinse
- Portable containers
- Hacksaw
- Pliers
- Plastic sheeting
- “Write-in-the-Rain” Field logbook and or PDA (Personal Digital Assistant)
- Indelible ink pen.

IV. Cautions

Electronic water-level probes and oil-water interface probes can sometimes produce false-positive readings. For example, if the inside surface of the well has condensation above the water level, then an electronic water-level probe may produce a signal by contacting the side of the well rather than the true water level in the well. To produce reliable data, the electronic water level probe and/or interface probe should be raised and lowered several times at the approximate depth where the instrument produces a tone indicating a fluid interface to verify consistent, repeatable results.

The graduated tape or cable with depth markings is designed to indicate the depth of the electronic sensor that detects the fluid interface, but not the depth of the bottom of the instrument. When using these devices to measure the total well depth, the additional length of the instrument below the electronic sensor must be added to the apparent well depth reading, as observed on the tape or cable of the instrument, to obtain the true total depth of the well. If the depth markings on the tape or cable are

worn or otherwise difficult to read, extra care must be taken in obtaining the depth readings.

V. Health and Safety Considerations

The HASP will be followed, as appropriate, to ensure the safety of field personnel. Access to wells may expose field personnel to hazardous materials such as contaminated groundwater or oil. Other potential hazards include stinging insects that may inhabit well heads, other biologic hazards, and potentially the use of sharp cutting tools (scissors, knife). Appropriate personal protective equipment (PPE) will be worn during these activities. Field personnel will thoroughly review client-specific health and safety requirements, which may preclude the use of fixed/folding-blade knives.

VI. Procedure

Electronic Water-Level Indicators and Oil-Water Indicators

Calibration procedures and groundwater level measurement procedures for electronic water-level indicators and oil-water indicators are described in the sections below.

Calibration Procedures

The indicator probe will be tested to verify that the meter has been correctly calibrated by the manufacturer. The following steps will be used to verify the accuracy of the indicator:

1. Measure the lengths between each increment marker on the indicator with a measuring tape. The appropriate length of indicator measuring tape, suitable to cover the depth range for the wells of interest, will be checked for accuracy.

2. If the indicator measuring tape is inaccurate, the probe will be sent back to the manufacturer.

3. Equipment calibration will be recorded in the field logbook and/or PDA.

Groundwater Level Measurement Procedures

A detailed procedure for obtaining water elevations will be as follows:

1. Identify site and monitoring well number in field notebook along with date, time, personnel and weather conditions using indelible ink.

2. Use safety equipment as specified in the Health and Safety Plan.

3. Decontaminate the indicator probe and tape in accordance with the appropriate cleaning procedures.

4. Place clean plastic sheeting on the ground next to the well.

5. Unlock and open the monitoring well cover while standing upwind from the well.

6. Measure the volatile organics present in the monitoring well head space with a PID and record the PID reading in the field logbook.

7. Allow the water level in the well to equilibrate with atmospheric pressure for a few minutes. Locate a measuring reference point on the monitoring well casing. If one is not found, create a reference point by notching the highest point on the inner casing (or outer if an inner casing is not present) with a hacksaw. All downhole measurements will be taken from the reference point. Document the creation of any new reference point or alteration of the existing reference point.

8. Measure to the nearest 0.01 foot and record the height of the inner and outer casing from reference point to ground level.

9. Slowly lower the level indicator probe until it touches the bottom of the well. Record the total depth of the well from the top of the inner casing (or outer casing if inner casing is not present). Measure depth to water level as the probe is drawn back up through the water column. If used to measure the level of surface water, slowly lower from the surveyed reference point, as appropriate. Double check all measurements and record depths to the nearest 0.01 foot.

10. Decontaminate the instrument using appropriate cleaning procedures.

11. Lock the well when all activities are completed.

Pressure Transducers

The detailed procedure for obtaining water elevations using a Mini-Troll® or Troll® pressure transducer with an In-Situ™ data logger and the Win-Situ software package will be as follows:

<u>Setup Procedures</u>

1. Connect the Mini-Troll® or Troll® transducer to a laptop computer serial port.

2. Open the Win-Situ software package on the laptop computer.

3. Verify that the Win-Situ software recognizes the transducer.

4. Synchronize the clock on the laptop computer with that of the transducer.

5. Add a test to the transducer and input the specifications of the test (e.g., frequency of data collection, start data collection).

6. Disconnect the transducer from the laptop computer, and prepare the transducer for field deployment.

Field Procedures

1. Decontaminate all equipment entering the monitoring well using appropriate cleaning procedures.

2. Connect transducer to laptop computer, and start the Win-Situ program.

3. Lower the transducer gently below the water table or surface-water level.

4. Take a water level reading from the transducer using the Win-Situ software package. Lift the transducer approximately 1-foot, and verify the transducer response on the Win-Situ program (i.e. depth to water should be 1-foot less).

5. Upon verification, set the transducer to the desired depth. Position the instrument below the lowest anticipated water level, but not so low that its range will be exceeded at the highest anticipated water level. The maximum operating depth below water is equal to 2.31 feet times the psi rating of the transducer (e.g., 23.1 feet for a 10 psi transducer).

6. Secure the cable at the well head or fixed object adjacent to surface-water body to prevent drift and movement.

7. Obtain a manual water-level reading using the procedure noted above, and record the measurement in the field notebook or PDA.

8. Set reference point (e.g. depth to water, groundwater elevation) and input it into the Win-Situ software package.

9. Periodically download data and collect additional manual depth-to-water measurements using the same water-level or oil-water indicator probe used during the equipment setup to verify the accuracy of the transducer.

VII. Waste Management

Decontamination fluids, PPE, and other disposable equipment will be properly stored on site in labeled containers and disposed of properly. Be certain that waste containers are properly labeled and documented in the field log book. Review appropriate waste management SOPs, which may be state- or client-specific.

VIII. Data Recording and Management

Groundwater level measurements should be documented in the field logbook and/or PDA. The following information will be documented in the field logbook:

- Sample identification
- Measurement time
- Total well depth
- Depth to water

Groundwater elevations recorded using a Mini-Troll® or Troll® pressure transducer with an In-Situ™ data logger and the Win-Situ software package will be downloaded and stored in the central project file.

IX. Quality Assurance

As described in the detailed procedure, the electronic water-level meter and/or oil-water interface probe will be calibrated prior to use versus an engineer's rule to ensure accurate length demarcations on the tape or cable. Fluid interface measurements will be verified by gently raising and lowering the instrument through each interface to confirm repeatable results.

X. References

No literature references are required for this SOP.

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Investigation-Derived Waste Handling and Storage

Rev. #: 2

Rev Date: March 6, 2009

Approval Signatures

Prepared by: Andrew Kamik Date: 3/6/09

Reviewed by: Liz Marsh Date: 3/6/09
(Technical Expert)

I. Scope and Application

The objective of this Standard Operating Procedure (SOP) is to describe the procedures to manage investigation-derived wastes (IDW), both hazardous and non-hazardous, generated during site activities, which may include, but are not limited to - drilling, trenching/excavation, construction, demolition, monitoring well sampling, soil sampling, decontamination and remediation. Please note that this SOP is intended for materials that have been deemed a solid waste as defined by 40 CFR § 261.2 (which may includes liquids, solids, and sludges). In some cases, field determinations will be made based on field screening or previous data that materials are not considered a solid waste. IDW may include soil, groundwater, drilling fluids, decontamination liquids, personal protective equipment (PPE), sorbent materials, construction and demolition debris, and disposable sampling materials that may have come in contact with potentially impacted materials. IDW will be collected and staged at the point of generation. Quantities small enough to be containerized in 55-gallon drums will be taken to a designated temporary storage area (discussed in further detail under Drum Storage) onsite pending characterization and disposal. Waste materials will be analyzed for constituents of concern to evaluate proper disposal methods. PPE and disposable sampling equipment will be placed in DOT-approved drums prior to disposal and typically does not require laboratory analysis. This SOP describes the necessary equipment, field procedures, materials, regulatory references, and documentation procedures necessary for proper handling and storage of IDW up to the time it is properly disposed. The procedures for handling IDW are based on the United States Environmental Protection Agency's Guide to Management of Investigation Derived Wastes (USEPA, 1992). IDW is assumed to be contaminated with the site constituents of concern (COCs) until analytical evidence indicates otherwise. IDW will be managed to ensure the protection of human health and the environment and will comply with all applicable or relevant and appropriate requirements (ARAR). The following Laws and Regulations on Hazardous Waste Management are potential ARAR for this site.

State Laws and Regulations

- To Be Determined Based on Location of Site and Location of Treatment, Storage, and/or Disposal Facility (TSDF) to be utilized

Federal Laws and Regulations

- Resource Conservation and Recovery Act (RCRA) 42 USC § 6901-6987
- Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) 42 USC § 9601-9675

- Superfund Amendments and Reauthorization Act (SARA)
- Department of Transportation (DOT) Hazardous Materials Transportation

Pending characterization, IDW will be stored appropriately within each area of contamination (AOC). Under RCRA, “storage” is defined as the holding of hazardous waste for a temporary period, at the end of which the hazardous waste is treated, disposed of, or stored elsewhere” (40 CFR § 260.10). The onsite waste staging area will be in a secure and controlled area. Waste characterization can either be based on generator knowledge, such as using materials safety data sheets (MSDS’), or can be based upon analytical results. The laboratory used for waste characterization analysis must have the appropriate state and federal certifications and be approved by ARCADIS and Client. IDW will be classified as RCRA hazardous or non-regulated under RCRA based on the waste characterization.

If IDW is characterized as RCRA hazardous waste, RCRA and DOT requirements must be followed for packaging, labeling, transporting, storing, and record keeping as described in 40 CFR § 262 and 49 CFR § 171-178. Wastes judged to potentially meet the criteria for hazardous wastes shall be stored in DOT approved packaging. Waste material classified as RCRA non-hazardous may be handled and disposed of as an industrial waste.

Liquid wastes judged to potentially meet the criteria for hazardous wastes shall be stored in DOT approved 55 gallon drums or other approved containers that are compatible with the type of material stored therein. Solid materials deemed to potentially meet hazardous criteria will be drummed where practicable. Large quantities of potentially hazardous solid materials must be containerized (such as in a roll-off box) for up to a maximum of 90 or 180 days as described in the Excavated Solids Section. Waste material classified as non-hazardous may be handled and disposed of as an industrial waste and is not subject to the 90-day or 180-day on-site storage limitation.

This is a standard (i.e., typically applicable) operating procedure which may be varied or changed as required, dependent upon site conditions, equipment limitations, or limitations imposed by the procedure. The ultimate procedure employed will be documented in the project work plans or reports. If changes to the sampling procedures are required due to unanticipated field conditions, the changes will be discussed with the Project Manager and Client as soon as practicable and documented in the report.

II. Personnel Qualifications

ARCADIS field sampling personnel will have current health and safety training including 40-hour HAZWOPER training, site supervisor training, site-specific training, first aid, and CPR, as needed. ARCADIS personnel may sign manifests on a case-to-case basis for clients, provided the appropriate agreement is in place between ARCADIS and the client documenting that ARCADIS is not the generator, but is acting as authorized representative for the generator. ARCADIS personnel who sign hazardous waste manifests will have the current DOT hazardous materials transportation training according to 49 CFR § 172.704. ARCADIS field personnel will also comply with client-specific training such as LPS. In addition, ARCADIS field sampling personnel will be versed in the relevant SOPs and posses the required skills and experience necessary to successfully complete the desired field work.

III. Equipment List

The following materials, as required, shall be available for IDW handling and storage:

Appropriate personal protective equipment as specified in the Site Health and Safety Plan

- 55-gallon steel drums, DOT 1A2 or equivalent
- ¾ -inch socket wrench
- Hammer
- Leather gloves
- Drum dolly
- Appropriate drum labels (outdoor waterproof self adhesive)
- Polyethylene storage tank
- Appropriate labeling, packing, chain-of-custody forms, and shipping materials as specified in the *Chain-of-Custody* SOP and *Field Sampling Handling, Packing, and Shipping* SOP.
- Indelible ink and/or permanent marking pens
- Plastic sheeting

- Appropriate sample containers, labels, and forms
- Stainless-steel bucket auger
- Stainless steel spatula or knife
- Stainless steel hand spade
- Stainless steel scoop
- Digital camera
- Field logbook.

IV. Cautions

- Filled drums can be very heavy, always use appropriate moving techniques and equipment.
- Similar media will be stored in the same drums to aid in sample analysis and disposal.
- Drum lids must be secured to prevent rainwater from entering the drums.
- Drums containing solid material may not contain any free liquids.
- Waste containers stored for extended periods of time may be subject to deterioration. Drum over packs may be used as secondary containment.
- All drums must be in good condition to prevent potential leakage and facilitate subsequent disposal. Inspect the drums for dents and rust, and verify the drum has a secure lid prior to use.

V. Health and Safety Considerations

- Appropriate personal protective equipment must be worn by all field personnel within the designated work area.
- Air monitoring may be required during certain field activities as required in the Site Health and Safety Plan.

- If excavating in potentially hazardous areas is possible, contingency plans should be developed to address the potential for encountering gross contamination or non-aqueous phase liquids.

- ARCADIS field personnel will be familiar and compliant with Client-specific health and safety requirements such as Chevron's hand safety policy including the prohibition of fixed and/or folding blade knives.

VI. Procedure

Waste storage and handling procedures to be used depend upon the type of generated waste. For this reason, IDW should be stored in a secure location onsite in separate 55-gallon storage drums, solids can be stockpiled onsite (if non-hazardous), and purge water may be stored in polyethylene tanks. Waste materials such as broken sample bottles or equipment containers and wrappings will be stored in 55-gallon drums unless they were not in contact with sample media.

Management of IDW

Minimization of IDW should be considered by the Project Manager during all phases of the project. Site managers may want to consider techniques such as replacing solvent-based cleaners with aqueous-based cleaners for decontamination of equipment, reuse of equipment (where it can be decontaminated), limitation of traffic between exclusion and support zones, and drilling methods and sampling techniques that generate little waste. Alternative drilling and subsurface sampling methods may include the use of small diameter boreholes, as well as borehole testing methods such as a core penetrometer or direct push technique instead of coring (EPA, 1993).

Drum Storage

Drums containing hazardous waste shall be stored in accordance with the requirements of 40 CFR 265 Subpart I (for containers) and 265 Subpart DD (for containment buildings). All 55-gallon drums will be stored at a secure, centralized on-site location that is readily accessible for vehicular pick-up. Drums confirmed as, or believed to contain hazardous waste will be stored over an impervious surface provided with secondary containment. The storage location will, for drums containing liquid, have a containment system that can contain at least the larger of 10% of the aggregate volume of staged materials or 100% of the volume of the largest container. Drums will be closed during storage and be in good condition in accordance with the Guide to Management of Investigation-Derived Wastes (USEPA, 1992).

Hazardous Waste Determination

Waste material must be characterized to determine if it meets any of the federal definitions of hazardous waste as required by 40 CFR § 262.11. If the waste does not meet any of the federal definitions, it must then be established if any state-specific hazardous waste criteria exist/apply.

Generator Status

Once hazardous waste determination has been made, the generator status will be determined. Large quantity generators (LQG) are generators who generate more than 1,000 kilograms of hazardous waste in a calendar month. Small quantity generators (SQG) of hazardous waste are generators who generate greater than 100 kilograms but less than 1,000 kilograms of hazardous waste in a calendar month. Conditionally exempt small quantity generators (CESQG) are generators who generate less than 100 kilograms of hazardous waste per month. Please note that a generator status may change from month to month and that a notice of this change is usually required by the generator's state agency.

Accumulation Time for Hazardous Waste

A LQG may accumulate hazardous waste on site for 90 days or less without a permit and without having interim status provided that such accumulation is in compliance with specifications in 40 CFR § 262.34. A SQG may accumulate hazardous waste on site for 180 days or less without a permit or without having interim status subject to the requirements of 40 CFR § 262.34(d). CESQG requirements are found in 40 CFR § 261.5. **NOTE**: The CESQG and SQG provisions of 40 CFR § 261.5, 262.20(e), 262.42(b) and 262.44 may not be recognized by some states (e.g. Rhode Island). **State-specific regulations must be reviewed and understood prior to the generation of hazardous waste.**

<u>Satellite Accumulation of Hazardous Waste</u>

Satellite accumulation (SAA) shall mean the accumulation of as much as fifty-five (55) gallons of hazardous waste, or the accumulation of as much as one quart of acutely hazardous waste, in containers at or near any point of generation where the waste initially accumulates, which is under the control of the operator of the process generating the waste, without a permit or interim status and without complying with the requirements of 40 CFR § 262.34(a) and without any storage time limit, provided that the generator complies with 40 CFR § 262.34(c)(1)(i).

Once more than 55 gallons of hazardous waste accumulates in SAA, the generator has three days to move this waste into storage.

Storage recommendations for hazardous waste include:

- Ignitable Hazardous wastes must be >50 feet from the property line per 40 CFR § 265.176 (LQG generators only).
- Hazardous waste must be stored on a concrete slab (asphalt is acceptable if there are no free liquids in the waste) per 40 CFR § 265.176.
- Drainage must be directed away from the accumulation area.
- Area must be properly vented.
- Area must be secure.

Drum/Container Labeling

Drums will be labeled on both the side and lid of the drum using a permanent marking pen. Old drum labels must be removed to the extent possible, descriptions crossed out should any information remain, and new labels affixed on top of the old labels. Other containers used to store various types of waste (polyethylene tanks, roll-off boxes, end-dump trailers, etc.) will be labeled with an appropriate "Waste Container" or “Testing in Progress” label pending characterization. Drums and containers will be labeled as follows:

- Appropriate waste characterization label (Testing In Progress, Hazardous, or Non-Hazardous)
- Waste generator's name (e.g., client name)
- Project name
- Name and telephone number of ARCADIS project manager
- Composition of contents (e.g., used oil, acetone 40%, toluene 60%)
- Media (e.g., solid, liquid)
- Accumulation start date

- Drum number of total drums as reconciled with the Drum Inventory maintained in the field log book.

IDW containers will remain closed except when adding or removing waste. Immediately upon beginning to place waste into the drum/container, a “Waste Container” or “Testing in Progress” label will be filled out to include the information specified above, and affixed to the container. Once the contents of the container are identified as either non-hazardous or hazardous, the following additional labels will be applied. Containers with waste determined to be non-hazardous will be labeled with a green and white "Non-Hazardous Waste" label over the "Waste Container" label. Containers with waste determined to be hazardous will be stored in an onsite storage area and will be labeled with the "Hazardous Waste" label and affixed over the "Waste Container" label. The ACCUMULATION DATE for the hazardous waste is the date the waste is first placed in the container and is the same date as the date on the "Waste Container" label. DOT hazardous class labels must be applied to all hazardous waste containers for shipment offsite to an approved disposal or recycling facility. In addition a DOT proper shipping name shall be included on the hazardous waste label. The transporter should be equipped with the appropriate DOT placards. However, placarding or offering placards to the initial transporter is the responsibility of the generator per 40 CFR § 262.33.

Inspections and Documentation

All IDW will be documented as generated on a Drum Inventory Log maintained in the field log book. The Drum Inventory will record the generation date, type, quantity, matrix and origin (e.g. Boring-1, Test Pit 3, etc) of materials in every drum, as well as a unique identification number for each drum. The drum inventory will be used during drum pickup to assist with labeling of drums. The drum storage area and any other areas of temporarily staged waste, such as soil/debris piles, will be inspected weekly. The weekly inspections will be recorded in the field notebook or on a Weekly Inspection Log. Digital photographs will be taken upon the initial generation and drumming/staging of waste, and final labeling after characterization to document compliance with labeling and storage protocols, and condition of the container. Evidence of damage, tampering or other discrepancy should be documented photographically.

Emergency Response and Notifications

Specific procedures for responding to site emergencies will be detailed in the HASP. If the generator is designated as a LQG, a Contingency Plan will need to be prepared to include emergency response and notification procedures per 40 CFR § 265 Subpart D. In the event of a fire, explosion, or other release which could threaten human health

outside of the site or when Client or ARCADIS has knowledge of a spill that has reached surface water, Client or ARCADIS must immediately notify the National Response Center (800-424-8802) in accordance with 40 CFR § 262.34. Other notifications to state agencies may also be necessary.

Drilling Soil Cuttings and Muds

Soil cuttings are solid to semi-solid soils generated during trenching activities, subsurface soil sampling, or installation of monitoring wells. Depending on the drilling method, drilling fluids known as "muds" may be used to remove soil cuttings. Drilling fluids flushed from the borehole must be directed into a settling section of a mud pit. This allows reuse of the decanted fluids after removal of the settled sediments. Soil cuttings will be labeled and stored in 55-gallon drums with bolt-sealed lids.

Excavated Solids

Excavated solids may include, but are not limited to soil, fill and construction and demolition debris. Excavated solids may be temporarily stockpiled onsite as long as the material is a RCRA non-hazardous waste and the solids will be treated onsite pursuant to a certified, authorized, or permitted treatment method, or properly disposed off-site. Stockpiled materials characterized as hazardous must be immediately containerized and removed from the site within 90 days of generation (except for soils using satellite accumulation). Excavated solids should be stockpiled and maintained in a secure area onsite. At a minimum, the floor of the stockpile area will be covered with a 20-mil high density polyethylene liner that is supported by a foundation or at least a 60-mil high density polyethylene liner that is not supported by a foundation. The excavated material will not contain free liquids. The owner/operator will provide controls for windblown dispersion, run-on control, and precipitation runoff. The run-on control system will prevent flow onto the active portion of the pile during peak discharge from at least a 25-year storm and the run-off management system will collect and control at least the water volume resulting from a 24-hour, 25-year storm (EPA, 1992). Additionally, the stockpile area will be inspected on a weekly basis and after storm events. Individual states may require that the stockpile be inspected/certified by a licensed professional engineer. Stockpiled material will be covered with a 6-mil polyvinyl chloride (PVC) liner. The stockpile cover will be secured in place with appropriate material (concrete blocks, weights, etc.) to prevent the movement of the cover. Excavated solids may also be placed in roll off containers and covered with a 6-mil PVC liner pending results for waste characterization.

Decontamination Solutions

Decontamination solutions are generated during the decontamination of personal protective equipment and sampling equipment. Decontamination solutions may range from detergents, organic solvents and acids used to decontaminate small field sampling equipment to steam cleaning rinsate used to wash heavy field equipment. These solutions are to be labeled and stored in 55-gallon drums with bolt-sealed lids.

Disposable Equipment

Disposable equipment includes personal protective equipment (tyvek coveralls, gloves, booties and APR cartridges) and disposable sampling equipment such as trowels or disposable bailers. If the media sampled exhibits hazardous characteristics per results of waste characterization sampling, disposable equipment will also be disposed of as a hazardous waste. These materials will be stored onsite in labeled 55-gallon drums pending analytical results for waste characterization.

Purge Water

Purge water includes groundwater generated during well development, groundwater sampling, or aquifer testing. The volume of groundwater generated will dictate the appropriate storage procedure. Monitoring well development and groundwater sampling may generate three well volumes of groundwater or more. This volume will be stored in labeled 55-gallon drums. Aquifer tests may generate significantly greater volumes of groundwater depending on the well yield and the duration of the test. Therefore, large-volume portable polyethylene tanks will be considered for temporary storage pending groundwater-waste characterization.

Purged Water Storage Tank Decontamination and Removal

The following procedures will be used for inspection, cleaning, and offsite removal of storage tanks used for temporary storage of purge water. These procedures are intended to be used for rented portable tanks such as Baker Tanks or Rain for Rent containers. Storage tanks will be made of inert polyethylene materials.

The major steps for preparing a rented tank for return to a vendor include characterizing the purge water, disposing of the purge water, decontaminating the tank, final tank inspection, and mobilization. Decontamination and inspection procedures are describe in further detail below.

- Tank Cleaning: Most vendors require that tanks be free of any sediment and water before returning, a professional cleaning service may be required. Each

specific vendor should be consulted concerning specific requirements for returning tanks.

- Tank Inspection: After emptying the tank, purged water storage tanks should be inspected for debris, chemical staining, and physical damage. The vendors require that tanks be returned in the original condition (i.e., free of sediment, staining and no physical damage).

VII. Waste Characterization Sampling and Shipping

Soil/Solids Characterization

Waste characterization will be conducted in accordance with waste hauler, waste handling facility, and state/federal requirements. In general, RCRA hazardous wastes are those solid wastes determined by a Toxicity Characteristic Leaching Procedure (TCLP) test or to contain levels of certain toxic metals, pesticides, or other organic chemicals above specific federally regulated thresholds. If the one or more of 40 toxic compounds listed in Table I of 40 CFR § 261.24 are detected in the sample at levels above the maximum unregulated concentrations, the waste must be characterized as a toxic hazardous waste. Wastes can also be considered “listed” hazardous waste depending on site-specific processes.

Composite soil samples will be collected at a frequency of one sample per 10 cubic yard basis for stockpiled soil or one per 55-gallon drum for containerized. A four point composite sample will be collected per 10 cubic yards of stockpiled material and for each drum. Sample and composite frequencies may be adjusted in accordance with the waste handling facility’s requirements. Waste characterization samples may be analyzed for the TCLP volatile organic compounds (VOCs), TCLP semi-volatile organic compounds (SVOCs), TCLP RCRA metals, and polychlorinated biphenyls, as well as corrosivity (pH), reactivity and flammability (flashpoint). Additional samples may be collected and analyzed by the laboratory on a contingency basis.

Wastewater Characterization

Waste characterization will be conducted in accordance with the requirements of the waste hauler, waste handling facility, and state/federal governments. In general, purge water should be analyzed by methods appropriate for the known contaminants, if any, that have been historically detected in the monitoring wells. Samples will be collected and analyzed in accordance with the requirements of the waste disposal facility.

Wastewater characterization samples may be analyzed for TCLP volatile organic compounds (VOCs), TCLP semi-volatile organic compounds (SVOCs), TCLP RCRA

metals, and polychlorinated biphenyls, as well as corrosivity (pH), reactivity and flammability (flashpoint). Additional samples may be collected and analyzed by the laboratory on a contingency basis.

Sample Handling and Shipping

All samples will be appropriately labeled, packed, and shipped, and the chain-of-custody will be filled out in accordance with the Chain-of-Custody SOP and Field Sampling Handling, Packing, and Shipping SOP and Hazardous Materials Packaging and Shipping SOP.

It should be noted that additional training is required for packaging and shipping of hazardous and/or dangerous materials. Please reference the following ARCADIS intranet team page for more information: http://team/sites/hazmat/default.aspx.

Preparing Waste Shipment Documentation (Hazardous and Non-Hazardous)

Waste profiles will be prepared by the ARCADIS PM and forwarded, along with laboratory analytical data to the Client PM for approval/signature. The Client PM will then return the profile to ARCADIS who will then forward to the waste removal contractor for preparation of a manifest. The manifest will be reviewed by ARCADIS prior to forwarding to the Client PM for approval. Upon approval of the manifest, the Client PM will return the original signed manifest directly to the waste contractor or to the ARCADIS PM for forwarding to the waste contractor.

Final drum labeling and pickup will be supervised by an ARCADIS representative who is experienced with waste labeling procedures. The ARCADIS representative will have a copy of the drum inventory maintained in the field book and will reconcile the drum inventory with the profile numbers on the labels and on the manifest. Different profile numbers will be generated for different matrices or materials in the drums. For example, the profile number for drill cuttings will be different than the profile number for purge water. **When there are multiple profiles it is critical that the proper label, with the profile number appropriate to a specific material be affixed to the proper drums.** A copy of the ARCADIS drum inventory will be provided to the waste transporter during drum pickup and to the facility receiving the waste.

VIII. Data Recording and Management

Waste characterization sample handling, packing, and shipping procedures will be documented in accordance with the *Quality Assurance Project Plan*, if one exists. Copies of the chains-of-custody forms will be maintained in the project file.

Following waste characterization, IDW containers will be re-labeled with the appropriate waste hazardous or non-hazardous waste labels and the client will initiate disposal at the appropriate waste disposal facility.

IX. Quality Assurance

The chain-of-custody and sample labels for waste characterization samples will be filled out in accordance with the *Quality Assurance Project Plan*.

X. References

United States Environmental Protection Agency (USEPA). 1992. Guide to Management of Investigation-Derived Wastes. Office of Remedial and Emergency Response. Hazardous Site Control Division. January 1992.

USEPA. 1991. *Guide to Discharging CERCLA Aqueous Wastes to Publicly Owned Treatment Works (POTWs)*. Office of Remedial and Emergency Response. Hazardous Site Control Division 0S-220W. March 1991.

ARCADIS
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Field Equipment Decontamination

Rev. #: 3

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Approval Signatures

Prepared by: _____ Date: 4/26/2010
Keith Shepherd

Reviewed by: _____ Date: 4/26/2010
Richard Murphy (Technical Expert)

I. Scope and Application

Equipment decontamination is performed to ensure that sampling equipment that contacts a sample, or monitoring equipment that is brought into contact with environmental media to be sampled, is free from analytes of interest and/or constituents that would interfere with laboratory analysis for analytes of interest. Equipment must be cleaned prior to use for sampling or contact with environmental media to be sampled, and prior to shipment or storage. The effectiveness of the decontamination procedure should be verified by collecting and analyzing equipment blank samples.

The equipment cleaning procedures described herein includes pre-field, in the field, and post-field cleaning of sampling tools which will be conducted at an established equipment decontamination area (EDA) on site (as appropriate). Equipment that may require decontamination at a given site includes: soil sampling tools; groundwater, sediment, and surface-water sampling devices; water testing instruments; down-hole instruments; and other activity-specific sampling equipment. Non-disposable equipment will be cleaned before collecting each sample, between sampling events, and prior to leaving the site. Cleaning procedures for sampling equipment will be monitored by collecting equipment blank samples as specified in the applicable work plan or field sampling plan. Dedicated and/or disposable (not to be re-used) sampling equipment will not require decontamination.

II. Personnel Qualifications

ARCADIS field sampling personnel will have current health and safety training, including 40-hour HAZWOPER training, site supervisor training, and site-specific training, as needed. In addition, ARCADIS field sampling personnel will be versed in the relevant SOPs and possess the skills and experience necessary to successfully complete the desired fieldwork. The project HASP and other documents will identify any other training requirements such as site specific safety training or access control requirements.

III. Equipment List

- health and safety equipment, as required in the site Health and Safety Plan (HASP)
- distilled water

- Non-phosphate detergent such as Alconox or, if sampling for phosphorus phosphorus-containing compounds, Luminox (or equivalent).
- tap water
- rinsate collection plastic containers
- DOT-approved waste shipping container(s), as specified in the work plan or field sampling plan (if decontamination waste is to be shipped for disposal)
- brushes
- large heavy-duty garbage bags
- spray bottles
- (Optional) – Isoprophyl alcohol (free of ketones) or methanol
- Ziploc-type bags
- plastic sheeting

IV. Cautions

Rinse equipment thoroughly and allow the equipment to dry before re-use or storage to prevent introducing solvent into sample medium. If manual drying of equipment is required, use clean lint-free material to wipe the equipment dry.

Store decontaminated equipment in a clean, dry environment. Do not store near combustion engine exhausts.

If equipment is damaged to the extent that decontamination is uncertain due to cracks or dents, the equipment should not be used and should be discarded or submitted for repair prior to use for sample collection.

A proper shipping determination will be performed by a DOT-trained individual for cleaning materials shipped by ARCADIS.

V. Health and Safety Considerations

Review the material safety data sheets (MSDS) for the cleaning materials used in decontamination. If solvent is used during decontamination, work in a well-ventilated area and stand upwind while applying solvent to equipment. Apply solvent in a manner that minimizes potential for exposure to workers. Follow health and safety procedures outlined in the HASP.

VI. Procedure

A designated area will be established to clean sampling equipment in the field prior to sample collection. Equipment cleaning areas will be set up within or adjacent to the specific work area, but not at a location exposed to combustion engine exhaust. Detergent solutions will be prepared in clean containers for use in equipment decontamination.

Cleaning Sampling Equipment

1. Wash the equipment/pump with potable water.

2. Wash with detergent solution (Alconox, Liquinox or equivalent) to remove all visible particulate matter and any residual oils or grease.

3. If equipment is very dirty, precleaning with a brush and tap water may be necessary.

4. (Optional) – Flush with isopropyl alcohol (free of ketones) or with methanol. This step is optional but should be considered when sampling in highly impacted media such as non-aqueous phase liquids or if equipment blanks from previous sampling events showed the potential for cross contamination of organics.

5. Rinse with distilled/deionized water.

Decontaminating Submersible Pumps

Submersible pumps may be used during well development, groundwater sampling, or other investigative activities. The pumps will be cleaned and flushed before and between uses. This cleaning process will consist of an external detergent solution wash and tap water rinse, a flush of detergent solution through the pump, followed

by a flush of potable water through the pump. Flushing will be accomplished by using an appropriate container filled with detergent solution and another contained filled with potable water. The pump will run long enough to effectively flush the pump housing and hose (unless new, disposable hose is used). Caution should be exercised to avoid contact with the pump casing and water in the container while the pump is running (do not use metal drums or garbage cans) to avoid electric shock. Disconnect the pump from the power source before handling. The pump and hose should be placed on or in clean polyethylene sheeting to avoid contact with the ground surface.

VII. Waste Management

Equipment decontamination rinsate will be managed in conjunction with all other waste produced during the field sampling effort. Waste management procedures are outlined in the work plan or Waste Management Plan (WMP).

VIII. Data Recording and Management

Equipment cleaning and decontamination will be noted in the field notebook. Information will include the type of equipment cleaned, the decontamination location and any deviations from this SOP. Specific factors that should be noted include solvent used (if any), and source of water.

Any unusual field conditions should be noted if there is potential to impact the efficiency of the decontamination or subsequent sample collection.

An inventory of the solvents brought on site and used and removed from the site will be maintained in the files. Records will be maintained for any solvents used in decontamination, including lot number and expiration date.

Containers with decontamination fluids will be labeled.

IX. Quality Assurance

Equipment blanks should be collected to verify that the decontamination procedures are effective in minimizing potential for cross contamination. The equipment blank is prepared by pouring deionized water over the clean and dry tools and collecting the deionized water into appropriate sample containers. Equipment blanks should be analyzed for the same set of parameters that are performed on the field samples collected with the equipment that was cleaned. Equipment blanks are collected per equipment set, which represents all of the tools needed to collect a specific sample.

X. References

USEPA Region 9, Field Sampling Guidance #1230, Sampling Equipment Decontamination.

USEPA Region 1, Low Stress (low flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells.

Approval Signatures

Prepared by: _____ Date: _____

Reviewed by: _____ Date: _____
(Technical Expert)

Reviewed by: _____ Date: _____
(Editorial Reviewer)

Reviewed by: _____ Date: _____
(Quality Assurance Reviewer)

Approved by: _____ Date: _____
(Project Manager)

Standard Operating Procedure: Measuring Basic Water Quality Parameters In-Situ

I. Scope and Application

Water quality parameters (e.g., turbidity, specific conductivity, pH, and temperature) of natural waters are usually measured in the field. The temperature, pH, specific conductivity, dissolved oxygen, and turbidity of surface water will be measured in-situ with a combination water quality meter (Horiba U-10 or equivalent).

Conductivity is the ability of a solution to pass an electric current. This current is carried by inorganic dissolved solids. The measurement of conductivity is useful to relate the chemical purity of the water and the amount of dissolved solids in a solution.

The measurement of turbidity is useful in that it expresses the relative amount of suspended particles in the water column.

II. Personnel Qualifications

BBL field sampling personnel will have current health and safety training, including 40-hour HAZWOPER training, site supervisor training, and site-specific training, as needed. In addition, BBL field sampling personnel will be versed in the relevant standard operating procedures (SOPs) and possess the skills and experience necessary to successfully complete the desired field work.

III. Equipment List

The following materials, as required, shall be available during field measurement of water quality:

- health and safety equipment, as required by the site Health and Safety Plan (HASP);
- cleaning equipment;
- combination water quality meter;
- standard solutions for calibration;
- distilled/deionized water;
- extra batteries for the meter; and
- appropriate forms and field notebook.

IV. Cautions

Follow health and safety procedures outlined in the site HASP.

V. Health and Safety Considerations

Follow health and safety procedures outlined in the site HASP.

VI. Procedures

1. Standard Procedures

   A. Calibration

   The meter will be calibrated following the manufacturer's instructions. Calibration information will be recorded in the field notebook. Additional details for pH, conductivity, temperature, dissolved oxygen, and turbidity calibration are presented in Equipment-Specific Procedures (Item 2. below).

   B. Operation

   The meter will be operated following the manufacturer's instructions. Two readings will be made and the average will be recorded in the field notebook. Additional details for pH, conductivity, temperature, dissolved oxygen, and turbidity operation are presented in Equipment-Specific Procedures (Item 2. below).

   C. Maintenance

   The meter will be maintained according to the manufacturer's instructions. Maintenance information will be recorded in the field notebook. A replacement meter and probes will be available onsite or ready for overnight shipment, as necessary. Additional details for pH, conductivity, temperature, dissolved oxygen, and turbidity maintenance are presented in Equipment-Specific Procedures (Item 2. below).

2. Equipment-Specific Procedures

   A. Calibration

   The pH meter will be calibrated daily.

   1) Switch on instrument.
   2) Connect electrode to meter via the BNC connector and remove protective cap from electrode.
   3) Rinse end of electrode in distilled/deionized water.
   4) Measure and record temperature of buffer solutions.
   5) Immerse pH electrode in pH buffer 7.00, set the temperature adjust dial to that of the buffer 7.00, and allow sufficient time for the electrode to stabilize. Adjust the calibration dial for the correct readout.
   6) Remove electrode from buffer and rinse with distilled/deionized water.
   7) Immerse pH electrode in buffer 4.00, set the temperature control to that of the buffer 4.00, and allow sufficient time for the electrode to stabilize. Adjust the slope control for the correct readout.
   8) Rinse electrode with distilled/deionized water. The meter is calibrated and ready for use.

   B. Operation

   1) Calibrate pH meter.
   2) Rinse probe in distilled/deionized water.
   3) Fill two 100-mL plastic disposable beakers with water from the sample.
   4) Measure and record temperature of sample. Adjust temperature dial for ambient water temperature.

5) Insert probe into one sample beaker and obtain a reading. The meter will read between 0 and 14, in 0.01 increments.
6) Rinse probe off with distilled/deionized water.
7) Repeat Steps 4, and 5, and 6 in other beaker.
8) Log results in field notebook - the average will be the actual result.
9) Rinse probe off with distilled/deionized water.

C. Maintenance

1) Replace batteries on a regular basis.
2) Store electrode in protective casing when not in use.
3) Keep records of usage, maintenance, calibration, problems, and repairs.
4) After use, the meter will be inspected and the inspection recorded in the field notebook.
5) A replacement meter will be available onsite or ready for overnight shipment.
6) pH meter will be sent back to the manufacturer for service when needed.

3. Procedures for Measuring Conductivity

Conductivity is the ability of a solution to pass an electric current. This current is carried by inorganic dissolved solids. The measurement of conductivity is useful to relate the chemical purity of the water and the amount of dissolved solids in a solution.

A. Calibration

The conductivity meter will be calibrated daily.

1) Be sure the probe is clean.
2) Soak the probe in distilled/deionized water for at least 30 minutes.
3) Remove the probe from the water and fling out drops clinging inside.
4) Immerse the probe to or beyond the vent holes in a beaker containing a 1,000 mg/L Sodium Chloride Standard Solution. Agitate vertically to remove entrapped air.
5) Repeat Steps 3 and 4 at least once more.
6) Press the Power key and CND key. Verify that the LO BAT indication does not appear.
7) Press the 2 milliSiemens per centimeter (mS/cm) range key.
8) Check the reading on the display. It should be 1.990 mS/cm. If adjustment is needed, use a small screwdriver to adjust the CAL control next to the display. Counterclockwise adjustment increases the reading.

B. Operation

1) Calibrate the conductivity meter.
2) Rinse probe in distilled/deionized water.
3) Fill two 100-mL plastic disposable beakers with water from the sample.
4) Turn meter on to the 2 mS/cm scale.
5) Insert probe into sample beaker and obtain a reading. The meter will read between 0 and 2.0 mS/cm in 0.001 increments.
6) Repeat Step 5 with other beaker.
7) Record both results in the field notebook and average.
8) Rinse probe in distilled/deionized water.

9) If the electrodes become coated with foreign compounds, the probe should be cleaned with a detergent solution and then rinsed with distilled/deionized water.

C. Maintenance

1) Replace batteries on a regular basis.
2) Store electrode in protective casing when not in use.
3) Keep records of usage, maintenance, calibration, problems, and repairs.
4) After use, the meter will be inspected and the inspection recorded in the field notebook.
5) A replacement meter will be available onsite or ready for overnight shipment.
6) Conductivity meter will be sent back to the manufacturer for service when needed.

4. Procedures for Measuring Temperature

Temperature readings will be taken at each water sampling location to assist in pH and conductivity measurement. It will also assist in chemical and biological interpretations. A thermometer may be part of a pH/conductivity meter or separate.

A. Operation

1) Rinse thermometer in distilled/deionized water.
2) Immerse thermometer in the water sample and read it to the nearest degree Celsius (°C).
3) Record reading in the field notebook or relevant log.

B. Preventative Maintenance

1) Use of a Teflon®-coated thermometer lends extra strength and shock-resistance to guard against accidental breakage.
2) Store in protective casing when not in use.

5. Procedures for Measuring Dissolved Oxygen (DO)

The DO test is an important analysis in determining the quality of natural waters. The effects of wastes on rivers/streams, the suitability of water for fish and other organisms, and the progress of self-purification can be measured or estimated from the DO content.

A. Calibration

The DO meter will be calibrated daily using the air calibration method.

1) Prepare the probe with a thin Teflon® membrane stretched over the sensor.
2) Perform a battery check and obtain a barometric pressure reading from a daily weather report.
3) With the unit off, adjust the meter pointer to zero with the screw in the center of the meter panel.
4) Switch dial to ZERO and adjust pointer using the ZERO knob.
5) Switch dial to FULL SCALE and adjust pointer using the FULL SCALE knob. Check batteries if pointer cannot reach full scale.
6) Attach probe to unit and tighten.
7) Turn unit on.
8) Allow 15 minutes for optimum probe stabilization and polarization.

9) Switch dial to CALIB O2.
10) Hold probe in the air for 10 minutes or until reading is stable.
11) Using the CALIB knob, set the pointer to the mark associated with the local barometric pressure and ambient air temperature. If barometric pressure is unknown, a correction value of 97% should be used.

B. Operation

1) Calibrate the DO meter.
2) Perform the battery check.
3) Set mode switch to operate and the operation switch to the desired range.
4) Place probe into water sample.
5) Take a water temperature measurement and adjust temperature dial.
6) Switch to DO content measurement and allow reading to stabilize.
7) Record water temperature and DO on appropriate form or in the field notebook.

C. Maintenance

1) Replace batteries on a regular basis, at a suggested interval of every 6 months or every 1,000 hours of operation.
2) Store electrode in protective casing when not in use.
3) Keep records of usage, maintenance, calibration, problems, and repairs.
4) A replacement DO meter will be ready for overnight shipment.
5) DO meter will be sent back to the manufacturer for service when needed.

6. Procedures for Measuring Turbidity

The measurement of turbidity is useful in that it expresses the amount of suspended particles in the water samples.

A. Standardization

Standardization will be performed before each set of tests to ensure consistently accurate results.

1) Turn the instrument off and check the mechanical zero setting. Adjust to a zero NTU reading if necessary.
2) Turn power switch on and perform a battery check.
3) Place the focusing template into the cell holder. This will block all light from reaching the detector and allow the instrument to be zeroed electronically in Steps 4 and 5.
4) Press the 1.0 range switch and adjust the Zero Control for a reading of zero NTU.
5) Press the 10.0 range switch to verify that the meter still indicates zero NTU. Readjust the Zero Control if necessary.
6) Remove the focusing template and place the appropriate Gelex secondary standard for the turbidity range to be used into the cell holder. Use the index mark on the standard to orient the vial in the same position each time, thereby eliminating variation due to rotation.
7) Place the light shield over the turbidity standard and allow the meter to stabilize.
8) Adjust the SPAN control for a meter reading equal to the value of the Gelex standard in the cell holder. Remove the light shield and turbidity standard. The instrument is now ready for use.

B. Calibration

Each range is calibrated at the factory, but should be checked from time to time against fresh Formazin turbidity standard dilutions. Three trimmer potentiometers on the amplifier circuit board provide an adjustment for each range. Check each range as described in the following procedure and make the appropriate adjustments when necessary using the procedures described in Range Calibration (Item C. below).

1) With the instrument turned off, check the mechanical zero adjustment on the meter face. Adjust for a zero reading if necessary.
2) Turn the instrument on and perform a battery check. Change battery if needed.
3) Place the focusing template into the cell holder, press the 1.0 range switch, and adjust the Zero Control to obtain a zero NTU reading.
4) Remove the focusing template and insert a 0.75 NTU turbidity standard. Adjust the SPAN control for a corrected 0.75 NTU reading.
5) Remove the 0.75 NTU standard and replace it with a 10 NTU standard. Press the 10.0 range switch. The meter should indicate 10 (+0.2) NTU. If it does not, the 10.0 range potentiometer needs adjustment as described in the Range Calibration procedure. Adjust the SPAN control for a reading of exactly 10 NTU.
6) Remove the 10 NTU standard and replace it with the cell riser and 100 NTU standard. Press the 100 range switch. The meter should indicate 100 (+2) NTU. If it does not, the 100 range potentiometer needs adjustment as described in the Range Calibration procedure.
7) Remove the 100 NTU standard and cell riser and insert the 10 NTU standard. Press the 10.0 NTU range switch. Adjust the SPAN control for a reading of exactly 10 NTU.
8) Remove the 10 NTU standard and replace it with a 0.75 NTU standard. Press the 1.0 range switch. The meter should indicate the corrected value for the 0.75 NTU standard (+0.02). If it does not, the 1.0 range potentiometer needs adjustment as described in the Range Calibration procedure.

C. Range Calibration

In the event the range adjustment potentiometers on the amplifier circuit board require adjustment, remove the instrument from its case and proceed as follows:

1) With the instrument turned off, check the meter's mechanical zero adjustment. Adjust for a zero reading if necessary.
2) Turn on power and perform a battery check.
3) Place the focusing template into the cell holder, press the 1.0 range switch, and adjust the SPAN control fully counterclockwise.
4) Adjust the Zero Control clockwise to obtain a 0.05 NTU reading on the 1.0 scale.
5) Adjust the SPAN control clockwise to obtain a reading of 0.15 NTU on the 1.0 scale. Do not alter the SPAN control setting for the remainder of this procedure.
6) Press the 100 range switch and adjust the Zero Control for a zero reading.
7) Remove the focusing template and insert the cell riser and 100 NTU Formazin turbidity standard. Cover the standard with the light shield and allow the meter to stabilize. Adjust the 100 range adjustment potentiometer to obtain a full-scale reading.
8) Remove the 100 NTU standard and cell riser and insert the focusing template into the cell holder.
9) Press the 10.0 range switch and adjust the Zero Control for a zero reading.

10) Remove the focusing template and substitute the 10 NTU Formazin standard. Cover with the light shield and allow the meter to stabilize. Adjust the 10.0 range adjustment potentiometer to obtain a full-scale reading.
11) Remove the 10 NTU standard and insert the focusing template.
12) Press the 1.0 range switch and adjust the Zero Control for a zero reading.
13) Remove the focusing template and insert the 0.75 NTU Formazin turbidity standard. Cover with the light shield and allow the meter to stabilize. Adjust the 1.0 range adjustment potentiometer to obtain a reading equal to the corrected NTU value determined when adding the turbidity of the dilution water to the nominal value of the standard.

D. Measurement

1) Turn power switch on and perform a battery check.
2) Press the appropriate range switch: 0-1, 0-10, 0-100 NTU.
3) Place the focusing template into the cell holder and adjust the Zero Control for a reading of zero NTU. Remove focusing template.
4) Fill a clean sample cell to the white line with the sample to be measured and place it into the cell holder. Use the white dot on the sample cell to orient the cell in the same position each time. Cover sample with the light shield and allow meter to stabilize.
5) Read and record the turbidity of the sample.
6) Perform a duplicate sample every 10 or set of samples, whichever is more frequent.

E. Maintenance

1) Recharge battery on a regular basis.
2) Store in protective casing when not in use.
3) Keep records of usage, maintenance, calibration, problems, and repairs.
4) After use, the meter will be inspected and the inspection recorded in the field notebook.
5) A replacement meter will be ready for overnight shipment.
6) Keep Nephelometric sample tubes clean inside and out. Replace them when they become scratched or etched. Do not handle the tubes in the region where the light beam enters them.
7) Clean lens periodically.
8) Nephelometer will be sent back to the manufacturer for service when needed.

VII. Waste Management

N/A

VIII. Data Recording and Management

N/A

IX. Quality Assurance

N/A

X. References

N/A

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Sediment Core Collection

Rev. #: 0

Rev Date: July 28, 2003

Approval Signatures

Prepared by: _____ Date: _____

Reviewed by: _____ Date: _____
(Technical Expert)

Reviewed by: _____ Date: _____
(Project Manager)

I. Scope and Application

This Standard Operating Procedure (SOP) describes the procedures to collect sediment core samples.

II. Personnel Qualifications

To be completed by Preparer and reviewed by Technical Expert.

III. Equipment List

Sediment Sampling Equipment

The following materials will be needed during sediment sampling activities:

- aluminum boat with outboard motor;
- health and safety equipment, as required by the site Health and Safety Plan (HASP);
- cleaning equipment;
- aluminum or stainless steel tray;
- duct tape;
- Lexan tubing with end caps;
- brass push rod;
- hacksaw;
- stainless steel core driver;
- vacuum pump;
- piston sampler;
- photoionization detector (PID);
- 6-foot rule or survey rod;

- transport container with ice;
- appropriate sample containers and forms; and
- field notebook.

Field Cleaning Equipment

The following equipment will be needed for field cleaning after sediment sampling is completed:

- health and safety equipment (as required in the HASP);
- distilled water (laboratory-supplied);
- non-phosphate soap (Alconox or equivalent);
- distilled water;
- appropriate cleaning solvent (e.g., hexane);
- rinse collection plastic containers;
- brushes;
- aluminum foil;
- garbage bags;
- spray bottles for solvent; and
- Ziploc-type bags.

IV. Cautions

To be completed by Preparer and reviewed by Technical Expert.

V. Health and Safety Considerations

To be completed by Preparer and reviewed by Technical Expert.

VI. Procedure

Sediment Sampling Procedure

1. Identify the proposed sample location in the field notebook along with other appropriate information collected during the sediment probing activities.

2. Don personal protective equipment (PPE), as required by the HASP.

3. At each sample location, lower a section of Lexan tube until it just reaches the top of sediment. Measure the depth of water. (Sections of Lexan tube may need to be spliced together in deep water locations.)

4. Push the Lexan tube into the sediment by hand until refusal. Measure the depth of sediment.

5. Drive the tube several more inches using a stainless steel core driver block and measure the distance. This procedure is performed to obtain a “plug” at the bottom of the core and prevent the loose sediment from escaping;

6. Pump the water out from inside the Lexan tubing.

7. Place a vacuum pump on the top end of the Lexan tube and create a vacuum to prevent the sediments/plug from escaping.

8. Slowly pull the tube from the sediment, twisting it slightly as it is removed (if necessary).

9. Before the tube is fully removed from the water, place a cap on the bottom end of the tube while it is still submerged.

10. Keeping the tube upright, wipe the bottom end dry and seal the cap with duct tape and label. Measure the length of sediment recovered and evaluate the integrity of the core. If the core is not suitably intact, repeat coring procedure within 5 to 10 feet of the first location attempted.

11. While still keeping the core upright, use a hacksaw to make a horizontal cut in the tube approximately 1 inch above the sediment.

12. Re-cap the cut end of the tube, seal the cap with duct tape, and mark this end as “top.”

13. Wipe the tube dry.

14. Place a completed sample label on the tube.

15. Record the following information on both the tube and on the cap: 1) sample number; 2) sampling date; and 3) sampling time.

16. Place the core sample upright in a container with ice.

17. Repeat the above procedures until the appropriate number of core samples are collected (for the sampling event or the sampling day).

18. Extrude the sediment cores from the Lexan tubing onto an aluminum or stainless steel tray. Describe and record sample description, including depths at which sediment characteristics change and visual characteristics.

19. Section the sediment cores into the intervals determined for the project. Use a decontaminated hacksaw or knife to section the sediment cores. Characterize each sediment sample for color, texture, and visual staining/odors. Place each sediment sample into the appropriate laboratory-supplied sample containers.

20. Label all sample containers according to the appropriate procedures.

21. Handle, pack, and ship samples using the chain-of-custody procedures in accordance with the appropriate SOP.

Field Cleaning Procedure

1. Follow health and safety procedures specified in the HASP.

2. Cleaning of reusable sampling equipment (e.g., trays, spatulas, scoops, and core driver) will follow the decontamination procedures presented in the equipment cleaning SOP.

3. Cleaning will be conducted in plastic containers to collect all decontamination rinsate.

VII. Waste Management

Materials generated during the sediment sampling activities and disposable equipment will be transported for offsite disposal in accordance with applicable rules and regulations.

VIII. Data Recording and Management

To be completed by Preparer and reviewed by Technical Expert.

IX. Quality Assurance

To be completed by Preparer and reviewed by Technical Expert.

X. References

To be completed by Preparer and reviewed by Technical Expert.

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Sediment Sampling

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Rev Date: July 29, 2003

Approval Signatures

Prepared by: _____ Date: _____

Reviewed by: _____ Date: _____
(Technical Expert)

Reviewed by: _____ Date: _____
(Project Manager)

I. Scope and Application

This Standard Operating Procedure (SOP) sets forth the field procedures for collection of sediment via Lexan tubing and grab samples using a hand-held dredge.

II. Personnel Qualifications

To be completed by Preparer and reviewed by Technical Expert.

III. Equipment List

The following materials will be available, as required, during sediment sampling:

- health and safety equipment (as required by the site Health and Safety Plan [HASP]);
- cleaning equipment;
- disposable aluminum pans;
- disposable spatulas;
- appropriate sample containers and forms;
- coolers with ice;
- field notebook;
- anchor;
- boat and motor;
- rope;
- survey's rod;
- duct tape;
- Lexan tubing with end caps;
- push rod;

- hacksaw;
- steel core driver;
- vacuum pump;
- piston sampler/check valve push core device; and
- 6-foot rule.

IV. Cautions

To be completed by Preparer and reviewed by Technical Expert.

V. Health and Safety Considerations

To be completed by Preparer and reviewed by Technical Expert.

VI. Procedures

The following procedures will be used to collect sediment samples:

1. Don health and safety equipment (as required in the HASP).
2. Clean reusable sampling equipment as follows: non-phosphate detergent and distilled water wash; distilled water rinse; rinse equipment with solvent (hexane); distilled water rinse; allow to air dry and wrap in aluminum foil.
3. Use GPS surveying techniques to locate the proposed sample location and position the boat with anchors.
4. Identify the proposed sample location in the field notebook, along with other appropriate information collected during sediment sampling activities.
5. Measure the total depth of the water using a surveyor's rod to the nearest 0.1 foot.
6. At each sample location, lower a section of Lexan tube until it just reaches the top of the sediment (sections of Lexan tube may need to be spliced together or the Lexan tube may be attached to a check valve core device).

7. Push the Lexan tube with a straight vertical entry into the sediment so as to secure a reliably representative core sample. Measure the depth of sediment.

8. Drive the tube several inches more using a steel core drive and measure the additional distance. (This procedure is performed to obtain a “plug” at the bottom of the core and prevent the loose sediment from escaping.)

9. Place a vacuum pump on the top end of the Lexan tube and create a vacuum to prevent the sediment from escaping (note this is not needed if using a check valve core device).

10. Slowly pull the tube from the sediment, twisting it slightly as it is removed (if necessary).

11. Before the tube is fully removed from the water, place a cap on the bottom end of the tube while it is still submerged.

12. Keeping the tube upright, wipe the bottom end dry and seal the end with duct tape and label. Measure the length of sediment recovered and evaluate the integrity of the core. If additional cores are necessary to obtain a sufficient sample, repeat the coring procedure at the location adjacent to the previous one sampled.

13. While keeping the core upright, use a hacksaw to make a horizontal cut in the tube approximately 1 inch above the sediment.

14. Recap the cut end of the tube, seal the cap with duct tape, and mark this end as “top.”

15. Wipe the tube dry.

16. If sample sectioning is required, slice tube open or push sediment from tube and slice according to appropriate segmenting scheme (i.e., every 2 inches in cap material and 0 to 3 inches in native sediment).

17. Homogenize samples in a disposable aluminum pan.

18. Place homogenized sample in appropriate sample containers and cap.

19. Label all sample containers.

20. Place filled sample containers on ice in a cooler.

21. Follow procedures for packing, handling, and shipping with associated chain-of-custody procedures.

22. Record required information on the appropriate forms and/or field notebook.

23. Field duplicate and matrix spike/matrix spike duplicate (MS/MSD) samples will be obtained for every 20 sediment samples collected.

24. As an alternative sampling method, Steps 6 through 15 may be replaced with Steps a through g, as follows:

    a. At each sample location, drop open dredge from side of boat making sure that the end of the rope is maintained at all times.

    b. Once the dredge has been allowed to settle into the bottom sediment, a hard pull on the rope will close the sediment inside the dredge.

    c. Retrieve the dredge into the boat.

    d. Open the dredge to allow the sediment to empty onto a stainless steel tray or bowl.

    e. Multiple casts will be made and composited at each location until sufficient sample volume is obtained.

    f. Observe the sample and record descriptions in the field notebook.

    g. If chemical laboratory analyses are being performed, rinse blanks will be obtained by pouring deionized water through a cleaned stainless steel dredge onto a cleaned stainless steel tray. From the tray, the appropriate sample containers will be filled. Rinse blanks should be collected at the start and finish of sampling activities.

VII. Data Recording and Project Management

To be completed by Preparer and reviewed by Technical Expert.

VIII. Quality Assurance

To be completed by Preparer and reviewed by Technical Expert.

IX. References

To be completed by Preparer and reviewed by Technical Expert.

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Extraction/Preservation of Soil/Sediment for VOCs

Rev. #: 1

Rev Date: April 9, 2008

Approval Signatures

Prepared by: Caron Koll Date: 4/9/08

Reviewed by: Dennis K. Cyprio Date: 4/9/08
(Technical Expert)

I. Scope and Application

Soil or sediment samples collected for volatile organic compound (VOC) analysis must be handled in a manner which will minimize the loss of contaminants due to volatilization and biodegradation. Based on experience and open literature, it has been concluded that field extraction and preservation must be conducted in a manner to ensure that contaminants do not degrade or volatilize during sample handling and transport. The following equipment and procedures summarize the method of field preservation of soil samples.

II. Personnel Qualifications

ARCADIS field personnel will have current health and safety training, including 40-hour HAZWOPER training, site supervision training, and site-specific health and safety training. At least one person on the sampling team must be trained per Department of Transportation (DOT) and (International Air Transportation Administration (IATA) requirements to prepare and offer shipments of samples by a commercial carrier and training in Materials of Trade when transporting this material in ARCADIS or private vehicles for work-related purposes. Trained personnel will use the following shipping guides:

- ARCADIS Hazardous Materials (aka Dangerous Goods) using Shipping Guide No. US-002 - Environmental Samples-Solids Known or Suspected of Being Hazardous per DOT Definition

- ARCADIS Hazardous Materials (aka Dangerous Goods) using Shipping Guide No. US-012 – Environmental Samples solid containing Methanol and or Sodium Bisulfate Preservative (collected using TeraCore® Encore®, EazyDraw® Syringe Samplers).

In addition, ARCADIS personnel overseeing, directing, or supervising soil collection will be versed in the applicable standard operating procedures (SOPs) to successfully complete the sample activities.

III. Equipment List

- portable balance, small electronic or manual scale calibrated with an appropriate certified weight;

- analyte-free water;

- Site specific Health and Safety Plan (HASP);

- personal protective equipment (PPE), per the HASP;
- 1¾ cm inside-diameter disposable soil coring device syringes (supplied by laboratory);
- coolers or transport containers with contained ice;
- large soil sampling device (e.g., split-spoon sampler);
- indelible ink pens;
- field logbook;
- duct tape;
- 1-gallon freezer bags;
- appropriate forms;
- preservative-free empty sample containers;
- Encore™ (or equivalent, e.g. TeraCore®, EazyDraw®) samplers and cut plastic syringes; and/or
- sampling containers provided by the laboratory (dependent on the type of purge and trap unit that will be used to analyze the samples):
  - low-concentration containers with a magnetic stir bar and a solution of 1 gram of sodium bisulfate dissolved in 5 milliliter (mL) of organic-free water. Tare weight of container and contents should be recorded on the label.
  - high-concentration [greater than 200 micrograms per kilogram (ug/kg)] containers will contain 10 mL of methanol and also have the tare weight recorded on the label. Tare weight of the container and contents should be recorded on the label.

IV. Cautions

Once the proper weight has been contained within the syringe, the piston of the syringe is used to push the soil into the 40-mL sample vial. Care must be taken so as not to spill or splash the preservative already in the vials. Caution must also be used when recapping the vial, as even a small amount of soil on the rim of the vial may

cause improper sealing and subsequently lead to loss of the preservative and surrogates. The samples must be placed in coolers and maintained at approximately 4°C. The soil sample vials will be weighed by the laboratory before extractions are completed. For this reason, extra labels or tape are not to be added to the vials. Containers or syringes that differ from the tare weight by more than 0.01 gram should not be used.

Avoid over tightening sample vials lids. Over tightened lids may damage the Teflon seal and integrity of the sample.

Samples unpreserved at 4°C have a holding time of 48-hours, from the time of collection and analysis or preservation. If samples are to be shipped unpreserved, plan to express mail via air and to shipment on the same day as collection, unless performance data can be provided to support longer holding times. The 40 mL vials are unacceptable as unpreserved sample containers due to VOC loss via volatilization and biodegradation.

Freezing unpreserved samples in proper containers may be considered to extend holding times to 5 days.

Soils are to be collected and contained in the least amount of time possible to minimize the loss of VOCs. Trimming of outer layer of the exposed the soil sample should be considered, if the sample has been exposed to the atmosphere for more than a couple of minutes,

V. Health and Safety Considerations

Care must be taken so as not to spill or splash the preservative already in the vials, when applicable. Sodium bisulfate is a strong acid and can cause severe burns. If the preservative makes contact, immediately flush with potable water. Immediately consult with a medical professional if any burning, pain, or irritation persists.

The 40-mL sample vials can shatter while tightening. Amber vials are more prone to breakage. Use appropriate cut resistant gloves to avoid possible laceration while tightening vials.

Refer to the site specific health and safety plan (HASP) for further health and safety considerations.

VI. Procedure

Container Preparation

Container preservation may be done either in the field or in the laboratory. Procedures for both methods are provided in this SOP. Standard sample containers for laboratory preservation will include either TeraCore® Encore®, EazyDraw®.

Field preservation will depend on the soil concentration, if known.

For high concentration soils (greater than 200 ug/kg), laboratory-prepared 40-mL VOA vials filled with 5 mL to 10 mL of analyte-free purge and trap grade methanol (at a minimum of 5 mL methanol) to 5 gram soil/sediment. The sample container size may be dependent on the type of purge and trap unit that will be used to analyze the samples.

Containers for low VOC concentrations will include 1 gram of sodium bisulfate dissolved in 5 mL of organic-free water.

The analytical laboratory also adds the appropriate surrogate compounds to the methanol based on the analytical method quality assurance [e.g. 8015, 8021, 8260b, Massachusetts Compendium of Analytical Methods for Volatile Petroleum Hydrocarbons (VPH), or 8260b, USEPA, 2002; DEQE, 2000; MADEP, 2003]. The laboratory records the weight of each vial to the nearest 0.1 gram after both methanol and surrogates have been added. These containers must be stored in coolers and maintained at approximately $4^{o}C \pm 2^{o}$.

Sampling

Selection of a soil/sediment sampling interval will be determined based on a site-specific sampling plan and collected either via TeraCore® Encore®, EazyDraw® or by preservation in the field with methanol and/or sodium bisulfate in containers pre-measured by the laboratory.

<u>Preservation in the Field (laboratory pre-filled sample containers)</u>

Soil/sediment is collected in-situ or from a larger sampling device (e.g., split-spoon, auger, or other sampling device) with a disposable coring device (syringe), also supplied by the laboratory, as soon as possible upon sample retrieval to avoid exposure to air and VOC loss. A coring device that may be used of amendable to soil/sediment type consists of a plastic syringe with the tip removed. It is essential that

the diameter be suitable for injection into the sample container. A small electronic or manual balance is needed for weighing the syringe and soil.

1. Once the tare weight of the syringe is determined and a sample interval is selected, soil sample collection is accomplished by manually pushing a syringe into the soil/sediment with the piston withdrawn or collection with a stainless steel spoon.

2. The soil sample weight is determined by subtracting the tared weight from the total weight of the soil and syringe.

3. Acceptable soil sample weight is 5 grams for a 40-mL vial sample container. However, the laboratory may supply larger sized sample containers and require a laboratory-specific weight of soil/sediment.

   - If a syringe is used and the sample weight is less than 5 grams, the syringe may be pushed into the soil again, with the piston withdrawn to gather additional soil.

   - If the sample weight is greater than 5 grams, a portion of soil may be extruded and removed from the syringe.

4. Weigh the containers in the field. Record the weight of each sample. Subtract the tare weight of the container and preservative to obtain the weight of sample. Record the weights on the sample labels and in the field notebook.

5. If the volatile concentrations of the sample are not known, two low-concentration vials and one high-concentration vial should be prepared, as discussed in Section III. Additional vials are needed for samples to be used for laboratory quality control purposes. Note: Samples that contain carbonate minerals may effervesce upon contact with the acidic low-concentration preservative. If the effervescence is small, the loss of volatiles will be limited by quickly capping the vial. If large amounts of gas are generated, target analytes may be lost and the vials may shatter. If this occurs, document the issue in the field notebook and collect another sample using a fresh container prepared with 5 mL (1 mL of water is equivalent to 1 gram of water) of analyte-free water and no preservative.

6. (Place samples on ice immediately after collection and ship or deliver to the laboratory as soon as possible.

7. An additional sample fraction should be placed in a clean glass jar with no preservative for laboratory use to determine percent solids. Moisture content determination is required to report the sample results on a dry weight basis. Moisture content determination is required to report the sample results on a dry weight basis. If soil samples will be analyzed for other parameters, the moisture content can usually be taken from the other sample containers. However, when sampling for VOCs only, a small separate laboratory-supplied container must be filled.

Laboratory Preservation (Encore™ or equivalent)

1. Collect an approximate 5-gram sample using an Encore™ sampler or cut plastic syringe.

2. Place samples on ice immediately after collection and ship or deliver to the laboratory as soon as possible. Samples in capped Encore™ samplers should be delivered within 24 hours of collection to allow the sample to be persevered within 48 hours from collection and meet holding time.

3. In addition to the soil sample collected for VOC analysis, soil must be collected and placed into an empty container for moisture content analysis. Moisture content determination is required to report the sample results on a dry weight basis. If soil samples will be analyzed for other parameters, the moisture content can usually be taken from the other sample containers. However, when sampling for VOCs only, a small separate laboratory-supplied container must be filled.

Shipping Container Preparation

Use ARCADIS Hazardous Materials (aka Dangerous Goods) using Shipping Guide No. US-012 – Environmental Samples solid containing Methanol and or Sodium Bisulfate Preservative (collected using TeraCore® Encore®, EazyDraw® Syringe Samplers) for sample container preparation. Among other requirements depending on whether the samples are shipped by air verse by ground shipping containers must be marked with **"This package conforms to 49 CFR 173.4."** Note: in order to comply with 49 CFR 173.4, the total volume of methanol mixture per shipping container must be less than 30 grams. In addition, other pertinent requirements of this reference are as follows:

- Each inner receptacle is securely packed in an inside packaging with cushioning and absorbent material. The inside packaging cannot react chemically with the

material and needs to be capable of absorbing the entire contents of the receptacle. (Note: a foam container for the vials meets these requirements.)

- The inside packaging is securely packed in a strong outside packaging. (Note: a cooler meets this requirement.)

- The gross mass of the completed package does not exceed 64 pounds.

Consult ARCADIS Hazardous Materials (aka Dangerous Goods) using Shipping Guide No. US-012 – Environmental Samples, Solid Containing Methanol and/or Sodium Bisulfate Preservative (collected using TeraCore® Encore®, EazyDraw® Syringe Samplers) for appropriate packing and labeling for shipments via air and ground. In addition, consult the Chain-of-Custody SOP.

VII. Waste Management

Used methanol or sodium bisulfate, if any, will be contained in an airtight drum or container. Containers will be labeled with the project name, date, and contents. Appropriate client specified personnel will be notified for the transport of container to the appropriate on-site storage area for disposal at an appropriate facility. Any unused sample containers with methanol or sodium bisulfate will be shipped back to the laboratory using original packaging material per DOT or IATA procedures.

VIII. Data Recording and Management

Sampling activities, (i.e. location, depth, soil/sediment type, sample identification, sample container tare weight, sample weights, effervescence) will be recorded in the field logbook. Chain of custody (COC) will be prepared per the approved SOP and copies of the COC will be transmitted to the project manager and maintained in project files.

IX. Quality Assurance

Quality assurance activities will be completed to comply with the site specific sampling plan and/or quality assurance project plan.

A methanol trip blank should accompany the sample containers at all times in the field and during transport. This consists of a sample container prepared in a similar manner as the soil sample containers. One trip blank should accompany each sample delivery group.

Field blanks and ambient air blanks are optional when sampling via the methanol preservation method.

Discrete blind duplicate samples may be collected in separate soil/sediment sample containers. Compositing or homogenizing multiple soil/sediment samples into one sample container is not acceptable.

Site-specific matrix spike and matrix spike duplicate (MS/MSD) analyses, if required, may be collected from a single soil/sediment sample container; no additional sample volume is required.

X. References

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Compositing or Homogenizing Samples

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Rev Date: March 11, 2009

Approval Signatures

Prepared by: Andrew Korik Date: 3/11/09

Reviewed by: Michael Gefell (Technical Expert) Date: 3/11/09

I. Scope and Application

The general procedures to be used in composting/homogenizing solid and semisolid samples are outlined below.

II. Personnel Qualifications

ARCADIS personnel directing, supervising, or leading compositing and/or homogenizing of samples should have a minimum of 2 years of previous field experience and current health and safety training including 40-hour HAZWOPER training, site supervisor training, site-specific training, first aid, and CPR, as needed. Field personnel will also be compliant with client-specific training requirements. In addition, ARCADIS field sampling personnel will be versed in the relevant SOPs and posses the required skills and experience necessary to successfully complete the desired field work

III. Equipment List

The following materials will be available, as required, when compositing or homogenizing samples.

- personal protective equipment (PPE), as specified by the site Health and Safety Plan (HASP)
- stainless steel, plastic, glass or ceramic spoon (or disposable equivalent)
- stainless steel, plastic, glass or ceramic bowl (or disposable equivalent)
- stainless steel, plastic, glass or ceramic jar/bottle (or disposable equivalent)
- shovel or trowel
- plastic sheeting
- decontamination supplies
- digital camera (if allowed by facility policy)
- appropriate sample containers and forms
- field notebook and/or personal digital assistant (PDA)

IV. Cautions

The field crew must be aware of the potential chemicals of concern (COCs), and equipped with a variety of sample homogenizing equipment. The field crew must take care not to use equipment that may react with suspected COCs. For example, stainless steel implements should not be used to homogenize strongly acidic materials.

Soil, sediment, sludge and other solid/semisolid materials that are easily mixed should be thoroughly homogenized. Excessive, vigorous mixing should be avoided as COCs can be mobilized/liberated posing a health and safety risk and diminishing the representativeness of the sample.

Implements used for compositing/homogenizing should be thoroughly decontaminated between samples. Field blanks and rinse blanks should be obtained.

A Shipping Determination must be performed, by DOT-trained personnel, for all environmental and geotechnical samples that are to be shipped, as well as some types of equipment/supplies that are to be shipped.

V. Health and Safety Considerations

- Sample compositing/homogenizing will be performed using procedures consistent with the project Health and Safety Plan.
- Appropriate personal protective equipment (PPE) must be worn by all field personnel within the designated work area.
- Air monitoring may be required during certain field activities as required in the Site Health and Safety Plan.

ARCADIS field personnel will be familiar and compliant with Client-specific health and safety requirements.

VI. Procedure

Samples may require homogenization across a given depth interval, or several discrete grabs (usually five) may be combined into a composite sample. Samples for volatile organic compound (VOC) analysis will not be homogenized or composited. The procedure for mixing samples is provided below.

1. Mix the materials in a stainless steel (or appropriate non-reactive material) bowl using a stainless steel spoon (or disposable equivalents). When dealing with large sample quantities, use disposable plastic sheeting and a shovel or trowel. Note: When preparing samples for metals analyses, do not use disposable aluminum (or metal tools or trays other than stainless steel), as it may influence the analytical results.

2. Flatten the pile by pressing the top without further mixing.

3. Divide the circular pile by into equal quarters by dividing out two diameters at right angles.

4. Mix each quarter individually using appropriate non-reactive bowls, spoons and/or sheeting.

5. Mix two quarters (as described above) to form halves, then mix the two halves to form a composite or homogenous sample.

6. Place composite or homogenized sample into specified containers. Remaining material will be disposed of in accordance with project requirements and applicable regulations.

VII. Waste Management

Investigation-derived waste will be managed as described in the Investigation-Derived Waste Handling and Storage SOP.

VIII. Data Recording and Management

Sample identification, interval depth (if appropriate), sample date and time will be recorded in the field notebook, the boring log, and/or the PDA. The sample will also be identified on an appropriate chain of custody form, for submittal to an analytical laboratory for analysis. Consider digital photography to record unusual field conditions or to document compliance (i.e. proper labeling and storage of drums/IDW containers).

IX. Quality Assurance

All materials to be re-used for sample compositing/homogenizing will be decontaminated as appropriate. Field blanks and rinse blanks will be collected to evaluate decontamination procedures and to provide an indication as to whether external contamination has potentially been introduced.

X. References

Not Applicable.

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Surface and Subsurface Soil Sampling Using Manual Methods

Rev. #: 1

Rev Date: March 6, 2009

Approval Signatures

Prepared by: _____ Date: 3/6/09

Reviewed by: _____ Date: 3/6/09
(Technical Expert)

I. Scope and Application

This document describes procedures for surface and subsurface soil sampling using hand tools.

II. Personnel Qualifications

ARCADIS personnel directing, supervising, or leading soil sampling activities should have a minimum of 2 years of previous environmental soil sampling experience. ARCADIS personnel providing assistance to soil sample collection and associated activities should have a minimum of 6 months of related experience or an advanced degree in environmental sciences.

III. Equipment List

The following materials will be available, as required, during soil sampling activities:

- personal protective equipment (PPE), as specified by the site Health and Safety Plan (HASP);
- stainless steel bowls;
- stainless steel spoons;
- stainless steel spades;
- stainless steel hand augers;
- indelible ink pens;
- engineer's ruler or survey rod;
- sealable plastic bags (e.g., Ziploc®);
- equipment decontamination materials
- sample bottles and preservatives appropriate for the parameters to be sampled for laboratory analysis, if any;
- transport container with ice (if sampling for laboratory analysis);
- appropriate sample containers and forms; and

- field notebook and/or personal digital assistant (PDA).

Documentation forms and notebooks to have on hand include: soil sample log forms, chain-of-custody forms, sample labels and seals, field logbook/PDA.

IV. Cautions / Hazards

Task specific Job Safety Analysis (JSAs) must be developed to identify site hazards associated with the investigation and reviewed by all field crew members prior to the start of work. Safe Performance Self-Assessment (SPSA) to be performed by employees before performing a new task. Underground utilities will be cleared per the ARCADIS Utility Location Policy and Procedure.

V. Health and Safety Considerations

Soil sample collection will be performed in accordance with a site-specific Health and Safety Plan (HASP) and task specific JSA forms, copies of which will be present on site during such activities.

VI. Procedure

Soil samples may be collected at intervals from the ground surface to various depths. Sample locations will be identified using stakes, flagging, or other appropriate means, and will be noted in a field logbook, PDA, and/or soil sampling logs. Sample points will be located by surveying, use of a global positioning system (GPS), and/or measurements from other surveyed site features.

1. Equipment that will come in contact with the soil sample should be cleaned in accordance with the appropriate equipment decontamination SOP(s), or else new, disposable equipment should be used. Collect equipment blanks in accordance with the project Quality Assurance Project Plan (QAPP).

2. Clear the ground surface of brush, root mat, grass, leaves, or other debris.

3. Use a spade, spoon, scoop, or hand auger to collect a sample of the required depth interval.

4. Use an engineer's ruler to verify that the sample is collected to the correct depth and record the top and bottom depths from the ground surface.

5. To collect samples below the surface interval, remove the surface interval first; then collect the deeper interval. To prevent the hole from collapsing, it may be

necessary to remove a wider section from the surface or use cut polyvinyl chloride (PVC) tubing or pipe to maintain the opening.

6. Collect samples for volatile organic compounds (VOCs) as discrete samples using Encore® samplers or cut syringes (see Extraction/Preservation of Soil/Sediment Samples for VOCs SOP).

7. Homogenize samples for other analyses across the required interval or mix them with other discrete grab samples to form a composite sample (see Compositing or Homogenizing Samples SOP).

8. Place sample in clean sample container; label with sample identification number, date, and time of collection; and place on ice (if obtained for laboratory analysis). Prepare samples for packaging and shipping to the laboratory in accordance with the Chain-of-Custody Handling, Packing, and Shipping SOP.

9. Backfill sample holes to grade with native material or with clean builder's sand or other suitable material.

VII. Waste Management

Waste soils will be managed as specified in the FSP or Work Plan, and according to state and /or federal requirements. Personal Protective Equipment (PPE) and decontamination fluids will be contained separately and staged at the project site for appropriate disposal. Waste containers must be a sealed and labeled at the time of generation. Labels will indicate date, sample locations, site name, city, state, and description of the matrix (e.g., soil, PPE).

VIII. Data Recording and Management

Field documentation such as log book entries and chain-of –custody records will be transmitted to the ARCADIS PM or Task Manager each day unless otherwise directed. The field team leader will retain all site documentation while in the field and add to project files when the field mobilization is complete.

IX. Quality Assurance

Quality assurance samples (rinse blanks, duplicates, and MS/MSDs) will be collected at the frequency specified in the FSP and/or QAPP and depending on the project quality objectives. Reusable soil sampling equipment will be cleaned prior to use following equipment cleaning SOP. Field rinse blanks will be used to confirm that decontamination procedures are sufficient and samples are representative of site

conditions. Any deviations from the SOP will be discussed with the project manager prior to changing any field procedures.

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Soil Drilling and Sample Collection

Rev. #: 2

Rev Date: March 8, 2011

Approval Signatures

Prepared by: _____ Date: 03/08/2011

Reviewed by: _____ Date: 03/08/2011
(Technical Expert)

I. Scope and Application

Overburden drilling is commonly performed using the hollow-stem auger drilling method. Other drilling methods suitable for overburden drilling, which are sometimes necessary due to site-specific geologic conditions, include: drive-and-wash, spun casing, Rotasonic, dual-rotary (Barber Rig), and fluid/mud rotary. Direct-push techniques (e.g., Geoprobe or cone penetrometer) may also be used. The drilling method to be used at a given site will be selected based on site-specific consideration of anticipated drilling depths, site or regional geologic knowledge, types of sampling to be conducted, required sample quality and volume, and cost.

No oils or grease will be used on equipment introduced into the boring (e.g., drill rod, casing, or sampling tools).

II. Personnel Qualifications

The Project Manager (a qualified geologist, environmental scientist, or engineer) will identify the appropriate soil boring locations, depth and soil sample intervals in a written plan.

Personnel responsible for overseeing drilling operations must have at least 16 hours of prior training overseeing drilling activities with an experienced geologist, environmental scientist, or engineer with at least 2 years of prior experience.

III. Equipment List

The following materials will be available during soil boring and sampling activities, as required:

- Site Plan with proposed soil boring/well locations;
- Work Plan or Field Sampling Plan (FSP), and site Health and Safety Plan (HASP);
- personal protective equipment (PPE), as required by the HASP;
- drilling equipment required by the American Society for Testing and Materials (ASTM) D 1586, when performing split-spoon sampling;
- disposable plastic liners, when drilling with direct-push equipment;
- appropriate soil sampling equipment (e.g., stainless steel spatulas, knife);

- equipment cleaning materials;
- appropriate sample containers and labels;
- chain-of-custody forms;
- insulated coolers with ice, when collecting samples requiring preservation by chilling;
- photoionization detector (PID) or flame ionization detector (FID); and
- field notebook and/or personal digital assistant (PDA).

IV. Cautions

Prior to beginning field work, underground utilities in the vicinity of the drilling areas will be identified by one of the following three actions (lines of evidence):

- Contact the State One Call
- Obtain a detailed site utility plan drawn to scale, preferably an “as-built” plan
- Conduct a detailed visual site inspection

In the event that one or more of the above lines of evidence cannot be conducted, or if the accuracy of utility location is questionable, a minimum of one additional line of evidence will be utilized as appropriate or suitable to the conditions. Examples of additional lines of evidence include but are not limited to:

- Private utility locating service
- Research of state, county or municipal utility records and maps including computer drawn maps or geographical information systems (GIS)
- Contact with the utility provider to obtain their utility location records
- Hand augering or digging
- Hydro-knife
- Air-knife
- Radio Frequency Detector (RFD)

- Ground Penetrating Radar (GPR)
- Any other method that may give ample evidence of the presence or location of subgrade utilities.

Overhead power lines also present risks and the following safe clearance must be maintained from them.

Power Line Voltage Phase to Phase (kV)	Minimum Safe Clearance (feet)
50 or below	10
Above 50 to 200	15
Above 200 to 350	20
Above 350 to 500	25
Above 500 to 750	35
Above 750 to 1,000	35

ANSI Standard B30.5-1994, 5-3.4.5

Avoid using drilling fluids or materials that could impact groundwater or soil quality, or could be incompatible with the subsurface conditions.

Water used for drilling and sampling of soil or bedrock, decontamination of drilling/sampling equipment, or grouting boreholes upon completion will be of a quality acceptable for project objectives. Testing of water supply should be considered.

Specifications of materials used for backfilling borehole will be obtained, reviewed and approved to meet project quality objectives.

V. Health and Safety Considerations

Field activities associated with overburden drilling and soil sampling will be performed in accordance with a site-specific HASP, a copy of which will be present on site during such activities.

VI. Procedure

Drilling Procedures

The drilling contractor will be responsible for obtaining accurate and representative samples; informing the supervising geologist of changes in drilling pressure; and

keeping a separate general log of soils encountered, including blow counts (i.e., the number of blows from a soil sampling drive weight [140 pounds] required to drive the split-barrel sampler in 6-inch increments). The term “samples” means soil materials from particular depth intervals, whether or not portions of these materials are submitted for laboratory analysis. Records will also be kept of occurrences of premature refusal due to boulders or construction materials that may have been used as fill. Where a boring cannot be advanced to the desired depth, the boring will be abandoned and an additional boring will be advanced at an adjacent location to obtain the required sample. Where it is desirable to avoid leaving vertical connections between depth intervals, the borehole will be sealed using cement and/or bentonite. Multiple refusals may lead to a decision by the supervising geologist to abandon that sampling location.

Soil Characterization Procedures

Soils encountered while drilling soil borings will be collected using one of the following methods:

- 2-inch split-barrel (split-spoon) sampler, if using the ASTM D 1586 - Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils

- Plastic internal soil sample sleeves if using direct-push drilling.

Soils are typically field screened with an FID or PID at sites where volatile organic compounds are present in the subsurface. Field screening is performed using one of the following methods:

- Upon opening the sampler, the soil is split open and the PID or FID probe is placed in the opening and covered with a gloved hand. Such readings should be obtained at several locations along the length of the sample

- A portion of the collected soil is placed in a jar, which is covered with aluminum foil, sealed, and allowed to warm to room temperature. After warming, the cover is removed, the foil is pieced with the FID or PID probe, and a reading is obtained.

Samples selected for laboratory analysis will be handled, packed, and shipped in accordance with the procedures outlined in the Work Plan, FSP, or Chain-of-Custody, Handling, Packing, and Shipping SOP.

A geologist will be onsite during drilling and sampling operations to describe each soil interval on the soil boring log, including:

- percent recovery;
- structure and degree of sample disturbance;
- soil type;
- color;
- moisture condition;
- density;
- grain-size;
- consistency; and
- other observations, particularly relating to the presence of waste materials

Further details regarding geologic description of soils are presented in the Soil Description SOP.

Particular care will be taken to fully describe any sheens observed, oil saturation, staining, discoloration, evidence of chemical impacts, or unnatural materials.

VII. Waste Management

Water generated during cleaning procedures will be collected and contained onsite in appropriate containers for future analysis and appropriate disposal.

PPE (such as gloves, disposable clothing, and other disposable equipment) resulting from personnel cleaning procedures and soil sampling/handling activities will be placed in plastic bags. These bags will be transferred into appropriately labeled 55-gallon drums or a covered roll-off box for appropriate disposal.

Soil materials will be placed in sealed 55-gallon steel drums or covered roll-off boxes and stored in a secured area. Once full, the material will be analyzed to determine the appropriate disposal method.

VIII. Data Recording and Management

The supervising geologist or scientist will be responsible for documenting drilling events using a bound field notebook and/or PDA to record all relevant information in a clear and concise format. The record of drilling events will include:

- start and finish dates of drilling;
- name and location of project;
- project number, client, and site location;
- sample number and depths;
- blow counts and recovery;
- depth to water;
- type of drilling method;
- drilling equipment specifications, including the diameter of drilling tools;
- documentation of any elevated organic vapor readings;
- names of drillers, inspectors, or other people onsite; and
- weather conditions.

IX. Quality Assurance

Equipment will be cleaned prior to use onsite, between each drilling location, and prior to leaving the site. Drilling equipment and associated tools, including augers, drill rods, sampling equipment, wrenches, and other equipment or tools that may have come in contact with soils and/or waste materials will be cleaned with high-pressure steam-cleaning equipment using a potable water source. The drilling equipment will be cleaned in an area designated by the supervising engineer or geologist that is located outside of the work zone. More elaborate cleaning procedures may be required for reusable soil samplers (split-spoons) when soil samples are obtained for laboratory analysis of chemical constituents.

X. References

American Society of Testing and Materials (ASTM) D 1586 - *Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils*.

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Field Log Book Entries

Rev. #: 0

Rev Date: 11 August 2009

Approval Signatures

Prepared by: Andrew Kanik Date: 8/11/09

Reviewed by: Michael J. Heffell Date: 8/11/09
(Technical Expert)

I. Scope and Application

This ARCADIS Standard Operating Procedure covers the entries needed in a field log book for environmental investigations.

This SOP does not address all of the entries that may be needed for a specific project, and does not address health and safety, equipment decontamination, field parameter measurements, sample preservation, chain-of-custody, or laboratory analysis. For direction on requirements in these areas, refer to other ARCADIS SOPs, the project work plans including the quality assurance project plan, sampling plan, and health and safety plan, as appropriate.

II. Personnel Qualifications

ARCADIS personnel participating in fieldwork and making entries into the field log book should have a minimum of one (1) year of field experience (or be under the supervision and accompanied in the field by someone who does) and current health and safety training including 40-hour HAZWOPER training, site supervisor training, site-specific training, first aid, and CPR, as needed. Field personnel will also be compliant with client-specific training requirements. In addition, ARCADIS field sampling personnel will be versed in the relevant SOPs and posses the required skills and experience necessary to successfully complete the desired field work.

III. Equipment List

- Field Log Book
- Ball point (medium point) pen with blue or black ink (black preferred). A fine point Sharpie pen may be used if the ink does not bleed through the page and become visible on back side of the page. If weather conditions prevent the use of a pen, indicate so in the log and use an alternate writing instrument .
- Zip-lock baggie or other weather-proof container to protect the field log book from the elements.

IV. Cautions

All entries in the field log must be legible and archivable. Do not leave the field log book exposed to the elements or other conditions that might moisten the pages and smear/dissolve the entries. When not in the field, the log book should be stored in a location that is easily accessible to field crews.

V. Health and Safety Considerations

ARCADIS field personnel will be familiar and compliant with Client-specific health and safety requirements.

VI. Procedure

- Print legibly. Do not use cursive writing.
- The name of the project, project number and project location should be written in indelible ink on the outside of the field log book.
- On the inside of the front cover, write "If Found, Please Return to ARCADIS" and include the appropriate address and phone number, the name of the person to which the book is assigned, and the name of the project manager.
- Reserve the first page of the book for a Table of Contents.
- Reserve the last five (5) pages of the book for important contacts, notes, reminders, etc.
- Each day of field work, the following should be recorded in the field log book as applicable:

    a) Project Name

    b) Date and time arrived

    c) Work Site Location

    d) Names of people on-site related to the project including ARCADIS employees, visitors, subcontractor employees, agency personnel, client representative, etc.

    e) Describe the work to be performed briefly, and list the equipment on-site

    f) Indicate the health and safety (H&S) level to be used

    g) Record instrument calibrations and checks

    h) Record time and general content of H&S briefing

    i) Describe the weather conditions, including temperature, precipitation, and wind speed and direction

    j) List periodic time entries in the far left hand column of each page

    k) Minimize unused space on each page

- The tailgate meeting must be recorded in the log book and the tailgate form completed. If H&S monitoring is performed, record the time and results of initial and followup monitoring.

- Note factual observations including collection of QA/QC samples, delays, well damage, accidents, work plan deviations, instrument problems, and problem resolutions.

- Describe work performed and how documented such as photographs, sample core logs, water sampling logs, etc.

- Describe bases for field decisions including pertinent conversations with visitors, regulators, or project personnel.

- Note final instrument calibrations and checks.

- Sign the log book at the end of each day at a minimum. Draw a line to the end of the page to indicate no further entries on that page. Sign the bottom of each page if possible.

- If an entry to the log book is changed, strike out the deleted text or item with a single line such that the entry remains legible, and initial and date the change. Such changes should only be made by the same person that made the initial entry.

- Field log book entries must be made in the field at the site, not at a later time at a different location. Supplemental entries to the log book may be made at a later date. The supplemental entry must be clearly identified as such and the entry must be signed and dated as described in this SOP.

- Problems noted in the field log book must be brought to the attention of the project manager and task manager in a timely fashion. Problems may be reported in person, on the telephone, or in a written daily log form. If daily logs are prepared and you will not be able to personally give the daily log to the project manager, send the daily log via FAX or overnight courier to the project manager and task manager.

VII. Waste Management

Investigation-derived waste will be managed as described in the Investigation-Derived Waste Handling and Storage SOP. A drum/waste inventory should be maintained on a pre-designated page in the field log book.

VIII. Data Recording and Management

Each page of the field log book should be scanned for electronic/digital archiving at periodic intervals. This will ensure that copies of the field notes are available in the event the field book is lost or damaged, and that field data can be easily disseminated to others without the risk of physically sending the field log book. Field log books that are full should be archived with the project files, and readily retrievable.

IX. Quality Assurance

Be mindful that the field log book may be produced in court. All entries should be legible (as discussed above). Entries should also be in English, unless working in a country where English is not the predominant language or you are directed otherwise by the project manager.

X. References

Not Applicable

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Standard Groundwater Sampling for Monitoring Wells

Rev. #: 1

Rev Date: July 16, 2008

Approval Signatures

Prepared by: _____ Date: 7/16/08

Reviewed by: _____ Date: 7/16/08
(Technical Expert)

I. Scope and Application

This Standard Operating Procedure (SOP) describes the procedures to be used to collect groundwater samples using traditional purging and sampling techniques. For low-flow purging techniques, please refer to the Low Flow Purging SOP. Monitoring wells must be developed after installation at least 1 week prior to groundwater sample collection. Monitoring wells will not be sampled until the well has been developed. During precipitation events, groundwater sampling will be discontinued until precipitation ceases or a cover has been erected over the sampling area and monitoring well.

Both filtered and unfiltered groundwater samples may be collected using this SOP. Filtered samples may be obtained using a 1.0-, 0.45-, or 0.1-micron disposable filter.

II. Personnel Qualifications

ARCADIS personnel directing, supervising, or leading groundwater sample collection activities should have a minimum of 2 years of previous groundwater sampling experience. Field employees with less than 6 months of experience should be accompanied by a supervisor (as described above) to ensure that proper sample collection techniques are employed.

