ARKEMA EARLY ACTION
EE/CA WORK PLAN

Work Plan Addendum

Appendix A
Field Sampling Plan

Prepared for
Legacy Site Services LLC
468 Thomas Jones Way
Exton, PA 19341

Prepared by

integral consulting inc.
319 SW Washington Street
Suite 1150
Portland, OR 97204

May 15, 2009

CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

ASTM	American Society for Testing and Materials
CDF	confined disposal facility
COI	constituent of interest
CPT	cone penetration testing
CU	consolidated, undrained triaxial shear stress
DDx	total of 2,4′- and 4,4′-DDD, DDE, DDT
DEQ	Oregon Department of Environmental Quality
DGPS	differential global positioning system
DOT	U.S. Department of Transportation
EE/CA	engineering evaluation and cost analysis
EPA	U.S. Environmental Protection Agency
EVS	Environmental Visual Software
FSP	field sampling plan
GUS	Gregory Undisturbed Sampler
Integral	Integral Consulting Inc.
IRM	interim remedial measure
LSS	Legacy Site Services LLC
NAD	North American Datum
NTCRA	non-time-critical removal action
OVM	organic vapor meter
PCB	polychlorinated biphenyl
PCDD/F	polychlorinated dibenzo-*p*-dioxin and polychlorinated dibenzofuran
PPE	personal protective equipment
QA	quality assurance
QAPP	quality assurance project plan
RAA	removal action area
SOP	standard operating procedure

SPT	standard penetration testing
SVOC	semivolatile organic compound
TCLP	toxicity characteristic leaching procedure
TZW	transition-zone water
UU	unconsolidated, undrained triaxial shear stress
VOC	volatile organic compound

1 INTRODUCTION

This field sampling plan (FSP) was prepared for the engineering evaluation/cost analysis (EE/CA) non-time-critical removal action (NTCRA) at the Arkema site (Site). This FSP is Appendix A to the EE/CA Work Plan Addendum (Work Plan Addendum). The Work Plan Addendum modifies and updates the May 11, 2007 EPA/Parametrix Arkema Early Action EE/CA Work Plan (EPA/Parametrix Work Plan) pursuant to agreements between the U.S. Environmental Protection Agency (EPA) and Legacy Site Services LLC (LSS), agent for Arkema Inc., between May 2007 and May 4, 2009, and findings by EPA (USEPA 2008). Together, the EPA/Parametrix Work Plan, the Work Plan Addendum, and this and other revised appendices encompass the Final EE/CA Work Plan for the Site.

The Site is located in Portland, Oregon on the northwest bank of the lower Willamette River between approximately river mile 6.9 and 7.6 (Parametrix 2007, Figure 1-1). The upland portion of the Site encompasses approximately 54 acres of land. The in-water portion of the Site is defined as the land below mean high water (18.1 ft City of Portland Datum)[1]; however, the NTCRA evaluation will include portions of the riverbank to the top of bank, as the riverbank cannot easily be subdivided for construction purposes. The EE/CA NTCRA is primarily focused on the in-water portion of the Site; however, elements of the removal action will be integrated with the upland portion of the Site. The portions of the riverbank (to the top of bank) that are deemed to be recontamination sources or to impact the removal and/or remedial action alternatives may be addressed by the NTCRA, while the remainder of the riverbank may be addressed directly with the Oregon Department of Environmental Quality (DEQ) in accordance with the Agreed Order on Consent dated October 31, 2008. Ultimately, the timing and coordination between the Upland and NTCRA projects will dictate under which program the NTCRA-affected riverbank portions will ultimately be addressed in the field.

This FSP describes the sampling design and rationale to meet the data needs of the removal action characterization activities associated with the EE/CA and, along with the Quality Assurance Project Plan (QAPP; Appendix B), provides specific field methodology and quality assurance procedures that will be followed by Integral Consulting Inc. (Integral) and its subcontractors. Integral is conducting this work under contract to LSS with approval and oversight by EPA and DEQ.

The primary objective of the EE/CA characterization activities is to fill data gaps to further refine the 5 mg/kg preliminary removal action area (RAA) boundary, especially at depth, as cited in the May 23, 2008 Final Decision on Disputes from Dan Opalski, Director, Office of

---

[1] The in-water portion of the Site below mean low tide is leased from the Oregon Division of State Lands.

Environmental Cleanup (Opalski Decision). The additional characterization falls into two general categories:

- Defining sediment quality characteristics
- Defining sediment physical and engineering characteristics.

The remainder of this FSP is organized as follows:

- Section 2: Data Gaps and Field Investigation Rationale—This section describes the rationale used to fill data gaps at the Site and provides a description of the EE/CA characterization activities.
- Section 3: Field Sampling Methods—This section provides a general description of the field methods that will be employed to fill data gaps at the Site.
- Section 4: References—References cited in this document.
- Attachment A: Standard Operating Procedures—These numbered documents provide specific, detailed information on conducting routine, repetitive field techniques (e.g., split-spoon sampling from a drill rig).
- Attachment B: Field Forms—These field forms will be utilized to record data in the field.

2 DATA GAPS AND FIELD INVESTIGATION RATIONALE

This section identifies data needs and presents approaches to fill data gaps for the removal action technologies and alternatives presented in the EE/CA EPA/Parametrix Work Plan and Work Plan Addendum (Parametrix 2007; Integral 2008), and as clarified by the Opalski Decision. The data needs for removal action technology groups are summarized in Table 2-1. The proposed investigation activities described in this FSP are intended to support the analysis and selection of removal action alternatives during the EE/CA, to identify a preferred removal action alternative, and in part to support engineering analyses during the design phase of the Arkema NTCRA.

2.1 DATA GAPS

The following sections address data gaps identified to complete the EE/CA.

2.1.1 Removal Action Technologies and Alternatives

Table 2-1 presents the sampling and analysis methods that will be considered for each potential removal and/or remedial action technology for the Site. Table 2-2 presents the sampling and analysis methods that may be considered for each potential disposal alternative. A checkmark (✓) indicates that sufficient data are available and that no additional data are needed for the sampling or analysis method. An "X" indicates that available data are insufficient and that additional data are needed for the sampling or analysis method.

These methods are discussed in more detail in the following sections.

2.1.2 Nature and Extent of Contamination

Although extensive sediment data have been gathered over portions of the Site, especially in the area of Arkema Docks 1 and 2 (Figure 2-1), additional data are needed for completion of the EE/CA. Sediment data are limited in certain portions of the study area, and additional sediment chemistry data are needed (predominantly vertically) to refine the RAA boundary limits at depth. Additional borings will also be used to further confirm the 5 mg/kg RAA boundary laterally. Currently sufficient data exist, including recent Round 3b Lower Willamette Group sampling data, upstream of Dock 1 to support the evaluation of recontamination caused by resuspension and redeposition of nearby upstream sediments into the RAA. Sediment quality data are generally less abundant with depth, as determined in part by the Environmental Visual Software (EVS) Drill Guide, resulting in greater statistical uncertainty about levels of contamination at different depth intervals between the sediment surface and bedrock within the 5 mg/kg total of 2,4′- and 4,4′-DDD, DDE, DDT (DDx) preliminary RAA. Therefore, in accordance with the Opalski Decision, much of the EE/CA characterization is focused on and designed to provide higher confidence in the definition of the base of the RAA within the RAA boundary. In addition, some ancillary sediment chemistry data are also needed for other non-site-specific analytes (e.g., dioxin/furan congeners and polychlorinated biphenyls [PCBs]) to obtain a better understanding of these river-wide constituents of interest (COIs) within the Arkema RAA for sediment management and handling.

2.1.3 Sediment Physical and Engineering Characteristics

A suite of physical tests is proposed to evaluate sediment properties pertinent to dredging and capping technologies, dredged material behavior in a disposal site, potential short-term impacts at the dredge and disposal sites, capacity of existing sediments to provide foundation support for capping material, and the viability of sheet pile wall construction or other technology for nearshore containment. The tests discussed below will be required to evaluate these technologies.