III. Equipment List

The following materials shall be available, as required, during groundwater sampling:

- site plan of monitoring well locations and site Field Sampling Plan (FSP);
- appropriate health and safety equipment, as specified in the site Health and Safety Plan (HASP);
- photoionization detector (PID) or flame ionization detector (FID), as needed, in accordance with the HASP;
- monitoring well construction logs or tables and historical water level information, if available;
- dedicated plastic sheeting or other clean surface to prevent sample contact with the ground;
- if bailers are to be used in sampling:

  - appropriate dedicated bottom-loading, bottom-emptying bailers (i.e., polyvinyl chloride [PVC], Teflon, or stainless steel);
  - polypropylene rope;
- if submersible pumps are to be used in sampling:
  - dedicated tubing and other equipment necessary for purging;
  - generator or battery for operation of pumps, if required;
  - a pump selected in accordance with the FSP or Work Plan (parameter-specific [e.g., submersible, bladder, peristaltic]);
- graduated buckets to measure purge water;
- water-level or oil/water interface probe, in accordance with the FSP or Work Plan;
- conductivity/temperature/pH meter;
- down-hole dissolved oxygen meter, oxidation reduction potential meter, and/or turbidity meter, if specified in the FSP;
- water sample containers appropriate for the analytical method(s) with preservative, as needed (parameter-specific);
- filter, as needed, in accordance with the analytical method and parameter;
- appropriate blanks (trip blank supplied by the laboratory), as specified in the FSP;
- Ziploc-type freezer bags for use as ice containers;
- appropriate transport containers (coolers) with ice and appropriate labeling, packing, and shipping materials;
- appropriate groundwater sampling log (example attached);
- chain-of-custody forms;
- site map with well locations and groundwater contour maps;

- keys to wells and contingent bolt cutters for rusted locks and replacement keyed-alike locks; and

- drums or other containers for purge water, as specified by the site investigation derived waste (IDW) management plan.

IV. Cautions

If heavy precipitation occurs and no cover over the sampling area and monitoring well can be erected, sampling must be discontinued until adequate cover is provided. Rain water could contaminate groundwater samples.

Remember that field logs and some forms are considered to be legal documents. All field logs and forms should therefore be filled out in indelible ink.

It may be necessary to field filter some parameters (e.g., metals) prior to collection, depending on preservation, analytical method, and project quality objectives.

Check monitoring well logs for use of bentonite pellets. Make note of potential use of bentonite pellets on the groundwater sampling log. Coated bentonite pellets have been found to contaminate monitoring wells with elevated levels of acetone.

Store and/or stage empty and full sample containers and coolers out of direct sunlight.

To mitigate potential cross-contamination, groundwater samples are to be collected in a pre-determined order from least impacted to more impacted based on previous analytical data. If no analytical data are available, samples are to be collected in the following order:

1. First sample the upgradient well(s).

2. Next, sample the well located furthest downgradient of the interpreted or known source.

3. The remaining wells should be progressively sampled in order from downgradient to upgradient, such that the wells closest to the interpreted or known source are sampled last.

Be careful not to over-tighten lids with Teflon liners or septa (e.g., 40 mL vials). Over-tightening can impair the integrity of the seal.

V. Health and Safety Considerations

If thunder or lighting is present, discontinue sampling until 30 minutes have passed after the last occurrence of thunder or lighting.

VI. Procedure

The procedures to sample monitoring wells will be as follows:

1. Don safety equipment, as required in the HASP. Depending on site-specific security and safety considerations, this often must be done prior to entering the work area.

2. Review equipment list (Section III above) to confirm that the appropriate equipment has been acquired.

3. Record site and monitoring well identification on the groundwater sampling log, along with date, arrival time, and weather conditions. Also identify the personnel present, equipment utilized, and other relevant data requested on the log.

4. Label all sample containers with indelible ink.

5. Place plastic sheeting adjacent to the well for use as a clean work area, if conditions allow. Otherwise, prevent sampling equipment from contacting the ground or other surface that could compromise sample integrity.

6. Remove lock from well and if rusted or broken, replace with a new brass keyed-alike lock.

7. Unlock and open the well cover while standing upwind of the well. Remove well cap and place on the plastic sheeting.

8. Set the sampling device,meters, and other sampling equipment on the plastic sheeting. If a dedicated sampling device stored in the well is to be used, this may also be set temporarily on the plastic sheeting, for convenience. However, if a dedicated sampling device is stored below the water table, removing it may compromise water-level data, so water level measurements should be taken prior to removing the device.

9. Obtain a water-level depth and bottom-of-well depth using an electric well probe and record on the groundwater sampling log using indelible ink. Clean the probe(s) after each use in accord with the FSP or the equipment

decontamination SOP.

Note: Water levels may be measured at all wells prior to initiating any sampling activities, depending on FSP requirements.

10. Calculate the number of gallons of water in the well using the length of water column (in feet). Record the well volume on the groundwater sampling log using indelible ink.

11. Remove the required purge volume of water from the well (measure purge water volume in measuring buckets). The required purge volume will be three to five well volumes (the water column in the well screen and casing) unless the well runs dry, in which case, the water that comes into the well will be sampled (USEPA, 1996). In any case, the pumping rate will be decreased during sampling to limit the potential for volatilization of organics potentially present in the groundwater.

12. Field parameter measurements will be periodically collected in accord with FSP specifications. The typical time intervals of field parameter measurement are (1) after each well volume removed, and (2) before sampling. If the field parameters are being measured above-ground (rather than with a downhole probe), then the final pre-sampling parameter measurement should be collected at the reduced flow rate to be used during sampling. The physical appearance of the purged water should be noted on the groundwater sampling log. In addition, water level measurements should be collected and recorded to verify that the well purging is in accord with the guidelines set forth in the previous step.

13. Unless otherwise specified by the applicable regulatory agencies, all purge water will be contained. Contained purge water will be managed in accordance with the FSP or Work Plan. If historical concentrations in the well are less than federal or state regulated concentrations appropriate for current land use, *and permission has been granted by the oversight regulatory agency* to dispose of clean purge water on the ground next to the well(s), then purge water will be allowed to infiltrate into the ground surface downgradient from the monitoring well after the well is sampled.

14. After the appropriate purge volume of groundwater in the well has been removed, or if the well has been bailed dry and allowed to recover, obtain the groundwater sample needed for analysis with the dedicated bailer or from the dedicated sampling tubing, pour the groundwater directly from the sampling device into the appropriate container in the order of volatilization sensitivity of

the parameters sampled, and tightly screw on the cap (snug, but not too tight). The suggested order for sample parameter collection, based on volatilization sensitivity, is presented below:

a. volatile organic compounds (VOCs);

b. semi-volatile organic compounds (SVOCs);

c. polychlorinated biphenyls (PCBs)/pesticides;

d. metals; and

e. wet chemistry.

15. When sampling for volatiles, water samples will be collected directly from the bailer or dedicated tubing into 40 mL vials with Teflon-lined septa.

16. For other analytical samples, sample containers for each analyte type should be filled in the order specified by the FSP. If a bailer is used, then the sample for dissolved metals and/or filtered PCBs should either be placed directly from the bailer into a pressure filter apparatus or pumped directly from the bailer with a peristaltic pump, through an in-line filter, into the pre-preserved sample bottle. If dedicated sample tubing is used, then the filter should be installed in-line just prior to filtered sample collection.

17. If sampling for total and filtered metals and/or PCBs, a filtered and unfiltered sample will be collected. Sample filtration for the filtered sample will be performed in the field utilizing a pump prior to preservation. Attach (clamp) a new 1.0-, 0.45-, or 0.1-micron filter to the discharge tubing of the pump (note the filter flow direction). Turn the pump on and allow 100 mL (or manufacturer recommended amount) of fluid through the filter before sample collection. Dispense the filtered liquid directly into the laboratory sample bottles. If bailers are used for purging and sampling, a proper volume of purge water will be placed in a disposable or decontaminated polyethylene container and pumped through the filter and into the sample container using a peristaltic pump.

18. Place the custody seal around the cap and the sampler container, if required. Note the time on the sample label. Secure with packing material and maintain at approximately 4°C on wet ice contained in double Ziploc-type freezer bags during storage in an insulated, durable transport container.

19. Replace the well cap and lock well, or install a new lock if needed.

20. Record the time sampling procedures were completed on the appropriate field logs (using indelible ink).

21. Complete the procedures for chain-of-custody, handling, packing, and shipping. Chain-of-custody forms should be filled out and checked against the labels on the sample containers progressively after each sample is collected.

22. Place all disposable sampling materials (such as plastic sheeting, disposable tubing or bailers, and health and safety equipment) in appropriate containers.

23. If new locks were installed, forward copies of the keys to the client Project Manager (PM) and ARCADIS PM at the end of the sampling activities.

VII. Waste Management

Purge water will be managed as specified in the FSP or Work Plan, and according to state and/or federal requirements. Personal protective equipment (PPE) and decontaminated fluids will be contained separately and staged at the sampling location. Containers must be labeled at the time of collection. Labels will include date, location(s), site name, city, state, and description of matrix contained (e.g., soil, groundwater, PPE). General guidelines for IDW management are set forth in a separate IDW management SOP.

VIII. Data Recording and Management

Initial field logs and chain-of-custody records will be transmitted to the ARCADIS PM at the end of each day unless otherwise directed by the PM. The groundwater team leader retains copies of the groundwater sampling logs. All field data should be recorded in indelible ink.

IX. Quality Assurance

Field-derived quality assurance blanks will be collected as specified in the FSP, depending on the project quality objectives. Typically, field rinse blanks will be collected when non-dedicated equipment is used during groundwater sampling. Field rinse blanks will be used to confirm that decontamination procedures are sufficient and samples are representative of site conditions. Trip blanks for VOCs, which aid in the detection of contaminates from other media, sources, or the container itself, will be kept with the coolers and the sample containers throughout the sampling activities.

X. References

USEPA. 1986. RCRA Groundwater Monitoring Technical Enforcement Guidance Document (September 1986).

USEPA. 1991. Handbook Groundwater, Volume ii Methodology, Office of Research and Development, Washington, DC. USEPN62S, /6-90/016b (July, 1991).

U.S. Geological Survey (USGS). 1977. National Handbook of Recommended Methods for Water-Data Acquisition: USGS Office of Water Data Coordination. Reston, Virginia.

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Standard Operating Procedure: Porewater sampling using an *in-situ* dialysis membrane sampling apparatus

Rev. #: 0

Rev Date: February 8, 2013

Approval Signatures

Prepared by: _____ Date: 13 February 2013

Prepared by: _____ Date: 13 February 2013

Reviewed by: _____ Date: 13 February 2013
(Technical Expert)

I. Scope and Application

Porewater sampling will occur to assess concentrations of dissolved-phase constituents in sediment of Operable Unit E (OU-E) ponds at the Former Georgia Pacific Wood Products Facility in Fort Bragg, CA. Field personnel will install diffusion controlled *in-situ* dialysis membrane porewater samplers (DMPS) to collect data. De-oxygenated, de-ionized (DI) water will be placed inside of the dialysis membrane and the sampler will be installed in the 0-0.5 ft. below sediment surface (bss) depth interval of the surficial sediment. The sampler will be left in the sediment for a minimum of 12 days to allow for the constituent concentrations in the sampler to reach equilibrium with surrounding porewater and no more than 14 days to reduce potential for degradation of the dialysis membrane. DMPS allow for the analysis of *in-situ* conditions and reduce the influence of sampling artifacts (e.g., oxidation and temperature) on data collection.

II. Personnel Qualifications

ARCADIS field personnel will have current health and safety training, including 40-hour HAZWOPER training, site supervision training, and site-specific health and safety training. In addition, personnel overseeing, directing, or supervising sediment collection will be versed in the applicable Standard Operating Procedures (SOPs) to successfully complete the sampling activities and be experienced with general sampling methods used in aquatic environments (e.g., sediment, surface water, an/or porewater).

III. Equipment List

The following equipment will be required during *in-situ* pore water sampling activities:

- Personal protective equipment (PPE) and safety equipment as required by the site health and safety plan (HASP) and Job Safety Analysis (JSA).
- *In-situ* DMPS:
    - 5 inch (in.) x 1 in. (Length (L) x inner diameter (ID)) slotted PVC pipe;
    - Acetate cellulose tubular dialysis membrane (ACDM; 8,000 dalton nominal molecular weight cutoff) cut into 15 in. strips with stainless steel or ceramic scissors;
    - 2 in. outer diameter closed pipe nipples;
    - Rubber stop corks;
    - 8 in. x 2.0 in. (L X ID) protective slotted PVC sheath;

- Manufactured DMPS sampling apparatus (top and bottom push-rod/anchor made out of slotted PVC and plexiglass “snowshoe”);
- Stainless steel or ceramic scissors;
- 50 milliliter (mL) pipette and pipette bulb;
- 5 gallon buckets with lid and air lock;
- Laboratory grade helium or nitrogen tank (including regulator and necessary hoses);
- Air stone;
- GPS equipment with sub-meter accuracy and sample locations entered;
- Chest waders;
- Boat (aluminum Jon boat and lightweight inflatable);
- Field probe with capabilities to measure oxidation-reduction potential (ORP), dissolved oxygen (DO), temperature and pH;
- Slide hammer;
- Hand auger with 1.5 in. screw head;
- Laminated site location map (with sample locations marked);
- Laboratory supplied sample containers;
- Indelible ink pen and ball point pen;
- Transport cooler(s) with ice;
- Laboratory supplied DI water;
- Field log book;
- Digital camera;
- Sample labels;
- Canopy and stakes/weights;
- Decontamination supplies (see Field Sampling Equipment Decontamination Procedures SOP, No. 1213199) and;
- Sample packaging and shipping supplies (see Field Sample Packing, Handling and Shipping SOP, No 1223199)

IV. Cautions

Helium/nitrogen tanks must be delivered to the site by an appropriate agent complying with Materials of Trade, Department of Transportation, and/or International Air Transport Association regulations, as necessary. Helium/nitrogen tanks must be stored and transported on-site in compliance with appropriate Materials of Trade and health and safety regulations.

If inclement weather occurs, then sampling must be conducted under cover to prevent potential contamination of porewater samples by rainwater.

To prevent oxidation of the porewater samples, the deployment and retrieval procedures must take place as quickly as possible, and agitation of the sampler should be minimized during deployment and retrieval.

If DMPS are to be used to sample for VOCs, then packing tape must be avoided on the sample containers to prevent contamination. If DMPS are to be used to sample for metals, then stainless steel or ceramic tools should be used to prevent contamination.

If a slide hammer must be used to insert the DMPS into the sediment, use caution as to not damage the sampling device. Use the hammer as gently as possible and position as best as possible in areas clear of debris and rocks.

To the extent possible, store and/or stage empty and full sample containers and coolers out of direct sunlight and under ice.

Be careful not to spill laboratory-prepared containers that may contain preservatives. Reduction of the preservative in the container may impact the integrity of the sample and analytical results and is a health and safety concern.

Shipping determinations must be made for samples to be collected prior to mobilization for the field event, and appropriate measure must be taken to ship the samples in accordance with Department of Transportation, and/or International Air Transport Association regulations.

V. Health and Safety Considerations

Always review and follow site specific SOPs and consult the site-specific HASP and JSAs.

Wear appropriate PPE and have safety equipment specified by the site HASP and JSAs. Use caution when transporting boats and working over water.

Follow appropriate health and safety standards and regulations for storing and transporting compressed gas cylinders.

VI. Procedure

Sampling devices will be custom manufactured and are modified based on methods described by Vrobleski et al., (2002).

Probe assembly:

1. Don PPE as specified by the HASP and JSA.

2. Decontaminate DMPS pieces and 5 gallon buckets to be used to hold DMPS during deoxygenation.

3. Place laboratory supplied DI water into the previously decontaminated 5 gallon buckets.

4. Assemble helium tank with regulator, hoses and air stone at end of discharge hose. Slowly turn on gas release valve to gauge appropriate pressure (i.e., seals and hoses maintain integrity) and evaluate potential leaks. If pressure is too high or if leaks are present, then turn off regulator and adjust tubing. Repeat this step as necessary to achieve appropriate pressure and stop leaks.

5. Bubble helium gas into a sufficient number of the DI filled buckets to hold all DMPS for the event until the dissolved oxygen (DO) concentration falls below 0.5 mg/L as measured by a calibrated field probe (see Measuring Basic Water Quality Parameters In-Situ SOP, No 1343199). Keep remaining DI filled buckets for the following step.

6. Label two buckets filled with DI water "1st rinse" and "2nd rinse".

7. Cut strips of ACDM to lengths of approximately 15 in. using scissors and dip the strip twice into the bucket labeled "1st rinse" and twice into the bucket labeled "2nd rinse" to remove any residual packing solution.

8. Insert the 5 in. x 1 in. (L x ID) slotted PVC pipe into ACDM and tie an overhand knot at one end of the ACDM.

9. Submerge the ACDM into the de-oxygenated, DI water, making sure that the bag is completely filled. Tie an overhand knot on the loose end of the sampler

to seal the bag. Turn the ACDM upside down to make sure that it is completely sealed.

10. Place the ACDM inside of its protective sheath (to create the DMPS); making sure that the sampler remains submerged in the de-oxygenated DI water. Screw on PVC nipples, with rubber stop cork previously inserted, to both ends of the DMPS. Keep the DMPS in the de-oxygenated, DI water with continuous helium bubbling until deployment.

Sampler deployment:

1. Don PPE, as required by the HASP and JSAs. If necessary, deploy the boat into the water body where sampler will be installed. Follow the boat deployment, trailering, and transport JSA when handling the boat.

2. Use GPS survey equipment to locate the proposed sample location. If sample location must be relocated from the pre-determined locations, then field staff must contact the Task Manager and/or Project Manger to discuss potential relocation of the location. Survey and document field modifications to sample locations, when necessary, and note reasons for the modification in the field notebook.

3. Identify the proposed sample location in the field notebook, along with other appropriate information collected during sediment sampling activities (i.e., texture, color, presence of debris, presence of oily sheen, and presence of organic matter, and odor; see Sediment Sampling with Dewatering SOP, No 1383199a).

4. Record the sampling location and station position with the GPS.

5. Submerge calibrated field probe (with push-rod if necessary) into the surficial sediment and record ORP, DO, temperature, and pH. Be careful not to force the probe, which may result in breakage of the sampling equipment. Record measurements in field notebook.

6. If sediment collection activities are proposed at the sample location, sediment samples will be collected directly adjacent to the area of porewater collection prior to porewater sampler deployment to prevent disturbance of the surface sediment that may occur during the porewater sampler deployment/retrieval process.

7. On shore (or onboard the boat if used), remove the DMPS from the de-oxygenated, DI water and attach to the spike and push-rod pieces of the sampling apparatus by screwing the pieces together.

8. Lower the sampling apparatus through the water column until it reaches the sediment surface (as judged by field staff using a sediment probe with a flat head).

9. Once the sediment surface is encountered, mark the distance on the sampling apparatus with permanent marker above the water surface that is equal to the distance between the bottom of the sampling apparatus and 1 in. above the top of the DMPS.

10. Insert the sampling apparatus perpendicular into the sediment until the mark made in step 8 is level with the water surface of the water.

11. If the sediment is too compact to direct push the sampling apparatus, then gently use a slide hammer to install the sampler to its appropriate depth. If the sampling apparatus will not install gently using a slide hammer, then dig a pilot hole using a 1.5 in. diameter screw head hand auger before perform the sampling apparatus final installation.

12. After the sampler has been inserted to its appropriate depth, place the weighted plexiglass “snow-shoe” on top of the DMPS by sliding in onto the push-rod and making sure that it encounters the sediment surface by probing with a piece of PVC.

13. Repeat steps 6 through 11 to deploy DMPS with sufficient volume to meet analytical needs.

Sampler retrieval:

1. Don PPE, as required by the HASP and JSAs. Identify the sample location in the field notebook.

2. Use GPS survey equipment, as well as visual inspection of the push-rod, to accurately locate the original sample location.

3. Record changes of the sampler location from the initial placement, as necessary, with the GPS.

4. Submerge calibrated field probe (with push-rod if necessary) into the surficial sediment and record DO, pH, oxidation-reduction potential (ORP) and temperature. Record measurements in field notebook.

5. Remove the sampling apparatus by slowly pulling the push-rod. Disassemble the DMPS from the sampling apparatus and pour as much residual sediment inside the spike and/or push-core back into the pond, directly above the location from which it was removed.

6. Bring the sampling apparatus to a stable platform (e.g., boat deck or shore), taking care not to agitate the device to prevent oxidation of the porewater samples. Sampling location should be under a canopy or cover, if necessary, dependent on weather (see Section IV of this SOP).

7. Un-screw the segments of the DMPS and remove the ACDM as soon as possible following retrieval; sampling of the DMPS should begin within 20 minutes of retrieval to prevent oxidation of the sample and precipitation of metals from solution. Dip the ACDM into a bucket of DI water to remove gross adsorption of sediment particles. Cut the knot off of the ACDM and pipette sample into laboratory supplied sampling containers, making sure not to place any residual sediment into the sample container.

8. Place push-core and spike into appropriate location for decontamination procedure.

VII. Waste Management

Materials generated during the sediment sampling and decontamination activities along with disposable equipment will be transported for off-site disposal in accordance with project requirements and applicable State regulations.

VIII. Data Recording and Management

Daily sampling activities will be recorded in the field notebook. Photographs of sampling apparatuses and field activities will be taken as appropriate, and photographs taken will be recorded (e.g., subject matter, photograph location, and photograph facing) in the field notebook. Copies of the field notebook will be forwarded to the Project Manager or designee, as requested. Upon completion of the field activities, field notebooks will be maintained in the project files.

IX. Quality Assurance

Field-derived quality assurance blanks will be collected as specified in the Work Plan, depending on the project quality objectives. There will be one method blank carried out on a DMPS apparatus for the de-oxygenated, DI water procedure. There will be another method blank carried out each day of the retrieval process on the scissors used to cut the ACDM.

X. References

Vrobleski DA, Petkewich MD, and Campbell TR. 2002. Field Tests of Diffusion Samplers for Inorganic Constituents in Wells and at a Groundwater-Discharge Zone. United States Geological Survey. Water Resources Investigations Report 02-4031.

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Monitoring Well Installation

Rev. #: 3

Rev Date: February 2, 2011

Approval Signatures

Prepared by: _____ Date: 2/2/2011

Reviewed by: _____ Date: 2/2/2011
(Technical Expert)

I. Scope and Application

The procedures set out herein are designed to produce standard groundwater monitoring wells suitable for: (1) groundwater sampling, (2) water level measurement, (3) bulk hydraulic conductivity testing of formations adjacent to the open interval of the well.

Monitoring well boreholes in unconsolidated (overburden) materials are typically drilled using the hollow-stem auger drilling method. Other drilling methods that are also suitable for installing overburden monitoring wells, and are sometimes necessary due to site-specific geologic conditions, include: drive-and-wash, spun casing, Rotasonic, dual-rotary (Barber Rig), and fluid/mud rotary with core barrel or roller bit. Direct-push techniques (e.g., Geoprobe or cone penetrometer) and driven well points may also be used in some cases within the overburden. Monitoring wells within consolidated materials such as bedrock are commonly drilled using water-rotary (coring or tri-cone roller bit), air rotary or Rotasonic methods. The drilling method to be used at a given site will be selected based on site-specific consideration of anticipated drilling/well depths, site or regional geologic knowledge, type of monitoring to be conducted using the installed well, and cost.

No oils or grease will be used on equipment introduced into the boring (e.g., drill rod, casing, or sampling tools). No polyvinyl chloride (PVC) glue/cement will be used in constructing or retrofitting monitoring wells that will be used for water-quality monitoring. No coated bentonite pellets will be used in the well drilling or construction process. Specifications of materials to be installed in the well will be obtained prior to mobilizing onsite, including:

- well casing;
- bentonite;
- sand; and
- grout.

Well materials will be inspected and, if needed, cleaned prior to installation.

II. Personnel Qualifications

Monitoring well installation activities will be performed by persons who have been trained in proper well installation procedures under the guidance of an experienced field geologist, engineer, or technician. Where field sampling is performed for soil or

bedrock characterization, field personnel will have undergone in-field training in soil or bedrock description methods, as described in the appropriate SOP(s) for those activities.

III. Equipment List

The following materials will be available during soil boring and monitoring well installation activities, as required:

- Site Plan with proposed soil boring/well locations;
- Work Plan or Field Sampling Plan (FSP), and site Health and Safety Plan (HASP);
- personal protective equipment (PPE), as required by the HASP;
- traffic cones, delineators, caution tape, and/or fencing as appropriate for securing the work area, if such are not provided by drillers;
- appropriate soil sampling equipment (e.g., stainless steel spatulas, knife);
- soil and/or bedrock logging equipment as specified in the appropriate SOPs;
- appropriate sample containers and labels;
- drum labels as required for investigation derived waste handling;
- chain-of-custody forms;
- insulated coolers with ice, when collecting samples requiring preservation by chilling;
- photoionization detector (PID) or flame ionization detector (FID);
- ziplock style bags;
- water level or oil/water interface meter;
- locks and keys for securing the well after installation;
- decontamination equipment (bucket, distilled or deionized water, cleansers appropriate for removing expected chemicals of concern, paper towels);

- field notebook.

Prior to mobilizing to the site, ARCADIS personnel will contact the drilling subcontractor or in-house driller (as appropriate) to confirm that appropriate sampling and well installation equipment will be provided. Specifications of the sampling and well installation equipment are expected to vary by project, and so communication with the driller will be necessary to ensure that the materials provided will meet the project objectives. Equipment typically provided by the driller could include:

- drilling equipment required by the American Society of Testing and Materials (ASTM) D 1586, when performing split-spoon sampling;
- disposable plastic liners, when drilling with direct-push equipment;
- drums for investigation derived waste;
- drilling and sampling equipment decontamination materials;
- decontamination pad materials, if required; and
- well construction materials.

IV. Cautions

Prior to beginning field work, underground utilities in the vicinity of the drilling areas will be delineated by the drilling contractor or an independent underground utility locator service. See separate SOP for utility clearance.

Some regulatory agencies require a minimum annular space between the well or permanent casing and the borehole wall. When specified, the minimum clearance is typically 2 inches on all sides (e.g., a 2-inch diameter well requires a 6-inch diameter borehole). In addition, some regulatory agencies have specific requirements regarding grout mixtures. Determine whether the oversight agency has any such requirements prior to finalizing the drilling and well installation plan.

If dense non-aqueous phase liquids (DNAPL) are known or expected to exist at the site, refer to the DNAPL Contingency Plan SOP for additional details regarding drilling and well installation to reduce the potential for inadvertent DNAPL remobilization.

Similarly, if light non-aqueous phase liquids (LNAPLs) are known or expected to be present as “perched” layers above the water table, refer to the DNAPL Contingency

Plan. Follow the general provisions and concepts in the DNAPL contingency plan during drilling above the water table at known or expected LNAPL sites.

Avoid using drilling fluids or materials that could impact groundwater or soil quality, or could be incompatible with the subsurface conditions.

Similarly, consider the material compatibility between the well materials and the surrounding environment. For example, PVC well materials are not preferred when DNAPL is present. In addition, some groundwater conditions leach metals from stainless steel.

Water used for drilling and sampling of soil or bedrock, decontamination of drilling/sampling equipment, or grouting boreholes upon completion will be of a quality acceptable for project objectives. Testing of water supply should be considered.

Specifications of materials used for backfilling bore hole will be obtained, reviewed and approved to meet project quality objectives. Bentonite is not recommended where DNAPLs are likely to be present. In these situations, neat cement grout is preferred.

No coated bentonite pellets will be used in monitoring well construction, as the coating could impact the water quality in the completed well.

Monitoring wells may be installed with Schedule 40 polyvinyl chloride (PVC) to a maximum depth of 200 feet below ground surface (bgs). PVC monitoring wells between 200 and 400 feet total depth will be constructed using Schedule 80 PVC. Monitoring wells deeper than 400 feet will be constructed using steel.

V. Health and Safety Considerations

Field activities associated with monitoring well installation will be performed in accordance with a site-specific HASP, a copy of which will be present on site during such activities.

VI. Procedures

The procedures for installing groundwater monitoring wells are presented below:

Hollow-Stem Auger, Drive-and-Wash, Spun Casing, Fluid/Mud Rotary, Rotasonic, and Dual-Rotary Drilling Methods

1. Locate boring/well location, establish work zone, and set up sampling equipment decontamination area.

2. Advance boring to desired depth. Collect soil and/or bedrock samples at appropriate interval as specified in the Work Plan and/or FSP. Collect, document, and store samples for laboratory analysis as specified in the Work Plan and/or FSP. Decontaminate equipment between samples in accordance with the Work Plan and/or FSP. A common sampling method that produces high-quality soil samples with relatively little soil disturbance is the ASTM D 1586 - Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils. Split-spoon samples are obtained during drilling using hollow-stem auger, drive-and-wash, spun casing, and fluid/mud rotary. Rotasonic drilling produces large-diameter soil cores that tend to be more disturbed than split-spoon samples due to the vibratory action of the drill casing. Dual-rotary removes cuttings by compressed air and allows only a general assessment of geology. High-quality bedrock samples can be obtained by coring.

3. Describe each soil or bedrock sample as outlined in the appropriate SOP. Record descriptions in the field notebook and/or personal digital assistant (PDA). It should be noted that PDA logs must be electronically backed up and transferred to a location accessible to other project team members as soon as feasible to retain and protect the field data. During soil boring advancement, document all drilling events in field notebook, including blow counts (number of blows required to advance split-spoon sampler in 6-inch increments) and work stoppages. Blow counts will not be available if Rotasonic, dual-rotary, or direct-push methods are used. When drilling in bedrock, the rate of penetration (minutes per foot) is recorded.

4. If it is necessary to install a monitor well into a permeable zone below a confining layer, particularly if the deeper zone is believed to have water quality that differs significantly from the zone above the confining layer, then a telescopic well construction should be considered. In this case, the borehole is advanced approximately 3 to 5 feet into the top of the confining layer, and a permanent casing (typically PVC, black steel or stainless steel) is installed into the socket drilled into the top of the confining layer. The casing is then grouted in place. The preferred methods of grouting telescoping casings include: pressure-injection grouting using an inflatable packer installed temporarily into the base of the casing, such that grout is injected out the bottom of the casing until it is observed at ground surface outside the casing; displacement-method grouting (also known as the Halliburton method), which entails filling the casing with grout and displacing the grout out the bottom of the casing by pushing a drillable plug, typically made of wood to the bottom of the casing, following by tremie grouting the remainder of the annulus outside the casing; or tremie grouting the annulus surrounding the casing using a tremie pipe installed to the base of the borehole. In all three cases, the casing is grouted to the ground

surface, and the grout is allowed to set prior to drilling deeper through the casing. Site-specific criteria and work plans should be created for the completion of non-standard monitoring wells, including telescopic wells.

5. In consolidated formations such as competent bedrock, a monitoring well may be completed with an open borehole interval without a screen and sandpack. In these cases, the borehole is advanced to the targeted depth of the top of the open interval. A permanent casing is then grouted in place following the procedures described in Step 4 above. After the grout sets, the borehole is advanced by drilling through the permanent casing to the targeted bottom depth of the open interval, which then serves as the monitoring interval for the well. If open-borehole interval stability is found to be questionable or if a specific depth interval is later selected for monitoring, a screened monitoring well may later be installed within the open-borehole interval, depending on the annular space and well diameter requirements.

6. Before installing a screened well – or after drilling an open-bedrock well –, it is important to confirm that the borehole has been advanced into the saturated zone. This is particularly important for wells installed to monitor the water table and/or the shallow saturated zone, as the capillary fringe may cause soils above the water table to appear saturated. If one or more previously installed monitoring wells exist nearby, use the depth to water at such well(s) to estimate the water-table depth at the new borehole location.

   To verify that the borehole has been advanced into the saturated zone, it is necessary to measure the water level in the borehole. For boreholes drilled without using water (e.g., hollow-stem auger, cable-tool, air rotary, air hammer), verify the presence of groundwater (and /or LNAPL, if applicable) in the borehole using an electronic water level probe, oil-water interface probe, or a new or decontaminated bailer. For boreholes drilled using water (e.g., drive and wash, spun-casing with roller-bit wash, rotasonic, or water rotary with core or roller bit), monitor the water level in the borehole as it re-equilibrates to the static level. In low-permeability units like clay, fine-grained glacial tills, shale and other bedrock formations, it may be necessary to wait overnight to allow the water level to equilibrate. To the extent practicable, ensure that the depth of the well below the apparent water table is deep enough so that the installed well can monitor groundwater year-round, accounting for seasonal water-table fluctuations. In most cases, the well should be installed at least five feet below the water-table depth, determined as described above. When in doubt, err on the side of slightly deeper well installation.

If necessary, the borehole should be drilled deeper to ensure that the well may intersects the water table or a permeable water-bearing zone.

7. Upon completing the borehole to the desired depth, if a screened well construction is desired, install the monitoring well by lowering the screen and casing assembly with sump through the augers or casing. Monitoring wells typically will be constructed of 2-inch-diameter, flush-threaded PVC or stainless steel slotted well screen and blank riser casing. Smaller diameters may be used if wells are installed using direct-push methodology or if multiple wells are to be installed in a single borehole. The screen length will be specified in the Work Plan or FSP based on regulatory requirements and specific monitoring objectives. Monitoring well screens are usually 5 to 10 feet long, but may be up to 25 feet long in very low permeability, thick geologic formations. The screen length will depend on the purpose for the well and the objectives of the groundwater investigation. Typically, the slot size will be 0.010 inch and the sand pack will be 20-40, Morie No. 0, or equivalent. In very fine-grained formations where sample turbidity needs to be minimized, it may be preferred to use a 0.006-inch slot size and 30-65, Morie No. 00, or equivalent sand pack. Alternatively, where monitoring wells are installed in coarse-grained deposits and higher well yield is required, a 0.020-inch slot size and 10-20, Morie No. 1, or equivalent sand pack may be preferred. To the extent practicable, the slot size and sand pack gradation may be predetermined in the Work Plan or FSP based on site-specific grain-size analysis or other geologic considerations or monitoring objectives. A blank sump may be attached below the well screen if the well is being installed for DNAPL recovery/monitoring purposes. If so, the annular space around the sump will be backfilled with neat cement grout to the bottom of the well screen prior to placing the sand pack around the screen. A blank riser will extend from the top of the screen to approximately 2.5 feet above grade or, if necessary, just below grade where conditions warrant a flush-mounted monitoring well. For wells greater than 50 feet deep, centralizers may be desired to assist in centralizing the monitoring well in the borehole during construction.

8. When the monitoring well assembly has been set in place and the grout has been placed around the sump (if any), place a washed silica sand pack in the annular space from the bottom of the boring to a height of 1 to 2 feet above the top of the well screen. The sand pack is placed and drilling equipment extracted in increments until the top of the sand pack is at the appropriate depth. The sand pack will be consistent with the screen slot size and the soil particle size in the screened interval, as specified in the Work Plan or FSP. A hydrated bentonite seal (a minimum of 2 feet thick) will then be placed in the annular space above the sand pack. If non-hydrated bentonite is used, the bentonite

should be permitted to hydrate in place for a minimum of 30 minutes before proceeding. No coated bentonite pellets will be used in monitoring well drilling or construction. Potable water may be added to hydrate the bentonite if the seal is above the water table. Monitor the placement of the sand pack and bentonite with a weighted tape measure. During the extraction of the augers or casing, a cement/bentonite or neat cement grout will be placed in the annular space from the bentonite seal to a depth approximately 2 feet bgs.

9. Place a locking, steel protective casing (extended at least 1.5 feet below grade and 2 feet above grade) over the riser casing and secure with a neat cement seal. Alternatively, for flush-mount completions, place a steel curb box with a bolt-down lid over the riser casing and secure with a neat cement seal. In either case, the cement seal will extend approximately 1.5 to 2.0 feet below grade and laterally at least 1 foot in all directions from the protective casing, and should slope gently away to promote drainage away from the well. Monitoring wells will be labeled with the appropriate designation on both the inner and outer well casings or inside of the curb box lid.

   When an above-grade completion is used, the PVC riser will be sealed using an expandable locking plug and the top of the well will be vented by drilling a small-diameter (1/8 inch) hole near the top of the well casing or through the locking plug, or by cutting a vertical slot in the top of the well casing. When a flush-mount installation is used, the PVC riser will be sealed using an unvented, expandable locking plug.

10. During well installation, record construction details and actual measurements relayed by the drilling contractor and tabulate materials used (e.g., screen and riser footages; bags of bentonite, cement, and sand) in the field notebook.

11. After completing the well installation, lock the well, clean the area, and dispose of materials in accordance with the procedures outlined in Section VII below.

Direct-Push Method

The direct-push drilling method may also be used to complete soil borings and install monitoring wells. Examples of this technique include the Diedrich ESP vibratory probe system, GeoProbe®, or AMS Power Probe® dual-tube system. Environmental probe systems typically use a hydraulically operated percussion hammer. Depending on the equipment used, the hammer delivers 140- to 350-foot pounds of energy with each blow. The hammer provides the force needed to penetrate very stiff/medium dense soil formations. The hammer simultaneously advances an outer steel casing that contains a dual-tube liner for sampling soil. The outside diameter (OD) of the outer

casing ranges from 1.75 to 2.4 inches and the OD of the inner sampling tube ranges from 1.1 to 1.8 inches. The outer casing isolates shallow layers and permits the unit to continue to probe at depth. The double-rod system provides a borehole that may be tremie-grouted from the bottom up. Alternatively, the inside diameter (ID) of the steel casing provides clearance for the installation of small-diameter (e.g., 0.75- to 1-inch ID) micro-wells. The procedures for installing monitoring wells in soil using the direct-push method are described below.

1. Locate boring/well location, establish work zone, and set up sample equipment decontamination area.

2. Advance soil boring to designated depth, collecting samples at intervals specified in the Work Plan. Samples will be collected using dedicated, disposable, plastic liners. Describe samples in accordance with the procedures outlined in Step 3 above. Collect samples for laboratory analysis as specified in the Work Plan and/or FSP.

3. Upon advancing the borehole to the desired depth, install the micro-well through the inner drill casing. The micro-well will consist of approximately 1-inch ID PVC or stainless steel slotted screen and blank riser. The sand pack, bentonite seal, and cement/bentonite grout will be installed as described, where applicable, in Step 7 and 8 above.

4. Install protective steel casing or flush-mount, as appropriate, as described in Step 9 above. During well installation, record construction details and tabulate materials used.

5. After completing the well installation, lock the well, clean the area, and dispose of materials in accordance with the procedures outlined in Section VII below.

Driven Well Point Installation

Well points will be installed by pushing or driving using a drilling rig or direct-push rig, or hand-driven where possible. The well point construction materials will consist of a 1- to 2-inch-diameter threaded steel casing with either 0.010- or 0.020-inch slotted stainless steel screen. The screen length will vary depending on the hydrogeologic conditions of the site. The casings will be joined together with threaded couplings and the terminal end will consist of a steel well point. Because they are driven or pushed to the desired depth, well points do not have annular backfill materials such as sand pack or grout.

VII. Waste Management

Investigation-derived wastes (IDW), including soil cuttings and excess drilling fluids (if used), decontamination liquids, and disposable materials (well material packages, PPE, etc.), will be placed in clearly labeled, appropriate containers, or managed as otherwise specified in the Work Plan, FSP, and/or IDW management SOP.

VIII. Data Recording and Management

Drilling activities will be documented in a field notebook. Pertinent information will include personnel present on site, times of arrival and departure, significant weather conditions, timing of well installation activities, soil descriptions, well construction specifications (screen and riser material and diameter, sump length, screen length and slot size, riser length, sand pack type), and quantities of materials used. In addition, the locations of newly-installed wells will be documented photographically or in a site sketch. If appropriate, a measuring wheel or engineer's tape will be used to determine approximate distances between important site features.

The well or piezometer location, ground surface elevation, and inner and outer casing elevations will be surveyed using the method specified in the site Work Plan. Generally, a local baseline control will be set up. This local baseline control can then be tied into the appropriate vertical and horizontal datum, such as the National Geodetic Vertical Datum of 1929 or 1988 and the State Plane Coordinate System. At a minimum, the elevation of the top of the inner casing used for water-level measurements should be measured to the nearest 0.01 foot. Elevations will be established in relation to the National Geodetic Vertical Datum of 1929. A permanent mark will be placed on top of the inner casing to mark the point for water-level measurements.

IX. Quality Assurance

All drilling equipment and associated tools (including augers, drill rods, sampling equipment, wrenches, and any other equipment or tools) that may have come in contact with soil will be cleaned in accordance with the procedures outlined in the appropriate SOP. Well materials will also be cleaned prior to well installation.

X. References

American Society of Testing and Materials (ASTM) D 1586 - *Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils*.

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Monitoring Well Development

Rev. #: 2.2

Rev. Date: March 22, 2010

Approval Signatures

Prepared by: _____ Date: 03/22/2010

Reviewed by: _____ Date: 03/22/2010
(Technical Expert)

I. Scope and Application

Monitoring wells (or piezometers, well points, or micro-wells) will be developed to clear them of fine-grained sediment to enhance the hydraulic connection between the well and the surrounding geologic formation. Development will be accomplished by evacuating well water by either pumping or bailing. Prior to pumping or bailing, the screened interval will be gently surged using a surge block, bailer, or inertia pump with optional surgeblock fitting as appropriate. Accumulated sediment in the bottom of the well (if present) will be removed by bailing with a bottom-loading bailer or via pumping using a submersible or inertia pump with optional surge-block fitting. Wells will also be gently brushed with a weighted brush to assist in removing loose debris, silt or flock attached to the inside of the well riser and/or screen prior to development. Pumping methods will be selected based on site-specific geologic conditions, anticipated well yield, water table depth, and groundwater monitoring objectives, and may include one or more of the following:

- submersible pump
- inertial pump (Waterra™ pump or equivalent)
- bladder pump
- peristaltic pump
- centrifugal pump

When developing a well using the pumping method, the pump (or, with inertial pumps, the tubing) is lowered to the screened portion of the well. During purging, the pump or tubing is moved up and down the screened interval until the well yields relatively clear water.

Submersible pumps have a motor-driven impeller that pushes the groundwater through discharge tubing to the ground surface. Inertial pumps have a check valve at the bottom of stiff tubing which, when operated up and down, lifts water to the ground surface. Bladder pumps have a bottom check valve and a flexible internal bladder that fills from below and is then compressed using pressurized air to force water out the top of the bladder through the discharge tubing to the ground surface. These three types of pumps have a wide range of applicability in terms of well depth and water depth.

Centrifugal and peristaltic pumps use atmospheric pressure to lift water from the well, and therefore can only be practically used where the depth to water is less than 25 feet.

II. Personnel Qualifications

Monitoring well development activities will be performed by persons who have been trained in proper well development procedures under the guidance of an experienced field geologist, engineer, or technician.

III. Equipment List

Materials for monitoring well development using a pump include the following:

- health and safety equipment, as required by the site Health and Safety Plan (HASP):
- cleaning equipment
- photoionization detector (PID) to measure headspace vapors
- pump
- polyethylene pump discharge tubing
- plastic sheeting
- power source (generator or battery)
- field notebook and/or personal digital assistant (PDA)
- graduated pails
- appropriate containers

- monitoring well keys
- water level indicator

Materials for monitoring well development using a bailer include the following:

- personal protective equipment (PPE) as required by the HASP
- cleaning equipment
- PID to measure headspace vapors
- bottom-loading bailer, sand bailer
- polypropylene or nylon rope
- plastic sheeting
- graduated pails
- appropriate containers
- keys to wells
- field notebook and/or PDA
- water level indicator
- weighted brush for well brushing

IV. Cautions

Where surging is performed to assist in removing fine-grained material from the sand pack, surging must be performed in a gentle manner. Excessive suction could promote fine-grained sediment entry into the outside of the sand pack from the formation.

Avoid using development fluids or materials that could impact groundwater or soil quality, or could be incompatible with the subsurface conditions.

In some cases it may be necessary to add potable water to a well to allow surging and development, especially for new monitoring wells installed in low permeability formations. Before adding potable water to a well, the Project Manager (PM) must be notified and the PM shall make the decision regarding the appropriateness and applicability of adding potable water to a well during well development procedures. If potable water is to be added to a well as part of development, the potable water source should be sampled and analyzed for constituents of concern, and the results evaluated by the PM prior to adding the potable water to the well. If potable water is added to a well for development purposes, at the end of development the well will be purged dry to remove the potable water, or if the well no longer goes dry then the well will be purged to remove at least three times the volume of potable water that was added.

V. Health and Safety Considerations

Field activities associated with monitoring well development will be performed in accordance with a site-specific HASP, a copy of which will be present on site during such activities.

VI. Procedure

The procedures for monitoring well development are described below. (Note: Steps 7, 8, and 10 can be performed at the same time using an inertial pump with a surge-block fitting.)

1. Don appropriate PPE (as required by the HASP).

2. Place plastic sheeting around the well.

3. Clean all equipment entering each monitoring well, except for new, disposable materials that have not been previously used.

4. Open the well cover while standing upwind of the well, remove well cap. Insert PID probe approximately 4 to 6 inches into the casing or the well headspace and cover with gloved hand. Record the PID reading in the field notebook. If the well headspace reading is less than 5 PID units, proceed; if the headspace reading is greater than 5 PID units, screen the air within the breathing zone. If the PID reading in the breathing zone is below 5 PID units, proceed. If the PID reading is above 5 PID units, move upwind from well for 5 minutes to allow the volatiles to dissipate. Repeat the breathing zone test. If the reading is still above 5 PID units, don the appropriate respiratory protection in accordance with the requirements of the HASP. Record all PID readings.

5. Obtain an initial measurement of the depth to water and the total well depth from the reference point at the top of the well casing. Record these measurements in the field log book.

6. Prior to redeveloping older wells that may contain solid particulate debris along the inside of the well casing and screen, gently lower and raise a weighted brush along the entire length of the well screen and riser to free and assist in removing loose debris, silt or flock. Perform a minimum of 4 “passes” along the screened and cased intervals of the well below the static water level in the well. Allow the resulting suspended material to settle for a minimum of one day prior to continuing with redevelopment activities.

7. Lower a surge block or bailer into the screened portion of the well. Gently raise and lower the surge block or bailer within the screened interval of the well to force water in and out of the screen slots and sand pack. Continue surging for 15 to 30 minutes.

8. Lower a bottom-loading bailer, submersible pump, or inertia pump tubing with check valve to the bottom of the well and gently bounce the bailer, pump, pump tubing on the bottom of the well to collect/remove accumulated sediment, if any. Remove and empty the bailer, if used. Repeat until the bailed/pumped water is free of excessive sediment and the bottom of the well feels solid. Alternatively, measurement of the well depth with a water level indicator can be used to verify that sediment and/or silt has been removed to the extent practicable, based on a comparison with the well installation log or previous measurement of total well depth.

9. After surging the well and removing excess accumulated sediment from the bottom of the well, re-measure the depth-to-water and the total well depth from the reference point at the top of the well casing. Record these measurements in the field log book.

10. Remove formation water by pumping or bailing. Where pumping is used, measure and record the pre-pumping water level. Operate the pump at a relatively constant rate. Measure the pumping rate using a calibrated container and stop watch, and record the pumping rate in the field log book. Measure and record the water level in the well at least

once every 5 minutes during pumping. Note any relevant observations in terms of water color, visual level of turbidity, sheen, odors, etc. Pump or bail until termination criteria specified in the Field Sampling Plan (FSP) are reached. Record the total volume of water purged from the well.

11. If the well goes dry, stop pumping or bailing. Note the time that the well went dry. After allowing the well to recover, note the time and depth to water. Resume pumping or bailing when sufficient water has recharged the well.

12. Contain all water in appropriate containers.

13. When complete, secure the lid back on the well.

14. Place disposable materials in plastic bags for appropriate disposal and decontaminate reusable, downhole pump components and/or bailer.

VII. Waste Management

Materials generated during monitoring well installation and development will be placed in appropriate labeled containers and disposed of as described in the Work Plan or Field Sampling Plan.

VIII. Data Recording and Management

Well development activities will be documented in a proper field notebook and/or PDA. Pertinent information will include personnel present on site; times of arrival and departure; significant weather conditions; timing of well development activities; development method(s); observations of purge water color, turbidity, odor, sheen, etc.; purge rate; and water levels before and during pumping.

IX. Quality Assurance

All reused, non-disposable, downhole well development equipment will be cleaned in accordance with the procedures outlined in the Field Equipment Cleaning-Decontamination SOP.

X. References

Not applicable.

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Drilling Procedures for Collecting and Screening of Soil Samples

Rev. #: 2

Rev Date: March 24, 2008

Approval Signatures

Prepared by: _____ Date: _____

Reviewed by: _____ Date: _____
(Technical Expert)

I. Scope and Application

This Standard Operating Procedure (SOP) describes the collection and field screening of soils samples using a truck- or track-mounted drill rig using the hollow-stem auger, drive and wash, or mud/water rotary drilling methods after completion of utility clearance procedures. Field screening of the soil samples upon collection may be conducted using a photoionization detector (PID) and/or a flame ionization detector (FID). These instruments are used to measure relative concentrations of volatile organic compounds (VOCs) for the selection of samples for further laboratory or field analysis.

II. Personnel Qualifications

The Project Manager (a qualified geologist, environmental scientist, or engineer) will identify the appropriate soil boring locations, depth and soil sample intervals in a written plan.

Personnel responsible for overseeing drilling operations must have at least 16 hours of prior training overseeing drilling activities with an experienced geologist, environmental scientist, or engineer with at least 2 years of prior experience.

III. Equipment List

- appropriate health and safety equipment;
- PID and FID;
- air-tight sample containers, 8-oz. glass Mason jars or driller's jars, and 40 mL headspace vials;
- aluminum foil;
- extra batteries for the PID;
- calibration gases and regulators;
- spare filter cartridges;
- field notebook and appropriate screening forms; and
- indelible ink pens.

IV. Cautions

Avoid using drilling fluids or materials that could impact groundwater or soil quality, or could be incompatible with the subsurface conditions.

Water used for drilling and sampling of soil or bedrock, decontamination of drilling/sampling equipment, or grouting boreholes upon completion will be of a quality acceptable for project objectives. Testing of water supply should be considered.

Specifications of materials used for backfilling bore hole will be obtained, reviewed and approved to meet project quality objectives.

V. Health and Safety Considerations

To be completed by Preparer and reviewed by Technical Expert.

VI. Procedure

All soil samples will be field screened upon collection with a PID for a relative measure of the total VOCs. Initial PID readings will be recorded in the surface log or field notebook. The true soil sample will be separated from the wash material (if any) by using disposable gloves and a pre-cleaned stainless steel spoon. A representative portion of the sample will be placed in a pre-cleaned air-tight 8-ounce and 40 mL sampling container (as quickly as possible to avoid loss of VOCs), filling the containers half full to allow for the accumulation of vapors above the soil. For the glass 8-ounce jar, an aluminum foil seal will be placed between the glass and metal cap and the cap will be screwed on tightly. For the 40-mL vial, a Teflon septum cap will be placed between the glass and the plastic threaded lid. The sample containers will be stored in a cooler chilled to approximately 4ºC until screening.

Upon completion of sample collection, the headspace of the 8-ounce sample jars will be measured using a PID as follows:

1. Samples will be taken to a warm work space and allowed to equilibrate to room temperature for at least one hour.

2. Prior to measuring the soil vapor headspace concentration, the 8-ounce jar will be shaken.

3. The headspace of the sample will then be measured directly from the 8-ounce sample container with the PID by piercing the aluminum foil seal with the probe

of the PID and measuring the relative concentration of VOCs in the headspace of the soil sample. The initial (peak) reading must be recorded.

Upon completion of sample collection, the headspace of the 40 mL sample vial will be measured using an FID as follows:

1. The 40 mL vials will be placed in a hot water bath for an equal and pre-determined period of time (estimated at 15 minutes).

2. A gas-tight syringe will be used to pierce the teflon septum to extract a volume of headspace (.1 to .5 mL) from the vial.

3. The headspace sample will then be injected directly into the FID of an OVA with a GC attachment. The septum injection port of the OVA should be set on the total field mode. The reading will be recorded on the field screening forms and/or in the field notebook. If a peak is noted in total field mode, a duplicate sample will be injected with the OVA in GC mode and recorded on the strip chart recorder. The retention time will be noted on the GC strip chart, along with the date, time of injection, and the sample identification.

The PID will be calibrated to a benzene-related compound (isobutylene). The FID will be calibrated to methane. The FID/PID must be calibrated according to the manufacturer's specifications at a minimum frequency of once per day prior to collecting FID/PID readings. The time, date, and calibration procedure must be clearly documented in the field notebook and/or the calibration log book. If at any time the FID/PID results appear erratic or inconsistent with field observations, then the unit will be recalibrated. If calibration is difficult to achieve, then the PID's lamp should be checked for dirt or moisture and cleaned. During humid or wet conditions, the unit should be calibrated on a more frequent basis as determined by field personnel. In addition, a blank and a field duplicate will be performed every 10 samples. Maintenance and calibration records will be kept as part of the field quality assurance program.

Sampling for Laboratory Analysis Procedures

Samples will be selected for laboratory analysis based on:

1. Their position in relation to identified source areas;

2. The visual presence of source residues;

3. The relative levels of total VOCs based on field screening measurements; and/or

4. The judgment of the field coordinator.

Samples designated for laboratory analysis will be placed in the appropriate containers. Sample containers for VOC analysis will be filled first. Next, a sufficient amount of the remaining soil will be homogenized by mixing in a stainless steel tray with a clean stainless steel trowel. Then sample containers will be filled for SVOCs, metals, cyanide, and, lastly, for PCBs. For every 20 soil samples obtained, a duplicate soil sample will be obtained by splitting the sample into two sets of sample containers.

VII. Waste Management

Soil cuttings brought to the ground surface during the drilling activities will be handled based on the location of the boring, a visual assessment of the soil, and PID field screening. Soil cuttings from borings located on asphalt or landscaped ground surfaces will be contained in labeled and dated Department of Transportation (DOT)-approved 55-gallon drums. Soil cuttings from borings drilled within the SWMU/disposal areas will be examined and screened with a PID. Soil cuttings will be discarded at ground surface if the soil cuttings consist of cover material above the SWMU/disposal area and no relatively elevated PID readings are measured. If wastes are encountered in the SWMU/disposal area and/or relatively elevated PID readings are measured the soils will be contained in labeled and dated DOT-approved 55-gallon DOT drums.

VIII. Data Recording and Management

A field survey control program will be conducted by a qualified survey crew using standard instrument survey techniques to document boring locations.

IX. Quality Assurance

Equipment cleaning will occur prior to use on the site, between each drilling location, and upon completion of the drilling prior to leaving the site. All drilling equipment and associated tools including augers, drill rods, sampling equipment, wrenches, and any other equipment or tools that may have come in contact with the soils will be cleaned with high-pressure steam cleaning equipment using a tap water source. The drilling equipment will be cleaned after each boring in an area designated by the field coordinator or supervising geologist. Cleaning water will be contained within a water-tight, lined cleaning area. The solids collected on the floor of the cleaning area will be stored in separate labeled and dated DOT-approved 55-gallon drums.

X. References

To be completed by Preparer and reviewed by Technical Expert.

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Soil Description

Rev. #: 0

Rev Date: May 20, 2008

Approval Signatures

Prepared by: _____ Date: 5/22/08

Reviewed by: _____ Date: 5/22/08
(Technical Expert)

I. Scope and Application

This ARCADIS standard operating procedure (SOP) describes proper soil description procedures. This SOP should be followed for all unconsolidated material unless there is an established client-required specific SOP or regulatory-required specific SOP. In cases where there is a required specific SOP, it should be followed and should be referenced and/or provided as an appendix to reports that include soil classifications and/or boring logs. When following a required non-ARCADIS SOP, additional information required by this SOP should be included in field notes with client approval.

This SOP has been developed to emphasize field observation and documentation of details required to:

- make hydrostratigraphic interpretations guided by depositional environment/geologic settings;

- provide information needed to understand the distribution of constituents of concern; properly design wells, piezometers, and/or additional field investigations; and develop appropriate remedial strategies.

This SOP incorporates elements from various standard systems such as ASTM D2488-06, Unified Soil Classification System, Burmister and Wentworth. However, none of these standard systems focus specifically on contaminant hydrogeology and remedial design. Therefore, although each of these systems contain valuable guidance and information related to correct descriptions, strict application of these systems can omit information critical to our clients and the projects that we perform.

This SOP does not address details of health and safety; drilling method selection; boring log preparation; sample collection; or laboratory analysis. Refer to other ARCADIS SOPS, the project work plans including the quality assurance project plan, sampling plan, and health and safety plan (HASP), as appropriate.

II. Personnel Qualifications

Soil descriptions will be completed only by persons who have been trained in ARCADIS soil description procedures. Field personnel will complete training on the ARCADIS soil description SOP in the office and/or in the field under the guidance of an experienced field geologist. For sites where soil descriptions have not previously been well documented, soil descriptions should be performed only by trained persons with a degree in geology or a geology-related discipline.

III. Equipment List

The following equipment should be taken to the field to facilitate soil descriptions:

- field book, field forms or PDA to record soil descriptions;
- field book for supplemental notes;
- this SOP for Soil Descriptions and any project-specific SOP (if required);
- field card showing Wentworth scale;
- Munsell® soil color chart;
- tape measure divided into tenths of a foot;
- stainless steel knife or spatula;
- hand lens;
- water squirt bottle;
- jar with lid;
- personal protective equipment (PPE), as required by the HASP; and
- digital camera.

IV. Cautions

Drilling and drilling-related hazards including subsurface utilities are discussed in other SOPs and site-specific HASPs and are not discussed herein.

Soil samples may contain hazardous substances that can result in exposure to persons describing soils. Routes for exposure may include dermal contact, inhalation and ingestion. Refer to the project specific HASP for guidance in these situations.

V. Health and Safety Considerations

Field activities associated with soil sampling and description will be performed in accordance with a site-specific HASP, a copy of which will be present on site during such activities. Know what hazardous substances may be present in the soil and understand their hazards. Always avoid the temptation to touch soils with bare hands, detect odors by placing soils close to your nose, or tasting soils.

VI. Procedure

1. Select the appropriate sampling method to obtain representative samples in accordance with the selected sub-surface exploration method, e.g. split-spoon or Shelby sample for hollow-stem drilling, Lexan or acetate sleeves for dual-tube direct push, etc.

2. Proceed with field activities in required sequence. Although completion of soil descriptions is often not the first activity after opening sampler, identification of stratigraphic changes is often necessary to select appropriate intervals for field screening and/or selection of laboratory samples.

3. Examine all of each individual soil sample (this is different than examining each sample selected for laboratory analysis), and record the following for each stratum:

- depth interval;
- principal component with descriptors, as appropriate;
- amount and identification of minor component(s) with descriptors as appropriate;
- moisture;
- consistency/density;
- color; and
- additional description or comments (recorded as notes).

The above is described more fully below.

DEPTH

To measure and record the depth below ground level (bgl) of top and bottom of each stratum, the following information should be recorded.

1. Measured depth to the top and bottom of sampled interval. Use starting depth of sample based upon measured tool length information and the length of sample interval.

2. Length of sample recovered, not including slough (material that has fallen into hole from previous interval), expressed as fraction with length of recovered sample as numerator over length of sampled interval as denominator (e.g. 14/24 for 14 inches recovered from 24-inch sampling interval that had 2 inches of slough discarded).

3. Thickness of each stratum measured sequentially from the top of recovery to the bottom of recovery.

4. Any observations of sample condition or drilling activity that would help identify whether there was loss from the top of the sampling interval, loss from the bottom of the sampling interval, or compression of the sampling interval. Examples: 14/24, gravel in nose of spoon; or 10/18 bottom 6 inches of spoon empty.

DETERMINATION OF COMPONENTS

Obtain a representative sample of soil from a single stratum. If multiple strata are present in a single sample interval, each stratum should be described separately. More specifically, if the sample is from a 2-foot long split-spoon where strata of coarse sand, fine sand and clay are present, then the resultant description should be of the three individual strata unless a combined description can clearly describe the interbedded nature of the three strata. Example: Fine Sand with interbedded lenses of Silt and Clay, ranging between 1 and 3 inches thick.

Identify principal component and express volume estimates for minor components on logs using the following standard modifiers.

Modifier	Percent of Total Sample (by volume)
and	36 - 50
some	21 - 35
little	10 - 20
trace	<10

Determination of components is based on using the Udden-Wentworth particle size classification (see below) and measurement of the average grain size diameter. Each size grade or class differs from the next larger grade or class by a constant ratio of ½. Due to visual limitations, the finer classifications of Wentworth's scale cannot be distinguished in the field and the subgroups are not included. Visual determinations in the field should be made carefully by comparing the sample to the field gauge card that shows Udden-Wentworth scale or by measuring with a ruler. Use of field sieves s

recommended to assist in estimating percentage of coarse grain sizes. Settling test or wash method (Appendix X4 of ASTM D2488) is recommended for determining presence and estimating percentage of clay and silt.

Udden-Wenworth Scale Modified ARCADIS, 2008			
Size Class	Millimeters	Inches	Standard Sieve #
Boulder	256 – 4096	10.08+	
Large cobble	128 - 256	5.04 -10.08	
Small cobble	64 - 128	2.52 – 5.04	
Very large pebble	32 – 64	0.16 - 2.52	
Large pebble	16 – 32	0.63 – 1.26	
Medium pebble	8 – 16	0.31 – 0.63	
Small pebble	4 – 8	0.16 – 0.31	No. 5 +
Granule	2 – 4	0.08 – 0.16	No.5 – No.10
Very coarse sand	1 -2	0.04 – 0.08	No.10 – No.18
Coarse sand	½ - 1	0.02 – 0.04	No.18 - No.35
Medium sand	¼ - ½	0.01 – 0.02	No.35 - No.60
Fine sand	1/8 -¼	0.005 – 0.1	No.60 - No.120
Very fine sand	1/16 – 1/8	0.002 – 0.005	No. 120 – No. 230
Silt (subgroups not included)	1/256 – 1/16	0.0002 – 0.002	Not applicable (analyze by pipette or hydrometer)
Clay (subgroups not included	1/2048 – 1/256	.00002 – 0.0002	

Identify components as follows. Remove particles greater than very large pebbles (64-mm diameter) from the soil sample. Record the volume estimate of the greater than very large pebbles. Examine the sample fraction of very large pebbles and smaller particles and estimate the volume percentage of the pebbles, granules, sand, silt and clay. Use the jar method, visual method, and/or wash method (Appendix X4 of ASTM D2488) to estimate the volume percentages of each category.

Determination of actual dry weight of each Udden-Wentworth fraction requires laboratory grain-size analysis using sieve sizes corresponding to Udden-Wentworth fractions and is highly recommended to determine grain-size distributions for each hydrostratigraphic unit.

Lab or field sieve analysis is advisable to characterize the variability and facies trends within each hydrostratigraphic unit. Field sieve-analysis can be performed on selected samples to estimate dry weight fraction of each category using ASTM D2488 Standard Practice for Classification of Soils for Engineering Purposes as guidance, but replace required sieve sizes with the following Udden-Wentworth set: U.S. Standard sieve mesh sizes 6; 12; 20; 40; 70; 140; and 270 to retain pebbles; granules; very coarse sand; coarse sand; medium sand; fine sand; and very fine sand, respectively.

PRINCIPAL COMPONENT

The principal component is the size fraction or range of size fractions containing the majority of the volume. Examples: the principal component in a sample that contained 55% pebbles would be “Pebbles”; or the principal component in a sample that was 20% fine sand, 30% medium sand and 25% coarse sand would be “Fine to coarse Sand” or for a sample that was 40% silt and 45% clay the principal component would be “Clay and Silt”.

Include appropriate descriptors with the principal component. These descriptors vary for different particle sizes as follows.

Angularity – Describe the angularity for very coarse sand and larger particles in accordance with the table below (ASTM D-2488-06). Figures showing examples of angularity are available in ASTM D-2488-06 and the ARCADIS Soil Description Field Guide.

Description	Criteria
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces.
Subangular	Particles are similar to angular description but have rounded edges.
Subrounded	Particles have nearly plane sides but have well-rounded corners and edges.
Rounded	Particles have smoothly curved sides and no edges.

Plasticity – Describe the plasticity for silt and clay based on observations made during the following test method (ASTM D-2488-06).

- As in the dilatancy test below, select enough material to mold into a ball about ½ inch (12 mm) in diameter. Mold the material, adding water if necessary, until it has a soft, but not sticky, consistency.

- Shape the test specimen into an elongated pat and roll by hand on a smooth surface or between the palms into a thread about 1/8 inch (3 mm) in diameter. (If the sample is too wet to roll easily, it should be spread into a thin layer and allowed to lose some water by evaporation.) Fold the sample threads and reroll repeatedly until the thread crumbles at a diameter of about 1/8 inch. The thread will crumble when the soil is near the plastic limit.

Description	Criteria
Nonplastic	A $^{1}/_{8}$ inch (3 mm) thread cannot be rolled at any water content.
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit

Dilatancy – Describe the dilatancy for silt and silt-sand mixtures using the following field test method (ASTM D-2488-06).

- From the specimen select enough material to mold into a ball about ½ inch (12 mm) in diameter. Mold the material adding water if necessary, until it has a soft, but not sticky, consistency.
- Smooth the ball in the palm of one hand with a small spatula.
- Shake horizontally, striking the side of the hand vigorously with the other hand several times.
- Note the reaction of water appearing on the surface of the soil.
- Squeeze the sample by closing the hand or pinching the soil between the fingers, and not the reaction as none, slow, or rapid in accordance with the table below. The reaction is the speed with which water appears while shaking and disappears while squeezing.

Description	Criteria
None	No visible change in the specimen.
Slow	Water appears slowly on the surface of the specimen during shaking and does not disappear or disappears slowly upon squeezing.
Rapid	Water appears quickly on the surface of the specimen during shaking and disappears quickly upon squeezing.

MINOR COMPONENT(S)

The minor component(s) are the size fraction(s) containing less than 50% volume. Example: the identified components are estimated to be 60% medium sand to granules, 25 % silt and clay; 15 % pebbles – there are two identified minor components: silt and clay; and pebbles.

Include a standard modifier to indicate percentage of minor components (see Table on Page 5) and the same descriptors that would be used for a principal component. Plasticity should be provided as a descriptor for the silt and clay. Dilatancy should be provided for silt and silt-sand mixtures. Angularity should be provided as a descriptor for pebbles and coarse sand. For the example above, the minor constituents with

modifiers could be: some silt and clay, low plasticity; little medium to large pebbles, sub-round.

SORTING

Sorting is the opposite of grading, which is a commonly used term in the USCS or ASTM methods to describe the uniformity of the particle size distribution in a sample. Well-sorted samples are poorly graded and poorly sorted samples are well graded. ARCADIS prefers the use of sorting for particle size distributions and grading to describe particle size distribution trends in the vertical profile of a sample or hydrostratigraphic unit because of the relationship between sorting and the energy of the depositional process. For soils with sand-sized or larger particles, sorting should be determined as follows:

- Well sorted – the range of particle sizes is limited (e.g. the sample is comprised of predominantly one or two grain sizes)
- Poorly sorted – a wide range of particle sizes are present

You can also use sieve analysis to estimate sorting from a sedimentological perspective; sorting is the statistical equivalent of standard deviation. Smaller standard deviations correspond to higher degree of sorting (see Remediation Hydraulics, 2008).

MOISTURE

Moisture content should be described for every sample since increases or decreases in water content is critical information. Moisture should be described in accordance with the table below (percentages should not be used unless determined in the laboratory).

Description	Criteria
Dry	Absence of moisture, dry to touch, dusty.
Moist	Damp but no visible water.
Wet (Saturated)	Visible free water, soil is usually below the water table.

CONSISTENCY or DENSITY

This can be determined by standard penetration test (SPT) blow counts (ASTM D-1586) or field tests in accordance with the tables below. For SPT blow counts the N-value is used. The N-value is the blows per foot for the 6" to 18" interval. Example: for 24-inch spoon, recorded blows per 6-inch interval are: 4/6/9/22. Since the second interval is 6" to12", the third interval is 12" to 18", the N value is 6+9, or 15. Fifty blow counts for less than 6 inches is considered refusal.

Fine-grained soil – Consistency

Description	Criteria
Very soft	N-value < 2 or easily penetrated several inches by thumb.
Soft	N-value 2-4 or easily penetrated one inch by thumb.
Medium stiff	N-value 9-15 or indented about ¼ inch by thumb with great effort.
Very stiff	N-value 16-30 or readily indented by thumb nail.
Hard	N-value > than 30 or indented by thumbnail with difficulty

Coarse-grained soil – Density

Description	Criteria
Very loose	N-value 1- 4
Loose	N-value 5-10
Medium dense	N-value 11-30
Dense	N-value 31- 50
Very dense	N-value >50

COLOR

Color should be described using simple basic terminology and modifiers based on the Munsell system. Munsell alpha-numeric codes are required for all samples. If the sample contains layers or patches of varying colors this should be noted and all representative colors should be described. The colors should be described for moist

samples. If the sample is dry it should be wetted prior to comparing the sample to the Munsell chart.

ADDITIONAL COMMENTS (NOTES)

Additional comments should be made where observed and should be presented as notes with reference to a specific depth interval(s) to which they apply. Some of the significant information that may be observed includes the following.

- **Odor** - You should not make an effort to smell samples by placing near your nose since this can result in unnecessary exposure to hazardous materials. However, odors should be noted if they are detected during the normal sampling procedures. Odors should be based upon descriptors such as those used in NIOSH “Pocket Guide to Chemical Hazards”, e.g. “pungent” or “sweet” and should not indicate specific chemicals such as “phenol-like” odor or “BTEX” odor.

- Structure

- Bedding planes (laminated, banded, geologic contacts)

- Presence of roots, root holes, organic material, man-made materials, minerals, etc.

- Mineralogy

- Cementation

- NAPL presence/characteristics, including sheen (based on client-specific guidance)

- Reaction with HCl (typically used only for special soil conditions)

- Origin, if known (capital letters: LACUSTRINE; FILL; etc.)

EXAMPLE DESCRIPTIONS

51.4 to 54.0' Clay, some silt, medium to high plasticity; trace small to large pebbles, subround to subangular up to 2" diameter; moist; stiff; dark grayish brown (10YR 4/2) NOTE: Lacustrine; laminated 0.01 to 0.02 feet thick, laminations brownish yellow (10 YR 4/3).

32.5 to 38.0' Sand, medium to Pebbles, coarse; sub-round to sub-angular; trace silt; poorly sorted; wet; grayish brown (10YR5/2). NOTE: sedimentary, igneous and metamorphic particles.

Unlike the first example where a density of cohesive soils could be estimated, this rotosonic sand and pebble sample was disturbed during drilling (due to vibrations in a loose Sand and Pebble matrix) so no density description could be provided. Neither sample had noticeable odor so odor comments were not included.

The standard generic description order is presented below.

- Depth

- Principal Components
    - Angularity for very coarse sand and larger particles
    - Plasticity for silt and clay
    - Dilatancy for silt and silt-sand mixtures
- Minor Components
- Sorting
- Moisture
- Consistency or Density
- Color
- Additional Comments

VII. Waste Management

Project-specific requirements should be identified and followed. The following procedures, or similar waste management procedures are generally required.

Water generated during cleaning procedures will be collected and contained onsite in appropriate containers for future analysis and appropriate disposal. PPE (such as gloves, disposable clothing, and other disposable equipment) resulting from personnel cleaning procedures and soil sampling/handling activities will be placed in plastic bags. These bags will be transferred into appropriately labeled 55-gallon drums or a covered roll-off box for appropriate disposal.

Soil materials will be placed in sealed 55-gallon steel drums or covered roll-off boxes and stored in a secured area. Once full, the material will be analyzed to determine the appropriate disposal method.

VIII. Data Recording and Management

Upon collection of soil samples, the soil sample should be logged on a standard boring log and/or in the field log book depending on Data Quality Objectives (DQOs) for the task/project. Two examples of standard boring logs are presented below.

The general scheme for soil logging entries is presented above; however, depending on task/project DQOs, specific logging entries that are not applicable to task/project goals may be omitted at the project manager's discretion. In any case, use of a consistent logging procedure is required.

Completed logs and/or logbook will be maintained in the task/project field records file. Digital photographs of typical soil types observed at the site and any unusual features should be obtained whenever possible. All photographs should include a ruler or common object for scale. Photo location, depth and orientation must be recorded in the daily log or log book and a label showing this information in the photo is useful.

ARCADIS Page _____ of _____

Sample Log

Well/Boring _____ Project Name and No. _____

Site Location _____ Drilling Started _____ Drilling Completed _____

Total Depth Drilled _____ feet Hole Diameter _____ inches Sampling Interval _____ feet

Length and Diameter of Sampling Device _____ Type of Sampling Device _____

Drilling Method _____ Drilling Fluid Used _____

Drilling Contractor _____ Driller _____ Helper _____

Prepared By _____ Hammer Weight _____ Hammer Drop _____ inches

Sample Depth (feet below land surface) From	To	Sample Recovery (feet)	Time/Hydraulic Pressure or Blows per 6 inches	Sample Description	PID (ppm)

IX. Quality Assurance

Soil descriptions should be completed only by appropriately trained personnel. Descriptions should be reviewed by an experienced field geologist for content, format and consistency. Edited boring logs should be reviewed by the original author to assure that content has not changed.

X. References

ARCADIS Soil Description Field Guide, 2008 (in progress)

Munsell® Color Chart – available from Forestry Suppliers, Inc.- Item 77341 "Munsell® Color Soil Color Charts

Field Gauge Card that Shows Udden-Wentworth scale – available from Forestry Suppliers, Inc. – Item 77332 "Sand Grain Sizing Folder"

ASTM D-1586, Test Method for Penetration Test and Split-Barrel Sampling of Soils

ASTM D-2488-00, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)

United States Bureau of Reclamation. Engineering Geology Field Manual. United States Department of Interior, Bureau of Reclamation. http://www.usbr.gov/pmts/geology/fieldmap.htm

Petrology of Sedimentary Rocks, Robert L. Folk, 1980, p. 1-48

NIOSH Pocket Guide to Chemical Hazards

Remediation Hydraulics, Fred C. Payne, Joseph A. Quinnan, and Scott T. Potter, 2008, p 59-63

ARCADIS
Infrastructure, environment, facilities

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Low-Flow Groundwater Purging and Sampling Procedures for Monitoring Wells

Rev. #: 4

Rev Date: February 2, 2011

Approval Signatures

Prepared by: _____ Date: 2/2/2011

Reviewed by: _____ Date: 2/2/2011

(Technical Expert)

I. Scope and Application

Groundwater samples will be collected from monitoring wells to evaluate groundwater quality. The protocol presented in this standard operating procedure (SOP) describes the procedures to be used to purge monitoring wells and collect groundwater samples. This protocol has been developed in accordance with the United States Environmental Protection Agency (USEPA) Region I Low Stress (Low Flow) Purging and Sampling Procedures for the Collection of Groundwater Samples from Monitoring Wells (USEPA SOP No. GW0001; July 30, 1996). Both filtered and unfiltered groundwater samples may be collected using this low-flow sampling method. Filtered samples will be obtained using a 0.45-micron disposable filter. No wells will be sampled until well development has been performed in accordance with the procedures presented in the SOP titled Monitoring Well Development, unless that well has been sampled or developed within the prior 1-year time period. Groundwater samples will not be collected within 1 week following well development.

II. Personnel Qualifications

ARCADIS personnel directing, supervising, or leading groundwater sample collection activities should have a minimum of 2 years of previous groundwater sampling experience. ARCADIS personnel providing assistance to groundwater sample collection and associated activities should have a minimum of 6 months of related experience or an advanced degree in environmental sciences, engineering, hydrogeology, or geology.

The supervisor of the groundwater sampling team will have at least 1 year of previous supervised groundwater sampling experience.

Prior to mobilizing to the field, the groundwater sampling team should review and be thoroughly familiar with relevant site-specific documents including but not limited to the site work plan, field sampling plan, QAPP, HASP, and historical information. Additionally, the groundwater sampling team should review and be thoroughly familiar with documentation provided by equipment manufacturers for all equipment that will be used in the field prior to mobilization.

III. Equipment List

Specific to this activity, the following materials (or equivalent) will be available:

- Health and safety equipment (as required in the site Health and Safety Plan [HASP]).

- Site Plan, well construction records, prior groundwater sampling records (if available).
- Sampling pump, which may consist of one or more of the following:
  - submersible pump (e.g., Grundfos Redi-Flo 2);
  - peristaltic pump (e.g., ISCO Model 150); and/or
  - bladder pump (e.g., Marschalk System 1, QED Well Wizard, Geotech, etc.).
- Appropriate controller and power source for pump:
  - Submersible and peristaltic pumps require electric power from either a generator or a deep cell battery.
  - Submersible pumps such as Grundfos require a pump controller to run the pump
  - Bladder pumps require a pump controller and a gas source (e.g., air compressor or compressed N_2 or CO_2 gas cylinders).
- Teflon® tubing or Teflon®-lined polyethylene tubing of an appropriate size for the pump being used. For peristaltic pumps, dedicated Tygon® tubing (or other type as specified by the manufacturer) will also be used through the pump apparatus.
- Water-level probe (e.g., Solinist Model 101).
- Water-quality (temperature/pH/specific conductivity/ORP/turbidity/dissolved oxygen) meter and flow-through measurement cell. Several brands may be used, including:
  - YSI 6-Series Multi-Parameter Instrument;
  - Hydrolab Series 3 or Series 4a Multiprobe and Display; and/or
  - Horiba U-10 or U-22 Water Quality Monitoring System.
- Supplemental turbidity meter (e.g., Horiba U-10, Hach 2100P, LaMotte 2020). Turbidity measurements collected with multi-parameter meters have been shown to sometimes be unreliable due to fouling of the optic lens of the

turbidity meter within the flow-through cell. A supplemental turbidity meter will be used to verify turbidity data during purging if such fouling is suspected. Note that industry improvements may eliminate the need for these supplemental measurements in the future.

- Appropriate water sample containers (supplied by the laboratory).
- Appropriate blanks (trip blank supplied by the laboratory).
- 0.45-micron disposable filters (if field filtering is required).
- Large glass mixing container (if sampling with a bailer).
- Teflon® stirring rod (if sampling with a bailer).
- Cleaning equipment.
- Groundwater sampling log (attached) or bound field logbook.

Note that in the future, the client may acquire different makes/models of some of this equipment if the listed makes/models are no longer available, or as a result of general upgrades or additional equipment acquisitions. In the event that the client uses a different make/model of the equipment listed, the client will use an equivalent type of equipment (e.g., pumps, flow-through analytical cells) and note the specific make/model of the equipment used during a sampling event on the groundwater sampling log. In addition, should the client desire to change to a markedly different sampling methodology (e.g., discrete interval samplers, passive diffusion bags, or a yet to be developed technique), the client will submit a proposed SOP for the new methodology for USEPA approval prior to implementing such a change.

The maintenance requirements for the above equipment generally involve decontamination or periodic cleaning, battery charging, and proper storage, as specified by the manufacturer. For operational difficulties, the equipment will be serviced by a qualified technician.

IV. Cautions

If heavy precipitation occurs and no cover over the sampling area and monitoring well can be erected, sampling must be discontinued until adequate cover is provided. Rain water could contaminate groundwater samples.

Do not use permanent marker or felt-tip pens for labels on sample container or sample coolers – use indelible ink. The permanent markers could introduce volatile constituents into the samples.

It may be necessary to field filter some parameters (e.g., metals) prior to collection, depending on preservation, analytical method, and project quality objectives.

Store and/or stage empty and full sample containers and coolers out of direct sunlight.

To mitigate potential cross-contamination, groundwater samples are to be collected in a pre-determined order from least impacted to impacted based on previous analytical data. If no analytical data are available, samples are collected in order of upgradient, then furthest downgradient to source area locations.

Be careful not to over-tighten lids with Teflon liners or septa (e.g., 40 mL vials). Over-tightening can cause the glass to shatter or impair the integrity of the Teflon seal.

V. Health and Safety Considerations

Use caution and appropriate cut resistant gloves when tightening lids to 40 mL vials. These vials can break while tightening and can lacerate hand. Amber vials (thinner glass) are more prone to breakage.

If thunder or lighting is present, discontinue sampling and take cover until 30 minutes have passed after the last occurrence of thunder or lighting.

Use caution when removing well caps as well may be under pressure, cap can dislodge forcefully and cause injury.

Use caution when opening protective casing on stickup wells as wasps frequently nest inside the tops of the covers. Also watch for fire ant mounds near well pads when sampling in the south or western U.S.

VI. Procedure

Groundwater will be purged from the wells using an appropriate pump. Peristaltic pumps will initially be used to purge and sample all wells when applicable. If the depth to water is below the sampling range of a peristaltic pump (approximately 25 feet), submersible pumps or bladder pumps will be used provided the well is constructed with a casing diameter greater than or equal to 2 inches (the minimum well diameter capable of accommodating such pumps). Bladder pumps are preferred over peristaltic and submersible pumps if sampling of VOCs is required to prevent volatilization. For smaller diameter wells where the depth to water is below the sampling range of a

peristaltic pump, alternative sampling methods (i.e., bailing or small diameter bladder pumps) will be used to purge and sample the groundwater. Purge water will be collected and containerized.

1. Calibrate field instruments according to manufacturer procedures for calibration.

2. Measure initial depth to groundwater prior to placement of pumps.

3. Prepare and install pump in well: For submersible and non-dedicated bladder pumps, decontaminate pump according to site decontamination procedures. Non-dedicated bladder pumps will require a new Teflon® bladder and attachment of an air line, sample discharge line, and safety cable prior to placement in the well. Attach the air line tubing to the air port on the top of the bladder pump. Attach the sample discharge tubing to the water port on the top of the bladder pump. Care should be taken not to reverse the air and discharge tubing lines during bladder pump set-up as this could result in bladder failure or rupture. Attach and secure a safety cable to the eyebolt on the top of bladder pump (if present, depending on pump model used). Slowly lower pump, safety cable, tubing, and electrical lines into the well to a depth corresponding to the approximate center of the saturated screen section of the well. Take care to avoid twisting and tangling of safety cable, tubing, and electrical lines while lowering pump into well; twisted and tangled lines could result in the pump becoming stuck in the well casing. Also, make sure to keep tubing and lines from touching the ground or other surfaces while introducing them into the well as this could lead to well contamination. If a peristaltic pump is being used, slowly lower the sampling tubing into the well to a depth corresponding to the approximate center of the saturated screen section of the well. The pump intake or sampling tube must be kept at least 2 feet above the bottom of the well to prevent mobilization of any sediment present in the bottom of the well.

4. If using a bladder pump, connect the air line to the pump controller output port. The pump controller should then be connected to a supply line from an air compressor or compressed gas cylinder using an appropriate regulator and air hose. Take care to tighten the regulator connector onto the gas cylinder (if used) to prevent leaks. Teflon tape may be used on the threads of the cylinder to provide a tighter seal. Once the air compressor or gas cylinder is connected to the pump controller, turn on the compressor or open the valve on the cylinder to begin the gas flow. Turn on the pump controller if an on/off switch is present and verify that all batteries are charged and fully operating before beginning to pump.

5. Connect the pump discharge water line to the bottom inlet port on the flow-through cell connected to the water quality meter.

6. Measure the water level again with the pump in the well before starting the pump. Start pumping the well at 200 to 500 milliliters (mL) per minute (or at lower site-specific rate if specified). The pump rate should be adjusted to cause little or no water level drawdown in the well (less than 0.3 feet below the initial static depth to water measurement) and the water level should stabilize. The water level should be monitored every 3 to 5 minutes (or as appropriate, lower flow rates may require longer time between readings) during pumping if the well diameter is of sufficient size to allow such monitoring. Care should be taken not to break pump suction or cause entrainment of air in the sample. Record pumping rate adjustments and depths to water. If necessary, pumping rates should be reduced to the minimum capabilities of the pump to avoid pumping the well dry and/or to stabilize indicator parameters. A steady flow rate should be maintained to the extent practicable. Groundwater sampling records from previous sampling events (if available) should be reviewed prior to mobilization to estimate the optimum pumping rate and anticipated drawdown for the well in order to more efficiently reach a stabilized pumping condition.

   If the recharge rate of the well is very low, alternative purging techniques should be used, which will vary based on the well construction and screen position. For wells screened across the water table, the well should be pumped dry and sampling should commence as soon as the volume in the well has recovered sufficiently to permit collection of samples. For wells screened entirely below the water table, the well should be pumped until a stabilized level (which may be below the maximum displacement goal of 0.3 feet) can be maintained and monitoring for stabilization of field indicator parameters can commence. If a lower stabilization level cannot be maintained, the well should be pumped until the drawdown is at a level slightly higher than the bentonite seal above the well screen. Sampling should commence after one well volume has been removed and the well has recovered sufficiently to permit collection of samples.

   During purging, monitor the field indicator parameters (e.g., turbidity, temperature, specific conductance, pH, etc.) every 3 to 5 minutes (or as appropriate). Field indicator parameters will be measured using a flow-through analytical cell or a clean container such as a glass beaker. Record field indicator parameters on the groundwater sampling log. The well is considered stabilized and ready for sample collection when turbidity values remain within 10% (or within 1 NTU if the turbidity reading is less than 10 NTU), the specific conductance and temperature values remain within 3%, ORP readings remain within ± 10 mV and pH remains within 0.1 units for three consecutive readings collected at 3- to 5-minute intervals (or other appropriate interval, alternate stabilization goals may exist in different geographic regions, consult the site-specific Work Plan for stabilization criteria). If the field indicator parameters do not stabilize within 1 hour of the start of purging, but the groundwater turbidity is

below the goal of 50 NTU and the values for all other parameters are within 10%, the well can be sampled. If the parameters have stabilized but the turbidity is not in the range of the 50 NTU goal, the pump flow rate should be decreased to a minimum rate of 100 mL/min to reduce turbidity levels as low as possible. Dissolved oxygen is extremely susceptible to various external influences (including temperature or the presence of bubbles on the DO meter); care should be taken to minimize the agitation or other disturbance of water within the flow-through cell while collecting these measurements. If air bubbles are present on the DO probe or in the discharge tubing, remove them before taking a measurement. If dissolved oxygen values are not within acceptable range for the temperature of groundwater (Attachment 1), then again check for and remove air bubbles on probe before re-measuring. If the dissolved oxygen value is 0.00 or less, then the meter should be serviced and re-calibrated. If the dissolved oxygen values are above possible results, then the meter should be serviced and re-calibrated.

During extreme weather conditions, stabilization of field indicator parameters may be difficult to obtain. Modifications to the sampling procedures to alleviate these conditions (e.g., measuring the water temperature in the well adjacent to the pump intake) will be documented in the field notes. If other field conditions exist that preclude stabilization of certain parameters, an explanation of why the parameters did not stabilize will also be documented in the field logbook.

7. Complete the sample label(s) and cover the label(s) with clear packing tape to secure the label onto the container.

8. After the indicator parameters have stabilized, collect groundwater samples by diverting flow out of the unfiltered discharge tubing into the appropriate labeled sample container. If a flow-through analytical cell is being used to measure field parameters, the flow-through cell should be disconnected after stabilization of the field indicator parameters and prior to groundwater sample collection. Under no circumstances should analytical samples be collected from the discharge of the flow-through cell. When the container is full, tightly screw on the cap. Samples should be collected in the following order: VOCs, TOC, SVOCs, metals and cyanide, and others (or other order as defined in the site-specific Work Plan).

9. If sampling for total and filtered metals and/or PCBs, a filtered and unfiltered sample will be collected. Install an in-line, disposable 0.45-micron particle filter on the discharge tubing after the appropriate unfiltered groundwater sample has been collected. Continue to run the pump until an initial volume of “flush” water has been run through the filter in accordance with the manufacturer’s directions (generally 100 to 300 mL). Collect filtered groundwater sample by diverting flow

out of the filter into the appropriately labeled sample container. When the container is full, tightly screw on the cap.

10. Secure with packing material and store at 4°C in an insulated transport container provided by the laboratory.

11. Record on the groundwater sampling log or bound field logbook the time sampling procedures were completed, any pertinent observations of the sample (e.g., physical appearance, and the presence or lack of odors or sheens), and the values of the stabilized field indicator parameters as measured during the final reading during purging (Attachment 2 – Example Sampling Log).

12. Turn off the pump and air compressor or close the gas cylinder valve if using a bladder pump set-up. Slowly remove the pump, tubing, lines, and safety cable from the well. Do not allow the tubing or lines to touch the ground or any other surfaces which could contaminate them. .

13. If tubing is to be dedicated to a well, it should be folded to a length that will allow the well to be capped and also facilitate retrieval of the tubing during later sampling events. A length of rope or string should be used to tie the tubing to the well cap. Alternatively, if tubing and safety line are to be saved and reused for sampling the well at a later date they may be coiled neatly and placed in a clean plastic bag that is clearly labeled with the well ID. Make sure the bag is tightly sealed before placing it in storage.

14. Secure the well and properly dispose of personal protective equipment (PPE) and disposable equipment.

15. Complete the procedures for packaging, shipping, and handling with associated chain-of-custody.

16. Complete decontamination procedures for flow-through analytical cell and submersible or bladder pump, as appropriate.

17. At the end of the day, perform calibration check of field instruments.

If it is not technically feasible to use the low-flow sampling method, purging and sampling of monitoring wells may be conducted using the bailer method as outlined below:

1. Don appropriate PPE (as required by the HASP).

2. Place plastic sheeting around the well.

3. Clean sampling equipment.

4. Open the well cover while standing upwind of the well. Remove well cap and place on the plastic sheeting. Insert PID probe approximately 4 to 6 inches into the casing or the well headspace and cover with gloved hand. Record the PID reading in the field log. If the well headspace reading is less than 5 PID units, proceed; if the headspace reading is greater than 5 PID units, screen the air within the breathing zone. If the breathing zone reading is less than 5 PID units, proceed. If the PID reading in the breathing zone is above 5 PID units, move upwind from well for 5 minutes to allow the volatiles to dissipate. Repeat the breathing zone test. If the reading is still above 5 PID units, don appropriate respiratory protection in accordance with the requirements of the HASP. Record all PID readings. For wells that are part of the regular weekly monitoring program and prior PID measurements have not resulted in a breathing zone reading above 5 PID units, PID measurements will be taken monthly.

5. Measure the depth to water and determine depth of well by examining drilling log data or by direct measurement. Calculate the volume of water in the well (in gallons) by using the length of the water column (in feet), multiplying by 0.163 for a 2-inch well or by 0.653 for a 4-inch well. For other well diameters, use the formula:

   Volume (in gallons) = π TIMES well radius (in feet) squared TIMES length of water column (in feet) TIMES 7.481 (gallons per cubic foot)

6. Measure a length of rope or twine at least 10 feet greater than the total depth of the well. Secure one end of the rope to the well casing and secure the other end to the bailer. Test the knots and make sure the rope will not loosen. Check bailers so that all parts are intact and will not be lost in the well.

7. Lower bailer into well and remove one well volume of water. Contain all water in appropriate containers.

8. Monitor the field indicator parameters (e.g., turbidity, temperature, specific conductance, and pH). Measure field indicator parameters using a clean container such as a glass beaker or sampling cups provided with the instrument. Record field indicator parameters on the groundwater sampling log.

9. Repeat Steps 7 and 8 until three or four well volumes have been removed. Examine the field indicator parameter data to determine if the parameters have stabilized. The well is considered stabilized and ready for sample collection when turbidity values remain within 10% (or within 1 NTU if the turbidity reading is less than 10 NTU), the specific conductance and temperature values remain

within 3%, and pH remains within ˜0 .1 units for three consecutive readings collected once per well volume removed.

10. If the field indicator parameters have not stabilized, remove a maximum of five well volumes prior to sample collection. Alternatively, five well volumes may be removed without measuring the field indicator parameters.

11. If the recharge rate of the well is very low, wells screened across the water table may be bailed dry and sampling should commence as soon as the volume in the well has recovered sufficiently to permit collection of samples. For wells screened entirely below the water table, the well should only be bailed down to a level slightly higher than the bentonite seal above the well screen. The well should not be bailed completely dry, to maintain the integrity of the seal. Sampling should commence as soon as the well volume has recovered sufficiently to permit sample collection.

12. Following purging, allow water level in well to recharge to a sufficient level to permit sample collection.

13. Complete the sample label and cover the label with clear packing tape to secure the label onto the container.

14. Slowly lower the bailer into the screened portion of the well and carefully retrieve a filled bailer from the well causing minimal disturbance to the water and any sediment in the well.

15. The sample collection order (as appropriate) will be as follows:

    a. VOCs;

    b TOC;

    c. SVOCs;

    d. metals and cyanide; and

    e. others.

16. When sampling for volatiles, collect water samples directly from the bailer into 40-mL vials with Teflon®-lined septa.

17. For other analytical samples, remove the cap from the large glass mixing container and slowly empty the bailer into the large glass mixing container. The

sample for dissolved metals and/or filtered PCBs should either be placed directly from the bailer into a pressure filter apparatus or pumped directly from the bailer with a peristaltic pump, through an in-line filter, into the pre-preserved sample bottle.

18. Continue collecting samples until the mixing container contains a sufficient volume for all laboratory samples.

19. Mix the entire sample volume with the Teflon® stirring rod and transfer the appropriate volume into the laboratory jar(s). Secure the sample jar cap(s) tightly.

20. If sampling for total and filtered metals and/or PCBs, a filtered and unfiltered sample will be collected. Sample filtration for the filtered sample will be performed in the field using a peristaltic pump prior to preservation. Install new medical-grade silicone tubing in the pump head. Place new Teflon® tubing into the sample mixing container and attach to the intake side of pump tubing. Attach (clamp) a new 0.45-micron filter (note the filter flow direction). Turn the pump on and dispense the filtered liquid directly into the laboratory sample bottles.