2.1.3.1 Index Properties

Grain Size

Grain size provides information on site geologic character and engineering properties and behavior of sediment proposed for capping, dredging, or nearshore containment. Sediment grain-size information is available for most surface sediments previously collected from the Site. Fewer grain-size data are available for the subsurface sediments within the 5 mg/kg DDx preliminary RAA boundary.

Atterberg Limits

Atterberg limits, which include the liquid limit, plastic limit, and plasticity index, are used to define plasticity characteristics of cohesive sediments and are useful index parameters for sediment characterization, engineering behavior, and shear strength correlations. Limited Atterberg limit data are available from historical studies within the preliminary RAA boundary. Selected fine-grained surface and subsurface sediments collected for grain size will also be analyzed for Atterberg limits.

Specific Gravity

The specific gravity of sediment samples is used to determine weight-volume relationships of sediment, which are used for unit weights and void ratio calculations. Limited data for specific gravity in sediment are available between the docks and nearshore (Portland Harbor Remedial Investigation sampling locations only). Selected samples will be analyzed in support of the remedial alternative selection.

Moisture/Bulk Density

Moisture content is used to determine the initial *in situ* void ratio of the sediment, to estimate short-term bulking (or increase in volume) during dredging activities, and to correlate with other geotechnical parameters. There have been no direct measurements in site sediments for moisture content or bulk density. Selected samples will be analyzed in support of the remedial alternative selection.

2.1.3.2 Subsurface Information and Advanced Geotechnical Parameters

In addition to index property testing, more advanced testing will be performed to estimate subsurface information and geotechnical parameters such as shear strength, stress history, compressibility, and hydraulic conductivity of the *in situ* material. These parameters are needed to support the analysis and design of the various removal action technologies under consideration for the Site. Analysis and design of sediment caps involves the evaluation of long-term stability and integrity, based upon physical and chemical parameters expected at the Site. Parameters to be evaluated during the design of a cap include chemical isolation, cap thickness, cap materials, cap armoring, shear strength and consolidation characteristics of underlying sediments, bioturbation, cap erosion and scour, vessel prop wash, slope stability, and settlement/consolidation (USACE 1998; USEPA 1998). Physical characteristics and shear strength parameters are also needed to assess the stability of proposed dredge cuts and potential impacts to adjacent shorelines and structures. Geotechnical parameters will also be needed to assess the suitability of the Site subsurface materials to support a nearshore confined disposal facility (CDF) and other structures that may be necessary during remedial construction. The geotechnical tests required to support evaluation of these removal action technologies are described below. None of these tests has been conducted previously on site sediments.

Shear Strength Testing

Shear strength test results are used to assess bearing capacity, slope stability, and earth pressures for analysis and design of removal action technologies such as *in situ* capping, CDFs, and dredging. Drained and undrained shear strength parameters will be used during design. These parameters will be assessed using a variety of approaches and include the use of unconsolidated, undrained (UU) and consolidated, undrained (CU) triaxial shear tests. In addition, shear strength will also be assessed based on the results of standard penetration testing (SPT), cone penetration testing (CPT), and index property testing, in conjunction with published correlations and engineering judgment.

In addition to the shear strength testing on sediment samples, the unconfined compressive strength of rock samples will be tested by performing point load index tests and unconfined compressive strength tests. These tests will be performed to assess the "rippability" and bearing characteristics of the underlying bedrock. These characteristics may become important in the assessment of constructability and feasibility of sheet pile structures such as CDF containment structures.

Consolidation Testing

Consolidation tests are performed to determine the compressibility and stress history parameters. These parameters are used for assessment of consolidation behavior of sediment deposits under loading conditions associated with capping materials and assessment of the shear strength of cohesive materials. An understanding of the consolidation of underlying sediment is important in evaluating the effective (or minimum) thickness of a cap (USACE 1998). The effective thickness of a cap is reduced by the consolidation in the underlying sediment. Vertical loads for cap consolidation testing and analyses are determined on the basis of the anticipated cap configuration and thickness (modified EM-1110-2-5027). Additionally, stress history parameters are useful in assessing the in-situ strength of the cohesive material. The use of strength data is explained in more detail under Shear Strength Testing.

Hydraulic Conductivity

Hydraulic conductivity testing will be conducted to assess the permeability of lower cohesive strata within the RAA boundary, which may serve as a key-in feature for nearshore CDF options considered during the EE/CA.

2.1.4 Upland Disposal of Dredged Material

In order to identify the appropriate type of upland disposal options for the dredged sediments, a waste determination analysis must be conducted. The waste determination analysis involves evaluating the source of the waste and the waste characteristics, including toxicity characteristic leaching procedure (TCLP) testing. For example, for assessing disposal options at offsite landfills, the waste would have to be evaluated per the Oregon Administrative Rules prior to disposal at a Subtitle D landfill.

Additionally, landfill-specific criteria such as the presence of free liquids and other permit required testing (e.g., total petroleum hydrocarbons, asbestos) will apply. These criteria are specific to the landfill selected to receive the dredged sediments. Therefore, other offsite landfill-specific testing may be performed to evaluate disposal options for any dredged material.

2.1.5 Hydrogeologic Characteristics

Groundwater characteristics have been evaluated for upland soils and in-water sediments, including the transition zone between sediments and overlying water (Integral 2007). Upland groundwater zones and their characteristics (including hydraulic gradient) are summarized in Section 3.2.2.3 of the Final EE/CA Work Plan (Parametrix 2007; Integral 2008). As stated in the

Final EE/CA Work Plan, the quality of some of the transition-zone water (TZW) data is considered to be unusable for the purpose of evaluating recontamination potential for chlorinated pesticides because of the collection method (i.e., unfiltered, turbid water samples from Trident probes). Other TZW data, including peepers samples (a sample device that uses a semi-permeable membrane) and filtered Trident probe samples, are more likely to be representative of water moving through the sediment prior to discharge at the sediment surface. These latter data will be used to evaluate the potential for long-term release and sediment or cap recontamination at the sediment interface for the EE/CA. No additional TZW data collection is proposed in this FSP.

Transition-zone groundwater seepage rates were measured as part of the recent Portland Harbor remedial investigation groundwater study, as described in Section 3.2.2.1 of the Final EE/CA Work Plan (Parametrix 2007; Integral 2008). The information from these studies, and other relevant site data, will be used in calculations and modeling to estimate long-term contaminant release or loss associated with placement of an isolation cap and to assist in the evaluation of hydraulic containment technologies. An understanding of groundwater advection in the sediments is important in evaluating the effective (or minimum) thickness of a cap. This information will also be beneficial in evaluating hydraulic containment alternatives for the Site.

Additional information is also needed to understand the depth to basalt bedrock and low-permeability horizons within the in-water portion of the Site. No other hydrogeologic data are required in support of the EE/CA.

2.1.6 Debris Survey, Dock Encumbrances, and Utilities

The nature and extent of debris within the project site RAA will need to be considered in the development and evaluation of sediment capping, dredging, and hydraulic containment technologies. Accordingly, a reconnaissance survey of the project area will be conducted to estimate the quantity and nature of surface debris. In addition, boring logs will be reviewed to identify subsurface debris encountered during both historical and proposed site investigations. This information will be compiled for consideration during the EE/CA and also will be useful for inclusion in the final design documents and remedial construction contract.

2.2 REMOVAL ACTION CHARACTERIZATION ACTIVITIES

This section summarizes the rationale for removal action sampling and analytical methods that will be employed in support of the EE/CA. Future sampling methods that may be necessary for the removal action, but are beyond the scope of this FSP, are also noted below.

2.2.1 Nature and Extent of Contamination

This section presents the sampling design and rationale for the EE/CA characterization to evaluate sediment characteristics at the Site. Additional information on sediment characteristics is required per the Opalski Decision to further refine the horizontal and vertical extent of the 5 mg/kg DDx preliminary RAA boundary. For the vertical boundary definition, the Opalski decision specifically states: *"the EE/CA shall proceed with analyses that considers the implications of dredging to a range of concentrations vertically, with that range to include at least the SLVs and the approximate 5 ppm concentration suggested by LSS' mass-based analysis."* The proposed investigations are designed to fill data gaps identified by conventional data gap analysis and by the Drill Guide to adequately define the base of the removal action within the RAA boundary, and to provide a baseline for monitoring remedial activities.

2.2.1.1 Rationale

Surface and subsurface samples will be collected and analyzed to support delineation of the 5 mg/kg RAA boundary in accordance with the Opalski Decision and development of removal action alternatives. Sampling locations have been selected to characterize sediment in areas identified by conventional data gap analysis and identified by the Drill Guide[1] to provide a higher statistical certainty in the 5 mg/kg RAA boundary contour.

2.2.1.2 Sampling Strategy

A total of 37 sediment chemistry boreholes are proposed (WB-30 through WB-66; Figure 2-1) and will be completed to basalt (or refusal) to evaluate the horizontal and vertical extent of COIs within and adjacent to the 5 mg/kg DDx RAA boundary. Samples will be collected for chemical analyses and/or archived at all proposed sampling locations. The proposed sampling, analysis, and archiving plan and rationale for each borehole location is summarized in Table 2-3. Proposed sediment samples are distributed at representative locations within the vicinity of the preliminary RAA boundary to measure the vertical and horizontal extent of DDx and other chemicals. In addition to characterizing the broader Site conditions, this sampling will focus on the perimeter of the 5 mg/kg preliminary RAA Boundary contour where the majority of DDx mass is located. Selected samples will be archived for possible subsequent analysis, depending on the analytical results from samples collected at nearby boreholes (Table 2-3; Figure 2-1).

In some locations, sediment chemistry cores will be near geotechnical borehole locations. In general, the installation sequence for the sediment chemistry and geotechnical boreholes does not matter. However in the area immediately downstream of Dock 2, sediment chemistry cores WB-49, WB-50, and WB-51 will be installed prior to the CPT boreholes (CPT-1 and CPT-3). If

[1] A description of EVS Drill Guide methodology is presented in Section 8.2 of the Work Plan Addendum (Integral 2008).

the geotechnical engineer determines that the sediment lithology in the Dock 2 area is substantially different[2] than the sediment lithology near Dock 1 then one of the collocated geotechnical boreholes (SPT) may be moved to this downstream location.

Sediment quality samples will be collected using a barge-mounted hollow-stem auger drill rig (or equivalent) advanced to basalt or refusal. Samples will be collected continuously at 2- to 3-ft intervals in accordance with Table 2-3 for the entire length of the borehole, using a variety of samplers, depending on the sample location and bottom conditions. Sampling equipment may include split-spoon samplers, Gregory Undisturbed Sampler (GUS) or Osterberg sampler, and/or Shelby tubes.

2.2.1.3 Analytical Strategy

The rationale, analytes, and laboratory methods for the sediment samples are detailed in Table 2-3 and the QAPP (Appendix B). Additional samples may be analyzed based on field observations, including visual observation, odor, and presence of volatile chemicals (e.g., using a photoionization detector). A portion of each sample interval will be archived for possible future chemical analysis. The analytes are grouped into standard and expanded lists.

Most samples will be analyzed for the standard analyte list, which includes the following:

- Conventional analytes (grain size, total solids, and total organic carbon) by American Society for Testing and Materials (ASTM) Method D-422, EPA Method 160.3 modified, and EPA Method SW846-9060A, respectively
- DDx by EPA Method SW846-8081A.

Other samples, as identified in Table 2-3, will be analyzed for an expanded analyte list to better characterize the nature and extent of river-wide COIs inside and adjacent to the preliminary RAA. The expanded analyte list includes the following:

- Standard analyte list (described above)
- Semi-volatile organic compounds (SVOCs) by EPA Method SW846-8270C
- PCB Aroclors by EPA Method SW846-8082
- Volatile organic compounds (VOCs) by EPA Method SW846-8260B
- Organochlorine pesticides by EPA Method SW846-8081A
- Polychlorinated dibenzo-*p*-dioxin and polychlorinated dibenzofuran (PCDD/Fs) by EPA Method 1613B.

[2] For the purposes of the geotechnical evaluation.

2.2.2 Physical and Engineering Characteristics

2.2.2.1 Rationale

A testing program will be performed to determine the sediment index properties and geotechnical engineering parameters within and adjacent to the RAA boundary. The physical characteristics of sediments are important in the evaluation of dredging, capping, and containment technologies, dredged material transport and disposal, dredged material behavior in a disposal site, potential short-term impacts at the dredge and disposal sites, and the capacity of the sediments to support capping materials.

2.2.2.2 Geotechnical Investigation Sampling Strategy

The geotechnical investigation program will consist of three mud-rotary sediment borings and 13 CPT explorations to evaluate geotechnical properties and subsurface conditions within and adjacent to the RAA boundary (Figure 2-1). CPTs were selected because they are an effective exploratory technique that can be used to collect continuous soil type and property data. Mud-rotary drilling was selected because the drilling mud used for mud-rotary drilling prevents soil heave in the borehole. Heave can obscure the results of SPT.

The CPT measures tip resistance, sleeve friction, and pore pressure essentially continuously to the total depth of the borehole. These three parameters are used to estimate the soil behavior type, which typically correlates well with stratigraphy obtained from drilling and sampling in a collocated mud-rotary borehole. CPT parameters will also be correlated with other important soil parameters used in geotechnical analysis and design, such as sediment shear strength. No sediment samples are collected with the CPT.

The three mud-rotary boreholes (identified as SPT on Figure 2-1) will be collocated with three of the CPTs (identified as CPT on Figure 2-1) to allow development of site-specific correlations between CPT parameters and parameters based on sampling and laboratory testing. The collocated explorations were selected strategically based on existing subsurface information such that correlations for both cohesive and granular soils can be established.

All geotechnical explorations will be advanced to bedrock refusal. Based on existing basalt surface information for the site, bedrock will be encountered at relatively shallow depths. The sediment cover between the shoreline and the existing docks is on the order of 20 to 40 ft. The sediment cover in the channel is only on the order of 2 to 10 ft. Sediment cover is important for the feasibility of installing sheet pile structures.

In the mud-rotary boreholes, SPTs will be performed in the boreholes continuously or at 2.5-ft intervals for the first 20 ft of drilling and at 5-ft intervals thereafter. The SPT is an *in situ* testing technique that is used to estimate soil density of granular material and consistency of cohesive material. Correlations of SPT results with soil parameters are used in geotechnical analysis and design. Disturbed split spoon samples will be collected for visual soil/sediment classification during SPT. Laboratory testing, consisting of index property testing for soil/sediment classification, will be conducted on selected split spoon samples (refer to Geotechnical Testing Strategy below).

Relatively undisturbed, thin-wall tube samples (Shelby tubes) will also be collected in the mud-rotary boreholes, for advanced laboratory testing (consolidation and shear strength testing) and index property testing on selected samples. Shelby tubes will be collected using a piston sampler (Osterberg Sampler or GUS) to ensure proper sample recovery and minimization of sample disturbance. Shelby tubes will be handled with utmost care so as to minimize further sample disturbance after retrieval. Sample disturbance can obscure the results of advanced geotechnical testing, including shear strength and consolidation parameters.

The preferred sequence for borehole installation is to install CPTs first where a CPT borehole is collocated with a mud-rotary borehole (see CPT -9, CPT-10, and CPT-13 on Figure 2-1). If the CPT is performed first, the stratigraphy at that location is already known prior to mud-rotary drilling, and the Shelby tube sampling depths can be targeted more easily. Shelby tubes will only be collected in cohesive material (i.e., silt and clay). Based on existing subsurface information, relatively thick deposits of cohesive material are expected to be encountered in borings SPT-1 and SPT-3. Shelby tube sampling will, therefore, likely be focused on these two locations. More than one borehole may be required at the mud-rotary locations to allow for undisturbed sampling and/or to provide enough sediment for all proposed tests.

In one of the mud-rotary boreholes (SPT-1; Figure 2-1), rock coring will be performed to 20 ft below the bedrock contact elevation to determine the quality of the rock. The constructability of certain structures may depend on the "rippability" of the bedrock at the site; therefore, unconfined compressive strength and point load index testing of rock samples will be conducted (see Section 2.2.2.3).