21. Secure with packing material and store at 4°C in an insulated transport container provided by the laboratory.

22. After sample containers have been filled, remove one additional volume of groundwater. Measure the pH, temperature, turbidity, and conductivity. Record on the groundwater sampling log or bound field logbook the time sampling procedures were completed, any pertinent observations of the sample (e.g., physical appearance, and the presence or lack of odors or sheens), and the values of the field indicator parameters.

23. Remove bailer from well, secure well, and properly dispose of PPE and disposable equipment.

24. If a bailer is to be dedicated to a well, it should be secured inside the well above the water table, if possible. Dedicated bailers should be tied to the well cap so that inadvertent loss of the bailer will not occur when the well is opened.

25. Complete the procedures for packaging, shipping, and handling with associated chain-of-custody.

VII. Waste Management

Materials generated during groundwater sampling activities, including disposable equipment, will be placed in appropriate containers. Containerized waste will be disposed of by the client consistent with the procedures identified in the HASP.

VIII. Data Recording and Management

Initial field logs and chain-of-custody records will be transmitted to the ARCADIS PM at the end of each day unless otherwise directed by the PM. The groundwater team leader retains copies of the groundwater sampling logs.

IX. Quality Assurance

In addition to the quality control samples to be collected in accordance with this SOP, the following quality control procedures should be observed in the field:

- Collect samples from monitoring wells in order of increasing concentration, to the extent known based on review of historical site information if available.
- Equipment blanks should include the pump and tubing (if using disposable tubing) or the pump only (if using tubing dedicated to each well).
- Collect equipment blanks after wells with higher concentrations (if known) have been sampled.
- Operate all monitoring instrumentation in accordance with manufacturer's instructions and calibration procedures. Calibrate instruments at the beginning of each day and verify the calibration at the end of each day. Record all calibration activities in the field notebook.
- Clean all groundwater sampling equipment prior to use in the first well and after each subsequent well using procedures for equipment decontamination.

X. References

United States Environmental Protection Agency (USEPA). 1986. RCRA Groundwater Monitoring Technical Enforcement Guidance Document (September 1986).

USEPA Region II. 1998. *Ground Water Sampling Procedure Low Stress (Low Flow) Purging and Sampling*.

USEPA. 1991. Handbook Groundwater, Volume II Methodology, Office of Research and Development, Washington, DC. USEPN62S, /6-90/016b (July, 1991).

U.S. Geological Survey (USGS). 1977. National Handbook of Recommended Methods for Water-Data Acquisition: USGS Office of Water Data Coordination. Reston, Virginia.

Attachment 1

Groundwater Sampling Log

Attachment 2

Oxygen Solubility in Fresh Water

Temperature (degrees C)	**Dissolved Oxygen** (mg/L)
0	14.6
1	14.19
2	13.81
3	13.44
4	13.09
5	12.75
6	12.43
7	12.12
8	11.83
9	11.55
10	11.27
11	11.01
12	10.76
13	10.52
14	10.29
15	10.07
16	9.85
17	9.65
18	9.45
19	9.26
20	9.07
21	8.9
22	8.72
23	8.56
24	8.4
25	8.24
26	8.09
27	7.95
28	7.81
29	7.67
30	7.54
31	7.41
32	7.28
33	7.16
34	7.05
35	6.93

Reference: Vesilind, P.A., *Introduction to Environmental Engineering*, PWS Publishing Company, Boston, 468 pages (1996).

Imagine the result

Surface Water Sampling
Standard Operating Procedure

Rev. #: 0

Date: June 3, 2013

Approval Signatures

Prepared by: _____ Date: June 3, 2013
Jesse Starr

Reviewed by: _____ Date: June 3, 2013
Shannon Dunn
(Technical Expert)

I. Scope and Application

This Standard Operating Procedure (SOP) describes the collection of surface water samples using a grab method, discrete depth sampler or peristaltic pump. This SOP should be followed whenever collecting surface water samples.

This SOP may change depending upon field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this SOP will be approved in advance by the Project Manager.

II. Personnel Qualifications

ARCADIS field personnel will have current health and safety training, including 40-hour HAZWOPER training, site supervisor training, and site-specific training, as needed. In addition, ARCADIS field personnel will be versed in the relevant SOPs and will possess the skills and experience necessary to successfully complete the desired field work. The project Health and Safety Plan (HASP) and other documents will identify any other training requirements such as site-specific safety training or access control requirements.

III. Equipment List

The following equipment list contains materials that may be needed in carrying out the procedures contained in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- personal protective equipment (PPE) and other safety equipment, as required in the project Health and Safety Plan (HASP)
- project Quality Assurance Project Plan (QAPP)
- Sampling and Analysis Plan (SAP)
- indelible ink pens
- appropriate sample containers, labels, and forms
- decontamination supplies including bucket, distilled or deionized water, cleansers appropriate for removing expected chemicals of concern.
- sample packing and shipping materials

- water-quality (temperature/pH/specific conductivity/ORP/turbidity/dissolved oxygen) meter and flow-through measurement cell. Several brands may be used, including:
  - YSI 6-Series Multi-Parameter Instrument
  - Hydrolab Series 3 or Series 4a Multiprobe and Display
  - Horiba U-10 or U-22 Water Quality Monitoring System
- for grab sampling method: pole with polyethylene and/or stainless steel dipper, if applicable
- for discrete depth sampling method: discrete depth samplers (e.g., Kemmerer or Van Dorn samplers)
- for peristaltic pump sampling method: peristaltic pump with appropriate power source, Teflon® tubing or Teflon®-lined polyethylene tubing of an appropriate size for the pump being used. For peristaltic pumps, dedicated Tygon® tubing (or other type as specified by the manufacturer) will also be used through the pump apparatus.

IV. Cautions

If heavy precipitation occurs and no cover over the sampling area can be erected, sampling must be discontinued until adequate cover is provided. Rain water could contaminate surface water samples.

Do not use permanent marker or felt-tip pens for labels on sample container or sample coolers – use indelible ink. The permanent markers could introduce volatile constituents into the samples.

It may be necessary to field-filter some parameters (e.g., metals) prior to collection, depending on preservation, analytical method, and project quality objectives.

Store and/or stage empty and full sample containers and coolers out of direct sunlight.

Be careful not to over-tighten lids with Teflon liners or septa (e.g., 40 mL vials). Over tightening can cause the glass to shatter or impair the integrity of the Teflon seal.

Use caution and appropriate cut resistant gloves when tightening lids to 40 mL vials. These vials can break while tightening and can lacerate hand. Amber vials (thinner glass) are more prone to breakage.

The ability to safely access the surface water sampling locations should be verified prior to sampling.

Field activities will be performed in accordance with a project-specific HASP, a copy of which will be present onsite during such activities.

Safety hazards associated with sampling surface water include fast-moving water, deep water, and steep slopes close to sampling sites. Extreme caution should be used when approaching sampling sites. Work will be performed in accordance with the project-specific HASP.

V. Procedure

Sampling Method

Surface water samples will be collected from sampling locations sequentially from downstream to upstream to prevent cross-contamination associated with sediment disturbance. Surface water samples will be collected prior to sediment sample collection.

Grab Sample Collection

Personnel conducting surface water sampling using grab sample collection techniques should perform the following:

1. Collect appropriate equipment, cleaned and decontaminated.

2. Obtain appropriate sampling containers.

3. Mobilize to surface water sampling location in accordance with the work plan or SAP.

4. Collect sample by directly lowering the laboratory-supplied sample container into the water and allowing the bottle to partially fill with water. The sampler will hold the bottle immediately below the water surface and allows the bottle to fill with sample. Field personnel will handle only the portions of the sample containers that do not come in contact with the sample, to avoid contamination. Additionally, care will be taken to avoid exposing samples and sample containers to atmospheric inputs such as dirt or dust.

5. Measure water quality parameters.

6. Transfer surface water samples into laboratory-supplied sample containers to complete the scope described in the SAP. Avoid overfilling sample containers to prevent preservatives, if present, in sample container from being lost.

Sample Collection Using a Discrete Depth Sampler (e.g., Kemmerer or Van Dorn)

Personnel conducting surface water sampling using grab sample collection techniques should perform the following:

1. Collect appropriate equipment, cleaned and decontaminated.

2. Obtain appropriate sampling containers.

3. Mobilize to surface water sampling location in accordance with the work plan or SAP.

4. Carefully set the sampling device so that water is allowed to pass through the tube.

5. Lower the pre-set sampling device to the predetermined depth using marked rope or line attached to the device.

6. When at desired depth; send down the messenger, closing the device. Avoid disturbing the bottom.

7. Retrieve sampler and discharge the first 10-20 mL to clear any potential cross-contamination.

8. Measure water quality parameters

9. Transfer surface water samples into laboratory-supplied sample containers to complete the scope described in the SAP. Avoid overfilling sample containers to prevent preservatives, if present, in sample container from being lost.

10. Pack and store samples appropriately for transport to laboratory.

Sample Collection Using Peristaltic Pump

Personnel conducting surface water sampling using peristaltic pump collection techniques should perform the following:

1. Surface water will be collected using a peristaltic pump if flow is slow and conventional sampling procedures are impossible without collecting excess

suspended sediment in the sample. Note any observations such as color or odors and determine the depth of water. Record the information in the field log book or field log forms.

2. Personnel should be aware that contact with peristaltic pump apparatus (e.g., control knobs) can serve as a source of metals contamination in dissolved metals analyses. Operation of pump controls should be conducted with gloves that do not come into contact with the sample or with materials that contact the sample.

3. Attach tubing to pump and configure tubing such that intake in positioned at the desired sample depth within the water column and discharge is into desired sample container.

4. Turn the pump on and adjust the flow rate as necessary to avoid splashing or overfilling.

5. Measure water quality parameters on a volume of sample that will not be shipped to the laboratory to avoid cross-contamination in the sample to be analyzed.

6. Collect surface water samples by diverting flow out of the unfiltered discharge tubing into the appropriate labeled sample container.

– If a flow-through analytical cell is being used to measure field parameters, the flow-through cell should be disconnected after stabilization of the field indicator parameters and prior to surface water sample collection. Under no circumstances should analytical samples be collected from the discharge of the flow-through cell.

– When the sample container is full, tightly screw on the cap.

– Samples should be collected in the following order: VOCs, TOC, SVOCs, metals and cyanide, and others (or other order as defined in the Sampling and Analysis Plan (SAP)).

7. Pack and store samples appropriately for transport to laboratory.

VI. Waste Management

Liquid investigation-derived wastes (IDWs), such decontamination liquids or excess surface water, will be collected into 55-gallon drums and may be transferred into large-volume polyethylene tanks with secondary containment pending treatment and/or disposal.

Non-aqueous liquid wastes, if generated (e.g., hexane, non-aqueous phase liquid [NAPL]), will be segregated and stored in appropriately sized buckets with secondary containment pending disposal.

PPE, soiled disposable items, and other trash will be stored in 55-gallon drums and stored on site pending disposal.

IDWs will be collected and stored on site in United States Department of Transportation (DOT)-compliant 55-gallon drums and/or large-volume tanks with secondary containment. Fifty-five-gallon drums and tanks will be labeled with DOT-compliant labels with the following information: drum contents, generator contact information, and date container was filled. IDWs known to be hazardous will be segregated and stored separately from non-hazardous IDWs. Solid IDWs will be segregated and stored separately from liquid IDWs.

IDWs will be sampled as needed for disposal characterization and stored on site pending treatment and/or disposal. IDWs may be managed in conjunction with remedial activities.

All IDWs will be stored in a secure onsite location pending treatment and disposal and/or discharge.

VII. Data Recording and Management

Record field data in field notebook and/or on field log sheets.

VIII. Quality Assurance

Sample quality will be achieved by complying with the procedures outlined in this SOP. Cross-contamination will be prevented by following standard decontamination protocols. Field activities will be supervised by appropriate experienced field supervisors. Additional quality assurance information is presented in the project-specific Quality Assurance Project Plan.

ARCADIS
Infrastructure · Water · Environment · Buildings

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Chain-of-Custody, Handling, Packing and Shipping

Rev. #: 2

Rev Date: March 6, 2009

Approval Signatures

Prepared by: _____ Date: 3/6/09
Caron Koll

Reviewed by: _____ Date: 3/6/09
Jane Kennedy(Technical Expert)

I. Scope and Application

This Standard Operating Procedure (SOP) describes the chain-of-custody, handling, packing, and shipping procedures for the management of samples to decrease the potential for cross-contamination, tampering, mis-identification, and breakage, and to insure that samples are maintained in a controlled environment from the time of collection until receipt by the analytical laboratory.

II. Personnel Qualifications

ARCADIS field sampling personnel will have current health and safety training, including 40-hour HAZWOPER training, Department of Transportation (DOT) training, site supervisor training, and site-specific training, as needed. In addition, ARCADIS field sampling personnel will be versed in the relevant SOPs and possess the skills and experience necessary to successfully complete the desired field work.

III. Equipment List

The following list provides materials that may be required for each project. Project documents and sample collection requirements should be reviewed prior to initiating field operations:

- indelible ink pens (black or blue);
- polyethylene bags (resealable-type);
- clear packing tape, strapping tape, duct tape;
- chain of custody
- DOT shipping forms, as applicable
- custody seals or tape;
- appropriate sample containers and labels,;
- insulated coolers of adequate size for samples and sufficient ice to maintain 4°C during collection and transfer of samples;
- wet ice;
- cushioning and absorbent material (i.e., bubble wrap or bags);

- temperature blank
- sample return shipping papers and addresses; and
- field notebook.

IV. Cautions

Review project requirements and select appropriate supplies prior to field mobilization.

Insure that appropriate sample containers with applicable preservatives, coolers, and packing material have been supplied by the laboratory.

Understand the offsite transfer requirements for the facility at which samples are collected.

If overnight courier service is required schedule pick-up or know where the drop-off service center is located and the hours of operation. Prior to using air transportation, confirm air shipment is acceptable under DOT and International Air Transport Association (IATA) regulation

Schedule pick-up time for laboratory courier or know location of laboratory/service center and hours of operation.

Understand DOT and IATA shipping requirements and evaluate dangerous goods shipping regulations relative to the samples being collected (i.e. complete an ARCADIS shipping determination). Review the ARCADIS SOPs for shipping, packaging and labeling of dangerous goods. Potential samples requiring compliance with this DOT regulation include:

- Methanol preservation for Volatile Organic Compounds in soil samples
- Non-aqueous phase liquids (NAPL)

V. Health and Safety Considerations

Follow health and safety procedures outlined in the project/site Health and Safety Plan (HASP).

Use caution and appropriate cut resistant gloves when tightening lids to 40 mL vials. These vials can break while tightening and can lacerate hand. Amber vials (thinner glass) are more prone to breakage.

Some sample containers contain preservatives.

- The preservatives must be retained in the sample container and should in no instance be rinsed out.
- Preservatives may be corrosive and standard care should be exercised to reduce potential contact to personnel skin or clothing. Follow project safety procedures if spillage is observed.
- If sample container caps are broken discard the bottle. Do not use for sample collection.

VI. Procedure

Chain-of-Custody Procedures

1. Prior to collecting samples, complete the chain-of-custody record header information by filling in the project number, project name, and the name(s) of the sampling technician(s) and other relevant project information. Attachment 1 provides an example chain-o- custody record

2. Chain-of-custody information MUST be printed legibly using indelible ink (black or blue).

3. After sample collection, enter the individual sample information on the chain-of-custody:

    a. Sample Identification indicates the well number or soil location that the sample was collected from. Appropriate values for this field include well locations, grid points, or soil boring identification numbers (e.g., MW-3, X-20, SB-30). When the depth interval is included, the complete sample ID would be “SB-30 (0.5-1.0) where the depth interval is in feet. Please note it is very important that the use of hyphens in sample names and depth units (i.e., feet or inches) remain consistent for all samples entered on the chain-of-custody form. DO NOT use the apostrophe or quotes in the sample ID. Sample names may also use the abbreviations “FB,” “TB,” and “DUP” as prefixes or suffixes to indicate that the sample is a field blank, trip blank, or field duplicate, respectively. NOTE: The sample

nomenclature may be dictated by the project database and require unique identification for each sample collected for the project. Consult the project data management plan for additional information regarding sample identification.

b. List the date of sample collection. The date format to be followed should be mm/dd/yy (e.g., 03/07/09) or mm/dd/yyyy (e.g. 03/07/2009).

c. List the time that the sample was collected. The time value should be presented using military format. For example, 3:15 P.M. should be entered as 15:15.

d. The composite field should be checked if the sample is a composite over a period of time or from several different locations and mixed prior to placing in sample containers.

e. The “Grab”. field should be marked with an “X” if the sample was collected as an individual grab sample. (e.g. monitoring well sample or soil interval).

f. Any sample preservation should be noted.

g. The analytical parameters that the samples are being analyzed for should be written legibly on the diagonal lines. As much detail as possible should be presented to allow the analytical laboratory to properly analyze the samples. For example, polychlorinated biphenyl (PCB) analyses may be represented by entering “PCBs” or “Method 8082.” Multiple methods and/or analytical parameters may be combined for each column (e.g., PCBs/VOCs/SVOCs or 8082/8260/8270). These columns should also be used to present project-specific parameter lists (e.g., Appendix IX+3 target analyte list. Each sample that requires a particular parameter analysis will be identified by placing the number of containers in the appropriate analytical parameter column. For metals in particular, indicate which metals are required.

h. Number of containers for each method requested. This information may be included under the parameter or as a total for the sample based on the chain of custody form used.

i. Note which samples should be used for site specific matrix spikes.

j. Indicate any special project requirements.

k. Indicate turnaround time required.

l. Provide contact name and phone number in the event that problems are encountered when samples are received at the laboratory.

m. If available attach the Laboratory Task Order or Work Authorization forms

n. The remarks field should be used to communicate special analytical requirements to the laboratory. These requirements may be on a per sample basis such as “extract and hold sample until notified,” or may be used to inform the laboratory of special reporting requirements for the entire sample delivery group (SDG). Reporting requirements that should be specified in the remarks column include: 1) turnaround time; 2) contact and address where data reports should be sent; 3) name of laboratory project manager; and 4) type of sample preservation used.

o. The “Relinquished By” field should contain the signature of the sampling technician who relinquished custody of the samples to the shipping courier or the analytical laboratory.

p. The “Date” field following the signature block indicates the date the samples were relinquished. The date format should be mm/dd/yyyy (e.g., 03/07/2005).

q. The “Time” field following the signature block indicates the time that the samples were relinquished. The time value should be presented using military format. For example, 3:15 P.M. should be entered as 15:15.

r. The “Received By” section is signed by sample courier or laboratory representative who received the samples from the sampling technician or it is signed upon laboratory receipt from the overnight courier service.

3. Complete as many chain-of-custody forms as necessary to properly document the collection and transfer of the samples to the analytical laboratory.

4. Upon completing the chain-of-custody forms, forward two copies to the analytical laboratory and retain one copy for the field records.

5. If electronic chain-of-custody forms are utilized, sign the form and make 1 copy for ARCADIS internal records and forward the original with the samples to the laboratory.

Handling Procedures

1. After completing the sample collection procedures, record the following information in the field notebook with indelible ink:

   - project number and site name;
   - sample identification code and other sample identification information, if appropriate;
   - sampling method;
   - date;
   - name of sampler(s);
   - time;
   - location (project reference);
   - location of field duplicates and both sample identifications;
   - locations that field QC samples were collected including equipment blanks, field blanks and additional sample volume for matrix spikes; and
   - any comments.

2. Complete the sample label with the following information in indelible ink:

   - sample type (e.g., surface water);
   - sample identification code and other sample identification information, if applicable;
   - analysis required;
   - date;
   - time sampled; and
   - initials of sampling personnel;

- sample matrix; and
- preservative added, if applicable.

3. Cover the label with clear packing tape to secure the label onto the container and to protect the label from liquid.

4. Confirm that all caps on the sample containers are secure and tightly closed.

5. In some instances it may be necessary to wrap the sample container cap with clear packing tape to prevent it from becoming loose.

6. For some projects individual custody seals may be required. Custody seal evidence tape may be placed on the shipping container or they may be placed on each sample container such that the cooler or cap cannot be opened without breaking the custody seal. The custody seal should be initialed and dated prior to relinquishing the samples.

Packing Procedures

Following collection, samples must be placed on wet ice to initiate cooling to 4°C immediately. Retain samples on ice until ready to pack for shipment to the laboratory.

1. Secure the outside and inside of the drain plug at the bottom of the cooler being used for sample transport with “Duct” tape.

2. Place a new large heavy duty plastic garbage bag inside each cooler

3. Place each sample bottle wrapped in bubble wrap inside the garbage bag. VOC vials may be grouped by sample in individual resealable plastic bags). If a cooler temperature blank is supplied by the laboratory, it should be packaged following the same procedures as the samples. If the laboratory did not include a temperature blank, do not add one. Place 1 to 2 inches of cushioning material (i.e., vermiculite) at the bottom of the cooler.

4. Place the sealed sample containers upright in the cooler.

5. Package ice in large resealable plastic bags and place inside the large garbage bag in the cooler. Samples placed on ice will be cooled to and maintained at a temperature of approximately 4°C.

6. Fill the remaining space in the cooler with cushioning material such as bubble wrap. The cooler must be securely packed and cushioned in an upright position and be surrounded (Note: to comply with 49 CFR 173.4, filled cooler must not exceed 64 pounds).

7. Place the completed chain-of-custody record(s) in a large resealable bag and tape the bag to the inside of the cooler lid.

8. Close the lid of the cooler and fasten with packing tape.

9. Wrap strapping tape around both ends of the cooler.

10. Mark the cooler on the outside with the following information: shipping address, return address, “Fragile, Handle with Care” labels on the top and on one side, and arrows indicating “This Side Up” on two adjacent sides.

11. Place custody seal evidence tape over front right and back left of the cooler lid, initial and date, then cover with clear plastic tape.

Note: Procedure numbers 2, 3, 5, and 6 may be modified in cases where laboratories provide customized shipping coolers. These cooler types are designed so the sample bottles and ice packs fit snugly within preformed styrofoam cushioning and insulating packing material.

Shipping Procedures

1. All samples will be delivered by an express carrier within 48 hours of sample collection. Alternatively, samples may be delivered directly to the laboratory or laboratory service center or a laboratory courier may be used for sample pickup.

2. If parameters with short holding times are required (e.g., VOCs [EnCore™ Sampler], nitrate, nitrite, ortho-phosphate and BOD), sampling personnel will take precautions to ship or deliver samples to the laboratory so that the holding times will not be exceeded.

3. Samples must be maintained at 4°C±2°C until shipment and through receipt at the laboratory

4. All shipments must be in accordance with DOT regulations and ARCADIS dangerous goods shipping SOPs.

5. When the samples are received by the laboratory, laboratory personnel will complete the chain-of-custody by recording the date and time of receipt of samples, measuring and recording the internal temperature of the shipping container, and checking the sample identification numbers on the containers to ensure they correspond with the chain-of-custody forms.

Any deviations between the chain-of-custody and the sample containers, broken containers, or temperature excursions will be communicated to ARCADIS immediately by the laboratory.

VII. Waste Management

Not applicable

VIII. Data Recording and Management

Chain-of-custody records will be transmitted to the ARCADIS PM or designee at the end of each day unless otherwise directed by the ARCADIS PM. The sampling team leader retains copies of the chain-of-custody forms for filing in . the project file. Record retention shall be in accordance with project requirements.

IX. Quality Assurance

Chain-of-custody forms will be legibly completed in accordance with the applicable project documents such as Sampling and Analysis Plan (SAP), Quality Assurance Project Plan (QAPP), Work Plan, or other project guidance documents. A copy of the completed chain-of-custody form will be sent to the ARCADIS Project Manager or designee for review.

X. References

Not Applicable

Attachment 1

ARCADIS
Infrastructure, environment, facilities

ID#:

CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

Page ___ of ___

Lab Work Order #

Send Results to:

Contact & Company Name: | Telephone:

Address: | Fax:

City | State | Zip | E-mail Address:

Project Name/Location (City, State): | Project #:

Sampler's Printed Name: | Sampler's Signature:

Preservative							
Filtered (✓)							
# of Containers							
Container Information							

PARAMETER ANALYSIS & METHOD

Keys

Preservation Key:
A. H_2SO_4
B. HCL
C. HNO_3
D. NaOH
E. None
F. Other: _____
G. Other: _____
H. Other: _____

Container Information Key:
1. 40 ml Vial
2. 1 L Amber
3. 250 ml Plastic
4. 500 ml Plastic
5. Encore
6. 2 oz. Glass
7. 4 oz. Glass
8. 8 oz. Glass
9. Other: _____
10. Other: _____

Matrix Key:
SO - Soil | SE - Sediment | NL - NAPL/Oil
W - Water | SL - Sludge | SW - Sample Wipe
T - Tissue | A - Air | Other: _____

Sample ID	Collection Date	Collection Time	Type (✓) Comp	Type (✓) Grab	Matrix								REMARKS

Special Instructions/Comments:

☐ **Special QA/QC Instructions(✓):**

Laboratory Information and Receipt		Relinquished By	Received By	Relinquished By	Laboratory Received By
Lab Name:	Cooler Custody Seal (✓)	Printed Name:	Printed Name:	Printed Name:	Printed Name:
☐ Cooler packed with ice (✓)	☐ Intact ☐ Not Intact	Signature:	Signature:	Signature:	Signature:
Specify Turnaround Requirements:	Sample Receipt:	Firm:	Firm/Courier:	Firm/Courier:	Firm:
Shipping Tracking #:	Condition/Cooler Temp: _____	Date/Time:	Date/Time:	Date/Time:	Date/Time:

20730826 CofC AR Form 01.12.2007

Distribution: **WHITE – Laboratory returns with results** **YELLOW – Lab copy** **PINK – Retained by BBL**

APPENDIX B

Rolling Knolls Landfill Settling Parties

Data Gaps Sampling and Analysis Plan

Rolling Knolls Landfill Superfund Site

Chatham, New Jersey

October 2014

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Data Gaps Sampling and Analysis Plan

Rolling Knolls Landfill Superfund Site
Chatham, New Jersey

Prepared for:
Rolling Knolls Landfill Settling Parties

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Date:
October 2014

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Acronyms and Abbreviations

Agreement	Administrative Settlement Agreement and Order on Consent
ARAR	Applicable or Relevant and Appropriate Requirement
ARCADIS	ARCADIS U.S., Inc.
BBL	Blasland, Bouck & Lee, Inc.
bgs	below ground surface
BERA	Baseline Ecological Risk Assessment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLP	Contract Laboratory Program
CTBH	Chatham Township Board of Health
Data Gaps SAP	Data Gaps Sampling and Analysis Plan
DLUR	Division of Land Use Regulation
EBSL	ecologically based screening level
FHA	flood hazard area
FIT	Field Investigation Team
Foster Wheeler	Foster Wheeler Environmental Corporation
FS	feasibility study
FWW GP-12	Freshwater Wetlands General Permit 12
GPS	global positioning satellite
GSNWR	Great Swamp National Wildlife Refuge
GWQC	Groundwater Quality Criteria
LDPE	low density polyethylene
MCL	Maximum Contaminant Limit

mL/min	milliliters per minute
N.J.A.C.	New Jersey Administrative Code
NJDEP	New Jersey Department of Environmental Protection
OCP	organochlorine pesticide
PAH	polycyclic aromatic hydrocarbon
PPNDP	passively placed narrow diameter points
PCB	polychlorinated biphenyl
PCSM	Preliminary Conceptual Site Model
PID	photoionization detector
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RI	remedial investigation
SAT	Site Assessment Team
SCSR	Site Characterization Summary Report
SEBS	styrene/ethylene/butylenes/silicone
SIM	selective ion monitoring
site	Rolling Knolls Landfill Superfund Site, located in Chatham Township, New Jersey
SRS	Soil Remediation Standard
SVOC	semivolatile organic compound
TAL	Target Analyte List
TCL	Target Compound List
TestAmerica	TestAmerica Laboratories, Inc.

the Group	Chevron Environmental Management Company, Lucent Technologies Inc., (now known as Alcatel-Lucent USA Inc.) and Novartis Pharmaceuticals Corporation
TOC	total organic carbon
USEPA	United States Environmental Protection Agency
USFWS	United States Fish & Wildlife Service
USGS	United States Geological Survey
VOC	volatile organic compound
Weston	Weston Solutions, Inc.
µg/L	micrograms per liter

1. Introduction

On behalf of Chevron Environmental Management Company, Lucent Technologies Inc., (now known as Alcatel-Lucent USA Inc.) and Novartis Pharmaceuticals Corporation (collectively, the Group), ARCADIS U.S., Inc. (ARCADIS) prepared this Data Gaps Sampling and Analysis Plan (Data Gaps SAP) for the Rolling Knolls Landfill Superfund Site, located in Chatham Township, New Jersey (the site, Figure 1).

On September 30, 2005, the Group entered into an Administrative Settlement Agreement and Order on Consent (Agreement) with the United States Environmental Protection Agency (USEPA) to conduct a remedial investigation/feasibility study (RI/FS) at the site (Comprehensive Environmental Response, Compensation, and Liability Act [CERCLA] Docket No. 02-2005-2034). Since that time, the Group has conducted several investigations and assessments to evaluate environmental conditions at the site. The investigations culminated in a Site Characterization Summary Report (SCSR) which was submitted to the USEPA in February 2012 (ARCADIS 2012). In its letter of March 7, 2013, the USEPA identified several data gaps related to delineation of constituents in environmental media (USEPA 2013). To address these data gaps, ARCADIS prepared a Preliminary Plan to Address Data Gaps (April 30, 2013; ARCADIS 2013). The work proposed in this Preliminary Plan was to be conducted during the design of the site remedy.

However, during subsequent scoping of the Baseline Ecological Risk Assessment (BERA), USEPA offered the Group the option of assessing the data gaps before implementing the BERA so that the additional data could be used in scoping the BERA (USEPA letter of July 30, 2014; USEPA 2014). The Group has accepted this option and has prepared this Data Gaps SAP to define the scope of the data gaps sampling and the sampling and analytical procedures. The scope of the sampling is consistent with the Preliminary Plan and with comments provided by USEPA to the Group in an email on August 12, 2014. The scope of the sampling was also discussed by the Group, ARCADIS, and the USEPA in a meeting on August 19, 2014.

1.1 Objectives

The objectives of the data gaps sampling are as follows.

- Assess the Data Gaps identified in EPA's August 12, 2014 email attachment

- Further delineate the extent of site constituents at concentrations above the New Jersey Soil Remediation Standards (SRSs) in soil in portions of the site.
- Delineate the extent of site constituents in groundwater at monitoring wells MW-3 and MW-10 by sampling groundwater, surface water, and sediment.
- Characterize surface water and sediment in ponds on the landfill that were not previously sampled.
- Investigate the potential presence of site constituents in sediment pore-water downgradient of monitoring well MW-10.
- Obtain a full round of groundwater samples from all monitoring wells to characterize current constituent concentrations in groundwater.
- Investigate the connection between groundwater and surface water on site.
- Assess conditions at the existing Hunt Club well HC-1.

The provisions of Section 4.2 of the NJDEP's Technical Requirement for Site Remediation will be met during implementation of the SAP. Data that may be considered for delineation of the nature and extent of the site include the depth of the landfilled materials, groundwater quality data, presence of a thick clay layer beneath the site, and other factors.

1.2 Data Gaps SAP Organization

This Data Gaps SAP is organized as described below.

- Section 2, Site Background and Setting, presents the site location; discusses usage of the site and properties adjacent to the site; describes the physical setting of the site; summarizes the site history, including the investigative and regulatory history, and summarizes the investigation results previously submitted to the USEPA in the SCSR.
- Section 3, Data Gaps SAP Tasks, presents each task that will be conducted as part of the Data Gaps SAP and outlines proposed technical activities that will be conducted to complete each task.
- Section 4, Schedule, presents a schedule for the Data Gaps SAP activities.
- Section 5, Project Management, introduces the project team and describes the responsibilities of each project team member.

- Section 6, References, provides references used in the development of this Data Gaps SAP.

A Quality Assurance Project Plan (QAPP), submitted separately, provides supporting information on site conditions, sampling requirements and procedures, and laboratory analytical procedures.

2. Site Background and Setting

2.1 Site Description

The Rolling Knolls Landfill site is an approximately 200-acre, unlined, former municipal landfill located at 35 Britten Road in the Green Village section of Chatham Township, Morris County, New Jersey. The facility is bound by the Great Swamp National Wildlife Refuge to the east, south, and west; Loantaka Brook and private property to the west; and private residential properties to the north and northwest. The Rolling Knolls Landfill overlaps the Refuge on its eastern and southern sides (Figure 1). As discussed in Sections 2.2.1 and 3.1 of the SCSR, observations made during test pit excavation (which, for that investigation, included hand auger borings in areas where proposed test pit locations were not accessible to excavation equipment) show that the waste material that constitutes the landfill includes 141 acres where waste has been filled, and 29 acres where a thin layer of waste and debris has been observed on but not below the ground surface (i.e., the surface debris area) along the western portion of the site. Figure 2 presents a Site Plan, which depicts the estimated landfill boundary, as understood prior to RI activities, as well as the estimated boundaries of the landfill and surface debris area, based on visual observations and test pit activities.

As shown on Figure 2, the central and western portions of the site are owned by Robert J. Miele as Trustee for the Trust created by the Last Will and Testament of Angelo J. Miele, the former landfill operator. Eastern and southern portions of the site are located within the Great Swamp National Wildlife Refuge (GSNWR) and owned by the United States Fish & Wildlife Service (USFWS). A northeastern portion of the site occurs on a parcel owned by the Green Village Fire Department, which also includes a baseball field and shooting range. Although the baseball field and shooting range are located within the estimated landfill boundary that was approximated prior to RI activities, test pit activities indicated that no landfilling occurred in these areas (Figure 2).

Water likely flows vertically through the waste materials with some small horizontal component, and upon reaching the saturated material below, flows laterally with the natural groundwater flow patterns. Groundwater flow is expected to occur laterally through the sand and/or silty sand units. The groundwater flow in the shallow water-bearing zone above the clay is expected to be horizontal until reaching areas of discharge. Groundwater flows radially from the northern portion of the landfill to the

south, east and west areas of lower topographic elevation as presented in Section 3.4.4.2 of the SCSR.

Physical access to the majority of the site is limited by a chained gate on Britten Road; wet areas and brooks along the eastern, western and southern boundaries; and the exclusion of visitors to the Wilderness Area section of the GSNWR located on a portion of the site and to the east and south. Black Brook is located east and south of the estimate landfill boundary and generally flows southward and westward in these respective areas. Loantaka Brook is located west of the estimated landfill boundary and flows southward. Residential properties are located north of the site and west of Loantaka Brook. The surrounding area is sparsely populated, consisting of individual residential properties on large parcels and undeveloped open spaces.

Current land use includes commercial/industrial and recreational uses; available data indicate that residents do not live within 200 feet of the estimate landfill boundary. Portions of the site are used for equipment storage by two landscaping companies. Therefore, workers are present at times to deliver, retrieve or maintain landscaping equipment and supplies. In addition, recreators may occasionally hunt on other portions of the site or use the softball field and shooting range.

2.2 Site History

The Rolling Knolls Landfill reportedly operated from the 1930s until 1968. During this period, materials disposed of at the landfill consisted primarily of municipal solid waste, but may have also included other waste such as industrial wastes (Foster Wheeler Environmental Corporation [Foster Wheeler] 2000). Chatham Township Board of Health (CTBH) inspection records indicate that municipal solid waste brought to the landfill included tree stumps, scrap metal, tires, normal household refuse, residential septage wastes, and construction and demolition debris from home construction or renovation. Reported sources of this waste include the surrounding municipalities of Summit, South Orange, Maplewood, Chatham Township, Chatham Borough, Millburn, Madison, Harding Township and Florham Park. Private haulers and homeowners also brought household waste to the landfill. Aerial photographs indicate that by 1966 the landfill had doubled in size from the observed size in 1940 (USEPA 2004). The landfill has been inactive since 1968.

CTBH regulation between 1955 and 1975 required rodent/mosquito control, stagnant surface water drainage, weekly inspections and application of minimal daily cover (Foster Wheeler 2000). The latter involved applying a layer of “swamp muck,” taken

from the edge of the landfill, over the daily rubbish fill. Additional landfill procedures documented by the CTBH in 1962 included weed control (herbicides), dead animal disposal, dust control measures (oil application on landfill roadways) and chemical spraying for rodent control (Foster Wheeler 2000). Prior to the construction of municipal sewer systems and sewage treatment plants, septage waste was allowed to flow over the working surface and percolate into the landfill. In the early- and mid-1960s, septage haulers were required to register with the Chatham Township police department to prevent out-of-town haulers from using the landfill for disposal (Foster Wheeler 2000).

As stated in a USEPA January 26, 2006 comment letter regarding the Preliminary Conceptual Site Model (PCSM) (Blasland, Bouck & Lee, Inc. [BBL] 2006), the USFWS purchased 310 acres of land eligible to be used for landfilling activities in 1964. These acres became part of the GSNWR. Approximately 40 of the 310 acres purchased by the USFWS were already filled with landfill material when purchased in 1964 (Foster Wheeler 2000), as evidenced in the 1963 aerial photograph. Evidence suggests that landfilling continued on the GSNWR property after the purchase. The refuge was initially created by land donation, acquisition and other means in the 1960s and has grown in size since then (Foster Wheeler 2000).

In 1974, an area between 200 and 400 feet wide and approximately 1,200 feet long was affected by a fire. Fire trucks and other support vehicles were unable to access the fire line and the fire was finally extinguished with the use of bulldozers. The physical composition of the landfill material limited access to the fire zone as vehicles driven off the regular access roads sank into the landfill. After this fire, between 1979 and 1982, fire roads were constructed of imported material, including construction and demolition debris, at an elevation approximately 4 feet above the surrounding landfill surface (Foster Wheeler 2000).

2.3 Investigative History

This section chronicles environmental investigations at the site. Results of the investigations were incorporated into the PCSM (BBL 2006) and summarized in the RI/FS Work Plan (ARCADIS BBL 2007).

In 1985, a site inspection was initiated by the USEPA Region 2 Field Investigation Team (FIT) in response to the possible presence of uncharacterized process waste. Four surface water, one surface soil and four sediment samples (0 to 6 inches deep) were collected at various locations on the landfill surface (in areas not associated with Loantaka Brook) or in the wet areas of the GSNWR, away from the landfilled material.

The samples were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), organochlorine pesticides (OCPs) and metals (Foster Wheeler 2000).

In 1986, the FIT conducted a drilling and soil sampling program to evaluate the depth of the fill, nature of possible soil impacts and presence of dioxin in landfill soil. The samples were collected at different depths from eight boreholes and were analyzed for VOCs, SVOCs, PCBs, OCPs, metals and dioxin (NUS Corporation 1986).

In 1988, the USFWS conducted a survey of fish tissue and sediments (USFWS 1991). Sampling locations were biased to evaluate the condition of streams associated with roadways and other potential source areas. The investigation quantified concentrations of metals and polycyclic aromatic hydrocarbons (PAHs; a subset of SVOCs) present in fish tissue and concentrations of metals, OCPs and PAHs present in sediment.

In 1989, a joint agreement between the USFWS and the United States Geological Survey (USGS) led to the collection of 18 surface water and three groundwater samples on the perimeter of the landfill and in Loantaka Brook. The surface water and groundwater samples were analyzed for major inorganic ions, dissolved trace elements, VOCs and SVOCs. Sediment from Loantaka Brook was analyzed primarily for inorganic constituents (USGS 1993).

In 1999, Foster Wheeler (on behalf of USEPA) conducted a field investigation to document current conditions. The investigation included seven exploratory soil borings, two monitoring well installations and environmental sample collection (i.e., 21 surface water, 10 groundwater, 21 sediment and 15 soil samples). Samples were analyzed for metals, OCPs, PCBs, SVOCs and VOCs (Foster Wheeler 2000). In April 2000, supplemental data were collected at sampling locations identified with a global positioning system (GPS) (Foster Wheeler 2000).

From March 31 to April 10, 2003, the USEPA Region 2 Site Assessment Team (SAT) conducted field investigations at the site. The initial phase of investigation included collection and PCB field screening of soil and sediment samples. The second phase of the investigation included collection of confirmatory soil and sediment samples analyzed in a laboratory. In the second phase, additional sediment samples were collected from locations where sampling personnel observed drums or other visual indications of possible source material. The samples were classified as soil if they were collected from non-wetland (i.e., upland) areas or sediment if they were collected from wetland areas. Samples were analyzed for Target Compound List (TCL) and Target

Analyte List (TAL) (excluding cyanide) constituents. Additional sample volume was collected at sediment sampling locations and analyzed for total organic carbon (TOC) and particle size (Weston Solutions Inc. [Weston] 2003a, 2003b, 2003c).

In 1999, the USFWS conducted a 10-year follow-up investigation to its 1988 investigation. The purpose of this investigation was threefold: 1) quantify concentrations of metals, OCPs and PAHs in GSNWR sediment and metals and OCP concentrations in fish tissue; 2) compare the data to the 1988 data; and 3) identify the change in concentrations, if any, in sediment and fish tissue samples (USFWS 2005). The USFWS did not collect samples outside its boundaries during its 1999 investigation because it was not granted access by property owners. Additionally, samples were not collected on the 40 acres of landfill owned by the USFWS.

After the Agreement was signed, the Settling Parties conducted an extensive site investigation sampling between June 2006 and January 2010. Results from this investigation are presented in the SCSR and summarized in Section 2.5.

2.4 Regulatory History

A Hazard Ranking System Documentation Package was issued by the SAT in April 2003. The site was proposed to the National Priorities List on April 30, 2003 and listed on September 29, 2003.

The Agreement was signed by the USEPA and the Group on September 30, 2005 (USEPA Index Number II-CERCLA-02-2005-2034). The Site USEPA ID number is NJD980505192.

2.5 Summary of the Results in the SCSR

The SCSR describes the results of RI activities conducted at the site. RI activities were comprehensive and intended to characterize the landfill and nature and extent of constituents associated with the landfill. The results of the investigations includes:

- The estimated landfill boundary covers 141 acres and consists of a relatively thin (18 feet or less) layer of waste material directly overlying native soil and/or wetlands. An area of surface debris was identified on 29 acres west of the landfill. The total area where waste is present is approximately 170 acres.

- Surface and subsurface soil impacts were identified across the site. Few, isolated impacts were observed within the surface debris area in western portion of the site and along the western and southwestern perimeter of the site. The baseball field and shooting range are located north of the landfill and analytical results do not identify landfill debris in soil in those areas.

- Two areas of impacted groundwater were observed in the shallow water-bearing zone (at monitoring wells MW-3 and MW-10). VOCs identified in groundwater at these two monitoring wells are likely associated with potential sources observed nearby: VOC-impacted soil and drums at test pit TP-09 near MW-3 and the refrigerators on the ground surface near MW-10. The supply well adjacent to the Hunt Club building was sampled and may provide a snapshot of water quality from the deep aquifer beneath the landfill. Impacts of organic constituents were not identified.

- Sub-slab soil gas from beneath the Hunt Club building, which is not currently used for residential occupancy was investigated. The small number of volatile compounds detected in soil gas and their low concentrations do not indicate extensive impacts to soil gas beneath the Hunt Club building.

- Surface water and sediment in the ponds and streams (Loantaka Brook and Black Brook) on or adjacent to the landfill exhibit some constituents that are found at the site. Many of these constituents are also found in surface water and sediment upstream of the site. Therefore, their presence in the streams may be in part due to sources upgradient of the site.

3. Data Gaps SAP Tasks

3.1 Pre-Characterization and Site Preparation Activities

The activities discussed in the following subsections will be conducted to prepare the study area prior to investigation activities.

3.1.1 Vegetation Clearing

The existing fire roads will be mowed to permit vehicle traffic. Sampling activities may require minor vegetation clearing (e.g., clearing a path not to exceed 3 feet in width by trimming vegetation with hand tools) along survey lines and/or to provide access to individual soil sampling locations. The amount of vegetation cleared during soil sampling activities will be the minimum necessary to safely mobilize equipment and personnel on foot to the proposed sampling location and provide a safe work area. During installation of temporary and permanent monitoring wells, vegetation may also be cleared with the aid of a track-mounted skid steer. ARCADIS will prepare the appropriate Land Use Regulation permit equivalencies, as discussed in Section 3.1.3, for vegetation clearing conducted with the aid of an excavator or other motorized vehicle.

Some activities will occur in potential bog turtle habitat, as identified on Figures 3a and 3b. In a June 30, 2009 comment letter on the Draft RI/FS Work Plan Addendum, USEPA provided USFWS recommendations for working in areas of potential bog turtle habitat in a manner that is protective of bog turtles. When working in these areas, field personnel will implement the following USFWS-recommended conservation measures:

- Carry a copy of the USFWS bog turtle fact sheet to aid in identification of bog turtles and their habitats.
- Be mindful of foot and equipment placement.
- Avoid walking on hummocks, as bog turtle use hummocks for nesting, resting and sunning.
- Use the minimum number of personnel for each activity.
- Enter and leave work area in a single file line in order to minimize the possibility of accidental trampling.

- In the event they are observed in the work area, avoid touching or disturbing suspected bog turtle(s) and quietly leave the work area.

- Report suspected or confirmed bog turtle sightings to GSNWR personnel as soon as practical.

3.1.2 Underground Utility Clearing

In accordance with New Jersey state law and site-specific health and safety procedures (described in the site Health and Safety Plan), subsurface utilities will be identified, located and marked out prior to initiating intrusive subsurface field activities, such as soil boring advancement or drilling. ARCADIS personnel will contact the New Jersey One-Call service center to coordinate utility mark outs with participating utility operators that have utilities in areas where intrusive subsurface activities are planned. In areas where another contractor will conduct intrusive subsurface field activities (e.g., driller), that contractor will be responsible for contacting the New Jersey One-Call service center to coordinate utility mark outs. ARCADIS will document results for both New Jersey One-Call utility mark outs.

Based on information obtained during previous RI activities, ARCADIS identified proposed sampling locations for which additional evidence is needed to minimize any reasonable concern regarding the location of subsurface utilities within the work area. Following the completion of utility mark outs by participating utility operators, these locations will either be cleared by hand or by a private utility locating service. At proposed sampling locations that will be sampled using a hand-driven Macrocore®, ARCADIS personnel will clear a proposed sampling location by advancing a hand auger or shovel to 1 foot below ground surface (bgs) at multiple locations around the proposed sampling location such that any reasonable concern regarding the location of subsurface utilities within the work area is minimized. Hand clearing will be conducted immediately prior to Macrocore® advancement. ARCADIS will reposition sampling locations as appropriate to avoid subsurface utilities while maintaining the integrity of the proposed sampling design.

3.1.3 Freshwater Wetland Permits/Permit Equivalencies

The New Jersey Department of Environmental Protection (NJDEP) Division of Land Use Regulation (DLUR) regulates certain activities under New Jersey Administrative Code (N.J.A.C.) 7:7A when conducted in freshwater wetlands or transition areas and under N.J.A.C. 7:13 when conducted in a flood hazard area (FHA) or riparian zone of a

regulated water. Activities proposed herein may include implementation of regulated activities, such as vegetation clearing, advancing borings deeper than 3 feet bgs and use of heavy machinery (e.g., skid steer) in freshwater wetlands, transition areas or FHA. Implementation of regulated activities typically requires acquisition of approved DLUR permits from NJDEP prior to the start of work. However, the proposed activities are a component of a USEPA-led RI conducted under CERCLA. As such, the proposed activities qualify for submittal of NJDEP DLUR permit equivalency packages. To this end, ARCADIS will prepare and submit the following land use permit equivalency packages to NJDEP in accordance with N.J.A.C. 7:7A and N.J.A.C. 7:13, respectively. These documents will include a compliance statement for the respective regulation and provide information regarding on-site wetlands, management practices and appropriate restoration measures.

Freshwater Wetlands General Permit 14 (FWW GP-14) – Water Monitoring Devices

A blanket FWW GP-14 authorizes the installation of groundwater monitoring wells or other water monitoring devices at locations in freshwater wetlands, transition areas and State open waters, including:

- drilling and installing permanent or temporary monitoring wells by machine
- cutting vegetation no wider than 5 feet by machine for a survey line
- cutting vegetation greater than 3 feet wide by hand for a survey line

FHA Permit-by-Rule 7:13-7.2(a)2 – Constructing in Disturbed Riparian Zones or at/or Below Grade in an FHA

An FHA Permit-by-Rule 7:13-7.2(a)2 authorizes activities in disturbed riparian zones or FHA, provided:

- the activity is conducted at or below grade in an FHA and existing surface elevations are not raised
- the activity is not located within 25 feet of any top of bank or water's edge
- the activity is not a major development, as defined at N.J.A.C. 7:8-1.2

- no vegetation is cleared, cut or removed from a riparian zone except where previous disturbance has occurred

- vegetation temporarily disturbed in the riparian zone is replanted with indigenous, non-invasive species

The need for additional land use permits, if any, will be identified during other pre-characterization activities.

3.2 Soil Sampling

3.2.1 Soil Sample Locations

The soil sampling locations are shown on Figures 3a and 3b, along with previous surface soil sample results that were used to select the proposed locations. Proposed locations are also summarized in Table 1. All locations are in potentially wet areas and will consist of wetland soil.

The soil sampling locations proposed (sample numbers SS-125 through SS-158) are in native soil near previous soil samples along the estimated landfill boundary where the concentrations of one or more constituents exceeded its SRS. In addition, USEPA recommended six additional soil samples to obtain data that can be used in developing the BERA Work Plan. One of these samples (sample number SS-159) is near the two ponds at the northern extent of the landfill, and the remaining five samples (sample numbers SS-160 through SS-164) are located in the southern and western portion of the site.

Sampling at locations SS-125 through SS-158 will be conducted in a step-out manner. Soil samples will be collected in two lines: an inner line approximately 25 feet from the edge of the estimated landfill boundary based on information collected during previous sampling activities, and an outer line approximately 50 feet from the edge of the landfill. (The approximate location of the edge of the estimated landfill boundary is shown in pink in Figure 2, and will be confirmed based on visual observations at the time of sampling. The purpose of the soil samples is to delineate the extent of any constituents associated with the site in the adjacent native soil. Therefore, it is necessary to estimate where the edge of the landfill is. Final sample locations may be adjusted if field observations indicate the location of the edge of the estimated landfill boundary differs from that shown in Figure 2.) All soil samples will be analyzed for full TCL/TAL parameters including PCBs as arcoclors. Certain SVOCs in the TCL will be

analyzed by selective ion monitoring (SIM) to obtain a lower detection limit. If PCBs are detected, these samples may be analyzed for PCB congeners, dioxins, and furans. If the results of these analyses exceed the SRSs, samples from the outer line will be analyzed for the same parameters. If the results from the outer line also exceed the SRSs, additional sampling may be needed to complete delineation. All soil sample analyses are summarized in Table 1.

All samples at locations SS-159 through SS-164 will be collected and analyzed directly.

3.2.2 Soil Sampling Procedures

ARCADIS field personnel will advance soil borings to collect surface soil samples using a hand-driven Macrocore®. At each sampling location, field personnel will use hand tools (e.g., slide-hammer) to advance a 2-inch-diameter by 2-foot-long stainless steel Macrocore® fitted with a dedicated acetate liner to 1 foot bgs. The Macrocore® cutting shoe may be equipped with a disposable, plastic basket to increase recovery of loose material. Other sampling methods (e.g., hand auger, shovel) may be used to collect soil samples if conditions at a proposed sampling location do not allow for advancement of or adequate recovery with a hand-driven Macrocore®.

After the Macrocore® is advanced to the specified depth, field personnel will carefully extract the Macrocore® from the borehole to minimize soil loss, remove the acetate liner containing the soil core from the Macrocore®, cut the acetate liner open, and photograph the soil core. Field personnel will record the length of each recovered soil core in a field log book then score the soil core at 6-inch intervals and field screen with a photoionization detector (PID). PID readings will be recorded in a field log book. If other sampling methods are required to collect soil, field personnel will attempt to remove a volume of soil approximately 1 foot long and 3 to 6 inches thick from the surface interval (i.e., 0.0 to 1.0 foot bgs), while attempting to minimize soil disturbance. Field personnel will process this soil volume in the same manner as a soil core contained in a Macrocore® acetate liner, as described above.

One sample for VOC analysis will be collected from the 6-inch interval with the highest PID reading. If PID readings higher than background levels are not observed, or if PID readings were consistent throughout the length of a core, one sample for VOC analysis will be collected from 0.5 to 1.0 foot bgs, or from any zone indicating waste material or discolloration.

Following sample collection for VOC analysis, field personnel will continue characterizing the soil core. The soil's physical characteristics and other relevant visual observations will be recorded in a field log book. When soil characterization is complete, a composite sample for non-VOC parameters will be collected from the remaining soil in the soil core. Surface soil samples for non-VOC parameters will be collected using decontaminated, non-dedicated stainless steel hand-tools (e.g., spoons, scoops or trowels) and bowls. Field personnel will place surface soil samples in laboratory-supplied containers. Field personnel will document, label, package and ship soil samples in accordance with procedures provided in Worksheet #21 of the QAPP. Non-disposable sample equipment (e.g., stainless steel bowls and spoons, Macrocore®, hand-auger, shovel) will be decontaminated between uses at subsequent sampling locations in accordance with the Equipment Decontamination standard operating procedure presented in the QAPP.

Field personnel will advance the Macrocore® or other hand tool to 1 foot bgs until adequate sample volume is obtained or until it is determined that a surface soil sample cannot be collected due to lack of soil at a sampling location. Field personnel will advance the Macrocore® or other hand tool a maximum of four times within 5 to 10 feet of each proposed sampling location in an attempt to obtain adequate sample volume. If adequate sample volume cannot be obtained after four attempts, no sample will be collected at that particular sampling location. Soil sampling will be attempted at the secondary (step out) location.

Some sampling will take place in potential bog turtle habitat. Field personnel conducting sampling activities in potential bog turtle habitat will implement USFWS-recommended conservation measures as described in Section 3.1.1.

The locations of all soil samples will be recorded by ARCADIS using a GPS unit.

3.2.3 Soil Sample Analyses

Soil samples will be analyzed for the constituents indicated in Table 1. Soil samples collected at locations SS-125 through SS-158, and locations SS-159 though SS-164, which were requested by USEPA (USEPA letter of July 30, 2014), will be analyzed for full TCL/TAL parameters. Certain SVOCs in the TCL will be analyzed by SIM to obtain a lower detection limit. If PCBs are detected, in samples SS-159 through SS-164, up to two of these samples may be analyzed for PCB congeners, dioxins, and furans.

3.3 Installation and Sampling of Temporary Monitoring Wells

The purpose of the temporary monitoring wells is to delineate constituents detected in monitoring wells MW-3 and MW-10. Previous data indicate that certain VOCs are present at concentrations above their New Jersey Ground Water Quality Criteria (GWQCs) for Class 2 aquifers. The temporary wells will be used to help identify potential sources of the VOCs, and to help select the locations of permanent monitoring wells in these areas for future monitoring. The constituents found in monitoring wells MW-3 and MW-10 will also be delineated by pore-water, surface water and sediment sampling, as discussed in Sections 3.4, 3.6, and 3.7.

3.3.1 Temporary Monitoring Well Locations

The proposed temporary monitoring well locations are shown in Figure 3a and 3b. Approximately five temporary wells will be drilled in the area of monitoring well MW-3. They will be located both upgradient and downgradient of monitoring well MW-3 to help identify potential sources of VOCs in this monitoring well and to delineate their downgradient extent.

Approximately four temporary wells are proposed in the vicinity of monitoring well MW-10. These locations are upgradient of monitoring well MW-10 to help identify potential sources of the VOCs. Given its location near wetlands, temporary or permanent monitoring wells cannot be installed downgradient of well MW-10.

3.3.2 Temporary Monitoring Well Installation and Sampling Procedures

Temporary monitoring wells will be installed in accordance with the NJDEP procedure for passively placed narrow diameter points (PPNDPs; NJDEP, 1994). Using a Geoprobe^{R}, a licensed driller will advance a Macrocore® fitted with a dedicated acetate liner to approximately 3 to 5 feet below the water table. The soil in the acetate liner will be logged and screened in accordance with the procedures presented in Section 3.2.3. Soil samples may be collected if PID readings higher than background levels are observed. Soil samples will be analyzed for full TCL/TAL parameters. Certain SVOCs in the TCL will be analyzed by SIM to obtain a lower detection limit.

Given the proximity to surface water in these areas of the site, the total depth of the PPNDPs will likely be less than 10 feet bgs. After reaching the required depth, the Macrocore® will be removed. A 1-inch diameter schedule 40 PVC well screen with

0.010 slots and a solid end cap is then placed in the borehole, with the screen crossing the water table.

Prior to sampling, three to five volumes of the standing water in the PPNDP will be purged using a peristaltic pump, inertial pump, or small centrifugal pump. During purging, a multifunction water quality meter will be used to record field parameter measurements (pH, specific conductance, oxidation-reduction potential, temperature, turbidity and dissolved oxygen) at the beginning, middle, and end of purging, as well as following sample collection. Field parameters will be recorded on field purge logs. Samples will be collected using a bailer and transferred to laboratory prepared bottles. In addition to the unfiltered sample at each temporary monitoring well, a filtered sample will also be collected by passing the unfiltered groundwater through a 0.45 micron filter. All samples will be stored in coolers on ice under full chain of custody procedures for shipment to the laboratory. Field personnel will document, label, package and ship temporary monitoring well samples in accordance with procedures provided in Worksheet #21 of the QAPP.

The well screen will be removed no more than 48 hours after placement. The borehole will be backfilled with prehydrated bentonite. The location of each PPNDP will be recorded by ARCADIS using GPS.

Purge water generated during sampling of temporary monitoring wells will be collected and contained in 55-gallon drums and staged for waste characterization and subsequent disposal.

3.3.3 Analysis of Groundwater Samples from Temporary Monitoring Wells

Groundwater samples from temporary monitoring wells will be analyzed for full TCL/TAL metals (filtered and unfiltered) and cyanide. Certain SVOCs in the TCL will be analyzed by SIM to obtain a lower detection limit.

3.4 Pore-Water Sampling

3.4.1 Pore-Water Sampler Locations

The purpose of pore-water sampling is to delineate the potential migration of contaminants in groundwater from the area of monitoring well MW-10 to the southwest. The area southwest of MW-10 is wetlands with surface water during most of the year. Therefore, a monitoring well will not be installed. Surface water samples could be

obtained in this area for comparison to groundwater results at MW-10; however, surface water is affected by precipitation, inflow from other areas, and other variables. Therefore, pore-water samples will be collected to delineate the contaminants in groundwater.

Two pore-water samplers will be installed in the sediment downgradient of well MW-10 to obtain samples beneath the wetlands. The proposed sampling locations are shown on Figure 3a.

3.4.2 Pore-Water Sampler Installation

Regenerated cellulose membrane samplers will be used to collect pore-water samples within the sediment column. The samplers will be constructed of regenerated cellulose membrane material installed in a 2-inch diameter slotted PVC casing with a closed drive point and a screw-on cap. It is anticipated that a 12-inch sampler will provide sufficient volume for analysis; the actual length may be adjusted based on laboratory volume requirements. The regenerated cellulose membrane will be prefilled with deoxygenated and deionized water.

The pore-water sampler will be hand pushed at each target locations until the sampler is fully submerged by sediment as close to the biologically active zone (0 to 0.5 feet) as possible. Two samplers may be installed at one of the proposed locations to provide adequate volume for quality assurance/quality control samples. Locations will be marked with weighted buoys and samplers will be left in place for 14 to 21 days to equilibrate before samples are collected.

3.4.3 Analysis of Pore-Water Samples

Pore-water samples will be analyzed for TCL VOCs and TAL Metals and cyanide.

3.5 Installation and Sampling of Permanent Monitoring Wells

3.5.1 Permanent Monitoring Well Locations

Approximate proposed locations for the permanent monitoring wells are shown in Figures 3a and 3b. The final locations of the permanent monitoring wells will be determined based on the results of the soil sampling and the temporary monitoring well samples. These data, and a proposal for the locations of the permanent monitoring wells, will be provided to the USEPA in an interim technical memorandum (discussed

in Section 3.10) for review and approval. The permanent monitoring wells will be installed after USEPA approval of the proposed well locations.

3.5.2 Permanent Monitoring Well Installation Procedures

Monitoring wells will be installed using a track-mounted hollow stem auger drill rig equipped with 4.25-inch-inner-diameter augers. Total well depths should be less than 15 feet bgs, based on water-level observations during previous RI activities. Continuous soil samples will be collected during borehole advancement using a 2-inch-diameter, 4-foot-long a Macrocore® fitted with a dedicated acetate liner. Each sample will be field screened with a PID. PID readings, descriptions of the soil's physical characteristics and other relevant visual observations will be recorded in a field log book. Samples for laboratory analysis will not be collected from the split-spoon samples.

Monitoring wells be constructed of 2-inch-diameter flush-joint threaded schedule 40 PVC riser with a 10-foot length of 0.01-inch slotted PVC well screen. Each monitoring well will be constructed so that the static water level is approximately 2 feet below the top of the well screen. A washed silica sand pack will be placed in the annular space between the well screen and riser and the formation to approximately 2 feet above the top of the well screen, followed by a 2-foot layer of fine sand (#00) as a seal. Cement-bentonite grout will be installed in the remaining annular space. Each monitoring well will be finished at the ground surface with a lockable steel stick-up protective housing and set within a 2- by 2-foot concrete pad constructed using a wooden form. Each well will be capped with an expandable well cap and marked permanently with the monitoring well ID and well permit number.

Soil cutting generated during monitoring well installation activities will be contained in 55-gallon drums and staged for waste characterization and disposal.

3.5.3 Monitoring Well Development/Redevelopment

Each newly installed monitoring well will be developed to remove fine-grained material that may have settled in and around the well during installation and to verify that the monitoring well is hydraulically connected to the surrounding formation. Existing monitoring wells will be redeveloped to remove accumulated sediment and/or to reestablish hydraulic connection between the well and surrounding formation if more than 0.5 ft of sediment has accumulated in the well.

Well development will be conducted in accordance with applicable NJDEP guidance (NJDEP 2005). Water-level measurements, purge rates and observations of the water's characteristics (e.g., odor, turbidity) will be recorded in a field log book during the purging activity.

Water generated during monitoring well development/redevelopment activities will be contained in 55-gallon drums and staged for waste characterization and disposal.

3.5.4 Hydraulic Monitoring

3.5.4.1 Evaluation of Hydraulic Connection of Northern Ponds to Groundwater

A surface water gauge will be installed in the easternmost of the two small ponds located near the northern edge of the landfill (Figure 3a). A surface water gauge was previously installed in the westernmost of these two ponds during the RI activities. Water-level measurements will be collected manually using an electronic water-level indicator at existing monitoring MW-9 and proposed monitoring well MW-11 and each surface water gauge in these two small ponds once a month for 4 months to evaluate the relative elevation of surface water in each pond and groundwater. Precipitation data will be collected from a local weather station for the same period. A monitoring period of four months should be adequate to observe how water levels are affected by variation in precipitation amounts. The hydrologic connection between the two small ponds and groundwater will then be evaluated.

3.5.4.2 Site-Wide Groundwater Elevation Measurements

Synoptic groundwater level measurements will be collected from all new and existing monitoring wells prior to each round of groundwater sampling.

The depth to water will be measured from the surveyed measuring point at each well using an electronic water level indicator, and will be accurate to within 0.01 feet. In addition to the groundwater levels, surface water elevations will be measured in the two small ponds located near the northern edge of the estimated landfill boundary (Figure 3a), and the large pond near the western edge of the estimated landfill boundary (Figure 3b) prior to groundwater sampling.

3.5.5 Monitoring Well Sampling Procedures

Three groundwater sampling events will be conducted. The first groundwater sampling event will consist of the existing permanent wells, and will be conducted at approximately the same time as the soil, sediment, surface water, pore-water, and temporary monitoring well sampling. The second groundwater sampling event will be conducted at least two weeks following installation and development of the new monitoring wells, and will include all the new wells, and the existing monitoring wells as necessary depending on the results of the first event at these wells. The third event will consist of all the new monitoring wells (i.e., a second round of samples at these wells). The third groundwater sampling event will be conducted approximately 90 days after the second event.

Groundwater samples will be collected using low-flow purging and sampling procedures. A bladder pump equipped with a Teflon® bladder, assembled with Teflon® and stainless steel fittings, will be used for low-flow purging and sampling. Dedicated Teflon® tubing will be used to discharge groundwater from the bladder pump. The bladder pump will be lowered to the middle of the saturated screened interval of the monitoring well. During purging, a multifunction water quality meter equipped with an in-line flow-through cell will be used to record field parameter measurements (pH, specific conductance, oxidation-reduction potential, temperature, turbidity and dissolved oxygen). Purge rates will be maintained between approximately 100 and 250 milliliters per minute (mL/min) and adjusted to avoid drawdown in the well greater than 0.1 meter (0.33 foot) to the extent possible.

Once field parameters stabilize, the influent feed line will be removed from the flow-through assembly. One groundwater sample will be collected directly from the influent feed line and placed in laboratory-supplied containers. Field personnel will document, label, package and ship groundwater samples in accordance with procedures provided in Worksheet #21 of the QAPP.

Purge water generated during monitoring well sampling activities will be contained in 55-gallon drums and staged on site for waste characterization and disposal.

3.5.6 Analysis of Groundwater Samples from Permanent Monitoring Wells

Samples collected during the first monitoring event (all existing wells) will be analyzed for full TCL/TAL metals and cyanide (filtered and unfiltered). Samples collected from the existing monitoring wells during the second monitoring event will be analyzed as

warranted depending on the results of the first monitoring event; a proposed list of analytes will be provided to USEPA in the Technical Memorandum described in Section 3.10. Samples collected from new monitoring wells during both the second and third monitoring events will be analyzed for full TCL/TAL metals and cyanide (filtered and unfiltered).

Groundwater data may be used to evaluate proposing monitored natural attenuation (MNA) as a remedy for groundwater. In support of this, additional data to characterize geochemical conditions in the aquifer may be obtained during the groundwater sampling. A list of proposed monitoring wells and analytical methods to be included in this sampling will be provided to USEPA before the sampling is conducted.

3.6 Surface Water Sampling

3.6.1 Surface Water Sampling Locations

Surface water samples will be collected from surface water bodies on the site that were not sampled during the previous investigations. In addition, surface water samples will be collected from a linear water body located southwest of the estimated landfill boundary, between monitoring wells MW-3 and MW-4. The proposed sampling locations are shown on Figures 3a and 3b and are summarized in Table 1. The order of sampling will be from downstream to upstream locations. All surface water samples will be co-located with sediment samples (Section 3.7), and will be collected prior to sediment samples to minimize turbidity in the water column.

The position of sample locations may be adjusted based on accessibility or on other information gathered during field activities. Some of the water bodies where sampling is proposed are small and have not been directly observed during previous activities at the site. They may be ephemeral or may be smaller than shown in the site figure, which is based on an aerial photograph taken in 2006. Surface water and sediment samples will be collected if any standing water is observed at the proposed sampling locations.

3.6.2 Surface Water Sampling Procedures

Surface water samples will be collected in accordance with sampling procedures developed based on USEPA, USEPA ERT, and NJDEP surface water sample collection guidance documents (USEPA 1996, 1995, 1994a; NJDEP 2005).

The total depth of the water column will be measured at each surface water sampling location using an electronic depth sounder, surveyor's rod, or tape measure. Samples analyzed for trace-mercury using laboratory analytical method Revision E: Mercury in Water by Oxidation, Purge and Trap, and Cold Vapor Atomic Fluorescence Spectrometry for Mercury (USEPA Method 1631) will be collected using the "Clean Hands and Dirty Hands" procedural techniques recommended in *Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels – Method 1669* (USEPA 1996). These samples will be collected separately from the other sample parameters by a dedicated "Clean Hands and Dirty Hands" team using a peristaltic pump equipped with white polyethylene and styrene/ethylene/butylenes/silicone (SEBS) tubing. The remaining sample parameters will be collected following the collection of trace-mercury samples, using either dedicated laboratory-decontaminated bottleware, bottom-loading Teflon® bailers, a Bacon bomb sampler or a peristaltic pump equipped with dedicated Teflon®-lined polyethylene and medical-grade silicon tubing. The appropriate sampling method will be selected based on sample parameters and site conditions at the time of sample collection. Samples will be collected from the mid-point of the water column at each location. A peristaltic pump will not be used to collect surface water samples to be analyzed for VOCs. For metals analyses, both filtered and unfiltered surface water samples will be collected. Samples will be filtered by the analytical laboratory using a 0.45-micron disposable filter. Samples collected for trace-mercury analysis will be filtered by the analytical laboratory. Surface water samples will be transferred directly into laboratory-supplied containers. Field personnel will document, label, package and ship surface water samples in accordance with procedures provided in Worksheet #21 of the QAPP.

Following surface water sample collection activities at each sampling location, water-quality parameters (e.g., pH, temperature, conductivity, and turbidity) will be measured using a combination water-quality meter (e.g., Horiba U-10, or equivalent). Water-quality measurement results will be recorded in a field log book.

3.6.3 Analysis of Surface Water Samples

All surface water samples will be analyzed for full TCL/TAL, SVOCs SIM, low-level mercury, filtered TAL metals and cyanide, and hardness.

3.7 Sediment Sampling

3.7.1 Sediment Sample Locations

Sediment samples will be collected from surface water bodies on the site that were not sampled during the previous investigations. In addition, sediment samples will be collected from a linear water body located southwest of the estimated landfill boundary, between monitoring wells MW-3 and MW-4. The proposed sampling locations are shown on Figures 3a and 3b and are summarized in Table 1. The order of sampling will be from downstream to upstream locations. All sediment samples will be co-located with surface water samples (Section 3.6); sediment samples will be collected after surface water samples to minimize turbidity in the water column.

The position of sample locations may be adjusted based on accessibility or on other information gathered during field activities. Some of the water bodies where sampling is proposed are small and have not been directly observed during previous activities at the site. They may be ephemeral or may be smaller than shown in the site figure, which is based on an aerial photograph taken in 2006. In such cases, the samples may be collected elsewhere or eliminated.

3.7.2 Sediment Sampling Procedures

Sediment samples will be collected in accordance with sampling procedures developed based on USEPA, USEPA ERT, and NJDEP sediment sample collection guidance documents (USEPA 1995, 1994b; NJDEP 2005, 1998).

Sediment samples will be collected by advancing a dedicated Lexan® coring device or stainless steel Macrocore® sampler equipped with a dedicated acetate liner to a minimum of 1 foot beneath the surface water/sediment interface. One of these sampling methods will be selected based on site conditions at the time of sample collection. Each sediment core will be field screened with a PID. PID readings, descriptions of the sediment's physical characteristics, and other relevant visual observations will be recorded in a field log book. A sample for VOC analysis will be collected from the 0.5 to 1.0-foot interval in accordance with NJDEP (1998). Sediment in the 0.0 to 0.5-foot interval will then be homogenized and transferred directly into laboratory-supplied containers for other analytical parameters. Field personnel will document, label, package and ship sediment samples in accordance with procedures provided in Worksheet #21 of the QAPP.

3.7.3 Sediment Sample Analysis

All sediment samples will be analyzed for full TCL/TAL, SVOC SIM, pH, total organic carbon, and grain size.

3.8 Assessment of Hunt Club Well HC-1

Well HC-1 is the existing well which supplies water to a spigot located outside the Hunt Club building. The water is used for non-potable uses only. The well is located on the east side of Britten Road in the vicinity of the Hunt Club Building (Figure 2). A well permit from 1962 appears to be for the Hunt Club well. This permit indicates the proposed well depth was 150 feet bgs. However, the NJDEP does not have a record for this well.

A sample of the water from this well was collected in 2007 and analyzed for full TCL/TAL parameters. The results indicate that the only constituents present at concentrations above their GWQCs were iron (1,840 micrograms per liter [µg/L] compared to its GWQC of 300 µg/L) and manganese (951 µg/L, compared to its GWQC of 50 µg/L). The GWQCs for iron and manganese are based on USEPA Secondary Maximum Contaminant Limits (MCLs), which are based on aesthetic considerations such as taste, odor, and appearance.

The investigation of the Hunt Club well will include removing the pump and piping from the well and obtaining a video log to estimate the depth of the well casing, length of open hole or screened interval, and total depth of the well. This task will be conducted by a licensed well driller under observation by a geologist or engineer from ARCADIS.

The final disposition of the well will be decided after the investigation is complete. The Group may propose not to reinstall the pump and piping to prevent any potential future exposure and/or to use the well as a monitoring point, if its construction is suitable. The Group will discuss reinstallation options with the property owner before proceeding.

3.9 Analytical Procedures

All analyses will be performed by TestAmerica Laboratories, Inc. (TestAmerica) using current USEPA methods. TestAmerica is a current participant in the Contract Laboratory Program (CLP). The analytical procedures are included in Table 1.

Additional information on TestAmerica and the analytical procedures is provided in the QAPP.

3.10 Reporting

3.10.1 Interim Technical Memorandum

Prior to installation of the permanent monitoring wells, an interim technical memorandum will be prepared. The purpose of the interim technical memorandum will be to provide a basis to select locations for the permanent monitoring wells.

The interim technical memorandum will include non-validated analytical results from soil samples, temporary monitoring wells, sediment samples and surface water samples. It will also include maps showing the soil sample, sediment sample, surface water sample and temporary well locations and sampling logs. It will contain recommendations for the locations of permanent monitoring wells, and will be submitted to USEPA for review and approval before the permanent monitoring wells are installed.

3.10.2 Final Report

A final report will be prepared and submitted to USEPA for review as a standalone document. This report will also be incorporated into the RI report. The final report will include a discussion of the new validated data results for all surface soil, surface water, sediment, pore-water, and groundwater samples collected as part of the Data Gaps SAP. A revised conceptual site model will also be included.

4. Schedule

The Data Gaps SAP sampling has been divided into two phases to (1) obtain data needed to select permanent well locations and allow USEPA to review the proposed locations before installation; and (2) obtain data needed to support preparation of the BERA Work Plan in early 2015, allowing implementation of the BERA field sampling during the 2015 field season. The final locations of the seven proposed permanent monitoring wells depend on the results of the soil and temporary well sampling. The data needed to help develop the BERA Work Plan are the results of the soil, pore-water, surface water, and sediment samples. Therefore, these samples will be collected in Phase 1 of the Data Gaps SAP field implementation, and the results should be available in early 2015.

After Phase 1 is complete, an Interim Technical Memorandum proposing the permanent monitoring well locations will be submitted to the USEPA. After approval of the well locations, Phase 2 of the Data Gaps SAP will be implemented. It will consist of installation and sampling of new monitoring wells, and additional sampling of the existing monitoring wells.

Concurrently, after Phase 1 is complete, the soil, pore-water, surface water, and sediment results will be used to help finalize the BERA WP.

The following schedule provides additional detail. The actual schedule will depend on USEPA review and approval of deliverables provided by the Group, weather, access, subcontractor availability, and other factors.

<u>Phase 1 Field Work</u>

- Submittal of permit equivalencies – November 7, 2014
- Soil sample collection – November 17 through December 2, 2014
- Installation of pore-water samplers – November 18, 2014
- Temporary monitoring well installation and sampling – December 1 through December 5, 2014
- Surface water and sediment sampling – December 2 through December 11, 2014
- Recovery of pore-water samplers and sample collection – December 3, 2014
- Assessment of Hunt Club well HC-1 – December 5, 2014
- Redevelopment and sampling of existing wells – December 8 through December 19, 2015
- Sample analysis – November 18, 2014 through January 19, 2015

Data Review and Document Preparation

- Data validation – January 13, 2015 through February 12, 2015
- Preparation of Interim Technical Memorandum – December 12, 2014 through February 12, 2015
- Submit Interim Technical Memorandum to USEPA – February 13, 2015
- USEPA review of Interim Technical Memorandum – February 16 through March 6, 2015
- Receive USEPA approval of proposed permanent well locations – March 6, 2015

Phase 2 Field Work

- Obtain well permits – March 9 through March 27, 2015
- Install and develop proposed permanent wells – March 30 through April 10, 2015
- Second groundwater sampling event (all new monitoring wells, and selected existing monitoring wells based on the results of the first groundwater sampling even) – April 27 through May 7, 2015
- Third groundwater sampling event (all new monitoring wells) – July 27 through August 7, 2015
- Groundwater sample analysis – April 28 through September 7, 2015
- Evaluation of connection between northern ponds and groundwater – April 10 through August 14, 2015

Final Reporting

- Data validation – June 7 through September 21, 2015
- Begin preparation of final report – September 22, 2015
- Submit final report to USEPA – October 30, 2015

Development of the BERA Work Plan will begin after the results of the Phase 1 field work are received. Completion of this work plan, review of the work plan by USEPA, and implementation of the BERA will proceed in parallel with the implementation of the Data Gaps SAP. A schedule for the BERA will be provided in the BERA Work Plan.

5. Project Management

5.1 Staffing

Implementation of Data Gap SAP activities will require integration of personnel from various organizations, collectively referred to as the "Project Team." Responsibilities of each member of the project team are presented in the QAPP.

A list of key project management personnel is provided below.

Company/Organization	Title	Name	Phone Number
USEPA	Remedial Project Manager	Tanya Mitchell	212-637-4362
USEPA	QA Manager	TBD	TBD
NJDEP	Case Manager	Jill McKenzie	609-292-1993
The Group	Primary Contact	Gary Fisher	908-582-5771
ARCADIS	Project Officer	John Persico	609-860-0590
ARCADIS	Project Manager	Suzanne Walls	865-777-3502
ARCADIS	QA Manager	Dennis Capria	315-446-2570

TBD – To be determined

5.2 Coordination

Personnel performing RI/FS Work Plan activities will be directed by representatives of the Project Team. A project organizational chart is provided as Figure 4.

6. References

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Weston Solutions Inc. 2003c. Sampling Trip Report - Rolling Knolls Landfill.

Table 1
Sample Locations, Depths, and Analyses
Data Gaps Sampling and Analysis Plan
Rolling Knolls Landfill Superfund Site
Chatham, New Jersey

Sample ID	Sample Media	Depth Interval (Feet)	Sample Collection Method	Laboratory Analyses													Notes
				VOCs	SVOCs	SVOCs - SIM	PCBs (as Aroclors)	Pesticides	TAL Metals and Cyanide	PCB Congeners, Dioxins, Furans	Full TCL/TAL	TAL Metals and Cyanide (unfiltered)	TAL Metals and Cyanide (filtered)	Low-Level Mercury	Hardness	pH, TOC, Grain Size	
Soil Samples																	
SS-125	Soil	0.0-1.0	Macrocore			X					X						
SS-126	Soil	0.0-1.0	Macrocore														*Contingent on sample SS-125
SS-127	Soil	0.0-1.0	Macrocore			X				X	X						
SS-128	Soil	0.0-1.0	Macrocore														*Contingent on sample SS-127
SS-129	Soil	0.0-1.0	Macrocore			X				X	X						
SS-130	Soil	0.0-1.0	Macrocore														*Contingent on sample SS-129
SS-131	Soil	0.0-1.0	Macrocore			X					X						
SS-132	Soil	0.0-1.0	Macrocore														*Contingent on sample SS-131
SS-133	Soil	0.0-1.0	Macrocore			X					X						
SS-134	Soil	0.0-1.0	Macrocore														*Contingent on sample SS-133
SS-135	Soil	0.0-1.0	Macrocore			X					X						
SS-136	Soil	0.0-1.0	Macrocore														*Contingent on sample SS-135
SS-137	Soil	0.0-1.0	Macrocore			X				X	X						
SS-138	Soil	0.0-1.0	Macrocore														*Contingent on sample SS-137
SS-139	Soil	0.0-1.0	Macrocore			X				X	X						
SS-140	Soil	0.0-1.0	Macrocore														*Contingent on sample SS-139
SS-141	Soil	0.0-1.0	Macrocore			X					X						
SS-142	Soil	0.0-1.0	Macrocore														*Contingent on sample SS-141
SS-143	Soil	0.0-1.0	Macrocore			X					X						

Table 1
Sample Locations, Depths, and Analyses
Data Gaps Sampling and Analysis Plan
Rolling Knolls Landfill Superfund Site
Chatham, New Jersey

Sample ID	Sample Media	Depth Interval (Feet)	Sample Collection Method	Laboratory Analyses													Notes
				VOCs	SVOCs	SVOCs - SIM	PCBs (as Aroclors)	Pesticides	TAL Metals and Cyanide	PCB Congeners, Dioxins, Furans	Full TCL/TAL	TAL Metals and Cyanide (unfiltered)	TAL Metals and Cyanide (filtered)	Low-Level Mercury	Hardness	pH, TOC, Grain Size	
SS-144	Soil	0.0-1.0	Macrocore														*Contingent on sample SS-143
SS-145	Soil	0.0-1.0	Macrocore			X					X						
SS-146	Soil	0.0-1.0	Macrocore														*Contingent on sample SS-145
SS-147	Soil	0.0-1.0	Macrocore			X					X						
SS-148	Soil	0.0-1.0	Macrocore														*Contingent on sample SS-147
SS-149	Soil	0.0-1.0	Macrocore			X					X						
SS-150	Soil	0.0-1.0	Macrocore														*Contingent on sample SS-149
SS-151	Soil	0.0-1.0	Macrocore			X					X						
SS-152	Soil	0.0-1.0	Macrocore														*Contingent on sample SS-151
SS-153	Soil	0.0-1.0	Macrocore			X					X						
SS-154	Soil	0.0-1.0	Macrocore														*Contingent on sample SS-153
SS-155	Soil	0.0-1.0	Macrocore			X					X						
SS-156	Soil	0.0-1.0	Macrocore														*Contingent on sample SS-155
SS-157	Soil	0.0-1.0	Macrocore			X					X						
SS-158	Soil	0.0-1.0	Macrocore														*Contingent on sample SS-157
SS-159	Soil	0.0-1.0	Macrocore			X				X	X						Congeners, dioxins, and furans will be analyzed on up to 2 samples if PCBs are detected in the TAL analysis.
SS-160	Soil	0.0-1.0	Macrocore			X				X	X						
SS-161	Soil	0.0-1.0	Macrocore			X				X	X						
SS-162	Soil	0.0-1.0	Macrocore			X				X	X						
SS-163	Soil	0.0-1.0	Macrocore			X				X	X						
SS-164	Soil	0.0-1.0	Macrocore			X				X	X						

Table 1
Sample Locations, Depths, and Analyses
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				VOCs	SVOCs	SVOCs - SIM	PCBs (as Aroclors)	Pesticides	TAL Metals and Cyanide	PCB Congeners, Dioxins, Furans	Full TCL/TAL	TAL Metals and Cyanide (unfiltered)	TAL Metals and Cyanide (filtered)	Low-Level Mercury	Hardness	pH, TOC, Grain Size	
Temporary Monitoring Wells																	
TWP-1	Groundwater	TBD	Macrocore			X					X		X				
TWP-2	Groundwater	TBD	Macrocore			X					X		X				
TWP-3	Groundwater	TBD	Macrocore			X					X		X				
TWP-4	Groundwater	TBD	Macrocore			X					X		X				
TWP-5	Groundwater	TBD	Macrocore			x					X		X				
TWP-6	Groundwater	TBD	Macrocore			X					X		X				
TWP-7	Groundwater	TBD	Macrocore			X					X		X				
TWP-8	Groundwater	TBD	Macrocore			X					X		X				
TWP-9	Groundwater	TBD	Macrocore			X					X		X				
Permanent Monitoring Wells (Existing)																	
MW-1	Groundwater	14.5	Low flow			X					X		X				
MW-2	Groundwater	12.5	Low flow			X					X		X				
MW-3	Groundwater	12.5	Low flow			X					X		X				
MW-4	Groundwater	12.5	Low flow			X					X		X				
MW-5	Groundwater	12.5	Low flow			X					X		X				
MW-6	Groundwater	12.5	Low flow			X					X		X				
MW-7	Groundwater	12.5	Low flow			X					X		X				
MW-8	Groundwater	12.5	Low flow			X					X		X				
MW-9	Groundwater	12.5	Low flow			X					X		X				
MW-10	Groundwater	12.5	Low flow			X					X		X				
X-1	Groundwater	18	Low flow			X					X		X				

Table 1
Sample Locations, Depths, and Analyses
Data Gaps Sampling and Analysis Plan
Rolling Knolls Landfill Superfund Site
Chatham, New Jersey

Sample ID	Sample Media	Depth Interval (Feet)	Sample Collection Method	Laboratory Analyses													Notes
				VOCs	SVOCs	SVOCs - SIM	PCBs (as Aroclors)	Pesticides	TAL Metals and Cyanide	PCB Congeners, Dioxins, Furans	Full TCL/TAL	TAL Metals and Cyanide (unfiltered)	TAL Metals and Cyanide (filtered)	Low-Level Mercury	Hardness	pH, TOC, Grain Size	
X-2	Groundwater	20	Low flow			X					X		X				
X-3	Groundwater	23	Low flow			X					X		X				
X-4	Groundwater	15.5	Low flow			X					X		X				
X-5	Groundwater	13.2	Low flow			X					X		X				This well was not sampled during previous sampling activities due to a lack
X-6	Groundwater	13	Low flow			X					X		X				
X-7	Groundwater	8.7	Low flow			X					X		X				This well was not sampled during previous sampling activities due to a lack
Permanent Monitoring Wells (Proposed)																	
MW-11	Groundwater	TBD	Low flow			X					X		X				
MW-12	Groundwater	TBD	Low flow			X					X		X				
MW-13	Groundwater	TBD	Low flow			X					X		X				
MW-14	Groundwater	TBD	Low flow			X					X		X				
MW-15	Groundwater	TBD	Low flow			X					X		X				
MW-16	Groundwater	TBD	Low flow			X					X		X				
MW-17	Groundwater	TBD	Low flow			X					X		X				
Pore Water Samples																	
PW-1	Pore Water	0.0-0.5	PDB	X								X					
PW-2	Pore Water	0.0-0.5	PDB	X								X					
Surface Water Samples																	
SW-34	Surface Water	TBD	Teflon-lined bailer/direct dip			X					X		X	X	X		

Table 1
Sample Locations, Depths, and Analyses
Data Gaps Sampling and Analysis Plan
Rolling Knolls Landfill Superfund Site
Chatham, New Jersey

Sample ID	Sample Media	Depth Interval (Feet)	Sample Collection Method	Laboratory Analyses													Notes
				VOCs	SVOCs	SVOCs - SIM	PCBs (as Aroclors)	Pesticides	TAL Metals and Cyanide	PCB Congeners, Dioxins, Furans	Full TCL/TAL	TAL Metals and Cyanide (unfiltered)	TAL Metals and Cyanide (filtered)	Low-Level Mercury	Hardness	pH, TOC, Grain Size	
SW-35	Surface Water	TBD	Teflon-lined bailer/direct dip			X					X		X	X	X		
SW-36	Surface Water	TBD	Teflon-lined bailer/direct dip			X					X		X	X	X		
SW-37	Surface Water	TBD	Teflon-lined bailer/direct dip			X					X		X	X	X		
SW-38	Surface Water	TBD	Teflon-lined bailer/direct dip			X					X		X	X	X		
SW-39	Surface Water	TBD	Teflon-lined bailer/direct dip			X					X		X	X	X		
SW-40	Surface Water	TBD	Teflon-lined bailer/direct dip			X					X		X	X	X		
SW-41	Surface Water	TBD	Teflon-lined bailer/direct dip			X					X		X	X	X		
SW-42	Surface Water	TBD	Teflon-lined bailer/direct dip			X					X		X	X	X		
SW-43	Surface Water	TBD	Teflon-lined bailer/direct dip			X					X		X	X	X		
SW-44	Surface Water	TBD	Teflon-lined bailer/direct dip			X					X		X	X	X		

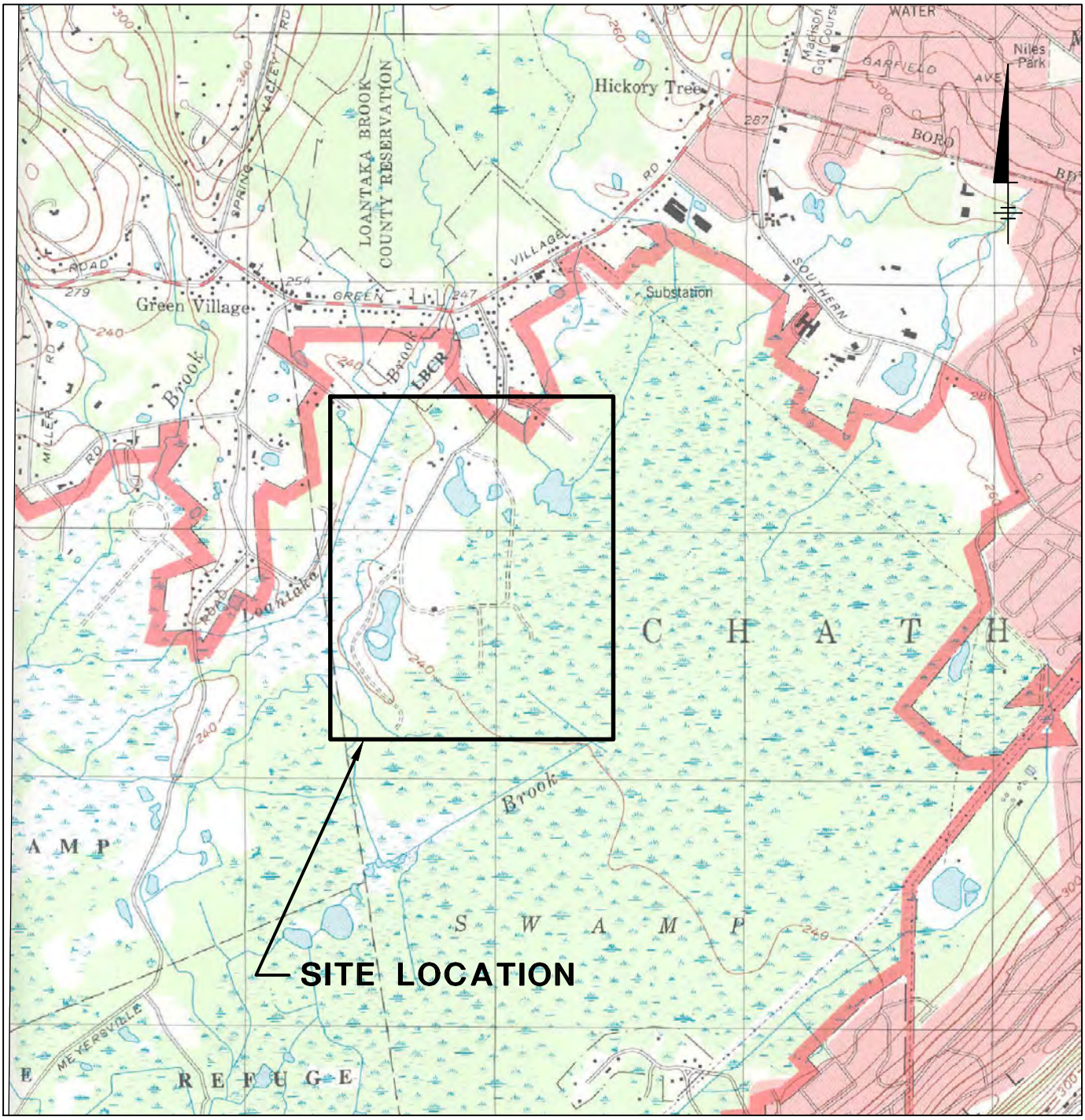
Table 1
Sample Locations, Depths, and Analyses
Data Gaps Sampling and Analysis Plan
Rolling Knolls Landfill Superfund Site
Chatham, New Jersey

Sample ID	Sample Media	Depth Interval (Feet)	Sample Collection Method	Laboratory Analyses													Notes
				VOCs	SVOCs	SVOCs - SIM	PCBs (as Aroclors)	Pesticides	TAL Metals and Cyanide	PCB Congeners, Dioxins, Furans	Full TCL/TAL	TAL Metals and Cyanide (unfiltered)	TAL Metals and Cyanide (filtered)	Low-Level Mercury	Hardness	pH, TOC, Grain Size	
Sediment Samples																	
SD-34	Sediment	0.0 - 1.0	Grab sample – Encore sampler			X					X					X	
SD-35	Sediment	0.0 - 1.0	Grab sample – Encore sampler			X					X					X	
SD-36	Sediment	0.0 - 1.0	Grab sample – Encore sampler			X					X					X	
SD-37	Sediment	0.0 - 1.0	Grab sample – Encore sampler			X					X					X	
SD-38	Sediment	0.0 - 1.0	Grab sample – Encore sampler			X					X					X	
SD-39	Sediment	0.0 - 1.0	Grab sample – Encore sampler			X					X					X	
SD-40	Sediment	0.0 - 1.0	Grab sample – Encore sampler			X					X					X	
SD-41	Sediment	0.0 - 1.0	Grab sample – Encore sampler			X					X					X	
SD-42	Sediment	0.0 - 1.0	Grab sample – Encore sampler			X					X					X	
SD-43	Sediment	0.0 - 1.0	Grab sample – Encore sampler			X					X					X	
SD-44	Sediment	0.0 - 1.0	Grab sample – Encore sampler			X					X					X	

Abbreviations:

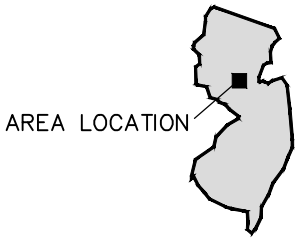
VOCs = volatile organic compounds
SVOCs = semivolatile organic compounds
PCBs = polychlorinated biphenyls
PDB = passive diffusion bag
TCL = Target Compound List
TOC = total organic carbon
TAL= Target Analyte List

Sample analyses will be conducted using the following analytical methods:
Target Compound List organics (VOCs, SVOCs, PCBs and pesticides) via SOM01.2, *Contract Laboratory Program (CLP Statement of Work for Organic Ar*
Target Analyte List metals and cyanide via ISM01.3, *CLP Statement of Work for Inorganic Analyses*
PCB Congeners via USEPA Method 1668A, *Chlorinated Biphenyl Congeners in Water, Soil, Sediment and Tissue by HRGC/HRMS*
Dioxins and furans via USEPA Method 1613, *Dioxins and Furans in Water, Soil, Sediment and Tissue by HRGC/HRMS.*
Low-level mercury via USEPA Method 1631, Revision E.
Hardness via SM 2340C.
pH via USEPA Method 9045D.
TOC via the Lloyd Kahn method.
Grain size via ASTM D-422.