The proposed rationale, test parameters, and laboratory methods for each geotechnical boring is presented in Table 2-4 and the QAPP (Appendix B).

2.2.2.3 Geotechnical Testing Strategy

The selection of samples for geotechnical testing will be determined on the basis of observed lithology, as required to characterize the observed range of lithologies and associated geotechnical conditions critical to the selection, evaluation, and design of candidate removal action technologies (Table 2-1). Target sample intervals in the SPT borehole will be determined in the field based on the interpretation of the collocated CPT explorations, which will be advanced prior to the SPT geotechnical boring. The geotechnical testing program will include the following parameters:

- Grain-size analysis by ASTM-D422

- Atterberg limits by ASTM-D4318
- Specific gravity by ASTM-D854
- Moisture content by ASTM-D2216
- Organic content by ASTM-D2974.
- Consolidation by ASTM D 2435 (Method B)
- UU triaxial shear stress by ASTM-D2850
- CU triaxial shear stress by ASTM-D4767
- Unconfined compressive strength (rock) by ASTM D-7012
- Point load index (rock) by ASTM-D5731
- Hydraulic conductivity by ASTM-D5084.

2.2.3 Waste Disposal Evaluation

2.2.3.1 Rationale

Representative large-volume samples are required for disposal design requirements (USEPA/USACE 1998). The assessment of offsite landfill disposal will be performed with landfill-specific acceptance criteria including hazardous waste determinations (i.e., TCLP).

2.2.3.2 Sampling Strategy

Two large-volume samples will be composited from each of seven boreholes located between Dock 1 and Dock 2 (WB-35, WB-36, WB-37, WB-39, WB-41, WB-42, and WB-43; Table 2-3). These areas are within or immediately downstream of the highest DDx concentrations in sediments within the RAA boundary. The composite sample analyses will provide data for sediment that could require disposal as part of the removal action. Figure 2-1 presents the proposed boring locations for each composite sample. Table 2-3 presents the compositing intervals for each large-volume sample. A total of 14 composite samples will be collected—two from each borehole.

2.2.3.3 Analytical Strategy

A representative sample of the composite sediment described above will be analyzed for hazardous waste determination and used to assess landfill disposal options. Composite sediment samples will be analyzed for the following:

- TCLP for standard TCLP VOCs, SVOCs, metals, pesticides, and herbicides (42 individual chemicals using EPA SW-846 methods)

- Asbestos (EPA Method 600/R-93-116).

Additional testing associated with disposal at a solid waste landfill may also be performed. These analyses may include:

- PCB Aroclors by EPA Method SW846-8082
- PCDD/Fs.

2.2.4 Debris Survey, Dock Encumbrances, and Utilities

There are two large docks at the Site within the RAA boundary area, both of which have been out of service since 2001. The docks are primarily timber construction (but each includes four large concrete dolphins), supported by a dense network of timber, steel, and concrete pilings. Three stormwater outfall structures extend into the preliminary RAA boundary. The dock and outfall structures will likely be removed as part of the removal action, as their presence will impact the feasibility of sediment capping or dredging. The site characterization program will include a survey of these structures to verify their condition and catalogue the type and quantity of construction materials. A historical review will be conducted to determine the extent of building and demolition debris in the area currently occupied by the docks and outfalls. In addition, the removal of large obstructions, such as the existing docks, that could affect the implementability of in-water removal and/or remedial actions will be evaluated in the EE/CA.

2.2.5 Future Sampling

The following sections briefly describe future sampling of surface water, groundwater, TZW, and biota. Although the sampling is not part of this FSP, a brief description of the objectives for sampling these media is presented below. The timing and details of these sampling activities will be submitted as addenda to this FSP and the QAPP after the EE/CA as specified below.

2.2.5.1 Water Quality/Chemical Mobility Testing During Dredging and Disposal

Representative sediment from areas that could be dredged will be collected in the future to assess chemical mobility during sediment dredging and disposal. This will consist primarily of elutriate testing (dredging elutriate testing and effluent elutriate testing) on representative dredged material to provide an assessment of contaminant mobility during dredging and disposal operations. However, this sampling will be delayed until after the removal area/removal action is selected so that it is better understood which specific tests, models, and sample locations are required. The water quality and chemical mobility testing will be conducted during the EE/CA design phase.

2.2.5.2 Surface Water

Future sampling of surface water will be conducted to provide baseline conditions and post-removal action monitoring to determine if there are any significant impacts during and after the in-water removal action. In addition, existing and future surface water sample data will provide information on potential Site recontamination from upstream water. The pre- and post-removal action surface water sampling will be included as an element of the removal action work plan. Pre-removal action sampling will be implemented prior to removal action activities.

2.2.5.3 Groundwater and Transition-Zone Water

Future sampling of groundwater and TZW will be required to verify the effectiveness of the Upland Source Control interim remedial measures (IRMs). The future sampling necessary for the NTCRA will depend on the selected removal action. The purpose of the sampling for the Upland Source Control IRMs will be to monitor groundwater conditions upland (upgradient) of the planned cutoff wall and in the shoreline area immediately downgradient of the planned groundwater cutoff wall. The timing and details of this sampling activity will be developed in coordination with the Upland Source Control IRMs and the selected removal action. Post-removal action TZW monitoring will be included as an element of the removal action work plan.

2.2.5.4 Biota

Future biota sampling will be needed for several objectives including, but not limited to, 1) identifying baseline conditions in biota before the removal action; 2) assessing the short term impacts of the removal action on biota contaminant levels; and 3) assessing the long-term effectiveness of the removal action. The details of this sampling activity will be developed in coordination with the selected removal action. Baseline and post-removal action biota monitoring will be included as an element of the removal action work plan.

3 FIELD SAMPLING METHODS

This section presents the field sampling methods to be used by Integral and its subcontractors for the RAA characterization. In general, field sampling methods will follow the standard operating procedures (SOPs) listed in Attachment A. Attachment B contains field forms and examples of chain-of-custody forms, sample labels, custody seals, and logbooks. All sampling will be conducted in accordance with the quality assurance (QA) procedures outlined in the QAPP. Safety guidelines are presented in the site health and safety plan. General guidelines for conducting the field work are described in the following sections.

3.1 HORIZONTAL AND VERTICAL CONTROL METHODS

3.1.1 Utility Survey

Prior to commencing field activities, a utility survey will be conducted to identify all known in-water utilities within the study area. Arkema representatives will be contacted regarding the locations of the private utilities in the study area, including stormwater outfalls and other utilities associated with former plant operations. The Oregon Utility Notification Center (1-800-332-2344) will be contacted to locate public utilities in the study area. If proposed sample locations interfere with utilities, alternate locations will be determined in consultation with the LSS Project Team, as designated in the Final EE/CA Work Plan.

3.1.2 Surface Debris Survey

A visual surface debris survey will be conducted to catalogue and identify the locations of outfalls, pilings, concrete, and other debris within the preliminary RAA boundary. The purpose of the survey is to identify any debris or structures that could affect the implementation of the Final EE/CA Work Plan and potential in-water removal and/or remedial actions.

The survey will be conducted during a low river stage when the riverbank and sediments are most visible. The debris survey in the in-water portion of the Site will be conducted using a small boat equipped with a differential global positioning system (DGPS) unit with an accuracy of approximately ±1 to 2 meters. The riverbank area will be surveyed using a DGPS unit after blackberries and other vegetation are removed. The DGPS unit will be used in accordance with SOP 1.

The DGPS beacon will be located directly on top of the structure or debris and the horizontal location of the debris will be recorded in latitude and longitude (North American Datum [NAD] 1983) in the field and converted to state plane coordinates (Oregon North, International Feet). Dense areas of debris will be mapped as areas rather than discrete points. Each structure or piece of debris will be photodocumented and a description (e.g., type of debris, size) will be recorded in the field logbook.

3.1.3 Sample Locations

The horizontal coordinates of each sample station are specified in Tables 2-3 and 2-4. The barge will be guided to the station locations using a DGPS unit with an accuracy of approximately ±1 meters. The DGPS beacon will be positioned where the drilling will occur (i.e., moon pool). The horizontal location of the station will be recorded in latitude and longitude (NAD 1983) in the field and converted to state plane coordinates (Oregon North, International Feet). Navigation and positioning will follow guidelines in SOP 1.

The mudline elevation at each station will be calculated using a staff gauge attached to one of the docks prior to the field effort (location to be determined). Prior to commencing work, the elevation of the staff gauge will be surveyed relative to the NAVD88 benchmark by an Oregon licensed professional land surveyor. The mudline depth from the water surface will be measured with a sounding device (e.g., weight tied to the end of a fiberglass tape measure) to the nearest 0.1 ft. The water surface elevation will be determined from the staff gauge. The mudline elevation will be calculated as the staff gauge elevation of the river minus the depth to mudline in feet.

The following parameters will be documented in the field logbook at every sample location:

- Horizontal location using a DGPS unit
- Depth to mudline from river level
- River level measured on surveyed tide staff gauge on Arkema dock (measurement must be made within 0.5 hour of the mudline measurement)
- Time and date.

3.2 SAMPLING METHODS

Sampling during this field effort will consist of surface and subsurface sediment sampling and large volume river water samples to be used for dredge material water quality tests.

3.2.1 Sediment Boreholes

3.2.1.1 General Guidelines

A hollow-stem auger (or equivalent) drill rig positioned on a barge will be used to complete the sediment boreholes for sediment quality sampling. The boreholes will be drilled through a moon pool (or equivalent access location) on the barge. Samples will be collected continuously as detailed in Table 2-3 to bedrock or refusal using a split spoon sampler or a GUS or Osterberg Sampler equipped with a stainless-steel or aluminum Shelby tube. A large-volume split-spoon sampler may also be used for sampling. All chemistry samples that are not identified for analysis will be archived at the analytical laboratory. The drilling and sampling procedures will follow SOP 3, except for the use of conductor casing on selected boreholes, as described below.

A mud-rotary (or equivalent) drill rig positioned on a barge will be used to complete the SPT geotechnical investigation boreholes. The SPT boreholes will be drilled through a moon pool (or equivalent access location) on the barge. SPTs will be performed in the boreholes continuously or at 2.5-ft intervals for the first 20 ft of drilling and at 5-ft intervals thereafter to bedrock or refusal. A GUS or Osterberg Sampler equipped with a stainless-steel or aluminum Shelby tube, or a large-volume split-spoon sampler may be used for sampling. The drilling and sampling procedures will follow SOP 3, except for the use of conductor casing on selected boreholes, as described below.

A CPT (or equivalent) rig positioned on a barge will be used to complete the CPT geotechnical explorations. The CPT explorations will be performed through a moon pool (or equivalent access location) on the barge. CPTs will be performed continuously to bedrock or refusal. The CPT procedures will follow SOP 3, except for the use of conductor casing on selected boreholes, as described below.

Target depths for geotechnical sampling (relatively undisturbed Shelby tube samples) will be based on the lithology observed at the collocated CPT exploration. The preferred sequence for geotechnical explorations is to install CPTs first where a CPT borehole is collocated with a mud-rotary borehole (see CPT -9, CPT-10, and CPT-13 on Figure 2-1). If the CPT is performed first, the stratigraphy at that location is already known prior to mud-rotary drilling, and the Shelby tube sampling depths can be targeted more easily. Shelby tubes will only be collected in cohesive material (i.e., silt and clay). Based on existing subsurface information, relatively thick deposits of cohesive material are expected to be encountered in borings SPT-1 and SPT-3. Shelby tube sampling will, therefore, likely be focused on these two locations. More than one borehole may be required at the mud-rotary locations to allow for undisturbed sampling and/or to provide enough sediment for all proposed tests.

The mudline elevation at each station will be calculated using a tide staff gauge attached to one of the docks, as described in Section 3.1.3. The tide staff gauge will be monitored periodically during drilling activities and adjustments to sample intervals will be made as necessary based on river stage.

3.2.1.2 Conductor Casing

Conductor casing will be employed for all boreholes to recover the majority of the sediment cuttings. Steel conductor casing will be chosen with an inside diameter that is slightly larger than the outside diameter of the hollow-stem auger (i.e., approximately 1 to 2 in.) so that the majority of the cuttings are extruded to the top of the casing on the barge deck. The conductor casing will be pushed approximately 2 ft into the sediment and will be securely attached to the barge deck using a clamping mechanism so it does not drop when drilling commences.

To contain the sediment cuttings as they surface during drilling activities, the top of the conductor casing will protrude through a 4-ft by 8-ft sheet of ¾-in. plywood that has a 2-in. by 6-in. frame attached. The sediment cuttings will be shoveled into properly labeled, U.S. Department of Transportation (DOT)-approved, 55-gallon steel drums and handled according to specifications in Section 3.8. Care will be taken to minimize any spilling of the sediment. The conductor casing will be retrieved after the augers are retrieved and the borehole has been grouted.

When the borehole is at depth and the augers are ready to be removed from the conductor casing, the augers will be rotated rapidly to bring as much sediment to the top of the conductor casing as possible.

Conductor casing will not be used for CPT boreholes which do not require the removal of sediment during explorations.

3.2.1.3 Logging and Sampling

Sediments from each borehole will be continuously collected and logged by a licensed geologist using ASTM (2000) guidelines, as described in SOP 4. Lithologic logging will include observations of bioturbation, where observed. Each sediment sample that is collected for potential chemical analysis will be processed in accordance with SOP 3. In addition, each sample will be screened for VOCs using an organic vapor meter (OVM) prior to mixing, in accordance with SOP 12. Each sediment sample for potential chemical analysis will be processed (i.e., mixed and composited) in accordance with SOP 2 (Attachment A). After processing[3], samples will be placed in the appropriate containers listed in Table 3-1 and labeled in accordance with Sections 3.3 and 3.5 and SOP 5. Samples for potential chemical analysis will be immediately placed in a cooler with ice for preservation. Additional QA guidelines, including sample handling and the collection of duplicate and rinsate blank samples, are presented in the QAPP. Sediment samples collected for the geotechnical investigation will not require mixing nor will they require preservation on ice for shipment.

The large-volume sediment sample for the waste disposal characterization will require the collection of composite samples from seven boreholes (Section 2.2.3). An equal volume of representative sediment will be collected from each composite interval subinterval (approximately 2 ft) and mixed in a large stainless-steel pot using a power mixer or equivalent

[3] With the exception of samples collected for VOCs.

device. All materials contacting the sediment will be decontaminated in accordance with Section 3.7 and SOP 9.

3.2.1.4 Borehole Abandonment

The boreholes will be abandoned with a high-solids bentonite grout, mixed according to the manufacturer's specifications, and placed inside the augers through a tremie pipe as the augers are withdrawn. Once the borehole is grouted, the augers will be brought to the barge deck, and any residual sediment left on the augers will be transferred to properly labeled, DOT-approved, 55-gallon drums. The conductor casing (if used) and augers will be decontaminated using a hot pressure-washer in accordance with Section 3.7 and SOP 9.

3.3 SAMPLE IDENTIFICATION

Sediment samples will be assigned an individual sample identification number in the following manner:

- ARK-WB-##-depth

  Where:

  ARK = Arkema
  WB = Boring
  ## = Station number
  Depth (e.g., 021 = 0 to 2 ft below mud surface).

Sediment sample processing will occur on the barge as described in the following sections. Sample processing methods are intended to result in high-quality samples that meet the program's QA objectives. Guidelines for sample handling and storage are presented in the QAPP. All samples will be placed immediately in a cooler with ice to preserve them at 4±2° C and will be kept at this temperature at all times. All samples will be labeled and identified in accordance with SOP 5.

Field QC samples (i.e., equipment rinsates and field blanks) will be assigned an individual sample identification number in the following manner:

- ARK-EB-## (Equipment Blank - Sample Number starting at 01).