SOURCE:
CHATHAM QUADRANGLE, NJ
7.5 MINUTE SERIES
CONTOUR INTERVAL 20 FEET

0 2000' 4000'
GRAPHIC SCALE



NEW JERSEY

ROLLING KNOLLS LANDFILL SUPERFUND SITE
CHATHAM, NEW JERSEY
DATA GAPS SAMPLING AND ANALYSIS PLAN

SITE LOCATION

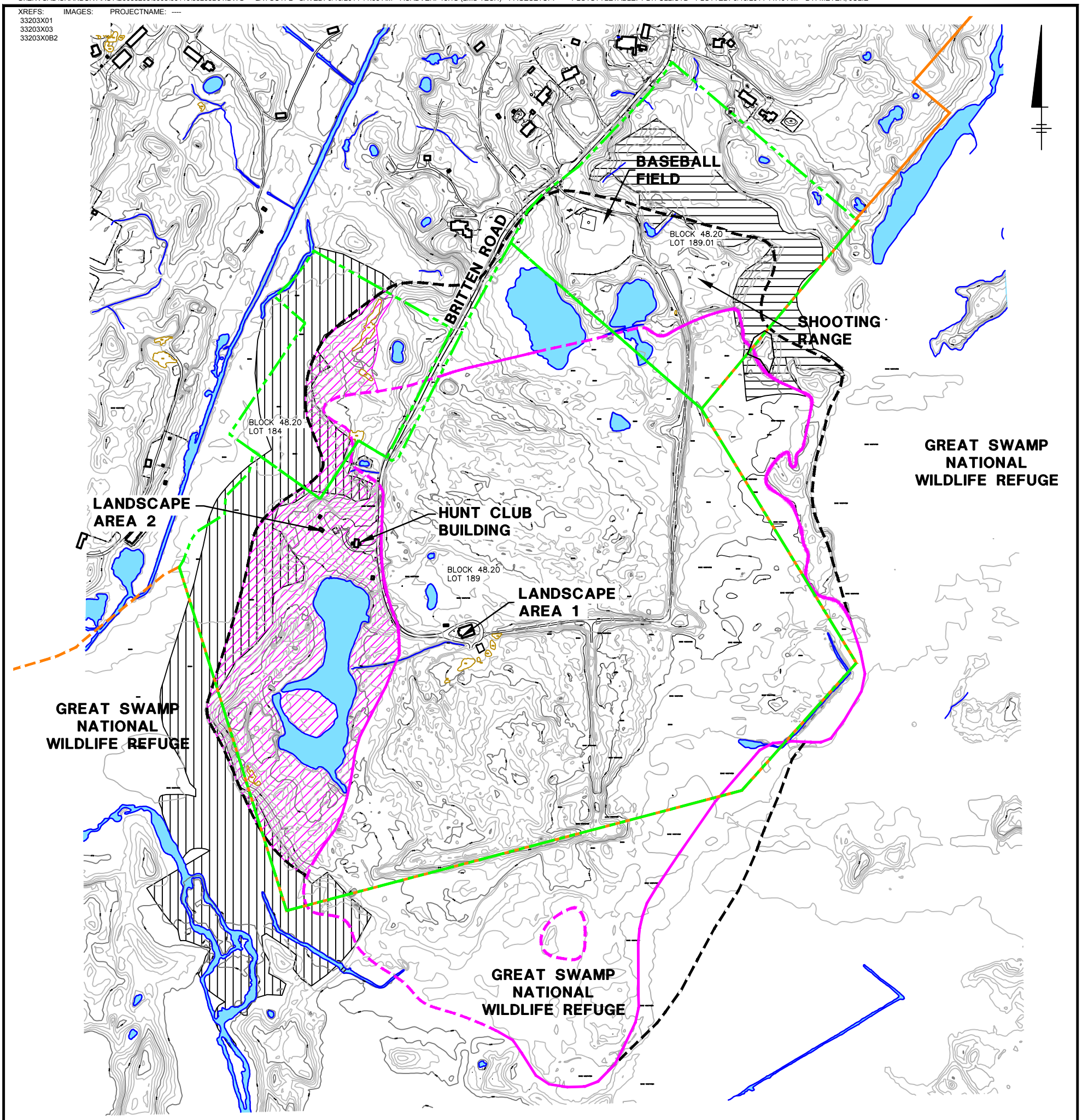
ARCADIS

FIGURE
1

CITY: CRANBURY-NJ DIV/GROUP: ENVCAD DB: TFATTO LD: TFATTO PIC: PM: K.ROMAINE TM: K.ROMAINE LYR: ON=*;OFF=*REF*
G:\ENVCAD\CRANBURY\ACT\B0033203\0003\00110\33203N01.dwg LAYOUT: 1 SAVED: 9/16/2014 11:41 AM ACADVER: 18.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 9/16/2014 11:41 AM BY: MEYER, JULIE
XREFS: IMAGES: 33203X01.jpg PROJECTNAME: ----

CITY:CRANBURY-NJ DIV/GROUP: ENVCAD DB: T.FATTO LD: T.FATTO PIC: PM: K.ROMAINE TM: S.WALLS LYR: ON=*;OFF=*REF*
G:\ENVCAD\CRANBURY\ACT\B0033203\0003\00110\33203B01.DWG LAYOUT: 2 SAVED: 9/16/2014 11:38 AM ACADVER: 18.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 9/16/2014 11:40 AM BY: MEYER, JULIE

XREFS: IMAGES: PROJECTNAME: ----
33203X01
33203X03
33203X0B2



LEGEND:

- OPEN WATER
- PRE-REMEDIAL INVESTIGATION PROJECTED EDGE OF LANDFILLED MATERIALS
- EDGE OF LANDFILLED WASTES OBSERVED DURING TEST PIT ACTIVITIES (DASHED WHERE APPROXIMATE)
- GREAT SWAMP NATIONAL WILDLIFE REFUGE PROPERTY BOUNDARY (DASHED WHERE APPROXIMATE)
- TAX PARCELS
- WASTE AND DEBRIS OBSERVED ON GROUND SURFACE BUT NOT OBSERVED OR ANTICIPATED TO BE BELOW GROUND SURFACE
- POTENTIAL BOG TURTLE HABITAT AREA A (35.31 ACRES)
- POTENTIAL BOG TURTLE HABITAT AREA B (10.89 ACRES)

NOTES:

1. THE PRE-REMEDIAL INVESTIGATION PROJECTED EDGE OF LANDFILLED MATERIALS ON THIS FIGURE IS APPROXIMATE AS DRAWN AND IS BASED ON VISUAL OBSERVATIONS OF THE GROUND SURFACE MADE DURING SITE VISITS CONDUCTED JUNE 20, 2006 THROUGH JULY 14, 2006.
2. THE EDGE OF LANDFILLED WASTES OBSERVED DURING TEST PIT ACTIVITIES IS DRAWN BASED ON OBSERVATIONS OF MATERIALS EXCAVATED DURING TEST PIT ACTIVITIES CONDUCTED FROM JULY 26, 2007 TO SEPTEMBER 6, 2007 AND MARCH 26, 2008.
3. THE PORTION OF THE GREAT SWAMP NATIONAL WILDLIFE REFUGE (GSNWR) PROPERTY BOUNDARY ON THIS FIGURE WITHIN CHATHAM TOWNSHIP, NJ WAS OBTAINED FROM CHATHAM TOWNSHIP TAX PARCEL DATA PROVIDED BY CIVIL SOLUTIONS. THE PORTION OF THE GSNWR PROPERTY BOUNDARY ON THIS FIGURE OUTSIDE OF CHATHAM TOWNSHIP IS APPROXIMATE AND WAS OBTAINED FROM THE UNITED STATES FISH AND WILDLIFE SERVICE (GEOGRAPHIC INFORMATION SYSTEMS AND SPATIAL DATA).
4. BLOCK 48.20, LOTS 184 AND 189 ARE OWNED BY ROBERT J. MIELE AS TRUSTEE FOR THE TRUST CREATED BY THE LAST WILL AND TESTAMENT OF ANGELO J. MIELE. BLOCK 48.20, LOT 189.01 IS OWNED BY THE GREEN VILLAGE FIRE DEPARTMENT.

SOURCES:

1. BASEMAP FROM JAMES M. STEWART INC., LAND SURVEYORS, PHILADELPHIA, PA., (ELECTRONIC FILE: 292406.DWG DATED: 6/30/06)
2. TAX PARCEL DATA FOR CHATHAM TOWNSHIP WAS PROVIDED BY CIVIL SOLUTIONS.

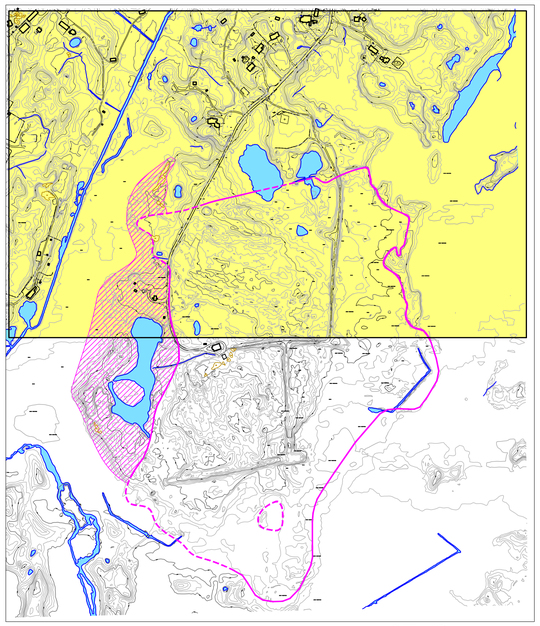
0 500' 1000'
GRAPHIC SCALE

ROLLING KNOLLS LANDFILL SUPERFUND SITE
CHATHAM, NEW JERSEY
DATA GAPS SAMPLING AND ANALYSIS PLAN

SITE PLAN

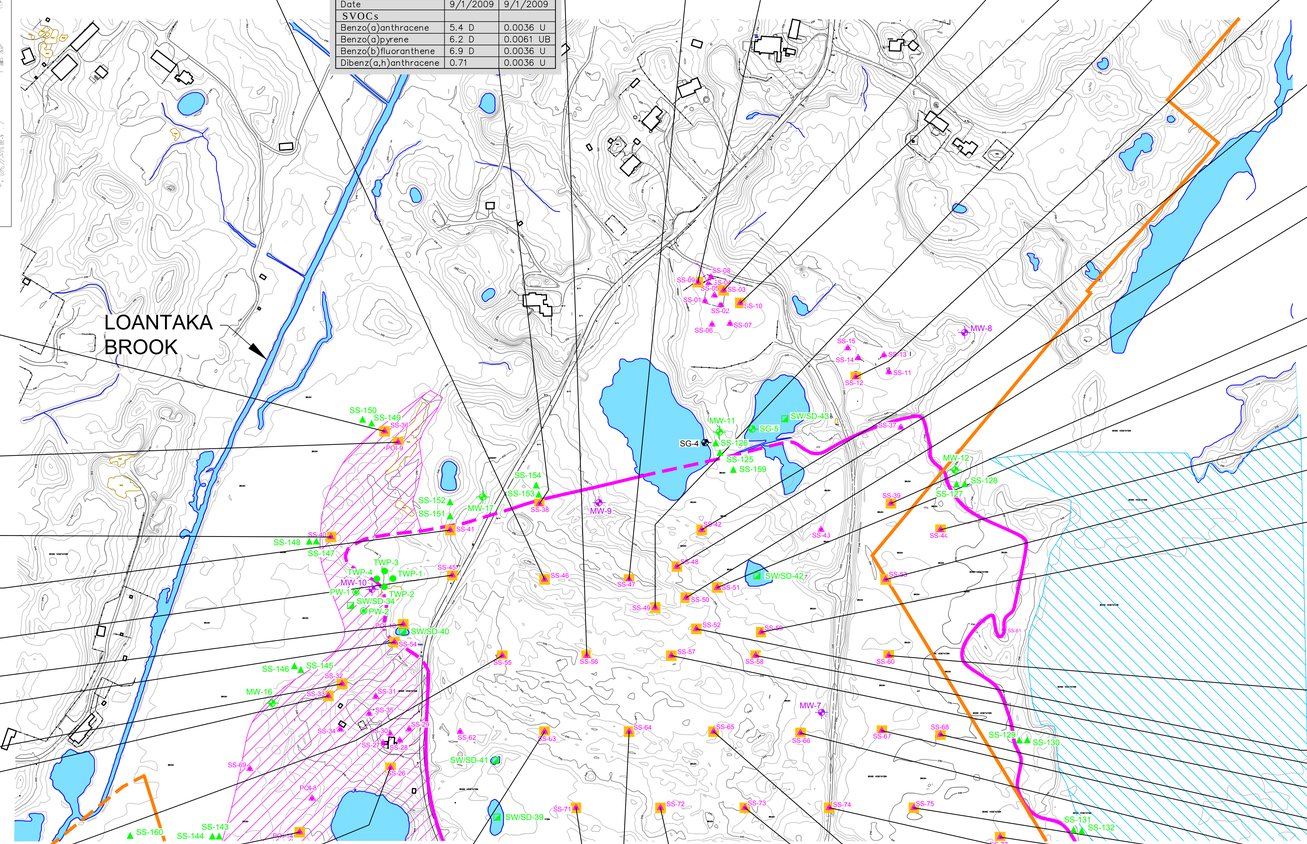
ARCADIS

FIGURE
2



SITE MAP

0 500' 1000'
GRAPHIC SCALE



SS-36	
Depth(Feet)	(0 – 1)
Date	8/31/2009
SVOCs	
Benzo(a)anthracene	2.2
Benzo(a)pyrene	2.3
Benzo(b)fluoranthene	3.1
Dibenz(a,h)anthracene	0.51 EJ
PCBs (Aroclors)	
Aroclor–1254	1.5 DJ
Total PCBs (Aroclors)	2.06 J
Metals	
Lead	2,910

SS-40	
Depth(Feet)	(0 – 1)
Date	8/31/2009
SVOCs	
Benzo(a)pyrene	0.25 J
PCBs (Aroclors)	
Aroclor–1254	1.3 D
Total PCBs (Aroclors)	1.56
Pesticides	
alpha–Chlordane	2.5 D
gamma–Chlordane	2.3 D
Metals	
Lead	825

POI-10	
Depth(Feet)	(0 – 1)
Date	8/26/2009
PCBs (Aroclors)	
Aroclor–1248	3.6 JN
Aroclor–1260	88 D
Total PCBs (Aroclors)	91.6 J
PCBs (Congeners)	
Total PCBs (Congeners)	2.05 J
Metals	
Copper	49,900 J
Lead	1,510 J

SS-32	
Depth(Feet)	(0 – 1)
Date	11/6/2007
SVOCs	
Benzo(a)pyrene	1 J

SS-55		
Depth(Feet)	(0 – 1)	(2 – 3)
Date	9/1/2009	9/1/2009
SVOCs		
Benzo(a)pyrene	0.3 J	0.17 J
PCBs (Aroclors)		
Aroclor–1248	1.5 DJ	0.049 U
Aroclor–1254	1.4 D	0.73
Total PCBs (Aroclors)	3.54 J	1.81
Metals		
Antimony	1,960 J	2.8 J
Arsenic	529 J	8.4 J
Lead	16,500	934

POI-9	
Depth(Feet)	(0 – 1)
Date	8/27/2009
SVOCs	
Benzo(a)anthracene	30 DJ
Benzo(a)pyrene	33 DJ
Benzo(b)fluoranthene	42 DJ
Benzo(k)fluoranthene	24 DJ
Dibenz(a,h)anthracene	5 J
Indeno(1,2,3–cd)pyrene	13 J
PCBs (Aroclors)	
Total PCBs (Aroclors)	1.97 J
Metals	
Lead	7,900 J

SS-41	
Depth(Feet)	(0 – 1)
Date	8/27/2009
SVOCs	
Benzo(a)pyrene	0.26

SS-45		
Depth(Feet)	(0 – 1)	(9 – 10)
Date	8/31/2009	8/31/2009
SVOCs		
Benzo(a)pyrene	0.77	0.006

SS-54	
Depth(Feet)	(0 – 1)
Date	8/31/2009
SVOCs	
Benzo(a)pyrene	0.22 [0.24]

SS-33	
Depth(Feet)	(0 – 1)
Date	11/6/2007
SVOCs	
Benzo(a)pyrene	0.39

POI-14	
Depth(Feet)	(0 – 1)
Date	8/24/2009
Metals	
Arsenic	31.7 J
Lead	9,210 J

SS-26	
Depth(Feet)	(0 – 1)
Date	11/5/2007
SVOCs	
Benzo(a)pyrene	0.23 J

SS-46		
Depth(Feet)	(0 – 1)	(6 – 7)
Date	9/1/2009	9/1/2009
SVOCs		
Benzo(a)pyrene	0.54 J	0.25 EJ
PCBs (Aroclors)		
Aroclor–1242	16 DJ	0.054 U
Aroclor–1254	12 DJ	1.2 D
Aroclor–1260	1.2 J	0.14
Aroclor–1268	2.8 J	0.067
Total PCBs (Aroclors)	32 J	2.03
PCBs (Congeners)		
Total PCBs (Congeners)	95 J	NA
Metals		
Arsenic	7 J	24.5 J
Lead	665	1,460

SS-56		
Depth(Feet)	(0 – 1)	(2 – 3)
Date	8/26/2009	8/26/2009
PCBs (Aroclors)		
Aroclor–1242	3 D	4.1 D
Aroclor–1254	7.2 D	4 D
Aroclor–1260	1.2	0.97
Total PCBs (Aroclors)	11.4	9.07
Pesticides		
Dieldrin	0.3 D	0.041 J
Metals		
Arsenic	14.6 J	20.6 J
Lead	2,060 J	1,120 J

SS-38		
Depth(Feet)	(0 – 1)	(9 – 10)
Date	9/1/2009	9/1/2009
SVOCs		
Benzo(a)anthracene	5.4 D	0.0036 U
Benzo(a)pyrene	6.2 D	0.0061 UB
Benzo(b)fluoranthene	6.9 D	0.0036 U
Dibenz(a,h)anthracene	0.71	0.0036 U

SS-47		
Depth(Feet)	(0 – 1)	(8 – 9)
Date	8/31/2009	8/31/2009
SVOCs		
Benzo(a)pyrene	0.2 J	0.21 J
PCBs (Aroclors)		
Aroclor–1254	3 D	0.61
Aroclor–1260	1.5 D	0.13
Total PCBs (Aroclors)	5.35	1.47 J
Metals		
Arsenic	23.1	5.5 J
Lead	7,140	835

SS-03	
Depth(Feet)	(0 – 1)
Date	9/19/2007
SVOCs	
Benzo(a)pyrene	0.92

SS-09	
Depth(Feet)	(0 – 1)
Date	9/20/2007
SVOCs	
Benzo(a)pyrene	1

SS-10	
Depth(Feet)	(0 – 1)
Date	9/20/2007
SVOCs	
Benzo(a)pyrene	0.74 D

SS-49	
Depth(Feet)	(0 – 1)
Date	8/31/2009
SVOCs	
Benzo(a)pyrene	1.7
Benzo(b)fluoranthene	2.4
Dibenz(a,h)anthracene	0.25 EJ
PCBs (Aroclors)	
Aroclor–1248	1.6 D
Aroclor–1254	2.7 D
Aroclor–1260	1.3 D
Total PCBs (Aroclors)	5.6
Metals	
Arsenic	21.1
Lead	1,010

SS-12	
Depth(Feet)	(0 – 1)
Date	9/20/2007
SVOCs	
Benzo(a)pyrene	0.77 D

SS-42	
Depth(Feet)	(0 – 1)
Date	8/28/2009
PCBs (Aroclors)	
Aroclor–1254	1.3 D
Total PCBs (Aroclors)	1.84

SS-48	
Depth(Feet)	(0 – 1)
Date	8/28/2009
SVOCs	
Benzo(a)pyrene	0.27 EJ
PCBs (Aroclors)	
Aroclor–1248	1.4 D
Aroclor–1254	2.4 D
Total PCBs (Aroclors)	4.4
Metals	
Lead	1,300

SS-50	
Depth(Feet)	(0 – 1)
Date	8/28/2009
PCBs (Aroclors)	
Aroclor–1254	2.3 D
Aroclor–1260	1.1
Total PCBs (Aroclors)	3.4
Metals	
Arsenic	19.1 J

SS-39	
Depth(Feet)	(0 – 1)
Date	9/16/2009
SVOCs	
Benzo(a)pyrene	0.41
PCBs (Aroclors)	
Aroclor–1242	6.1
Aroclor–1254	6.2
Total PCBs (Aroclors)	12.3
PCBs (Congeners)	
Total PCBs (Congeners)	100 J
Metals	
Lead	1,050

SS-51	
Depth(Feet)	(0 – 1)
Date	8/28/2009
SVOCs	
Benzo(a)pyrene	0.44
PCBs (Aroclors)	
Aroclor–1248	1.6 D
Aroclor–1254	3 D
Total PCBs (Aroclors)	5.45
Metals	
Lead	2,200

SS-44	
Depth(Feet)	(0 – 1)
Date	9/1/2009
PCBs (Aroclors)	
Aroclor–1254	1.1 D
Total PCBs (Aroclors)	1.83
Metals	
Lead	1,580

SS-53	
Depth(Feet)	(0 – 1)
Date	9/17/2009
SVOCs	
Benzo(a)pyrene	0.57
PCBs (Aroclors)	
Aroclor–1242	4.1
Aroclor–1254	5.6
Aroclor–1260	1.2
Total PCBs (Aroclors)	10.9
Metals	
Lead	1,110 J

SS-59	
Depth(Feet)	(0 – 1)
Date	8/27/2009
PCBs (Aroclors)	
Aroclor–1242	6.5 D
Aroclor–1254	2.7 D
Total PCBs (Aroclors)	10
Metals	
Lead	1,250 J

SS-60	
Depth(Feet)	(0 – 1)
Date	9/18/2009
PCBs (Aroclors)	
Aroclor–1248	1.2 J
Aroclor–1254	3.6 J
Aroclor–1260	1.2 J
Total PCBs (Aroclors)	6 J
Pesticides	
Dieldrin	0.29 DJ
Metals	
Lead	974

SS-52	
Depth(Feet)	(0 – 1)
Date	8/31/2009
SVOCs	
Benzo(a)anthracene	2.7
Benzo(a)pyrene	3.2 J
Benzo(b)fluoranthene	4.2 J
Dibenz(a,h)anthracene	0.58 EJ
PCBs (Aroclors)	
Aroclor–1242	9.4 D
Aroclor–1254	5.3 D
Total PCBs (Aroclors)	15.4
PCBs (Congeners)	
Total PCBs (Congeners)	12.4 J
Metals	
Lead	2,850

SS-58	
Depth(Feet)	(0 – 1)
Date	8/28/2009
PCBs (Aroclors)	
Aroclor–1248	67 D
Aroclor–1254	57 D
Aroclor–1260	1.7
Total PCBs (Aroclors)	126
PCBs (Congeners)	
Total PCBs (Congeners)	157 J
Pesticides	
Aldrin	0.27 DJN
Metals	
Lead	927

SS-57		
Depth(Feet)	(0 – 1)	(4 – 5)
Date	8/27/2009	8/27/2009
SVOCs		
Benzo(a)pyrene	2.3	0.38 J
Benzo(b)fluoranthene	3.6	0.58 J
Dibenz(a,h)anthracene	0.17 J	0.69 EJ
PCBs (Aroclors)		
Aroclor–1248	2.8 D	4.2 D
Aroclor–1254	2.7 DJN	4.6 D
Aroclor–1260	7 D	3.3 D
Total PCBs (Aroclors)	12.5 J	12.1
Pesticides		
Heptachlor epoxide	RX	0.33 DJN
Metals		
Lead	795 J	1,060 J

SS-68	
Depth(Feet)	(0 – 1)
Date	9/2/2009
SVOCs	
Benzo(a)pyrene	0.32 [0.18 EJ]
PCBs (Aroclors)	
Aroclor–1248	1.2 DJ [1.3 DJ]
Aroclor–1254	3.2 D [2.6 D]
Total PCBs (Aroclors)	4.99 J [4.41 J]
PCBs (Congeners)	
Total PCBs (Congeners)	4.91 J [9.46 J]
Metals	
Lead	1,320 [1,150]

SS-67	
Depth(Feet)	(0 – 1)
Date	9/3/2009
SVOCs	
Benzo(a)pyrene	0.49
PCBs (Aroclors)	
Total PCBs (Aroclors)	1.32 J
Metals	
Lead	1,580

SS-66	
Depth(Feet)	(0 – 1)
Date	8/28/2009
SVOCs	
Benzo(a)pyrene	0.28
PCBs (Aroclors)	
Aroclor–1248	15
Aroclor–1254	55 D
Aroclor–1260	8.1
Total PCBs (Aroclors)	78.1
PCBs (Congeners)	
Total PCBs (Congeners)	9.66 J
Metals	
Arsenic	21.9
Lead	2,100

SS-77	
Depth(Feet)	(0 – 1)
Date	9/17/2009
PCBs (Aroclors)	
Aroclor–1248	1.7
Total PCBs (Aroclors)	2.16 J

SS-75	
Depth(Feet)	(0 – 1)
Date	9/15/2009
PCBs (Aroclors)	
Aroclor–1248	1.3
Aroclor–1254	2.3
Total PCBs (Aroclors)	4.17
Metals	
Arsenic	32.3
Lead	1,360

SS-65		
Depth(Feet)	(0 – 1)	(5 – 6)
Date	8/27/2009	8/27/2009
SVOCs		
Acetophenone	18 D	0.05 J
Benzo(a)anthracene	66 D	0.86
Benzo(a)pyrene	51 D	0.88
Benzo(b)fluoranthene	49 D	1.2
Benzo(k)fluoranthene	51 D	1.3
Dibenz(a,h)anthracene	4.8 J	0.44 EJ
Indeno(1,2,3–cd)pyrene	12 J	0.15 J
PCBs (Aroclors)		
Aroclor–1242	0.065 U	4.2 DJ
Aroclor–1248	1.8 D	0.15 U
Aroclor–1254	1.5 DJ	3 D
Total PCBs (Aroclors)	3.68 J	7.73 J
Metals		
Lead	1,560 J	3,380 J

SS-72		
Depth(Feet)	(0 – 1)	(9 – 10)
Date	8/25/2009	8/25/2009
PCBs (Aroclors)		
Aroclor–1242	0.11 U	1.8
Aroclor–1248	2.5 D	0.11 U
Aroclor–1254	3.3 D	3.9 D
Total PCBs (Aroclors)	7.07 J	6.09
PCBs (Congeners)		
Total PCBs (Congeners)	8.65 J	NA
Metals		
Arsenic	26 J	12.6 J
Lead	1,750 J	950 J

SS-71	
Depth(Feet)	(0 – 1)
Date	8/26/2009
PCBs (Aroclors)	
Total PCBs (Aroclors)	1.1 J
Metals	
Lead	1,070 J
Vanadium	6,140

SS-63		
Depth(Feet)	(0 – 1)	(3.5 – 4.5)
Date	8/26/2009	8/26/2009
SVOCs		
Benzo(a)pyrene	0.26	0.19 EJ
PCBs (Aroclors)		
Aroclor–1242	0.24 U	2.8 D
Aroclor–1248	7.7 DJ	0.074 U
Aroclor–1254	5.3 DJ	4 D
Total PCBs (Aroclors)	13.9 J	7.44
PCBs (Congeners)		
Total PCBs (Congeners)	44.1 J	NA
Metals		
Arsenic	19.3 J	24.3 J
Lead	2,020 J	2,520 J

SS-64		
Depth(Feet)	(0 – 1)	(5 – 6)
Date	8/27/2009	8/27/2009
SVOCs		
Dibenz(a,h)anthracene	0.21 EJ	0.49 EJ [0.36 EJ]
PCBs (Aroclors)		
Aroclor–1242	0.061 U	0.061 U [2.6 D]
Aroclor–1248	2.1 D	3.2 DJ [0.11 U]
Aroclor–1254	1.5 D	2.3 DJ [4.9 D]
Total PCBs (Aroclors)	3.99	6.32 J [8.24]
Metals		
Lead	1,930 J	1,020 J [1,130 J]

SS-73		
Depth(Feet)	(0 – 1)	(6 – 7)
Date	8/25/2009	8/25/2009
SVOCs		
Benzo(a)pyrene	0.12 EJ	0.24 J
PCBs (Aroclors)		
Aroclor–1242	0.11 U	1.7
Aroclor–1248	1.3	0.19 U
Aroclor–1254	2.5 D	1.3 J
Total PCBs (Aroclors)	4.49	3.16 J
Metals		
Lead	1,880 J	3,020 J

SS-74		
Depth(Feet)	(0 – 1)	(6 – 7)
Date	8/24/2009	8/24/2009
SVOCs		
Benzo(a)anthracene	1	2.2
Benzo(a)pyrene	1.1	2.7
Benzo(b)fluoranthene	1.2	3.8 D
Dibenz(a,h)anthracene	0.3 EJ	0.76 EJ
PCBs (Aroclors)		
Aroclor–1254	0.039 U	1.3 D
Total PCBs (Aroclors)	0.211 J	2.17

Nonresidential Soil Remediation Standards	
Constituent	Value
VOCs	
Carbon Tetrachloride	2
Chloroform	2
SVOCs	
Acetophenone	5
Benzo(a)anthracene	2
Benzo(a)pyrene	0.2
Benzo(b)fluoranthene	2
Benzo(k)fluoranthene	23
Dibenz(a,h)anthracene	0.2
Indeno(1,2,3–cd)pyrene	2
PCBs	
Aroclor–1242	1
Aroclor–1248	1
Aroclor–1254	1
Aroclor–1260	1
Aroclor–1262	1
Aroclor–1268	1
Total PCBs (Aroclors)	1
PCBs (Congeners)	
Total PCBs (Congeners)	1
Pesticides	
Aldrin	0.2
alpha–Chlordane	1
Dieldrin	0.2
gamma–Chlordane	1
Heptachlor	0.7
Heptachlor epoxide	0.3
Metals	
Antimony	450
Arsenic	19
Cadmium	78
Copper	45,000
Lead	800
Manganese	5,900
Mercury	65
Vanadium	1,100

LEGEND:

- OPEN WATER
- EDGE OF LANDFILLED WASTES OBSERVED DURING TEST PIT ACTIVITIES (DASHED WHERE APPROXIMATE)
- GREAT SWAMP NATIONAL WILDLIFE REFUGE PROPERTY BOUNDARY (DASHED WHERE APPROXIMATE)
- WASTE AND DEBRIS OBSERVED ON GROUND SURFACE BUT NOT OBSERVED OR ANTICIPATED TO BE BELOW GROUND SURFACE
- AREAS WHERE SURFACE WATER FLOW DOES NOT EXHIBIT TYPICAL BED AND BANK MORPHOLOGY
- SOIL SAMPLING LOCATION
- SOIL SAMPLING LOCATION WITH DETECTED CONCENTRATIONS GREATER THAN NJDEP NONRESIDENTIAL SOIL REMEDIATION STANDARDS
- PROPOSED MONITORING WELL
- EXISTING MONITORING WELL
- PROPOSED TEMPORARY WELL POINT
- PROPOSED SOIL SAMPLE
- PROPOSED SURFACE WATER AND SEDIMENT SAMPLE
- PROPOSED POREWATER SAMPLE
- EXISTING STREAM GAUGE
- PROPOSED STREAM GAUGE

DATA NOTES:

UNITS = MILLIGRAMS PER KILOGRAM

[] = DUPLICATE SAMPLE

PCBS = POLYCHLORINATED BIPHENYLS

SVOCS = SEMIVOLATILE ORGANIC COMPOUNDS

VOCS = VOLATILE ORGANIC COMPOUNDS

NA = NOT ANALYZED

D = CONCENTRATIONS IDENTIFIED FROM ANALYSIS OF THE SAMPLE AT A SECONDARY DILUTION.

E = THE COMPOUND WAS QUANTITATED ABOVE THE CALIBRATION RANGE.

J = THE COMPOUND WAS POSITIVELY IDENTIFIED; HOWEVER, THE ASSOCIATED NUMERICAL VALUE IS AN ESTIMATED CONCENTRATION ONLY.

JN = THE ANALYSIS INDICATES THE PRESENCE OF A COMPOUND FOR WHICH THERE IS PRESUMPTIVE EVIDENCE TO MAKE A TENTATIVE IDENTIFICATION. THE ASSOCIATED NUMERICAL VALUE IS AN ESTIMATED CONCENTRATION ONLY.

U = THE COMPOUND WAS ANALYZED FOR BUT NOT DETECTED. THE ASSOCIATED VALUE IS THE COMPOUND QUANTITATION LIMIT.

RX = THE SAMPLE RESULTS ARE REJECTD DUE TO MATRIX INTERFERENCE.

NOTES:

1. ANALYTICAL RESULTS GIVEN IN MILLIGRAMS PER KILOGRAM FOR SOIL SAMPLES WITH DETECTED CONCENTRATIONS GREATER NEW JERSEY NONRESIDENTIAL SOIL REMEDIATION STANDARDS (DATED OCTOBER 2011).
2. THE EDGE OF LANDFILLED WASTES OBSERVED DURING TEST PIT ACTIVITIES IS DRAWN BASED ON OBSERVATIONS OF MATERIALS EXCAVATED DURING TEST PIT ACTIVITIES CONDUCTED FROM JULY 26, 2007 TO SEPTEMBER 6, 2007 AND MARCH 26, 2008.
3. THE PORTION OF THE GREAT SWAMP NATIONAL WILDLIFE REFUGE (GSNWR) PROPERTY BOUNDARY ON THIS FIGURE WITHIN CHATHAM TOWNSHIP, NJ WAS OBTAINED FROM CHATHAM TOWNSHIP TAX PARCEL DATA PROVIDED BY CIVIL SOLUTIONS. THE PORTION OF THE GSNWR PROPERTY BOUNDARY ON THIS FIGURE OUTSIDE OF CHATHAM TOWNSHIP IS APPROXIMATE AND WAS OBTAINED FROM THE UNITED STATES FISH AND WILDLIFE SERVICE (GEOGRAPHIC INFORMATION SYSTEMS AND SPATIAL DATA).
4. BLOCK 48.20, LOTS 184 AND 189 ARE OWNED BY ROBERT J. MIELE AS TRUSTEE FOR THE TRUST CREATED BY THE LAST WILL AND TESTAMENT OF ANGELO J. MIELE. BLOCK 48.20, LOT 189.01 IS OWNED BY THE GREEN VILLAGE FIRE DEPARTMENT.
5. THE EXTENT OF AREAS WHERE SURFACE WATER FLOW DOES NOT EXHIBIT TYPICAL BED AND BANK MORPHOLOGY IS BASED ON FIELD OBSERVATIONS MADE THROUGHOUT THE PERIOD OF INVESTIGATION ACTIVITIES. THE EXTENT OF THE AREA SHOWN IS APPROXIMATE.
6. ONLY SOIL ANALYTICAL RESULTS GREATER THAN NEW JERSEY NON–RESIDENTIAL SOIL REMEDIATION STANDARDS ARE POSTED.

SOURCES:

1. BASEMAP FROM JAMES M. STEWART INC., LAND SURVEYORS, PHILADELPHIA, PA., (ELECTRONIC FILE: 292406.DWG DATED: 6/30/06)
2. TAX PARCEL DATA FOR CHATHAM TOWNSHIP WAS PROVIDED BY CIVIL SOLUTIONS.

0 200' 400'
GRAPHIC SCALE

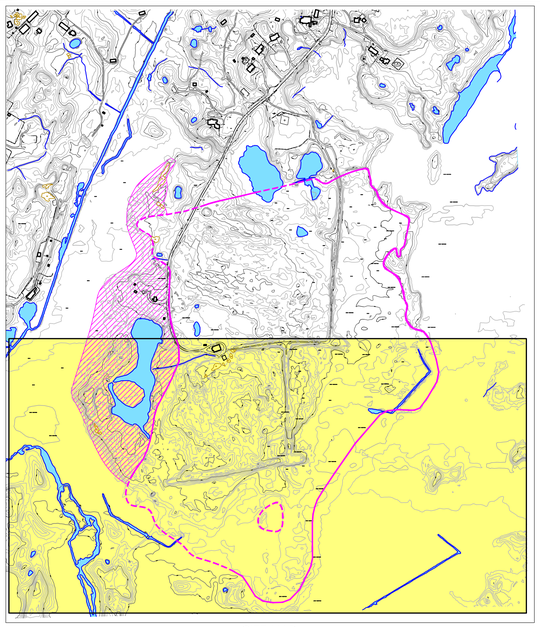
ROLLING KNOLLS LANDFILL SUPERFUND SITE
CHATHAM, NEW JERSEY
DATA GAPS SAMPLING AND ANALYSIS PLAN

PROPOSED SAMPLE LOCATIONS - NORTH

ARCADIS

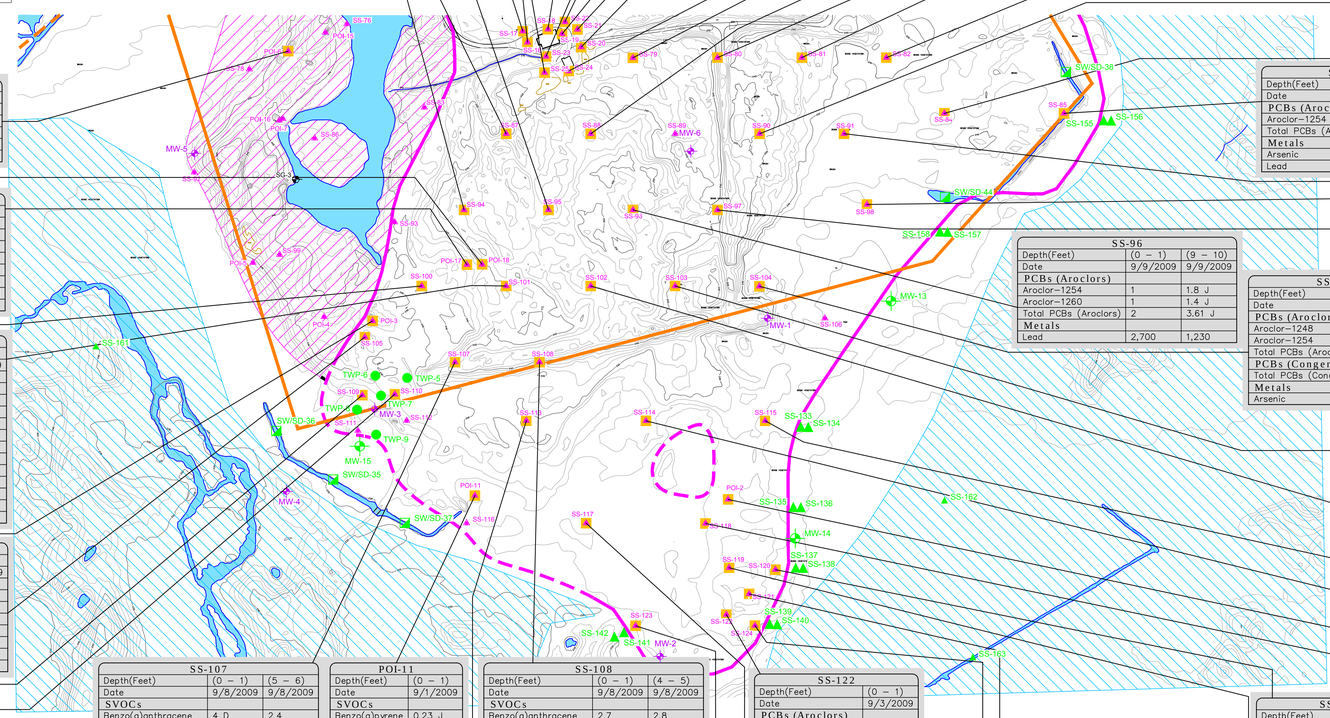
FIGURE
3a

CITY: CRANBURY-NJ DIVGROUP: ENVCAD DB: T.FATTO LD: T.FATTO PIC:(0H) PM: K.ROMAINE TM: L.HYATT LYR: ON=*;OFF=*REF*
G:\ENVCAD\CRANBURY\ACTIB\03320\03020\0011\B03320P03.DWG LAYOUT: 3A SAVED: 9/5/2014 9:52 AM ACADVER: 18.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 9/16/2014 11:43 AM BY: MEYER, JULIE
XREFS: 32203X01 32203X03 IMAGES: PROJECTNAME: ----



SITE MAP

0 500' 1000'
GRAPHIC SCALE



SS-17	
Depth(Feet)	(0 – 1)
Date	11/2/2007
SVOCs	
Benzo(a)pyrene	1.2
Metals	
Lead	901 DJ

SS-16	
Depth(Feet)	(0 – 1)
Date	11/1/2007
SVOCs	
Benzo(a)pyrene	1.1 EJ

SS-25	
Depth(Feet)	(0 – 0.85)
Date	11/5/2007
SVOCs	
Benzo(a)pyrene	0.21

SS-18	
Depth(Feet)	(0 – 1)
Date	11/1/2007
SVOCs	
Benzo(a)pyrene	0.77 J

SS-23	
Depth(Feet)	(0 – 1)
Date	11/2/2007
SVOCs	
Benzo(a)pyrene	0.75

SS-22	
Depth(Feet)	(0 – 1)
Date	6/21/2007
SVOCs	
Benzo(a)anthracene	2.3 [3.3]
Benzo(a)pyrene	2.3 J [3.1]
Benzo(b)fluoranthene	3.3 J [4.5]

SS-19	
Depth(Feet)	(0 – 0.8)
Date	11/2/2007
SVOCs	
Benzo(a)anthracene	2.9
Benzo(a)pyrene	2.9
Benzo(b)fluoranthene	4.4
PCBs (Aroclors)	
Aroclor–1254	2.8 D
Total PCBs (Aroclors)	2.8
PCBs (Congeners)	
Total PCBs (Congeners)	6.41 J
Metals	
Lead	1,090 DJ

SS-21	
Depth(Feet)	(0 – 1)
Date	6/21/2007
SVOCs	
Benzo(a)anthracene	4.3
Benzo(a)pyrene	4.3 J
Benzo(b)fluoranthene	6.2 J
Indeno(1,2,3–cd)pyrene	2.6 J

SS-20	
Depth(Feet)	(0 – 1)
Date	11/2/2007
SVOCs	
Benzo(a)anthracene	2.7
Benzo(a)pyrene	2.4
Benzo(b)fluoranthene	3.4

SS-24	
Depth(Feet)	(0 – 1)
Date	11/5/2007
SVOCs	
Benzo(a)pyrene	0.65 J
PCBs (Aroclors)	
Aroclor–1248	2.6 D
Aroclor–1260	2.1 D
Total PCBs (Aroclors)	4.7
PCBs (Congeners)	
Total PCBs (Congeners)	6.89 J
Metals	
Lead	1,080 DJ

SS-79	
Depth(Feet)	(0 – 1)
Date	9/3/2009
PCBs (Aroclors)	
Aroclor–1254	2.7 J
Total PCBs (Aroclors)	4 J
Metals	
Lead	1,900

SS-88		
Depth(Feet)	(0 – 1)	(7 – 8)
Date	9/9/2009	9/9/2009
SVOCs		
Benzo(a)pyrene	0.51 J [0.72 J]	0.88 J
Dibenz(a,h)anthracene	0.21 EJ [0.54 EJ]	0.23 EJ
PCBs (Aroclors)		
Aroclor–1248	1.1 J [0.42 JN]	0.26 U
Aroclor–1254	4.8 J [2.4]	1.6
Total PCBs (Aroclors)	7.29 J [3.39 J]	2.01
Metals		
Arsenic	17.7 [19.8]	17.1
Lead	1,630 [2,370]	1,440

SS-95		
Depth(Feet)	(0 – 1)	(6 – 7)
Date	9/10/2009	9/10/2009
PCBs (Aroclors)		
Aroclor–1254	1.7 J	2.1
Total PCBs (Aroclors)	2.46 J	3.73 J
Metals		
Lead	1,550	1,110

SS-87		
Depth(Feet)	(0 – 1)	(6 – 7)
Date	9/10/2009	9/10/2009
SVOCs		
Benzo(a)pyrene	0.28	0.36
PCBs (Aroclors)		
Aroclor–1254	7.3 J	0.52 J
Aroclor–1260	1.4 J	0.23 J
Aroclor–1268	0.92 U	2.3 J
Total PCBs (Aroclors)	8.7 J	3.26 J
Metals		
Arsenic	22.6	28.2
Lead	1,640	886

SS-94		
Depth(Feet)	(0 – 1)	(9 – 10)
Date	9/9/2009	9/9/2009
SVOCs		
Benzo(a)pyrene	0.077 EJ	0.22 EJ
PCBs (Aroclors)		
Aroclor–1248	1.3 J	0.16 J
Aroclor–1254	2.9 J	0.38
Total PCBs (Aroclors)	5.03 J	0.67 J
Metals		
Arsenic	16.9	22.7
Lead	1,400	1,040

SS-80		
Depth(Feet)	(0 – 1)	(9 – 10)
Date	9/2/2009	9/2/2009
SVOCs		
Benzo(a)anthracene	11 D	5.1 D
Benzo(a)pyrene	11 D	5.8 D
Benzo(b)fluoranthene	13 DJ	6 D
Dibenz(a,h)anthracene	1.1 J	0.48 J
Indeno(1,2,3–cd)pyrene	2.5 J	1.5 J
PCBs (Aroclors)		
Aroclor–1254	0.32	1.5
Total PCBs (Aroclors)	0.407	3.18
Metals		
Lead	2,490	1,010

SS-81	
Depth(Feet)	(0 – 1)
Date	9/3/2009
PCBs (Aroclors)	
Aroclor–1242	0.6 U [3.1]
Aroclor–1248	1.7 J [0.6 U]
Aroclor–1254	5 [3.8]
Aroclor–1260	1.1 [0.87]
Total PCBs (Aroclors)	7.8 J [7.77]
Metals	
Lead	2,290 [3,190]

SS-90		
Depth(Feet)	(0 – 1)	(6 – 7)
Date	9/8/2009	9/8/2009
SVOCs		
Benzo(a)pyrene	0.082 J	0.49
PCBs (Aroclors)		
Aroclor–1242	2.4 U	1.3
Aroclor–1248	17 J	0.6 U
Aroclor–1254	12 J	2.3
Aroclor–1262	2.4 U	3.9
Total PCBs (Aroclors)	29 J	7.5
Metals		
Lead	1,540	1,620 J

SS-82	
Depth(Feet)	(0 – 1)
Date	9/3/2009
PCBs (Aroclors)	
Aroclor–1254	2.3
Total PCBs (Aroclors)	3.1 J
Metals	
Arsenic	22.4 J
Lead	4,010

SS-84	
Depth(Feet)	(0 – 1)
Date	9/2/2009
SVOCs	
Benzo(a)pyrene	0.47 J
PCBs (Aroclors)	
Aroclor–1254	9.4 D
Aroclor–1260	1.2
Total PCBs (Aroclors)	10.6
PCBs (Congeners)	
Total PCBs (Congeners)	125 J
Metals	
Lead	4,510

POI-6	
Depth(Feet)	(0 – 1)
Date	8/25/2009
SVOCs	
Benzo(a)pyrene	0.28 J
Metals	
Lead	2,570 J

POI-18	
Depth(Feet)	(5 – 6)
Date	1/14/2010
PCBs (Aroclors)	
Aroclor–1248	1.1 DJ
Aroclor–1254	2.5 D
Total PCBs (Aroclors)	4.07 J
Metals	
Arsenic	21.2 J
Lead	1,540

POI-17	
Depth(Feet)	(5 – 6)
Date	1/13/2010
PCBs (Aroclors)	
Aroclor–1254	2.1 D [3.1 D]
Aroclor–1260	3.2 D [0.86 J]
Total PCBs (Aroclors)	5.67 [5.15 J]
Metals	
Arsenic	41.9 J [57.7 J]
Lead	1,900 [1,940]

SS-85	
Depth(Feet)	(0 – 1)
Date	9/2/2009
PCBs (Aroclors)	
Aroclor–1254	2.2
Total PCBs (Aroclors)	3.74
Metals	
Arsenic	22.8 J
Lead	2,360

SS-91	
Depth(Feet)	(0 – 1)
Date	9/17/2009
SVOCs	
Benzo(a)pyrene	0.59
PCBs (Aroclors)	
Aroclor–1254	3.1
Total PCBs (Aroclors)	4.58 J

SS-100	
Depth(Feet)	(0 – 1)
Date	9/10/2009
PCBs (Aroclors)	
Aroclor–1254	2.6
Total PCBs (Aroclors)	4.06 J
Metals	
Lead	2,650

SS-101		
Depth(Feet)	(0 – 1)	(4 – 5)
Date	9/9/2009	9/9/2009
SVOCs		
Benzo(a)pyrene	0.21 EJ	0.16 J
PCBs (Aroclors)		
Aroclor–1242	1.4	0.63 U
Aroclor–1248	0.61 U	1.9 J
Aroclor–1254	4.4	3.4 J
Aroclor–1260	1.5	2.7 J
Total PCBs (Aroclors)	7.3	8 J
PCBs (Congeners)		
Total PCBs (Congeners)	10.6 J	NA
Metals		
Arsenic	19.5	13
Lead	1,380	3,010

SS-96		
Depth(Feet)	(0 – 1)	(9 – 10)
Date	9/9/2009	9/9/2009
PCBs (Aroclors)		
Aroclor–1254	1	1.8 J
Aroclor–1260	1	1.4 J
Total PCBs (Aroclors)	2	3.61 J
Metals		
Lead	2,700	1,230

SS-104	
Depth(Feet)	(0 – 1)
Date	9/2/2009
PCBs (Aroclors)	
Aroclor–1248	3.3 D
Aroclor–1254	1.9 D
Total PCBs (Aroclors)	5.57 J
PCBs (Congeners)	
Total PCBs (Congeners)	5.83 J
Metals	
Arsenic	22 J

SS-97		
Depth(Feet)	(0 – 1)	(6 – 7)
Date	9/4/2009	9/4/2009
SVOCs		
Benzo(a)pyrene	0.31 D	0.042 D
PCBs (Aroclors)		
Aroclor–1242	5.7	20 J
Aroclor–1254	10	4.8
Total PCBs (Aroclors)	15.7	24.8 J
PCBs (Congeners)		
Total PCBs (Congeners)	50.2 J	NA
Metals		
Arsenic	8.4 J	28.4 J
Lead	1,430	648

SS-98	
Depth(Feet)	(0 – 1)
Date	9/18/2009
PCBs (Aroclors)	
Aroclor–1248	2.4 J
Aroclor–1254	4.6
Total PCBs (Aroclors)	7.51 J
Metals	
Arsenic	25.7
Lead	2,710

POI-3		
Depth(Feet)	(0 – 1)	(0.5 – 1)
Date	8/25/2009	8/25/2009
VOCs		
Carbon Tetrachloride	NA	4.4
Chloroform	NA	4.5 D
SVOCs		
Benzo(a)pyrene	0.22 J	NA
Metals		
Arsenic	29.3 J	NA
Lead	1,720 J	NA
Manganese	13,600 J	NA
Mercury	85.1	NA

SS-105	
Depth(Feet)	(0 – 1)
Date	8/26/2009
PCBs (Aroclors)	
Aroclor–1248	4.6 D
Aroclor–1254	4.4 D
Total PCBs (Aroclors)	9.31
PCBs (Congeners)	
Total PCBs (Congeners)	22.7 J
Metals	
Lead	1,070 J

SS-103		
Depth(Feet)	(0 – 1)	(4 – 5)
Date	9/2/2009	9/2/2009
PCBs (Aroclors)		
Aroclor–1248	1.9 DJ	2.3 D
Aroclor–1254	3.1 D	4.1 D
Total PCBs (Aroclors)	5.55 J	7.01
Metals		
Arsenic	20.4 J	15 J
Cadmium	38.1 J	22,500 J
Lead	13,800	951

SS-102		
Depth(Feet)	(0 – 1)	(9 – 10)
Date	9/10/2009	9/10/2009
PCBs (Aroclors)		
Aroclor–1254	2.5	2.1
Total PCBs (Aroclors)	4.22 J	3.75
Metals		
Lead	1,870	4,700

SS-115	
Depth(Feet)	(0 – 1)
Date	9/14/2009
SVOCs	
Benzo(a)pyrene	1.5
Dibenz(a,h)anthracene	0.29 EJ
Metals	
Arsenic	33
Lead	6,170

SS-114	
Depth(Feet)	(0 – 1)
Date	9/14/2009
PCBs (Aroclors)	
Total PCBs (Aroclors)	1.17
Metals	
Lead	2,540

SS-110	
Depth(Feet)	(0 – 1)
Date	9/1/2009
SVOCs	
Benzo(a)pyrene	0.83
PCBs (Aroclors)	
Total PCBs (Aroclors)	1.28 J

SS-109	
Depth(Feet)	(0.5 – 1)
Date	8/31/2009
VOCs	
Chloroform	1,900 DJ

SS-107		
Depth(Feet)	(0 – 1)	(5 – 6)
Date	9/8/2009	9/8/2009
SVOCs		
Benzo(a)anthracene	4 D	2.4
Benzo(a)pyrene	3.6 D	2.7
Benzo(b)fluoranthene	4.2 D	3.1 D
Dibenz(a,h)anthracene	0.69 EJ	0.16 J
Metals		
Lead	792	1,070

POI-11	
Depth(Feet)	(0 – 1)
Date	9/1/2009
SVOCs	
Benzo(a)pyrene	0.23 J

SS-108		
Depth(Feet)	(0 – 1)	(4 – 5)
Date	9/8/2009	9/8/2009
SVOCs		
Benzo(a)anthracene	2.7	2.8
Benzo(a)pyrene	3.1	2.9
Benzo(b)fluoranthene	4.5 DJ	3.4 DJ
Dibenz(a,h)anthracene	0.27 J	0.24 J
PCBs (Aroclors)		
Aroclor–1254	0.29	2.5 DJ
Aroclor–1260	0.12	4.8 D
Total PCBs (Aroclors)	0.481	7.81 J
Metals		
Arsenic	9.8 J	28.3 J
Lead	6,270	3,340

SS-113	
Depth(Feet)	(0 – 1)
Date	9/16/2009
PCBs (Aroclors)	
Aroclor–1254	1.4
Total PCBs (Aroclors)	2.29 J
PCBs (Congeners)	
Total PCBs (Congeners)	3.55
Metals	
Antimony	881 J
Arsenic	33.9
Lead	2,280

SS-122	
Depth(Feet)	(0 – 1)
Date	9/3/2009
PCBs (Aroclors)	
Total PCBs (Aroclors)	1.28
Metals	
Lead	1,270

SS-117	
Depth(Feet)	(0 – 1)
Date	9/17/2009
PCBs (Aroclors)	
Aroclor–1254	1.8 J
Total PCBs (Aroclors)	2.66 J
Metals	
Arsenic	28.5
Lead	1,420 J

SS-123	
Depth(Feet)	(0 – 1)
Date	9/15/2009
PCBs (Aroclors)	
Aroclor–1254	1.3
Aroclor–1260	1.2
Total PCBs (Aroclors)	3.15
Metals	
Lead	1,370

SS-121	
Depth(Feet)	(0 – 1)
Date	9/3/2009
PCBs (Aroclors)	
Aroclor–1254	1.7 J
Aroclor–1260	6.9 J
Total PCBs (Aroclors)	8.6 J
PCBs (Congeners)	
Total PCBs (Congeners)	12.3 J
Metals	
Arsenic	30.2 J
Lead	1,340

SS-124	
Depth(Feet)	(0 – 1)
Date	9/15/2009
PCBs (Aroclors)	
Total PCBs (Aroclors)	1.48 J

SS-120	
Depth(Feet)	(0 – 1)
Date	9/3/2009
PCBs (Aroclors)	
Aroclor–1254	1.8
Aroclor–1260	1.6
Total PCBs (Aroclors)	3.4
Metals	
Arsenic	25.3 J
Lead	1,310

POI-2	
Depth(Feet)	(0 – 1)
Date	9/3/2009
PCBs (Aroclors)	
Total PCBs (Aroclors)	2.18
Metals	
Lead	1,490

SS-119	
Depth(Feet)	(0 – 1)
Date	9/3/2009
SVOCs	
Benzo(a)pyrene	1.5
Benzo(b)fluoranthene	3.2
Dibenz(a,h)anthracene	0.33 EJ
PCBs (Aroclors)	
Aroclor–1254	1.3
Total PCBs (Aroclors)	2.3
Pesticides	
Heptachlor	1.1 D
Metals	
Lead	1,070

SS-118	
Depth(Feet)	(0 – 1)
Date	9/15/2009
SVOCs	
Benzo(a)pyrene	0.4 D
PCBs (Aroclors)	
Aroclor–1242	11 J
Aroclor–1254	7.7 J
Aroclor–1260	4.3 J
Total PCBs (Aroclors)	23 J
Metals	
Lead	2,560

Nonresidential Soil Remediation Standards	
Constituent	Value
VOCs	
Carbon Tetrachloride	2
Chloroform	2
SVOCs	
Acetophenone	5
Benzo(a)anthracene	2
Benzo(a)pyrene	0.2
Benzo(b)fluoranthene	2
Benzo(k)fluoranthene	23
Dibenz(a,h)anthracene	0.2
Indeno(1,2,3–cd)pyrene	2
PCBs	
Aroclor–1242	1
Aroclor–1248	1
Aroclor–1254	1
Aroclor–1260	1
Aroclor–1262	1
Aroclor–1268	1
Total PCBs (Aroclors)	1
PCBs (Congeners)	
Total PCBs (Congeners)	1
Pesticides	
Aldrin	0.2
alpha–Chlordane	1
Dieldrin	0.2
gamma–Chlordane	1
Heptachlor	0.7
Heptachlor epoxide	0.3
Metals	
Antimony	450
Arsenic	19
Cadmium	78
Copper	45,000
Lead	800
Manganese	5,900
Mercury	65
Vanadium	1,100

LEGEND:

- OPEN WATER
- EDGE OF LANDFILLED WASTES OBSERVED DURING TEST PIT ACTIVITIES (DASHED WHERE APPROXIMATE)
- GREAT SWAMP NATIONAL WILDLIFE REFUGE PROPERTY BOUNDARY (DASHED WHERE APPROXIMATE)
- WASTE AND DEBRIS OBSERVED ON GROUND SURFACE BUT NOT OBSERVED OR ANTICIPATED TO BE BELOW GROUND SURFACE
- AREAS WHERE SURFACE WATER FLOW DOES NOT EXHIBIT TYPICAL BED AND BANK MORPHOLOGY
- SOIL SAMPLING LOCATION
- SOIL SAMPLING LOCATION WITH DETECTED CONCENTRATIONS GREATER THAN NJDEP NONRESIDENTIAL SOIL REMEDIATION STANDARDS
- PROPOSED MONITORING WELL
- EXISTING MONITORING WELL
- PROPOSED TEMPORARY WELL POINT
- PROPOSED SOIL SAMPLE
- PROPOSED SURFACE WATER AND SEDIMENT SAMPLE
- EXISTING STREAM GAUGE

DATA NOTES:

UNITS = MILLIGRAMS PER KILOGRAM

[] = DUPLICATE SAMPLE

PCBS = POLYCHLORINATED BIPHENYLS

SVOCS = SEMIVOLATILE ORGANIC COMPOUNDS

VOCS = VOLATILE ORGANIC COMPOUNDS

NA = NOT ANALYZED

D = CONCENTRATIONS IDENTIFIED FROM ANALYSIS OF THE SAMPLE AT A SECONDARY DILUTION.

E = THE COMPOUND WAS QUANTITATED ABOVE THE CALIBRATION RANGE.

J = THE COMPOUND WAS POSITIVELY IDENTIFIED; HOWEVER, THE ASSOCIATED NUMERICAL VALUE IS AN ESTIMATED CONCENTRATION ONLY.

JN = THE ANALYSIS INDICATES THE PRESENCE OF A COMPOUND FOR WHICH THERE IS PRESUMPTIVE EVIDENCE TO MAKE A TENTATIVE IDENTIFICATION. THE ASSOCIATED NUMERICAL VALUE IS AN ESTIMATED CONCENTRATION ONLY.

U = THE COMPOUND WAS ANALYZED FOR BUT NOT DETECTED. THE ASSOCIATED VALUE IS THE COMPOUND QUANTITATION LIMIT.

RX = THE SAMPLE RESULTS ARE REJECTD DUE TO MATRIX INTERFERENCE.

NOTES:

1. ANALYTICAL RESULTS GIVEN IN MILLIGRAMS PER KILOGRAM FOR SOIL SAMPLES WITH DETECTED CONCENTRATIONS GREATER NEW JERSEY NONRESIDENTIAL SOIL REMEDIATION STANDARDS (DATED OCTOBER 2011).
2. THE EDGE OF LANDFILLED WASTES OBSERVED DURING TEST PIT ACTIVITIES IS DRAWN BASED ON OBSERVATIONS OF MATERIALS EXCAVATED DURING TEST PIT ACTIVITIES CONDUCTED FROM JULY 26, 2007 TO SEPTEMBER 6, 2007 AND MARCH 26, 2008.
3. THE PORTION OF THE GREAT SWAMP NATIONAL WILDLIFE REFUGE (GSNWR) PROPERTY BOUNDARY ON THIS FIGURE WITHIN CHATHAM TOWNSHIP, NJ WAS OBTAINED FROM CHATHAM TOWNSHIP TAX PARCEL DATA PROVIDED BY CIVIL SOLUTIONS. THE PORTION OF THE GSNWR PROPERTY BOUNDARY ON THIS FIGURE OUTSIDE OF CHATHAM TOWNSHIP IS APPROXIMATE AND WAS OBTAINED FROM THE UNITED STATES FISH AND WILDLIFE SERVICE (GEOGRAPHIC INFORMATION SYSTEMS AND SPATIAL DATA).
4. BLOCK 48.20, LOTS 184 AND 189 ARE OWNED BY ROBERT J. MIELE AS TRUSTEE FOR THE TRUST CREATED BY THE LAST WILL AND TESTAMENT OF ANGELO J. MIELE. BLOCK 48.20, LOT 189.01 IS OWNED BY THE GREEN VILLAGE FIRE DEPARTMENT.
5. THE EXTENT OF AREAS WHERE SURFACE WATER FLOW DOES NOT EXHIBIT TYPICAL BED AND BANK MORPHOLOGY IS BASED ON FIELD OBSERVATIONS MADE THROUGHOUT THE PERIOD OF INVESTIGATION ACTIVITIES. THE EXTENT OF THE AREA SHOWN IS APPROXIMATE.
6. ONLY SOIL ANALYTICAL RESULTS GREATER THAN NEW JERSEY NON–RESIDENTIAL SOIL REMEDIATION STANDARDS ARE POSTED.

SOURCES:

1. BASEMAP FROM JAMES M. STEWART INC., LAND SURVEYORS, PHILADELPHIA, PA., (ELECTRONIC FILE: 292406.DWG DATED: 6/30/06)
2. TAX PARCEL DATA FOR CHATHAM TOWNSHIP WAS PROVIDED BY CIVIL SOLUTIONS.

0 200' 400'
GRAPHIC SCALE

ROLLING KNOLLS LANDFILL SUPERFUND SITE
CHATHAM, NEW JERSEY
DATA GAPS SAMPLING AND ANALYSIS PLAN

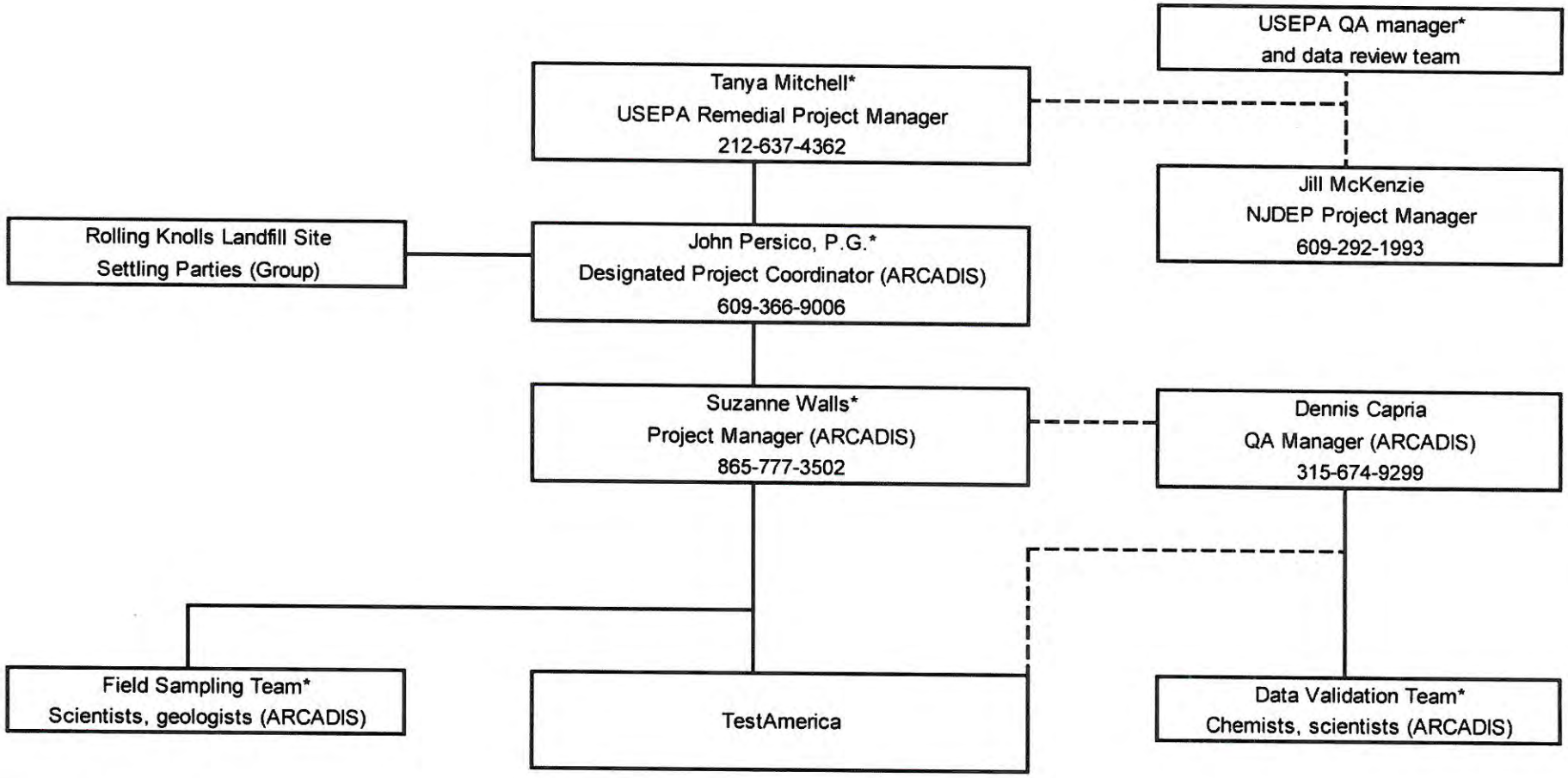
PROPOSED SAMPLE LOCATIONS - SOUTH

ARCADIS

FIGURE
3b

CITY: CRANBURY,NJ DIV/GROUP: ENVCAD DB: T.FATTO LD: T.FATTO PIC: (0pt) PM: K.ROMANE TM: L.HYATT LYR: ON=*;OFF=*REF*
G:\ENVCAD\CRANBURY\ACT\B0033203\0003\00110\B0033203P04.DWG LAYOUT: 3B SAVED: 9/5/2014 9:33 AM ACADVER: 18.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 9/16/2014 11:44 AM BY: MEYER, JULIE
XREFS: 33203X01 33203X03 IMAGES: PROJECTNAME: ----

CITY:CRANBURY-NJ DIV/GROUP:ENVCAD DB:JMEYER LD:FATTO PIC:(Opt) PM:A.GUTHERZ TM:(Opt) LYR:(Opt)ON=*;OFF=*REF*
G:\ENVCAD\CRANBURY\ACT\B0033203\0003\00110\B0033203N02.dwg LAYOUT: 4 SAVED: 10/28/2014 11:22 AM ACADVER: 18.1S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 10/29/2014 10:30 AM BY: MEYER, JULIE
XREFS: IMAGES: PROJECTNAME: ---



* - QAPP recipient

ROLLING KNOLLS LANDFILL SUPERFUND SITE
CHATHAM, NEW JERSEY
DATA GAPS SAMPLING AND ANALYSIS PLAN

PROJECT ORGANIZATIONAL CHART

ARCADIS

FIGURE
4

APPENDIX C

QAPP Worksheet #12
(UFP-QAPP Manual Section 2.6.2)

Title:
Revision Number:

Measurement Performance Criteria Table

Matrix	Aqueous/Soil
Analytical Group[1]	Semi-Volatiles
Concentration Level	

Sampling Procedure[2]	Analytical Method/SOP[3]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
NA	See worksheet #28 & #23	Precision Accuracy	% RPD < 30 Compound Specific (full range: D-262%)	LCS Duplicate	A
		Accuracy	Factor of two(-50% to + 100%) from the initial/continuing calibration	Internal standards	A
		Accuracy	Compound Specific (full range: D-262%)	Matrix spike	A
		Accuracy	Limits 30%-120% for Base Neutrals Limits 20%-120% for Acids	Surrogate Compounds	A
		Accuracy	< RL	Method Blank	A

QAPP Worksheet #12
(UFP-QAPP Manual Section 2.6.2)

Title:
Revision Number:

Measurement Performance Criteria Table

Matrix	Aqueous/Soil
Analytical Group[1]	Metals/Mercury
Concentration Level	Low

Sampling Procedure[2]	Analytical Method/SOP[3]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
NA	See #28/ #23	Precision	% RPD < 20(Aq), % RPD <25(Soil)	LCS Duplicate	A
		Accuracy	Limits: Average Recovery ± 20% aqueous, ± 25% Soil)	LCS	A
		Accuracy	± 20% aqueous, ± 25% Soil)	Matrix spike	A
		Precision	< RL Except for Al, Fe, Ca, K, Mg and Na	Interference Check Sample(ICP/AES)	A
		Accuracy	< RL	Method Blank	A
		Precision	RPD < 20 %	Serial Dilution Test(ICP/AES)	A
		Accuracy	Range of 0.60-1.87 of the original response in the calibration blank	Internal Standards(ICP-MS)	A

QAPP Worksheet #12
(UFP-QAPP Manual Section 2.6.2)
.

Title:
Revision Number:
Revision Date:
Page ___ of ___

Measurement Performance Criteria Table

Matrix	Aqueous/Soils
Analytical Group[1]	Microbiology
Concentration Level	N/A

Sampling Procedure[2]	Analytical Method/SOP[3]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
NA	See worksheets #28/ #23	Media selectivity,sensitivity	Growth promotion	LCS(Positive Control)	A
		Precision	10% (different analyst) 5%(same analyst)	Sample Duplicates Count	A
		Contamination	No growth	Method Blank	A
		Media /containers selectivity,sensitivity Contamination	No growth	Sterility or Performance Testing	A

QAPP Worksheet #12
(UFP-QAPP Manual Section 2.6.2)

Title:
Revision Number:
Revision Date:

Measurement Performance Criteria Table

Matrix	Aqueous/Soil
Analytical Group[1]	Pest/PCB
Concentration Level	

Sampling Procedure[2]	Analytical Method/SOP[3]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
NA	See worksheets #28/ #23	Precision Accuracy	% RPD < 30 Average Recovery 50-150%	LCS Duplicate	A
		Accuracy	Compound Specific (full range: 30-150%)	Matrix spike	A
		Accuracy	Limits 30%-150%	Surrogate Compounds	A
		Accuracy	< RL	Method Blank	A

QAPP Worksheet #12
(UFP-QAPP Manual Section 2.6.2)

Title:
Revision Number:

Measurement Performance Criteria Table

Matrix	Aqueous/Soil
Analytical Group[1]	Sanitary
Concentration Level	Low

Sampling Procedure[2]	Analytical Method/SOP[3]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
NA	See worksheets #28/ #23	Precision	% RPD < 20	LCS Duplicates	A
		Accuracy	90-110% or manufacturer limits	LCS	A
		Accuracy	± 20%	Matrix Spike	A
		Precision	% RPD < 20	Sample Duplicates	A
		Accuracy	< RL	Method Blank	A

Measurement Performance Criteria Table

Matrix	Aqueous/Soil
Analytical Group[1]	VOA
Concentration Level	Low(aq)/Medium(soil)

Sampling Procedure[2]	**Analytical Method/SOP[3]**	**Data Quality Indicators (DQIs)**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
NA	See worksheets #28/ #23	Precision Accuracy	% RPD < 20 Average Recovery 70-130%	LCS Duplicate	A
		Accuracy	Factor of two(-50% to + 100%) from the initial/continuing calibration	Internal standards	A
		Accuracy	Compound Specific (full range: 17-259%)	Matrix spike	A
		Accuracy	Limits 70%-130%(Aqueous) Table 7 of C-123(low Soil)	Surrogate Compounds	A
		Accuracy	< RL	Method Blank	A

QAPP Worksheet #12
(UFP-QAPP Manual Section 2.6.2)
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Title:
Revision Number:

Measurement Performance Criteria Table

Matrix	Aqueous
Analytical Group[1]	VOA
Concentration Level	Trace

Sampling Procedure[2]	Analytical Method/SOP[3]	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample and/or Activity Used to Assess Measurement Performance	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
NA	See worksheets #28/ #23	Precision Accuracy	% RPD < 20 Average Recovery(80-120%)	LCS Duplicate	A
		Accuracy	+/- 40% from the initial/continuing calibration	Internal standards	A
		Accuracy	Limits 70%-130%	Matrix spike	A
		Accuracy	Limits 80%-120%	Surrogate Compounds	A
		Accuracy	< RL	Method Blank	A

QAPP Worksheet #15
Reference Limits and Evaluation Table

Matrix: Aqueous
Analytical Group: Metals-ICP/AES
Concentration Level:

Analyte	CAS Number	Project (PRP) Quantitation Limit [3]	Method CRQLs µg/l	Achievable (DESA) Limits[2] MDLs µg/l	RLs µg/l
Aluminum	7429-90-5		200	93.9	200
Antimony	7440-36-0		60	0.71	20
Arsenic	7440-38-2		10	2.26	8
Barium	7440-39-3		200	0.83	6
Beryllium	7440-41-7		5	0.24	5
Cadmium	7440-43-9		5	0.11	4
Calcium	7440-70-2		5000	68.0	1000
Chromium	7440-47-3		10	0.22	6
Cobalt	7440-48-4		50	0.18	8
Copper	7440-50-8		25	5.89	10
Iron	7439-89-6		100	35.6	100
Lead	7439-92-1		10	1.18	7
Magnesium	7439-95-4		5000	30..5	1000
Manganese	7439-96-5		15	0.07	5
Mercury	7439-97-6		0.2	.017	0.2
Nickel	7440-02-0		40	0.46	5
Potassium	7440-09-7		5000	53.3	1000
Selenium	7782-49-2		35	1.34	7
Silver	7440-22-4		10	.030	6
Sodium	7440-23-5		5000	161	1000
Thallium	7440-28-0		25	1.62	20
Vanadium	7440-62-2		50	2.14	10
Zinc	7440-66-6		60	4.84	8

QAPP Worksheet #15
Reference Limits and Evaluation Table

Matrix: Aqueous
Analytical Group: Metals-ICP/MS
Concentration Level:

Analyte	CAS Number	Project (PRP) Quantitation Limit [3]	Method CRQLs µg/l	Achievable (DESA) Limits[2]	
				MDLs µg/l	RLs µg/l
Aluminum	7429-90-5		-	1.19	10
Antimony	7440-36-0		2	0.022	2.0
Arsenic	7440-38-2		1	0.062	1.0
Barium	7440-39-3		10	0.031	1.0
Beryllium	7440-41-7		1	0.010	1.0
Cadmium	7440-43-9		1	0.009	1.0
Calcium	7440-70-2		-		-
Chromium	7440-47-3		2	0.314	1.0
Cobalt	7440-48-4		1	0.015	1.0
Copper	7440-50-8		2	0.315	1.0
Iron	7439-89-6		-		-
Lead	7439-92-1		1	0.011	1.0
Magnesium	7439-95-4		-		-
Manganese	7439-96-5		1	0.135	1.0
Mercury	7439-97-6		-		-
Nickel	7440-02-0		1	0.471	1.0
Potassium	7440-09-7		-		-
Selenium	7782-49-2		5	0.183	5.0
Silver	7440-22-4		1	0.007	1.0
Sodium	7440-23-5		-		-
Thallium	7440-28-0		1	0.013	1.0
Vanadium	7440-62-2		1	0.082	1.0
Zinc	7440-66-6		2	0.165	1.0

QAPP Worksheet #15
Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: Metals
Concentration Level:

Analyte	CAS Number	Project (PRP) Quantitation Limit [3]	Method CRQLs mg/kg	Achievable (DESA) Limits[2]	
				MDLs - mg/kg	RLs - mg/kg
Aluminum	7429-90-5		20	*	100
Antimony	7440-36-0		6	0.22	2
Arsenic	7440-38-2		1	0.35	0.8
Barium	7440-39-3		20	0.24	10
Beryllium	7440-41-7		0.5	0.02	0.3
Cadmium	7440-43-9		0.5	0.02	0.3
Calcium	7440-70-2		500	12.57	50
Chromium	7440-47-3		1	0.34	0.5
Cobalt	7440-48-4		5	0.03	2
Copper	7440-50-8		2.5	0.26	1
Iron	7439-89-6		10	*	5
Lead	7439-92-1		1	0.23	0.8
Magnesium	7439-95-4		500	5.06	50
Manganese	7439-96-5		1.5	0.33	0.5
Mercury	7439-97-6		0.1	.0043	0.05
Nickel	7440-02-0		4	0.09	2
Potassium	7440-09-7		500	12.36	50
Selenium	7782-49-2		3.5	0.22	2
Silver	7440-22-4		1	0.06	0.5
Sodium	7440-23-5		500	22.48	100
Thallium	7440-28-0		2.5	3.14	2
Vanadium	7440-62-2		5	0.40	2
Zinc	7440-66-6		6	1.57	2

* MDL study cannot be successfully performed on these analytes because of high background levels in matrix (sand).

QAPP Worksheet #15
Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: PEST/PCBs
Concentration Level:

Analyte	CAS Number	Project (PRP) Quantitation Limit [3]	Method QLs µg/kg	Achievable (DESA) Limits[2]	
				MDLs µg/kg	RLs µg/kg
alpha-BHC	319-89-6		1.7	2.15	2.5
gamma-BHC	58-89-9		1.7	1.89	2.5
beta-BHC	319-85-7		1.7	1.35	2.5
delta-BHC	319-86-8		1.7	1.51	2.5
Heptachlor	76-44-8		1.7	2.05	2.5
Aldrin	309-00-2		1.7	1.66	2.5
Heptachlor epoxide	1024-57-3		1.7	1.34	2.5
Gamma-chlordane	5103-74-2		1.7	0.96	2.5
alpha-chlordane	5103-71-9		1.7	1.01	2.5
Endosulfan I	1031-07-8		1.7	1.16	2.5
4,4'-DDE	72-55-9		3.3	1.92	5.0
Dieldrin	60-57-1		3.3	1.91	5.0
Endrin	72-20-8		3.3	1.84	5.0
4,4'-DDD	72-54-8		3.3	1.35	5.0
Endosulfan II	1031-078		3.3	1.27	5.0
4,4'-DDT	50-29-3		3.3	1.52	5.0
Endrin aldehyde	7421-93-4		3.3	2.24	5.0
Methoxychlor	72-43-5		17	8.00	25
Endosulfan sulfate	1031-07-8		3.3	1.24	2.5
Endrin ketone	53494-70-5		3.3	1.18	2.5
Toxaphene	8001-35-2		170	75.9	190
Technical chlordane				56.1	62
AROCLOR 1016	12674-11-2		33		31
AROCLOR 1221	11104-28-2		33		62
AROCLOR 1232	11141-16-5		33		31
AROCLOR 1242	53469-21-9		33	29.9	31
AROCLOR 1248	12672-29-6		33		31
AROCLOR 1254	11097-69-1		33		31
AROCLOR 1260	11096-82-5		33		31
AROCLOR 1262	37324-23-5		33		31
AROCLOR 1268	11100-14-4		33		31

QAPP Worksheet #15
Reference Limits and Evaluation Table

Matrix: Aqueous
Analytical Group: PEST/PCB Aroclors
Concentration Level:

Analyte	CAS Number	Project (PRP) Quantitation Limit [3]	Method CRQLs µg/L	Achievable (DESA) Limits[2]	
				MDLs µg/L	RLs µg/L
alpha-BHC	319-89-6		0.050	0.001	0.0025
gamma-BHC	58-89-9		0.050	0.001	0.0025
beta-BHC	319-85-7		0.050	0.002	0.0025
delta-BHC	319-86-8		0.050	0.002	0.0025
Heptachlor	76-44-8		0.050	0.001	0.0025
Aldrin	309-00-2		0.050	0.001	0.0025
Heptachlor epoxide	1024-57-3		0.050	0.005	0.0025
Gamma-chlordane	5103-74-2		0.050	0.001	0.0025
Alpha-chlordane	5103-71-9		0.050	0.002	0.0025
Endosulfan I	1031-07-8		0.050	0.002	0.0025
4,4'-DDE	72-55-9		0.10	0.003	0.005
Dieldrin	60-57-1		0.10	0.004	0.005
Endrin	72-20-8		0.10	0.004	0.005
4,4'-ddd	72-54-8		0.10	0..005	0.005
Endosulfan II	1031-078		0.10	0.004	0.005
4,4'-DDT	50-29-3		0.10	0.004	0.005
Endrin aldehyde	7421-93-4		0.10	0.006	0.005
Methoxychlor	72-43-5		0.50	0.032	0.050
Endosulfan sulfate	1031-07-8		0.10	0.004	0.005
Endrin ketone	53494-70-5		0.10	0.004	0.005
Toxaphene	8001-35-2		5.0	0.049	0.1875
Technical chlordane				0.020	0.0625
AROCLOR 1016	12674-11-2		1.0		0.03125
AROCLOR 1221	11104-28-2		1.0		0.0625
AROCLOR 1232	11141-16-5		1.0		0.03125
AROCLOR 1242	53469-21-9		1.0	0.020	0.03125
AROCLOR 1248	12672-29-6		1.0		0.03125
AROCLOR 1254	11097-69-1		1.0	0.014	0.03125
AROCLOR 1260	11096-82-5		1.0		0.03125
AROCLOR 1262	37324-23-5		1.0		0.03125
AROCLOR 1268	11100-14-4		1.0		0.03125

QAPP Worksheet #15
Reference Limits and Evaluation Table

Matrix: Aqueous

Analytical Group: Sanitary Chemistry

Concentration Level:

Analyte	CAS Number	Project (PRP) Quantitation Limit [3]	Method QLs [5]	Achievable (DESA) Limits	
				MDLs mg/L	**RLs mg/l**
Alkalinity	471-34-1			0.11	1.0
Ammonia	7664-41-7			0.010	0.05
Chloride	16887-00-6			0.54	1.0
COD				8.89	20
Cyanide	57-12-5		10 µg/L	1.29 µg/l	5.0 µg/l
Fluoride (IC)				0.0040o	0.10
Fluoride (ISE)	016984488			.036	1.00
Hexavalent Chromium	018540299			6.21 µg/l	10.0 µg/L
Nitrite (NO2) (as N)	014797650			0.010	0.05
Nitrite (NO2) (as N) IC				0.0030	0.10
Nitrate (NO3) (as N)	014797558			0.010	0.05
Nitrate (NO3) (as N) IC				0.050	0.10
Nitrite + Nitrate (as N)	7727-37-9			0.0020	0.05
O-PO4	14265-44-2			0.0030	0.01
0P04 (IC)				0.039	0.10
Oil and Grease(Hexane extractable Material)				1.280	5.0
TPH(Silica-Gel treated Hexane Extractable material)				4.66	5.0
TSS				N/A	10
BOD	E1640606			N/A	2.0
Total Phenols				7.13 µg/l	10.0 µg/l
Sulfate	14808-79-8			1.34	5.0
Total Phosphorus	77723-14-0			0.0060	0.05
TKN				0.070	0.10
Sulfide				0.0090	0.05
TOC	10-19-5			0.19	1.0

QAPP Worksheet #15
Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: Semi -Volatile Organic Compounds
Concentration Level: low

Analyte	CAS Number	Project (PRP) Quantitation Limit [3]	Method QLs [5] µg/kg	Achievable (DESA) Limits[2]	
				MDLs µg/kg	RLs µg/kg
Benzaldehyde	100-52-7		170		120
Phenol	108-95-2		170		120
Bis(2-chloroethyl)ether	111-44-4		170		120
2-Chlorophenol	95-57-8		170		120
2-Methylphenol	95-48-7		170		120
Bis(2-chloroisopropyl)ether	108-60-1		170		120
Acetophenone	98-86-2		170		120
4-Methylphenol	106-44-5		170		120
N-Nitroso-di-n-propylamine	621-64-7		170		120
Hexachloroethane	67-72-1		170		120
Nitrobenzene	98-95-3		170		120
Isophorone	78-59-1		170		120
2-Nitrophenol	88-75-5		170		120
2,4-dimethylphenol	105-67-9		170		120
Bis(2-chloroethoxy)methane	111-91-1		170		120
2,4-dichlorophenol	120-83-2		170		120
Naphthalene	91-20-3		170		120
4-Chloroaniline	106-47-8		170		120
Hexachlorobutadiene	87-68-3		170		120
Caprolactam	105-60-2		170		120
4-Chloro-3-methylphenol	59-50-7		170		120
2-methyl naphthalene	91-57-6		170		120
Hexachlorocyclopentadiene	77-47-4		170		120
1,2,4,5-Tetrachlorobenzene	95-94-3		170		120
2,4,6-Trichlorophenol	88-06-2		170		120
2,4,5-Trichlorphenol	95-95-4		170		120
1,1'-Biphenyl	92-52-4		170		120
2-Chloronaphthalene	91-58-7		170		120
2-Nitroaniline	88-74-4		330		120
Dimethyl phthalate	131-11-3		170		120
Acenaphthylene	208-96-8		170		120
2,6-Dinitrotoluene	606-20-2		170		120

Analyte	CAS Number	Project (PRP) Quantitation Limit [3]	Method QLs [5] µg/kg	Achievable (DESA) Limits[2]	
				MDLs µg/kg	RLs µg/kg
3-Nitroaniline	99-09-2		330		120
Acenaphthene	83-32-9		170		120
2,4-Dinitrophenol	51-28-5		330		800
4-Nitrophenol	100-02-7		330		400
Dibenzofuran	132-64-9		170		120
2,4-Dinitrotoluene	121-14-2		170		120
2,3,4,6-Tetrachlorophenol	58-90-2		170		120
Fluorene	86-73-7		170		120
Diethylphthalate	84-66-2		170		120
4-Chlorophenyl phenyl ether	7005-72-3		170		120
4-Nitroaniline	100-01-6		330		120
4,6-Dinitro-2-Methylphenol	534-52-1		330		400
N-Nitrosodiphenylamine	86-30-6		170		120
4-Bromophenyl phenyl ether	101-55-3		170		120
Hexachlorobenzene	118-74-1		170		120
Atrazine	1912-24-9		170		120
Pentachlorophenol	87-86-5		330		400
Phenanthrene	85-01-8		170		120
Anthracene	120-12-7		170		120
Carbazole	86-74-8		170		120
Di-n-butyl phthalate	84-74-2		170		120
Fluoranthene	206-44-0		170		120
Pyrene	129-00-0		170		120
Butylbenzylphthalate	85-68-7		170		120
3,3-Dichlorobenzidine	91-94-1		170		120
Benzo(a)anthracene	56-55-3		170		120
Chrysene	218-01-9		170		120
Bis(2-ethylhexyl)phthalate	117-81-7		170		120
Di-n-octyl phthalate	117-84-0		170		120
Benzo(b)Fluoranthene	205-99-2		170		120
Benzo(k)Fluoranthene	207-08-9		170		120
Benzo(a)pyrene	50-32-8		170		120
Indeno(1,2,3-cd)pyrene	193-39-5		170		120
Dibenzo(a,h)anthracene	53-70-6-3		170		120
Benzo(g,h,i)perylene	191-24-2		170		120
1,4-Dioxane					

Note: Based on the new CRQLs the MDL study is currently being reanalyzed.