Duplicate sediment samples delivered to the laboratory will be given a blind sample identification (to be determined) that will correspond to the numbering system described above.

3.4 SEDIMENT PROCESSING

Compositing will be performed within individual locations to ensure that adequate sediment is available for the required analyses.[4] Power Grab and split-spoon samples not used for analysis will be managed in accordance with applicable investigation-derived waste requirements as described in SOP 11.

Sediment composite samples will be processed according to the following step-by-step procedure and SOPs 2 and 3:

1. Screen a representative subsample of all sediment samples collected for volatile organics using an OVM following procedures in SOP 12. Do not composite or homogenize the sample before screening.
2. Transfer sediment from split-spoon to a clean, stainless-steel bowl and cover with aluminum foil.
3. Stir the composite sample until the sample is of uniform color and texture. If any material (e.g., shells, rocks) has to be removed from the sample, note it in the field logbook or on the sample description sheet.
4. Fill jars for physical and chemical analyses.
5. Seal each glass container in a plastic bag in case of breakage. Place in ice chest and pack samples to minimize the chances of breaking.
6. Decontaminate the equipment as described in Section 3.7 and SOP 9.
7. Collect excess sediment from the composite and dispose of as investigation-derived waste, as discussed in Section 3.8 and SOP 11.

3.5 SAMPLE CONTAINERS AND LABELS

Guidelines for sample handling and storage are presented in the QAPP. All samples will be placed immediately in a cooler with ice to preserve them at 4±2° C and will be kept at this temperature at all times. All samples will be labeled and identified in accordance with SOP 5.

3.5.1 Sampling Handling Procedures

The following sections describe documentation with sampling and handling procedures. Details are outlined in SOP 6.

[4] Compositing and homogenizing is not appropriate for the analysis of volatile organics. Discrete samples will be collected only for analysis of volatile organics in soil and sediments.

3.5.1.1 Sample Labels

Sample containers will be clearly labeled with waterproof black ink at the time of sampling. Sample labels will contain the following information:

- Sample identification numbers
- Sample date
- Sample time
- Preservation used, if any (this information will also be included on the chain-of-custody form)
- Initials of sampling personnel.

The sample label will be attached to the sample container prior to, or just after, the container is filled and the lid secured. As an added measure of security, the finished label will be covered with clear packaging tape to protect the ink from moisture and to tightly secure the label to the sample container. Information on the sample label must match the information on the chain-of-custody form and in the site logbook for each sample.

3.5.1.2 Custody Seal

Custody seals will be used on sample shipping containers (coolers) that will either be shipped or sent by messenger to the laboratory as described in SOP 7. Custody seals will be attached to the lid and body of the coolers to detect any tampering during shipment. The custody seals will be signed and dated by the sampler or sample shipper. Custody seals are not required for samples delivered by hand directly to the lab unless left unattended.

3.5.1.3 Sample Summary Log

Sample summary logs will be maintained by the field team leader and used to keep track of all phases of the sampling and analysis process for all individual samples. The sample summary logs will include sample collection date(s), sample delivery date(s), the date(s) analytical results are received, laboratory sample delivery group, and laboratory work order number. The sample summary logs will also identify blind sample numbers given to the laboratory with corresponding numbering in the field.

3.5.1.4 Sample Custody/Tracking Procedures

The samples collected must be traceable from the time they are collected until their derived data are used in the final report. In general, the following provisions apply to sample handling and are described in SOPs 6 and 7:

- The field team leader, or sampler, will be responsible for the care and custody of the samples collected until they are properly transferred or dispatched to the laboratory.
- All appropriate documentation forms will be used, including sample labels, chain-of-custody forms, sample logs, and any other appropriate forms. Documentation will be completed neatly using waterproof black ink.
- When transferring possession of samples, the individuals relinquishing and receiving them will sign, date, and note the time on the chain-of-custody form. Containers shipped by common carrier will have the chain-of-custody form enclosed in a watertight container (e.g., plastic resealable bag) and placed in the container prior to sealing.
- Samples will be packaged properly according to the current DOT requirements and promptly dispatched to the laboratory for analysis. Sample containers will be packed in coolers (or other shipping containers) with a low-density packing material, such as bubble wrap, and Blue Ice® or its equivalent. The coolers will be securely sealed.
- Each cooler will be accompanied by its own chain-of-custody form identifying its contents. A copy of the chain-of-custody form will be retained by the field team leader for inclusion in project records.
- For coolers shipped via express delivery service, custody seals will be affixed to the outside of the coolers (shipping containers). The field team leader, sampler, or shipper will sign and date the custody seals.
- All samples will be shipped via express delivery for overnight delivery or hand delivered to the laboratory.

3.6 FIELD DOCUMENTATION PROCEDURES

The primary methods of documentation that will be used for this project include site logbook, photo logs, sample log forms, field change request forms, and sample tracking forms. A description of each of these documentation methods is provided in the following sections. Example field forms are presented in Attachment B.

3.6.1 Field Logbooks

Field logbooks will be used to document all field sampling activities performed at the project site, as described in SOP 8. The logbooks will contain the date, time, and description of all field activities performed; names of personnel; weather conditions; the names of visitors to the Site; areas where photographs were taken; and any other data pertinent to the project. The site logbooks will also contain all sample collection and identification information and (if appropriate) a drawing of each area sampled, along with the exact location (coordinates) of where the sample was collected. The sampling information will be transferred to sample log forms when the sampler returns to the site office. The logbook is the official, legal record of site activities, and will serve as the key to sample designations and locations. It will include the date, time, river stage, depth to mudline, horizontal DGPS coordinates, site/sample location, sample identification number, sample matrix, how the sample was collected, any comments, and the sampler's name. In addition, the logbook will document deviations from the project plans and health and safety tailgate meeting minutes.

Requirements for logbooks include the following:

- Logbooks will be sturdy, weatherproof, and bound, with consecutively numbered pages. If multiple logbooks are used, they will be numbered sequentially.
- Entries will be made legibly with waterproof, black (or dark) permanent ink.
- Removal of any pages, even if illegible, will be prohibited. Any mistakes will be crossed out with a single line, initialed, and dated.
- Unbiased, accurate language will be used.
- Entries will be made while activities are in progress or as soon afterward as possible (the time of the observation will be noted and the time that the notation is made will be noted if significantly later than the observation time).
- Each consecutive day's first entry will be made on a new, blank page. Each page of the field logbook will be numbered, dated, and signed by the author.
- The date will appear at the top of each page. The time, based on a 24-hour clock (e.g., 0900 for 9:00 a.m. and 2100 for 9:00 p.m.), also will appear for each entry.
- Blank pages, if any, will be marked "page intentionally left blank."

An example of the field logbook can be found in Attachment B.

3.6.2 Photo Documentation

Digital photographs will be taken at sampling locations and of selected samples. These photos will help to identify the sampling locations and will provide an accurate visual record of the material being sampled. All photographs taken will be identified in the field logbooks (preferably in a separate section of the book set aside for that purpose). Photographic logs will contain, at a minimum, the file number, date, time, initials of the photographer, and a description of the image in the photograph.

3.6.3 Sample Collection Information Form

Sampling logs and collection forms will be used to document site and sample characteristic data, which should agree with the information recorded in the site logbooks. Field personnel are required to fill out one sample log form for each sample collected. A copy of these forms will be stored in the field office or field files, with the original stored in the project file. A copy of these forms will also be included in the final data report and other documents, as appropriate. At a minimum, the log for each sample will contain the sample number, the date and time of sample collection, and a description of the sampling site, as well as the physical characteristics of the sample, the planned analysis, and the initials of the sampler. Example field forms are located in Attachment B.

3.6.4 Field Change

The field team leader will be responsible for all environmental sampling activities, and will occasionally be required to adjust the field program to accommodate site-specific needs after consultation with the project manager and/or QA manager. The field team leader will notify the project manager of any significant field changes. The project manager will immediately notify EPA for approval (verbal or written) of any significant field changes. This notification/approval will typically occur via e-mail or telephone, to avoid suspension of field work. The project manager and/or field team leader will follow up these conversations with an e-mail and field change request form that summarizes the approved changes for EPA signature. When it becomes necessary to modify a program or task, the changes will be documented in the field logbook.