QAPP Worksheet #15
Reference Limits and Evaluation Table

Matrix: Aqueous
Analytical Group: Semi -Volatile Organic Compounds
Concentration Level: Low

Analyte	CAS Number	Project (PRP) Quantitation Limit [3]	Method QLs	Achievable (DESA) Limits	
				MDLs µg/L	RLs
Benzaldehyde	100-52-7		5 µg/L	0.10	5 µg/L
Phenol	108-95-2		5 µg/L	1.36	5 µg/L
Bis(2-Chloroethyl)ether	111-44-4		5 µg/L	1.38	5 µg/L
2-Chlorophenol	95-57-8		5 µg/L	1.43	5 µg/L
2-Methylphenol	95-48-7		5 µg/L	0.99	5 µg/L
Bis(2-Chloroisopropyl)ether	108-60-1		5 µg/L	1.23	5 µg/L
Acetophenone	98-86-2		5 µg/L	0.9	5 µg/L
4-Methylphenol	106-44-5		5 µg/L	0.81	5 µg/L
N-Nitroso-di-n-propylamine	621-64-7		5 µg/L	0.99	5 µg/L
Hexachloroethane	67-72-1		5 µg/L	1.35	5 µg/L
Nitrobenzene	98-95-3		5 µg/L	1.13	5 µg/L
Isophorone	78-59-1		5 µg/L	0.76	5 µg/L
2-Nitrophenol	88-75-5		5 µg/L	1.08	5 µg/L
2,4-Dimethylphenol	105-67-9		5 µg/L	1.81	5 µg/L
Bis(2-Chloroethoxy)methane	111-91-1		5 µg/L	0.97	5 µg/L
2,4-Dichlorophenol	120-83-2		5 µg/L	0.94	5 µg/L
Naphthalene	91-20-3		5 µg/L	1.05	5 µg/L
4-Chloroaniline	106-47-8		5 µg/L	0.42	5 µg/L
Hexachlorobutadiene	87-68-3		5 µg/L	1.02	5 µg/L
Caprolactam	105-60-2		5 µg/L	1.0	5 µg/L
4-Chloro-3-methylphenol	59-50-7		5 µg/L	0.62	5 µg/L
2-Methyl naphthalene	91-57-6		5 µg/L	0.88	5 µg/L
Hexachlorocyclopentadiene	77-47-4		5 µg/L	0.92	5 µg/L
1,2,4,5-Tetrachlorobenzene	95-94-3		5 µg/L	0.8	5 µg/L
2,4,6-Trichlorophenol	88-06-2		5 µg/L	0.55	5 µg/L
2,4,5-Trichlorphenol	95-95-4		5 µg/L	0.76	5 µg/L
1,1'-Biphenyl	92-52-4		5 µg/L	1.0	5 µg/L
2-Chloronaphthalene	91-58-7		5 µg/L	0.80	5 µg/L
2-Nitroaniline	88-74-4		10 µg/L	0.70	5 µg/L
Dimethyl phthalate	131-11-3		5 µg/L	0.47	5 µg/L
Acenaphthylene	208-96-8		10 µg/L	0.77	5 µg/L
2,6-Dinitrotoluene	606-20-2		5 µg/L	0.79	5 µg/L
3-Nitroaniline	99-09-2		10 µg/L	0.76	5 µg/L

Analyte	CAS Number	Project (PRP) Quantitation Limit [3]	Method QLs	Achievable (DESA) Limits	
				MDLs µg/L	RLs
Acenaphthene	83-32-9		5 µg/L	0.72	5 µg/L
2,4-Dinitrophenol	51-28-5		10 µg/L	0.33	20µg/L
4-Nitrophenol	100-02-7		10 µg/L	0.35	10µg/L
Dibenzofuran	132-64-9		5 µg/L	0.72	5 µg/L
2,4-Dinitrotoluene	121-14-2		5 µg/L	0.48	5 µg/L
2,3,4,6-Tetrachlorophenol	58-90-2		5 µg/L		5 µg/L
Fluorene	86-73-7		5 µg/L	0.61	5 µg/L
Diethylphthalate	84-66-2		5 µg/L	0.39	5 µg/L
4-Chlorophenyl Phenyl Ether	7005-72-3		5 µg/L	0.57	5 µg/L
4-Nitroaniline	100-01-6		10 µg/L	0.34	5 µg/L
4,6-Dinitro-2-Methylphenol	534-52-1		10 µg/L	0.85	10µg/L
N-Nitrosodiphenylamine	86-30-6		5 µg/L	0.61	5 µg/L
4-Bromophenyl Phenyl Ether	101-55-3		5 µg/L	0.58	5 µg/L
Hexachlorobenzene	118-74-1		5 µg/L	0.49	5 µg/L
Atrazine	1912-24-9		5 µg/L	1.5	5 µg/L
Pentachlorophenol	87-86-5		10 µg/L	0.91	10µg/L
Phenanthrene	85-01-8		5 µg/L	0.47	5 µg/L
Anthracene	120-12-7		5 µg/L	0.58	5 µg/L
Carbazole	86-74-8		5 µg/L	1.2	5 µg/L
Di-N-Butyl Phthalate	84-74-2		5 µg/L	0.48	5 µg/L
Fluoranthene	206-44-0		5 µg/L	0.51	5 µg/L
Pyrene	129-00-0		5 µg/L	0.53	5 µg/L
Butylbenzylphthalate	85-68-7		5 µg/L	0.49	5 µg/L
3,3-Dichlorobenzidine	91-94-1		5 µg/L	0.4	5 µg/L
Benzo(a)anthracene	56-55-3		5 µg/L	0.58	5 µg/L
Chrysene	218-01-9		5 µg/L	0.53	5 µg/L
Bis(2-Ethylhexyl)phthalate	117-81-7		5 µg/L	0.68	5 µg/L
Di-n-octyl phthalate	117-84-0		5 µg/L	0.57	5 µg/L
Benzo(b)fluoranthene	205-99-2		5 µg/L	0.41	5 µg/L
Benzo(k)fluoranthene	207-08-9		5 µg/L	0.60	5 µg/L
Benzo(a)pyrene	50-32-8		5 µg/L	0.55	5 µg/L
Indeno(1,2,3-cd)pyrene	193-39-5		5 µg/L	0.50	5 µg/L
Dibenzo(a,h)anthracene	53-70-6-3		5 µg/L	0.42	5 µg/L
Benzo(g,h,i)perylene	191-24-2		5 µg/L	0.35	5 µg/L
*1,4-Dioxane					2 µg/L

* MDL study is being performed

QAPP Worksheet #15
Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: Volatile Organic Compounds
Concentration Level: Low

Analyte	CAS Number	Project (PRP) Quantitation Limit [3]	Method QLs µg/kg	Achievable (DESA) Limits[2]	
				MDLs µg/kg	RLs µg/kg
Dichlorodifluoromethane	75-71-8		5	0.7	5
Chloromethane	74-87-3		5	2.2	5
Vinyl Chloride	75-01-4		5	*	5
Bromomethane	74-83-9		5	1.3	5
Chloroethane	75-00-3		5	0.9	5
Trichlorofluoromethane	75-69-4		5	0.4	5
1,1-Dichloroethene	75-35-4		5	0.7	5
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1		5	0.8	5
Carbon Disulfide	75-15-0		5	0.8	5
Acetone	67-64-1		10	4.0	10
Methyl Acetate	79-20-9		5	1.6	5
Methylene Chloride	75-09-2		5	0.6	5
trans-1,2-Dichloroethene	156-60-5		5	0.5	5
cis-1,2-Dichloroethene	156-59-2		5	0.6	5
Methyl tert-Butyl Ether	1634-04-4		5	0.3	5
1,1-Dichloroethane	75-34-3		5	0.7	5
2-Butanone	78-93-3		10	1.2	10
Chloroform	67-66-3		5	0.3	5
1,2-Dichloroethane	107-06-2		5	0.5	5
1,1,1-Trichloroethane	71-55-6		5	0.3	5
Cyclohexane	110-82-7		5	0.4	5
Carbon Tetrachloride	56-23-5		5	1.9	5
Benzene	71-43-2		5	0.5	5
Trichloroethene	79-01-6		5	0.6	5
Methylcyclohexane	108-87-2		5	0.8	5
1,2-Dichloropropane	78-87-5		5	0.5	5
Bromodichloromethane	75-27-4		5	0.5	5
cis-1,3-Dichloropropene	10061-01-5		5	0.6	5
trans-1,3-Dichloropropene	10061-02-6		5	0.6	5
1,1,2-Trichloroethane	79-00-5		5	0.3	5
Dibromochloromethane	124-48-1		5	0.5	5
4-Methyl-2-Pentanone	108-10-1		10	0.6	10
Toluene	108-88-3		5	1.2	5

Analyte	CAS Number	Project (PRP) Quantitation Limit [3]	Method QLs µg/kg	Achievable (DESA) Limits[2]	
				MDLs µg/kg	RLs µg/kg
1,2-Dibromoethane	106-93-4		5	0.4	5
Chlorobenzene	108-90-7		5	0.8	5
Tetrachloroethene	127-18-4		5	0.5	5
2-Hexanone	591-78-6		10	0.5	10
Ethylbenzene	100-41-4		5	0.6	5
m,p-Xylene	179601-23-1		5	1.1	5
o-Xylene	95-47-6		5	0.7	5
Styrene	100-42-5		5	0.7	5
Bromoform	75-25-2		5	0.6	5
Isopropylbenzene	98-82-8		5	0.6	5
1,1,2,2-Tetrachloroethane	79-34-5		5	0.4	5
1,3-Dichlorobenzene	541-73-1		5	1.1	5
1,4-Dichlorobenzene	106-46-7		5	1.2	5
1,2-Dichlorobenzene	95-50-1		5	1.0	5
1,2-Dibromo-3-Chloropropane	96-12-8		5	0.5	5
1,2,4-Trichlorobenzene	120-82-1		5	1.5	5
1,2,3-Trichlorobenzene	87-61-6		5	1.5	5
Bromochloromethane	74-97-5		5	0.6	5

* MDL Study will be performed

QAPP Worksheet #15
Reference Limits and Evaluation Table

Matrix: Soil
Analytical Group: Volatile Organic Compounds
Concentration Level: Medium

Analyte	CAS Number	Project (PRP) Quantitation Limit [3]	Method CRQL µg/kg	Achievable (DESA) Limits[2]	
				MDLs µg/kg	RLs µg/kg
Dichlorodifluoromethane	75-71-8		250		250
Chloromethane	74-87-3		250		250
Vinyl Chloride	75-01-4		250		250
Bromomethane	74-83-9		250		250
Chloroethane	75-00-3		250		250
Trichlorofluoromethane	75-69-4		250		250
1,1-Dichloroethene	75-35-4		250		250
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1		250		250
Carbon Disulfide	75-15-0		250		250
Acetone	67-64-1		500		500
Methyl Acetate	79-20-9		250		250
Methylene Chloride	75-09-2		250		250
trans-1,2-Dichloroethene	156-60-5		250		250
cis-1,2-Dichloroethene	156-59-2		250		250
Methyl tert-butyl ether	1634-04-4		250		250
1,1-Dichloroethane	75-34-3		250		250
2-Butanone	78-93-3		500		500
Chloroform	67-66-3		250		250
1,2-Dichloroethane	107-06-2		250		250
1,1,1-Trichloroethane	71-55-6		250		250
Cyclohexane	110-82-7		250		250
Carbon Tetrachloride	56-23-5		250		250
Benzene	71-43-2		250		250
Trichloroethene	79-01-6		250		250
Methylcyclohexane	108-87-2		250		250
1,2-Dichloropropane	78-87-5		250		250
Bromodichloromethane	75-27-4		250		250
cis-1,3-Dichloropropene	10061-01-5		250		250
trans-1,3-Dichloropropene	10061-02-6		250		250
1,1,2-Trichloroethane	79-00-5		250		250
Dibromochloromethane	124-48-1		250		250
4-Methyl-2-pentanone	108-10-1		500		500
Toluene	108-88-3		250		250

Analyte	CAS Number	Project (PRP) Quantitation Limit [3]	Method CRQL µg/kg	Achievable (DESA) Limits[2]	
				MDLs µg/kg	RLs µg/kg
1,2-Dibromoethane	106-93-4		250		250
Chlorobenzene	108-90-7		250		250
Tetrachloroethene	127-18-4		250		250
2-Hexanone	591-78-6		500		500
Ethylbenzene	100-41-4		250		250
m,p-Xylene	179601-23-1		250		250
o-Xylene	95-47-6		250		250
Styrene	100-42-5		250		250
Bromoform	75-25-2		250		250
Isopropylbenzene	98-82-8		250		250
1,1,2,2-Tetrachloroethane	79-34-5		250		250
1,3-Dichlorobenzene	541-73-1		250		250
1,4-Dichlorobenzene	106-46-7		250		250
1,2-Dichlorobenzene	95-50-1		250		250
1,2-Dibromo-3-Chloropropane	96-12-8		250		250
1,2,4-Trichlorobenzene	120-82-1		250		250
1,2,3-Trichlorobenzene	87-61-6		250		250
Bromochloromethane	74-97-5		250		250

Note: Based on the new CRQLs the MDL study is currently being reanalyzed.

QAPP Worksheet #15
Reference Limits and Evaluation Table

Matrix: Aqueous
Analytical Group: Volatile Organic Compounds
Concentration Level: Low

Analyte	CAS Number	Project (PRP) Quantitation Limit [3]	Method QLs	Achievable (DESA) Limit	
				MDLs	µg/L RLs
Dichlorodifluoromethane	75-71-8		5 µg/L	0.3	5 µg/L
Chloromethane	74-87-3		5 µg/L	0.54	5 µg/L
Vinyl Chloride	75-01-4		5 µg/L	1.52	5 µg/L
Bromomethane	74-83-9		5 µg/L	1.90	5 µg/L
Chloroethane	75-00-3		5 µg/L	1.01	5 µg/L
Trichlorofluoromethane	75-69-4		5 µg/L	2.18	5 µg/L
1,1-Dichloroethene	75-35-4		5 µg/L	1.12	5 µg/L
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1		5 µg/L	0.3	5 µg/L
Carbon Disulfide	75-15-0		5 µg/L	1.58	5 µg/L
Acetone	67-64-1		10 µg/L	0.67	10 µg/L
Methyl Acetate	79-20-9		5 µg/L	0.4	5 µg/L
Methylene Chloride	75-09-2		5 µg/L	0.52	5 µg/L
trans-1,2-Dichloroethene	156-60-5		5 µg/L	0.91	5 µg/L
cis-1,2-Dichloroethene	156-59-2		5 µg/L	0.2	5 µg/L
Methyl tert-Butyl Ether	1634-04-4		5 µg/L	0.4	5 µg/L
1,1-Dichloroethane	75-34-3		5 µg/L	0.58	5 µg/L
2-Butanone	78-93-3		10 µg/L	0.7	10 µg/L
Chloroform	67-66-3		5 µg/L	0.44	5 µg/L
1,2-Dichloroethane	107-06-2		5 µg/L	0.55	5 µg/L
1,1,1-Trichloroethane	71-55-6		5 µg/L	0.6	5 µg/L
Cyclohexane	110-82-7		5 µg/L	0.6	5 µg/L
Carbon Tetrachloride	56-23-5		5 µg/L	1.23	5 µg/L
Benzene	71-43-2		5 µg/L	0.46	5 µg/L
Trichloroethene	79-01-6		5 µg/L	0.99	5 µg/L
Methylcyclohexane	108-87-2		5 µg/L	0.7	5 µg/L
1,2-Dichloropropane	78-87-5		5 µg/L	0.44	5 µg/L
Bromodichloromethane	75-27-4		5 µg/L	0.51	5 µg/L
cis-1,3-Dichloropropene	10061-01-5		5 µg/L	0.63	5 µg/L
trans-1,3-Dichloropropene	10061-02-6		5 µg/L	0.4	5 µg/L
1,1,2-Trichloroethane	79-00-5		5 µg/L	0.3	5 µg/L
Dibromochloromethane	124-48-1		5 µg/L	0.2	5 µg/L
4-Methyl-2-Pentanone	108-10-1		10 µg/L	0.64	10 µg/L
Toluene	108-88-3		5 µg/L	0.77	5 µg/L

Analyte	CAS Number	Project (PRP) Quantitation Limit [3]	Method QLs	Achievable (DESA) Limit	
				MDLs	µg/L RLs
1,2-Dibromoethane	106-93-4		5 µg/L	0.2	5 µg/L
Chlorobenzene	108-90-7		5 µg/L	0.59	5 µg/L
Tetrachloroethene	127-18-4		5 µg/L	1.11	5 µg/L
2-Hexanone	591-78-6		10 µg/L	0.68	10 µg/L
Ethylbenzene	100-41-4		5 µg/L	0.59	5 µg/L
m,p-Xylene	179601-23-1		5 µg/L	1.17	5 µg/L
o-Xylene	95-47-6		5 µg/L	0.56	5 µg/L
Styrene	100-42-5		5 µg/L	0.57	5 µg/L
Bromoform	75-25-2		5 µg/L	0.43	5 µg/L
Isopropylbenzene	98-82-8		5 µg/L	0.3	5 µg/L
1,1,2,2-Tetrachloroethane	79-34-5		5 µg/L	0.64	5 µg/L
1,3-Dichlorobenzene	541-73-1		5 µg/L	0.82	5 µg/L
1,4-Dichlorobenzene	106-46-7		5 µg/L	0.84	5 µg/L
1,2-Dichlorobenzene	95-50-1		5 µg/L	0.75	5 µg/L
1,2-Dibromo-3-Chloropropane	96-12-8		5 µg/L	0.7	5 µg/L
1,2,4-Trichlorobenzene	120-82-1		5 µg/L	0.4	5 µg/L
*1,2,3-Trichlorobenzene	87-61-6		5 µg/L		5 µg/L
* Bromochloromethane	74-97-5		5 µg/L		5 µg/L

* MDL study will be performed.

QAPP Worksheet #15
Reference Limits and Evaluation Table

Matrix: Aqueous
Analytical Group: Volatile Organic Compounds
Concentration Level: Trace

Analyte	CAS Number	Project (PRP) Quantitation Limit [3]	Method CRQLs	Achievable (DESA) Limits[2]	
				MDLs µg/L	RLs
Dichlorodifluoromethane	75-71-8		0.5 µg/L	0.11	0.5 µg/L
Chloromethane	74-87-3		0.5 µg/L	0.07	0.5 µg/L
Vinyl Chloride	75-01-4		0.5 µg/L	0.12	0.5 µg/L
Bromomethane	74-83-9		0.5 µg/L	0.14	0.5 µg/L
Chloroethane	75-00-3		0.5 µg/L	0.14	0.5 µg/L
Trichlorofluoromethane	75-69-4		0.5 µg/L	0.11	0.5 µg/L
1,1-Dichloroethene	75-35-4		0.5 µg/L	0.10	0.5 µg/L
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1		0.5 µg/L		0.5 µg/L
Carbon Disulfide	75-15-0		0.5 µg/L	0.10	0.5 µg/L
Acetone	67-64-1		5.0µg/L	0.36	0.5 µg/L
Methyl Acetate	79-20-9		0.5 µg/L		0.5 µg/L
Methylene Chloride	75-09-2		0.5 µg/L	0.18	0.5 µg/L
trans-1,2-Dichloroethene	156-60-5		0.5 µg/L	0.09	0.5 µg/L
cis-1,2-Dichloroethene	156-59-2		0.5 µg/L	0.06	0.5 µg/L
Methyl tert-butyl ether	1634-04-4		0.5 µg/L	0.03	0.5 µg/L
1,1-Dichloroethane	75-34-3		0.5 µg/L	0.08	0.5 µg/L
2-Butanone	78-93-3		5.0µg/L	0.21	0.5 µg/L
Chloroform	67-66-3		0.5 µg/L	0.07	0.5 µg/L
1,2-Dichloroethane	107-06-2		0.5 µg/L	0.09	0.5 µg/L
1,1,1-Trichloroethane	71-55-6		0.5 µg/L	0.09	0.5 µg/L
Cyclohexane	110-82-7		0.5 µg/L		0.5 µg/L
Carbon Tetrachloride	56-23-5		0.5 µg/L	0.10	0.5 µg/L
Benzene	71-43-2		0.5 µg/L	0.07	0.5 µg/L
Trichloroethene	79-01-6		0.5 µg/L	0.08	0.5 µg/L
Methylcyclohexane	108-87-2		0.5 µg/L		0.5 µg/L
1,2-Dichloropropane	78-87-5		0.5 µg/L	0.04	0.5 µg/L
Bromodichloromethane	75-27-4		0.5 µg/L	0.06	0.5 µg/L
cis-1,3-Dichloropropene	10061-01-5		0.5 µg/L	0.05	0.5 µg/L
trans-1,3-Dichloropropene	10061-02-6		0.5 µg/L	0.04	0.5 µg/L
1,1,2-Trichloroethane	79-00-5		0.5 µg/L	0.08	0.5 µg/L
Dibromochloromethane	124-48-1		0.5 µg/L	0.03	0.5 µg/L
4-Methyl-2-pentanone	108-10-1		0.5 µg/L	0.10	0.5 µg/L
Toluene	108-88-3		0.5 µg/L	0.08	0.5 µg/L

Analyte	CAS Number	Project (PRP) Quantitation Limit [3]	Method CRQLs	Achievable (DESA) Limits[2]	
				MDLs µg/L	RLs
1,2-Dibromoethane	106-93-4		0.5 µg/L	0.04	0.5 µg/L
Chlorobenzene	108-90-7		0.5 µg/L	0.06	0.5 µg/L
Tetrachloroethene	127-18-4		0.5 µg/L	0.09	0.5 µg/L
2-Hexanone	591-78-6		5.0µg/L	0.11	0.5 µg/L
Ethylbenzene	100-41-4		0.5 µg/L	0.06	0.5 µg/L
m,p-Xylene	179601-23-1		0.5 µg/L	0.13	0.5 µg/L
o-Xylene	95-47-6		0.5 µg/L	0.05	0.5 µg/L
Styrene	100-42-5		0.5 µg/L	0.03	0.5 µg/L
Bromoform	75-25-2		0.5 µg/L	0.07	0.5 µg/L
Isopropylbenzene	98-82-8		0.5 µg/L	0.06	0.5 µg/L
1,1,2,2-Tetrachloroethane	79-34-5		0.5 µg/L	0.05	0.5 µg/L
1,3-Dichlorobenzene	541-73-1		0.5 µg/L	0.05	0.5 µg/L
1,4-Dichlorobenzene	106-46-7		0.5 µg/L	0.03	0.5 µg/L
1,2-Dichlorobenzene	95-50-1		0.5 µg/L	0.04	0.5 µg/L
1,2-Dibromo-3-Chloropropane	96-12-8		0.5 µg/L	0.18	0.5 µg/L
1,2,4-Trichlorobenzene	120-82-1		0.5 µg/L	0.06	0.5 µg/L
1,2,3-Trichlorobenzene	87-61-6		0.5 µg/L	0.05	0.5 µg/L
Bromochloromethane	74-97-5		0.5 µg/L	0.10	0.5 µg/L

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QAPP Worksheet #19
(UFP-QAPP Manual Section 3.1.1)
For each matrix, analytical group, and concentration level, list the analytical and preparation method/SOP and associated sample volume, container specifications, preservation requirements, and maximum holding time.

Title:
Revision Number:
Revision Date:
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Analytical SOP Requirements Table

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/SOP Reference[1]	Sample Volume	Containers (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
Aqueous	TCL Volatiles	Low Medium	DW-1 (*Ref: EPA 524.2)* C-89 (*Ref: EPA 624*)	3 X40ml 6 X 40ml (QC)	VOA vial with Teflon-lined septum	Cool, 4ºC ; HCL to pH < 2 $Na_2S_2O_3$, if Res CL present	Preserved w/HCL: 14 days: Unpreserved: 7 days
Soil	TCL Volatiles	Low- Medium	C-123 (*Ref:* SOM01.1)	1 x 100g or 4 X Encore Same(QC)	Glass, wide mouth or Encore samplers	Cool, 4ºC or Frozen (-10 to -14)	14 days
Aqueous	TCL Semi-Volatiles	Low	C-90 *(Ref: EPA 625)*	2 X 1000ml 2 X1000 ml(QC)	Amber Glass	Cool, 4ºC ; $Na_2S_2O_3$, if Res CL present	To extraction: 7 days;40 days to analysis
Soil	TCL Semi-Volatiles	Low	C-90 *(Ref: EPA 625)*	1 x 250g 1 x 250g(QC)	Glass, wide mouth	Cool, 4ºC	To extraction: 14 days;40 days to analysis
Aqueous	Pesticides/PCBs	Low	C-91 *(Ref: EPA 608)*	2 X 1000ml 2 X1000 ml(QC)	Amber Glass	Cool, 4ºC	To extraction: 7 days;40 days to analysis
Soil	Pesticides/PCBs	Low	C-91 *(Ref: EPA 608)*	1 x 100g 1 x 100g(QC)	Glass, wide mouth	Cool, 4ºC	To extraction: 14 days;40 days to analysis

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/SOP Reference[1]	Sample Volume	Containers (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
Aqueous	TAL Metals/Mercury	Low	C-109, C-116 (*Ref: EPA 200.7)* C- 110, C-112 (*Ref: EPA 245.1*)	1 X 500ml 1 X 250ml(QC)	Rigid Plastic	HNO3 to pH <2	6 months Hg- 28days
Soil	TAL Metals/Mercury	Low	C-109, C-116 (*Ref: EPA 200.7)* C- 110, C-112 (*Ref: EPA 245.1)*	1 X 250ml 1 X 250ml(QC)	Rigid Plastic	HNO3 to pH <2	6 months Hg- 28days
Soil	TCLP Metals/Mercury	Low	C-107, C-109, C-116 (*Ref: EPA 200.7)* C-107, C- 110, C-112 (*Ref: EPA 245.1)*	1 X 1000ml 1 X 1000ml(QC)	Rigid/Glass, wide mouth	Cool, 4ºC	To extraction: 6 months Hg- 28days;6 months Hg- 28days to analysis
Soil	TCLP - Volatiles	Low-medium	C-106, C-89 *(Ref: EPA 624)*	2 X 100g or 1 x 100g And 2 x Encore Same (QC)	Glass, wide mouth and/ or Encore samplers	Cool, 4ºC or Frozen (-10 to-14)	To extraction: 14 days; 14 days to analysis
Soil	TCLP – Semi-Volatiles	Low	C-107, C-90 (*Ref: EPA 625)*	1 X 1000g 1 x 1000g (QC)	Amber Glass	Cool, 4ºC	To (TCLP_extraction): 14 days; 7 days after (TCLP_extraction); 40 days after 2nd extraction.
Soil	TCLP – Pesticides	Low	C-107, C-91 *(Ref: EPA 608)*	1 X 250g 1 x 250g (QC)	Glass, wide mouth	Cool, 4ºC	To (TCLP_extraction): 14 days; 7 days after (TCLP_extraction); 40 days after 2nd extraction.
Soil	Cyanide	Low	C-28 (*Ref:* EPA 335.4)	1 X 20g 1 X 50g (QC)	Rigid/Glass, wide mouth	Cool, 4ºC	14 days
Soil	TOC	N/A	C-88 (*Ref: SM 5310 B*)	1 x 50g 1 X 50g (QC)	Glass, wide mouth	Cool, 4ºC	28 days
Soil	pH	N/A	C-24 *(Ref: EPA 4500-H+ B*)	1 X 100g 1 X 250g(QC)	Rigid Plastic, widemouth	Cool, 4ºC	As soon as possible

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/SOP Reference[1]	Sample Volume	Containers (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
Aqueous	BOD	N/A	C-21 (*Ref: SM 5210 B*)	1 X 2000 ml or 2 X 1000ml (QC)	Rigid Plastic	Cool, 4ºC ;	48 hours
Aqueous	Ammonia	N/A	C-80 (*Ref: EPA 350.1*)	1 X 250 ml 1 X 100ml (QC)	Rigid Plastic	Cool, 4ºC ; H_2SO_4 to pH < 2	28 days
Aqueous	Chloride	N/A	C-22 (*Ref: EPA 405.1*) C-94 (*Ref: EPA 300)*	1 X 50 ml 1 X 100ml (QC)	Rigid Plastic	None	28 days
Aqueous	COD	N/A	C-53 (*Ref: EPA 410.4)*	1 X 50 ml 1 X 100ml (QC)	Rigid Plastic	Cool, 4ºC ; H_2SO_4 to pH < 2	28 days
Aqueous	Fluoride	N/A	C-93 (*Ref: USGS-I-4327-85)* C-94 (*Ref: EPA 300)*	1 X 50 ml 1 X 100ml (QC)	Rigid Plastic	None	28 days
Aqueous	Nitrite	N/A	C-79 (*Ref: EPA 353.2)* C-94 (*Ref: EPA 300)*	1 X 50 ml 1 X 100ml (QC)	Rigid Plastic	Cool, 4ºC	48 hours
Aqueous	Nitrate	N/A	C-79 (*Ref: EPA 353.2)* C-94 (*Ref: EPA 300)*	1 X 50 ml 1 X 100ml (QC)	Rigid Plastic	Cool, 4ºC	48 hours
Aqueous	Nitrite+ Nitrate	N/A	C-79 (*Ref: EPA 353.2)* C-94 (*Ref: EPA 300)*	1 X 50 ml 1 X 100ml (QC)	Rigid Plastic	Cool, 4ºC	28 days
Aqueous-Grab	Oil +Grease	N/A	C-95 (*Ref: EPA 1664A)*	1 X 1000 ml 3 X 1000ml (QC)	Glass	Cool, 4ºC ; H_2SO_4 to pH < 2	28 days

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/SOP Reference[1]	Sample Volume	Containers (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
Aqueous-Grab	Total Petroleum Hydrocarbon	N/A	C-95 (*Ref: EPA 1664A*)	1 X 1000 ml 3 X 1000ml (QC)	Glass	Cool, 4ºC ; H_2SO_4 to pH < 2	28 days
Soil	Total Petroleum Hydrocarbon	N/A	C-95 (*Ref: EPA 1664A*)	250g 250g (QC)	Glass, wide mouth	Cool, 4ºC	28 days
Aqueous	Total Phenols	N/A	C-29 (*Ref: EPA 420.4)*	1 X 250ml 1 X 250ml (QC)	Glass	Cool, 4ºC ; H_2SO_4 to pH < 2	28 days
Aqueous	Sulfate	N/A	C-19 (*Ref: ASTM D516-02)* C-94 (*Ref: EPA 300.0*)	1 X 100ml 1 X 50ml (QC)	Rigid Plastic	Cool, 4ºC	28 days
Aqueous	Sulfide	N/A	C-115 (*Ref: SM 4500-S^2D)*	1 X 100ml 1 X 250ml (QC)	Rigid Plastic	Cool, 4ºC ; ZnAcetate +NaOH pH > 9	7 days
Aqueous	Total Phosphorus	N/A	C-68 (*Ref: EPA 365.1)*	1 X 50ml 1 X 100ml (QC)	Rigid Plastic	Cool, 4ºC ; H_2SO_4 to pH < 2	28 days
Aqueous	TKN	N/A	C-40 (*Ref: EPA 351.2)*	1 X 50ml 1 X 100ml (QC)	Rigid Plastic	Cool, 4ºC ; H_2SO_4 to pH < 2	28 days

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/SOP Reference[1]	Sample Volume	Containers (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
Aqueous	Turbidity	N/A	C-81 (*Ref: EPA 351.2)*	1 X 100ml 1 X 250ml (QC)	Rigid Plastic	Cool, 4ºC	48 hours
Aqueous	Total Suspended Solids(TSS)/Volatile Suspended Solids(VSS)	N/A	C-33 (*Ref: SM 2540 D)*	1 X 250ml 1 X 500ml (QC)	Rigid Plastic	Cool, 4ºC	7 days
Aqueous	Total Dissolved Solids (TDS)	N/A	C-37 (*Ref: SM 2540 C)*	1 X 250ml 1 X 500ml (QC)	Rigid Plastic	Cool, 4ºC	7 days
Aqueous	Total Organic Carbon (TOC)	N/A	C-83 (*Ref: SM 5310 B)*	1 X 50ml 1 X 100ml (QC)	Rigid Plastic	Cool, 4ºC	28 days
NAPL	Ignitability	N/A	C-23 (*Ref: SW846 Method 1010)*	1 X 250ml 1 X 250ml (QC)	Glass, wide mouth or Metal Can	None	None
Aqueous	Specific Conductance	N/A	C-36 (*Ref: EPA 120.1)*	1 X 100ml 1 X 250ml (QC)	Rigid Plastic	Cool, 4ºC	28 days
Aqueous	Hexavalent Chromium	N/A	C-96 (*Ref: USGS-I-1230-85)*	1 X 250ml 1 X 500ml (QC)	Rigid Plastic	Cool, 4ºC/ Cool, 4ºC pH= 9.3-9.7 Ammonium Sulfate Buffer solution	24 hours/ 28 days

Matrix	Analytical Group	Concentration Level	Analytical and Preparation Method/SOP Reference[1]	Sample Volume	Containers (number, size, and type)	Preservation Requirements (chemical, temperature, light protected)	Maximum Holding Time (preparation/ analysis)
Aqueous	Alkalinity	N/A	C-18 (*Ref: SM 2320 B)*	1 X 100ml 1 X 250ml (QC)	Rigid Plastic	Cool, 4ºC	14 days
Aqueous	Total Coliform/ Fecal Coliform	N/A	B-6/B-8 (*Ref: SM 9221B/9221E)*	1 X 150ml 1 X 150ml (QC)	Rigid Plastic, wide mouth	Cool, 4ºC ; $Na_2S_2O_3$, if Res CL present	6 hours
Sewage Sludge	Total Coliform /Fecal Coliform	N/A	B-6/B-8 (*Ref: SM 9221B/9221E)* *B-5/B-7* (*Ref: SM 9222B/9222E)* Colilert-18 *(Ref: SM9223B)*	1 X 250g 1 X 250g (QC)	Rigid Plastic, wide mouth	Cool, 4ºC	24 hours
Aqueous	Heterotrophic Plate Count	N/A	B-32 (*Ref: EPA 9215B)* *B-38* *(Ref: Simplate IDEX)*	1X125 ml	Rigid Plastic, wide mouth	Cool, 4ºC ; $Na_2S_2O_3$, if Res CL present	8 hours
Soil/Sediment	Grain (Particle) Size	N/A	Bio 8.3 *Ref: ASTM D422-63)*	1 X 16oz/500g/500ml 1 X 16oz/500g/500ml (QC)	Rigid Plastic/ Glass wide mouth	Cool, 4ºC	None

[1]Specify the appropriate reference letter or number from the Analytical SOP References table (Worksheet #23).

QAPP Worksheet #23
(UFP-QAPP Manual Section 3.2.1)

Title:
Revision Number:

Analytical SOP References Table

Reference Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
Bio 8.3	Grain (Particle)Size, Rev 2.0, 3/07	Definite	Grain (Particle)Size	Soil Hydrometer	DESA	N
B-5/B-7	Total Coliform/ Fecal Coliform, Rev 2.0, 2/07	Definite	Total Coliform/ Fecal Coliform	N/A	DESA	N
B-6/B-8	Total Coliform/ Fecal Coliform, Rev 2.0, 2/07	Definite	Total Coliform/ Fecal Coliform	N/A	DESA	N
C-18	Alkalinity, , Rev 2.0, 3/07	Definite	Alkalinity	Auto Titrator System	DESA	N
C-19, C-94	Sulfate, Rev 2.0, 3//07, Anions by Ion Chromatography, Rev 2.0, 3/07	Definite	Sulfate	Spectrophotometer, AutoAnalyzer, IC	DESA	N
C-21	BOD/CBOD, Rev 2.0, 3/07	Definite	BOD	DO meter	DESA	N
C-22, C-94	Chloride, Rev 2.0, 3//07, Anions by Ion Chromatography, Rev 2.0, 3/07	Definite	Chloride	Titration unit, AutoAnalyzer,, IC	DESA	N
C-23	Ignitability, Rev 1.0, 1/06	Definite	Ignitability	Auto flash Point Test Instrument	DESA	N
C-24	pH, Rev 2.0, 3/07	Definite	pH	pH meter	DESA	N
C-28	Cyanides, Total, Rev 2.0, 3/07	Definite	Cyanide	AutoAnalyzer	DESA	N

Reference Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
C-29	Total Phenols, Rev 2.0, 3/07	Definite	Total Phenols	AutoAnalyzer	DESA	N
C-33	Total Suspended Solids(TSS)/Volatile Suspended Solids(VSS), Rev 2.0, 2/07	Definite	Total Dissolved Solids (TDS)	N/A	DESA	N
C-36	Specific Conductance, Rev 2.0, 3/07	Definite	Specific Conductance	Conductivity Meter	DESA	N
C-37	Total Dissolved Solids (TDS) , Rev 2.0, 2/07	Definite	Total Dissolved Solids (TDS)	N/A	DESA	N
C-40	TKN, Rev 2.0, 2/07	Definite	TKN	AutoAnalyzer	DESA	N
C-53	COD, Rev 2.0, 3/07	Definite	COD	COD Reactor, Spectrophotometer	DESA	N
C-68	Total Phosphorus, Rev 2.0, 12/06	Definite	Total Phosphorus	AutoAnalyzer	DESA	N
C-79, C-94	Nitrite, Nitrate, Nitrite+ Nitrate Rev 2.0, 2//07, Anions by Ion Chromatography, Rev 2.0, 12/06	Definite	Nitrite	AutoAnalyzer, IC	DESA	N
C-80	Ammonia, Rev 2.0, 12/06	Definite	Ammonia	AutoAnalyzer	DESA	N
C-81	Turbidity, Rev 2.0, 3/07	Definite	Turbidity	Turbidimeter	DESA	N

Reference Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
C-83	Total Organics in Aqueous, Rev 2.0, 3/07	Definite	Total Organics Carbon	TOC analyzer	DESA	N
C-88	Total Organics in Soil, Rev 1.0, 1/05	Definite	Total Organics Carbon	TOC analyzer	DESA	N
C-89	Analysis of Volatile Organic Compounds in Aqueous, Soil/Sediment and Waste Oil/Waste Organic Solvents Samples by Purge and Trap GC/MS, Rev 2.0, 3/07	Definite	TCL Volatiles(Aqueous)	GC-MS	DESA L	N
C-123	Analysis of Volatile Organic Compounds by Automated Closed System by Purge and Trap GC/MS, Rev 2.0, 3/07	Definite	TCL Volatiles(Low Soil)	GC-MS	DESA Laboratory	N
DW-1	Volatile Organics in Drinking Water by Purge and Trap by GC/MS, Rev 2.0, 3/07	Definite	TCL Volatiles (Trace)	GC-MS	DESA Laboratory	N
C-90	Analysis of Base/Neutral and Acid Compounds in Aqueous, Soil/Sediment and Waste Oil/Waste Organic Solvent Samples, Rev 2.0, 3/07	Definite	TCL Semi-Volatiles	GC-MS	DESA Laboratory	N
C-91	Analysis of Pesticides and PCBs in Aqueous, Soil/Sediments and Waste Oil/Transformer Fluid Matrices, Rev 2.0, 3/07	Definite	Pesticides/ PCBs	GC-ECD	DESA Laboratory	N

Reference Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
C-93, C-94	Fluoride, Rev 1.0, 1/05, Anions by Ion Chromatography, Rev 2.0, 12/06	Definite	Fluoride	AutoAnalyzer, Ion Selective Electrode, IC	DESA Laboratory	N
C-95	Oil +Grease, Total Petroleum Hydrocarbon Gravimetric, SPE, Rev 2.0, 03/07	Definite	Oil +Grease	SPE apparatus	DESA Laboratory	N
C-96	Hexavalent Chromium, Rev 2.0, 3/07	Definite	Hexavalent Chromium	Spectrophotometer	DESA Laboratory	N
C-109	Determination of Trace Elements in Aqueous Trace Metals in Aqueous, Soil/Sediment/Sludge-ICP-AES, Rev 2.0, 3/07	Definite	TAL Metals	ICP-AES	DESA Laboratory	N
C-110	Mercury Analysis in Water and Soil/Sediments By CVAAS, Rev 2.0, 3/07	Definite	Mercury	CVAA	DESA Laboratory	N
C-112	Trace Metals in Aqueous, Soil/Sediment/Sludge, Waste Oil/Organic Solvent and Biological tissue by Inductively Coupled Plasma-Mass Spectrometry, Rev 2.0, 3/07	Definite	TAL Metals	ICP-MS	DESA Laboratory	N
C-115	Sulfide, Rev 1.0, 3/07	Definite	Sulfide	Spectrophotometer	DESA Laboratory	N

QAPP Worksheet #24
(UFP-QAPP Manual Section 3.2.2)
Identify all analytical instrumentation that requires calibration and provide the SOP reference number for each. In addition, document the frequency, acceptance criteria, and corrective action requirements on the worksheet.

Title:
Revision Number:
Revision Date:
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Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[1]
ICP-AES	See SOP C-109	See SOP C-109	See SOP C-109	See SOP C-109	Assigned Laboratory personnel	SOP C-109
ICP-MS	See SOP C-112	See SOP C-112	See SOP C-112	See SOP C-112	Assigned Laboratory personnel	SOP C-112
CVAAS	See SOP C-110	See SOP C-110	See SOP C-110	See SOP C-110	Assigned Laboratory personnel	SOP C-110
IC	See SOP C-94	See SOP C-94	See SOP C-94	See SOP C-94	Assigned Laboratory personnel	SOP C-94
Spectrophotometer	See SOP C-96	See SOP C-96	See SOP C-96	See SOP C-96	Assigned Laboratory personnel	SOP C-96
Colorimetric/AutoAnalyzer	See SOP C-28 Per manufacture's manual	See SOP C-28	See SOP C-28	See SOP C-28	Assigned Laboratory personnel	SOP C-28
GC-ECD	See SOP C-91	See SOP C-91	See SOP C-91	See SOP C-91	Assigned Laboratory personnel	SOP C-91
GC-MS	See SOP C- 90, C-89	See SOP C- 90, C-89	See SOP C- 90, C-89	See SOP C- 90, C-89	Assigned Laboratory personnel	SOP C- 90, C-89
TOC Analyzer	See SOP C-88, Per manufacture's manual	See SOP C-88	See SOP C-88	See SOP C-88	Assigned Laboratory personnel	SOP C-88
pH Electrode	See SOP C-24	See SOP C-24	See SOP C-24	See SOP C-24	Assigned Laboratory personnel	SOP C-24

[1]Specify the appropriate reference letter or number from the Analytical SOP References table (Worksheet #23). Details can be found in Equipment Calibration# SOP C-19

QAPP Worksheet #25
(UFP-QAPP Manual Section 3.2.3)
Identify all analytical instrumentation that requires maintenance, testing, or inspection and provide the SOP reference number for each. In addition, document the frequency, acceptance criteria, and corrective action requirements on the worksheet.

Title:
Revision Number:
Revision Date:
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Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[1]
See list of Instrument given in Worksheet #24	See LQMP, G-10, G-11, G-12, G-19	See LQMP, G-10, G-11, G-12, G-19	See LQMP, G-10, G-11, G-12, G-19	See LQMP, G-10, G-11, G-12, G-19	See LQMP, G-10, G-11, G-12, G-19	See LQMP, G-10, G-11, G-12, G-19	See LQMP, G-10, G-11, G-12, G-19	See LQMP, G-10, G-11, G-12, G-19

[1]Specify the appropriate reference letter or number from the Analytical SOP References table (Worksheet #23).

QAPP Worksheet #26
(UFP-QAPP Manual Appendix A)
Use this worksheet to identify components of the project-specific sample handling system. Record personnel, and their organizational affiliations, who are primarily responsible for ensuring proper handling, custody, and storage of field samples from the time of collection, to delivery, to final sample disposal. Indicate the number of days field samples and their extracts/digestates will be archived prior to disposal.

Title:
Revision Number:
Revision Date:
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Sample Handling System

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization):
Sample Packaging (Personnel/Organization):
Coordination of Shipment (Personnel/Organization):
Type of Shipment/Carrier:
SAMPLE RECEIPT AND ANALYSIS (Details in SOP G-25)
Sample Receipt (Personnel/Organization): OSCAR/DESA Laboratory
Sample Custody and Storage (Personnel/Organization): OSCAR/DESA Laboratory
Sample Preparation (Personnel/Organization): Laboratory Personnel/DESA Laboratory
Sample Determinative Analysis (Personnel/Organization): Laboratory Personnel/DESA Laboratory
SAMPLE ARCHIVING
Field Sample Storage (No. of days from sample collection):
Sample Extract/Digestate Storage (No. of days from extraction/digestion): up to 60 days
Biological Sample Storage (No. of days from sample collection):
SAMPLE DISPOSAL (Details in SOP G-6)
Personnel/Organization: DESA Laboratory
Number of Days from Analysis: 60 days

QAPP Worksheet #27
(UFP-QAPP Manual Section 3.3.3)
Describe the procedures that will be used to maintain sample custody and integrity. Include examples of chain-of-custody forms, traffic reports, sample identification, custody seals, sample receipt forms, and sample transfer forms. Attach or reference applicable SOPs.

Title:
Revision Number:
Revision Date:
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Sample Custody Requirements

Field Sample Custody Procedures (sample collection, packaging, shipment, and delivery to):

Sample Custody Procedures (receipt of samples, archiving, disposal):

See LQMP, SOP G-25(OSCAR)

Sample Identification Procedures:

See LQMP, SOP G-25(OSCAR)

Chain-of-custody Procedures:

See LQMP, SOP G-25(OSCAR)

QAPP Worksheet #28 (Semi volatiles)
(UFP-QAPP Manual Section 3.4)
Complete a separate worksheet for each sampling technique, analytical method/SOP, matrix, analytical group, and concentration level. If method/SOP QC acceptance limits exceed the measurement performance criteria, the data obtained may be unusable for making project decisions.

Title:
Revision Number:
Revision Date:
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QC Samples Table

Matrix	Aqueous/ Soil
Analytical Group	SVOC
Concentration Level	
Sampling SOP	
Analytical Method/ SOP Reference	C-90 (Ref: EPA 625)
Sampler's Name	
Field Sampling Organization	
Analytical Organization	USEPA Region 2 Laboratory
No. of Sample Locations	

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Tuning	12 hr period	Pass all DFTPP tune criteria	Check Instrument Reanalyze, Retune	Laboratory personnel	Sensitivity	Pass all DFTPP tune criteria
Initial Calibration	SOP C-90	% RSD +/- 35% Allowed to fail 10% of total number of analytes but % RSD not be more than 60%	Check Instrument, Reanalyze	Laboratory personnel	Accuracy/ Precision	% RSD +/- 35% Allowed to fail 10% of total number of analytes but % RSD not be more than 60%

Continuing Calibration Check Standard (Alternate check standard)	1 per analytical batch of ≤ 20 samples	Min RRF 0.05 Max %D +/- 20% 10% of total analytes allowed to fail but not more than 60%	Reanalyze, Qualify data	Laboratory personnel	Accuracy	Min RRF 0.05 Max %D RRF +/- 20% 10% of total analytes allowed to fail but not more than 60%
Method Blank	1 per extraction batch of ≤ 20 samples	< RL	Investigate source of contamination	Laboratory personnel	Sensitivity Contamination	< RL
LCS/LFB	2 per extraction batch of ≤ 20 samples	Limits listed in Table3 in SOP C-90 for aqueous, manufacture's limits for soil % RPD < 30	Qualify data unless high recovery and/or Not Detected)	Laboratory personnel	Accuracy/ Precision	Limits listed in Table3 in SOP C-90 for aqueous, manufacture's limits for soil % RPD < 30
Matrix spikes	1 per extraction batch of ≤ 20 samples	Limits listed in Table3 in SOP C-90	Qualify data unless high recovery and/or Not Detected)	Laboratory personnel	Accuracy	Limits listed in Table3 in SOP C-90
Internal Standards	Each sample, standard, blank	Factor of two (-50% to -100%)	Check Instrument Analyse / Qualify data	Laboratory personnel	Quantitation	Factor of two (-50% to -100%)
Surrogates	Each sample, standard, blank	30%-120% for Base Neutrals 20-120% for Acids	Reinject, Qualify data as per SOP C-90	Laboratory personnel	Extraction efficiency, Accuracy	30%-120% for Base Neutrals 20-120% for Acids

QAPP Worksheet #28 (Metal+ Mercury)
(UFP-QAPP Manual Section 3.4)
Complete a separate worksheet for each sampling technique, analytical method/SOP, matrix, analytical group, and concentration level. If method/SOP QC acceptance limits exceed the measurement performance criteria, the data obtained may be unusable for making project decisions.

Title:
Revision Number:
Revision Date:
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QC Samples Table

Matrix	Aqueous/Soil
Analytical Group	Metals & Mercury
Concentration Level	Trace/Low
Sampling SOP	
Analytical Method/ SOP Reference	C-109,C-112, C-110 (Ref: EPA 200.7, 200.8, 245.1)
Sampler's Name	
Field Sampling Organization	
Analytical Organization	USEPA Region 2 Laboratory
No. of Sample Locations	

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Tuning/System Stability(ICP-MS)	As per C-112	Pass all the tune/stability criteria	Check Instrument Reanalyze, Retune	Laboratory personnel	Sensitivity	Pass all the tune/stability criteria
Initial Calibration Verification	Immediately following each calibration ,after every 10 samples and at the end of each analytical run	90%-110%	Check Instrument, Reanalyze	Laboratory personnel	Accuracy	90%-110%

Continuing Calibration Check Standard (Alternate check standard)	Every 10 samples and at the end of each analytical run	80%-120%	Reanalyze, Qualify data	Laboratory personnel	Accuracy	80%-120%
Initial Calibration Blank(ICB)	After ICV	< RL	Investigate source of contamination	Laboratory personnel	Sensitivity Contamination	< RL
Continuing Calibration Blank(CCB)	After every CCV	< RL	Investigate source of contamination	Laboratory personnel	Sensitivity Contamination	< RL
Low Level Check Standard	At Beginning and end of each analytical run	± 30% of the true value	Check Instrument, Re-calibrate	Laboratory personnel	Accuracy	± 30% of the true value
Interference Check Sample(ICP-200.7)	At Beginning and end of each analytical run	< RL Except Al ,Fe, Ca, K, Mg and Na	As per C-109	Laboratory personnel	Precision	< RL Except Al ,Fe, Ca, K, Mg and Na
Method blank	1 per extraction batch of ≤ 20 samples	< RL	Investigate source of contamination	Laboratory personnel	Sensitivity Contamination	< RL
LCS/LFB	2 per extraction batch of ≤ 20 samples	Limits: Average Recovery ± 20% aqueous, ± 25% Soil) % RPD < 20(Aq), % RPD <25(Soil)	Qualify data	Laboratory personnel	Accuracy/ Precision	Limits: Average Recovery ± 20% aqueous, ± 25% Solids) % RPD < 20(Aq), % RPD <25(Soil
Matrix spikes	1 per extraction batch of ≤ 20 samples	Limits ± 20% aqueous, ± 25% Soil)	Qualify data	Laboratory personnel	Accuracy	Limits ± 20% aqueous, ± 25% Soil)
Serial Dilution Test(ICP-200.7)	Matrix spike sample	RPD < 20 %	Qualify data	Laboratory personnel	Precision	RPD < 20 %
Internal Standards(ICP-MS 200.8)	Each sample, standard, blank	Range of 0.60-1.87 of the original response in the calibration blank	Check Instrument Analyse / Qualify data	Laboratory personnel	Quantitation	Range of 0.60-1.87 of the original response in the calibration blank

QAPP Worksheet #28 (Microbiology)
(UFP-QAPP Manual Section 3.4)

Title:
Revision Number:
Revision Date:
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QC Samples Table

Matrix	Aqueous/Soilds
Analytical Group	Microbiology
Concentration Level	N/A
Sampling SOP	
Analytical Method/ SOP Reference	See notes
Sampler's Name	
Field Sampling Organization	
Analytical Organization	USEPA Region 2 Laboratory
No. of Sample Locations	

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Sterility or Performance Testing	Each lot of pre-prepared, ready to use medium or batch of medium prepared in the Laboratory, sample containers on a non-selective media	No growth	Investigate source of contamination Prepared Media is discarded	Laboratory personnel	Media selectivity, sensitivity Contamination	No growth
Method Blank	1 per preparation batch of 20 samples	No growth	Investigate source of contamination	Laboratory personnel	Contamination	No growth
Control Sample (LCS)-positive control	1 per preparation batch of 20 samples	Growth promotion	Reanalyzed	Laboratory personnel	Media selectivity, sensitivity	Growth promotion
Duplicate counts (Membrane Filtration or Heterotrophic Plate count)	Monthly on one positive sample for each month the test is performed	10% (different analyst) 5% (same analyst)	Qualify data	Laboratory personnel	Precision	10% (different analyst) 5% (same analyst)

Laboratory SOPs: B-5/B-7(*SM 9222B/D);* B-6/B-8(*SM 9221B/E*) , B-32; (*Ref: EPA 9215B); B-38(Ref: Simplate IDEX)*

QAPP Worksheet #28 (Pesticides/PCBs)
(UFP-QAPP Manual Section 3.4)
Complete a separate worksheet for each sampling technique, analytical method/SOP, matrix, analytical group, and concentration level. If method/SOP QC acceptance limits exceed the measurement performance criteria, the data obtained may be unusable for making project decisions.

Title:
Revision Number:
Revision Date:
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QC Samples Table

Matrix	Aqueous/Soil
Analytical Group	Pesticides/PCBs
Concentration Level	
Sampling SOP	
Analytical Method/ SOP Reference	C-91 (Ref: EPA 608)
Sampler's Name	
Field Sampling Organization	
Analytical Organization	USEPA Region 2 Laboratory
No. of Sample Locations	

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Instrument Performance (PEM)	Beginning of each analytical run	Total breakdown <30%	Check Instrument	Laboratory personnel	Sensitivity Contamination	Total breakdown <30%
Initial Calibration	C-91 (Ref: EPA 608)	% RSD +/- 25% Not more than 10% of total analytes failure RSD not more than 30%	Check Instrument, Reanalyze	Laboratory personnel	Accuracy/ Precision	% RSD +/- 25% Not more than 10% of total analytes failure RSD not more than 30%
Continuing Calibration Check Standard (Alternate check standard)	Beginning and the end of each analytical run	Max %D RRF +/- 25%	Reanalyze, Qualify data	Laboratory personnel	Accuracy	Max %D RRF +/- 25%
Method Blank	1 per extraction batch	< RL	Investigate source of contamination	Laboratory personnel	Sensitivity Contamination	< RL

LCS/LFB	2 per extraction batch	Limits: Average Recovery 50-150% % RPD < 30	Qualify data unless high recovery and/or Not Detected)	Laboratory personnel	Accuracy/ Precision	Limits: Average Recovery 50-150% % RPD < 30
Matrix spikes	1 per extraction batch	Limits 30-150%	Qualify data unless high recovery and/or Not Detected)	Laboratory personnel	Accuracy	Limits 30-150%
Surrogates	Each sample, standard, blank	Limits 30%-150%	Reinject, Qualify data	Laboratory personnel	Extraction efficiency, Accuracy	Limits 30%-150%

QAPP Worksheet #28 (Sanitary Chemistry)
(UFP-QAPP Manual Section 3.4)

Complete a separate worksheet for each sampling technique, analytical method/SOP, matrix, analytical group, and concentration level. If method/SOP QC acceptance limits exceed the measurement performance criteria, the data obtained may be unusable for making project decisions.

Title:
Revision Number:
Revision Date:
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QC Samples Table

Matrix	Aqueous/Soil
Analytical Group	Sanitary Chemistry
Concentration Level	Low/Medium
Sampling SOP	
Analytical Method/ SOP Ref	See notes below
Sampler's Name	
Field Sampling Organization	
Analytical Organization	USEPA Region 2 Laboratory
No. of Sample Locations	

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible	Data Quality Indicator (DQI)	Measurement Performance Criteria
Initial Calibration Verification (ICV)	Immediately after initial calibration	90%-110% of the true value except for TOC (± 15%)	Recalibrate	Corrective Action by Laboratory personnel	Accuracy/ Precision	90%-110% of the true value
Initial calibration Blank(ICB)	Immediately after ICV	< RL	Investigate source of contamination		Sensitivity Contamination	< RL
Continuing Calibration Verification (CCV) (Alternate check standard)	After every ten samples and at the end of the analytical run.	90%-110% of the true value	Reanalyze, Qualify data		Accuracy	90%-110% of the true value
Continuing Calibration Blank (CCB)		< RL	Investigate source of contamination		Sensitivity Contamination	< RL
Method Blank	1 per extraction /analytical batch					
Laboratory Control Sample (LCS/LFB)	2 per extraction batch of ≤ 20 samples	Limits: Average Recovery meet standard manufacturer's limits; % RPD < 20	Reanalyze, Qualify data		Accuracy/ Precision	Limits: Average Recovery meet standard manufacturer's limits; % RPD < 20
Matrix spike (MS)	1 per extraction batch of ≤ 20 samples	Limits 80-120%	Qualify data		Accuracy	Limits 80-120%

Laboratory SOPs: C-28,C-29,C-40, C-53,C-68,C-79, C-80,C-83, C-88, C-94,C-96 (Ref: EPA 335.4, 420.4, 351.2, 410.4, 365.1, 353.2, 350.1, SM 5310 B, EPA 300.0, I-1230-85)

QAPP Worksheet #28 (Sanitary Chemistry)
(UFP-QAPP Manual Section 3.4)

Title:
Revision Number:
Revision Date:
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QC Samples Table

Matrix	Aqueous/Soil
Analytical Group	Sanitary Chemistry
Concentration Level	
Sampling SOP	
Analytical Method/ SOP Reference	See notes below
Sampler's Name	
Field Sampling Organization	
Analytical Organization	USEPA Region 2 Laboratory
No. of Sample Locations	

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per analytical batch of 20 samples	< RL	Investigate source of contamination	Laboratory personnel	Sensitivity Contamination	< RL
Control Sample (LCS/LFB)	2 per analytical batch of 20 samples	Limits: Average Recovery within the standard manufacture's limits or method limits; % RPD < 20	Reanalyzed or Qualify data	Laboratory personnel	Accuracy/ Precision	Limits: Average Recovery within the standard manufacture's limits % RPD < 20
Sample Duplicates - TSS,TDS, Specific Conductance, Turbidity, pH, Ignitability	1 per analytical batch of 20 samples	% RPD < 20	Affected sample Qualified	Laboratory personnel	Precision	% RPD < 20
Matrix spike (MS) - Alkalinity, Sulfate, Chloride, BOD/ cBOD	1 per extraction batch of 20 samples	Limits 80-120%	Affected sample Qualified	Laboratory personnel	Accuracy	Limits 80-120%

Laboratory SOPs: C-18,C-19,C-21, C-22, C-23, C-24, C-33, C-36, C-37, C-81
(Ref: SM 2320 B, ASTM D516-02, SM 5210 B, SM4500CI-C, SW 846 1010, SM 4500-H+ B, SM 2540 D, EPA 120.1, SM 2540 C, EPA 180.1)

QAPP Worksheet #28 (Volatiles-Low)
(UFP-QAPP Manual Section 3.4)
Complete a separate worksheet for each sampling technique, analytical method/SOP, matrix, analytical group, and concentration level. If method/SOP QC acceptance limits exceed the measurement performance criteria, the data obtained may be unusable for making project decisions.

Title:
Revision Number:
Revision Date:
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QC Samples Table

Matrix	Aqueous/Soil
Analytical Group	VOC
Concentration Level	Low(Aq)/Medium (soil
Sampling SOP	
Analytical Method/ SOP Reference	C-89 (Ref: EPA 624)
Sampler's Name	
Field Sampling Organization:	
Analytical Organization	USEPA Region 2 Laboratory
No. of Sample Locations	

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible	Data Quality Indicator (DQI)	Measurement Performance Criteria
Tuning	12 hr period	Pass all PBFB tune criteria	Check Instrument Reanalyze, Retune	Corrective Action by Laboratory personnel	Sensitivity	Pass all PBFB tune criteria
Initial Calibration	SOP C-89	% RSD +/- 35% Not more than 10% of total analytes failure % RSD not more than 60%	Check Instrument, Reanalyze		Accuracy/ Precision	% RSD +/- 35% Not more than 10% of total analytes failure % RSD not more than 60%
Continuing Calibration Check Standard (Alternate check standard)	1 per analytical batch of 20 samples	Max %D RRF +/- 30% Not more than 10% of total analytes failure % D not more than 60%	Reanalyze, Qualify data	Laboratory personnel	Accuracy	Max %D RRF +/- 30% Not more than 10% of total analytes failure % D not more than 60%
Method Blank	1 per extraction batch of 20 samples	< RL	Investigate source of contamination	Laboratory personnel	Sensitivity Contamination	< RL
Trip Blank	1 per cooler containing VOC samples	Client Defined	Investigate source of contamination	Laboratory personnel	Sensitivity Contamination	

LCS/LFB	2 per extraction batch of 20 samples	Limits: Average Recovery 70-130% % RPD < 20	Qualify data unless high recovery and/or Not Detected)	Laboratory personnel	Accuracy/ Precision	Limits: Average Recovery 70-130% % RPD < 20
Matrix spikes	1 per extraction batch of 20 samples	Table 4 of C-89 compound specific (full range- 17-259%)	Qualify data unless high recovery and/or Not Detected)	Laboratory personnel	Accuracy	Table 4 of C-89 compound specific (full range- 17-259%)
Internal Standards	Each sample, standard, blank	Factor of two(-50% to + 100%) from the initial/continuing calibration	Check Instrument Analyse / Qualify data	Laboratory personnel	Quantitation	Factor of two(-50% to + 100%) from the initial/continuing calibration
Surrogates	Each sample, standard, blank	Limits 70%-130%	Reinject, Qualify data	Laboratory personnel	Extraction efficiency, Accuracy	Limits 70%-130%

QAPP Worksheet #28 (Volatiles-Low)
(UFP-QAPP Manual Section 3.4)
Complete a separate worksheet for each sampling technique, analytical method/SOP, matrix, analytical group, and concentration level. If method/SOP QC acceptance limits exceed the measurement performance criteria, the data obtained may be unusable for making project decisions.

Title:
Revision Number:
Revision Date:
Page ___ of ___

QC Samples Table

Matrix	Soil
Analytical Group	VOC
Concentration Level	Low
Sampling SOP	
Analytical Method/ SOP Reference	C-123 (Ref: EPA 624)
Sampler's Name	
Field Sampling Organization	
Analytical Organization	USEPA Region 2 Laboratory
No. of Sample Locations	

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Tuning	12 hr period	Pass all PBFB tune criteria	Check Instrument Reanalyze, Retune	Laboratory personnel	Sensitivity	Pass all PBFB tune criteria
Initial Calibration	SOP C-123	% RSD +/- 50% Min RRF 0.010	Check Instrument, Reanalyze	Laboratory personnel	Accuracy/ Precision	% RSD +/- 50% Min RRF 0.010
Continuing Calibration Check Standard (Alternate check standard)	1 per analytical batch of 20 samples	Max %D listed in Table 4A of C-123	Reanalyze, Qualify data	Laboratory personnel	Accuracy	Max %D listed in Table 4A of C-123
Method Blank	1 per extraction batch of 20 samples	< RL	Investigate source of contamination	Laboratory personnel	Sensitivity Contamination	< RL

Trip Blank	1 per cooler containing VOC samples	Client Defined	Investigate source of contamination	Laboratory personnel	Sensitivity Contamination	
LCS/LFB	2 per extraction batch of 20 samples	Limits: Average Recovery 70-130% % RPD < 20	Qualify data unless high recovery and/or Not Detected)	Laboratory personnel	Accuracy/ Precision	Limits: Average Recovery 70-130% % RPD < 20
Matrix spikes	1 per extraction batch of 20 samples	Table 8 of C-123 compound specific (full range- 17-259%)	Qualify data unless high recovery and/or Not Detected)	Laboratory personnel	Accuracy	Table 8 of C-123 compound specific (full range- 17-259%)
Internal Standards	Each sample, standard, blank	Factor of two(-50% to + 100%) from the initial/continuing calibration	Check Instrument Analyse / Qualify data	Laboratory personnel	Quantitation	Factor of two(-50% to + 100%) from the initial/continuing calibration
Surrogates	Each sample, standard, blank	Table 7 of C-123	Reinject, Qualify data	Laboratory personnel	Extraction efficiency, Accuracy	Table 7 of C-123

QAPP Worksheet #28 (Volatiles- Trace)
(UFP-QAPP Manual Section 3.4)
Complete a separate worksheet for each sampling technique, analytical method/SOP, matrix, analytical group, and concentration level. If method/SOP QC acceptance limits exceed the measurement performance criteria, the data obtained may be unusable for making project decisions.

Title:
Revision Number:
Revision Date:
Page ___ of ___

QC Samples Table

Matrix	Aqueous
Analytical Group	VOC
Concentration Level	Trace
Sampling SOP	
Analytical Method/ SOP Reference	DW-1 (Ref: EPA 524.2)
Sampler's Name	
Field Sampling Organization	
Analytical Organization	USEPA Region 2 Laboratory
No. of Sample Locations	

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Tuning	12 hr period	Pass all PBFB tune criteria	Check Instrument Reanalyze, Retune	Laboratory personnel	Sensitivity	Pass all PBFB tune criteria
Initial Calibration	SOP DW-1	% RSD +/- 20% Not more than 10% of total analytes failure	Check Instrument, Reanalyze	Laboratory personnel	Accuracy/ Precision	% RSD +/- 20% Not more than 10% of total analytes failure
Continuing Calibration Check Standard (Alternate check standard)	1 per analytical batch	Max %D RRF +/- 30% Not more than 10% of total analytes failure	Reanalyze, Qualify data	Laboratory personnel	Accuracy	Max %D RRF +/- 30% Not more than 10% of total analytes failure

Method Blank	1 per extraction batch	< RL	Investigate source of contamination	Laboratory personnel	Sensitivity Contamination	< RL
Trip Blank	1 per cooler containing VOC samples	Client Defined	Investigate source of contamination	Laboratory personnel	Sensitivity Contamination	
LCS/LFB	2 per extraction batch	Limits: Average Recovery 70-130% % RPD < 20	Qualify data unless high recovery and/or Not Detected)	Laboratory personnel	Accuracy/ Precision	Limits: Average Recovery 70-130% RPD 20%
Matrix spikes	1 per extraction batch	Limits 70-130%	Qualify data unless high recovery and/or Not Detected)	Laboratory personnel	Accuracy	Limits 70-130%
Internal Standards	Each sample, standard, blank	+/- 40% from the initial/continuing calibration	Check Instrument Analyse / Qualify data	Laboratory personnel	Quantitation	+/- 40% from the initial/continuing calibration
Surrogates	Each sample, standard, blank	Limits 80%-120%	Reinject, Qualify data	Laboratory personnel	Extraction efficiency, Accuracy	Limits 80%-120%

QAPP Worksheet #29
(UFP-QAPP Manual Section 3.5.1)
Identify the documents and records that will be generated for all aspects of the project including, but not limited to, sample collection and field measurement, on-site and off-site analysis, and data assessment.

Title:
Revision Number:
Revision Date:
Page ___ of ___

Project Documents and Records Table

Sample Collection Documents and Records	On-site Analysis Documents and Records	Off-site Analysis Documents and Records	Data Assessment Documents and Records	Other
Field Chains-of-Custody	Internal Chains-of-Custody		Sample acceptance checklist	Customer Service Survey Cards
Packing Slips and Sample Tags	Sample Preparation Log		PT Sample Results	Telephone Logs
Request Forms and Associated Correspondence	Standard Traceability Record		Training Records	Procurement Request Forms
	Instrument Analysis Log			
Sample Acceptance Checklist	QC summary checklist with all relevant information		MDL Study Records	Equipment Maintenance Logs
LIMS Sample Receipts	Sample Analysis Data		Initial DOC / CDOC Records	Validated Computer Software Records
Automated OSCAR Logs	Instrument Calibration Data		Internal Audit Reports	
sample identification numbers	Instrument/ Computer Printouts		Corrective Action Reports	
	Definition of Qualifiers		External Assessment	
	Cover Letter		NELAC Accreditation	
	Approval Form			
	Case Narrative			
	Final Report			

QAPP Worksheet #31
(UFP-QAPP Manual Section 4.1.1)
Identify the type, frequency, and responsible parties of planned assessment activities that will be performed for the project.

Title:
Revision Number:
Revision Date:
Page ___ of ___

Planned Project Assessments Table

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment (Title and Organizational Affiliation)	Person(s) Responsible for Responding to Assessment Findings (Title and Organizational Affiliation)	Person(s) Responsible for Identifying and Implementing Corrective Actions (CA) (Title and Organizational Affiliation)	Person(s) Responsible for Monitoring Effectiveness of CA (Title and Organizational Affiliation)
PT	Semiannually	External	NELAC	PT provider	Laboratory Personnel	Laboratory Personnel	Laboratory QA Officer
NELAC	Every two years	External	NELAC	Florida DOH	Laboratory QA Officer	Laboratory Personnel	Florida DOH
INTERNAL AUDIT	Monthly	Internally	DESA Laboratory	Laboratory QA Officer	Laboratory Personnel	Laboratory Personnel	Laboratory QA Officer

QAPP Worksheet #32

(UFP-QAPP Manual Section 4.1.2)
For each type of assessment describe procedures for handling QAPP and project deviations encountered during the planned project assessments.

Title:
Revision Number:
Revision Date:
Page ___ of ____

Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (Name, Title, Organization)	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (Name, Title, Org.)	Timeframe for Response
Proficiency Testing (PT)	Letter with PT failure indicated	Laboratory QA Officer	30 days after the audit	Investigate the reason for the PT failure	Laboratory QA Officer	45 days after the CA report
NELAC	Audit Report with Non-conformance to QAPP, SOPs, NELAC+LQMP	Laboratory Management	30 days after the audit	Investigate and have a corrective action plan for the deficiencies	Florida DOH	30 days after receiving notification
INTERNAL	Audit Report with Non-conformance to QAPP, SOPs, NELAC Regulations	Laboratory Management	30 days after the audit	Investigate and have a corrective action plan for the deficiencies	Laboratory QA Officer	45 days after the CA report

QAPP Worksheet #34
(UFP-QAPP Manual Section 5.2.1)
Describe the processes that will be followed to verify project data. Manual (Section 5.1). Describe how each item will be verified, when the activity will occur, and what documentation is necessary, and identify the person responsible. *Internal* or *external* is in relation to the data generator.

Title:
Revision Number:
Revision Date:
Page ___ of ___

Verification (Step I) Process Table

Verification Input	Description	Internal/ External	Responsible for Verification (Name, Organization)
Chain of Custody	Chain-of-custody forms will be verified against the sample cooler they represent. Sample Acceptance Checklist is completed. The OSCAR staff supervisor utilizes the analyses request information and the external COC to review the accuracy and completeness of LIMS log-in entries, as reflected on the LIMS Sample Receipt Form Details can be found in Quality Management Plan, SOP G-25	Internal	OSCAR Personnel DESA Laboratory
Analytical data package/ Final Report	The procedures for data review : 1- Data reduction/review by Primary Analyst. 2- Review complete data package (raw data) by independent Peer Reviewer 3- The Sample Project Coordinator reviews the project documentation for completeness followed by a QA review by the QAO 4- Final review by Branch Chief/Section Chief prior to release, this review is to ensure completeness and general compliance with the objectives of the project. This final review typically does not include a review of raw data. Details can be found in the Quality Management Plan.	Internal	Primary Analyst, Peer Reviewer, Sample Project Coordinator, Quality Assurance Officer, Section Chief/ Branch Chief. DESA Laboratory

QAPP Worksheet #35

UFP-QAPP Manual Section 5.2.2
Describe the processes that will be followed to validate project data. Validation inputs include items such as those listed in Table 9 of the UFP-QAPP Manual (Section 5.1). Describe how each item will be validated, when the activity will occur, and what documentation is necessary and identify the person responsible. Differentiate between steps IIa and IIb of validation.

Revision Number:
Revision Date:

Validation (Steps IIa and IIb) Process Table

Step IIa/IIb	Validation Input	Description	Responsible for Validation (Name, Organization)
	Chain of Custody	Chain-of-custody forms will be verified against the sample cooler they represent. Sample Acceptance Checklist is completed. The OSCAR staff supervisor utilizes the analyses request information and the external COC to review the accuracy and completeness of LIMS log-in entries, as reflected on the LIMS Sample Receipt Form Details can be found in Quality Management Plan, SOP G-25	OSCAR Personnel DESA Laboratory
	Analytical data package/ Final Report	The procedures for data review : 1- Data reduction/review by Primary Analyst. 2- Review complete data package (raw data) by independent Peer Reviewer 3- The Sample Project Coordinator reviews the project documentation for completeness followed by a QA review by the QAO 4- Final review by Branch Chief/Section Chief prior to release, this review is to ensure completeness and general compliance with the objectives of the project. This final review typically does not include a review of raw data. Details can be found in the Quality Management Plan.	Primary Analyst, Peer Reviewer, Sample Project Coordinator, Quality Assurance Officer, Section Chief/ Branch Chief. DESA Laboratory

* DESA performs the validation.

APPENDIX D

Eleven Chain of Custody Rules to Remember

COCs MUST REFLECT:

1. Case Number*
2. Case Open or Closed
3. Analysis Required (use standard codes)
4. TAT Requirement
5. Modified Analysis Number (if applicable)
6. Sample Date and Time (matching label)
7. Destination Laboratory
8. Lab Address (verify subcontract lab and lower tier address)
9. Sampler's Signature
10. Relinquisher's Signature
11. CLP Sample Numbers

Resources:

CLP Guidance for Field Samplers. January 2011

*A case # is used for CLP Lab Assignments

Only DESA gets the Regional COC

Items 1, 3, 4, 5, 7 & 8 must match Lab Assignment Form

Questions contact -

Scott Kirchner/ Jeniffer Oxford/ Vanessa Macwan

United States Environmental Protection Agency

ANSETS Data Requirement

Sampling Start Date: _____

Date: _____ Sampling End Date: _____

Project Numbers			
Project Number:	Regional Account Number:	DAS Number:	Assoc. CLP Case No:
Site Information			
Site Name:		City:	State:
CERCLIS ID:	Operable Unit:	Action:	Funding Lead:
Responsible EPA Project Individual:		Sampling Organization:	CDM Smith

Analytical Services Information	
If field analytical services are used during this project write "field analysis" in the Laboratory Name Column. If fixed laboratory is used write the name of the laboratory in the Laboratory Name Column. Please specify in this box all field analytical techniques used.	COST:

Laboratory Name (include location if multiple lab locations)	No. Samples	Matrix	Analysis	Requested Turnaround (Days)

Completed by:		**Organization:**		**Date:**

Please use this FedEx airbill to return **all coolers** sent to your lab under this case number. It should be sent FedEx Ground and addressed:

CDM Federal Warehouse
115 Newfield Ave.
Edison, NJ 08837
Attn: Equipment Return

Thanks,

CDM Federal Programs Corporation

Please use this FedEx airbill to return **all coolers** sent to your lab under this case number. It should be sent via FedEx Ground and addressed:

CDM Federal Warehouse
115 Newfield Ave.
Edison, NJ 08837
Attn: Equipment Return

Thanks,

CDM Federal Programs Corporation

Rolling Knolls Landfill Superfund Site Oversight
Chatham, New Jersey

Daily Quality Control Report

DATE:	**Prepared by:**

Contractors and Personnel Onsite:	

Weather	Bright Sun	Clear	Overcast	Rain	Snow
Temperature	To 32 º F	32 to 50 º F	50 to 70 º F	70 to 85 º F	85+ º F
Wind	Still	Moderate	High		
Humidity	Dry	Moderate	Humid		

Daily Health and Safety Meeting Completed:

Description of Field Activities:

Equipment In Use:

Issues/Problems Encountered/Deficiencies/Deviations from UFP-QAPP (and resolutions):

Projected Work- Near Term:

Additional Activities And Remarks:

CDM Smith

Rolling Knolls Landfill Superfund Site Oversight
Chatham, New Jersey
Field Change Request

Date: _____

Request No.: _____

FCR Title: _____

Description: _____

_____

_____

_____

Reason for Deviation: _____

_____

_____

_____

Recommended/Modification: _____

_____

_____

_____

Impact on Data Quality Objectives: _____

_____

_____

_____

USACE Contract No.: W912DQ-11-D-3004

Task Order No.: 019

Signatures:

_____	_____
CDM Smith Field Oversight Staff	Paul Hagerman, CDM Smith Project Manager

cc:

Tanya Mitchell, EPA RPM	Amy Darpinian, USACE Project Manager
Bill Sy, EPA QA Officer	Jeniffer Oxford, CDM Smith QA Specialist
CDM Smith Field Staff	

PHOTOLOG

SITE NAME: Rolling Knolls Landfill Superfund Site Oversight

CAMERA # _____

Photograph #	Description	Date/Time	Photographer

SAMPLE TRACKING LOG

LDL VOC LAB: _____ INORGANIC CLP LAB: _____

CLP CASE NO: _____ ORGANIC CLP LAB: _____ SUBCONTRACT LAB: _____

SAMPLE ID	SAMPLE DATE	SAMPLE TIME	MATRIX	DEPTH (feet)	LDL VOC CLP NO.	ORGANIC CLP NO.	INORGANIC CLP NO.	SUBCONTRACT ANALYSIS	QA/QC

ANALYSIS SUMMARY: _____

_____

SUBCONTRACTOR LABORATORY SAMPLE TRACKING LOG

SITE NAME: **Rolling Knolls Landfill Superfund Site Oversight**

DATE SHIPPED OR RECEIVED	NUMBER OF SAMPLES SHIPPED (OR SUPPLIES RECEIVED)	ANALYTICAL PARAMETERS REQUIRED	NUMBER OF COOLERS SHIPPED

APPENDIX E

Sample Custody

SOP 1-2
Revision: 7
Date: January 2012

Prepared:	David O. Johnson	**Technical Review:**	C. Zakowski
QA Review:	Jo Nell Mullins	**Approved:**	*Signature/Date*
Issued:	*Signature/Date*		

1.0 Objective

Because of the evidentiary nature of samples collected during environmental investigations, possession must be traceable from the time the samples are collected until their derived data are introduced as evidence in legal proceedings. To maintain and document sample possession, sample custody procedures are followed. All paperwork associated with the sample custody procedures will be retained in CDM Smith files unless the client requests that it be transferred to them for use in legal proceedings or at the completion of the contract.

Note: Sample custody documentation requirements vary with the specific EPA region or client. This technical standard operating procedure (SOP) is intended to present basic sample custody requirements, along with common options. Specific sample custody requirements shall be presented in the project-specific quality assurance (QA) project plan or project-specific modification or clarification form (see Section U-1).

2.0 Background

2.1 Definitions

Sample - A sample is material to be analyzed that is contained in single or multiple containers representing a unique sample identification number.

Sample Custody - A sample is under custody if:

1. It is in your possession
2. It is in your view, after being in your possession
3. It was in your possession and you locked it up
4. It is in a designated secure area

Chain-of-Custody Record - A chain-of-custody record is a form used to document the transfer of custody of samples from one individual to another.

Custody Seal - A custody seal is a tape-like seal that is part of the chain-of-custody process and is used to detect tampering with samples after they have been packed for shipping.

Sample Label - A sample label is an adhesive label placed on sample containers to designate a sample identification number and other sampling information.

Sample Tag - A sample tag is attached with string to a sample container to designate a sample identification number and other sampling information. Tags may be used when it is difficult to physically place adhesive labels on the container (e.g., in the case of small air sampling tubes). Check with your EPA regional Contract Laboratory Program (CLP) coordinator as not all Regions require sample tags.

3.0 General Responsibilities

Sampler - The sampler is personally responsible for the care and custody of the samples collected until they are properly transferred or dispatched.

Field Team Leader - The field team leader (FTL) is responsible for ensuring that strict chain-of-custody procedures are maintained during all sampling events. The FTL is also responsible for coordinating with the subcontractor laboratory to ensure that adequate information is recorded on custody records. The FTL determines whether proper custody procedures were followed during the fieldwork.

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Field Sample Custodian - The field sample custodian, when designated by the FTL, is responsible for accepting custody of samples from the sampler(s) and properly packing and shipping the samples to the laboratory assigned to do the analyses. A field sample custodian is typically designated only for large and complex field efforts.

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site/quality assurance project plan (QAPP).

4.0 Required Supplies

- Chain-of-custody records (applicable client or CDM Smith forms)
- Sample labels and/or tags
- EPA Field Operations Records Management System II Lite™ (FORMS II Lite™) software or Scribe software (if required)
- Custody seals
- Clear tape
- Computer
- Printer and paper

5.0 Procedures

5.1 Chain-of-Custody Record

This procedure establishes a method for maintaining custody of samples through use of a chain-of-custody record. This procedure will be followed for all samples collected or split samples accepted.

Field Custody

1. Collect only the number of samples needed to represent the media being sampled. To the extent possible, determine the quantity and types of samples and sample locations before the actual fieldwork. As few people as possible shall handle samples.

2. Complete sample labels or tags for each sample using waterproof ink.

3. Maintain personal custody of the samples (in your possession) at all times until custody is transferred for sample shipment or directly to the analytical laboratory.

Transfer of Custody and Shipment

1. Complete a chain-of-custody record for all samples (see Figure 1 for an example of a chain-of-custody record. Similar forms may be used when requested by the client). When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents sample custody transfer from the sampler, often through another person, to the sample custodian in the appropriate laboratory.

   - The date/time will be the same for both signatures when custody is transferred directly to another person. When samples are shipped via common carrier (e.g., Federal Express), the date/time will not be the same for both signatures. Common carriers are not required to sign the chain-of-custody record.
   - In all cases, it must be readily apparent that the person who received custody is the same person who relinquished custody to the next custodian.
   - If samples are left unattended or a person refuses to sign, this must be documented and explained on the chain-of-custody record.

   Note: If a field sample custodian has been designated, he/she may initiate the chain-of-custody record, sign, and date as the relinquisher. The individual sampler(s) must sign in the appropriate block, but does (do) not need to sign and date as a relinquisher (refer to Figure 1).

2. Package samples properly for shipment and dispatch to the appropriate laboratory for analysis. Each shipment must be accompanied by a separate chain-of-custody record. If a shipment consists of multiple coolers, a chain-of-custody record shall be filled out for each cooler documenting only samples contained in that particular cooler.

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3. The original record will accompany the shipment, and the copies will be retained by the FTL and, if applicable, distributed to the appropriate sample coordinators. Freight bills will also be retained by the FTL as part of the permanent documentation. The shipping number from the freight bill shall be recorded on the applicable chain-of-custody record and field logbook in accordance with SOP 4-1, Field Logbook Content and Control.

Procedure for Completing CDM Smith Example Chain-of-Custody Record
The following procedure is to be used to fill out the CDM Smith chain-of-custody record. The record provided herein (Figure 1) is an example chain-of-custody record. If another type of custody record (i.e., provided by the EPA Contract Laboratory Program (CLP) or a subcontract laboratory or generated by Scribe or FORMS II Lite™) is used to track the custody of samples, the custody record shall be filled out in its entirety.

1. Record project number.
2. Record FTL for the project (if a field sample custodian has been designated, also record this name in the “Remarks” box).
3. Record the name and address of the laboratory to which samples are being shipped.
4. Enter the project name/location or code number.
5. Record overnight courier’s airbill number.
6. Record sample location number.
7. Record sample number.
8. Note preservatives added to the sample.
9. Note media type (matrix) of the sample.
10. Note sample type (grab or composite).
11. Enter date of sample collection.
12. Enter time of sample collection in military time.
13. When required by the client, enter the names or initials of the samplers next to the sample location number of the sample they collected.
14. List parameters for analysis and the number of containers submitted for each analysis.
15. Enter appropriate designation for laboratory quality control (e.g., matrix spike/matrix spike duplicate [MS/MSD], matrix spike/duplicate [MS/D]), or other remarks (e.g., sample depth).
16. Sign the chain-of-custody record(s) in the space provided. All samplers must sign each record.
17. If sample tags are used, record the sample tag number in the “Remarks” column.
18. The originator checks information entered in Items 1 through 16 and then signs the top left “Relinquished by” box, prints his/her name, and enters the current date and time (military).
19. Send the top two copies (usually white and yellow) with the samples to the laboratory; retain the third copy (usually pink) for the project files. Retain additional copies for the project file or distribute as required to the appropriate sample coordinators.
20. The laboratory sample custodian receiving the sample shipment checks the sample label information against the chain-of-custody record. Sample condition is checked and anything unusual is noted under “Remarks” on the chain-of-custody record. The laboratory custodian receiving custody signs in the adjacent “Received by” box and keeps the copy. The white copy is returned to CDM Smith.

5.2 Sample Labels and Tags

Unless the client directs otherwise, sample labels or tags will be used for all samples collected or accepted for CDM Smith projects.

1. Complete one label or tag with the information required by the client for each sample container collected. A typical label or tag would be completed as follows (see Figure 2 for example of sample tag; labels are completed with the equivalent information):

   - Record the project code (i.e., project or task number).
   - Enter the station number (sample number or EPA CLP identification number) if applicable.
   - Record the date to indicate the month, day, and year of sample collection.
   - Enter the time (military) of sample collection.
   - Place a check to indicate composite or grab sample.

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- Record the station (sample) location.
- Sign in the space provided.
- Place a check next to “yes” or “no” to indicate if a preservative was added.
- Place a check under “Analyses” next to the parameters for which the sample is to be analyzed. If the desired analysis is not listed, write it in the empty slot. Note: Do not write in the box for “laboratory sample number.”
- Place or write additional relevant information under “Remarks.”

2. Place adhesive labels directly on the sample containers. Place clear tape over the label to protect from moisture.

3. Securely attach sample tags to the sample bottle if required. On 2.27 liter (80 oz.) amber bottles, the tag string may be looped through the ring-style handle and tied. On all other containers, it is recommended that the string be looped around the neck of the bottle, then twisted, and relooped around the neck until the slack in the string is removed.

4. Double-check that the information recorded on the sample label or tag is consistent with the information recorded on the chain-of-custody record.

5.3 Custody Seals

Two custody seals must be placed on opposite corners of all shipping containers (e.g., cooler) before shipment. The seals shall be signed and dated by the shipper.

Custody seals may also be required to be placed on individual sample bottles. Check with the client or refer to EPA regional guidelines for direction.

5.4 Sample Shipping

SOP 2-1, *Packaging and Shipping Environmental Samples* defines the requirements for packaging and shipping environmental samples.

6.0 Restrictions/Limitations

Check with the EPA region or client for specific guidelines. If no specific guidelines are identified, this procedure shall be followed.

For EPA CLP sampling events, combined chain-of-custody/traffic report forms generated with EPA FORMS II Lite™, Scribe or other EPA-specific records may be used. Refer to regional guidelines for completing these forms.

The EPA FORMS II Lite™ or Scribe software may be used to customize sample labels and custody records when directed by the client or the CDM Smith project manager.

7.0 References

U. S. Army Corps of Engineers. 2001 or current revision. *Requirements for the Preparation of Sampling and Analysis Plan*, EM 200-1-3. Appendix F. February.

U. S. Environmental Protection Agency. Revised March 1992 or current revision. *National Enforcement Investigations Center, Multi-Media Investigation Manual*, EPA-330/9-89-003-R. p.85.

_____. Region IV. 1996 or current revision. *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual*. Section 3.3. May.

_____. 2002 or current revision. *FORMS II Lite™ User’s Guide, Version 5.1*. http://www.epa.gov/superfund/programs/clp/f2lite.htm

_____. 2006-2011. Scribe Manuals. http://www.ertsupport.org/scribe_home.htm and http://www.epaosc.org/scribe

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_____. 2002 or current revision. *EPA Guidance for Quality Assurance Project Plans*, EPA QA/G-5, EPA/240/R-02/009. Section 2.2.3. December.

_____. 2011 or current revision. *Sampler's Guide, Contract Laboratory Program Guidance for Field Samplers*, EPA-540-R-09-03. January.

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Figure 1
Example CDM Smith Chain-of-Custody Record

125 Maiden Lane, 5th Floor
New York, NY 10038
(212) 785-9123
Fax: (212) 785-6114

CHAIN OF CUSTODY RECORD

PROJECT ID.	FIELD TEAM LEADER	LABORATORY AND ADDRESS	DATE SHIPPED
PROJECT NAME/LOCATION		LAB CONTRACT:	AIRBILL NO.

MEDIA TYPE	PRESERVATIVES	SAMPLE TYPE
1. Surface Water	1. HCl, pH <2	G = Grab
2. Groundwater	2. HNO3, pH <2	C = Composite
3. Leachate	3. NaOH, pH >12	
4. Field QC	4. H2SO4, pH <2	
5. Soil/Sediment	5. Zinc Acetate, pH >9	
6. Oil	6. Ice Only	
7. Waste	7. Not Preserved	
8. Other _____	8. Other _____	

SAMPLE LOCATION NO.	LABORATORY SAMPLE NUMBER	PRESER-VATIVES ADDED	MEDIA TYPE	SAMPLE TYPE	20__ DATE	TIME SAMPLED	ANALYSES (List no. of containers submitted)								REMARKS (Note if MS/MSD)
1.															
2.															
3.															
4.															
5.															
6.															
7.															
8.															
9.															
10.															

SAMPLER SIGNATURES:

RELINQUISHED BY: (PRINT)	DATE/TIME	RECEIVED BY: (PRINT)	DATE/TIME	RELINQUISHED BY: (PRINT)	DATE/TIME	RECEIVED BY: (PRINT)	DATE/TIME
(SIGN)		(SIGN)		(SIGN)		(SIGN)	
RELINQUISHED BY: (PRINT)	DATE/TIME	RECEIVED BY: (PRINT)	DATE/TIME	RELINQUISHED BY: (PRINT)	DATE/TIME	RECEIVED BY: (PRINT)	DATE/TIME
(SIGN)		(SIGN)		(SIGN)		(SIGN)	

COMMENTS:

DISTRIBUTION: White and yellow copies accompany sample shipment to laboratory; yellow copy retained by laboratory. Pink copy retained by samplers.

1/98

Note: If requested by the client, different chain-of-custody records may be used. Copies of the template for this record may be obtained from the Chantilly Graphics Department.

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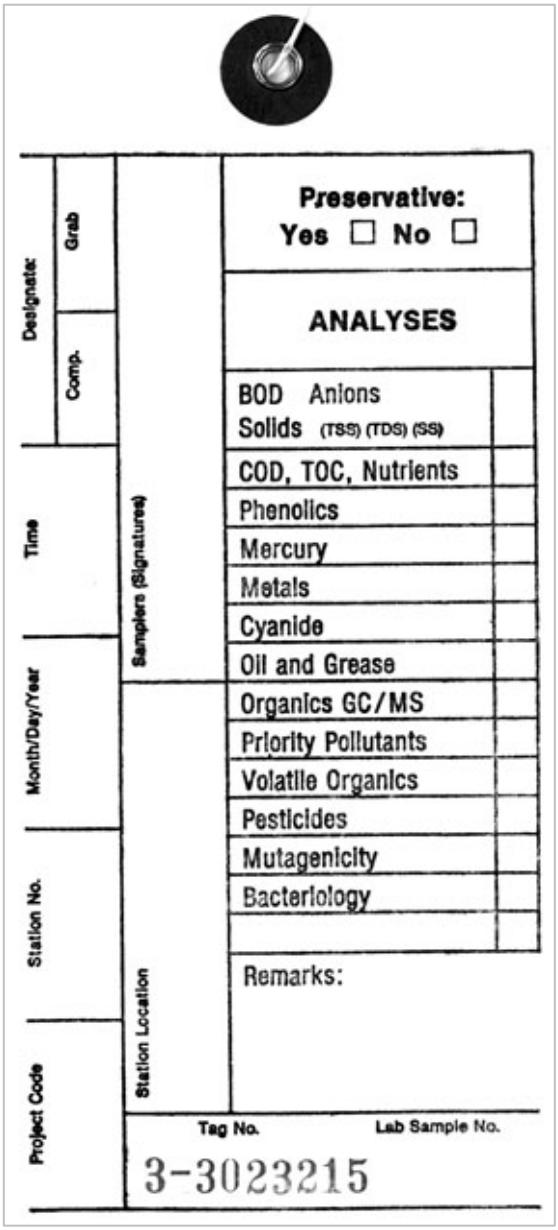
Figure 2
Example Sample Tag



Note: Equivalent sample labels or tags may be used.

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Packaging and Shipping Environmental Samples

SOP 2-1
Revision: 5
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Prepared:	Krista Lippoldt	**Technical Review:**	C. Zakowski
QA Review:	Jo Nell Mullins	**Approved:**	*Signature/Date*
Issued:	*Signature/Date*		

1.0 Objective

The objective of this technical standard operating procedure (SOP) is to outline the requirements for the packaging and shipment of environmental samples. Additionally, Sections 2.0 through 7.0 outline requirements for the packaging and shipping of regulated environmental samples under the Department of Transportation (DOT) Hazardous Materials Regulations, the International Air Transportation Association (IATA), and International Civil Aviation Organization (ICAO) Dangerous Goods Regulations for shipment by air and applies only to domestic shipments. This SOP does not cover the requirements for packaging and shipment of equipment (including data loggers and self-contained breathing apparatus [SCBAs] or bulk chemicals that are regulated under the DOT, IATA, and ICAO.

1.1 Packaging and Shipping of All Samples

This SOP applies to the packaging and shipping of all environmental samples. If the sample is preserved or radioactive, the following sections may also be applicable.

Section 2.0 - Packaging and Shipping Samples Preserved with Methanol
Section 3.0 - Packaging and Shipping Samples Preserved with Sodium Hydroxide
Section 4.0 - Packaging and Shipping Samples Preserved with Hydrochloric Acid
Section 5.0 - Packaging and Shipping Samples Preserved with Nitric Acid
Section 6.0 - Packaging and Shipping Samples Preserved with Sulfuric Acid
Section 7.0 - Packaging and Shipping Limited-Quantity Radioactive Samples

NOTE: This SOP does not address shipment of hazardous materials. Don't ship a hazardous material unless you have received training that meets the requirements of CDM Smith and the DOT. Check with CDM Smith University for training courses.

1.2 Background

1.2.1 Definitions

Environmental Sample - An aliquot of air, water, plant material, sediment, or soil that represents the contaminant levels on a site. Samples of potential contaminant sources, like tanks, lagoons, or non-aqueous phase liquids are normally not "environmental" for this purpose. This procedure applies only to environmental samples that contain less than reportable quantities for any foreseeable hazardous constituents according to DOT regulations promulgated in 49 CFR - Part 172.101 Appendix A.

Custody Seal - A custody seal is a narrow adhesive-backed seal that is applied to individual sample containers and/or the container (i.e., cooler) before offsite shipment. Custody seals are used to demonstrate that sample integrity has not been compromised during transportation from the field to the analytical laboratory.

Inside Container - The container, normally made of glass or plastic, that actually contacts the shipped material. Its purpose is to keep the sample from mixing with the ambient environment.

Outside Container - The container, normally made of metal or plastic, that the transporter contacts. Its purpose is to protect the inside container.

Secondary Containment - The outside container provides secondary containment if the inside container breaks (i.e., plastic overpackaging if liquid sample is collected in glass).

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Excepted Quantity - Excepted quantities are limits to the mass or volume of a hazardous material in the inside and outside containers below which DOT, IATA, ICAO regulations do not apply. The excepted quantity limits are very low. Most regulated shipments will be made under limited quantity.

Limited Quantity - Limited quantity is the maximum amount of a hazardous material below which there are specific labeling or packaging exceptions.

Performance Testing - Performance testing is the required testing of outer packaging. These tests include drop and stacking tests.

Qualified Shipper - A qualified shipper is a person who has been adequately trained to perform the functions of shipping hazardous materials.

1.2.2 Associated Procedures

- SOP 1-2, *Sample Custody*

1.2.3 Discussion

Proper packaging and shipping is necessary to ensure the protection of the integrity of environmental samples shipped for analysis. These shipments are potentially subject to regulations published by DOT, IATA, or ICAO. Failure to abide by these rules places both CDM Smith and the individual employee at risk of serious fines. The analytical holding times for the samples must not be exceeded. The samples shall be packed in time to be shipped for overnight delivery. Make arrangements with the laboratory before sending samples for weekend delivery.