3.6.5 Sample Tracking Forms

Sample tracking is an important aspect of field investigation activities, as it documents the proper handling and integrity of the samples. Sample tracking forms for the project will include chain-of-custody forms, sample labels, custody seals, and sample summary logs. Example forms are located in Attachment B.

3.6.6 Chain-of-custody Form

The chain-of-custody form is used to document the history of each sample and its handling from its collection through all transfers of custody until it reaches the analytical laboratory. Internal laboratory records will document custody of the sample from the time it is received in the lab through its final disposition. The chain-of-custody form will be filled out after the samples have been collected and will be double-checked prior to the transport of the samples to the laboratory. At a minimum, the chain-of-custody form will contain the following information and follow procedures described in SOP 7:

- Name of project
- Names of sampling personnel
- Sample identification numbers
- Collection date and time

- Number and type of containers per sample
- Sample matrix
- Sample preservation, if any
- Analysis requested.

The completed chain-of-custody form will be placed in a large capacity Ziploc® bag and secured to the sample transport container. If coolers are used to transport samples, the chain-of-custody form will be taped to the underside of the cooler lid.

3.7 DECONTAMINATION PROCEDURES

Equipment decontamination will be performed using procedures outlined below and in SOP 9. Site personnel will perform decontamination of all equipment prior to removal from the Site and between sample locations. All decontamination fluids will be containerized in properly labeled, DOT-approved, 55-gallon drums. If any solvents or acids are utilized during the decontamination process, they will be containerized in separate, properly labeled 5-gallon containers. Investigation-derived wastes will be handled in accordance with Section 3.8.

The hollow-stem augers, drill rods, and conductor casing will be decontaminated with a hot water pressure washer.

All non-disposable components of the sediment coring equipment (e.g., split spoons), or other equipment used to collect sediment samples that contacts the sediments, will be decontaminated as follows:

- Potable water rinse
- Alconox™/Liquinox™ detergent wash
- Potable water rinse
- Solvent rinse (if visible contamination is observed)[5]
- Deionized water rinse
- Air dry.

As specified in SOP 10 and the QAPP, rinsate blank samples will be collected once per sampling type (e.g., Power Grab sampling) to document the level of decontamination of sampling equipment. Two equipment rinsate blanks will be collected from the first two cores and will be expedited to the extent practicable (given the number of parameters and low-level methods required) to determine the effectiveness of the procedure. In the event contamination is

---

[5] Solvent rinse will include the use of clean paper towels to remove water followed by a hexane rinse. The hexane solvent rinse is only required if visible non-aqueous phase liquid is observed on the sampling equipment.

detected in the rinsate blanks, a field change to the decontamination procedure would be implemented as outlined in Section 3.6.4.

All disposable personal protection equipment (PPE) and liquids generated as a result of decontamination processes will be containerized and handled as investigation-derived wastes, as discussed in Section 3.8 and SOP 11.

3.8 INVESTIGATION-DERIVED WASTES

The primary waste streams to be generated during this project and the proposed storage/disposal methods are described below. LSS is responsible for the proper characterization and disposal of investigation-derived waste streams.

3.8.1 Sediment Cuttings and Excess/Rejected Sediment Samples

Sediment cuttings from drilling activities will be placed in properly labeled, DOT-approved, 55-gallon drums on the barge deck. The drums will be lifted onto one of the docks at the end of the field event, staged on site, and characterized for offsite disposal in accordance with state and federal regulations.

Sediment samples that are rejected and/or determined to be in excess of what is required to conduct analytical sampling will be containerized in 55-gallon drums and managed as described in SOP 11.

3.8.2 Decontamination Wastewaters

Liquid wastes (i.e., decontamination waters) will be potentially contaminated with Site chemicals, including DDx. The presence of any of these constituents in the wastewaters is expected to be diluted; therefore, the wastewaters are not expected to be classified as hazardous waste. Decontamination waters will be containerized in 55-gallon drums as described in SOP 11. The drums will be lifted onto one of the docks at the end of the field event, staged on site, and characterized for offsite disposal in accordance with state and federal regulations.

For solvents (e.g., methanol and hexane), decontamination activities will be conducted so as to minimize the potential for spills/releases of wastewaters. Spent decontamination solvents must be stored in leak-proof container(s) with secured lid(s). The lid will remain closed except when the container is being used for decontamination activities. It is anticipated that liquid wastes will be placed in 5-gallon buckets or similar containers for characterization and offsite disposal.

3.8.3 Personal Protective Equipment/Miscellaneous Debris

Sediment sampling activities will generate PPE and miscellaneous debris. Gross contamination will be removed from these items, and the items will be placed in plastic bags. Interim storage of these materials in plastic bags is acceptable. The bags will be disposed of at a solid waste facility dumpster at the end of each day.

4 REFERENCES

ASTM. 2000. Standard practice for description and identification of soils (Visual-Manual Procedure). Designation: D2488-00. American Society for Testing and Materials, West Conshohocken, PA.

DiGiano, F.A., C.T. Miller, and J. Yoon. 1995. Dredging elutriate test (DRET) development. Contract Report D-95-1, NTIS No. AD A299 354. U.S. Army Corps of Engineers Waterways Experiment Station, Vicksburg, MS.

Integral. 2007. Conceptual Site Model Update - February 2007. Draft. IC07-0006. Prepared for the Lower Willamette Group, Portland, OR. Integral Consulting Inc., Mercer Island, WA.

Integral. 2008. Arkema Early Action EE/CA Work Plan, Work Plan Addendum. Prepared for Legacy Site Services LLC, Exton, PA. Integral Consulting Inc., Portland, OR.

Palermo, M.R. 1986. Development of a modified elutriate test for estimating the quality of effluent from confined dredged material disposal areas. Technical Report D-86-4. U.S. Army Corps of Engineers Waterways Experiment Station, Vicksburg, MS.

Parametrix. 2007. Arkema Early Action EE/CA Work Plan. Prepared for U.S. Environmental Protection Agency Region 10, Environmental Cleanup Office, Seattle, WA. Prepared by Parametrix, Portland, OR.

USACE. 1998. Guidance for subaqueous dredged material capping. Dredging Operations and Environmental Research Program. Technical Report DOER-1. U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS.

USACE. 2003. Evaluation of dredged material proposed for disposal at island, nearshore, or upland confined disposal facilities – testing manual. ERDC/ELTR-03-01. U.S. Army Corps of Engineers, Research and Development Center, Washington, DC.