1.3 Required Equipment

- Coolers with return address of the appropriate CDM Smith office
- Heavy-duty plastic garbage bags
- Plastic zip-type bags, small and large
- Clear tape
- Nylon reinforced strapping tape
- Duct tape
- Kitty litter/pine bedding (or an equivalent nonflammable material that is inert and absorbent)*
- Bubble wrap (optional)
- Ice
- Custody seals
- Completed chain-of-custody record or contract laboratory program (CLP) custody records, if applicable
- Completed bill of lading
- This End Up and directional arrow labels

*Check for any client-specific or laboratory requirements related to the use of absorbent packaging materials.

1.4 Packaging Environmental Samples

The following steps must be followed when packing sample bottles and jars for shipment:

1. Verify the samples undergoing shipment meet the definition of “environmental sample” and are not a hazardous material as defined by DOT. Professional judgment and/or consultation with qualified persons such as the appropriate health and safety coordinator or the health and safety manager shall be observed.

2. Select a sturdy cooler in good repair. Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler. Line the cooler with a large heavy-duty plastic garbage bag.

3. Be sure the caps on all bottles are tight (will not leak); check to see that labels and chain-of-custody records are completed properly (SOP 1-2, Sample Custody).

4. Place all bottles in separate and appropriately sized plastic zip-top bags and close the bags. Up to three VOA vials may be packed in one bag. Binding the vials together with a rubber band on the outside of the bag, or separating them so that they do not contact each other, will reduce the risk of breakage. Bottles may be wrapped in bubble wrap. Optionally,

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place three to six VOA vials in a quart metal can and then fill the can with kitty litter/pine bedding or equivalent. ***Note***: Trip blanks must be included in coolers containing VOA samples.

5. Place 2 to 4 inches of an absorbent material into a cooler that has been lined with a garbage bag, and then place the bottles and cans in the bag with sufficient space to allow for the addition of packing material between the bottles and cans. It is preferable to place glass sample bottles and jars into the cooler vertically. Glass containers are less likely to break when packed vertically rather than horizontally.

6. While placing sample containers into the cooler, conduct an inventory of the contents of the shipping cooler against the chain-of-custody record. The chain-of-custody with the cooler shall reflect only those samples within the cooler.

7. Put ice in large plastic zip-top bags (double bagging the zip-tops is preferred) and properly seal. Place the ice bags on top of and/or between the samples. Several bags of ice are required (dependant on outdoor temperature, staging time, etc.) to maintain the cooler temperature at approximately 4° Celsius (C) if the analytical method requires cooling. Fill all remaining space between the bottles or cans with packing material. Securely fasten the top of the large garbage bag with fiber or duct tape.

8. Place the completed chain-of-custody record or the CLP traffic report form (if applicable) for the laboratory into a plastic zip-top bag, seal the bag, tape the bag to the inner side of the cooler lid and close the cooler.

9. The cooler lid shall be secured with nylon reinforced strapping tape by wrapping each end of the cooler a minimum of two times. Attach a completed chain-of-custody seal across the opening of the cooler on opposite sides. The custody seals shall be affixed to the cooler with half of the seal on the strapping tape so that the cooler cannot be opened without breaking the seal. Complete two more wraps around with fiber tape and place clear tape over the custody seals.

10. The shipping container lid must be marked **"THIS END UP"** and arrow labels that indicate the proper upward position of the container shall be affixed to the cooler. A label containing the name and address of the shipper (CDM Smith) shall be placed on the outside of the container. Labels used in the shipment of hazardous materials (such as Cargo Only Air Craft, Flammable Solids, etc.) are not permitted on the outside of containers used to transport environmental samples and shall not be used. The name and address of the laboratory shall be placed on the container, or when shipping by common courier, the bill of lading shall be completed and attached to the lid of the shipping container.

2.0 Packaging and Shipping Samples Preserved with Methanol

2.1 Containers

1. The maximum volume of methanol in a sample container is limited to 30 ml.

2. The sample container must not be full of methanol.

2.2 Responsibility

It is the responsibility of the qualified shipper to:

1. Ensure that the samples undergoing shipment contain no other contaminant that meets the definition of "hazardous material" as defined by DOT

2. Determine the amount of preservative in each sample so that accurate determination of quantities can be made

   Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site-/project-specific quality assurance project plan (QAPP).

2.3 Additional Required Equipment

The following equipment is needed in addition to the required equipment listed in Section 1.3:

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1. Inner packing may consist of glass or plastic jars
2. Outer packaging (for limited quantities) insulated cooler that has passed the ICAO drop test
3. Survey documentation (if shipping from Department of Energy [DOE] or radiological sites)
4. Class 3 flammable liquid labels
5. Orientation labels
6. Consignor/consignee labels

2.4 Packaging Samples Preserved with Methanol

The following steps are to be followed when packaging limited-quantity sample shipments:

1. Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler.
2. All sample containers will be properly labeled and the label protected with waterproof tape before sampling.

   At a minimum the label must contain:

   - Project name
   - Project number
   - Date and time of sample collection
   - Sample location
   - Sample identification number
   - Collector's initials
   - Preservative (note amount of preservative used in miscellaneous section of the chain-of-custody form)

3. Wrap each container (40-ml VOA vials) in bubble wrap (secure with waterproof tape) to prevent breakage.
4. Place the bubble-wrapped container into a 2.7-mil zip-type bag, removing trapped air.
5. Place wrapped containers inside a polyethylene bottle filled with an absorbent; seal the bottle. (Maximum of 4 VOA vials will fit inside a 500-ml wide-mouth polyethylene bottle.)
6. Total volume of methanol per shipping container must not exceed 500 ml.
7. Place sufficient amount of an absorbent in the bottom of the cooler to absorb any leakage that may occur.
8. Place a garbage bag in the cooler.
9. Pack the samples appropriately inside the garbage bag (bottles placed upright) to prevent movement during shipment.
10. Place a sufficient amount of double-bagged ice around the samples to maintain the required temperature during shipment.
11. Seal the garbage bag by tieing or taping.
12. The maximum weight of the cooler shall not exceed 30 kg (66 lbs) for any limited-quantity shipment of dangerous goods.
13. Secure the chain-of-custody form (placed inside a zip-type bag) to the interior of the cooler lid.
14. If the shipment is from a DOE or other facility, place the results of the radiation screen and cooler/sample survey with the chain-of-custody.

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15. Wrap strapping tape or duct tape around both ends of the cooler and around the cooler lid.

16. Affix custody seals to opposite sides of the cooler lid. Cover the custody seals with clear waterproof tape.

17. Mark the outside of the cooler with the proper shipping name of the contents, corresponding UN number, and LTD. QTY. (as shown below).

    Methanol Mixture
    UN1230
    LTD. QTY.

18. Place a label on the front of the cooler with the company name, contact name, phone number, full street address, and state with zip code for both shipper and recipient.

19. Affix a Flammable Liquid label to the outside of the cooler.

20. Affix package orientation labels on two opposite sides of the cooler.

21. Secure the marking and labels to the surface of the cooler with clear waterproof tape to prevent accidental removal during shipment. An example of cooler labeling/marking locations is shown in Figure 1.

    Note: No marking or labeling can be obscured by strapping or duct tape.

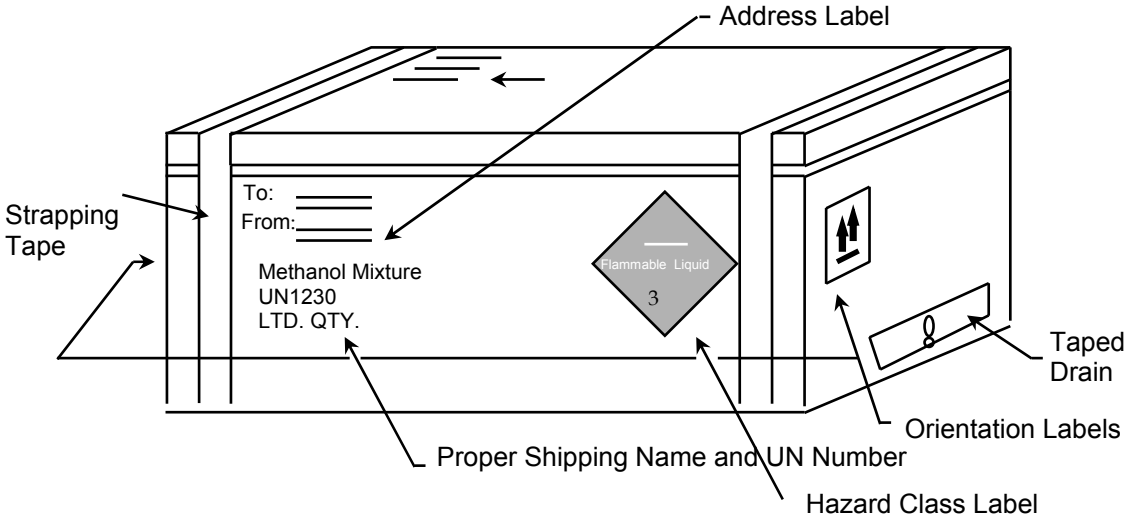
    Note: The inner packaging of dangerous goods must be placed into the designated cooler for shipment. Other nonregulated environmental samples may be added to the cooler for shipment.

22. When shipping from a DOE facility, the cooler will be surveyed by a qualified radiation control technician to ensure that radiation flux on exterior surfaces does not exceed 0.5 mrem/h on all sides. This survey will be documented and the results reviewed by the qualified shipper.

23. Complete the Dangerous Goods and Hazardous Materials Inspection Checklist for Shipping Limited-Quantity(Appendix A).

24. Complete a Dangerous Goods Airbill.

Figure 1
Example of Cooler Label/Marking Locations



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3.0 Packaging and Shipping Samples Preserved with Sodium Hydroxide

3.1 Containers

The inner packaging container (and amount of preservative) that may be used for these shipments includes:

Excepted Quantities of Sodium Hydroxide Preservatives

Preservative		*Desired in Final Sample*		*Quantity of Preservative (ml) for Specified Container*				
		pH	**Conc.**	**40 ml**	**125 ml**	**250 ml**	**500 ml**	**1 L**
NaOH	30%	>12	0.08%		.25	0.5	1	2

5 drops = 1 ml

3.2 Responsibility

It is the responsibility of the qualified shipper to determine the amount of preservative in each sample so that accurate determination of quantities can be made.

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site-/project-specific quality assurance project plan (QAPP).

3.3 Additional Required Equipment

The following equipment is needed in addition to the required equipment listed in Section 1.3:

- Outer packaging (for limited quantities) insulated cooler that has passed the ICAO drop test
- Inner packings may consist of glass or plastic jars no larger than 1 pint
- Survey documentation (if shipping from DOE or radiological sites)
- Class 8 corrosive labels
- Orientation labels
- Consignor/consignee labels

3.4 Packaging Samples Preserved with Sodium Hydroxide

Samples containing NaOH as a preservative that exceed the excepted concentration of 0.08 percent (2 ml of a 30 percent NaOH solution per liter) may be shipped as a limited quantity per packing instruction Y819 of the IATA/ICAO Dangerous Goods Regulations.

The following steps are to be followed when packaging limited-quantity samples shipments:

1. Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler.

2. All sample containers will be properly labeled and the label protected with waterproof tape before sampling.

   At a minimum the label must contain:

   - Project name
   - Project number
   - Date and time of sample collection
   - Sample location
   - Sample identification number
   - Collector's initials
   - Preservative (note amount of preservative used in miscellaneous section of the chain-of-custody form)

3. This step is optional; wrap each container in bubble wrap (secure with waterproof tape) to prevent breakage.

4. Place the bubble-wrapped container into a 2.7-mil zip-type bag, removing trapped air.

5. Place glass containers inside a polyethylene bottle filled with an absorbent; seal the bottle.

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6. The total volume of sample in each cooler must not exceed 1 liter.

7. Place sufficient amount of an absorbent in the bottom of the cooler to absorb any leakage that may occur.

8. Place a garbage bag in the cooler.

9. Pack the samples appropriately inside the garbage bag (bottles placed upright) to prevent movement during shipment.

10. Place sufficient amount of double-bagged ice around the samples to maintain the required temperature during shipment.

11. Seal the garbage bag by tieing or taping.

12. The maximum weight of the cooler shall not exceed 30 kg (66 lbs) for any limited-quantity shipment of dangerous goods.

13. Secure the chain-of-custody form (placed inside a zip-type bag) to the interior of the cooler lid.

14. If the shipment is from a DOE or other facility, place the results of the radiation screen and cooler/sample survey with the chain-of-custody.

15. Wrap strapping tape or duct tape around both ends of the cooler and around the cooler lid.

16. Affix custody seals to opposite sides of the cooler lid. Cover the custody seals with clear waterproof tape.

17. Mark the outside of the cooler with the proper shipping name of the contents, corresponding UN number, and LTD. QTY. (as shown below).

    Sodium Hydroxide Solution
    UN1824
    LTD. QTY.

18. Place a label on the front of the cooler with the company name, contact name, phone number, full street address, and state with zip code for both shipper and recipient.

19. Affix a Corrosive label to the outside of the cooler.

20. Affix package orientation labels on two opposite sides of the cooler.

21. Secure the marking and labels to the surface of the cooler with clear waterproof tape to prevent accidental removal during shipment. An example of cooler labeling/marking locations is shown in Figure 1.

    Note: Samples meeting the exception concentration of 0.08 percent NaOH by weight may be shipped as nonregulated or nonhazardous following the procedure in Section 1.4.

    Note: No marking or labeling can be obscured by strapping or duct tape.

    Note: The inner packaging of dangerous goods must be placed into the designated cooler for shipment. Other nonregulated environmental samples may be added to the cooler for shipment.

22. When shipping from a DOE facility, the cooler will be surveyed by a qualified radiation control technician to ensure that radiation flux on exterior surfaces does not exceed 0.5 mrem/h on all sides. This survey will be documented and the results reviewed by the qualified shipper.

23. Complete the Dangerous Goods and Hazardous Materials Inspection Checklist for Shipping Limited-Quantity (Appendix A).

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24. Complete a Dangerous Goods Airbill.

4.0 Packaging and Shipping Samples Preserved with Hydrochloric Acid

4.1 Containers

The inner packaging container (and amount of preservative) that may be used for these shipments includes:

Excepted Quantities of Hydrochloric Acid Preservatives

Preservative		*Desired in Final Sample*		*Quantity of Preservative (ml) for Specified Container*		
		pH	**Conc.**	**40 ml**	**125 ml**	**250 ml**
HCl	2N	<1.96	0.04%	.2	.5	1

5 drops = 1 ml

4.2 Responsibility

It is the responsibility of the qualified shipper to:

- Determine the samples undergoing shipment contain no other contaminant that meets the definition of hazardous material as defined by DOT
- Determine the amount of preservative in each sample so that accurate determination of quantities can be made

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site-/project-specific quality assurance project plan (QAPP).

4.3 Additional Required Equipment

The following equipment is needed in addition to the required equipment listed in Section 1.3.

- Inner packing may consist of glass or plastic jars no larger than 1 pint.
- Outer packaging (for limited quantities) insulated cooler that has passed the ICAO drop test.
- Survey documentation (if shipping from DOE or radiological sites)
- Class 8 corrosive labels
- Orientation labels
- Consignor/consignee labels

4.4 Packaging Samples Preserved with Hydrochloric Acid

The following steps are to be followed when packaging limited-quantity sample shipments:

1. Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler.

2. All sample containers will be properly labeled and the label protected with waterproof tape before sampling.

   At a minimum the label must contain:

   - Project name
   - Project number
   - Date and time of sample collection
   - Sample location
   - Sample identification number
   - Collector's initials
   - Preservative (note amount of preservative used in miscellaneous section of the chain-of-custody form)

- Wrap each container (40-ml VOA vials) in bubble wrap (secure with waterproof tape) to prevent breakage.

- Place the bubble-wrapped container into a 2.7-mil zip-type bag, removing trapped air.

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- Place wrapped containers inside a polyethylene bottle filled with an absorbent; seal the bottle. (No more than 4 VOA vials will fit inside a 500-ml wide-mouth polyethylene bottle.)
- Total volume of sample inside each cooler must not exceed 1 liter.
- Place sufficient amount of an absorbent in the bottom of the cooler to absorb any leakage that may occur.

3. Place a garbage bag in the cooler.
4. Pack the samples appropriately inside the garbage bag (bottles placed upright) to prevent movement during shipment.
5. Place sufficient amount of double-bagged ice around the samples to maintain the required temperature during shipment.
6. Seal the garbage bag by tieing or taping.
7. The maximum weight of the cooler shall not exceed 30 kg (66 lbs) for any limited-quantity shipment of dangerous goods.
8. Secure the chain-of-custody form (placed inside a zip-type bag) to the interior of the cooler lid.
9. If the shipment is from a DOE or other facility, place the results of the radiation screen and cooler/sample survey with the chain-of-custody.
10. Wrap strapping tape or duct tape around both ends of the cooler and around the cooler lid.
11. Affix custody seals to opposite sides of the cooler lid. Cover the custody seals with clear waterproof tape.
12. Mark the outside of the cooler with the proper shipping name of the contents, corresponding UN number, and LTD. QTY. (as shown below).

    Hydrochloric Acid Solution
    UN1789
    LTD. QTY.

13. Place a label on the front of the cooler with the company name, contact name, phone number, full street address, and state with zip code for both shipper and recipient.
14. Affix a Corrosive label to the outside of the cooler.
15. Affix package orientation labels on two opposite sides of the cooler.
16. Secure the marking and labels to the surface of the cooler with clear waterproof tape to prevent accidental removal during shipment. An example of cooler labeling/marking locations is shown in Figure 1.

    Note: Samples containing less than the exception concentration of 0.04 percent HCl by weight will be shipped as nonregulated or nonhazardous following the procedure in Section 1.4.

    Note: No marking or labeling can be obscured by strapping or duct tape.

    Note: The inner packaging of dangerous goods must be placed into the designated cooler for shipment. Other nonregulated environmental samples may be added to the cooler for shipment.

17. When shipping from a DOE facility, the cooler will be surveyed by a qualified radiation control technician to ensure that radiation flux on exterior surfaces does not exceed 0.5 mrem/h on all sides. This survey will be documented and the results reviewed by the qualified shipper.

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18. Complete the Dangerous Goods and Hazardous Materials Inspection Checklist for Shipping Limited-Quantity (Appendix A).

19. Complete a Dangerous Goods Airbill.

5.0 Packaging and Shipping Samples Preserved with Nitric Acid

5.1 Containers

The inner packaging container (and amount of preservative) that may be used for these shipments includes:

Excepted Quantities of Nitric Acid Preservatives

Preservative		*Desired in Final Sample*		*Quantity of Preservative (ml) for Specified Container*				
		pH	**Conc.**	**40 ml**	**125 ml**	**250 ml**	**500 ml**	**1 L**
HNO_3	6N	<1.62	0.15%		2	4	5	8

5 drops = 1 mg/L

5.2 Responsibility

It is the responsibility of the qualified shipper to:

1. Determine the samples undergoing shipment contain no other contaminant that meets the definition of hazardous material as defined by DOT

2. Determine the amount of preservative in each sample so that accurate determination of quantities can be made

   Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site-/project-specific quality assurance project plan (QAPP).

5.3 Additional Required Equipment

The following equipment is needed in addition to the required equipment listed in Section 1.3:

- Inner packings may consist of glass or plastic jars no larger than 100 ml.
- Outer packaging (for limited quantities) insulated cooler that has passed the ICAO drop test.
- Survey documentation (if shipping from DOE or radiological sites)
- Class 8 corrosive labels
- Orientation labels
- Consignor/consignee labels

5.4 Packaging Samples Preserved with Nitric Acid

Samples containing HNO_3 as a preservative that exceed the excepted concentration of 0.15 percent HNO_3 will be shipped as a limited quantity per packing instruction Y807 of the IATA/ICAO Dangerous Goods Regulations.

The following steps are to be followed when packaging limited-quantity sample shipments:

1. Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler.

2. All sample containers will be properly labeled and the label protected with waterproof tape before sampling.

   At a minimum the label must contain:
   - Project name
   - Project number
   - Date and time of sample collection
   - Sample location
   - Sample identification number
   - Collector's initials
   - Preservative (note amount of preservative used in miscellaneous section of the chain-of-custody form)

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3. This step is optional; wrap each container in bubble wrap (secure with waterproof tape) to prevent breakage.
4. Place the bubble-wrapped container into a 2.7-mil zip-type bag, removing trapped air.
5. Place glass containers inside a polyethylene bottle filled with an absorbent; seal the bottle.
6. Place sufficient amount of an absorbent in the bottom of the cooler to absorb any leakage that may occur.
7. Place a garbage bag in the cooler.
8. Pack the samples appropriately inside the garbage bag (bottles placed upright) to prevent movement during shipment.
9. Place sufficient amount of double-bagged ice around the samples to maintain the required temperature during shipment.
10. Seal the garbage bag by tieing or taping.
11. The maximum volume of preserved solution in the cooler must not exceed 500 ml.
12. The maximum weight of the cooler shall not exceed 30 kg (66 lbs) for any limited-quantity shipment of dangerous goods.
13. Secure the chain-of-custody form (placed inside a zip-type bag) to the interior of the cooler lid.
14. If the shipment is from a DOE or other facility, place the results of the radiation screen and cooler/sample survey with the chain-of-custody.
15. Wrap strapping tape or duct tape around both ends of the cooler and around the cooler lid.
16. Affix custody seals to opposite sides of the cooler lid. Cover the custody seals with clear waterproof tape.
17. Mark the outside of the cooler with the proper shipping name of the contents, corresponding UN number, and LTD. QTY. (as shown below).

    Nitric Acid Solution (with less than 20 percent)
    UN2031
    Ltd. Qty.

18. Place a label on the front of the cooler with the company name, contact name, phone number, full street address, and state with zip code for both shipper and recipient.
19. Affix a Corrosive label to the outside of the cooler.
20. Affix package orientation labels on two opposite sides of the cooler.
21. Secure the marking and labels to the surface of the cooler with clear waterproof tape to prevent accidental removal during shipment. An example of cooler labeling/marking locations is shown in Figure 1.

    Note: Samples meeting the exception concentration of 0.15 percent HNO3 by weight will be shipped as nonregulated or nonhazardous following the procedure in Section 1.4.

    Note: No marking or labeling can be obscured by strapping or duct tape.

    Note: The inner packaging of dangerous goods must be placed into the designated cooler for shipment. Other nonregulated environmental samples may be added to the cooler for shipment.

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22. When shipping from a DOE facility, the cooler will be surveyed by a qualified radiation control technician to ensure that radiation flux on exterior surfaces does not exceed 0.5 mrem/h on all sides. This survey will be documented and the results reviewed by the qualified shipper.

23. Complete the Dangerous Goods and Hazardous Materials Inspection Checklist for Shipping Limited-Quantity (Appendix A).

24. Complete a Dangerous Goods Airbill.

6.0 Packaging and Shipping Samples Preserved with Sulfuric Acid

6.1 Containers

The inner packaging container (and amount of preservative) that may be used for these shipments includes:

Excepted Quantities of Sulfuric Acid Preservatives

Preservative		***Desired in Final Sample***		***Quantity of Preservative (ml) for Specified Container***				
		pH	**Conc.**	**40 ml**	**125 ml**	**250 ml**	**500 ml**	**1 L**
H_2SO_4	37N	<1.15	0.35%	.1	.25	0.5	1	2

5 drops = 1 ml

6.2 Responsibility

It is the responsibility of the qualified shipper to:

1. Determine the samples undergoing shipment contain no other contaminant that meets the definition of hazardous material as defined by DOT

2. Determine the amount of preservative in each sample so that accurate determination of quantities can be made

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site-/project-specific quality assurance project plan (QAPP).

6.3 Additional Required Equipment

The following equipment is needed in addition to the required equipment listed in Section 1.3:

- Inner packings may consist of glass or plastic jars no larger than 100 ml.
- Outer packaging (for limited quantities) insulated cooler that has passed the ICAO drop test.
- Survey documentation (if shipping from DOE or radiological sites)
- Class 8 corrosive labels
- Orientation labels
- Consignor/consignee labels

6.4 Packaging of Samples Preserved with Sulfuric Acid

Samples containing H_2SO_4 as a preservative that exceed the excepted concentration of 0.35 percent will be shipped as a limited quantity per packing instruction Y809 of the IATA/ICAO Dangerous Goods Regulations.

The following steps are to be followed when packaging limited-quantity samples shipments:

1. Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler.

2. All sample containers will be properly labeled and the label protected with waterproof tape before sampling.

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At a minimum the label must contain:

- Project name
- Project number
- Date and time of sample collection
- Sample location
- Sample identification number
- Collector's initials
- Preservative (note amount of preservative used in miscellaneous section of the chain-of-custody form)

3. Wrap each glass container in bubble wrap (secure with waterproof tape) to prevent breakage.

4. Place the bubble-wrapped container into a 2.7-mil zip-type bag, removing trapped air.

5. Place glass containers inside a polyethylene bottle filled with an absorbent; seal the bottle.

6. Place sufficient amount of an absorbent in the bottom of the cooler to absorb any leakage that may occur.

7. Place a garbage bag in the cooler.

8. Pack the samples appropriately inside the garbage bag (bottles placed upright) to prevent movement during shipment.

9. Place sufficient amount of double-bagged ice around the samples to maintain the required temperature during shipment.

10. Seal the garbage bag by tieing or taping.

11. The maximum volume of preserved solution in the cooler must not exceed 500 ml.

12. The maximum weight of the cooler shall not exceed 30 kg (66 lbs) for any limited-quantity shipment of dangerous goods.

13. Secure the chain-of-custody form (placed inside a zip-type bag) to the interior of the cooler lid.

14. If the shipment is from a DOE or other facility, place the results of the radiation screen and cooler/sample survey with the chain-of-custody.

15. Wrap strapping tape or duct tape around both ends of the cooler and around the cooler lid.

16. Affix custody seals to opposite sides of the cooler lid. Cover the custody seals with clear waterproof tape.

17. Mark the outside of the cooler with the proper shipping name of the contents, corresponding UN number, and LTD. QTY. (as shown below).

    Sulfuric Acid Solution
    UN2796
    LTD. QTY.

18. Place a label on the front of the cooler with the company name, contact name, phone number, full street address, and state with zip code for both shipper and recipient.

19. Affix a Corrosive label to the outside of the cooler.

20. Affix package orientation labels on two opposite sides of the cooler.

21. Secure the marking and labels to the surface of the cooler with clear waterproof tape to prevent accidental removal during shipment. An example of cooler labeling/marking locations is shown in Figure 1.

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Note: Samples containing less than the exception concentration of 0.35 percent H2SO4 by weight will be shipped as nonregulated or nonhazardous in accordance with the procedure described in Section 1.4.

Note: No marking or labeling can be obscured by strapping or duct tape.

Note: The inner packaging of dangerous goods must be placed into the designated cooler for shipment. Other nonregulated environmental samples may be added to the cooler for shipment.

22. When shipping from a DOE facility, the cooler will be surveyed by a qualified radiation control technician to ensure that radiation flux on exterior surfaces does not exceed 0.5 mrem/h on all sides. This survey will be documented and the results reviewed by the qualified shipper.

23. Complete the Dangerous Goods and Hazardous Materials Inspection Checklist for Shipping Limited-Quantity (Appendix A).

24. Complete a Dangerous Goods Airbill.

7.0 Packaging and Shipping Limited-Quantity Radioactive Samples

7.1 Containers

The inner packaging containers that may be used for these shipments include:

1. Any size sample container

7.2 Description/Responsibilities

The qualified shipper will determine that the samples undergoing shipment contain no other contaminant that meets the definition of hazardous material as defined by DOT.

The qualified shipper will ship all samples that meet the Class 7 definition of radioactive materials and meet the activity requirements specified in Table 7 of 49 CFR 173.425, as Radioactive Materials in Limited Quantity. The qualified shipper will verify that all packages and their contents meet the requirements of 49 CFR 173.421, *Limited Quantities of Radioactive Materials*.

The packaging used for shipping will meet the general requirements for packaging and packages specified in 49 CFR 173.24 and the general design requirements provided in 173.410. These standards state that a package must be capable of withstanding the effects of any acceleration, vibration, or vibration resonance that may arise under normal condition of transport without any deterioration in the effectiveness of the closing devices on the various receptacles or in the integrity of the package as a whole and without loosening or unintentionally releasing the nuts, bolts, or other securing devices even after repeated use.

If the shipment is from a DOE facility, radiological screenings will be completed on all samples taken. The qualified shipper will review the results of each screening (alpha, beta, and gamma speciation). Samples will not be shipped offsite until the radiological screening has been performed.

The total activity for each package will not exceed the relevant limits listed in Table 7 of 49 CFR 173.425. The A_2 value of the material will be calculated based on all radionuclides found during previous investigations (if any) in the area from which the samples are derived. The A_2 values to be used will be the most restrictive of all potential radionuclides as listed in 49 CFR 173.435.

The radiation level at any point on the external surface of the package bearing the sample(s) will not exceed 0.005 mSv/hour (0.5 mrem/hour). These will be verified by dose and activity monitoring before shipment of the package.

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The removable radioactive surface contamination on the external surface of the package will not exceed the limits specified in 49 CFR 173.443(a). CDM Smith will apply the DOE-established free release criteria for removable surface contamination of less than 20 dpm/100 cm^2 (alpha) and 1,000 dpm/100 cm^2 (beta/gamma). It shall be noted that these values are more conservative than the DOT requirements for removable surface contamination.

The qualified shipper will verify that the outside of the inner packaging is marked "Radioactive."

The qualified shipper will verify that the excepted packages prepared for shipment under the provisions of 49 CFR 173.421 have a notice enclosed, or shown on the outside of the package, that reads, **"This package conforms to the conditions and limitations specified in 49 CFR 173.421 for radioactive material, excepted package-limited quantity of material, UN2910."**

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site-/project-specific quality assurance project plan (QAPP).

7.3 Additional Required Equipment

The following equipment is needed in addition to the required equipment listed in Section 1.3:

- Survey documentation/radiation screening results (if shipping from DOE or radiological sites)
- Orientation labels
- Excepted quantities label
- Consignor/consignee labels

7.4 Packaging of Limited-Quantity Radioactive Samples

The following steps are to be followed when packaging limited-quantity sample shipments:

1. The cooler is to be surveyed by a qualified radiation control technician to ensure that radiation flux on exterior surfaces does not exceed 0.5 mrem/h on all sides. This survey will be documented and the results reviewed by the qualified shipper.

2. Tape any interior opening in the cooler (drain plug) from the inside to ensure control of interior contents. Also, tape the drain plug from the outside of the cooler.

3. All sample containers will be properly labeled and the label protected with waterproof tape before sampling. At a minimum the label must contain:

   - Project name
   - Project number
   - Date and time of sample collection
   - Sample location
   - Sample identification number
   - Collector's initials

4. This step is optional; wrap each container in bubble wrap (secure with waterproof tape) to prevent breakage.

5. Place sufficient amount of an absorbent, or approved packaging material, in the bottom of the cooler to absorb any leakage that may occur.

6. Place a garbage bag in the cooler.

7. Pack the samples appropriately inside the garbage bag (bottles placed upright) to prevent movement during shipment.

8. If required, place a sufficient amount of double-bagged ice around the samples to maintain the required temperature during shipment.

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9. Seal the garbage bag by tieing or taping.

10. Place a label marked Radioactive on the outside of the sealed bag.

11. Enclose a notice that includes the name of the consignor or consignee and the following statement: ***"This package conforms to the conditions and limitations specified in 49 CFR 173.421 for radioactive material, excepted package-limited quantity of material, UN2910."***

12. Note that both DOT and IATA apply different limits to the quantity in the inside packing and in the outside packing.

13. The maximum weight of the package shall not exceed 30 kg (66 lbs) for any limited-quantity shipment of dangerous goods.

14. Secure the chain-of-custody form (placed inside a zip-type bag) to the interior of the cooler lid.

15. If the shipment is from a DOE or other facility, place the results of the radiation screen and cooler/sample survey with the chain-of-custody.

16. If a cooler is used, wrap strapping tape or duct tape around both ends of the cooler and around the cooler lid.

17. Affix custody seals to opposite sides of the cooler lid. Cover the custody seals with clear waterproof tape.

18. Place a label on the front of the cooler with the company name, contact name, phone number, full street address, and state with zip code for both shipper and recipient.

19. Affix package orientation labels on two opposite sides of the cooler/package.

20. Affix a completed Excepted Quantities label to the side of the cooler/package.

21. Secure any marking and labels to the surface of the cooler with clear waterproof tape to prevent accidental removal during shipment. An example of the cooler labeling/marking is shown in Figure 2.

    Note: No marking or labeling can be obscured by strapping or duct tape.

22. Complete the Shipment Quality Assurance Checklist (Appendix B).

    Note: Except as provided in 49 CFR 173.426, the package will not contain more than 15 grams of ^{235}U.

    Note: A declaration of dangerous goods is not required.

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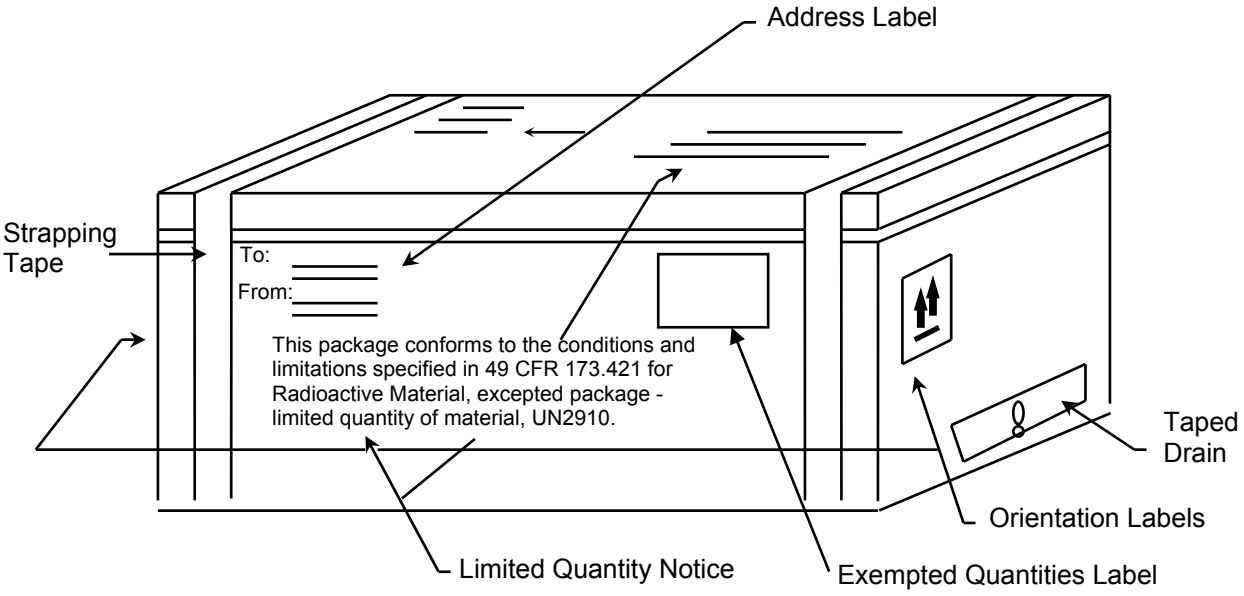
Figure 2
Radioactive Material – Limited-Quantity Cooler Marking Example



8.0 References

U. S. Environmental Protection Agency. Region IV. February 1991 or current revision. *Standard Operating Procedures and Quality Assurance Manual*.

_____. 2007 or current revision. *Sampler's Guide, Contract Laboratory Program, Guidance for Field Samplers*, EPA-540-R-07-06.

Title 49 Code of Federal Regulations, Department of Transportation. 2005 or current revision. *Hazardous Materials Table, Special Provisions, Hazardous, Materials Communications, Emergency Response Information, and Training Requirements*, 49 CFR 172.

Title 49 Code of Federal Regulations, Department of Transportation. 2005 or current revision. *Shippers General Requirements for Shipments and Packagings*, 49 CFR 173.

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Appendix A

Dangerous Goods and Hazardous Materials Inspection Checklist for Shipping Limited-Quantity

Sample Packaging

Yes	No	N/A	
☐	☐	☐	The VOA vials are wrapped in bubble wrap and placed inside a zip-type bag.
☐	☐	☐	The VOA vials are placed into a polyethylene bottle, filled with an absorbent, and tightly sealed.
☐	☐	☐	The drain plug is taped inside and outside to ensure control of interior contents.
☐	☐	☐	The samples have been placed inside garbage bags with sufficient bags of ice to preserve samples at 4°C.
☐	☐	☐	The cooler weighs less than the 66-pound limit for limited-quantity shipment.
☐	☐	☐	The garbage bag has been sealed with tape (or tied) to prevent movement during shipment.
☐	☐	☐	The chain-of-custody has been secured to the interior of the cooler lid.
☐	☐	☐	The cooler lid and sides have been taped to ensure a seal.
☐	☐	☐	The custody seals have been placed on both the front and back hinges of the cooler, using waterproof tape.

Air Waybill Completion

Yes	No	N/A	
☐	☐	☐	Section 1 has the shipper's name, company, and address; the account number, date, internal billing reference number; and the telephone number where the shipper can be reached.
☐	☐	☐	Section 2 has the recipient's name and company along with a telephone number where they can be reached.
☐	☐	☐	Section 3 has the **Bill Sender** box checked.
☐	☐	☐	Section 4 has the **Standard Overnight** box checked.
☐	☐	☐	Section 5 has the **Deliver Weekday** box checked.
☐	☐	☐	Section 6 has the number of packages and their weights filled out. Was the total of all packages and their weights figured up and added at the bottom of Section 6?
☐	☐	☐	Under the **Transport Details** box, the **Cargo Aircraft Only** box is obliterated, leaving only the **Passenger and Cargo Aircraft** box.
☐	☐	☐	Under the **Shipment Type**, the **Radioactive** box is obliterated, leaving only the **Non-Radioactive** box.
☐	☐	☐	Under the **Nature and Quantity of Dangerous Goods** box, the **Proper Shipping Name, Class or Division, UN or ID No., Packing Group, Subsidiary Risk, Quantity and Type of Packing, Packing Instructions, and Authorization** have been filled out for the type of chemical being sent.
☐	☐	☐	The **Name, Place and Date, Signature, and Emergency Telephone Number** appears at the bottom of the FedEx Airbill.
☐	☐	☐	The statement "In accordance with IATA/ICAO" appears in the **Additional Handling Information** box.
☐	☐	☐	The E**mergency Contact Information** at the bottom of the FedEx Airbill is truly someone who can respond any time of the day or night.

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Proper Shipping Name	*Class or Division*	*UN or ID No.*	*Packing Group*	*Sub Risk*	*Quantity*	*Packing Instruction*	*Authorization*
Hydrochloric Acid Solution	8	UN1789	II		1 plastic box × 0.5 L	Y809	Ltd. Qty.
Nitric Acid Solution (with less than 20%)	8	UN2031	II		1 plastic box × 0.5 L	Y807	Ltd. Qty.
Sodium Hydroxide Solution	8	UN1824	II		1 plastic box × 0.5 L	Y809	Ltd. Qty.
Sulfuric Acid Solution	8	UN2796	II		1 plastic box × 0.5 L	Y809	Ltd. Qty.
Methanol	3	UN1230	II		1 plastic box × 1 L	Y305	Ltd. Qty.

Sample Cooler Labeling

Yes	No	N/A	
☐	☐	☐	The proper shipping name, UN number, and Ltd. Qty. appears on the shipping container.
☐	☐	☐	The corresponding hazard labels are affixed on the shipping container; the labels are not obscured by tape.
☐	☐	☐	The name and address of the shipper and receiver appear on the top and side of the shipping container.
☐	☐	☐	The air waybill is attached to the top of the shipping container.
☐	☐	☐	**Up Arrows** have been attached to opposite sides of the shipping container.
☐	☐	☐	Packaging tape does not obscure markings or labeling.

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Appendix B

Shipment Quality Assurance Checklist

Date: _____ Shipper: _____ Destination: _____

Item(s) Description: _____

Radionuclide(s): _____

Radiological Survey Results: surface _____mrem/hr 1 meter _____

Instrument Used: Mfgr: _____ Model: _____

S/N: _____ Cal Date: _____

Limited-Quantity or Instrument and Article

Yes	No		
___	___	1.	Strong tight package (package that will not leak material during conditions normally incidental to transportation).
___	___	2.	Radiation levels at any point on the external surface of package less than or equal to 0.5 mrem/hr.
___	___	3.	Removable surface contamination less than 20 dpm/100 cm^2 (alpha) and 1,000 dpm/100 cm^2 (beta/gamma).
___	___	4.	Outside inner package bears the marking “Radioactive.”
___	___	5.	Package contains less than 15 grams of ^{235}U (check yes if ^{235}U not present).
___	___	6.	Notice enclosed in or on the package that includes the consignor or consignee and the statement, **“This package conforms to the conditions and limitations specified in 49 CFR 173.421 for radioactive material, excepted package-limited quantity of material, UN2910.”**
___	___	7.	Activity less than that specified in 49 CFR 173.425. Permissible package limit: Package Quantity:
___	___	8.	On all air shipments, the statement **Radioactive Material, excepted package-limited quantity of material** shall be noted on the air waybill.

Qualified Shipper: _____ Signature: _____

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Field Logbook Content and Control

SOP 4-1
Revision: 7
Date: January 2012

Prepared: Del Baird

Technical Review: Laura Splichal

QA Review: Jo Nell Mullins

Approved:

Signature/Date

Issued:

Signature/Date

1.0 Objective

The objective of this technical standard operating procedure (SOP) is to set criteria for content entry and form of field logbooks. Field logbooks are an essential tool to document field activities for historical and legal purposes.

2.0 Background

2.1 Definitions

Biota - The flora and fauna of a region.

Magnetic Declination Corrections - Compass adjustments to correct for the angle between magnetic north and geographical meridians.

2.2 Discussion

Information recorded in field logbooks includes field team names; observations; data; calculations; date/time; weather; and description of the data collection activity, methods, instruments, and results. Additionally, the logbook may contain deviations from plans and descriptions of wastes, biota, geologic material, and site features including sketches, maps, or drawings as appropriate.

3.0 General Responsibilities

Field Team Leader (FTL) - The FTL is responsible for ensuring that the format and content of data entries are in accordance with this procedure.

Site Personnel - All CDM Smith employees who make entries in field logbooks during onsite activities are required to read this procedure before engaging in this activity. The FTL will assign field logbooks to site personnel who will be responsible for their care and maintenance. Site personnel will return field logbooks to the records file at the end of the assignment.

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities should be defined in the field plan or site-/project-specific quality assurance plan.

4.0 Required Equipment

- Site-specific plans
- Field logbook
- Indelible black or blue ink pen
- Ruler or similar scale

5.0 Procedures

5.1 Preparation

In addition to this SOP, site personnel responsible for maintaining logbooks must be familiar with all procedures applicable to the field activity being performed. These procedures should be consulted as necessary to obtain specific information about equipment and supplies, health and safety, sample collection, packaging, decontamination, and documentation. These procedures should be located at the field office or vehicle for easy reference.

Field logbooks shall be bound with lined, consecutively numbered pages. All pages must be numbered before initial use of the logbook. Before use in the field, each logbook will be marked with a specific document control number issued by the document control administrator, if required by the contract quality implementation plan (QIP). Not all contracts require document control numbers. The following information shall be recorded on the cover of the logbook:

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- Field logbook document control number (if applicable).
- Activity (if the logbook is to be activity-specific), site name, and location.
- Name of CDM Smith contact and phone number(s) (typically the project manager).
- Start date of entries.
- End date of entries.
- In specific cases, special logbooks may be required (e.g., waterproof paper for stormwater monitoring).

The first few (approximately five) pages of the logbook will be reserved for a table of contents (TOC). Mark the first page with the heading and enter the following:

Table of Contents

Date/Description	Pages
(Start Date)/Reserved for TOC	1-5

The remaining pages of the table of contents will be designated as such with "TOC" written on the top center of each page. The table of contents should be completed as activities are completed and before placing the logbook in the records file.

5.2 Operation

Requirements that must be followed when using a logbook:

- Record work, observations, quantities of materials, calculations, drawings, and related information directly in the logbook. If data collection forms are specified by an activity-specific plan, this information does not need to be duplicated in the logbook. However, any forms used to record site information must be referenced in the logbook.
- Do not start a new page until the previous one is full or has been marked with a single diagonal line so that additional entries cannot be made. Use both sides of each page.
- Do not erase or blot out any entry at any time. Indicate any deletion by a single line through the material to be deleted. Initial and date each deletion. Take care to not obliterate what was written previously.
- Do not remove any pages from the book.

Specific requirements for field logbook entries include:

- Initial and date each page.
- Sign and date the final page of entries for each day.
- Initial and date all changes.
- Multiple authors must sign out the logbook by inserting the following:
  Above notes authored by:
  - (Sign name)
  - (Print name)
  - (Date)
- A new author must sign and print his/her name before additional entries are made.
- Draw a diagonal line through the remainder of the final page at the end of the day.
- Record the following information on a daily basis:
  - Date and time
  - Name of individual making entry
  - Names of field team and other persons onsite
  - Description of activity being conducted including station or location (i.e., well, boring, sampling location number) if appropriate
  - Weather conditions (i.e., temperature, cloud cover, precipitation, wind direction, and speed) and other pertinent data
  - Level of personal protection used
  - Serial numbers of instruments
  - Equipment calibration information
  - Serial/tracking numbers on documentation (e.g., carrier air bills)

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Entries into the field logbook shall be preceded with the time (written in military units) of the observation. The time should be recorded frequently and at the point of events or measurements that are critical to the activity being logged. All measurements made and samples collected must be recorded unless they are documented by automatic methods (e.g., data logger) or on a separate form required by an operating procedure. In these cases, the logbook must reference the automatic data record or form.

At each station where a sample is collected or an observation or measurement made, a detailed description of the location of the station is required. Use a compass (include a reference to magnetic declination corrections), scale, or nearby survey markers, as appropriate. A sketch of station location may be warranted. All maps or sketches made in the logbook should have descriptions of the features shown and a direction indicator. It is preferred that maps and sketches be oriented so that north is toward the top of the page. Maps, sketches, figures, or data that will not fit on a logbook page should be referenced and attached to the logbook to prevent separation.

Other events and observations that should be recorded include:

- Changes in weather that impact field activities.
- Deviations from procedures outlined in any governing documents. Also record the reason for any noted deviation.
- Problems, downtime, or delays.
- Upgrade or downgrade of personal protection equipment.
- Visitors to the site.

5.3 Post-Operation

To guard against loss of data as a result of damage or disappearance of logbooks, completed pages shall be periodically photocopied (weekly, at a minimum) and forwarded to the field or project office. Other field records shall be photocopied and submitted regularly and as promptly as possible to the office. When possible, electronic media such as disks and tapes should be copied and forwarded to the project office.

At the conclusion of each activity or phase of site work, the individual responsible for the logbook will ensure that all entries have been appropriately signed and dated and that corrections were made properly (single lines drawn through incorrect information, then initialed and dated). The completed logbook shall be submitted to the records file.

6.0 Restrictions/Limitations

Field logbooks constitute the official record of onsite technical work, investigations, and data collection activities. Their use, control, and ownership are restricted to activities pertaining to specific field operations carried out by CDM Smith personnel and their subcontractors. They are documents that may be used in court to indicate dates, personnel, procedures, and techniques employed during site activities. Entries made in these logbooks should be factual, clear, precise, and nonsubjective. Field logbooks, and entries within, are not to be used for personal use.

7.0 References

Sandia National Laboratories. 1991. *Procedure for Preparing Sampling and Analysis Plan, Site-Specific Sampling Plan, and Field Operating Procedures,* QA-02-03. Albuquerque Environmental Program, Department 3220, Albuquerque, New Mexico.

Sandia National Laboratories. 1992. *Field Operation Procedure for Field Logbook Content and Control*. Environmental Restoration Department, Division 7723, Albuquerque, New Mexico.

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Photographic Documentation of Field Activities

SOP 4-2
Revision: 8
Date: January 2012

Prepared:	David O. Johnson	**Technical Review:**	Sharon Budney
QA Review:	Jo Nell Mullins	**Approved:**	*Signature/Date*
Issued:	*Signature/Date*		

1.0 Objective

The purpose of this technical standard operating procedure (SOP) is to provide standard guidelines and methods for photographic documentation, which include still and digital photography and videotape or DVD recordings of field activities and site features (geologic formations, core sections, lithologic samples, water samples, general site layout, etc.). This document shall provide guidelines designed for use by a professional or amateur photographer. This SOP is intended for circumstances when formal photographic documentation is required. Based on project requirements, it may not be applicable for all photographic activities.

2.0 Background

2.1 Definitions

Photographer - A photographer is the camera operator (professional or amateur) of still photography, including digital photography, or videotape or digital versatile discs (DVD) recording whose primary function with regard to this SOP is to produce documentary or data-oriented visual media.

Identifier Component - Identifier components are visual components used within a photograph such as visual slates, reference markers, and pointers.

Standard Reference Marker - A standard reference marker is a reference marker that is used to indicate a feature size in the photograph and is a standard length of measure, such as a ruler, meter stick, etc. In limited instances, if a ruled marker is not available or its use is not feasible, it can be a common object of known size placed within the visual field and used for scale.

Slates - Slates are blank white index cards or paper used to present information pertaining to the subject/procedure being photographed. Letters and numbers on the slate will be bold and written with black indelible marking pens.

Arrows and Pointers - Arrows and pointers are markers/pointers used to indicate and/or draw attention to a special feature within the photograph.

Contrasting Backgrounds - Contrasting backgrounds are backdrops used to lay soil samples, cores, or other objects on for clearer viewing and to delineate features.

Data Recording Camera Back - A data recording camera back is a camera attachment or built-in feature that will record, at the very least, frame numbers and dates directly on the film.

2.2 Associated Procedures

- SOP 4-1, *Field Logbook Content and Control*

2.3 Discussion

Photographs and videotape or DVD recordings made during field investigations are used as an aid in documenting and describing site features, sample collection activities, equipment used, and possible lithologic interpretation. This SOP is designed to illustrate the format and desired placement of identifier components, such as visual slates, standard reference markers, and pointers. These items shall become an integral part of the “visual media” that, for the purpose of this document, shall encompass still photographs, digital photographs, videotape recordings (or video footage), and recordings

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on DVDs. The use of a photographic logbook and standardized entry procedures are also outlined. These procedures and guidelines will minimize potential ambiguities that may arise when viewing the visual media and ensure the representative nature of the photographic documentation.

3.0 General Responsibilities

Field Team Leader - The field team leader (FTL) is responsible for ensuring that the format and content of photographic documentation are in accordance with this procedure. The FTL is responsible for directing the photographer to specific situations, site features, or operations that the photographer will be responsible for documenting.

Photographer - The photographer shall seek direction from the FTL and regularly discuss the visual documentation requirements and schedule. The photographer is responsible for maintaining a logbook per Sections 5.1, 5.2.4, and 5.3.1 of this SOP. Responsibilities will be defined in the project sampling plan.

Note: Responsibilities may vary from site to site. Therefore, all field team member responsibilities shall be defined in the field plan or site/quality assurance project plan (QAPP).

4.0 Required Equipment

A general list of equipment that may be used:

- 35mm camera or disposable single use camera (35mm or panoramic use)
- Digital camera
- Extra batteries for 35mm camera
- Video camera and appropriate storage media (e.g., video tapes, DVDs)
- Logbook
- Indelible black or blue ink pen
- Standard reference markers
- Slates
- Arrows or pointers
- Contrasting backgrounds
- Medium speed, or multi purpose fine-grain, color, 35mm negative film or slide film (project dependent)
- Data recording camera back (if available)
- Storage medium for digital camera

5.0 Procedures

5.1 Documentation

A commercially available, bound logbook will be used to log and document photographic activities. Review SOP 4-1, *Field Logbook Content and Control* and prepare all supplies needed for logbook entries.

Note: A separate photographic logbook is not required. A portion of the field logbook may be designated as the photographic log and documentation section.

Field Health and Safety Considerations

There are no hazards that an individual will be exposed to specific to photographic documentation. However, site-specific hazards may arise depending on location or operation. Personal protective equipment used in this operation will be site-specific and dictated through requirements set by the site safety officer, site health and safety plan, and/or prescribed by the CDM Smith Corporate Health and Safety Program. The photographer should contact the site safety officer for health and safety orientation before commencing field activities. The site health and safety plan must be read before entry to the site, and all individuals must sign the appropriate acknowledgement that this has been done.

The photographer should be aware of any potential physical hazards while photographing the subject (e.g., traffic, low overhead hazard, edge of excavation).

5.2 Operation

5.2.1 General Photographic Activities in the Field

The following sections provide general guidelines that should be followed to visually document field activities and site features using still/digital cameras and video equipment. Listed below are general suggestions that the photographer should consider when performing activities under this SOP:

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- The photographer should be prepared to make a variety of shots, from close-up to wide-angle. Many shots will be repetitive in nature or format, especially close-up site feature photographs. Consideration should therefore be given to designing a system or technique that will provide a reliable repetition of performance.

- All still film photographs should be made using a medium speed, or multi purpose fine-grain, color negative film in the 35mm format unless otherwise directed by the FTL.

- It is suggested that Kodak brand "Ektapress Gold Deluxe" film or equivalent be used as the standard film for the still photography requirements of the field activities. This film is stable at room temperature after exposure and will better survive the time lag between exposure and processing. It is suggested that film speed ASA 100 should be used for outdoor photographs in bright sunlight, ASA 200 film should be used in cloudy conditions, and ASA 400 film should be used indoors or for very low-light outdoor photographs.

- No preference of videotape or DVD brand along with digital storage medium is specified and is left to the discretion of the photographer.

- The lighting for sample and feature photography should be oriented toward a flat condition with little or no shadow. If the ambient lighting conditions are inadequate, the photographer should be prepared to augment the light (perhaps with reflectors or electronic flash) to maintain the desired visual effect.

- Digital cameras have multiple photographic quality settings. A camera that obtains a higher resolution (quality) has a higher number of pixels and will store a fewer number of photographs per digital storage medium.

5.2.2 General Guidelines for Still Photography

Slate Information

It is recommended that each new roll of film or digital storage medium shall contain on the first usable frame (for film) a slate with consecutively assigned control numbers (a consecutive, unique number that is assigned by the photographer as in sample numbers).

Caption Information

All still photographs will have a full caption permanently attached to the back or permanently attached to a photo log sheet. The caption should contain the following information (digital photographs should have a caption added after the photographs are downloaded):

- Film roll control number (if required) and photograph sequence number
- Date and time
- Photographer
- Description of activity/item shown (e.g., name of facility/site, specific project name, project number)
- Direction (if applicable)

When directed by the sampling plan, a standard reference marker should be used in all documentary visual media. While the standard reference marker will be predominantly used in close-up feature documentation, inclusion in all scenes should be considered.

Digital media should be downloaded at least once each day to a personal computer; the files should be in either "JPEG" or "TIFF" format. Files should be renamed at the time of download to correspond to the logbook. It is recommended the electronic files be copied to a compact disc for backup.

Close-Up and Feature Photography

When directed by the sampling plan, close-up photographs should include a standard reference marker of appropriate size as an indication of the feature size and contain a slate marked with the site name and any identifying label, such as a well number or core depth, that clearly communicates to the viewer the specific feature being photographed.

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Feature samples, core pieces, and other lithologic media should be photographed as soon as possible after they have been removed from their in situ locations. This enables a more accurate record of their initial condition and color. When directed by the sampling plan, include a standard reference color strip (color chart such as Munsell Soil Color Chart or that available from Eastman Kodak Co.) within the scene. This is to be included for the benefit of the viewer of the photographic document and serves as a reference aid to the viewer for formal lithologic observations and interpretations.

Site Photography
Site photography, in general, will consist predominantly of medium- and wide-angle shots. A standard reference marker should be placed adjacent to the feature or, when this is not possible, within the same focal plane.

While it is encouraged that a standard reference marker and caption/slate be included in the scene, it is understood that situations will arise that preclude their inclusion within the scene. This will be especially true of wide-angle shots. In such a case, the film/tape control number shall be entered in the photographic logbook along with the frame number and all other information pertinent to the scene.

Panoramic
In situations where a wide-angle lens does not provide sufficient subject detail, a single-use disposable panoramic camera is recommended. If this type of camera is not available, a panoramic series of two or three photos would be appropriate. Panoramas can provide greater detail while covering a wide subject, such as an overall shot of a site.

To shoot a panoramic series using a standard 35mm or digital camera, the following procedures are recommended:

- Use a stable surface or tripod to support the camera
- Allow a 20- to 30-percent overlap while maintaining a uniform horizon
- Complete two to three photos per series

5.2.3 General Photographic Documentation Using Video Cameras
As a reminder, it is not within the scope of this document to set appropriate guidelines for presentation or “show” videotape or DVD recording. The following guidelines are set for documentary videotape or DVD recordings only and should be implemented at the discretion of the site personnel.

Documentary videotape or DVD recordings of field activities may include an audio slate for all scenes. At the beginning of each video session, an announcer will recite the following information: date, time (in military units), photographer, site ID number, and site location. This oral account may include any additional information clarifying the subject matter being recorded.

A standard reference marker may be used when taking close-up shots of site features with a video camera. The scene may also include a caption/slate. It should be placed adjacent and parallel to the feature being photographed.

It is recommended that a standard reference marker and caption/slate be included in all scenes. The caption information is vital to the value of the documentary visual media and should be included. If it is not included within the scene, it should be placed before the scene.

Original video recordings will not be edited. This will maintain the integrity of the information contained on the videotape or DVD. If editing is desired, a working copy of the original video recording can be made.

A label should be placed on the videotape or DVD with the appropriate identifying information (project name, project number, date, location, etc.).

5.2.4 Photographic Documentation
Photographic activities must be documented in a photographic logbook or in a section of the field logbook. The photographer will be responsible for making proper entries.

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In addition to following the technical standards for logbook entry as referenced in SOP 4-1, the following information should be maintained in the appropriate logbook:

- Photographer name.
- If required, an entry shall be made for each new roll/tape/DVD control number assigned.
- Sequential tracking number for each photograph taken (for digital cameras, the camera-generated number may be used).
- Date and time (military time).
- Location.
- A description of the activity/item photographed.
- If needed, a description of the general setup, including approximate distance between the camera and the subject, may be recorded in the logbook.
- Record as much other information as possible to assist in the identification of the photographic document.

5.3 Post Operation

All film will be sent for development and printing to a photographic laboratory (to be determined by the photographer). The photographer will be responsible for arranging transport of the film from the field to the photographic laboratory. The photographer shall also be responsible for arranging delivery of the negatives and photographs, digital storage medium, or videotape or DVD to the project management representative to be placed in the project files.

5.3.1 Documentation

At the end of each day's photographic session, the photographer(s) will ensure that the appropriate logbook has been completely filled out and maintained as outlined in SOP 4-1.

5.3.2 Archive Procedures

- Photographs and the associated set of uncut negatives, digital media, and original unedited documentary video recordings will be submitted to the project files and handled according to contract records requirements. The project manager will ensure their proper distribution.

- Completed pages of the appropriate logbook will be copied weekly and submitted to the project files.

6.0 Restrictions/Limitations

This document is designed to provide a set of guidelines for the field amateur or professional photographer to ensure that an effective and standardized program of visual documentation is maintained.

It is not within the scope of this document to provide instruction in photographic procedures, nor is it within the scope of this document to set guidelines for presentation or "show" photography.

The procedures outlined herein are general by nature. The photographer is responsible for specific operational activity or procedure. Questions concerning specific procedures or requirements should be directed to the project manager or FTL.

Note: Some sites do not permit photographic documentation. Check with the site contact for any restrictions.

7.0 References

U. S. Army Corps of Engineers. 2001. *Requirements for the Preparation of Sampling and Analysis Plans*, EM 200-1-3. Appendix F. February.

U. S. Environmental Protection Agency. 1992. National Enforcement Investigations Center. *Multi-Media Investigation Manual*, EPA-330/9-89-003-R. p. 85. Revised March.

_____. Region IV. 2001. *Environmental Investigations Standard Operating Procedures and Quality Assurance Manual*. Athens, Georgia. November.

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Environmental Data Management

SOP 4-8
Revision: 2
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1.0 Objective

The objective of this technical standard operating procedure (SOP) is to provide instruction to data managers, technical staff, and project managers in preparing an environmental project data management plan. The data management plan identifies and documents a project's requirements and responsibilities for managing and using environmental information. Details determined and provided in the data management plan must clearly define:

- Data types the project will generate and use
- Responsibilities for activities associated with information management
- How the project data will be managed
- When data transfers will occur and who will provide and receive data

Additionally, this SOP defines the technical approach for data management activities associated with the collection and analysis of environmental data.

2.0 Background

The data management plan must be completed at the beginning of the project lifecycle. This ensures that the necessary environmental data management systems and personnel are identified and in place before the initiation of data collection. Reviews and updates of the data management plan must also be completed as necessary.

The data management plan only addresses the management of a project's environmental information. Environmental information includes electronic and hardcopy records that document environmental processes and conditions and are used to support the project objectives related to environmental and remedial decisions. Information generated by the project activities (e.g., chemical, physical) and information obtained from outside sources (e.g., historical data) are managed within the scope of the data management plan. Information such as human resources and financial records are not within the scope of the data management plan.

Project managers, technical staff, and data coordinators have the responsibility for developing the data management plan. Additional staff (e.g., field team leaders, data users) shall also be involved in the data management plan generation as necessary. The minimum project data requirements will depend on the statement of work for individual projects. The project team shall work together to identify project data management requirements, define the environmental data collection and handling process, and define the project data management responsibilities. The process to generate a data management plan is provided in Section 4.0.

2.1 Associated Procedures

All SOPs used to collect environmental data are subject to the procedures and processes presented in this SOP. These include:

- SOP 1-1, *Surface Water Sampling*
- SOP 1-2, *Sample Custody*
- SOP 1-3, *Surface Soil Sampling*
- SOP 1-4, *Subsurface Soil Sampling*
- SOP 1-5, *Groundwater Sampling Using Bailers*
- SOP 1-6, *Water Level Measurement*

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- SOP 1-7, *Wipe Sampling*
- SOP 1-8, *Volatile Organic Compound Air Sampling Using USEPA Method TO-15 with SUMMA® Canister*
- SOP 1-9, *Tap Water Sampling*
- SOP 1-10, *Field Measurement of Organic Vapors*
- SOP 1-11, *Sediment/Sludge Sampling*
- SOP 2-1, *Packaging and Shipping Environmental Samples*
- SOP 3-1, *Geoprobe Sampling*
- SOP 3-2, *Topographic Survey*
- SOP 3-4, *Geophysical Logging, Calibration, and Quality Control*
- SOP 3-5, *Lithologic Logging*
- SOP 4-1, *Field Logbook Content and Control*
- SOP 4-3, *Well Development and Purging*
- SOP 4-4, *Design and Installation of Monitoring Wells in Aquifers*
- SOP 4-6, *Hydraulic Conductivity Testing*

3.0 General Roles and Responsibilities

A general description of roles and responsibilities associated with environmental data management is provided below. It shall be understood that not all roles listed below will be required on all projects and that one person may perform multiple roles.

Project Manager - The project manager has the overall responsibility for completing the project. With respect to data management, this involves directing the project team in identifying existing sources of data, identifying the specific project study parameters (e.g., scope of the project), and selecting an effective data collection approach. Additionally, the project manager ensures that data management requirements are effectively communicated in subcontractor statements of work.

Technical Leader - The technical leader serves as the single point of contact for technical issues. This person provides support during the planning, implementation, and reporting of the project.

Project Team - The project team consists of technical and support staff (e.g., data management and administrative staff) who completes various tasks on the project. The project team is responsible for the development of requirement documents (e.g., sampling plans) and ensuring that client contractual requirements are met.

Field Team Leader - The field team leader supervises field teams during planning and implementation of field data collection. The field team leader ensures that field activities are documented according to project-specific requirements, reviewed as required, and that deviations are tracked and justified.

Field Team - The field team consists of individuals who perform activities detailed in the project-specific requirement documents. Field team responsibilities include recording field activities and information as required by the project-specific planning documents. Quality assurance reviews of procedure implementation are completed by a qualified field team member. Quality assurance reviews include ensuring samples are collected as required, calibrations are completed correctly, and that all information is recorded as required.

Data Management Team - The data management team consists of a data manager and data support staff. The data manager is responsible for developing and implementing the project data management plan and ensuring that requirements specified in the data management plan are met. The data manager ensures that existing data and new data generated during the course of the project are incorporated into the project files and applicable databases. The data manager also identifies and obtains appropriate data management training for the project team. The data manager is responsible for overseeing the data support staff.

Data support staff are responsible for entering environmental project data into the project files or database and ensuring that all information is entered accurately. Data support staff also work with the field teams and data users to ensure that data collection is complete and access to the data is appropriate.

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Laboratory Coordinator - The laboratory coordinator develops the project-specific analytical statement of work. Analytical methods, detection limits, laboratory quality control requirements, and deliverable requirements must be detailed in the statement of work. The laboratory coordinator also communicates with the data manager to ensure that hardcopy and electronic deliverable formats are specified and meet project requirements.

Data Validation Coordinator - The data validation coordinator is responsible for developing the data validation process specific to the project requirements and is responsible for supervising data validation staff. Included in this process is the approach to verifying that analytical data and field data are complete and accurate, have fulfilled the requested analyses, and are in concurrence with the contract requirements. If discrepancies arise, the data validation coordinator interfaces with the laboratory for resolution. If data validation occurs via a subcontractor, the data validation coordinator is responsible for the development of the subcontractor statement of work and supervision and review of the subcontractor's work.

Data validation staff are responsible for ensuring that analytical data and field data are accurate according to a project-specific set of criteria, including the evaluation of quality control samples to ensure analyses are performed within specified control limits. All validation issues must be identified and corrected. Qualifiers may be assigned to the data to indicate concerns about usability.

Data User - Data users are members of the project team who require access to project information for project decisions and to prepare deliverables. The data user is responsible for documenting information used (e.g., geographic information system [GIS] coverage, database queries, statistical analysis completed) to generate any data deliverables (e.g., data tables, maps). This requirement ensures that deliverables may be reproduced in the future using an identical process. Additionally, the data user is responsible for determining whether or not the data used meet their specific usability requirements.

Note: Responsibilities may vary from site to site. Therefore, all team member responsibilities shall be defined in a work plan or site-/project-specific quality assurance project plan (QAPP).

4.0 Data Management Plan

This section describes the process to complete preparation of a project data management plan. The data management plan must be completed early in the life cycle of a project to ensure that the necessary and appropriate data management systems and personnel are identified and in place before a project begins to generate data. The data management plan identifies and documents the project requirements and responsibilities for managing and using environmental information. The data management plan must provide enough detail to clearly define:

- The types of data the project will generate and use
- Responsibilities for information management activities and procedures to follow
- How the project will manage its data
- When data transfers will occur and who will provide and receive data

4.1 Data Management Plan Outline

The project manager, data manager, and technical leader will evaluate project and client requirements to prepare the data management plan. The following outline shall be customized to meet the project-specific requirements. Additionally, as the project evolves over time, the data management plan must be reviewed and updated periodically to ensure that it suitably meets modifications to the project requirements.

Section 1 - Introduction

- Briefly describe project objectives
- Briefly describe data quality and management objectives
- Briefly describe data management plan objectives and organization
- Summarize the types of data required by the project
- Summarize the data management activities

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Section 2 - Data Sources and Needs
- Identify the project data needs (e.g., internal sources, external sources)
- Identify data collection formats (e.g., field forms to be used, GIS coverage)

Section 3 - Data Management Team Organization
- Present roles and responsibilities
- Identify lines of communication

Section 4 - Data Management Activities
- Project planning and setup and data flow process (e.g., sample locations and identification nomenclature, laboratory subcontracting)
- Field data collection (e.g., sample tracking, field data entry, historical data)
- Data validation, evaluation, and qualification
- Database entry and post qualification
- Data analysis and output (e.g., mapping format and specifications, data sharing, figure generation)
- Data quality assurance and quality control
- Data usability

Section 5 - Data Management and Geographic Information System and Process Administration
- Identify project data management and geographic information systems to be used
- Identify any project-specific systems to be used for analysis, modeling, or mapping
- Describe how the project will ensure that data, geographic, and analysis systems and processes are controlled (e.g., configuration change control, security)
- Project documentation and storage (records management)
- Quality control implementation (e.g., quality control of electronic documents, GIS software guidelines, other analytical software guidelines)

4.2 Data Management Plan Preparation

Data management plan development includes a seven-step process. Each of the steps involved in the process are annotated below. Critical issues of the data management plan are the definition of project activities, roles, and responsibilities related to data management.

- **Determine the Data Manager** - Every project must have a project data manager. The data manager is responsible for assisting in identification of data management and data record needs according to project and client requirements. The data manager will work with the project technical leader in the development of the data management plan.

- **Identify the Project Data Needs and Sources** - The data needs and sources will be determined during project scoping meetings and by discussions with the project team. The data types, sources, and uses must be considered when requirements are being defined. Identification of data types includes topics such as:

  - Maps
  - Field measurements
  - Inspection information
  - Sample media
  - Analyses
  - Locations
  - Quantity of samples
  - Quality for intended use
  - Observations

  Data source considerations will include historical, project-generated, and other similar projects. Examples of data uses include modeling (contaminant contouring/transport, geospatial), regulatory compliance, remedial investigation, and risk assessment.

- **Identify Existing Database Requirements** - A requirement may exist that all project information shall be transferred into a pre-existing client database. Close coordination with the client data managers and review of guidance will provide information associated with specific requirements. These requirements will include specific data loading tools, submission file groupings, and data entry guidance.

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- **Identify Records Management Requirements** - The project manager, data manager, and technical leader will identify the records management requirements. Additionally, they will identify the types and quantities of records that will be generated and determine what requirements are necessary for their transmittal to the client or central storage location. Records will consist of the guidance and planning documents (sampling plan, quality assurance plan) that detail how samples and data are collected, processed, evaluated, and used by the project.

- **Define Data Management Activities and Responsibilities** - This step details the data flow process for the project. Within this process, responsibilities for data collection, data transfer, updates, and maintenance are defined. A clear understanding of these responsibilities is critical to ensure that the technical activities of the project are completed efficiently and effectively. Section 5.0 of this procedure provides generic activity descriptions and responsibilities common to many environmental projects.

  The data flow process must be reviewed by the project team to ensure completeness and project specificity. Small projects may allow one individual to complete several roles and responsibilities whereas large projects may require multiple personnel to complete one role. Project team understanding and comprehension of the activities and responsibilities are important to the efficient implementation of the overall data management program.

- **Determine Database Needs** - The project manager, data manager, and technical leader will determine the database needs and requirements. Project components to consider during this process are the complexity, types, and volume of data the project will generate; types, frequency, and detail of reports required; and required accessibility of the data. Based on these components and any other project requirements, a database need will be determined. Automation of the database shall also be considered during this step. Database automation consideration shall include factors such as:

  - Volume of data
  - Frequency that data will be received
  - Format of the received data (electronic or hardcopy)
  - Time constraints on data reports
  - Complexity of the data

  After database needs have been determined, the project manager and data manager will identify appropriate personnel to support the data management process. Personnel identification support can include geographical information system specialists, laboratory coordinators, and data support staff. Additionally, the project manager and data manager must identify any training requirement appropriate to the project data management process.

- **Prepare the Data Management Plan** - Based on the decisions made in the preceding steps and the customized outline, the data manager and technical leader will prepare the data management plan.

5.0 Project Data Management Activities

This section identifies typical environmental data management activities in the context of a generic project lifecycle. It is unlikely that all activities presented will be implemented on a single project. Only activities applicable to project-specific data management requirements need to be implemented. The activities presented below have been grouped into three sections. Section 5.1 presents planning activities that will identify the project data needs, identify existing information, plan for project data collection, and identify data management requirements. Section 5.2 presents data collection activities, which include data management support that will provide for efficient field data and field sample collection, data processing, and reporting. Section 5.3 provides review and data use activities that include the evaluation of data quality and project reporting.

5.1 Planning Activities

Environmental projects are most commonly conducted to determine contaminant characterization, remedial design parameters, remedial action requirements, or to complete environmental monitoring of some type. Data generated from these activities are used as the basis for decisionmaking.

5.1.1 Project Scoping

Before making decisions on data management requirements, a complete understanding of the project is required. Completing a scoping exercise based on client requirements and available information is the first step in planning for development of data management requirements. The following activities are included in the project scoping exercise:

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- **Project Definition** - The effort to define projects is highly variable and completely dependent on the complexity of the project. For example, the project may be defined specifically in the client statement of work (e.g., sample wells 1, 2, and 3 and analyze water for volatile organics) or may be iterative where a specific condition may require investigation with further refinement of the project scope based on the results and findings (e.g., delineate nature and extent of contamination). Some projects may also be defined by first determining what questions need to be answered to meet the project objective. Therefore, project scoping can be conducted in multiple phases. First, the project scope is initially determined based on limited information and data (such as the information provided in the client statement of work). Next, after the review of more detailed and specific information, the project may be defined more accurately. Some projects may go through a systematic planning process such as implementing the data quality objective (DQO) steps where contractor, client, and regulators are involved. Project definition serves as the method of focusing and developing a conceptual model of the project so that appropriate management tools can be identified. For example, for a project where characterizing the nature and extent of contamination is the objective, the conceptual site model will include determining the environmental setting, the area of contamination, the contaminants of concern, fate and transport of contaminants of concern, and potential human health and ecological risks associated with contaminants of concern.

- **Identify Historical Information** - Information may exist from previous investigations and similar projects within the project boundaries. This information can prove to be valuable in providing insight into operational processes, contaminants of concern, and environmental compliance issues as well as geographical information.

- **Project Scoping Meeting** - A project scoping meeting must be held to finalize the project objectives, project decisions, and project tasks necessary to meet the project objectives. The scoping meeting may include the project team members only or may also include clients, regulators, and other technical team members such as project engineers/geologists and risk assessors.

- **Implement DQOs** - During the scoping meeting, DQOs shall be discussed and resolved. The following seven step DQO process shall be implemented:

  1. State the problem
  2. Identify the goal of the study
  3. Identify information inputs
  4. Define the boundaries of the study
  5. Develop the analytic approach
  6. Specify performance or acceptance criteria
  7. Develop the plan for obtaining data

- **Project Data Requirements** - During the scoping meeting, project data collection needs shall be clearly identified in terms of data use, quantity, and quality. Additionally, decision criteria, acceptable levels of uncertainty, and acceptable levels of false positive and false negative decisions need to be established in accordance with applicable data quality objective guidance.

5.1.2 Acquiring Existing Data

Environmental data collected during previous investigations and studies can prove to be valuable with respect to descriptive information and contaminants. Historical information may contain details in areas such as environmental compliance, geographical data, and characterization investigations. Existing data shall undergo the same review and evaluation as any recently collected information. This review assists in ensuring the quality of data collected during the initial stages of the project. While a quality review of this data is advisable, obtaining the necessary quality control data is not always possible. Included in the process of acquiring existing data are the following activities:

- **Locate the Existing Data** - The project manager will define the criteria by which existing data will be considered relevant (e.g., time period). Based on these criteria and additional information potentially provided by the client, a file search will be completed. These data can include physical, chemical, and geographic information.

- **Document Existing Data** - Once existing data have been located and acquired, documentation of these data must be completed. These data will be transferred into the project data management files.

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- **Evaluate Existing Data** - Data users will evaluate the existing data for relevance to the current project objectives and data requirements. An essential part of this step is to determine the quality and suitability of the existing data to the current project objectives and requirements. Existing data may have been collected for very different intended uses. After evaluation, the project team will determine which existing data are useful and applicable to the current project. Documenting and inventorying the evaluation and data selected for inclusion to the project files must then be completed.

- **Process Existing Data** - The data manager will incorporate the appropriate existing data into the project database. Processing the data includes converting information into common systems to be used for the project (e.g., common coordinate systems). All data processing steps completed during conversion and incorporation must be documented.

5.1.3 Project Data Collection Planning

Before starting this step, the project goals and data requirements must be defined to allow for the development of more detailed project plans. Included in the process of planning project data collection are the following activities:

- **Data Requirements** - Project data requirements need to have been developed during the previous project scoping activities. Types of data that will be required include site operations with respect to:

  - Hazardous substances
  - Disposal practices
  - Quantities of hazardous substances
  - Potential migration of contaminants
  - Site conditions
  - Historical and aerial photographs and base map data
  - GIS coverage of soils, geology, hydrogeology, and delineated contaminated plumes

- **Develop Project Work Plans** - All projects require that guidance documents be developed to describe in detail how the project objectives will be met. These guidance documents will range in complexity dependent on the project type, project complexity, and the project regulatory requirements. The guidance document must be developed using the level of detail required to enable any entity to implement it. Examples of projects requiring guidance documents include:

  - Remedial investigation/feasibility studies
  - Remedial design/remedial action
  - Engineering evaluation/cost analysis

  Additionally, supporting plans and procedures may need to be developed to supplement the work plan. Examples of supplemental plans are:

  - Sampling and analysis plans
  - Quality assurance plans
  - Health and safety plans
  - Waste management plans

- **Develop the Laboratory Statement of Work** - The laboratory coordinator will prepare the laboratory statement of work specific to the project requirements determined in the project work plans. The laboratory statement of work must detail:

  - The number of samples to be sent for analysis
  - The analytical methods
  - Reporting limits
  - Laboratory quality assurance/quality control requirements
  - Data deliverable requirements

  The statement of work must define the electronic data deliverable format and requirements and request an example from the laboratory to confirm requirements will be met. Additionally, the laboratory statement of work must define the data deliverable requirements necessary to ensure that validation and evaluation may be completed.

- **Develop Data Validation and Evaluation Criteria** - The data validation coordinator is responsible for developing the data validation and evaluation process. The data validation and evaluation process will document the approach to verify that project DQOs are achieved. The range of effort required to meet the project validation and evaluation needs may

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range from none to very exhaustive, dependent on the client and project objectives. Validation and evaluation criteria may be modeled after national guidelines (e.g., National Functional Guidelines), client requirements (e.g., specific client work instructions or procedures), or a combination of both. Variables that are usually considered include:

- Sample preservation and holding times
- Calibration of instruments
- Blanks
- Laboratory quality control samples
- Field quality control analysis

The data validation and evaluation process will be included as a section in the project work plan or equivalent. If data validation and evaluation are completed by a subcontractor, the statement of work (detailing the project required process) will be developed.

5.2 Data Collection

The following data collection activities identify the data management team support and project team interactions that will ensure efficient field data and field sample collection, event documentation, data processing, and reporting.

5.2.1 Field Activity Preparation

After completing the work plan and detailed project plans, preparing for field activities is the next step. Preparing for field activities ensures that data and sampling processes for the project are complete and appropriate. Field preparation activities may include obtaining permits, surveying and marking sample locations, installing wells, and testing any required equipment. Data management team preparation activities include ensuring all data users have been trained and have access to the data management system, laboratory data deliverables can be transferred into the project database (laboratory test electronic data deliverables have been received and checked), project field forms have been created, and the records management requirements identified in the data management plan are established. Additional field preparation activities are detailed below.

- **Data Management Plan and Data File Management** - The data manager will ensure that the data management plan is implemented. Implementation of the plan must begin before collecting field data to ensure that the system developed is appropriate and functional. The data manager will also ensure that the data file management system is established before collecting field samples or measurements.

- **Site Survey** - The field team leader inspects the project site area for placement of sampling locations and equipment. These locations shall be documented on site maps and stored in the project files (hardcopy, GIS etc.). These identified locations shall be physically marked at the site with flagging, paints, stakes, etc.

- **Identification of Sampling Locations** - The sampling stations identified are differentiated by assigning a unique identifier to each location. Historical location identifiers must be confirmed and consistently used throughout the project. Geographic coordinates must then be obtained for each sampling location. The method of determining the geographic location shall be selected based on project accuracy requirements. Information used to select and document accuracy must be maintained. Examples of this information include the type of equipment, processing software, and accuracy reports.

- **Installation of Sampling Locations** - Sampling location installation will include the placement of:
  - Monitoring wells
  - Boreholes
  - Direct push locations
  - Cone penetrometer locations

  Record and maintain the following information:
  - Drilling and monitoring well construction information (e.g., borelogs, construction logs)
  - Development logs
  - Purging logs
  - Associated measurements (e.g., air monitoring, water quality monitoring)

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- **Instrumentation and Equipment** - After placement of the sampling locations, any required instrumentation and equipment must be installed. An inventory of the instrumentation and equipment must be maintained. Included in the inventory will be:

  - The type and manufacturer of the instrument and equipment
  - Calibration requirements
  - Identification numbers
  - Type of data the instrument will collect

- **Project Database Update** - All information and data collected during the preparation activities shall be captured in the project database. After these preparatory steps have been completed, the collection of environmental data will begin. The project data manager shall be kept current on sampling and data collection schedules and activities.

5.2.2 Field Data Collection

Depending on the type of project, field data may consist of several different types. Field data may consist of observations, checklists, photographs, or preliminary field screening analytical data. Any time field data collection activities are conducted, they must be planned and scheduled. Data entry items such as checklists, field logbooks, and field data forms must be generated during the planning stage to ensure that the required data are captured. Information and data collected during the field data collection activities must enable the project team members to recreate or reconstruct the events that occurred during the activity. Due to project data needs ranging from simple to complex, not all steps provided below will apply to all projects.

- **Schedule -** The project manager is responsible for scheduling the field activity. Each field activity event will be defined by the site requirements and the data requiring collection. The appropriate work plans will be referenced to specify the data that will be collected. After completing the schedule, the field team and data manager are informed of the requirements by holding a field planning meeting.

- **Mobilization -** Mobilizing for a field activity includes generating any specific field forms or checklists, ordering, receiving and inspecting required field equipment, and conducting required project-specific training.

- **Field Data Forms -** Field data forms that will contain predefined information about the field event (e.g., location identifiers, site name, and quality control samples) shall be preprinted to ensure consistency and increase efficiency in the field. Some projects may have automated field data collection systems that would replace the need for field forms (e.g., data loggers). These data loggers will be prepared and tested at this time.

- **Field Instruments -** Many instruments used for collecting field measurements require calibration. Calibration of these instruments provides for accurate field measurements. Information that must be collected during the calibration of field equipment includes the type of instrument, instrument serial number or property number, time and date of calibration, instrument reading before and after calibration, and the calibration medium used. Calibrations of field equipment shall always be completed in accordance with the manufacturer's recommendations. For field equipment that only requires a calibration check, the vendor's date of calibration shall be recorded.

- **Field Data -** Field data are always collected at the same time as analytical samples. Examples of field data are:
  - Photographs
  - Water quality parameters
  - Checklists
  - Surveys
  - Time and date of sample collection
  - Weather conditions

- **Quality Assurance Review** - The project manager is responsible for ensuring that quality assurance reviews are completed. A quality assurance review of the field data collected will be completed. The field data (e.g., logbooks, field forms) review ensures that the data are recorded correctly and the activities are completed in compliance with the planning documents. The quality assurance review will determine if discrepancies between the planned events and actual events occurred.

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- **Compilation of Field Data** - The field team leader is responsible for ensuring that the field data are compiled and submitted to the data manager. Compiling the field data will include copying the field forms, downloading data loggers, and verifying that the field data were recorded as required.

5.2.3 Field Data Processing

Processing field data provides the mechanism for making the data available to the data users. The project manager is responsible for completing this process. Field data will include logbook copies, field forms, checklists, and data logger data. Since project data collection will vary significantly from one project to the next, not every project will require the completion of the following steps. An important part of preparing the data management plan is defining this process specific to the project requirements.

- **Project Files -** The field data collected during the field activity and any changes or deviations implemented must be documented and placed into the project files.

- **Field Data -** The following steps only apply to a project where an electronic database is required. Hardcopy field data will be entered into the electronic database. The data entry will be reviewed for accuracy by an independent person to verify correctness. Electronic field data (e.g., from data loggers) will be processed by programs that are designed for use with the specific piece of equipment that logged the data.

- **Error Resolution -** Any errors identified during field data processing or on review of field documentation must be resolved. Resolution is accomplished through discussions with project personnel.

- **Updates -** Upon completion of field data processing, the project database and project files must be updated. The data manager then makes the data available to project personnel for use.

5.2.4 Field Sample Collection

Field sample collection includes all activities implemented to gather samples from a particular site. Field sampling activities are planned and scheduled. Before implementation, the required field data forms, field logbooks, etc. are prepared. Recorded information is intended to provide data and observations to enable the reconstruction of the field sampling activities. The following process steps can be implemented as required:

- **Schedule -** The project manager will prepare a schedule of sampling events. The schedule shall include the types and number of samples to be collected at each location.

- **Generation of Sampling Labels and Forms -** Each sample collected during the scheduled sampling event will receive a sample label and sample collection form. Information to be captured on the sample container labels includes the sample location, container type, preservative, and analysis. Field forms for each can also be generated. Field forms may be preprinted and include lines for documenting conditions under which the sample was collected (e.g., moisture content, depth, water quality parameters).

- **Notification of Analytical Laboratories -** The analytical laboratories need to be notified of the sampling activity schedule. The laboratory needs to be informed of the anticipated arrival of sample shipments including the numbers of samples and the types of analyses that will be requested.

- **Acquisition of Equipment and Supplies -** All equipment required to complete the field sampling activity must be ordered, received, and documented. Notation of all equipment identification numbers and serial numbers must be made. An equipment checklist may be used to document this step. All supplies needed to accomplish the scheduled sampling activities, including sample containers and shipping materials need to be assembled.

- **Sample Collection -** Samples will be collected in accordance with required sampling procedures. Information regarding sampling activities, site conditions, and deviations from the planning documents will be recorded in the field logbook or field data forms.

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- **Sample Processing -** Samples collected in the field may need additional preparation before shipping to the laboratory. Two examples of additional processing that may be required are compositing of samples and filtering of an aliquot of the sample.

- **Updates -** The project database and project files need to be updated with the information collected during the field activities. A part of this process includes the verification that field data entered into the database are correct. Verification consists of comparing field forms and field logbooks to the information entered.

5.2.5 Submitting Samples for Analysis

Submitting samples to a laboratory for analysis includes preparation, packing, documenting, shipping, and verification of sample receipt. The process for submitting samples to a laboratory for analysis is detailed below.

- **Preparation for Shipment -** Preparing to ship samples includes the final sample processing such as splitting, compositing, or filtering. All sample containers shipped to a laboratory must have labels identifying, at a minimum, the sample number or identifier, analyses to be completed, and sample collection date and time. Sampling shipments shall be completed in accordance with SOP 2-1, *Packaging and Shipping of Environmental Samples*.

- **Chain-of-Custody Documentation -** All samples collected need to be documented and accompanied by a chain-of-custody form. The chain-of-custody must identify, at a minimum, the following:

  - Sample identification number
  - Matrix
  - Collection date and time
  - Sample type
  - Preservative
  - Analyses
  - Signature blocks for documenting sample transfers

  Sample chain-of-custody must be completed in accordance with SOP 1-2, *Sample Custody*.

- **Shipping Samples -** Samples will be shipped in accordance with SOP 2-1, *Packaging and Shipping of Environmental Samples*. Each sample shipped shall be checked against the chain-of-custody as it is packed for shipment.

- **Laboratory Receipt of Samples -** The laboratory will confirm that custody seals are still intact, the number of samples received matches the chain-of-custody, and the analyses match the sample labels and chain-of-custody. Additionally, the laboratory will note the condition of the samples when they are received against any noted requirements (e.g., 4° Celsius) on the chain-of-custody. The chain-of-custody will be signed and dated as received by the laboratory. A copy of the chain-of-custody shall be faxed back to the shipper for confirmation of sample receipt.

- **Confirmation of Sample Receipt -** The laboratory coordinator is responsible for confirming that the information provided by the laboratory is accurate. Confirmation is required for the following items:

  - What samples were received
  - Condition of samples upon receipt
  - Presence of signature on laboratory chain-of-custody form
  - Sample identification numbers
  - Types of analyses performed

  The laboratory coordinator is responsible for resolution and reconciliation of any conflicting information.

- **Sample Shipping Documentation -** Sample shipment files will include information with respect to the completion of the shipping process. This documentation will include:

  - Signed copy of the chain-of-custody
  - Shipping company airbill if applicable
  - Laboratory sample receipt or login form
  - Field forms associated with samples included in the shipment

- **Laboratory Analysis -** The laboratory will analyze samples according to the laboratory statement of work and the requested analyses identified on the chain-of-custody.

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5.2.6 Sample Data Processing

Sample data processing includes receiving and processing the laboratory data package and making the data available for review. Activities associated with this process are data package receipt, evaluation of the data package, and updating the project database with the data package information. The process for these activities is detailed below.

- **Receiving the Data Package -** The laboratory shall send the data package to the project laboratory coordinator. At a minimum, the data package will consist of a hardcopy of the analytical results. The laboratory coordinator will note which samples the data package represents and review the data package for completeness and legibility. Any problems identified during this review must be communicated to the laboratory and corrected. If an electronic data deliverable is a part of the data package, it may be either sent directly to the data management team or retained by the laboratory coordinator and distributed after review. If an electronic data deliverable is not provided as a component of the data package and the data needs to be entered into the database, the laboratory coordinator will provide a copy of the data package to the data management team as required for data entry.

- **Evaluation of the Data Package -** Upon receipt of electronic data deliverables, the CD-ROM or other media will be scanned for possible viruses before loading the information onto a computer. If a virus is detected, the laboratory will be notified immediately and another electronic deliverable requested. Electronic data deliverables shall be compared to the hardcopy version of the data package to ensure consistency and accuracy. In cases where no electronic copy exists, and the entry of the hardcopy data package into an electronic database is a project requirement, verification of the accuracy of the entered data is required subsequent to completion of data entry. All errors and problems identified during the evaluation must be documented and resolved during the evaluation. Any changes made to the hardcopy data package and the electronic data package must be documented.

- **Update the Project Database -** The project database will be updated with the sample results and associated laboratory data qualifiers. Some projects may also require additional quality control information in the database. Examples of the type of information that may be required include:

  - Results from the matrix spike/matrix spike duplicates
  - Percent recoveries
  - Laboratory control samples
  - Blanks

  Documentation of problem resolution and changes made to the data package must be maintained.

5.3 Review and Data Use

The data review process determines whether a set of environmental data meets the requirements established during the project scoping. The process involves the data management team, the laboratory coordinator, and the data users. Before completing the data review, the data validation and evaluation process must be completed to ensure data meet analytical guidelines since qualifiers affect the usability of the data..

5.3.1 Data Validation and Evaluation

Validation and evaluation of environmental data is performed to evaluate the usability of the data for the intended application. The process is equally applicable to field data as well as analytical laboratory data. Data of questionable quality or representativeness are qualified to inform the data user of the limitations associated with the data use. The process to complete a data validation and evaluation is presented below.

- **Data Deliverables** - Data are received in either hardcopy or electronic format by the data validation coordinator. These data deliverables are evaluated against the requirements specified in the analytical laboratory statement of work or the client requirements. Upon completion of the evaluation of the data deliverables with respect to the contract requirements (laboratory subcontract or client contract), the data deliverables are forwarded to the validation and evaluation personnel. If the data validation and evaluation is not required for the data deliverable, it is forwarded to the data manager for uploading into the project database.

- **Validation and Evaluation of Data** - Data deliverables are validated and evaluated according to the procedures and requirements established during the project planning and data management plan development. Following validation and evaluation, the data are forwarded to the data management team for subsequent update of the project database.

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- **Data Validation and Evaluation Report** - The data validator and evaluator will prepare a report documenting the process used to validate and evaluate the data, the usability of the data, and the qualification of the data, if applicable.

5.3.2 Data Review

Review of the data encompasses all data and supporting documentation, historical and recent, collected by the project activities as defined during the project scoping. Evaluation of the data will include the following process.

- **Evaluate Data for Outliers** - The data evaluation will first review the data to detect possible outliers. If extreme values are observed, a review of the potential for sampling and analysis problems must be completed to determine the accuracy of the data point. This review may include the evaluation of historical data ranges for the particular analyte at a particular location, or comparing similar analytical method results for samples processed differently (e.g., filtered vs. unfiltered). Based on the results of this evaluation, a determination about the use of the outlier result can be made.

- **Evaluate Precision, Accuracy, Representativeness, Completeness, and Comparability (PARCC)** - Precision, accuracy, representativeness, completeness, and comparability make up the PARCC parameters.

  Precision is the degree of agreement between independent measurements and is determined by the evaluation of laboratory control sample and laboratory control sample duplicate pairs, the matrix spike/matrix spike duplicate pair or an environmental sample and environmental duplicate pair analyses.

  Accuracy is the closeness of agreement between an observed value and an accepted value. Accuracy is determined by comparing percent recovery of spiked samples such as laboratory control samples and matrix spike samples.

  Representativeness expresses the degree to which the data accurately reflect the analyte or parameter for the environmental media examined at the site. Representativeness is a qualitative term and is evaluated based on use of proper sample design, sample collection methods, use of standard analysis methods, etc.

  Completeness is the measure of the amount of valid data received from the laboratory or field measurements. Completeness is determined by dividing the number of valid results by the number of possible results.

  Comparability is the confidence with which one data set may be compared to another data set produced by different laboratories or field instruments. Comparability is a qualitative term and can be evaluated by reviewing sampling methods, sampling devices, and standard control limits. Understanding the PARCC parameters provides a level of confidence in the data reported for decisionmaking purposes.

- **Evaluate Data Quality** - An integral component of the data review process is the comparison of results against the project-specific data quality requirements established during project planning. Results of the data quality evaluation will determine if the data meet or exceed the data quality requirements necessary for decisionmaking. A final usability determination is made by the data reviewers. If required, data qualifiers are placed on the data to indicate usability.

- **Update Database** - After the data review is complete, the project database must be updated with the qualifiers assigned. Updating of the database also includes noting the qualifiers on the hardcopy of the data package.

5.3.3 Data Analysis and Use

Data analysis and use consists of the activities necessary to process the data and transform the entire data set into customized data sets for the generation of deliverables for decisionmaking and reporting. Data users may use only portions of data (e.g., geological or chemical) or summarize the data to generate tables, graphs, text, maps, or other deliverables necessary to describe the results obtained and the conclusions drawn. The analysis process is very often iterative. Results and conclusions from one analysis will often lead to other analyses. The process for data analysis and use is presented below.

- **Data Selection** - Data analysis will usually focus on a particular subset of the data collected. Data selection involves defining these subsets, querying the data, consolidating these data from the project database, and transferring the data to the appropriate tool for analysis (drafting, GIS, statistical program, etc.). Standardization may also need to occur at this point in the process (e.g., units, analytes, spatial).

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- **Report and Analyze Data** - Data analysis involves summarizing the data to ensure that the technical requirements of the project are met. Examples of data analysis include statistical, risk assessment, and modeling. Results of the analysis are then used to report information in the form of tables, graphs, maps, text, and three-dimensional visualizations.

- **Documentation** - The information necessary to recreate a data analysis must be documented and kept. This includes the query criteria used to acquire the data subset, the database that provided the data for analysis, the procedure completed to perform the analysis, and the date the analysis is performed.

6.0 Software and Computer System

This section defines the documentation, quality assurance, and configuration control requirements for software and databases used on environmental projects. Section 6.1 applies to all projects using an electronic database and provides requirements for project-specific databases and software. Section 6.2 applies to all projects using an electronic database and defines requirements for the day-to-day operation of the data management system. The project data manager is responsible for implementation and providing guidance to meet the project objectives.

6.1 Project-Specific Database and Software Requirements

The need for a project-specific database and software will vary depending on the requirements of the project. A project may use an existing data management system and therefore not have project-specific software or databases, while other projects may develop project-specific databases and spreadsheets or software programs to analyze the project data. This section presents the minimum documentation, quality assurance, and configuration control requirements for project-specific databases and software developed during the course of a project.

- **Database Documentation** - Project databases will include spreadsheets and databases defined by the project data management team. The database documentation will identify the commercial database product, the database name, structure, and location using an entity relationship diagram (ERD) and data dictionary. The backup and recovery plans and processes for the database will also be documented. The minimum database documentation will consist of the name of the software used, names of the project databases created, database structure definitions (including names and field descriptions), any table relationships, and the storage location.

- **Software Documentation** - Software documentation will include the software program name, description, special requirements, revision, completion date, and evidence of technical and quality review. Documentation of deliverables created must also include the necessary information required to describe exactly how the data deliverable was produced. Software documentation may be maintained in hardcopy or included as a comment block embedded within the project software program. The minimum software documentation will consist of the name of the commercial software, name and version of any software written by the project personnel, author, date, revision, system requirements, and storage location.

- **Software Quality Assurance** - The project will define the quality assurance requirements for project-specific software. At a minimum, the functionality and analytical results of software programs will be reviewed to ensure that they meet requirements and objectives. The reviewer of the software will be someone other than the person who wrote the program. The project-specific software quality assurance requirements will be defined in the project data management plan.

- **Software Configuration Control** - Project-specific software will be protected from unauthorized modification or deletion. This can be accomplished by administrative controls or file security options. Changes to project software will be documented and maintained in the project files. The minimum project software configuration control documentation will include the commercial software used, the program names, revisions including the date, and the storage location.

6.2 System Administration

This section addresses the day-to-day operations of the data management system, including backups, access, security, data entry, and database control. All projects using an electronic database will adhere to the requirements in this section. The data manager is responsible for implementation of system security.

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- **System Backup** - Project data will be protected from loss through a preventive backup and recovery process. Database backups will be performed on a periodic basis at a frequency to be defined for each project in the data management plan. The frequency will be selected to minimize the extent of consequences of data loss and time required to recover the data. Recovery procedures will be developed and documented. The detailed description of the backup and recovery procedures will be presented in the data management plan.

- **System Access** - Access to the computer system will be made available only to authorized personnel with an assigned role that specifies their access rights. Before gaining access, personnel may login by providing a login name and password.

- **Database Access** - Projects will protect data from unauthorized access by implementing administrative controls. Access will be managed based on the specific data user role. The mechanism for implementing control will be documented in the project data management plan.

- **Data Security** - Security considerations must establish a balance between making the data inaccessible to unauthorized individuals while still making it accessible to those who have access and maintaining the integrity of the data. Security processes apply to field data, electronic data, the database, and distribution of data outside of CDM Smith. Original copies of all field records (e.g., chain-of-custody forms, sample collection sheets, and shipping airbills) will be placed in the permanent project file. All electronic files will be maintained in an electronic file management system and administered accordingly. Security of data distributed outside of CDM Smith will be maintained by providing read only access to the data and/or including time, date, and version on the data files within the file naming convention.

- **Data Entry** - Data entry and transcription activities will be reviewed and checked to ensure that data integrity is maintained. Review and checking must occur for all data when moving or copying data from one media to another. For example, if a field technician collects data from a water quality instrument and records it in a logbook, enters the data from the logbook into an electronic format, and then transfers the data into a deliverable, verification of accuracy would be completed during or immediately after the transcription. The mechanism for data entry and transcription must be documented in the project data management plan.

- **Database Control** - Each project must establish database control requirements for the contents of the project database. The requirements must ensure traceability of field and laboratory data from its original reported values through changes to current values stored in the database. The control requirements will define the approval process required for making changes to the database and the documentation required for each database change. The minimum information maintained for each database change will include:

  - Description of the change
  - Reason the change was made
  - Name of the individual making the change
  - Date the change was made

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Contract Laboratory Program Guidance for Field Samplers

Disclaimer: This version of the document replaces any prior versions of the document in their entirety.

Foreword

This guidance document is designed to provide users with general information regarding environmental sample collection for the United States Environmental Protection Agency's (USEPA) Contract Laboratory Program (CLP). This document provides minimum CLP requirements, an explanation of the general sampling process sequence of events, and any related information. The appendices contain useful reference information and checklists to aid in planning and documenting sampling activities.

CLP users also are encouraged to review the Introduction to the Contract Laboratory Program document that contains a general overview of the CLP, how it works, and how to access the program. The CLP requires samplers to use the functionality provided by either the Field Operations and Records Management System (FORMS) II Lite™ software or Scribe software, which are the preferred means of creating CLP sample documentation. For guidance in using the software to record and submit sampling data, users should reference the FORMS II Lite User's Guide or Scribe reference materials.

The FORMS II Lite User's Guide, software, and training module can be downloaded from the CLP Web site at the following address:

http://www.epa.gov/superfund/programs/clp/f2lite.htm

The Scribe software can be accessed from the USEPA Environmental Response Team (ERT) at the following address:

http://www.ertsupport.org/scribe_home.htm

The ERT User Manual for Scribe, reference, and training materials can be accessed from the Scribe Support Web site at the following address:

http://www.epaosc.org/scribe

Both the Introduction to the Contract Laboratory Program and the Contract Laboratory Program Guidance for Field Samplers can be downloaded from the CLP Web site at the following address:

http://www.epa.gov/superfund/programs/clp/guidance.htm

For more information regarding the CLP or this guide, please contact Eric Reynolds via email at reynolds.eric@epa.gov or via telephone at (703) 603-9928.

Key Information

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ARO	Aroclor
ASB	Analytical Services Branch
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLP	Contract Laboratory Program
CLP PO	CLP Project Officer
CRQL	Contract Required Quantitation Limit
CVAA	Cold Vapor Atomic Absorption
DOT	Department of Transportation
DQO	Data Quality Objective
dbf	Database Format File
ESDS	Electronic Sample Documentation System
ERT	Environmental Response Team (USEPA)
ET	Eastern Time
FORMS II Lite™	Field Operations Records Management System II Lite
FSP	Field Sampling Plan
HCN	Hydrocyanic acid
IATA	International Air Transport Association
ICP-AES	Inductively Coupled Plasma-Atomic Emission Spectroscopy
ICP-MS	Inductively Coupled Plasma-Mass Spectrometry
MA	Modified Analysis
MS	Matrix Spike
MSD	Matrix Spike Duplicate
$NaHSO_4$	Sodium Bisulfate
NPL	National Priorities List
OSC	On-scene/on-site Coordinator
OSHA	Occupational Safety and Health Administration
OSRTI	Office of Superfund Remediation and Technology Innovation
OSWER	Office of Solid Waste and Emergency Response
PAHs	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls
PE	Performance Evaluation
ppb	Parts-Per-Billion
ppt	Parts-Per-Trillion
PRP	Potentially Responsible Party
PT	Proficiency Testing
PTFE	Polytetrafluoroethylene
PVC	Polyvinyl Chloride
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QASPER	Quality Assurance Sampling Plan for Environmental Response
QATS	Quality Assurance Technical Support
QC	Quality Control
RAS	Routine Analytical Services
RPM	Remedial Project Manager
RSCC	Regional Sample Control Center Coordinator
SAM	Site Assessment Manager
SAP	Sampling Analysis Plan
SARA	Superfund Amendments and Reauthorization Act
SDG	Sample Delivery Group
SMC	System Monitoring Compound

SMO	Sample Management Office
SOP	Standard Operating Procedure
SOW	Statement of Work
SVOA	Semivolatile Organic Analyte
TR/COC	Traffic Report/Chain of Custody
txt	Text File
UN	United Nations
USEPA	United States Environmental Protection Agency
VOA	Volatile Organic Analyte
XML	eXtensible Markup Language

1.0 INTRODUCTION

1.1 About this Guide

This document describes the important organizational roles and responsibilities for those who plan and conduct environmental sample collection projects for analysis through the Superfund's Contract Laboratory Program (CLP). This chapter introduces the structure and purpose of this document. Chapter 2, *Pre-field Activities*, addresses pre-field planning activities that the sampling team could complete prior to the actual sampling event. Chapter 3, *In-field Activities*, addresses those activities that need to be completed during the sampling event.

Appendix A describes the functions within a sampling project which are taken from the Quality Assurance Project Plan (QAPP) requirements. Appendix B and Appendix C contain the sample collection guidelines for Volatile Organic Analytes (VOAs) in soil and in water. Appendix D recommends sampling techniques. Appendix E contains checklists to help the sampler ensure that all necessary steps are completed. Appendix F contains the glossary of terms. Appendix G contains the FORMS II Lite analysis codes. Appendix H contains the Scribe analysis codes.

Note

A project and site-specific QAPP providing Regional guidance will override guidance given within this document.

1.2 Overview of the CLP

The CLP is a national network of USEPA personnel, commercial laboratories, and support contractors whose fundamental mission is to provide data of known and documented quality. The CLP supports USEPA's Superfund program which was established under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 and presently exists under the Superfund Amendments and Reauthorization Act (SARA) of 1986. The CLP is directed by the USEPA Analytical Services Branch (ASB) from within the Office of Superfund Remediation and Technology Innovation (OSRTI) in the Office of Solid Waste and Emergency Response (OSWER).

The CLP primary service is the provision of analytical data of known and documented quality to CLP customers through its routine and modified chemical analytical services. The CLP has implemented supporting services to ensure that data of known and documented quality is provided to CLP users. Because of its supportive infrastructure, the CLP is able to provide all services in a cost-effective and efficient manner. To achieve this goal, the CLP has established strict Quality Control (QC) procedures and detailed documentation requirements. Current CLP users include the USEPA Regions, States and Tribal governments, and other Federal agencies. CLP users also are encouraged to review the *Introduction to the Contract Laboratory Program* document that contains a general overview of the CLP, how it works, and how to access the program.

1.2.1 Key Players Within the CLP

In coordinating Superfund sampling efforts, the ASB is supported by the Sample Management Office (SMO) contractor, Regional CLP Project Officers (CLP POs), Regional Sample Control Center Coordinators (RSCCs), Site Assessment Managers (SAMs), On-scene/On-site Coordinators (OSCs), and Remedial Project Managers (RPMs). Samplers may work directly with the RSCC, and/or an OSC from the Site Support Personnel during a sampling event. See Table 1-1 for a brief description of the functions performed by key participants (functions may vary by Region).

Table 1-1. Participants in the CLP Sampling Process

Participants	Responsibilities
Analytical Services Branch	USEPA ASB directs the CLP from within the Office of Superfund Remediation and Technology Innovation (OSRTI) in the Office of Solid Waste and Emergency Response (OSWER). ASB responsibilities include: • Development of the Statements of Work (SOWs) that define required analytical methods (including QC, detection/quantitation limits, and holding times) for the analytical services procured under the CLP; • Development and implementation of policies and budgets for Superfund analytical operations; • Development of information management policies and products for analytical data; • Management of SMO and Quality Assurance Technical Support (QATS) contracts; • National administration, evaluation, and management of the CLP; and • Direction of CLP Quality Assurance (QA) activities in coordination with overall OSWER QA activities. To obtain the most current ASB contact list, refer to the following Web site: http://www.epa.gov/superfund/programs/clp/contacts.htm#ASB
CLP Sample Management Office	The contractor-operated SMO provides necessary management, operations, and administrative support to the CLP. SMO receives Regional analytical requests, coordinates and schedules sample analyses, and tracks sample shipments. SMO also receives and checks data for completeness and compliance, processes laboratory invoices, and maintains a repository of sampling records and program data.
CLP Contract Laboratories	The contractor-operated laboratories within CLP provide necessary analytical services for the isolation, detection, and quantitation of the CLP's target compounds and analytes. To obtain the most current list of CLP Contract Laboratories, refer to the following Web site: http://www.epa.gov/superfund/programs/clp/download/lablist.pdf
Regional CLP Project Officer	The CLP PO monitors the technical performance of the contract laboratories in each Region. The CLP PO works closely with ASB Program Managers to identify and resolve laboratory technical issues, and leads laboratory on-site evaluations. To obtain the most current CLP PO contact list, refer to the following Web site: http://www.epa.gov/superfund/programs/clp/reglist.htm
Regional Sample Control Center Coordinator	In most Regions, the RSCC coordinates sampling efforts and serves as the central point-of-contact for sampling questions and problems. The RSCC works with SMO to schedule sample shipments to laboratories. In addition, the RSCC's activities may include: informing SMO of sample shipment, cancellations, special instructions, and sampling issues. To obtain the most current RSCC contact list, refer to the following Web site: http://www.epa.gov/superfund/programs/clp/reglist.htm
Site Support Personnel	The Site Support Personnel consists of the USEPA personnel responsible for developing the Quality Assurance Project Plan (QAPP) and Sampling Plan for the sampling episode at the site, such as the sampling team, Quality Assurance personnel, OSC, SAM, and Remedial Project Manager (RPM). In most Regions, the Site Support Personnel develops Standard Operating Procedures (SOPs) for field sampling and related procedures, and assists sampling teams in following those SOPs. The sampling team determines what type(s) of CLP services will be required for a particular sampling event. The Site Support Personnel reviews Sampling Analysis Plans (SAPs) prepared by sampling teams and oversees sampling teams in the field.

1.3 Overview of the Sampling Process

Once USEPA has determined that physical, chemical, and/or biological testing of a site is necessary, samples of material from the site area must be collected. The type of material that must be collected and the analytical method to be used depends upon the physical location of the site, detection level(s), site history (previous sampling), and known or unknown conditions and contaminants. The sampling process includes carefully planned and consistently applied procedures that produce accurate and legally defensible data. The sampling team should consider the procedures and plans presented in this guide as minimum sampling process guidelines to maintain sample integrity and identity. Samples should be collected according to the approved project and site-specific QAPP and SAP. This document does not define specific sampling procedures because specific sampling protocols depend on individual site conditions, Regional requirements, and acceptance and performance criteria. Since Regions may have their own specific requirements for individual sampling programs, they are responsible for generating Region-specific sampling SOPs.

At–a-Glance:
Overview of the Sampling Process

- ✓ Procedures must be consistent.
- ✓ Analytical data must be accurate and defensible.
- ✓ Procedures must meet minimum requirements.

1.3.1 Procedures Must Be Consistent

The purpose of sampling is to collect representative portions from a suspected contaminated site. Sample collection is critical to determining the presence, type, concentration, and extent of environmental contamination by hazardous substances; thus it is a crucial part of every sampling and environmental testing effort. Sampling procedures must be consistently written and followed to mitigate risk of error and the expense of re-sampling.

Failure to follow proper sampling and shipping procedures could result in samples that are contaminated, broken, mislabeled, lost during shipping, or unusable because of a missed holding time. If procedures are inconsistently or improperly followed, any resultant analytical data may be inaccurate and may not be defensible in a court of law.

Note: If re-sampling is needed due to improper sampling, the sampling team may incur the cost.

1.3.2 Analytical Data Must Be Accurate and Defensible

The data gathered during sampling activities helps to accurately characterize contaminated waste sites so that the impact on human health and the environment can be properly evaluated. Acquiring accurate and defensible data that will be accepted in a court of law is the CLP's primary objective; therefore, the sampler must collect samples according to strict sampling procedures, plans, and guidelines. USEPA and many other Federal agencies use data resulting from analytical testing of samples to:

- Determine if a site is contaminated with organic and/or inorganic compounds
- Identify pollution sources and Potentially Responsible Parties (PRPs)
- Validate remedial design methodologies
- Assess response and remedial priorities
- Assess risk to human health and the environment
- Determine appropriate cleanup actions
- Determine cleanup achievements

1.3.3 Sampling Procedures and Guidelines Must Meet Minimum Requirements

It is imperative that samplers be aware of the minimum CLP and Regional requirements that directly impact and define how a sampling event will take place. It is important to note that the procedures and guidelines set forth in this document are considered minimum CLP requirements. Samplers should reference the following sections within this document that specifically address important requirements that must be met for a successful sampling event:

- Section 1.4.3 CLP Documentation Requirements
- Section 2.4.1 Request Scheduling of Analysis, SMO-assigned CLP Case Numbers, CLP Sample Numbers, and Laboratory Contact Information
- Section 2.7 Comply with Transportation and Shipping Requirements
- Section 2.8 Provide Shipment Notification
- Section 3.1 Collect Samples
- Section 3.2 Complete Documentation

1.4 Overview of Sampling Documentation Requirements

The sampler must properly document samples collected for analysis in order to uniquely identify each sample and ensure adequate chain-of-custody procedures. When collecting samples, the sampler should always keep in mind that any samples collected may be used in future litigation. This is especially important when samples are from privately owned property. If sampling on privately owned property, samplers should also provide the property owner with a receipt for samples collected and removed from that owner's property. Samplers may also be required by a Region to use a sample label, sample tag, or field operations records documenting information such as daily activities, equipment and materials used, personnel involved, site security, etc. These types of documentation help ensure proper sample identification and provide additional chain-of-custody records.

The documentation required by a Region for a sampling event is outlined in project plans such as the QAPP, SAP, and Field Sampling Plan (FSP).

At a Glance:
Overview of the Sampling Document Requirements

- ✓ Must use FORMS II Lite or Scribe to create sample documentation. Analytical data must be accurate and defensible.
- ✓ CLP documentation requirements:
  - CLP Sample number
  - SMO-assigned CLP Case number
  - Traffic Report/Chain of Custody (TR/COC) record
  - Sample labels
  - Sample tags
  - Custody seals
  - Field operation records

Under no circumstances should the site name appear on any documentation that is sent to the laboratory (for the CLP).

The two sampling documentation software tools prescribed and used by the CLP are: Field Operations Records Management System II Lite (FORMS II Lite) and Scribe.

1.4.1 FORMS II Lite

In an effort to automate sample documentation in the field, ASB has developed a stand-alone, Windows-based software application that samplers can use to automatically create and generate sample documentation. The FORMS II Lite software allows users to enter information prior to and during sampling events. It allows users to multi-task and electronically create, edit, and print documentation associated with sampling activities. Users can customize data entry screens throughout the entire documentation process. Users can also customize the format and content of sample labels based on specific requirements.

The program simplifies and accelerates the tedious manual sample documentation process by reducing the generation of handwritten documents by almost 70%. The FORMS II Lite software enables samplers to:

- Augment CLP-provided Sample numbers or manually assign their own unique, project-specific non-CLP Sample numbers
- Input the SMO-assigned CLP Case Number into the appropriate field
- Create sample labels, sample tags, TR/COC Records, Sample Weight forms, and receipts for samples taken from a site
- Track samples from the field to the laboratory
- Electronically capture sample information into databases
- Export electronic data as a database format (.dbf) file, text (.txt), or eXtensible Markup Language (.xml) file

For assistance with obtaining or using the FORMS II Lite software, please contact the FORMS II Lite Help Desk at 703-818-4200 from 9:00 AM - 5:00 PM Eastern Time (ET). For additional information regarding FORMS II Lite use and training, please refer to the following Web site:

http://www.epa.gov/superfund/programs/clp/f2lite.htm

1.4.2 Scribe

In an effort to automate sample documentation in the field, the USEPA Environmental Response Team (ERT) has developed a stand-alone, Windows-based desktop application that samplers can use to automatically create and generate sample documentation. The Scribe software allows users to enter information prior to and during sampling events. It allows users to multi-task and electronically create, edit, and print documentation associated with sampling activities. Users can customize data entry screens throughout the entire documentation process. Users can also customize the format and content of sample labels based on specific requirements.

The Scribe application simplifies and accelerates the tedious manual sample documentation process by reducing the generation of handwritten documents. Scribe enables samplers to:

- Augment CLP-provided Sample numbers or manually assign their own unique, project-specific non-CLP Sample numbers
- Input the SMO-assigned CLP Case Number into the appropriate field
- Electronically capture sample information into databases
- Create sample labels, sample tags, COC Records, and receipts for samples taken from a site
- Track samples from the field to the laboratory
- Electronically capture laboratory results, property details and sample location details
- Export electronic data as a database format (.mdb) file, text (.txt), or eXtensible Markup Language (.xml) file

The Scribe CLP Analysis Codes provided in Appendix H may cause a delay in processing at the CLP laboratories based on interpretation.

Samplers are advised to use the analysis codes found in Appendix G: *FORMS II Lite Analysis Codes* for CLP analysis.

Scribe users should contact the ERT Software Support Help Desk for assistance in adding the custom analysis onto Scribe. For assistance with obtaining or using Scribe software, please contact the ERT Software Support Help Desk at 800-999-6990. For additional information regarding Scribe use and training materials, please refer to the following Web site:

http://www.epaosc.org/Scribe

1.4.3 CLP Documentation Requirements

Samplers must:

1) Record the CLP Sample Number and the SMO-assigned CLP Case Number on each sample bottle

2) Complete the Traffic Report/Chain of Custody (TR/COC) record using the FORMS II Lite or Scribe software, making sure to indicate on the TR/COC record if the samples require the use of a Modified Analysis
3) Complete and attach sample labels
4) Complete and attach sample tags to meet Regional requirements (if applicable)
5) Complete and attach custody seals to meet Regional requirements
6) Complete field operations records, as necessary

Please contact your RSCC (see Table 1-1) for information regarding CLP Sample numbers, SMO-assigned CLP Case numbers, TR/COC records, and chain of custody seals for sampling events.

1.4.3.1 CLP Sample Number

A *CLP Sample Number* is unique per sampling location, is used to identify and track samples throughout the sampling and analytical processes, and is recorded on many types of sampling documentation (e.g., TR/COC Records, sample labels, and sample tags). CLP Sample Numbers are provided to samplers by their RSCC or SMO. The CLP Sample Number should not contain the letters "I," "O," "U," and "V."

Samplers must contact their RSCC (or designee) to obtain CLP Sample numbers for their sampling event. Samplers must correctly assign the CLP Sample numbers to the appropriate sample bottle or container. Please refer to Section 3.2.1 for more detailed information regarding the use of CLP Sample Numbers.

Note: Contact the RSCC with any questions regarding the assignment of CLP sample and SMO-assigned Case numbers.

1.4.3.2 SMO-assigned CLP Case Number

SMO-assigned CLP Case numbers are used to track groups of samples throughout the sampling and analytical processes and are recorded on many types of sampling documentation (e.g., TR/COC records, sample labels, and/or sample tags). Samplers must correctly assign the SMO-assigned CLP Case number to the appropriate sample bottle or container. To obtain a SMO-assigned CLP Case number, samplers may contact their RSCC (or designee) to obtain their laboratory assignment notification or they may be provided by SMO.

1.4.3.3 Laboratory Assignment

Samplers are responsible for shipping samples to the appropriate SMO-assigned laboratory for analysis. Samplers may contact their RSCC (or designee) to obtain their laboratory assignment notification or they may be provided by SMO.

1.4.3.4 TR/COC Record

The TR/COC record is used as physical evidence of sample custody and functions as a permanent record of each sample collected.

Per CLP documentation requirements, each cooler must contain a TR/COC record that lists all the samples contained therein.

1.4.3.5 Chain-of-Custody Seals

A chain-of-custody seal is any adhesive label or tape that can be used to seal a sample bottle, container, plastic bag, or shipping cooler such that if it is opened or tampered with, the seal will be broken. Custody seals must be placed on each sample bottle, container, or bag (as appropriate) and each shipping cooler or container. The custody seal is an excellent means of maintaining a record of chain-of-custody, as well as guarding against possible sample contamination or tampering during shipping.

1.4.3.6 Sample Labels

A sample label is a sticker attached to a sample bottle or container that contains a field sample or QC sample. Sample labels are affixed to each sample container as samples are collected in

the field or affixed prior to going in the field. A sample label must contain, at a minimum, a CLP Sample number so that they can be associated with, and listed on, the associated TR/COC record. The sample label should also include the required analysis, Case number, and preservative used (to eliminate confusion at the laboratory). Samplers should refer to their project plans for Region-specific sample label requirements.

1.4.3.7 Sample Tags

A sample tag identifies a sample bottle or container that contains a sample. The tag also provides specific analytical direction and proof that a sample existed. To support the use of sample data in potential enforcement actions, samples with other than in situ measurements (e.g., pH, temperature, conductivity) can be identified with a sample tag. A CLP Sample number and SMO-assigned CLP Case number must be recorded on a sample tag to indicate that the sample container comprises the whole sample in the case where there is just one container of sample, or part of the indicated sample in the case of multiple containers of sample. Samplers should refer to their project plans for Region-specific sample tag requirements.

1.4.3.8 Field Operation Records

Samplers should maintain complete, accurate, and legible field operations records as they perform a sampling activity. The following records are included: field logbooks; Corrective Action reports; Sampling trip reports; supplemental standardized forms; logs; and records such as maps or photographs that document each step of the work performed in the field. Samplers should refer to their project plans for Region-specific field operations record requirements. These records are very important tools because they are considered part of the official project file when legal issues arise.

1.4.3.9 Weight Logs

A sample weight log identifies the tared, sample and final weights per bottle for VOA samples. In order to support Method 5035A for VOAs, samplers should enter tared and final weights per bottle in the CLP Sample Weight Log.

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2.0 PRE-FIELD ACTIVITIES

This chapter provides instructions for completing the suggested pre-field activities that samplers could complete prior to performing sampling activities. These important pre-field activities will save time and help the sampler to better prepare for the sampling event. Samplers should be aware of issues that routinely arise during the sampling process so that they can avoid making the same mistakes or having the same problems that could adversely affect their sampling event. Samplers are also expected to review all pertinent project plans and meet both CLP and Regional requirements that directly impact the structure and purpose of a sampling event.

The project plans provide information such as the types and numbers of samples to be collected, the analytical methods to be used based on the desired level of quantitation, and the necessary equipment and supplies. The plans also describe the sampling method which may require different specific sample volumes/masses, containers, preservation, shipping, and handling to maintain the integrity of the samples without degradation or contamination.

At a Glance:
Pre-field Activities

- ✓ Prepare for and communicate during a sampling event.
- ✓ Review project plans containing Regional requirements.
- ✓ Plan to meet documentation requirements.
- ✓ Obtain any necessary permits, licenses, and clearances.
- ✓ Identify and obtain sampling materials.
- ✓ Comply with transportation and shipping requirements.
- ✓ Provide shipment notification.
- ✓ Perform Readiness Review/Run-through.

In addition to reviewing project plans, samplers should determine if the sampling site is privately or publicly owned and obtain the necessary permission to access the sampling site. If the site is privately owned, samplers should make sure to have receipts available to provide to the owner for all samples collected and removed from the property. Samplers must also prepare to identify and obtain sampling materials, prepare to meet documentation requirements by obtaining and learning to use the required software, comply with transportation and shipping requirements, and perform a readiness review/dry run of the sampling process.

2.1 Prepare for a Sampling Event

Samplers must prepare to meet CLP and Regional requirements for a sampling event, appropriately use the CLP Sample number and SMO-assigned CLP Case number, complete the TR/COC record using the FORMS II Lite or Scribe software, and complete and attach the custody seal(s). It is very important that the sampler include the correct CLP Sample number on each sample. It is also imperative that the TR/COC record be accurately completed and submitted with the sample(s). Finally, the sampler must accurately and legibly complete and attach a custody seal to each sample container, or plastic sample bag (as appropriate), and each shipping cooler or container.

However, meeting the sampling requirements requires more than just the proper application of a CLP Sample number on each sample, completion of the TR/COC record, and use of a custody seal. The actual collection of samples, packaging, and shipping of those samples are equally important to a successful sampling event.

For example, if a sampler collects insufficient volume of a sample, the laboratory may not be able to perform the requested analysis. Insufficient sample volumes may also result in a laboratory being unable to perform laboratory quality control, such as Matrix Spike (MS), Matrix Spike Duplicate (MSD), and Duplicates sample analysis. Additionally, if the laboratory receives a sample that is either unpreserved or the sample pH is outside of the required range, the sample cannot be properly analyzed.

Unfortunately, improper shipping and labeling processes and procedures often result in:

- Samples being shipped to the wrong laboratory
- Broken or empty samples being received at the laboratory
- Custody seals or sealant tape that is missing or broken on sample bottles, containers, plastic bags, or shipping coolers shipped to the laboratories

The importance of completing the paperwork associated with a sampling event cannot be overemphasized. Samplers must make a conscientious effort to accurately complete the TR/COC record since this is the main document used to derive vital information about a particular sample. The person completing a TR/COC record must be careful to avoid errors, such as the appropriate sample(s) not being listed, or the wrong samples being listed. In an effort to eliminate such errors and the confusion that can be associated with handwritten TR/COC records, samplers must use either the FORMS II Lite or Scribe software to complete the TR/COC record and other associated sampling documentation.

It is extremely important that QC samples, including field sample duplicates, field samples for Matrix Spike and Matrix Spike Duplicate analyses, and Proficiency Testing (PT) samples, also known as Performance Evaluation (PE) samples, be designated and labeled per Regional guidance by samplers in the field. Mislabeling of QC samples can result in improper and/or inaccurate analysis of a sample at the laboratory.

2.2 Communicate During a Sampling Event

Communication is a key element in planning, administrating, and conducting a sampling event. It is extremely important that all parties involved in a sampling event be in contact throughout the sampling process. The procedures and recommendations outlined in this guide are based on more than 20 years of experience. It has been demonstrated that approximately 50% of all sampling efforts have been negatively affected by incorrect sampling procedures and poor communication among participants.

The key elements of communication for a sampling event include the relationship between the RSCC, SMO, the samplers in the field, and the laboratories who will be accepting the samples. For instance, the samplers must contact the RSCC to start the process for setting up a sampling event. The RSCC will in turn contact SMO who will schedule the sampling event, establish laboratory availability, and arrange for the laboratory to accept projected samples. For MAs requesting tissue analysis, it is also important to notify the laboratory if they should be expecting whole fish, fish fillet or other types of tissues for analysis. After scheduling, SMO will communicate the laboratory assignment to the Region and possibly the sampler.

SMO provides SMO-assigned CLP Case and CLP Sample Numbers in time for the sampling event. SMO also schedules a laboratory and makes sure the laboratory will not have any capacity problems. Communication is also important because if there is a change in the sampling event due to a cancellation or an increase or decrease in the number of samples that will be sent to the laboratory, the sampler can contact the RSCC who can work with SMO to remedy potential capacity, availability, or overbooking problems.

2.3 Review Project Plans Containing Regional Requirements

In addition to meeting CLP requirements, the sample collection process must fulfill numerous Regional requirements. These requirements are determined by a variety of factors that affect how samples should be collected for an individual sampling event. These factors include:

- The type of samples being collected (organic/inorganic, water, soil/sediment, etc.)
- The method by which the samples will be analyzed
- The acceptance or performance criteria [i.e., Data Quality Objectives (DQOs)]
- The type of data needed

The QAPP for each sampling project is written to meet requirements outlined in the documents *EPA Requirements for Quality Assurance Project Plans* (QA/R-5), *EPA Guidance on Quality Assurance Project Plans* (G-5), and Regional QAPP preparation documents. The QAPP is prepared in advance of field activities and is used by samplers to develop any subsequent plans such as the SAP or the FSP. Samplers should review the QAPP and any subsequent project plans for information outlining the basic components of a sampling activity. QAPP and project plans should be finalized and approved by appropriate Regional QA personnel, the OSC, SAM, or the RPM before providing them to the sampling team. This should be done prior to the start of field activities. Appendix A explains the functions within a sampling project (as these functions relate to a sampling event) and the elements of that function as described in a typical QAPP. Copies of all project plans and relevant SOPs should be maintained in the field for the duration of the sampling project.

2.4 Plan to Meet Documentation Requirements

At a Glance:
Plan to meet documentation requirements.

- ✓ Request SMO-assigned CLP Case and CLP Sample Numbers.
- ✓ Prepare sample cooler return documentation.
- ✓ Prepare to use the FORMS II Lite or Scribe software.

Sampling events require a variety of accurate and complete documentation. Samplers should review their project plans to determine the types of documentation that must be completed for a sampling project and to ensure that the appropriate documentation will be on-hand in the field. The CLP documentation requirements include the CLP Sample Number, the SMO-assigned CLP Case Number, the TR/COC Record, sample labels, custody seals, and field operations records (as necessary). Samplers need to request SMO-assigned CLP Case and CLP Sample Numbers for each sampling event prior to starting field activities. Samplers also need to make sure that the correct TR/COC Records (Organic TR/COC Record for organic analysis or Inorganic TR/COC Record for inorganic analysis) are being used within the FORMS II Lite or Scribe software. Finally, samplers should be prepared to complete the appropriate shipping cooler return documentation.

Samplers are required to use the FORMS II Lite or Scribe software to prepare and submit sampling project documentation and maintain sample chain-of-custody. Samplers must have access to FORMS II Lite or Scribe generated TR/COC Records at sampling events. FORMS II Lite or Scribe software users must be familiar with all emergency backup procedures that should be followed in the event of a system failure. In the event of a system crash, samplers must have backup hardcopies of FORMS II Lite or Scribe TR/COC Records. For information regarding emergency backup procedures, please refer to the following Web site:

http://www.epa.gov/superfund/programs/clp/trcoc.htm

For assistance while using the FORMS II Lite software, please contact the FORMS II Lite Help Desk at 703-818-4200 from 9:00 AM - 5:00 PM ET.

For assistance while using the Scribe software, please contact the ERT Software Support Help Desk at 800-999-6990 from 9:00 AM - 5:00 PM ET. Refer to the following web site for additional information on the use and training of Scribe:

http://www.epaosc.org/Scribe

2.4.1 Request Scheduling of Analysis, SMO-assigned CLP Case Numbers, CLP Sample Numbers, and Laboratory Contact Information

SMO-assigned CLP Case Numbers are assigned based on a request for CLP Routine Analytical Services (RAS), which is processed though the RSCC (or designee). The sampler must request the RSCC to schedule CLP RAS analysis. The sampler should specify the number of samples, analyses, etc., being shipped each week when requesting the RSCC to schedule CLP RAS analyses. The CLP does have the capacity to schedule sampling on an emergency basis, however the sampler must contact the RSCC (or designee) to obtain details regarding how to handle such a situation. When scheduling a sampling event that will last for more than one week, it is recommended that the sampler contact the RSCC (or designee) on a weekly basis to provide updates. This contact between the sampler, the RSCC (or designee), and SMO is very important because it will ensure better availability of laboratory capacity.

In addition to SMO-assigned CLP Case and CLP Sample numbers, samplers should make sure to have accurate laboratory contact information, such as:

- Laboratory name
- Laboratory address
- Contact name
- Laboratory phone number

This information which is provided on the Regional Lab Assignment Notification Form is used for both TR/COC records and chain-of-custody documentation and shipping paperwork such as address labels and airbills.

The SMO-assigned CLP Case number is used to track groups of samples throughout the sampling and analytical processes. Samplers must correctly indicate the assigned Case number on the appropriate sample bottle or container.

The RSCC (or designee) provides the CLP Case numbers and Sample numbers for each sampling event to samplers. Once the CLP Sample numbers have been provided to the sampler, the sampler can use FORMS II Lite or Scribe to print them onto sample labels.

A CLP Sample number is defined as a number that is unique per sampling location and identifies each CLP sample (see Section 1.4.3.1). Since samples must be identified per analytical program (either organic or inorganic), there are two types of TR/COC Records and two letter codes to denote organic vs. inorganic analysis.

A CLP sample is defined as one discrete portion of material to be analyzed that is contained at one concentration level, from one station location for each individual or set of analyses -- provided the analyses are all requested for the same CLP analytical service (i.e., organic or inorganic), and identified by a unique Sample number.

When samples are collected from several station locations to form a composite sample, the sample should be assigned either a number from one of the station locations used during collection, or a unique number that represents the composite sample, for tracking purposes. The numbering scheme used internally at a sampling event for identifying composite samples should also be documented appropriately (e.g., in the field logs).

Organic CLP Sample numbers begin with the Regional letter code, followed by four letters and/or numbers. Inorganic CLP Sample numbers begin with "M" followed by the Regional letter code and then four letters and/or numbers. See Table 2-1 for Region and letter codes for each sample type (i.e., organic or inorganic).

Table 2-1. CLP Sample Number Letter Codes

Region	Letter Code	
	Organic	Inorganic
1	A	MA
2	B	MB
3	C	MC
4	D	MD
5	E	ME
6	F	MF
7	G	MG
8	H	MH
9	Y	MY
10	J	MJ

According to CLP guidelines, each individual inorganic water sample may be analyzed for total metals or filtered metals, but not both. Therefore, water samples collected for total metal and filtered metal analyses from the same sampling location must be assigned separate (unique) CLP Sample numbers. A sampler can use the same CLP Sample Number for an inorganic soil or water sample collected for total metals, mercury and cyanide analyses.

Organic soil and water samples may be collected for analysis under the SOM01.X SOW to detect:

- Aroclors
- Semivolatile Organic Analytes (SVOAs)
- SVOA Selective Ion Monitoring (SIM)
- Pesticides
- Volatile Organic Analytes (VOAs)
- Trace Volatile Organic Analytes (Trace VOAs)
- Trace VOA SIM

Inorganic soil and water samples may be collected for analysis under the ISM01.X SOW to detect:

- Cyanide using Distillation/Colorimetry
- Metals using Inductively Coupled Plasma-Atomic Emission Spectroscopy (ICP-AES), Inductively Coupled Plasma-Mass Spectrometry (ICP-MS)
- Mercury using Cold Vapor Atomic Absorption (CVAA)

Inorganic wipes and air filter samples may be collected for metals using ICP-AES under ISM01.X SOW.

2.4.2 Prepare Sample Cooler Return Documentation

CLP laboratories must routinely return sample shipping coolers to the appropriate sampling office within 14 calendar days following receipt of shipment from the sampler. For sample coolers to be returned, the sampler must complete the appropriate cooler documentation and work with Regions and government agencies to provide a cost-effective mechanism for laboratories to return the empty coolers to the appropriate sampling office. The sampling cooler return documentation should be prepared in advance and provided to samplers before field activities begin. **The sampler (not the CLP laboratory) is responsible for paying for the return of the cooler and should also include shipping airbills bearing the sampler's account number, as well as a return address, to allow for cooler return.**

To maintain consistency among cooler transportation programs, samplers should:

- Minimize the use of multiple transportation carriers to avoid confusion
- Use multiple-copy labels so the laboratory and the sampling team can each retain a copy for their records
- Prepare labels in advance so that the laboratory can simply affix a completed shipping label on the cooler
- Include third-party billing information (i.e., their shipping account number) on labels so the laboratory will not be billed by the transportation carrier
- Confirm that the laboratory knows which transportation carrier to use
- Include the SMO-assigned CLP Case Number on return information

2.5 Obtain Municipal Permits, Licenses, and Clearances

Before starting a sampling event, samplers must make sure to obtain the proper municipal permits, accesses to the property, and any government clearances, if required. The sampler must also contact any appropriate utility companies to ascertain where any underground pipes, cables, etc., may be located.

At a Glance:
Obtain permits, licenses, and clearances.

- ✓ Request access to County, State, Tribal, military, and/or Federal property.
- ✓ Contact private property owner(s).
- ✓ Contact utility companies.

2.5.1 Request Access to County, State, Tribal, Military, and/or Federal Property

Proper access to perform sampling activities is important not only for legal reasons, but also to eliminate delays in work and possible refusal to allow sampling to take place. It is crucial that the appropriate permits, licenses, and clearances be secured to obtain access for sampling activities that will be performed on County, State, Tribal, military, and/or Federal property. The sampler must contact the appropriate government offices or personnel well in advance to determine what kinds of approval are required. Pre-approval may be required for specific types of sample collection such as drilling or excavation. For example, drilling on a military base requires pre-approval. Base security may require clearances for all members of the sampling team, including subcontractors. This process may take two or more days.

If arrangements are not made in advance, the team may not be allowed to enter the site until their clearances are processed and the team has been approved to drill. As a result, the sampling schedule is delayed, costing extra time and money.

2.5.2 Contact Private Property Owners

The sampler must obtain written permission from the private property owner(s) before sampling on their property, even if verbal permission has been granted. It is recommended that samplers obtain verbal permission prior to their arrival at the sampling location, but written permission can be obtained on the day of sampling. If a property owner refuses to grant access to their property, it may be necessary for sampling participants to contact the appropriate authorities for assistance.

2.5.3 Contact Utility Companies

The sampler should contact local utility companies (e.g., power, phone, gas, cable, sanitation, etc.) at least one week prior to the sampling event to have underground cables, lines, and pipes flagged and marked. This is required by law. A national one-call directory can be found at:

http://www.call811.com.

This will eliminate potential safety hazards and service disruption. For example, soil sampling in a residential area may require digging below the soil's surface. It is very important to know where utility lines and pipes are located so that samplers do not hit live electrical wires or rupture gas lines. Samplers should follow Regional or other appropriate program procedures for the procurement of such services. The utility service(s) disruption dates should be confirmed at least two days prior to sampling activities.

Note: Pre-payment of survey fees to local utility companies may be required.

2.6 Identify and Obtain Sampling Materials

Samplers must be prepared for a sampling project with the appropriate sampling materials (equipment, supplies, sample containers, packing materials, and shipping materials). The equipment and supplies must be properly cleaned, calibrated, and tested as necessary to meet the needs of the sampling project.

At a Glance:
Identify and obtain sampling materials.

- ✓ Procure appropriate equipment and supplies.
- ✓ Procure sample containers.
- ✓ Procure shipping supplies.

2.6.1 Procure Appropriate Equipment and Supplies

Each sampling event requires the procurement of equipment and materials to collect, document, identify, pack, and ship samples. The proper field sampling equipment is vital to a successful sample collection. Regional or other samplers should obtain, and arrange in advance, all of the equipment and supplies required for each sampling event. Samplers should review the project plans to verify that the proper equipment is being used for sample collection.

At a minimum, the following materials are generally required during a sampling event:

- Sample storage containers
- Packing material
- Sample containers
- Shipping containers
- Access to the FORMS II Lite or Scribe software for creating sample labels, stickers, tags, and TR/COC Records
- Custody seals
- Sampling equipment such as bowls, augers, pumps, etc

Sampling events may also require specific items such as:

- Cooler temperature blanks
- Trip blanks for VOA analysis
- Preservation supplies (e.g., ice or acid)
- Specially prepared sample vials (e.g., for SW-846 Method 5035A)
- Utensils or equipment in handling tissue samples requested by modified analysis

2.6.2 Procure Sample Containers

The analytical protocol(s) to be used for sample analysis often requires the use of a particular type of sample container. The type of container also may depend on the sample matrix and analysis. It is recommended that samplers use borosilicate glass containers, which are inert to most materials, when sampling for pesticides and/or other organics. Conventional polyethylene is recommended when sampling for metals because of the lower cost and absorption rate of metal ions.

Using the wrong container may result in breakage, gathering of an insufficient volume needed to perform sample analysis, or the container material may interfere with the analysis. Therefore, samplers should identify and use the correct sample containers for each sampling event.

Have extra containers readily available for each sampling event in case of breakage, loss, or contamination.

Containers procured for a sampling event are usually pre-cleaned and shipped ready for use from the manufacturer to the sampling site. Regardless of the type of container used, samplers must ensure that the containers have been analyzed or certified clean to levels below concern for the project. These containers must meet the USEPA container type specifications listed in Table 2-2.

Samplers should document the lot numbers for every lot of cleaned containers used for each project and maintain corresponding certificates of analysis on file and available upon request.

Table 2-2. Sample Container Type Specifications

Reference Number	Container Type	Specifications	
		Closure	Septum
1	40 mL amber glass vial, 24 mm neck finish.	Polypropylene or phenolic, open-top screw-cap, 15 cm opening, 24-400 size.	24 mm disc of 0.005 in. Polytetrafluoroethylene (PTFE) bonded to 0.120 in. silicone for a total thickness of 0.125 in.
2	1 L high density polyethylene, cylinder-round bottle, 28 mm neck finish.	Polyethylene cap, ribbed, 28-410 size; F217 polyethylene liner.	N/A
3	8 oz short, wide mouth, straight-sided, glass jar, 70 mm neck finish.	Polypropylene or phenolic cap, 70-400 size; 0.015 in. PTFE liner.	N/A
4	4 oz (120 mL) tall, wide mouth, straight-sided, glass jar, 48 mm neck finish.	Polypropylene or phenolic cap, 48-400 size; 0.015 in. PTFE liner.	N/A
5	1 L amber round glass bottle, 33 mm pour-out neck finish.	Polypropylene or phenolic cap, 33-430 size; 0.015 in. PTFE liner.	N/A
6	500 mL high density polyethylene, cylinder-round bottle, 28 mm neck finish.	Polypropylene cap, ribbed, 28-410 size; F217 polyethylene liner.	N/A
7	Coring tool used as a transport device (e.g., 5 g Sampler).	Has built-in closing mechanism.	N/A
8	250 mL high density polyethylene, cylinder-round bottle, 28 mm neck finish.	N/A	N/A
9	1 qt polymer zip-top bag	Has built-in closing mechanism.	N/A

Table 2-2. Sample Container Type Specifications

Reference Number	Container Type	Specifications	
		Closure	Septum
10	Filter cassette used as transport device	N/A	N/A
11	Heavy duty aluminum foil	N/A	N/A

The information contained in this table is also cross-referenced in the sample collection parameters discussed in Chapter 3. The container Reference Numbers are used in Tables 3-2 to 3-5 under the Containers column. For example, samples collected for low-level soil VOA analysis using SW-846 Method 5035A may require the sampler to use pre-prepared, tared closed-system purge-and-trap vials with a preservative (refer to Appendix B). Refer to the Regional QAPP and Appendix D for additional references.

2.6.3 Procure Shipping Supplies

Samples should be correctly packaged into the appropriate shipping containers to reduce the risk of breakage or leakage, and the shipping containers should be appropriately prepared for shipment. Before heading into the field, samplers should refer to the appropriate project plans to determine the types of samples that will be taken during the sampling project so that samplers will have the proper packaging materials at the site for all pertinent sample container types and sample matrices.

Samplers should also make sure to obtain the appropriate shipping paperwork (e.g., shipping forms required by the delivery service).

The CLP strongly discourages the use of vermiculite and cat litter as sources for packing material. These materials interfere with labeling and documentation and are difficult to remove from sample containers and shipping containers.

2.7 Comply with Transportation and Shipping Requirements

Samplers are expected to review the applicable project plans to be aware of all State, Federal, Department of Transportation (DOT), and International Air Transport Association (IATA) regulations governing environmental and hazardous sample packaging. The person who ships the samples is responsible for being in compliance with applicable packaging, labeling, and shipping requirements.

Samplers should request and receive USDA soil permits for soil samples shipped from outside the continental United States, prior to shipping.

Additional information can be obtained on Hazardous Materials Safety Program regulations from the DOT's Research and Special Programs Administration. Federal transportation regulations can be found in 49-CFR Parts 100-185, and are available on the Internet at:

http://www.phmsa.dot.gov/hazmat/regs

2.8 Provide Shipment Notification

Some Regions may require that samplers notify their RSCC (or designee) when samples are shipped, and some Regions allow samplers to contact SMO directly to provide shipment notification. It is recommended that samplers contact the RSCC of sample origin to verify if such notification is necessary. If samplers are shipping samples after 5:00 PM ET, samplers must notify the RSCC (or designee) and SMO by 8:00 AM ET on the following business day.

For Saturday delivery at the laboratory, samplers MUST notify the RSCC (or designee) and SMO as soon as possible so that SMO will receive the delivery information by 3:00 PM ET on the Friday prior to delivery.

2.9 Perform Readiness Review/Dry Run

A readiness review/dry run is a test run of the proposed sampling event. This is a recommended practice since it gives samplers a chance to check all plans, documentation software (i.e., FORMS II Lite or Scribe), and equipment lists for accuracy and completeness prior to sampling activities. It also provides an opportunity to consult with sampling team members to make sure all the elements are in place and everyone understands their task before actually going out to the field. Sampling project managers should provide the readiness review or dry run dates and schedules to samplers so that samplers can prepare accordingly.

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3.0 IN-FIELD ACTIVITIES

This chapter addresses the in-field activities a sampler will focus on during a sampling event such as determining the type of samples to be collected; collecting the samples; meeting volume, preservation, and holding time requirements; completing documentation; and packing and shipping samples.

When performing a sampling event, the sampler is expected to follow prescribed sampling techniques. The sampler should also be aware of any special sampling considerations, contamination issues, and sample compositing and mixing methods that could affect their sampling efforts. Please refer to Appendix D for more detailed information.

At-a-Glance:
In-field Activities

- ✓ Collect samples
- ✓ Complete documentation
- ✓ Provide sample receipts
- ✓ Procure shipping
- ✓ Pack and ship samples

Note: Appropriate Regional guidance and procedures should be consulted for detailed sample collection, preservation, handling and storing, equipment decontamination, and QA/QC procedures.

3.1 Collect Samples

CLP RAS are generally used to analyze samples from Superfund sites. The matrices can be water, soil, sediment, filter, or wipe. Additional matrices requested under modified analysis may include oil, sludge, ash, biosolid or tissue.

A CLP sample consists of all sample aliquots (portions), provided that the analyses are all requested from the same CLP analytical program:

- for each individual or set of analytical analyses
- from one station location
- for one sample matrix
- at one concentration level
- for one laboratory
- for one analytical program

In some instances, a mixed-matrix sample may be collected which contains either a supernate (for a sediment/soil sample) or a precipitate (for a water sample). In this event, samplers should consult their sampling plans and/or discuss the required procedures with the RPM (or designee). In general, it is recommended that two individual samples be collected by separating the aqueous layer from the solid/precipitate layer at the point of collection if possible. If the phases or layers cannot be separated effectively in the field at the point of collection, arrangements should be made to separate the layers under controlled conditions at the receiving laboratory. In this case, additional sample numbers will be needed for the separate phases. They may be assigned two different sample IDs (e.g., Sample IDs ABC124 and ABC125 for Sample ID ABC123), along with a note in the field sample log or tracking system that the sample IDs are derived or related to the same sample ID, to ensure correct follow-up upon receipt of results from the laboratory.

3.1.1 Determine Types of Samples to be Collected

Samplers may be required to take several types of samples or sample aliquots during a sampling event. They should refer to their project plans to determine the types of samples or aliquots to be taken, the volumes needed of each sample or aliquot, and the preservation needed for each sample. For an explanation of the various sample types and the requirements for collecting and submitting each particular type, refer to Table 3-1.

Table 3-1. Sample Types and CLP Submission Requirements

Sample Type	Purpose	Collection[1]	CLP Sample Number
Field Duplicate	To check reproducibility of laboratory and field procedures. To indicate non-homogeneity.	Collect from areas that are known or suspected to be contaminated. Collect one sample per week or 10% (Regions may vary) of all field samples per matrix, whichever is greater.	Assign two separate (unique) CLP Sample numbers (i.e., one number to the field sample and one to the duplicate). Submit blind to the laboratory.
Field Blank	To check cross-contamination during sample collection, preservation, and shipment, as well as in the laboratory. Also to check sample containers and preservatives.	Collect for each group of samples of similar matrix with the frequency specified in the QAPP and Sampling Plan. Organics - Use water (demonstrated to be free of the contaminants of concern). Inorganics - Use metal-free (deionized or distilled) water or a single clean wipe or filter.	Assign separate CLP Sample numbers to the field blanks.
Temperature Blank	To provide an accurate measurement of field sample upon arrival to the laboratory. Also to establish whether the temperature range has been maintained while in transit.	Collect for each shipping container with the frequency specified in the QAPP and Sampling Plan.	Shipped together with samples from the field to the laboratory.
Trip Blank (Volatile Organic Analysis Only)	To check contamination of VOA samples during handling, storage, and shipment from field to laboratory.	Prior to going into the field, prepare and seal one trip blank sample per shipment per matrix. Trip blanks should be matched with respect to matrix and volume of the preservatives used. Before going into the field prepare trip blank samples with the same laboratory grade methanol and sodium bisulfate solution or reagent water used for field sampling. Carry each through the same sampling and handling protocols used for field samples. Aqueous trip blank samples should be prepared using water demonstrated to be free of the contaminants of concern (deionized water is appropriate). Place one trip blank sample for each matrix in each cooler used to ship VOA samples.	Assign separate CLP Sample numbers to the trip blanks.
Equipment Blank or Rinsate Blank	To check field decontamination procedures.	Collect when sampling equipment is decontaminated and reused in the field or when a sample collection vessel (bailer or beaker) will be used. Use blank water (water demonstrated to be organic-free, deionized or distilled for inorganics) and rinse water into the sample containers.	Assign separate CLP Sample numbers to the equipment blanks.
Matrix Spike (MS) and Matrix Spike Duplicate (MSD) (Organic Analysis Only)	To check accuracy and precision of organic analyses in specific sample matrices.	Collect from areas that are known or suspected to be contaminated. For smaller sampling events (i.e., 20 samples or less), MS/MSD additional volume should be collected in the first round of sampling and included in the first shipment of samples to the laboratory. Collect triple volume[2] for aqueous samples and soil VOA samples designated for MS/MSD analyses. Collect double volume for soil samples requiring SVOA, Pesticide, and/or Aroclor analysis and MS/MSD. See Table 3-2 and Appendix B for VOA collection volumes.	Assign the same CLP Sample number to the field sample and the extra volume for MS/MSD. Identify the sample designated for MS/MSD on the TR/COC record.
Matrix Spike (MS) and Duplicate (Inorganic Analysis Only)	To check accuracy and precision of inorganic analyses in specific sample matrices.	Collect from areas that are known or suspected to be contaminated. For smaller sampling events (i.e., 20 samples or less), Matrix Spike and Duplicates should be collected in the first round of sampling and included in the first shipment of samples to the laboratory. Additional sample volume may be required for inorganic analysis.[3]	Assign the same CLP Sample number to the field sample and extra volume (if collected). Identify the sample(s) designated for Matrix Spike and Duplicates on the TR/COC record.

Table 3-1. Sample Types and CLP Submission Requirements

Sample Type	Purpose	Collection[1]	CLP Sample Number
PE Samples	Specially-prepared QC samples used to evaluate a laboratory's analytical proficiency.	The PE samples contain analytes with concentrations unknown to the laboratory. Designated Regional or authorized personnel (depending on Regional policy) arrange for Case-specific CLP PE samples to be prepared and shipped by the QATS contractor. The PE samples can be shipped to the site, or shipped per Regional direction. QATS provides the appropriate preparation instructions and chain-of-custody materials.	Samplers must order PE samples and ship them to the laboratory if required by the Region.

[1] Consult Regional or Project Manager Guidance for field QC sample frequencies; laboratory QC sample frequencies are generally fixed in the laboratory subcontracts or specified in analytical methods.

[2] An aqueous sample for SVOA analysis would require the field sampler to collect at least 2 L of field samples and at least 2 L each for the MS and MSD samples for a total volume of 6 L. If Pesticide or Aroclor MS/MSD analyses are required for the same sample, an additional 6 L must be collected for each analysis method. Collect additional volume for MS/MSD samples to allow for sufficient volume for these analyses in the event sample volume is lost as a result of samples breaking, leaking, or laboratory accidents.

[3] Double volume should be sent for inorganic aqueous MS and Duplicate samples to allow for sufficient volume for these analyses in the event sample volume is lost as a result of samples breaking, leaking, re-extraction/redigestion, reanalysis, or laboratory accidents. Additional soil volume is not necessary for inorganic samples.

3.1.1.1 Collect Field QC Samples

Field QC samples are designed to assess variability of the media being sampled and to detect contamination and sampling error in the field. The types of field QC samples that are generally collected include field duplicates and field blanks (such as equipment, trip, or rinse blanks). Generally, field duplicate samples should remain "blind" to the laboratory (i.e., they should have separate CLP Sample numbers).

3.1.1.2 Collect Laboratory QC Samples

A laboratory QC sample is an additional analysis of a field sample, as required by the laboratory's contract. There are three types of laboratory QC samples:

- MS (for organic and inorganic samples)
- MSD (for organic samples only)
- Duplicates (for inorganic samples only)

Samplers should obtain Regional guidance regarding the collection of laboratory QC samples (especially for organics analyses). These are not required for wipes and air filter samples.

Samplers should select one sample per matrix per 20 samples as a "laboratory QC" sample. Designated organic laboratory QC samples should be noted on the Organic TR/COC record. Designated inorganic laboratory QC samples should be noted on the Inorganic TR/COC record. The sample(s) designated for laboratory QC should be noted in both "QC Type" column and the "Sample(s) to be used for laboratory QC" fields on the Organic and Inorganic TR/COC records.

The sampler should select a field sample as the laboratory QC sample. QC samples should be sent in the same cooler as the field samples when possible. If the sampler fails to designate a laboratory QC, this may cause a delay in the analyses of the samples.

In the event of multiple sample shipments during a sampling event, it is recommended that the sampler submit laboratory QC samples in the first sample shipment, and as necessary in subsequent shipments to meet laboratory contract requirements.

3.1.2 Meet Volume, Preservation, and Holding Time Requirements

Samplers should refer to their project plans to obtain the specific sample volumes to be collected, the preservation needed for those samples, and the technical holding times under which they must submit samples to the scheduled CLP laboratory. Sample collection parameters (including sample volumes, preservatives, and technical holding times) for organic collection and analysis are listed in Tables 3-2 and 3-3. Sample collection parameters for inorganic analysis and collection are listed in Table 3-4 and 3-5.

3.1.2.1 Collect Sample Volume

Collecting sufficient sample volume is critical. There must be sufficient physical sample volume for the analysis of all required parameters and completion of all QC determinations. The type of analytical procedure(s) to be performed will often dictate the sample volume to collect. For example, each water sample collected for VOA analysis by CLP SOW SOM01.X requires a minimum of three vials, each filled completely to a 40 mL capacity. See Appendix C for information regarding the collection of VOAs in water. When sampling for VOAs in soils, samplers must use SW-846 Method 5035A guidelines included in Appendix B. It is extremely important that samplers refer to their specific project plans to identify and collect the correct sample volume during each sampling event.

If a modified analysis requesting tissue samples required processing or homogenizing, it should be performed at a sample processing facility under clean room condition to reduce potential contamination. Tissue samples should be packed and cooled on ice immediately. Tissue samples should never be sent on Friday for Monday delivery.

3.1.2.2 Preserve Samples

Degradation of some contaminants may occur naturally (e.g., VOAs). The sampler must chemically preserve some water samples for certain analytes before shipping them to the laboratory. Any visible reaction between the sample and added chemical preservative should be noted in the field record.

The sampler should preserve and immediately cool all water samples to 4°C (±2°C) upon collection and samples should remain cooled until the time of analysis (do not freeze water samples). Preservation techniques vary among Regions so the sampler should obtain Region-specific instructions and review the appropriate project plans and SOPs. See Appendix C for information regarding the collection of VOAs in water.

3.1.2.3 Ship within Holding Times

Samplers should ship samples to scheduled CLP laboratories as soon as possible after collection. Daily shipment of samples to CLP laboratories is preferred whenever possible. If samples cannot be shipped on a daily basis, they must be properly preserved and maintained to meet CLP-specified temperatures, holding times, and custody requirements.

The technical holding times are the maximum time allowed between a sample collection and the completion of the sample extraction and/or analysis. In contrast, contractual holding times are the maximum lengths of time that the CLP laboratory can hold the sample prior to extraction and/or analysis. The contractual holding time is the elapsed time expressed in days from the date of receipt of the sample by the laboratory until the date of its analysis, as described in the appropriate CLP SOW. Contractual holding times are generally set to be two days less than the technical holding times to allow for sample packing and shipping.

If samplers are shipping samples after 5:00 PM ET, they must notify the RSCC (or designee) and SMO by 8:00 AM ET on the following business day. When making a Saturday delivery, samplers must notify the RSCC (or designee) and SMO as soon as possible so that SMO will receive the delivery information by 3:00 PM ET on the Friday prior to delivery.

Table 3-2. Sample Collection Requirements for CLP SOW SOM01.X (VOAs)

Matrix	Sample Type	Container Type[1]	Minimum Number of Containers Needed				Minimum Volume/Mass[2]	Important Notes	Preservative[3]	Technical Holding Time[4]
			with Water	Dry	% Moisture	TOTAL				
Water	Samples Only	40 mL amber glass vial, 24 mm neck finish. See Table 2-2, Reference Number 1.	-	-	-	**3**	Fill to capacity	Containers/vials must be filled to capacity with no headspace or air bubbles. Refer to Appendix C for samples requiring QC analyses.	Preserve to a pH of 2 with HCl and cool to 4°C (±2ºC) immediately after collection. DO NOT FREEZE water samples.	14 days
	Samples with SIM		-	-	-	**5**				
	Samples with MS/MSD		-	-	-	**9**				
Soil/ Sediment	Samples Only	**OPTION 1** Closed-system 40 mL amber glass vial containing magnetic stirrer, 24 mm neck finish. See Table 2-2, Reference Number 1.	-	3	1	**4**	5g	Place samples on side prior to being iced. Refer to Appendix B for samples requiring QC analyses.	Frozen to (-□7°C to -□15°C) **OR** Iced to 4° (±2°C).	14 days **OR** 48 hours (unpreserved)[5]
	Samples with MS/MSD		-	9	1	**10**				
	Samples Only	**OPTION 2** Closed-system 40 mL amber glass vial containing magnetic stirrer, 24 mm neck finish and 5 mL water. See Table 2-2, Reference Number 1.	2	1	1	**4**	5 g	Place samples on side prior to being iced. Refer to Appendix B for samples requiring QC analyses.	Frozen to (-□7°C to -□15°C) **OR** Iced to 4° (±2°C).	14 days **OR** 48 hours (unpreserved)[5]
	Samples with MS/MSD		6	1	1	**8**				
	Samples Only	**OPTION 3** Coring tool used as a transport device. See Table 2-2, Reference Number 7.	-	3	1	**4**	5g	Refer to Appendix B for samples requiring QC analysis. Place samples on side prior to being iced.	Frozen to (-□7°C to -□15°C) **OR** Iced to 4° (±2°C).	14 days **OR** 48 hours (unpreserved)[5]
	Samples with MS/MSD		-	9	1	**10**				

Notes

1 Vials for soil analysis are typically pre-labeled and tared vials for water analysis are not pre-labeled or tared.

2 Minimum volume/mass to be collected in order to ensure sample analysis can be performed. Collect additional volume for MS/MSD samples to allow for sufficient volume for these analyses in the event sample volume is lost as a result of samples breaking, leaking, or laboratory accidents.

3 Check Regional guidance regarding use of acid as a preservative of samples that may contain carbonates, residual chlorine, and other oxidants.

4 Technical holding time is calculated from the time of sample collection to sample extraction, and determined as 14 days for preserved (frozen or iced) samples and 48 hours for non-preserved (iced) samples. Sample extracts are to be analyzed within 40 days of extraction. It is recommended that samplers ship samples to the laboratory on the same day that they are collected, or as soon as possible thereafter.

5 Unpreserved soil samples can be frozen or iced at the time of receipt by the laboratory to increase holding time.

Table 3-3. Sample Collection Requirements for CLP SOW SOM01.X (SVOAs, Pesticides and Aroclors)

Analysis	Matrix	Sample Type	Container Type	Minimum Volume/Mass[1]	Important Notes	Preservative/ Collection	Technical Holding Time[2]
SVOAs	Water[3]	Samples Only	1 L amber round glass bottle, 33 mm pour-out neck finish. See Table 2-2, Reference Number 5.	2 L	If amber containers are not available, the samples should be protected from light.	Cool all samples to 4°C (±2°C) immediately after collection. DO NOT FREEZE water samples.	7 days
		Samples with MS/MSD	1 L amber round glass bottle, 33 mm pour-out neck finish. See Table 2-2, Reference Number 5.	6 L			
	Soil/ Sediment[4]	Samples Only	One 8 oz short, wide mouth, straight-sided, glass jar, 70 mm neck finish or two 4 oz tall, wide mouth, straight-sided, glass jar, 48 mm neck finish. See Table 2-2, Reference Numbers 3 and 4.	150 grams		Cool all samples to 4°C (±2°C) immediately after collection.	14 days
		Samples with MS/MSD	Two 8 oz short, wide mouth, straight-sided, glass jars, 70 mm neck finish or 4 oz tall, wide mouth, straight-sided, glass jar, 48 mm neck finish. See Table 2-2, Reference Numbers 3 and 4.	300 grams			
SVOA SIM	Water[3]	Samples Only	1 L amber round glass bottle, 33 mm pour-out neck finish. See Table 2-2, Reference Number 5.	2L	If amber containers are not available, the samples should be protected from light.	Cool all samples to 4°C (±2°C) immediately after collection. DO NOT FREEZE water samples.	7 days
		Samples with MS/MSD	1 L amber round glass bottle, 33 mm pour-out neck finish. See Table 2-2, Reference Number 5.	10L			
	Soil/ Sediment[4]	Samples Only	One 8 oz short, wide mouth, straight-sided, glass jar, 70 mm neck finish or two 4 oz tall, wide mouth, straight-sided, glass jar, 48 mm neck finish. See Table 2-2, Reference Numbers 3 and 4.	150 grams		Cool all samples to 4°C (±2°C) immediately after collection.	14 days
		Samples with MS/MSD	Two 8 oz short, wide mouth, straight-sided, glass jars, 70 mm neck finish or four 4 oz tall, wide mouth, straight-sided, glass jar, 48 mm neck finish. See Table 2-2, Reference Numbers 3 and 4.	300 grams			

Table 3-3. Sample Collection Requirements for CLP SOW SOM01.X (SVOAs, Pesticides and Aroclors) (Continued)

Analysis	Matrix	Sample Type	Container Type	Minimum Volume/Mass[1]	Important Notes	Preservative/ Collection	Technical Holding Time[2]
Pesticides	Water[3]	Samples Only	1 L amber round glass bottle, 33 mm pour-out neck finish. See Table 2-2, Reference Number 5.	2 L	If amber containers are not available, the samples should be protected from light.	Cool all samples to 4°C (±2°C) immediately after collection. DO NOT FREEZE water samples.	7 days
		Samples with MS/MSD	1 L amber round glass bottle, 33 mm pour-out neck finish. See Table 2-2, Reference Number 5.	6 L			
	Soil/ Sediment[4]	Samples Only	One 8 oz short, wide mouth, straight-sided, glass jar, 70 mm neck finish or four 4 oz tall, wide mouth, straight-sided, glass jar, 48 mm neck finish. See Table 2-2, Reference Numbers 3 and 4.	150 grams		Cool all samples to 4°C (±2°C) immediately after collection.	14 days
		Samples with MS/MSD	Two 8 oz short, wide mouth, straight-sided, glass jars, 70 mm neck finish or four 4 oz tall, wide mouth, straight-sided, glass jar, 48 mm neck finish. See Table 2-2, Reference Numbers 3 and 4.	300 grams			
Aroclors	Water[3]	Samples Only	1 L amber round glass bottle, 33 mm pour-out neck finish. See Table 2-2, Reference Number 5.	2 L	If amber containers are not available, the samples should be protected from light.	Cool all samples to 4°C (±2°C) immediately after collection. DO NOT FREEZE water samples.	7 days
		Samples with MS/MSD	1 L amber round glass bottle, 33 mm pour-out neck finish. See Table 2-2, Reference Number 5.	6 L			
	Soil/ Sediment[4]	Samples Only	One 8 oz short, wide mouth, straight-sided, glass jar, 70 mm neck finish or 4 oz tall, wide mouth, straight-sided, glass jar, 48 mm neck finish. See Table 2-2, Reference Numbers 3 and 4.	150 grams		Cool all samples to 4°C (±2°C) immediately after collection.	14 days
		Samples with MS/MSD	Two 8 oz short, wide mouth, straight-sided, glass jars, 70 mm neck finish or four 4 oz tall, wide mouth, straight-sided, glass jar, 48 mm neck finish. See Table 2-2, Reference Numbers 3 and 4.	300 grams			

Notes

1 Minimum volume/mass to be collected in order to ensure sample analysis can be performed.

2 This technical holding time is calculated from the time of sample collection to sample extraction. Sample extracts are to be analyzed within 40 days of extraction. It is recommended that samplers ship samples to the laboratory on the same day that they are collected, or as soon as possible thereafter.

3 An aqueous sample for SVOA analysis would require the field sampler to collect at least 2 L of field samples and at least 2 L each for the MS and MSD samples for a total volume of 6 L. If Pesticide or Aroclor MS/MSD analyses are required for the same sample, an additional 6 L must be collected for each analysis method. Collect additional volume for MS/MSD samples to allow for sufficient volume for these analyses in the event sample volume is lost as a result of samples breaking, leaking, or laboratory accidents.

4 If one or two extractable analyses are required for soil/sediment, only a single 8 oz. jar is required. If three extractable analyses are required, two 8 oz. jars are required. The number of jars should be doubled if MS/MSD is required.

Table 3-4. Sample Collection Requirements for CLP SOW ISM01.X

Analysis	Matrix	Sample Type	Container Type	Minimum Volume/ Mass[1]	Important Notes	Preservative/ Collection[2]	Technical Holding Time[3]
Metals/ICP-AES, Metals/ICP-MS, and/or Mercury by CVAA	Water	Samples Only	1 L high density polyethylene, cylinder-round bottle, 28 mm neck finish. See Table 2-2, Reference Number 2.	1L	DO NOT FREEZE water samples.	Acidify to pH < 2 with HNO_3 and cool to 4°C (±2°C) immediately after collection.[4]	6 months for all metals except Mercury (28 days)
		Samples with MS/Duplicate		2L			
	Soil/ Sediment[5]	Samples Only	One 8 oz short, wide mouth, straight-sided, glass jar, 70 mm neck finish. See Table 2-2, Reference Number 3.	Fill to capacity		Cool to 4°C (±2°C) immediately after collection.	6 months
		Samples with MS/Duplicate					
Metals/ICP-AES[6]	Wipe		1 qt polymer zip-top bag. See Table 2-2, Reference Number 9.	N/A		Store at room temperature.	6 months
	Filter		Filter cassette (25 or 37 mm) as transport device. See Table 2-2, Reference Number 10.	N/A		Store at room temperature.	6 months
Cyanide/ Spectrophotometric Determination	Water	Samples Only	1 L high density polyethylene, cylinder-round bottle, 28 mm neck finish. See Table 2-2, Reference Number 2.	1L	DO NOT FREEZE water samples.	To neutralize residual chlorine, add 0.6 g ascorbic acid for each liter of sample collected, immediately upon collection.[7] Add NaOH until pH >12 and cool to 4°C (±2°C) immediately after collection.	14 days
		Sample with MS/Duplicate		2L			
	Soil/ Sediment[5]	Samples Only	One 8 oz short, wide mouth, straight-sided, glass jar, 70 mm neck finish. See Table 2-2, Reference Number 3.	Fill to capacity		Cool to 4°C (±2°C) immediately after collection.	14 days
		Samples with MS/Duplicate					

Notes

1 Minimum volume/mass to be collected in order to ensure sample analysis can be performed.
2 Check Regional guidance regarding use of acid as a preservative of samples that may contain carbonates, residual chlorine, and other oxidants.
3 This technical holding time is calculated from the time of sample collection to sample extraction. Sample extracts are to be analyzed within 40 days of extraction.
4 Water samples collected for total metal and filtered metal analyses from the same sampling location must be assigned separate (unique) CLP Sample Numbers.
5 Only one 8 oz. jar is needed for soil/sediment when all metals (including mercury) and cyanide analyses are required for soil/sediment samples.
6 Filter method is intended for 25 mm or 37 mm mixed cellulose ester (MCE) filters in cassettes. Wipe materials have varied from laboratory tissues (e.g., Kimwipes®) to pre-moistened "baby wipes" from the nearest store.
7 Samplers must test for sulfide and oxidizing agents (e.g., chlorine) in aqueous samples in the field upon collection. Please refer to the SAP and Appendix C for guidance. Sulfides adversely affect the analytical procedure. The following can be done to test for and neutralize sulfides. Place a drop of the sample on lead acetate test paper to detect the presence of sulfides. If sulfides are present, treat 25 mL more of the sample than that required for the cyanide determination with powdered cadmium carbonate or lead carbonate. Yellow cadmium sulfide or black lead sulfide precipitates if the sample contains sulfide. Repeat this operation until a drop of the treated sample solution does not darken the lead acetate test paper. Filter the solution through a dry filter paper into a dry beaker, and from the filtrate measure the sample to be used for analysis. Avoid a large excess of cadmium carbonate and a long contact time in order to minimize a loss by complication or occlusion of cyanide on the precipitated material. Sulfide removal should be performed in the field, if practical, prior to pH adjustment with NaOH.

3.2 Complete Documentation

Samplers must complete all documentation, including the recording of the CLP Sample Number on the sample container or bottle, sample labels, and chain-of-custody seals (as appropriate), the TR/COC record, and the field operations records (as necessary).

Samplers should use the FORMS II Lite or Scribe software to create and print sample labels and the TR/COC record. Samplers can create and print out two copies of a sample label and attach one to the sample container or bottle, and place the other on the sample tag that may be attached to the sample container or bottle.

Samplers are expected to review their project plans to determine what documentation they are expected to include during a sampling event. It is highly recommended that samplers provide documentation, even if the Region does not require it.

Under no circumstances should the site name appear on any documentation being sent to the laboratory, unless the laboratory is a Regional USEPA laboratory. Then the Region copy of the TR/COC record shall be sent to the USEPA laboratory.

An example of a packaged sample is shown in Figure 3-1. A description of each type of documentation and instructions for accurate completion are included in the following sections.

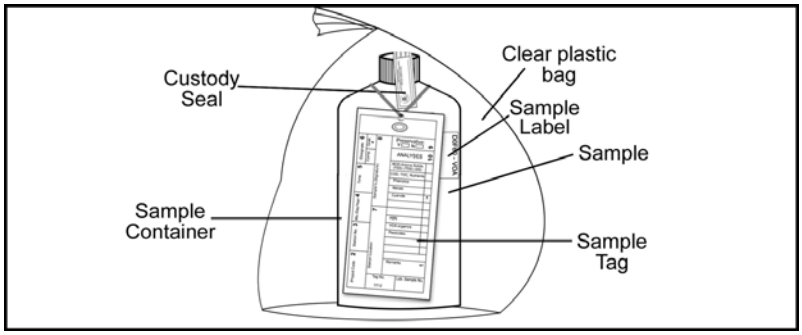

Figure 3-1. Packaged Sample with Identification and Chain-of-Custody Documentation (Excluding TR/COC Record)

3.2.1 Identify a Sample with a CLP Sample Number and SMO-assigned CLP Case Number

The analysis method, CLP Sample number, and SMO-assigned CLP Case number **must** be recorded on each sample taken during a sampling event (see Section 1.4.3). Samplers record these numbers on the sample tag, bottle or container label using permanent ink. The numbers must also be recorded on the sample tag, if required.

Filtered metal samples and total metal samples taken from the same sampling location cannot have the same CLP Sample Number because two different sets of data will be generated. Water samples collected for total metal and filtered metal analyses from the same sampling location must be assigned separate (unique) CLP Sample numbers.

3.2.2 Complete TR/COC Records

A Traffic Report is used as physical evidence of sample custody and as a permanent record for each sample collected. A chain-of-custody record documents the exchange and transportation of samples from the field to the laboratory.

ASB requires samplers to use the FORMS II Lite or Scribe software to create documentation for all CLP sampling efforts. For assistance with obtaining or using the FORMS II Lite software, please contact the FORMS II Lite Help Desk at 703-818-4200 from 9:00 AM - 5:00 PM ET. For assistance with obtaining

or using the Scribe software, please contact ERT Software Support Help Desk at 800-999-6990 from 9:00 AM - 5:00 PM ET.

To meet CLP sample documentation and chain-of-custody requirements, the sampler must attach a separate TR/COC record to each cooler they ship. The TR/COC record must document each sample within the cooler. TR/COC records should be separated and shipped in the coolers with the samples listed on them. Do not ship samples in a cooler without the corresponding TR/COC record. This practice maintains the chain-of-custody for all samples in case of incorrect shipment.

If more than one TR/COC record is used for the samples within one cooler, all of the records must have complete header information and original signatures. Samplers are responsible for the care and custody of samples from the time of collection to the time of shipment to the laboratories for analysis. A sample is considered under custody if:

- It is in possession or in view after being in possession
- It was in possession and then secured or sealed to prevent tampering
- It was in possession when placed in a secured area

Each time the custody of samples is turned over to another person, the TR/COC record must be signed off by the former custodian and accepted by the new custodian. Samplers are, therefore, responsible for properly completing any forms or other Region-required documentation used to establish the chain-of-custody for each sample during a sampling event.

3.2.2.1 Complete a TR/COC Record Using the FORMS II Lite Software

Once the sampler inputs sample collection information into FORMS II Lite, a TR/COC record will be generated electronically. The software automatically displays only the information to be entered by the sampler. FORMS II Lite then generates a laboratory and a Regional copy of the TR/COC record (see Figures 3-2 through 3-5). The sampler can print out multiple copies of the TR/COC record as necessary. The sampler must sign and submit original copies of the TR/COC record as appropriate.

An electronic TR/COC record created using the FORMS II Lite software contains basic header information; however, the sampler can also include some additional detailed information. For example, not only is the sample matrix listed on the electronic TR/COC record, but the name of the sampler taking the sample can also be entered. Samplers should note that certain information will not appear on the electronic TR/COC record (e.g., matrix and preservative descriptions).

3.2.2.2 Complete a COC Record Using the Scribe Software

Once the sampler inputs sample collection information into Scribe, a Chain-of-Custody (COC) record will be generated electronically. The software automatically displays only the information to be entered by the sampler. Scribe then generates a laboratory and a Regional copy of the COC record (see Figures 3-6 through 3-9). The sampler can print out multiple copies of the COC record as necessary. The sampler must sign and submit original copies of the COC record as appropriate.

An electronic COC record created using the Scribe software contains basic header information; however, the sampler can also include some additional detailed information. For example, not only is the sample matrix listed on the electronic COC record, but the name of the sampler taking the sample can also be entered. Samplers should note that certain information will not appear on the electronic COC record (e.g., matrix and preservative descriptions).

3.2.2.3 Indicate Modified Analysis on FORMS II Lite TR/COC Records

When completing a TR/COC record using FORMS II Lite, the sampler should identify any samples that will be analyzed using a CLP Modified Analysis. Samplers should indicate use of a Modified Analysis by creating a new analysis within the FORMS II Lite Wizard or through the FORMS II Lite reference tables. This newly-created analysis should contain the Modification Reference Number within the name assigned to the analysis. For example, if a Region submits a Modified Analysis for an additional analyte, and SMO assigns the Modification Reference Number 1301.0, the FORMS II Lite analysis could be named "VOA

by M.A. 1301.0." The associated abbreviation for this analysis could be "VOA M.A." If you have any questions regarding identification of Modified Analysis using FORMS II Lite, please contact the FORMS II Lite Help Desk at 703-818-4200 from 9:00 AM - 5:00 PM ET.

3.2.2.4 Indicate Modified Analysis on Scribe COC Records

When completing a COC record using Scribe, the sampler should identify any samples that will be analyzed using a CLP Modified Analysis. Samplers should indicate use of a Modified Analysis (MA) by creating a new analysis within the Scribe Analyses table or at the time of entering the Analyses for the sample. This newly-created analysis should contain the Modification Reference Number within the name assigned to the analysis. For example, if a Region submits a MA for an additional analyte, and SMO assigns the Modification Reference Number 1301.0, the Scribe Analyses could be named "CLP VOA by M.A. 1301.0." The associated abbreviation for this analysis could be "VOA M.A." If you have any questions regarding identification of Modified Analysis using Scribe, please contact the ERT Software Support Help Desk at 800-999-6990.

3.2.2.5 Make Manual Edits to Printed FORMS II Lite TR/COC Records

If a FORMS II Lite TR/COC Record has been printed and deletions or edits need to be made by the sampler, the following procedures must be followed:

- If corrections occur after shipment, adhere to Region-specific procedures and guidelines on handling hard copy TR/COC records.
- If making a deletion, manually cross out the information to be disregarded from the TR/COC record, initial and date the deletion.
- If making an addition, enter the new information and initial, sign and date the newly added information.

All modifications made on a printed TR/COC record must be initialed and dated.

3.2.2.6 Make Manual Edits to Printed Scribe COC Records

If a Scribe COC Record has been printed and deletions or edits need to be made by the sampler, the following procedures must be followed:

- If corrections occur after shipment, adhere to Region-specific procedures and guidelines on handling hard copy COC records.
- If making a deletion, correct the deletion in Scribe and reprint the COC record. Discard the original.
- If making an addition, enter the new information in Scribe and reprint the COC record. Discard the original.

USEPA Contract Laboratory Program
Organic Traffic Report & Chain of Custody Record

Case No:	**39400**
DAS No:	DAS9000
SDG No:	

L

Date Shipped:	11/9/2009
Carrier Name:	FedEx
Airbill:	987654321123456789
Shipped to:	Organic Laboratory 1234 Smith Drive Anywhere AR 123456 (123) 456-7890

Chain of Custody Record

Relinquished By	(Date / Time)	Received By	(Date / Time)
1			
2.			
3.			
4.			

Sampler Signature:

For Lab Use Only

Lab Contract No:	
Unit Price:	
Transfer To:	
Lab Contract No:	
Unit Price:	

ORGANIC SAMPLE No.	MATRIX/ SAMPLER	CONC/ TYPE	ANALYSIS/ TURNAROUND	TAG No./ PRESERVATIVE/ Bottles	STATION LOCATION	SAMPLE COLLECT DATE/TIME		INORGANIC SAMPLE No.	FOR LAB USE ONLY Sample Condition On Receipt
C3TK1	Surface Water/ BOBBY SAMPLER	/G	1310.0 (21), BNA (14), CLP ARO (14), CLP PEST (14), VOA (14)	6-2119002, 6-2119003, 6-2119004 (Ice Only), 6-2119005 (Ice Only), 6-2119006, 6-2119008 (6)	LOCATION ONE	S: 11/6/2009	14:57	MC3TK1	
C3TK2	Surface Water/ DAN SAMPLER	/G	BNA (14), CLP ARO (14), CLP PEST (14), VOA (14)	6-2119010, 6-2119011, 6-2119012 (Ice Only), 6-2119013 (Ice Only), 6-2119014 (5)	LOCATION TWO	S: 11/9/2009	8:13	MC3TK2	
C3TK4	Surface Water/ DAN SAMPLER	/G	1310.0 (21)	6-2119026 (1)	LOCATION THREE	S: 11/9/2009	8:14	MC3TK4	
C3TK5	Surface Water/ JOHN SAMPLER	/G	BNA (14), CLP ARO (14), CLP PEST (14), VOA (14)	6-2119027 (Ice Only), 6-2119028 (Ice Only) (5)	LOCATION FOUR	S: 11/9/2009	8:14		
C3TK6	Surface Water/ JOHN SAMPLER	/G	1310.0 (21), BNA (14), CLP ARO (14), CLP PEST (14), VOA (14)	6-2119033, 6-2119034, 6-2119035 (Ice Only), 6-2119036 (Ice Only), 6-2119037, 6-2119039 (6)	LOCATION FIVE	S: 11/9/2009	8:14	MC3TK6	
C3TK7	Surface Water/ JOHN SAMPLER	/G	1310.0 (21), BNA (14), CLP ARO (14), CLP PEST (14), VOA (14)	6-2119041, 6-2119042, 6-2119043 (Ice Only), 6-2119044 (Ice Only), 6-2119045, 6-2119047 (6)	LOCATION SIX	S: 11/9/2009	8:14	MC3TK7	

Shipment for Case Complete?N	**Sample(s) to be used for laboratory QC:** C3TK1	**Additional Sampler Signature(s):**	**Cooler Temperature Upon Receipt:**	**Chain of Custody Seal Number:**
Analysis Key:	**Concentration:** L = Low, M = Low/Medium, H = High	**Type/Designate:** Composite = C, Grab = G		**Custody Seal Intact?** ___ **Shipment Iced?** ___

1310.0 = VOA by MA 1310.0, BNA = CLP TCL Semivolatiles, CLP ARO = CLP TCL PCB (Aroclors), CLP PEST = CLP TCL Pesticides, VOA = CLP TCL Volatiles

TR Number: 3-043013577-050310-0004

LABORATORY COPY

PR provides preliminary results. Requests for preliminary results will increase analytical costs.
Send Copy to: Sample Management Office, Attn: Heather Bauer, CSC, 15000 Conference Center Dr., Chantilly, VA 20151-3819; Phone 703/818-4200; Fax 703/818-4602

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Figure 3-2. FORMS II Lite Organic Traffic Report & Chain of Custody Record (Laboratory Copy)

USEPA Contract Laboratory Program
Inorganic Traffic Report & Chain of Custody Record

Case No:	**39400**		**L**
DAS No:	DAS9000		
SDG No:			

Date Shipped:	11/9/2009	**Chain of Custody Record**		**Sampler Signature:**	**For Lab Use Only**
Carrier Name:	FedEx	**Relinquished By**	**(Date / Time)**	**Received By**	**(Date / Time)**
Airbill:	123456789987654321	1			**Lab Contract No:**
Shipped to:	Inorganic Laboratory 1234 Watson Drive Anywhere NC 123456 (123) 456-7892	2.			**Unit Price:**
		3.			**Transfer To:**
		4.			**Lab Contract No:**
					Unit Price:

INORGANIC SAMPLE No.	MATRIX/ SAMPLER	CONC/ TYPE	ANALYSIS/ TURNAROUND	TAG No./ PRESERVATIVE/ Bottles	STATION LOCATION	SAMPLE COLLECT DATE/TIME		ORGANIC SAMPLE No.	FOR LAB USE ONLY Sample Condition On Receipt
MC3TK1	Surface Water/ BOBBY SAMPLER	/G	1705.0 (21), AES 1-4 (14)	6-2119001, 6-2119007 (2)	LOCATION ONE	S: 11/6/2009	14:57	C3TK1	
MC3TK2	Surface Water/ DAN SAMPLER	/G	AES 1-4 (14)	6-2119009 (1)	LOCATION TWO	S: 11/9/2009	8:13	C3TK2	
MC3TK4	Surface Water/ DAN SAMPLER	/G	1705.0 (21)	6-2119025 (1)	LOCATION THREE	S: 11/9/2009	8:14	C3TK4	
MC3TK6	Surface Water/ JOHN SAMPLER	/G	1705.0 (21), AES 1-4 (14)	6-2119032, 6-2119038 (2)	LOCATION FIVE	S: 11/9/2009	8:14	C3TK6	
MC3TK7	Surface Water/ JOHN SAMPLER	/G	1705.0 (21), AES 1-4 (14)	6-2119040, 6-2119046 (2)	LOCATION SIX	S: 11/9/2009	8:14	C3TK7	

Shipment for Case Complete? Y	**Sample(s) to be used for laboratory QC:** MC3TK1	**Additional Sampler Signature(s):**		**Cooler Temperature Upon Receipt:**	**Chain of Custody Seal Number:**
Analysis Key:	**Concentration:** L = Low, M = Low/Medium, H = High	**Type/Designate:** Composite = C, Grab = G			**Custody Seal Intact?** ___ **Shipment Iced?** ___
1705.0 = TCLP Metals and Hg by 1705.0, AES 1-4 = AES-Ba, Ca, Cr, Al					

TR Number: **3-043013577-050310-0003**

LABORATORY COPY

PR provides preliminary results. Requests for preliminary results will increase analytical costs.
Send Copy to: Sample Management Office, Attn: Heather Bauer, CSC, 15000 Conference Center Dr., Chantilly, VA 20151-3819; Phone 703/818-4200; Fax 703/818-4602

F2V5.1. 047 Page 1 of 1

Figure 3-3. FORMS II Lite Inorganic Traffic Report & Chain of Custody Record (Laboratory Copy)

USEPA Contract Laboratory Program
Organic Traffic Report & Chain of Custody Record

Case No:	**39400**		R
DAS No:	DAS9000		

Region:	3	**Date Shipped:**	11/9/2009	**Chain of Custody Record**	**Sampler Signature:**
Project Code:		**Carrier Name:**	FedEx		
Account Code:	QW-123 ACCT000	**Airbill:**	987654321123456789	**Relinquished By** (Date / Time)	**Received By** (Date / Time)
CERCLIS ID:		**Shipped to:**	Organic Laboratory 1234 Smith Drive Anywhere AR 123456 (123) 456-7890	1	
Spill ID:	ID3			2.	
Site Name/State:	REAL SITE/VA			3.	
Project Leader:	DAN SAMPLER			4.	
Action:	Combined RI/FS				
Sampling Co:	SMITH CO.				

ORGANIC SAMPLE No.	MATRIX/ SAMPLER	CONC/ TYPE	ANALYSIS/ TURNAROUND	TAG No./ PRESERVATIVE/ Bottles	STATION LOCATION	SAMPLE COLLECT DATE/TIME		INORGANIC SAMPLE No.	QC Type
C3TK1	Surface Water/ BOBBY SAMPLER	/G	1310.0 (21), BNA (14), CLP ARO (14), CLP PEST (14), VOA (14)	6-2119002, 6-2119003, 6-2119004 (Ice Only), 6-2119005 (Ice Only), 6-2119006, 6-2119008 (6)	LOCATION ONE	S: 11/6/2009	14:57	MC3TK1	Lab QC
C3TK2	Surface Water/ DAN SAMPLER	/G	BNA (14), CLP ARO (14), CLP PEST (14), VOA (14)	6-2119010, 6-2119011, 6-2119012 (Ice Only), 6-2119013 (Ice Only), 6-2119014 (5)	LOCATION TWO	S: 11/9/2009	8:13	MC3TK2	Trip Blank
C3TK4	Surface Water/ DAN SAMPLER	/G	1310.0 (21)	6-2119026 (1)	LOCATION THREE	S: 11/9/2009	8:14	MC3TK4	--
C3TK5	Surface Water/ JOHN SAMPLER	/G	BNA (14), CLP ARO (14), CLP PEST (14), VOA (14)	6-2119027 (Ice Only), 6-2119028 (Ice Only) (5)	LOCATION FOUR	S: 11/9/2009	8:14		Rinsate
C3TK6	Surface Water/ JOHN SAMPLER	/G	1310.0 (21), BNA (14), CLP ARO (14), CLP PEST (14), VOA (14)	6-2119033, 6-2119034, 6-2119035 (Ice Only), 6-2119036 (Ice Only), 6-2119037, 6-2119039 (6)	LOCATION FIVE	S: 11/9/2009	8:14	MC3TK6	PE
C3TK7	Surface Water/ JOHN SAMPLER	/G	1310.0 (21), BNA (14), CLP ARO (14), CLP PEST (14), VOA (14)	6-2119041, 6-2119042, 6-2119043 (Ice Only), 6-2119044 (Ice Only), 6-2119045, 6-2119047 (6)	LOCATION SIX	S: 11/9/2009	8:14	MC3TK7	Field Duplicate

Shipment for Case Complete? N	**Sample(s) to be used for laboratory QC:** C3TK1	**Additional Sampler Signature(s):**	**Chain of Custody Seal Number:**
Analysis Key:	**Concentration:** L = Low, M = Low/Medium, H = High	**Type/Designate:** Composite = C, Grab = G	**Shipment Iced?**

1310.0 = VOA by MA 1310.0, BNA = CLP TCL Semivolatiles, CLP ARO = CLP TCL PCB (Aroclors), CLP PEST = CLP TCL Pesticides, VOA = CLP TCL Volatiles

TR Number: 3-043013577-050310-0004

REGION COPY

PR provides preliminary results. Requests for preliminary results will increase analytical costs.

Send Copy to: Sample Management Office, Attn: Heather Bauer, CSC, 15000 Conference Center Dr., Chantilly, VA 20151-3819; Phone 703/818-4200; Fax 703/818-4602

F2V5.1.047 Page 1 of 1

Figure 3-4. FORMS II Lite Organic Traffic Report & Chain of Custody Record (Region Copy)

USEPA Contract Laboratory Program
Inorganic Traffic Report & Chain of Custody Record

Case No:	**39400**	R
DAS No:	DAS9000	

Region:	3	**Date Shipped:**	11/9/2009	**Chain of Custody Record**	**Sampler Signature:**
Project Code:	QW-123	**Carrier Name:**	FedEx	**Relinquished By** (Date / Time)	**Received By** (Date / Time)
Account Code:	ACCT000	**Airbill:**	123456789987654321	1	
CERCLIS ID:		**Shipped to:**	Inorganic Laboratory 1234 Watson Drive Anywhere NC 123456 (123) 456-7892	2.	
Spill ID:	ID3			3.	
Site Name/State:	REAL SITE/VA			4.	
Project Leader:	DAN SAMPLER				
Action:	Combined RI/FS				
Sampling Co:	SMITH CO.				

INORGANIC SAMPLE No.	MATRIX/ SAMPLER	CONC/ TYPE	ANALYSIS/ TURNAROUND	TAG No./ PRESERVATIVE/ Bottles	STATION LOCATION	SAMPLE COLLECT DATE/TIME		ORGANIC SAMPLE No.	QC Type
MC3TK1	Surface Water/ BOBBY SAMPLER	/G	1705.0 (21), AES 1-4 (14)	6-2119001, 6-2119007 (2)	LOCATION ONE	S: 11/6/2009	14:57	C3TK1	Lab QC
MC3TK2	Surface Water/ DAN SAMPLER	/G	AES 1-4 (14)	6-2119009 (1)	LOCATION TWO	S: 11/9/2009	8:13	C3TK2	Trip Blank
MC3TK4	Surface Water/ DAN SAMPLER	/G	1705.0 (21)	6-2119025 (1)	LOCATION THREE	S: 11/9/2009	8:14	C3TK4	--
MC3TK6	Surface Water/ JOHN SAMPLER	/G	1705.0 (21), AES 1-4 (14)	6-2119032, 6-2119038 (2)	LOCATION FIVE	S: 11/9/2009	8:14	C3TK6	PE
MC3TK7	Surface Water/ JOHN SAMPLER	/G	1705.0 (21), AES 1-4 (14)	6-2119040, 6-2119046 (2)	LOCATION SIX	S: 11/9/2009	8:14	C3TK7	Field Duplicate

Shipment for Case Complete? Y	**Sample(s) to be used for laboratory QC:** MC3TK1	**Additional Sampler Signature(s):**	**Chain of Custody Seal Number:**
Analysis Key:	**Concentration:** L = Low, M = Low/Medium, H = High	**Type/Designate:** Composite = C, Grab = G	**Shipment Iced?** _____

1705.0 = TCLP Metals and Hg by 1705.0, AES 1-4 = AES-Ba, Ca, Cr, Al

TR Number: **3-043013577-050310-0003**

PR provides preliminary results. Requests for preliminary results will increase analytical costs.

Send Copy to: Sample Management Office, Attn: Heather Bauer, CSC, 15000 Conference Center Dr., Chantilly, VA 20151-3819; Phone 703/818-4200; Fax 703/818-4602

REGION COPY

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Figure 3-5. FORMS II Lite Inorganic Traffic Report & Chain of Custody Record (Region Copy)

Page 1 of 1

USEPA CLP Organics COC (LAB COPY)
DateShipped: 2/1/2010
CarrierName: FedEx
AirbillNo: 841821272121

CHAIN OF CUSTODY RECORD
Case #: 12345
Cooler #: 4

No: 39428-01/29/10-0016
Lab: Generic Organic Lab
Lab Contact: Mr. Lab Contact
Lab Phone: 555-555-1234

Organic Sample #	Matrix/Sampler	Coll. Method	Analysis/Turnaround	Tag/Preservative/Bottles	Station Location	Collected	Inorganic Sample #	For Lab Use Only
B7260	Sediment/ SERAS	Grab	CLP TCL Pesticides(14), CLP TCL PCBs(14), BNA(14)	1587, 1588, 1589 (3)	ERT4-3-A	01/29/2010 11:40	MB7260	
B7261	Sediment/ SERAS	Grab	BNA(14), CLP TCL PCBs(14), CLP TCL Pesticides(14)	1594, 1596, 1597 (3)	ERT4-3-B	01/29/2010 11:40	MB7261	
B7262	Sediment/ SERAS	Grab	BNA(14), CLP TCL PCBs(14), CLP TCL Pesticides(14)	1600, 1602, 1603 (3)	ERT4-3-C	01/29/2010 11:40	MB7262	
B7263	Sediment/ SERAS	Grab	BNA(14), CLP TCL PCBs(14), CLP TCL Pesticides(14)	1606, 1608, 1609 (3)	ERT4-3-D	01/29/2010 11:40	MB7263	
B7264	Sediment/ SERAS	Grab	BNA(14), CLP TCL PCBs(14), CLP TCL Pesticides(14)	1612, 1614, 1615 (3)	ERT4-3-E	01/29/2010 11:40	MB7264	
B7265	Sediment/ SERAS	Grab	BNA(14), CLP TCL PCBs(14), CLP TCL Pesticides(14)	1618, 1620, 1621 (3)	ERT4-3-F	01/29/2010 11:40	MB7265	
B7266	Sediment/ SERAS	Grab	BNA(14), CLP TCL PCBs(14), CLP TCL Pesticides(14)	1624, 1626, 1627 (3)	ERT4-3-G	01/29/2010 11:40	MB7266	
B7267	Sediment/ SERAS	Grab	BNA(14), CLP TCL PCBs(14), CLP TCL Pesticides(14)	1630, 1632, 1633 (3)	ERT4-3-H	01/29/2010 11:40	MB7267	
B7268	Sediment/ SERAS	Grab	BNA(14), CLP TCL PCBs(14), CLP TCL Pesticides(14)	1636, 1638, 1639 (3)	ERT4-3-I	01/29/2010 11:40	MB7268	
B7269	Sediment/ SERAS	Grab	BNA(14), CLP TCL PCBs(14), CLP TCL Pesticides(14)	1642, 1644, 1645 (3)	ERT4-3-J	01/29/2010 11:40	MB7269	
B7270	Sediment/ SERAS	Grab	BNA(14), CLP TCL PCBs(14), CLP TCL Pesticides(14)	1648, 1650, 1651 (3)	ERT4-3-K	01/29/2010 11:40	MB7270	

Special Instructions:	**Shipment for Case Complete? N**
	Samples Transferred From Chain of Custody #
Analysis Key: BNA=CLP TCL Semivolatiles	

Items/Reason	Relinquished by	Date	Received by	Date	Time	Items/Reason	Relinquished By	Date	Received by	Date	Time

Figure 3-6. Scribe Organics Chain of Custody Record (Laboratory Copy)

Page 1 of 1

USEPA CLP Organics COC (REGION COPY)
DateShipped: 2/1/2010
CarrierName: FedEx
AirbillNo: 841821272121

CHAIN OF CUSTODY RECORD
Scribe CLP Site
Cooler #: 4

No: 39428-01/29/10-0016
Lab: Generic Organic Lab
Lab Contact: Mr. Lab Contact
Lab Phone: 555-555-1234

Organic Sample #	Matrix/Sampler	Coll. Method	Analysis/Turnaround	Tag/Preservative/Bottles	Station Location	Collected	Inorganic Sample #	Sample Type
B7260	Sediment/ SERAS	Grab	CLP TCL Pesticides(14), CLP TCL PCBs(14), BNA(14)	1587, 1588, 1589 (3)	ERT4-3-A	01/29/2010 11:40	MB7260	Field Sample
B7261	Sediment/ SERAS	Grab	BNA(14), CLP TCL PCBs(14), CLP TCL Pesticides(14)	1594, 1596, 1597 (3)	ERT4-3-B	01/29/2010 11:40	MB7261	Field Sample
B7262	Sediment/ SERAS	Grab	BNA(14), CLP TCL PCBs(14), CLP TCL Pesticides(14)	1600, 1602, 1603 (3)	ERT4-3-C	01/29/2010 11:40	MB7262	Field Sample
B7263	Sediment/ SERAS	Grab	BNA(14), CLP TCL PCBs(14), CLP TCL Pesticides(14)	1606, 1608, 1609 (3)	ERT4-3-D	01/29/2010 11:40	MB7263	Field Sample
B7264	Sediment/ SERAS	Grab	BNA(14), CLP TCL PCBs(14), CLP TCL Pesticides(14)	1612, 1614, 1615 (3)	ERT4-3-E	01/29/2010 11:40	MB7264	Field Sample
B7265	Sediment/ SERAS	Grab	BNA(14), CLP TCL PCBs(14), CLP TCL Pesticides(14)	1618, 1620, 1621 (3)	ERT4-3-F	01/29/2010 11:40	MB7265	Field Sample
B7266	Sediment/ SERAS	Grab	BNA(14), CLP TCL PCBs(14), CLP TCL Pesticides(14)	1624, 1626, 1627 (3)	ERT4-3-G	01/29/2010 11:40	MB7266	Field Sample
B7267	Sediment/ SERAS	Grab	BNA(14), CLP TCL PCBs(14), CLP TCL Pesticides(14)	1630, 1632, 1633 (3)	ERT4-3-H	01/29/2010 11:40	MB7267	Field Sample
B7268	Sediment/ SERAS	Grab	BNA(14), CLP TCL PCBs(14), CLP TCL Pesticides(14)	1636, 1638, 1639 (3)	ERT4-3-I	01/29/2010 11:40	MB7268	Field Sample
B7269	Sediment/ SERAS	Grab	BNA(14), CLP TCL PCBs(14), CLP TCL Pesticides(14)	1642, 1644, 1645 (3)	ERT4-3-J	01/29/2010 11:40	MB7269	Field Sample
B7270	Sediment/ SERAS	Grab	BNA(14), CLP TCL PCBs(14), CLP TCL Pesticides(14)	1648, 1650, 1651 (3)	ERT4-3-K	01/29/2010 11:40	MB7270	Field Sample

Special Instructions:	**Shipment for Case Complete? N**
	Samples Transferred From Chain of Custody #
Analysis Key: BNA=CLP TCL Semivolatiles	

Items/Reason	Relinquished by	Date	Received by	Date	Time		Items/Reason	Relinquished By	Date	Received by	Date	Time

Figure 3-7. Scribe Organics Chain of Custody Record (Region Copy)

Page 2 of 3

USEPA CLP Inorganics COC (LAB COPY)
DateShipped: 2/1/2010
CarrierName: FedEx
AirbillNo: 841821272187

CHAIN OF CUSTODY RECORD
Case #: 12345
Cooler #: 2

No: 39428-01/29/10-0012
Lab: Generic Inorganic Lab
Lab Contact: Mr. Lab Contact
Lab Phone: 555-555-1234

Inorganic Sample #	Matrix/Sampler	Coll. Method	Analysis/Turnaround	Tag/Preservative/Bottles	Station Location	Collected	Organic Sample #	For Lab Use Only
MB7268	Sediment/ SERAS	Grab	CLP TAL/Hg/CN(14)	1635 (1)	ERT4-3-I	01/29/2010 11:40	B7268	
MB7269	Sediment/ SERAS	Grab	CLP TAL/Hg/CN(14)	1641 (1)	ERT4-3-J	01/29/2010 11:40	B7269	
MB7270	Sediment/ SERAS	Grab	CLP TAL/Hg/CN(14)	1647 (1)	ERT4-3-K	01/29/2010 11:40	B7270	
MB7271	Sediment/ SERAS	Grab	CLP TAL/Hg/CN(14)	1656 (1)	ERT3-3-A	01/29/2010 11:00	B7271	
MB7272	Sediment/ SERAS	Grab	CLP TAL/Hg/CN(14)	1659 (1)	ERT3-3-B	01/29/2010 11:00	B7272	
MB7273	Sediment/ SERAS	Grab	CLP TAL/Hg/CN(14)	1665 (1)	ERT3-3-C	01/29/2010 11:00	B7273	
MB7274	Sediment/ SERAS	Grab	CLP TAL/Hg/CN(14)	1671 (1)	ERT3-3-D	01/29/2010 11:00	B7274	
MB7275	Sediment/ SERAS	Grab	CLP TAL/Hg/CN(14)	1677 (1)	ERT3-3-E	01/29/2010 11:00	B7275	
MB7276	Sediment/ SERAS	Grab	CLP TAL/Hg/CN(14)	1683 (1)	ERT3-3-F	01/29/2010 11:00	B7276	
MB7277	Sediment/ SERAS	Grab	CLP TAL/Hg/CN(14)	1689 (1)	ERT3-3-G	01/29/2010 11:00	B7277	
MB7278	Sediment/ SERAS	Grab	CLP TAL/Hg/CN(14)	1695 (1)	ERT3-3-H	01/29/2010 11:00	B7278	

Sample(s) to be used for Lab QC: MB7276	**Shipment for Case Complete? N**
	Samples Transferred From Chain of Custody #
Analysis Key: TM=CLP TAL Total Metals, CN=CLP CN	

Items/Reason	Relinquished by	Date	Received by	Date	Time	Items/Reason	Relinquished By	Date	Received by	Date	Time

Figure 3-8. Scribe Inorganics Chain of Custody Record (Laboratory Copy)

Page 2 of 3

USEPA CLP Inorganics COC (REGION COPY)
DateShipped: 2/1/2010
CarrierName: FedEx
AirbillNo: 841821272187

CHAIN OF CUSTODY RECORD
Scribe CLP Site
Case #: 12345
Cooler #: 2

No: 39428-01/29/10-0012
Lab: Generic Inorganic Lab
Lab Contact: Mr. Lab Contact
Lab Phone: 555-555-1234

Inorganic Sample #	Matrix/Sampler	Coll. Method	Analysis/Turnaround	Tag/Preservative/Bottles	Station Location	Collected	Organic Sample #	Sample Type
MB7268	Sediment/ SERAS	Grab	CLP TAL/Hg/CN(14)	1635 (1)	ERT4-3-I	01/29/2010 11:40	B7268	Field Sample
MB7269	Sediment/ SERAS	Grab	CLP TAL/Hg/CN(14)	1641 (1)	ERT4-3-J	01/29/2010 11:40	B7269	Field Sample
MB7270	Sediment/ SERAS	Grab	CLP TAL/Hg/CN(14)	1647 (1)	ERT4-3-K	01/29/2010 11:40	B7270	Field Sample
MB7271	Sediment/ SERAS	Grab	CLP TAL/Hg/CN(14)	1656 (1)	ERT3-3-A	01/29/2010 11:00	B7271	Field Sample
MB7272	Sediment/ SERAS	Grab	CLP TAL/Hg/CN(14)	1659 (1)	ERT3-3-B	01/29/2010 11:00	B7272	Field Sample
MB7273	Sediment/ SERAS	Grab	CLP TAL/Hg/CN(14)	1665 (1)	ERT3-3-C	01/29/2010 11:00	B7273	Field Sample
MB7274	Sediment/ SERAS	Grab	CLP TAL/Hg/CN(14)	1671 (1)	ERT3-3-D	01/29/2010 11:00	B7274	Field Sample
MB7275	Sediment/ SERAS	Grab	CLP TAL/Hg/CN(14)	1677 (1)	ERT3-3-E	01/29/2010 11:00	B7275	Field Sample
MB7276	Sediment/ SERAS	Grab	CLP TAL/Hg/CN(14)	1683 (1)	ERT3-3-F	01/29/2010 11:00	B7276	Field Sample
MB7277	Sediment/ SERAS	Grab	CLP TAL/Hg/CN(14)	1689 (1)	ERT3-3-G	01/29/2010 11:00	B7277	Field Sample
MB7278	Sediment/ SERAS	Grab	CLP TAL/Hg/CN(14)	1695 (1)	ERT3-3-H	01/29/2010 11:00	B7278	Field Sample

Sample(s) to be used for Lab QC: MB7276	**Shipment for Case Complete? N** **Samples Transferred From Chain of Custody #**
Analysis Key: TM=CLP TAL Total Metals, CN=CLP CN	

Items/Reason	Relinquished by	Date	Received by	Date	Time		Items/Reason	Relinquished By	Date	Received by	Date	Time

Figure 3-9. Scribe Inorganics Chain of Custody Record (Region Copy)

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3.2.3 Complete and Attach Custody Seals

Custody seals are usually pre-printed stickers that are signed (or initialed) and dated by the sampler after sample collection and placed on sample bottles or containers and/or shipping coolers or containers (see Figure 3-10). The custody seals document the person who sealed the sample container and verify that the sample has not been tampered with. The seals must be placed such that they will break if the sample bottle or container or the shipping cooler or container is tampered with or opened after leaving custody of samplers. Custody seals can also be used to maintain custody of other items such as envelopes containing videotapes of the sample collection process. Instructions for completing and attaching a custody seal are included in Table 3-5.

The use and type of custody seals can vary by Region or collecting organization. Samplers should obtain the appropriate custody seals and specific instructions for correctly attaching them from the RSCC.

Note

Custody seals should never be placed directly onto a coring tool used as a transport device (e.g., 5 g Sampler) or tared, 40 mL closed-system vials. The seals must be placed on the bag for the coring tool used as a transport device, or on the bag used to enclose the vials. Refer to Appendix B for details.

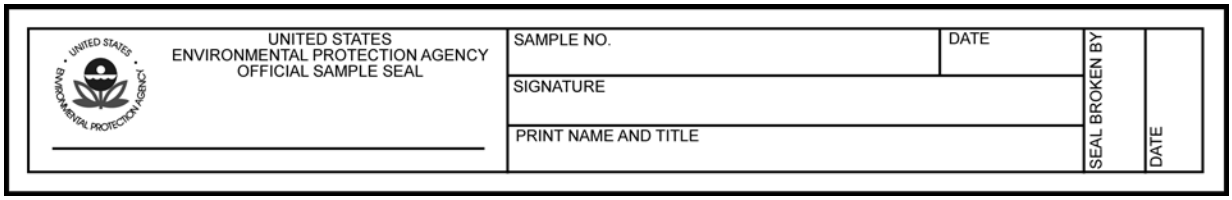

Figure 3-10. Custody Seal

Table 3-5. Completing and Attaching a Custody Seal

Step	Action	Important Notes
1	Record the CLP Sample number.	The space for the CLP Sample number does not need to be completed on custody seals being placed on the opening of a cooler, only on those being placed on the opening of sample bottles or containers.
2	Record the month, day, and year of sample collection.	
3	Sign the seal in the signature field.	
4	Print your name and title in the "Print Name and Title" field.	
5	Place the custody seal over the edge of the sample bottle or container such that it will break if tampered with.	Custody seals can be placed directly on any sample container except for coring tools used as a transport device (e.g., 5 g Samplers) and tared VOA bottles. If packing coring tools used as a transport device or tared VOA bottles, place them in a clear plastic bag and place the custody seal on the outside of the bag.
6	If possible, cover the custody seal with clear plastic tape to protect it.	Take special care to not place the protective tape over the seal in such a way that it can be removed and then re-attached without signs of tampering.

3.2.4 Complete and Attach Sample Labels

Samplers affix sample labels to each sample container. A sample label must contain the associated CLP Sample Number (either written or pre-printed), SMO-assigned CLP Case Number, and the preservative used. It must also denote the analysis. Samplers may also include additional information such as the station location or the date/time of collection. Samplers should use FORMS II Lite or Scribe to create and print sample labels. The sampler can print two labels and attach one to the sample container or bottle, and place the other label on the sample tag that should also be attached to the sample container or bottle. The labels should then be covered with clear packaging tape to protect the label and maintain legibility. If

handwriting a sample label, the sampler should complete the label information using waterproof ink, place the label on the outside of the sample bottle or container, then cover the label with clear packaging tape to protect the label and maintain legibility (see Figure 3-1).

Do not attach labels to tared VOA sample vials. Avoid wrinkles in the tape and labels.

3.2.5 Complete and Attach Sample Tags

To support use of sample data in potential enforcement actions, sample characteristics other than on-site measurements (e.g., pH, temperature, conductivity) can be identified with a sample tag. Typically, site-specific information is written on the tags using waterproof ink. The use and type of sample tags may vary by Region. For each sampling event, samplers should contact the RSCC concerning the use of sample tags and the type of information required for the tags. An example of a completed sample tag is included in Figure 3-11 below:

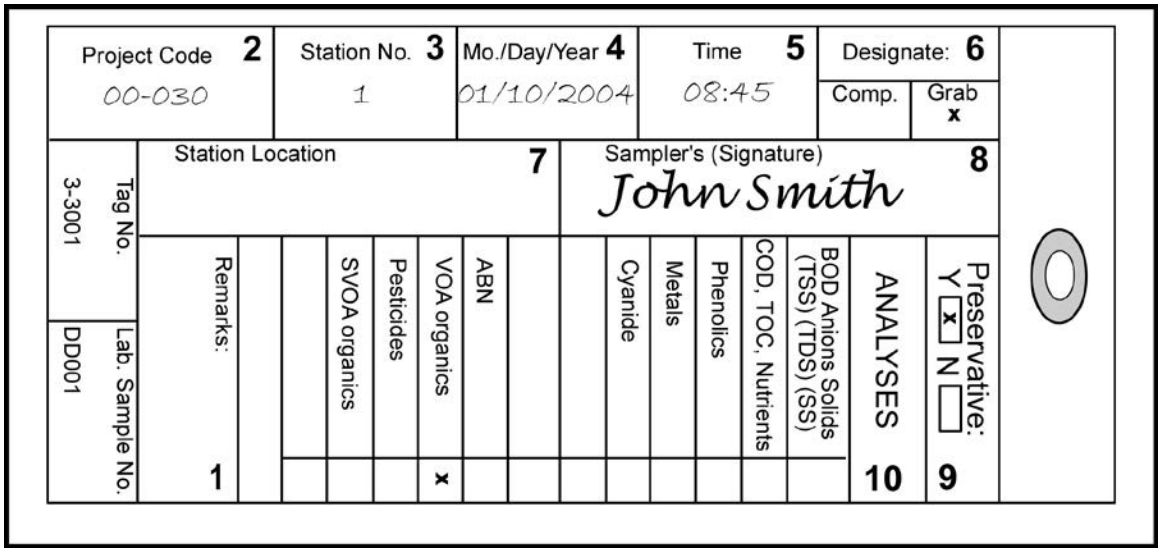

Figure 3-11. Completed Sample Tag

The sampler can use FORMS II Lite or Scribe to create and print out multiple sample labels, one of which can be attached to the sample tag and then covered with clear packaging tape to protect the label and maintain legibility. If FORMS II Lite- or Scribe-created sample labels are not available, a detailed set of instructions for completing and attaching a handwritten sample tag are included in Table 3-6.

Table 3-6. Completing and Attaching a Handwritten Sample Tag

Step	Action
1	Under the "Remarks" heading, record the CLP Sample Number and SMO-assigned CLP Case Number in a legible manner.
2	Record the project code (e.g., Contract number, Work Assignment number, Interagency Agreement number, etc.) assigned by USEPA.
3	Enter the station number assigned by the sampling team coordinator.
4	Record the month, day, and year of sample collection.
5	Enter the military time of sample collection (e.g., 13:01 for 1:01 PM).
6	Identify the designate and place an "X" in either the composite (Comp.) or grab (Grab) sample box.
7	Record the station location.
8	Sign the sample tag in the signature area.
9	Place an "X" in the box next to Yes or No to indicate if a preservative was added to the sample.
10	Under "Analyses", place an "X" in the box next to the parameters for which the sample is to be analyzed.

Table 3-6. Completing and Attaching a Handwritten Sample Tag

Step	Action
11	Leave the box for "Laboratory Sample Number" blank.
12	It is recommended that the sample tag be attached to the neck of the sample bottle or container using regular string, stretch string, or wire.

3.3 Provide Sample Receipt

After samples have been taken from private property, the sampler should prepare a receipt for these samples and provide this receipt to the property owner. This is especially important when sampling on private property since these samples could be used during future litigation and the receipt will verify that the owner granted approval for the removal of the samples from the property. An example of a sample receipt created using FORMS II Lite is shown in Figure 3-12. An example of a sample receipt created using Scribe is shown in Figure 3-13.

EPA Region 3
U.S. ENVIRONMENTAL PROTECTION AGENCY

RECEIPT FOR SAMPLES

PROJECT NO.	PROJECT NAME	NAME & LOCATION OF FACILITY/SITE
QW-123		EXAMPLE SITE
SAMPLERS: (SIGNATURES)		

STATION NO.	LOCATION/DESCRIPTION	DATE	TIME	Comp/Grab	NO. OF EPA CONTAINERS	SPLIT SAMPLE Y OR N	EPA SAMPLE TAG NO.'S
STATION ONE	LOCATION ONE	2/20/2001	15:55	G	11	Yes	112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122
STATION ONE	LOCATION TWO	2/20/2001	16:01	C	11	Yes	123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133
STATION TWO	LOCATION ONE	2/20/2001	16:02	C	11	Yes	134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144

SPLIT SAMPLES TRANSFERRED BY: (PRINT)	DATE	SPLIT SAMPLES RECEIVED BY ☐ OR DECLINED BY ☐ (PRINT)	DATE/TIME
(SIGN)	TIME	(SIGN)	TELEPHONE
		TITLE	

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Figure 3-12. Sample Receipt Created Using the FORMS II Lite Software

Page 1 of 1

Receipt for Samples
Samples Residential Sampling

Project No: 045RD20 | Project Name: Demo Project | WA Number: 0003
Samples Transferred: | Signature: | Samples Signature:
Samples Received By: | Signature: | John Doe

Sample #	SS-0002	SS-0002	SS-0002	SS-0008
Sample Date	6/9/2010	6/9/2010	6/9/2010	6/9/2010
EventID	Front Yard Soil Sampling	Front Yard Soil Sampling	Front Yard Soil Sampling	PCB Sampling
Location	H002-F	H002-F	H002-F	H002-F
PropertyID	H002	H002	H002	H002
Matrix	Soil	Soil	Soil	Soil
Collection Method	Grab	Grab	Grab	Grab
Sample Type	Field Sample	Field Sample	Field Sample	Field Sample
Analyses	TAL-Metals-6010B	CLP TCL Volatiles	CLP TCL Semivolatiles	PCBs
Tag	A	1003	1002	A
Container	Ziploc	40 ml Vial	4oz Glass	16 oz glass
COC	Soil 001	CLP Chain-0001	CLP Chain-0001	Soil-002
Lab	ACME Environmental Lab	ABC Special Lab	ABC Special Lab	ABC Special Lab
Remarks				

Sample #	SS-0009	SS-0017	SS-0017	SS-0017
Sample Date	6/9/2010	6/9/2010	6/9/2010	6/9/2010
EventID	PCB Sampling	Back Yard Soil Sampling	Back Yard Soil Sampling	Back Yard Soil Sampling
Location	H002-R	H002-R	H002-R	H002-R
PropertyID	H002	H002	H002	H002
Matrix	Soil	Soil	Soil	Soil
Collection Method	Grab	Grab	Grab	Grab
Sample Type	Field Sample	Field Sample	Field Sample	Field Sample
Analyses	PCBs	TAL-Metals-6010B	CLP TCL Volatiles	CLP TCL Semivolatiles
Tag	A	A	1013	1012
Container	16 oz glass	Ziploc	40 ml Vial	4oz Glass
COC	Soil-002	Soil-003	9-062510-135425-0004	9-062510-135425-0004
Lab	ABC Special Lab	ACME Environmental Lab	ABC Special Lab	ABC Special Lab
Remarks				

Figure 3-13. Sample Receipt Created Using the Scribe Software

3.4 Pack and Ship Samples

Once the samples have been collected, it is very important that the sampler properly package the samples for shipment and ensure that the samples are sent to the appropriate laboratory as quickly as possible. Prompt and proper packaging of samples will:

- Protect the integrity of samples from changes in composition or concentration caused by bacterial growth or degradation from increased temperatures;
- Reduce the chance of leaking or breaking of sample containers that would result in loss of sample volume, loss of sample integrity, and exposure of personnel to toxic substances; and
- Help ensure compliance with shipping regulations.

3.4.1 Sample Containers

Once samples are collected, they must be stored in conditions that maintain sample integrity. All samples should be placed in shipping containers or other suitable containers with ice to reduce the temperature as soon as possible after collection.

Ideally, all samples should be shipped the day of collection for overnight delivery to the laboratory. If samples cannot be shipped on the day of collection, the sample temperature should be maintained at 4°C (±2°C) until they are shipped to the laboratory.

One CLP RAS sample may be contained in several bottles and vials. For example, one water sample may consist of all containers needed for three of the analytical analyses available under this service (i.e., SVOA analysis, Pesticide analysis, and Aroclor analysis), even though the analyses are collected in separate containers. Therefore, the analysis to be performed and the matrix type will determine the type of container(s) that will be used, as well as the volume that must be collected for that particular sample analysis.

3.4.2 Inventory of Samples and Documentation

Prior to shipment, samplers should conduct an inventory of the contents of the shipping cooler or container against the corresponding TR/COC Record when packing for shipment to laboratories. An inventory will ensure that the proper number of containers have been collected for each analysis of the samples, that the required PE and QC samples and cooler temperature blanks are included, and the correct Sample Numbers and analyses have been assigned to each sample. Refer to Appendix G and Appendix H when referencing the CLP analysis codes.

3.4.3 Shipping Regulations

Sample shipping personnel are legally responsible for ensuring that the sample shipment will comply with all applicable shipping regulations. If dry ice is used for shipping tissue samples, special packaging precautions are required before shipping by aircraft to comply with U.S. DOT regulations. Refer to the Code of Federal Regulations (49CFR 173.217) classified dry ice as Hazard Class 9 *UN 1845* (Hazardous Material). For example, hazardous material samples must be packaged, labeled, and shipped in compliance with all IATA Dangerous Goods regulations or DOT regulations and USEPA guidelines. Refer to Appendix B for detailed shipping guidelines when using SW-846 Method 5035A to preserve and ship samples.

3.4.4 Sample Packaging for Shipment

Samplers are responsible for the proper packaging of samples for shipment. To ensure that samples are appropriately packaged (e.g., to avoid breakage and/or contamination) the sampler should consult their respective project plans to determine the proper packing and shipping procedures. The sampler must determine the sample type, pack the shipping containers correctly, include necessary paperwork, label and seal shipping containers or coolers, and ship the samples.

3.4.4.1 Determine the Sample Type and Container

Samplers should know what kinds of samples they are handling to ensure proper packaging. Samplers should refer to their appropriate project plans to determine which type of sample container should be used for each type of sample being taken during the sampling event.

Note: Please follow Regional guidance with reference to samples containing dioxin or radioactive waste.

3.4.4.2 Pack Shipping Containers

It is imperative that samples are correctly and carefully packed in shipping containers to prevent the sample containers from breaking or leaking. Samplers must prepare and pack a shipping cooler or container according to the instructions outlined in Table 3-7.

Table 3-7. Packing Samples for Shipment

Step	Action	Important Notes
1	Seal all drain holes in the shipping container, both inside and out, to prevent leakage in the event of sample breakage.	
2	Check all lids/caps to make sure the samples are tightly sealed and will not leak.	
3	Wipe loose soil residue from containers.	
4	Seal samples within a clear plastic bag.	Custody seals can be placed directly on any sample container except for coring tools used as a transport device (e.g., 5 g Samplers) and tared VOA bottles. If packing coring tools used as a transport device or tared VOA bottles, place them in a clear plastic bag and place the custody seal on the outside of the bag.
5	Fully chill samples to 4°C (±2°C) prior to placement within suitable packing materials.	
6	Prior to placing samples within the shipping cooler, it is recommended that samplers line shipping containers with non-combustible, absorbent packing material.	The CLP strongly discourages the use of vermiculite and cat litter as sources for packing material. These materials interfere with labeling and documentation and are difficult to remove from sample containers and shipping containers.
7	Place samples in CLEAN, sealed, watertight shipping containers (metal or hard plastic coolers).	All soil/sediment samples known to contain dioxin should be securely enclosed in metal cans (e.g., paint cans) with the lids sealed.
8	Conduct an inventory of the contents of the shipping cooler/container against the corresponding TR/COC Record.	
9	Cover samples in double-bagged ice to prevent water damage to packing materials.	Do NOT pour loose ice directly into the sample cooler. The ice is used to maintain the temperature of the samples within the shipping cooler.
10	It is recommended that a temperature blank be included in an area within each shipping container which will allow for easy access by the laboratory upon opening the shipping container.	The temperature blank is generally a 40 mL vial filled with water and labeled “temperature blank” but does not have a Sample Number.
11	Ensure that the site name or other site-identifying information does not appear on any documentation being sent to the laboratory.	

3.4.4.3 Include Necessary Paperwork

Samplers must properly place the necessary paperwork in the shipping cooler or acceptable container. All paperwork must be placed in a plastic bag or pouch and then secured to the underside of the shipping container lid (see Figure 3-14).

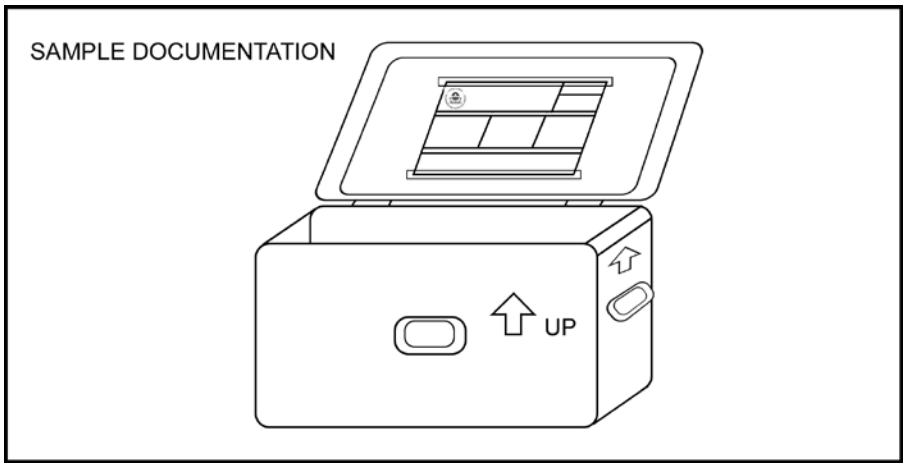

Figure 3-14. Sample Cooler with Attached TR/COC Record, PES Instructions (if applicable), and Cooler Return Documentation

Necessary paperwork includes TR/COC Records and sample weight logs (see Figures 3-15 and 3-16), if required (for VOA samples). If PE samples are included in the cooler, the PE instruction sheets must be included with the paperwork. Samplers should contact their RSCC (or designee) for specific paperwork requirements.

USEPA Contract Laboratory Program
Sample Weight Log

Shipped to: AAA Testing Laboratory
1700 Mill Avenue
Houston TX 77099
(281) 983-1234

Case No. 39563
DAS No. DAS34
Date Shipped: 9/29/2003

Sample No.	Matrix	Analysis	Preservative	Bottle/ Tag Number	Tared Weight (g)	Final Weight (g)	Sample Weight (g)	Laboratory Weight	Traffic Report No.
C0036	Subsurface Soil (>12")	CLP TCL Volatiles	Ice Only	199548	32.80	37.20	4.40		3-103018225-092903-0001
C0036	Subsurface Soil (>12")	CLP TCL Volatiles	Ice Only	199547	32.10	38.30	6.20		3-103018225-092903-0001
C0036	Subsurface Soil (>12")	CLP TCL Volatiles	Ice Only	199549	31.20	38.60	7.40		3-103018225-092903-0001
C0037	Surface Soil (0"-12")	CLP TCL Volatiles	Ice Only	199552	32.00	36.90	4.90		3-103018225-092903-0001
C0037	Surface Soil (0"-12")	CLP TCL Volatiles	Ice Only	199551	32.40	37.10	4.70		3-103018225-092903-0001
C0037	Surface Soil (0"-12")	CLP TCL Volatiles	Ice Only	199550	31.90	35.90	4.00		3-103018225-092903-0001

Completed By:	Date:

All weights are measured in grams

Figure 3-15. FORMS II Lite Sample Weight Log

Page 1 of 1

Sample Weight Log
Chain of Custody - Additional Info - VOA Samples

Shipped To: ABC Special Lab
123 Main Street
Anywhere, USA

Completed By:
Date:

Case No. 12345
DAS No. DAS123
Date Shipped: 12/24/2010

CLP Sample #	Y0004	Y0005	Y0006	Y0007	Y0008
Matrix	Soil	Soil	Soil	Soil	Soil
Analyses	CLP TCL Volatiles	CLP TCL Volatiles	CLP TCL Volatiles	CLP TCL Volatiles	CLP TCL Volatiles
Preservative	Ice	Ice	Ice	Ice	Ice
Tag	1011	1013	1015	1017	1019
Tared Weight (g)	32.80	32.10	31.20	32.00	31.90
Final Weight (g)	37.20	38.30	38.60	36.90	35.90
Sample Weight (g)	4.4	6.2	7.4	4.9	4
Laboratory Weight					
COC #	9-062510-135425-0004	9-062510-135425-0004	9-062510-135425-0004	9-062510-135425-0004	9-062510-135425-0004

Figure 3-16. Scribe Sample Weight Log

3.4.4.4 Label and Seal Sample Shipping Coolers

After samples are packaged within shipping coolers, samplers must carefully secure the top and bottom of the coolers with tape, place return address labels clearly on the outside of the cooler, and attach the required chain-of-custody seals (see Figure 3-17).

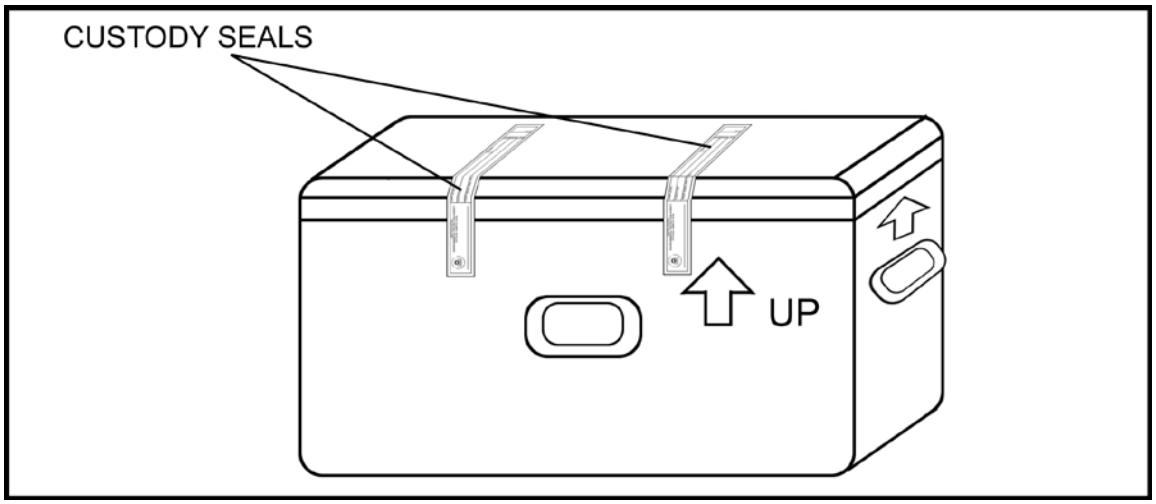

Figure 3-17. Shipping Cooler with Custody Seals

If more than one cooler is being delivered to a laboratory, samplers should mark each cooler as "1 of 2", "2 of 2", etc. In addition, samplers must accurately complete and attach shipping airbill paperwork for shipment of the samples to the laboratory. An airbill, addressed to the Sample Custodian of the receiving laboratory, should be completed for each cooler shipped. Samplers should receive the correct name, address, and telephone number of the laboratory to which they must ship samples from the RSCC or SMO. To avoid delays in analytical testing, samplers should make sure they are sending the correct types of samples to the correct laboratory when collecting samples for multiple types of analysis. For example, inorganic samples may be shipped to one laboratory for analysis, while organic samples may need to be shipped to another laboratory.

3.4.4.5 Ship Samples

The sampling contractor should ensure that samplers know the shipping company's name, address, and telephone number. In addition, they should be aware of the shipping company's hours of operation, shipping schedule, and pick-up/drop-off requirements.

Overnight Delivery

It is imperative that samples be sent via overnight delivery. Delays caused by longer shipment times may cause technical holding times to expire, which in turn may destroy sample integrity or require the recollection of samples for analysis.

Saturday Delivery

For shipping samples for Saturday delivery, the sampler MUST notify the RSCC (or their designee) and SMO as soon as possible so that SMO will receive the delivery information by 3:00 PM ET on the Friday prior to delivery.

3.4.5 Shipment Notification

When samples are shipped to CLP Laboratories, samplers **must immediately** report all sample shipments to the RSCC (or designee) or to SMO. **Under no circumstances should the sampler contact the laboratory directly.** If samplers are shipping samples after 5:00 PM ET, they must notify the RSCC (or designee) or SMO by 8:00 AM ET on the following business day. Samplers should receive the name and phone number of the appropriate SMO coordinator to contact from the Region/RSCC.

Samplers must provide the following information to the RSCC (or designee) or to SMO:

- Name and phone number at which they can easily be reached (preferably closest on-site phone number if still in the field)
- SMO-assigned CLP Case Number (see Section 2.4.1)
- Number, concentration, matrix and analysis of samples being shipped, and MA number (if required);
- Name of laboratory (or laboratories) to which the samples were shipped

- Airbill number(s)
- Date of shipment
- Case status (i.e., whether or not the Case is complete)
- Problems encountered, special comments, or any unanticipated issues
- When to expect the next anticipated shipment
- An electronic export of the TR/COC Record must be sent as soon as possible after sample shipment via the Electronic Sample Documentation System (ESDS) to transmit FORMS II Lite and Scribe files to SMO. For information regarding electronic export of TR/COC Records, refer to the following Web site:

  http://www.epa.gov/superfund/programs/clp/download/esdsprocedures.pdf

For Saturday delivery, samplers MUST notify the RSCC (or designee) and SMO as soon as possible so that SMO will receive the delivery information by 3:00 PM ET on the Friday prior to delivery.

Samplers should be aware if their Region requires them to notify the RSCC (or designee) and/or SMO of sample shipment.

3.4.6 Return Sample Shipping Coolers

CLP laboratories must routinely return sample shipping coolers within 14 calendar days following shipment receipt. Therefore, the sampler should also include cooler return instructions with each shipment. The **sampler** (not the CLP laboratory) is responsible for paying for return of the cooler and should also include shipping airbills bearing the sampler's account number, as well as a return address to allow for cooler return. **Samplers should use the least expensive option possible.**

Appendix A: Functions within a Sampling Project

The following table describes Quality Assurance Project Plan (QAPP) requirements taken from *EPA Requirements for Quality Assurance Project Plans* (EPA QA/R-5).

Functions Within a Sampling Project	Elements of that Function
Project Management	
Project/Task Organization	Identifies the individuals or organizations participating in the project and defines their specific roles and responsibilities.
Problem Definition/Background	States the specific problem to be solved or decision to be made and includes sufficient background information to provide a historical and scientific perspective for each particular project.
Project/Task Description	Describes the work to be performed and the schedule for implementation to include: X Measurements to be made during the course of the project X Applicable technical, regulatory, or program-specific quality standards, criteria, or objectives X Any special personnel and equipment requirements; assessment tools needed X A work schedule and any required project and quality records, including types of reports needed
Quality Objectives and Criteria	Describes the project quality objectives and measurement performance criteria.
Special Training/Certification	Ensures that any specialized training for modified field sampling techniques, field analyses, laboratory analyses, or data validation should be specified.
Documents and Records	X Itemizes the information and records that must be included in the data report package and specifies the desired reporting format for hard copy and electronic forms, when used. X Identifies any other records and/or documents applicable to the project such as audit reports, interim progress reports, and final reports that will be produced. X Specifies or references all applicable requirements for the final disposition of records and documents, including location and length of retention period.
Data Generation and Acquisition	
Sampling Process Design (Experimental Design)	X Describes the experimental design or data collection design for the project. X Classifies all measurements as critical or non-critical.
Sampling Methods	X Describes the procedures for collecting samples and identifies sampling methods and equipment. Includes any implementation requirements, support facilities, sample preservation requirements, and materials needed. X Describes the process for preparing and decontaminating sampling equipment to include the disposal of decontamination by-products, selection and preparation of sample containers, sample volumes, preservation methods, and maximum holding times for sampling, preparation, and/or analysis. X Describes specific performance requirements for the method. X Addresses what to do when a failure in sampling occurs, who is responsible for corrective action, and how the effectiveness of the corrective action shall be determined and documented
Sample Handling and Custody	X Describes the requirements and provisions for sample handling and custody in the field, laboratory, and transport, taking into account the nature of the samples, the maximum allowable sample holding times before extraction and analysis, and the available shipping options and schedules. X Includes examples of sample labels, custody forms, and sample custody logs.

Functions Within a Sampling Project	Elements of that Function
Analytical Methods	X Identifies the analytical methods and equipment required, including sub-sampling or extraction methods, waste disposal requirements (if any), and specific method performance requirements. X Identifies analytical methods by number, date, and regulatory citation (as appropriate). If a method allows the user to select from various options, the method citations should state exactly which options are being selected. X Addresses what to do when a failure in the analytical system occurs, who is responsible for corrective action, and how the effectiveness of the corrective action shall be determined and documented. X Specifies the laboratory turnaround time needed, if important to the project schedule. X Specifies whether a field sampling and/or laboratory analysis Case Narrative is required to provide a complete description of any difficulties encountered during sampling or analysis.
Quality Control (QC)	X Identifies required measurement QC checks for both the field and laboratory. X States the frequency of analysis for each type of QC check, and the spike compounds sources and levels. X States or references the required control limits for each QC check and corrective action required when control limits are exceeded and how the effectiveness of the corrective action shall be determined and documented. X Describes or references the procedures to be used to calculate each of the QC statistics.
Instrument/Equipment Testing, Inspection, and Maintenance	X Describes how inspections and acceptance testing of environmental sampling and measurement systems and their components will be performed and documented. Identifies and discusses the procedure by which final acceptance will be performed by independent personnel. X Describes how deficiencies are to be resolved and when re-inspection will be performed. X Describes or references how periodic preventative and corrective maintenance of measurement or test equipment shall be performed. X Identifies the equipment and/or system requiring periodic maintenance. X Discusses how the availability of spare parts identified in the operating guidance and/or design specifications of the systems will be assured and maintained.
Instrument/Equipment Calibration and Frequency	X Identifies all tools, gauges, instruments, and other sampling, measuring, and test equipment used for data collection activities affecting quality that must be controlled, and at specific times, calibrated to maintain performance within specified limits. X Identifies the certified equipment and/or standards used for calibration. X Describes or references how calibration will be conducted using certified equipment and/or standards with known valid relationships to nationally recognized performance standards. If no such standards exist, documents the basis for calibration. X Indicates how records of calibration shall be maintained and traced to the instrument.
Inspection/Acceptance of Supplies and Consumables	X Describes how and by whom supplies and consumables shall be inspected and accepted for use in the project. X States acceptance criteria for such supplies and consumables.
Non-direct Measurements	X Identifies any types of data needed for project implementation or decision-making that are obtained from non-measurement sources (e.g., computer databases, programs, literature files, historical databases). X Describes the intended use of data. X Defines the acceptance criteria for the use of such data in the project. X Specifies any limitations on the use of the data.
Data Management	X Describes the project data management scheme, tracing the data path from generation in the field or laboratory to their final use or storage. X Describes or references the standard record-keeping procedures, document control system, and the approach used for data storage and retrieval on electronic media.

Appendix B: CLP Sample Collection Guidelines for VOAs in Soil by SW-846 Method 5035A

A. Preferred Options for the Contract Laboratory Program (CLP) are Options 1, 2, and 3:

This method employs sample vials that are filled and weighed in the field and never opened during the analytical process. As a result, sampling personnel should be equipped with a portable balance capable of weighing to 0.01g.

Note: Soil samples must be placed on their sides prior to being frozen or placed on ice. Dry ice or field freezers are the only options.

Option 1.

Closed-system Vials:

Container - tared or preweighed 40 mL VOA vial containing a magnetic stir bar.

Collect 5 g of soil per vial (iced or frozen in the field). Check the pre-tared weight of the (dry) VOA vials prior to departure for the sampling event under controlled conditions. Weigh vials and soil samples to the nearest 0.01 g. This check is to ensure that the original weight was properly recorded.

Regular Samples	3 Vials - Dry (5 g soil per vial) 1 Vial - Dry (filled with soil, no headspace) 4 Total Vials
Regular Samples Requiring QC Analysis	9 Vials - Dry (5 g soil per vial) 1 Vial - Dry (filled with soil, no headspace) 10 Total Vials

Option 2.

Closed-system Vials Containing Water:

Container - tared or pre-weighed 40 mL VOA vial containing a magnetic stir bar and 5 mL water.

Collect 5 g of soil per vial (iced or frozen in the field). Weigh vials and soil samples to the nearest 0.01 g.

Regular Samples	2 Vials with water added (5 g soil and 5 mL water per vial) 1 Vial - Dry (5 g soil in vial) 1 Vial - Dry (filled with soil, no headspace) 4 Total Vials (2 with water and 2 dry)
Regular Samples Requiring QC Analysis	6 Vials with water added (5 g soil and 5 mL water per vial) 1 Vials - Dry (5 g soil per vial) 1 Vial - Dry (filled with soil, no headspace) 8 Total Vials (6 with water and 2 dry)

Option 3.

Container - 5 g Samplers or equivalent and coring tool used as a transport device.

Note: All Samplers should be iced or frozen in the field and bagged individually.

Regular Samples	3 Samplers (5 g soil per Sampler) 1 Vial - Dry (filled with soil, no headspace) 4 Total (3 Samplers and 1 Vial)

Regular Samples	9 Samplers (5 g soil per Sampler)
Requiring QC Analysis	1 Vial - Dry (filled with soil, no headspace)
	10 Total (9 Samplers and 1 Vial)

B. Options 4, 5, and 6 are NOT preferred options for the CLP:

Option 4.

Closed-system Vials:

Container - tared or preweighed 40 mL VOA vial containing a magnetic stir bar and preservative.

Collect 5 g of soil per vial and add Sodium bisulfate ($NaHSO_4$) preservative (5 mL water + 1 g $NaHSO_4$) - iced in the field.

Caution: This option is NOT a Preferred Option for the CLP because:

$NaHSO_4$ preservation creates low pH conditions that will cause the destruction of certain CLP target analytes (e.g., vinyl chloride, trichloroethene, trichlorofluoromethane, cis- and trans-1,3-dichloropropene). Projects requiring the quantitation of these analytes should consider alternative sample preservation methods. $NaHSO_4$ also cannot be used on carbonaceous soils. Check the soil before using this method of collection! Soil can be checked by placing a test sample in a clean vial, then adding several drops of $NaHSO_4$ solution. If the soil bubbles, use Option 4b and note this issue on the TR/COC Record.

Option 4a. Samples preserved in the field

Regular Samples	2 Vials with $NaHSO_4$ preservative added (5g soil per vial)
	1 Vial without $NaHSO_4$ preservative added (5g soil per vial)
	1 Vial - Dry (filled with soil, no headspace)
	4 Total Vials (2 with $NaHSO_4$ preservative and 2 without)
Regular Samples Requiring QC Analyses	6 Vials with $NaHSO_4$ preservative added (5g soil per vial)
	3 Vials without $NaHSO_4$ preservative added (5 g soil per vial)
	1 Vial - Dry (filled with soil, no headspace)
	10 Total Vials (6 with $NaHSO_4$ and 4 without)

Option 4b. Samples are preserved by the laboratory (No $NaHSO_4$ preservative is added to these samples in the field).

Regular Samples	3 Vials - Dry (5 g soil per vial)
	1 Vial - Dry (filled with soil, no headspace)
	4 Total Vials
Regular Samples Requiring QC Analyses	9 Vials - Dry (5 g soil per vial)
	1 Vial - Dry (filled with soil, no headspace)
	10 Total Vials

Option 5.

Methanol Preservation (medium-level analysis only):

Container - tared or pre-weighed 40 mL VOA vials containing 5 mL methanol.

Collect 5 g of soil per vial (iced in the field).

Caution: This is NOT a preferred option for the CLP because:

Samples preserved with methanol can only be analyzed by the medium-level method. Low-level Contract Required Quantitation Limit (CRQLs) cannot be achieved when samples are preserved this way. If this soil

option is used, then samples for low-level analysis by one of the other options should also be collected and accompany the medium-level soil.

Additional problems associated with use of methanol as a preservative in the field include:

- Possible contamination of the methanol by sampling-related activities (e.g., absorption of diesel fumes from sampling equipment);
- Leakage of methanol from the sample vials during shipping, resulting in loss of VOAs prior to analysis.

Regular Samples	2 Vials (5 g soil and 5 mL methanol per vial) 1 Vial - Dry (filled with soil, no headspace) 3 Total Vials (2 with methanol and 1 dry)
Regular Samples Requiring QC Analyses	6 Vials (5 g soil and 5 mL methanol per vial) 1 Vial -Dry (filled with soil, no headspace) 7 Total Vials (6 with methanol and 1 dry)

If shipping samples containing methanol as a preservative, a shipping label must be used to indicate methanol. This label must also contain the United Nations (UN) identification number for methanol (UN 1230), and indicate Limited Quantity.

Option 6.

Glass Containers filled with sample - No Headspace:

Container - 4 oz Glass Jars.

Glass container filled with soil with no headspace and iced.

Caution: This is NOT a preferred option for the CLP because:

Samples collected in this manner lose most of their volatile analytes prior to analysis when the sample containers are opened and sub-sampled in the laboratory. This option is only available due to Regional requirements.

Regular Samples	2 Glass Jars (4 oz) filled with sample, no headspace 1 Vial - Dry (filled with soil, no headspace) 3 Total Containers
Regular Samples Requiring QC Analyses	2 Glass Jars (4 oz) filled with sample, no headspace 1 Vial - Dry (filled with soil, no headspace) 3 Total Containers

C. Caution:

1. Extreme care must be taken to ensure that frozen or iced samples do not break during shipment.
2. Before adding soil to pre-weighed vials containing a stir bar, weigh the vials to confirm the tared weight. If the weight varies by more than 0.1 g, record the new weight on the label and the sample documentation. Do NOT add labels to these vials once the tared weight has been determined or confirmed.

D. Dry Samples:

All options include taking a sample in a dry 40 mL VOA vial (or a 4 oz wide mouth jar) with no headspace. No water, $NaHSO_4$, or methanol is added to this sample. This sample is taken to determine moisture content; therefore, it does not need to be tared or have a stir bar.

E. Iced or Frozen Samples:

1. Iced means cooled to 4°C (±2°C) immediately after collection.
2. Frozen means cooled to between -7°C and -15°C immediately after collection.
3. Dry ice is not a long-term freezing agent and may contaminate samples.

F. Sample Delivery:

CLP strongly recommends that all samples reach the laboratory by COB the next day after sample collection.

G. Notes:

1. For Options 2, 4, and 5, check the weight of the pre-tared VOA vials plus liquid in the field due to the possibility that liquid leaked out during packing, transit, or deployment in the field just prior to sampling. This check is to ensure that the original weight is properly recorded.
2. For Option 4, samples can be preserved with $NaHSO_4$ either:
   - In the field; or
   - In the laboratory upon receipt. In this case, the sampler should put the following information in the Preservation Column of the TR/COC Record - "To be preserved at lab with $NaHSO_4$". This Regional request should also be communicated to SMO so that the laboratory can be notified.
3. Regional QAPPs may require the use of Option 5. Please note that this option is for medium-level analysis ONLY.
4. If water, methanol, or $NaHSO_4$ preservative is added to the vials in the field, a field blank containing the appropriate liquid used in the vials should be sent to the laboratory for analysis.

Appendix C: General CLP Sample Collection Guidelines VOAs in Water

Regional guidance and/or specific Project Plan requirements will supersede the guidelines listed below.

Collect the following:

- At least three 40 mL glass containers with polytetrafluoroethylene (PTFE)-lined septa and open top screw-caps that are filled to capacity with no air bubbles, preserved to a pH of 2 with HCl, and cooled to 4°C (±2°C) immediately after collection. DO NOT FREEZE THE SAMPLES.

Regular Samples	3 vials (40 ml filled to capacity with no headspace or air bubbles)
Regular Samples Requiring QC Analysis	3 vials for Sample (40 ml filled to capacity with no headspace or air bubbles) 3 vials for MS (40 ml filled to capacity with no headspace or air bubbles) 3 vials for MSD (40 ml filled to capacity with no headspace or air bubbles)

- If Selected Ion Monitoring (SIM) analysis is requested, at least two additional 40 mL glass containers with PTFE-lined septa and open top screw-caps that are filled to capacity with no air bubbles, preserved to a pH of 2 with HCl, and cooled to 4°C (±2°C) immediately after collection.

Regular Samples With SIM Analysis	3 vials for Sample (40 ml filled to capacity with no headspace or air bubbles) 2 vials (40 ml filled to capacity with no headspace or air bubbles)

Test for Carbonates, Residual Chlorine, Oxidants, and Sulfides:

- It is very important that samplers obtain Regional guidance when testing and ameliorating for:
  - Carbonates;
  - Residual chlorine (e.g., municipal waters or industrial waste waters that are treated with chlorine prior to use or discharge); or
  - Oxidants.
- VOA samples containing carbonates react with the acid preservative causing effervescence (due to formation of carbon dioxide), which can cause loss of volatile analytes.
- Residual chlorine present in VOA samples can continue to react with dissolved organic matter. This continuous reaction may lead to inaccurate quantitation of certain analytes present in the sample at the time of collection.
- Residual chlorine and oxidants present in VOA samples can cause degradation of certain volatile analytes (e.g., styrene).

Perform the following for *Pre-Preserved* Vials:

1. Pour the sample slowly down the edge of the sample vial to avoid excess aeration or agitation of the sample during filling.
2. Fill the vial completely so that a reverse (convex) meniscus is present and ensure that there are no air bubbles present (either in the body or especially at the top of the vial).
3. Place the septum on the vial so that the PTFE side is in contact with the sample, and then firmly tighten the cap.
4. Gently flip the vial a few times to ensure that the sample is mixed with the acid preservative.
5. While holding the vial upright, gently tap the sample to check for air bubbles (either in the body or especially at the top of the vial).
6. If air bubbles are present, discard the sample and select a new vial in which to recollect a new sample. Repeat Steps 1 to 5 above.
7. Do NOT mix or composite samples for VOAs.

8. Cool sample to a temperature of 4°C (±2°C). Samplers should begin the cooling process in the field as samples are being collected. Double-bagged ice should be used. DO NOT FREEZE WATER SAMPLES.
9. Immediately transfer the vial to the sample shuttle (device that contains a "set" of VOA vials) once it has been collected. Do NOT allow ice to touch the vials.

Perform the Following for *Empty* Vials:

1. Rinse the vial with sample water prior to actual sample collection and preservation.

   Regions vary in their approach to pre-rinsing and/or re-using sample vials (e.g., some Regions do not recommend pre-rinsing and/or re-use of pre-cleaned containers using sample water). Be sure to follow Regional guidance.

2. Add 1-2 mL of acid preservative to the vial. Check to ensure that the sample you are collecting requires a preservative (follow Regional guidance).
3. Pour the sample slowly down the edge of the sample vial to avoid excess aeration and agitation of the sample.
4. Fill the vial completely so that a reverse (convex) meniscus is present and ensure that there are no air bubbles present (either in the body or especially at the top of the vial).
5. Place the septum on the vial so that the PTFE side is in contact with the sample, and then firmly tighten the cap.
6. Gently flip the vial a few times to ensure that the sample is mixed with the acid preservative.
7. While holding the vial upright, gently tap the vial to check for air bubbles (either in the body or especially at the top of the vial).
8. If air bubbles are present, discard the sample and recollect a new sample using the same sample vial. Repeat Steps 1 - 7 above.
9. Check the re-collected sample for air bubbles. If air bubbles are present, additional sample water may be added to the vial to eliminate air bubbles. If there are air bubbles after three consecutive attempts to eliminate air bubbles by the addition of sample water, the entire sample and sample vial should be discarded and a new sample collected.
10. Do NOT mix or composite samples for VOAs.
11. Cool sample to a temperature of 4°C (±2°C). Samplers should begin the cooling process in the field as samples are being collected. Double-bagged ice should be used. DO NOT FREEZE WATER SAMPLES.
12. Immediately transfer the vial to the sample shuttle (device which contains a "set" of VOA vials) once it has been collected. Do NOT allow ice to touch the vials.

Things to Remember:

- Samples must be shipped as soon as possible, preferably on the same day as sample collection to avoid exceeding sample holding times. If overnight transit is not possible, samples should be maintained at 2 - 4°C until they are shipped to the laboratory.
- If samples are not preserved (a requirement for certain analytes), the technical holding time is shortened to 7 days.

Appendix D: Sampling Techniques and Considerations

During a sampling event, the sampler is expected to follow prescribed sampling techniques. The sampler should also be aware of any special sampling considerations, contaminant issues, and sample compositing and mixing methods that could affect their sampling efforts.

Regional guidance will take precedence over any of the techniques and considerations listed below.

D.1 General Sampling Techniques

Information regarding surface water, sediment, soil, and groundwater sampling can be found in many documents including, but not limited to, the following sources:

- Compendium of ERT Surface Water and Sediment Sampling Procedures, EPA/540/P-91/005
- Compendium of ERT Soil Sampling and Surface Geophysics Procedures, EPA/540/P-91/006
- Compendium of ERT Groundwater Sampling Procedures, EPA/540/P-91/007
- Lead in Surface Wipe Samples, NIOSH Method 9100, August 15, 1994
- Elements on Wipes, NIOSH Method 9102, March 15, 2003
- Surface Wipe Sampling Procedure, IH75190, Brookhaven National Laboratory, Industrial Hygiene Group, February 9, 2009
- General Air Sampling Guidelines, US EPA ERT, SOP 2008, November 16, 1994
- Quality Assurance Sampling Plan for Environmental Response (QASPER) software, Version 4.1, ERT
- *Requirements for the Preparation of Sampling and Analysis Plans*; United States Army Corps of Engineers, February 1, 2001, EM 200-1-3

When working with potentially hazardous materials, samplers should follow USEPA and OSHA requirements, specific health and safety procedures, and DOT requirements.

D.2 Special Sampling Considerations

Samplers should refer to Regionally-developed SOPs to obtain specific procedures for properly collecting and preserving samples in the field. For additional guidance regarding sampling for VOAs in soil and water, see Appendices B and C. Samplers should obtain Regional guidance when testing and ameliorating for:

- Carbonates in VOA soil and water
- Residual chlorine in VOA soil and water, or cyanide water
- Oxidants in VOA soil and water
- Sulfides in cyanide

D.3 Contaminant Sampling

Certain compounds can be detected in the parts-per-billion (ppb) and/or parts-per-trillion (ppt) range. Extreme care MUST be taken to prevent cross-contamination of these samples. The following precautions should be taken when trace contaminants are a concern:

- Disposable gloves should be worn each time a different location is sampled.
- When collecting both surface water and sediments, surface water samples should be collected first. This reduces the chance of sediment dispersal into surface water, and the resulting loss of surface water sample integrity.
- Sampling should occur in a progression from the least to the most contaminated area, if this information is known to the sampling team.
- Samplers should use equipment constructed of PTFE, stainless steel, or glass that has been properly pre-cleaned for the collection of samples for trace organic and/or inorganic analyses. Equipment constructed of plastic or polyvinyl chloride (PVC) should NOT be used to collect samples for trace organic compound analyses.
- Equipment constructed of stainless steel should NOT be used to collect samples for trace metals analyses.

D.4 Sample Compositing

Sample compositing is a site-specific activity that must be conducted according to the SAP. Compositing is typically used for large sites under investigation to improve the precision (i.e., lower the variance) of the estimated average

contaminant concentrations. **Samples for VOA analysis should NOT be composited to minimize loss of VOAs/analytes.**

Composite samples consist of a series of discrete grab samples that are mixed together to characterize the average composition of a given material. The discrete samples are usually of equal volume, but may be weighted to reflect an increased flow or volume. Regardless, all discrete samples must be collected in an identical manner and the number of grab samples forming a composite should be consistent. There are several compositing techniques that may be required such as:

- Flow-proportioned – Collected proportional to the flow rate during the compositing period by either a time-varying/constant volume or a time-constant/varying volume method. This technique is usually associated with wastewater or storm water runoff sampling.
- Time – Composed of a varying number of discrete samples collected at equal time intervals during the compositing period. This technique is typically used to sample wastewater and streams, and in some air sampling applications.
- Areal – Collected from individual grab samples collected in an area or on a cross-sectional basis. Areal composites are comprised of equal volumes of grab samples where all grabs are collected in an identical manner. This technique is typically used for estimating average contaminant concentrations in soils or sediments. This technique is useful when contaminants are present in nugget form (i.e., TNT chunks, lead shot, etc.), thus exhibiting large differences in concentration over a small sample area.
- Vertical – Collected from individual grab samples but taken from a vertical cross section. Vertical composites are comprised of equal volumes of grab samples where all grab samples are collected in an identical manner. Examples would include vertical profiles of a soil borehole or sediment columns.
- Volume – Collected from discrete samples whose aliquot volumes are proportional to the volume of sampled material. Volume composites are usually associated with hazardous waste bulking operations where the sample represents combined or bulked waste.

When compositing solid or tissue samples (i.e., sediment, soil, or sludge) for analysis of compounds present in trace quantities, use a stainless steel or PTFE bowl and spatula.

D.5 Sample Mixing and Homogenizing

Mixing of the sample for the remaining parameters is necessary to create a representative sample media. It is extremely important that solid samples be mixed as thoroughly as possible to ensure that the sample is as representative as possible of the sample location. Please refer to the project-specific SAP regarding instructions on removal of any extraneous materials (e.g., leaves, sticks, rocks, etc.). The mixing technique will depend on the physical characteristics of the solid material (e.g., particle size, moisture content, etc.). Grinding and homogenization of tissue is easier when it is partially frozen. The mixing container should be large enough to hold the sample volume and accommodate the procedures without spilling. Both the mixing container (generally a bowl or tray) and the mixing implement should be properly decontaminated before use. Samples should be homogenized according to procedures listed in the project-specific SAP. Table D-1 provides a short procedure for mixing a soil sample with a small particle size (less than 1/4 in) and filling sample containers in the field.

Table D-1. Mixing a Sample and Filling Sample Containers

Step	Action
1	Roll the contents of the compositing container to the middle of the container and mix.
2	Quarter the sample and move to the sides of the container.
3	Mix each quarter individually, then combine and mix OPPOSITE quarters, then roll to the middle of the container.
4	Mix the sample once more, and then quarter the sample again.
5	Mix each quarter individually, then combine and mix ADJACENT corners, then roll to the middle of the container. The goal is to achieve a consistent physical appearance before sample containers are filled.
6	Flatten piled material into an oblong shape.
7	Using a flat-bottomed scoop, collect a strip of soil across the entire width of the short axis and place it into a sample container.
8	Repeat Step 7 at evenly-spaced intervals until the sample containers are filled.
9	Record the approximate quantity of each subsample in the field log book.

Appendix E: Sampling Checklists

Appendix E-1: Personnel Preparation Checklist

(Page 1 of 1)

Personnel Briefing	Yes	No	Comments
1. Did you review sampling team responsibilities and identify individual(s) responsible for corrective actions?			
2. Did you ensure that you have met the appropriate personal safety and protection requirements?			
3. Did you identify sampling locations and receive permission to access them, as appropriate?			
4. Did you contact the appropriate utility companies PRIOR to the start of sampling? By law, utility companies must be contacted prior to the start of digging/sampling so that any underground utilities (gas lines, water lines, electrical lines, etc.) can be marked. A list of one-call centers for each state may be found at: http://www.call811.com.			
5. If sampling on private property, do you have sample receipts to provide to the property owner for all samples taken and removed from the property?			
6. Have you determined the number and type of samples to be collected?			
7. Did you review sample collection methods?			
8. Have you reviewed sample container requirements?			
9. Did you review decontamination requirements, procedures, and locations?			
10. Did you determine holding times and conditions?			
11. Did you determine Performance Evaluation (PE) and Quality Control (QC) sample requirements?			
12. Have you obtained shipping cooler temperature blanks, if required?			
13. Did you review sample label and tag requirements?			
14. Did you review Traffic Report/Chain of Custody (TR/COC) record and custody seal requirements?			
15. Have you obtained the laboratory name, shipping addresses, and telephone number?			
16. Did you review cooler return instructions?			
17. Have you obtained shipping company information (name, telephone number, account number, pickup schedule)?			
18. Have you obtained shipping schedules?			
19. Did you review shipment reporting requirements and the appropriate contact names and telephone numbers for reporting?			
20. Have you included any sampler comments regarding sampling issues (e.g., low volumes, matrix, suspected concentrations based on field measurements)?			

Appendix E-2: General Sample Collection Checklist

(Page 1 of 1)

General Sample Collection	Yes	No	Comments
1. Did you identify and mark the sampling location with buoys, flags, or stakes according to the sampling plans, maps, and grids?			
2. If the sampling location is inaccessible, did you contact the appropriate field or Regional personnel for instructions?			
3. Did you use the correct sampling equipment?			
4. Did you follow the correct decontamination procedures?			
5. Did you follow the correct collection procedures?			
6. Did you use the correct sample containers for each sample collected?			
7. Did you use certified clean containers for all samples? Are certificates kept on record?			
8. Did you use certified clean water for all field, trip, equipment and rinsate blanks? Are certificates kept on record?			
9. Did you collect the correct volume for each sample?			
10. Did you collect the correct type of sample, including primary samples and Quality Control (QC) samples?			
11. Did you properly preserve each sample collected?			
12. Did you correctly document and label each sample with all necessary information? Under no circumstances should the site name appear on any documentation being sent to the laboratory, unless the laboratory is a Regional USEPA laboratory. Then the Region copy of the TR/COC shall be sent to the USEPA laboratory.			
13. If sampling on private property, did you provide a sample receipt to the owner of the property for all samples taken and removed from the property?			

Appendix E-3: Completing Field Logbook Checklist

(Page 1 of 1)

Completing Field Logbook	Yes	No	Comments
1. Did you use waterproof ink when writing in the field logbook?			
2. Did you document sampling project information such as: X Project name, ID, and location X Names of samplers X Geological observations, including maps X Atmospheric conditions X Field measurements X Sampling dates, times, and locations? Under no circumstances should the site name appear on any documentation being sent to the laboratory, unless the laboratory is a Regional USEPA laboratory. Then the Region copy of the TR/COC shall be sent to the USEPA laboratory.			
3. Did you record sampling activity information such as: X Sampling dates and times X Sample identifications X Sample matrices X Sample descriptions (e.g., odors and/or colors) X Number of samples taken X Sampling methods/equipment X Description of QC samples?			
4. Did you document any and all deviations from the sampling plan?			
5. Did you document any and all difficulties in sampling and/or any unusual circumstances?			
6. Were all errors corrected by crossing a line through the error, initialing the error, dating the error, and then adding the correct information?			

Appendix E-4: Completing Handwritten Sample Labels Checklist

(Page 1 of 1)

Completing Handwritten Sample Labels	Yes	No	Comments
1. Did the Region provide CLP Sample numbers and SMO-assigned CLP Case numbers?			
2. If additional CLP Sample numbers were needed, did you contact the appropriate Regional personnel?			
3. Were the CLP Sample numbers and SMO-assigned CLP Case numbers on the labels correct? Organic CLP Sample numbers begin with the Regional letter code, followed by letters and numbers. Inorganic CLP Sample Numbers begin with "M," followed by the Regional letter code, and then letters and numbers.			
4. Were samples uniquely numbered and designated to only one sample? Samples collected for total metal and dissolved metal analyses must receive separate, unique, CLP Sample numbers.			
5. Were Quality Control (QC) samples numbered accordingly?			
6. Were the specific requirements followed for total and dissolved metals analysis, QC and Performance Evaluation (PE) samples, and SW-846 Method 5035A?			
7. Were all temperature blanks labeled with "TEMPERATURE BLANK"?			
8. Was a sample label containing the CLP Sample number, SMO-assigned CLP Case number, location, concentration, preservative, and the analysis, attached to each sample bottle or container as the sample was collected? Under no circumstances should the site name appear on any documentation being sent to the laboratory, unless the laboratory is a Regional USEPA laboratory. Then, the Region copy of the TR/COC record shall be sent to the USEPA laboratory.			
9. Was clear tape placed over the sample labels to protect the labels from moisture and to help the labels adhere to the sample bottle? Use only CLEAR tape over the sample labels and avoid wrinkles in the tape and the sample labels.			
10. Were all errors corrected by crossing a line through the error, initialing the error, dating the error, and then adding the correct information?			

Appendix E-5: Completing Handwritten Sample Tags & Custody Seals Checklists

(Page 1 of 1)

Completing Handwritten Sample Tags	Yes	No	Comments
1. Was waterproof ink used on the sample tags?			
2. If Regionally required for individual sample containers, was the project code on the sample tag completed?			
3. Was the station number on the sample tag completed?			
4 Was the date filled in using the format MM/DD/YYYY?			
5. Was the time of sample collection indicated in military time format HH:MM?			
6. Was the box checked indicating composite or grab sample?			
7. Was the station location on the sample tag completed?			
8. Did you indicate whether or not the sample was preserved by checking "yes" or "no?"			
9. Was the appropriate analysis indicated on the sample tag?			
10. Were the appropriate CLP Sample number and SMO-assigned CLP Case number indicated and cross-referenced with the numbers on the sample label?			
11. Did you sign the sample tags?			
12 Did you attach the sample tag to the neck of the sample bottle with string, stretch string, or wire? Do **NOT** use wire to attach a sample tag to a metal sample.			
13. Were all errors corrected by crossing a line through the error, initialing the error, dating the error, and then adding the correct information?			
Completing Custody Seals	**Yes**	**No**	**Comments:**
1. Did you sign and date the custody seal?			
2. Did you attach a completed custody seal to the sample bottle, container, or plastic bag, placing the seal over the cap or lid of each sample bottle or container or on the bag opening such that it will be broken if the sample bottle, container, or bag is opened or tampered with?			
3. As appropriate, did you attach the completed custody seal to the sample shipping container or cooler, placing the seal such that it will be broken if the container or cooler is opened or tampered with?			
4. Were all errors corrected by crossing a line through the error, initialing the error, dating the error, and then adding the correct information?			

Appendix E-6: Packing Sample Container Checklist

(Page 1 of 1)

Packing Sample Container	Yes	No	Comments
1. Did you follow all State, Federal, Department of Transportation (DOT), and International Air Transportation Association (IATA) regulations governing the packaging of environmental and hazardous samples? If samples contain methanol preservation (e.g., samples to be analyzed by SW-846 Method 5035A), refer to the packaging instructions in Appendix A.			
2. Were all CLP Sample numbers, SMO-assigned CLP Case numbers, analyses, labels, tags, and custody seals attached to the correct sample containers?			
3. Is modified analysis indicated if requested?			
4. Was an inventory conducted of CLP Sample numbers, SMO-assigned CLP Case numbers, analyses, and containers, and verified against the TR/COC records?			
5. Were the correct number and type of Performance Evaluation (PE) and Quality Control (QC) samples collected?			
6. Were all sample containers sealed in clear plastic bags with the sample label and tag visible through the packaging?			
7. Were all soil/sediment samples known or suspected to contain dioxin securely enclosed in metal cans (e.g., paint cans) with the lids sealed?			
8. Was suitable absorbent packing material placed around the sample bottles or containers?			
9. Were the outsides of metal containers labeled properly with the CLP Sample number, SMO-assigned CLP Case number, and the analysis of the sample inside?			

Appendix E-7: Packing Shipping Container Checklist

(Page 1 of 1)

Packing Shipping Container	Yes	No	Comments
1. Were you shipping samples in a clean waterproof metal or hard plastic ice chest or cooler in good condition?			
2. Were all non-applicable labels from previous shipments removed from the container?			
3. Were all inside and outside drain plugs closed and covered with suitable tape (e.g., duct tape)?			
4. Was the inside of the cooler lined with plastic (e.g., large heavy-duty garbage bag)?			
5. Was the lined shipping cooler packed with noncombustible absorbent packing material?			
6. Were sample containers placed in the cooler in an upright position not touching one another?			
7. Was a sample shipping cooler temperature blank included in the cooler?			
8. Did the documentation in the cooler only address the samples in that cooler?			
9. Was the site name absent from all documentation? Under no circumstances should the site name appear on any documentation being sent to the laboratory, unless the laboratory is a Regional USEPA laboratory. Then the Region copy of the TR/COC shall be sent to the USEPA laboratory.			
10. Was there sufficient packing material around and in between the sample bottles and cans to avoid breakage during transport?			
11. If required, was double-bagged ice placed on top and around sample bottles to keep the samples cold at 4°C (± 2° C)? Do not pack loose ice into the cooler.			
12. Was the top of the plastic liner fastened and secured with tape?			
13. Was a completed custody seal placed around the top of the fastened plastic liner (if required by the Region)?			
14. Were all sample documents enclosed within the cooler (e.g., TR/COC record and cooler return instructions) in a waterproof plastic bag?			
15. Was the plastic bag, containing the documentation, taped to the underside of the cooler lid?			
16. Were cooler return instructions and airbills taped to the underside of the cooler lid?			
17. Was the return address of the cooler written with permanent ink on the underside of the cooler lid?			
18. Was tape placed around the outside of the entire cooler and over the hinges?			
19. Were the completed custody seals placed over the top edge of the cooler so the cooler cannot be opened without breaking the seals?			
20. Was the return address label attached to the top left corner of the cooler lid?			
21. Were instructional labels attached to the top of the cooler, as necessary (e.g., "This End Up," "Do Not Tamper With," or "Environmental Laboratory Samples")?			
22. Have all US D.O.T. regulations been met for the shipment when shipping hazardous samples?			
23. If shipping samples containing methanol as a preservative (e.g., samples to be analyzed by SW-846 Method 5035A), was a label used to indicate methanol, the United Nations (UN) identification number for methanol (UN 1230), and Limited Quantity?			

Appendix E-8: Shipping & Reporting CLP Samples Checklist

(Page 1 of 1)

Shipping CLP Samples	Yes	No	Comments:
1. Did you follow all State, Federal, Department of Transportation (DOT), and International Air Transportation Association (IATA) regulations governing the shipment of environmental and hazardous samples?			
2. Was a separate airbill filled out for each cooler being shipped?			
3. Was the airbill filled out completely, including correct laboratory name, address, and telephone number, identification of recipient as "Sample Custodian," and appropriate delivery option (e.g., overnight or Saturday)?			
4. Was the completed airbill attached to the top of the cooler with the correct laboratory address?			
5. If more than one cooler was being shipped to the same laboratory, were they marked as "1 of 2," "2 of 2," etc.?			
6. Were the samples being shipped "overnight" through a qualified commercial carrier?			
Reporting CLP Samples	**Yes**	**No**	**Comments:**
1. Did you contact the RSCC (or designee) or the Contract Laboratory Program Sample Management Office (SMO) on the same day samples were shipped?			
2. If the samples were shipped after 5:00 PM Eastern Time (ET), were they reported to the RSCC (or designee) or to SMO by 8:00 AM ET the following business day?			
3. Did you notify the RSCC (or designee) or SMO so that SMO will receive the delivery information by 3:00 PM ET on Friday for sample shipments that will be delivered to the laboratory on Saturday?			
4. Did you provide the RSCC (or designee) or SMO with: X Your name, phone number, and Region number; X Case Number of the project; X Modified Analysis Number, if requested; X Exact number of samples, matrix(ces), concentration(s), and type of analysis; X Laboratory(ies) to which the samples were shipped; X Carrier name and airbill number; X Date of shipment; X Date of next shipment; and X Any other information pertinent to the shipment?			

Appendix F: Glossary

Analyte -- The element, compound, or ion that is determined in an analytical procedure; the substance or chemical constituent of interest.

Analytical Services Branch (ASB) -- Directs the Contract Laboratory Program (CLP) from within the United States Environmental Protection Agency's (USEPA's) Office of Superfund Remediation and Technology Innovation (OSRTI) in the Office of Solid Waste and Emergency Response (OSWER).

Aroclor -- Polychlorinated biphenyls (PCBs) or a class of organic compounds with 1 to 10 chlorine atoms attached to biphenyl and a general chemical formula of $C_{12}H_{10-x}Cl_x$. PCBs, commercially produced as complex mixtures containing multiple isomers at different degrees of chlorination, were marketed in North America under the trade name Aroclor.

Case -- A finite, usually predetermined, number of samples collected over a given time period from a particular site. Case numbers are assigned by the Sample Management Office (SMO). A Case consists of one or more Sample Delivery Groups (SDGs).

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) -- First authorized by Congress in December 1980, and amended in 1986, CERCLA provided broad Federal authority to respond directly to the release or possible release or hazardous substances that may endanger human health or the environment. CERCLA also established a Trust Fund to provide for cleanup when no responsible party could be identified; hence, CERCLA is commonly referred to as "Superfund."

Contract Laboratory Program (CLP) -- A national program of commercial laboratories under contract to support the USEPA's nationwide efforts to clean up designated hazardous waste sites by providing a range of chemical analytical services to produce environmental data of known and documented quality. This program is directed by USEPA's Analytical Services Branch (ASB).

Contract Laboratory Program Project Officer (CLP PO) -- Monitors technical performance of the contract laboratories in each Region.

Contract Laboratory Program Sample Management Office (CLP SMO) -- A contractor-operated facility operated under the CLP, awarded and administered by the USEPA, which provides necessary management, operations, and administrative support to the CLP. SMO coordinates and schedules sample analyses, tracks sample shipments and analyses, receives and tracks data for completeness and compliance, and processes laboratory invoices.

Custody Seal -- An adhesive label or tape that is used to seal a sample bottle or container that maintains chain-of-custody and that will break if the sample bottle or container is opened or tampered with.

Cyanide (Total) -- Cyanide ion and complex cyanides converted to hydrocyanic acid (HCN) by reaction in a reflux system of a mineral acid in the presence of magnesium ion.

Data Quality Objective (DQO) -- The requirements established to maintain the quality of the data being collected.

Data Validation -- Data validation is based on Region-defined criteria and limits, professional judgment of the data validator, and (if available) the Quality Assurance Project Plan (QAPP) and Sampling and Analysis Plan (SAP).

Duplicate -- Sample required by the laboratory's contract to check the accuracy and precision of inorganic analyses. It is a second aliquot of the same sample to determine the precision of the method.

Equipment Blank -- A sample used to check field decontamination procedures. See Field Blank.

Field Blank -- Any blank sample that is submitted from the field. Each field blank is assigned its own unique USEPA Sample number. A field blank checks for cross-contamination during sample collection, sample shipment, and in the laboratory. A field blank includes trip blanks, rinse blanks, equipment blanks, etc.

Field Duplicate -- Checks reproducibility of laboratory and field procedures and indicates non-homogeneity.

Field Operations and Record Management System (FORMS) II Lite -- A stand-alone, Windows-based software application that enables samplers to automatically create and generate sample documentation both prior to and during a sampling event.

Field QC Sample -- Used to detect for contamination or error in the field.

Field Sample -- Primary sample material taken out in the field from which other samples, such as duplicates or split samples are derived. A field sample can be prepared in the field and sent for analysis in one or multiple containers, and is identified by a unique USEPA Sample number.

Field Sampling Plan (FSP) -- Developed to outline the actual steps and requirements pertaining to a particular sampling event, and explains, in detail, each component of the event to all involved samplers.

Holding Time -- The elapsed time expressed in hours, days, or months from the date of collection of the sample until the date of its analysis.

> **Contractual** -- The maximum lengths of time that the CLP laboratory can hold samples prior to extraction and/or analysis, and are described in the CLP analytical services Statements of Work (SOWs).
>
> **Technical** -- The maximum lengths of time that samples may be held from time of collection to time of preparation and/or analysis and still be considered valid.

Laboratory Blank -- See Method Blank.

Laboratory Duplicate -- A sample required by the laboratory's contract to check the precision of inorganic analyses.

Laboratory QC Sample -- An additional volume of an existing sample, as required by the laboratory's contract, used to detect contamination or error in the laboratory's practices.

Matrix -- The predominant material of which a sample to be analyzed is composed.

Matrix Spike (MS) -- Sample required by the laboratory's contract to check the accuracy of organic and inorganic analyses. It is an aliquot of a sample (water or soil) that is fortified (spiked) with known quantities of a specific compound and subjected to the entire analytical procedure. See Matrix Spike Duplicate.

Matrix Spike Duplicate (MSD) -- Sample required by the laboratory's contract to check the accuracy and precision of organic analyses. It is a second aliquot of the same matrix as the Matrix Spike (MS) that is spiked to determine the precision of the method. See Matrix Spike.

Method Blank -- An analytical control consisting of all reagents, internal standards and surrogate standards [or System Monitoring Compounds (SMCs) for volatile organic analysis], that is carried throughout the entire analytical procedure. The method blank is used to define the level of laboratory, background, and reagent contamination, also referred to as laboratory blank when defining the level of laboratory contamination.

Modified Analysis – A change in the technical requirements that fall outside the scope of the Statement of Work (SOW).

Performance Evaluation (PE) Sample -- A sample of known composition provided by the USEPA for contractor analysis. Used by USEPA to evaluate contractor performance.

Pesticides -- Substances intended to repel, kill, or control any species designated a "pest," including weeds, insects, rodents, fungi, bacteria, and other organisms. Under the CLP, only organochlorine pesticides are analyzed (e.g., DDT, Dieldrin, Endrin, etc.).

Polychlorinated Biphenyls (PCBs) -- A group of toxic, persistent chemicals used in electrical transformers and capacitors for insulating purposes, and in gas pipeline systems as a lubricant. The sale and new use of PCBs were banned by law in 1979.

Quality Assurance (QA) -- An integrated system of management activities involving planning, implementation, assessment, reporting, and quality improvement to ensure that a process, item, or service is of the type and quality needed and expected by the customer.

Quality Assurance Project Plan (QAPP) -- Document written to meet requirements outlined in the document *EPA Guidance for Quality Assurance Project Plans* (EPA QA/R-5). Prepared in advance of field activities and used by samplers to develop any subsequent plans such as the Sampling Analysis Plan (SAP) or the Field Sampling Plan (FSP).

Quality Control (QC) -- The overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are used to fulfill requirements for quality.

Regional Sample Control Center (RSCC) Coordinator -- In most Regions, coordinates sampling efforts and serves as the central point-of-contact for sampling questions and problems. Also assists in coordinating the level of Regional sampling activities to correspond with the monthly projected demand for analytical services.

Regional Site Manager -- Coordinates the development of data quality objectives and oversees project-specific remedial or removal contractors, State officials, or private parties conducting site sampling efforts.

Rinse Blank -- A sample used to check decontamination procedures. Also see Field Blank.

Routine Analytical Service (RAS) -- The standard inorganic and organic analyses available through the CLP.

Sample -- A discrete portion of material to be analyzed that is contained in single or multiple containers, and identified by a unique Sample number.

Sample Delivery Group (SDG) – A unit within a sample Case that is used to identify a group of samples for delivery. An SDG is defined by the following, whichever is most frequent:

- Each Case of field samples received; or
- Each 20 field samples (excluding PE samples) within a Case; or
- Each 7 calendar day period (3 calendar day period for 7-day turnaround) during which field samples in a Case are received (said period beginning with the receipt of the first sample in the SDG).

In addition, all samples and/or sample analyses assigned to an SDG must have been scheduled under the same contractual turnaround time. Preliminary Results have no impact on defining the SDG. Sample may be assigned to SDGs by matrix (e.g., all soil samples in one SDG, all water samples in another) at the discretion of the laboratory.

Sample Label -- An identification label attached to a sample bottle or container to identify the sample.

Sample Number -- A unique number used to identify and track a sample. This number can be recorded on a sample label or written on the sample bottle or container using indelible ink.

Sample Tag -- A tag attached to a sample that identifies the sample and maintains chain-of-custody.

Sampling Analysis Plan (SAP) -- A document that explains how samples are to be collected and analyzed for a particular sampling event.

Scribe -- A stand-alone Windows-based desktop application that samplers can use to automatically create and generate sample documentation prior to and during sampling events.

Semivolatile Organic Analyte (SVOA) -- A compound amenable to analysis by extraction of the sample using an organic solvent.

Standard Operating Procedure (SOP) – A written document that details the method for an operation, analysis, or action with thoroughly prescribed techniques and steps, and that is officially approved as the methods for performing certain routine or repetitive tasks.

Statement of Work (SOW) -- A document that specifies how laboratories analyze samples under a particular Contract Laboratory Program (CLP) analytical program.

Superfund -- The program operated under the legislative authority of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Superfund Amendments and Reauthorization Act (SARA), that funds and carries out USEPA removal and remedial activities at hazardous waste sites. These activities include establishing the National Priorities List (NPL), investigating sites for inclusion on the list, determining their priority, and conducting and/or supervising cleanup and other remedial actions.

Superfund Amendments and Reauthorization Act (SARA) -- The 1986 amendment to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

Traffic Report/Chain of Custody (TR/COC) Record -- A record that is functionally similar to a packing slip that accompanies a shipment of goods. Used as physical evidence of sample custody and functions as a permanent record for each sample collected.

Trip Blank -- A sample used to check for contamination during sample handling and shipment from field to laboratory. Also see Field Blank.

Volatile Organic Analyte (VOA) -- A compound amenable to analysis by the purge-and-trap technique. Used synonymously with the term purgeable compound.

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Appendix G: FORMS II Lite Analysis Codes

Analysis Name	Abbreviation
Aluminum	Al
Antimony	Sb
Arsenic	As
Barium	Ba
Beryllium	Be
Cadmium	Cd
Calcium	Ca
Chromium	Cr
CLP TAL Total Metals ICP-MS	ICP/MS
CLP TAL Total Metals/ICP-AES	ICP-AES
CLP TCL Aroclors	CLP ARO
CLP TCL Pesticides	CLP PEST
CLP TCL Semivolatiles	CLP SVOA
CLP TCL Semivolatiles-SIM	CLP SVSIM
CLP TCL Trace Volatiles	CLP TVOA
CLP TCL Trace Volatiles-SIM	CLP TVSIM
CLP TCL Volatiles	CLP VOA
Cobalt	Co
Copper	Cu
Cyanide	CN
Iron	Fe
Lead	Pb
Magnesium	Mg
Manganese	Mn
Mercury	Hg
Nickel	Ni
Potassium	K
Selenium	Se
Silver	Ag
Sodium	Na
Thallium	Tl
Vanadium	V
Zinc	Zn

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Appendix H: Scribe CLP Analysis Codes

Analysis Name	Abbreviation
CLP Aluminum	Al
CLP Antimony	Sb
CLP Arsenic	As
CLP Barium	Ba
CLP Beryllium	Be
CLP Cadmium	Cd
CLP Calcium	Ca
CLP Chromium	Cr
CLP Cobalt	Co
CLP Copper	Cu
CLP Iron	Fe
CLP Lead	Pb
CLP Magnesium	Mg
CLP Manganese	Mn
CLP Nickel	Ni
CLP Potassium	K
CLP Selenium	Se
CLP Silver	Ag
CLP Sodium	Na
CLP TAL Dissolved Metals	DM
CLP TAL Total Metals	TM
CLP TAL Total Metals (No Hg)	TM (No Hg)
CLP TAL Total Metals and Cyanide	TM/CN
CLP TAL Total Metals ICP/MS	ICP/MS
CLP Thallium	Tl
CLP Vanadium	V
CLP Zinc	Zn
CLP TCL Pesticide/PCBs	PEST
CLP TCL Semivolatiles	BNA
CLP TCL Semivolatiles and Pesticides/PCBs	BNA/PEST
CLP TCL Volatiles	VOA

The Scribe CLP Analysis Codes provided may cause a delay in processing at the CLP laboratories based on interpretation. **Samplers are advised to use the analysis codes provided in *Appendix G: FORMS II Lite Analysis Codes* for CLP analysis.**

Scribe users are advised to contact the ERT Software Support Help Desk at 800-999-6990 for assistance in adding the custom analysis onto Scribe, please contact or refer to the following Web site:

http://www.epaosc.org/Scribe

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