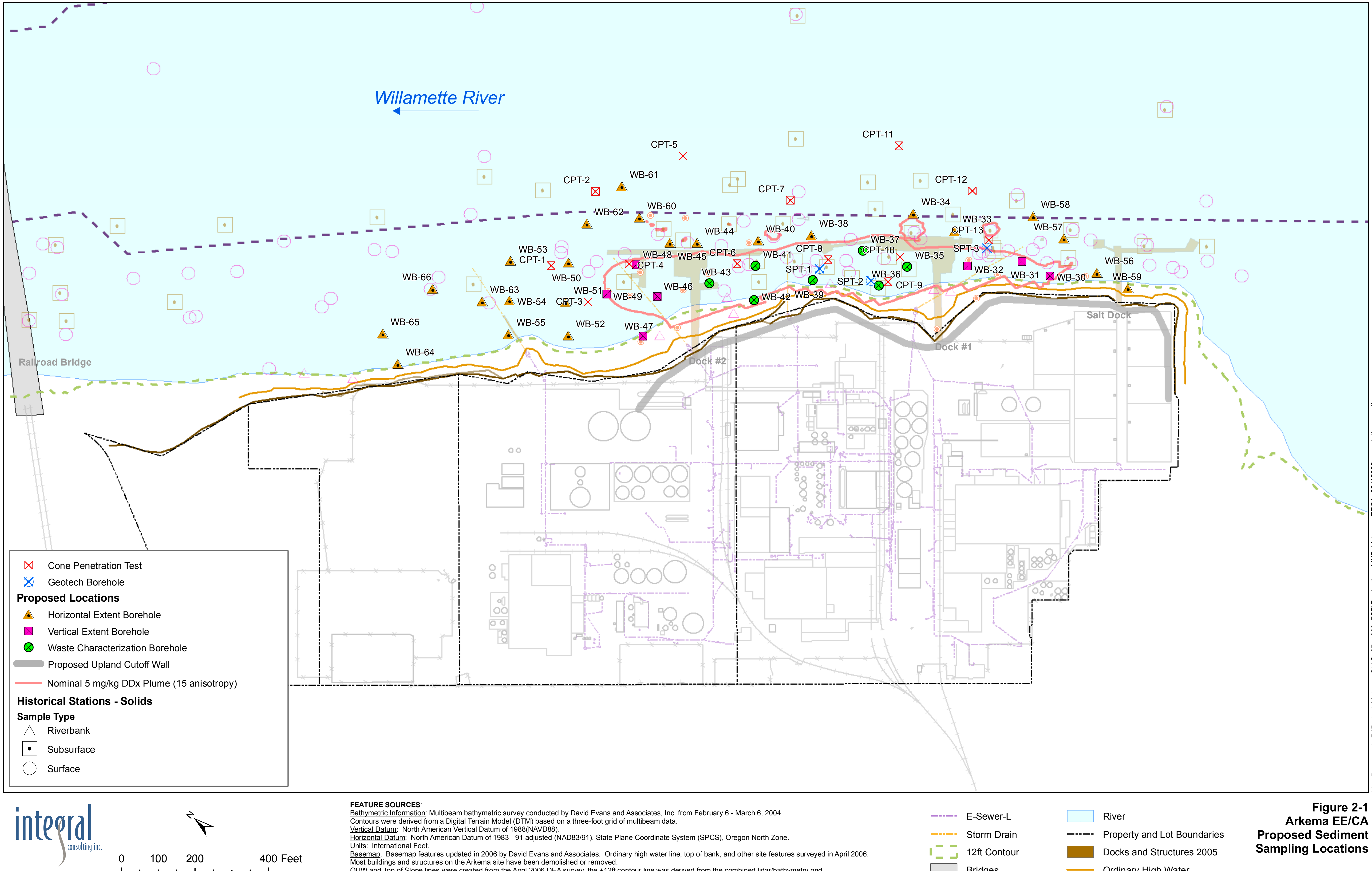
USEPA. 1998. Assessment and remediation of contaminated sediments (ARCS) program guidance for in situ subaqueous capping of contaminated sediments. EPA/905/B-96/004. U.S. Environmental Protection Agency, Great Lakes National Program Office, Chicago, IL.

USEPA. 2000. Methods for measuring the toxicity and bioaccumulation of sediment-associated contaminants with freshwater invertebrates. Second Edition. EPA 600/R-99/064. U.S. Environmental Protection Agency, Office of Research and Development, Duluth, MN.

USEPA. 2008. Final Decision on Disputes of February 19, 2008 and March 27, 2008 by Legacy Site Services LLC (LSS) Regarding U.S. EPA Region 10 Docket No. CERCLA 10-2005-0191. U.S. Environmental Protection Agency Region 10, Office of Environmental Cleanup, Seattle, WA.

USEPA/USACE. 1998. Evaluation of dredged material proposed for discharges in waters of the U.S. – testing manual (Inland Testing Manual). EPA-823-B-98. USEPA Office of Water, Office of Science and Technology, Washington, D.C. and Department of the Army, U.S. Army Corps of Engineers, Operations, Construction, and Readiness Division, Washington, DC.

FIGURES



Map Document: (P:\Projects\Arkema-Oly\C167_1003_FSP\Production_MXDs\Arkema_EECA_05112009_newstations.mxd)
5/11/2009 -- 1:17:25 PM

integral consulting inc.

FEATURE SOURCES:
Bathymetric Information: Multibeam bathymetric survey conducted by David Evans and Associates, Inc. from February 6 - March 6, 2004.
Contours were derived from a Digital Terrain Model (DTM) based on a three-foot grid of multibeam data.
Vertical Datum: North American Vertical Datum of 1988(NAVD88).
Horizontal Datum: North American Datum of 1983 - 91 adjusted (NAD83/91), State Plane Coordinate System (SPCS), Oregon North Zone.
Units: International Feet.
Basemap: Basemap features updated in 2006 by David Evans and Associates. Ordinary high water line, top of bank, and other site features surveyed in April 2006.
Most buildings and structures on the Arkema site have been demolished or removed.
OHW and Top of Slope lines were created from the April 2006 DEA survey, the +12ft contour line was derived from the combined lidar/bathymetry grid.
Lot Lines: Created by importing pdf file from ERM, georeferencing to CAD lines (RMS error = 2.3042) and heads-up digitizing the lot lines.

E-Sewer-L
Storm Drain
12ft Contour
Bridges
Navigation Channel
River
Property and Lot Boundaries
Docks and Structures 2005
Ordinary High Water
Top of Bank

Figure 2-1
Arkema EE/CA
Proposed Sediment Sampling Locations

TABLES

Table 2-1. Sampling/Analysis Methods – Potential Remedial Action Technologies[a]

Sampling/Analysis Tools	Monitored Natural Recovery	Thin-Layer Placement	Isolation Cap	Sediment Dredging/Disposal – Characterization	Hydraulic Containment
Sediment Samples					
Chemical Analyses (COIs, Conventionals[b])	X	X	X	X	--
Physical Analyses (Grain Size)	X	X	X	X	--
Geotechnical Analyses					
Grain Size	--	--	X	X	X
Standard Penetration Test	--	--	X	X	X
Atterberg Limits	--	--	X	X	X
Specific Gravity	--	--	X	X	X
Moisture Content	--	--	X	X	X
Consolidation	--	--	X	X	X
Shear Strength[c]	--	--	X	X	X
Unconfined Compressive Strength (Rock)	--	--	--	X	X
Point Load Index (Rock)	--	--	X	X	X
Hydraulic Conductivity	X	X	X	--	X
Debris Survey	--	X	X	--	X

Notes:

[a] Once the final RAA boundary is established, several factors pertaining to the area will be examined in the EE/CA report, including constructability, short-term impact, recontamination potential, permanence of the removal action, and proposed institutional controls.

[c] May include *in situ* vane shear, cone penetration testing, and/or laboratory shear strength testing.

[d] Suite of conventional and chemical analyses including anions/cations, TOC, COIs.

[e] The ATT is required by Oregon for all applicable pesticide wastes in determining its acceptability into a Subtitle D Landfill.

✓ Sufficient data are available and no additional data and evaluation are needed for the sampling or analysis tool.
X Insufficient data are available and additional data and evaluation are needed for the sampling or analysis tool.

-- Data not required for the EE/CA.
ATT – aquatic toxicity test
COI – constituent of interest

EE/CA – engineering evaluation/cost analysis
RAA – remedial action area
TOC – total organic carbon

Table 2-2. Sampling/Analysis Methods – Potential Disposal Alternatives[a,b]

	Onsite Disposal		Offsite Disposal
Sampling/Analysis Tools	Nearshore CDF	Onsite Landfill	Subtitle C/D Landfill
Sediment Boreholes			
Chemical Analyses (COIs, TOC)	X	X	X
Index Parameters			
Grain Size	X	X	X
SPT	X	X	X
Atterberg Limits	X	X	X
Specific Gravity	X	X	X
Moisture Content	X	X	X
Geotechnical Tests			
Consolidation	X	--	--
Shear Strength[c]	X	--	--
Permeability	X	--	--
Unconfined Compressive Strength (Rock)	X	--	--
Point Load Index (Rock)	X	--	--
Waste Characterization			
RCRA Characteristic/TCLP	--	X	X
ATT	--	X	X

Notes:

[a] Once the final RAA boundary is established, several factors pertaining to the area will be examined in the EE/CA report including constructability, short-term impact, recontamination potential, permanence of the removal action, and proposed institutional controls.
[b] Chemical analyses that include an evaluation of the leachability of sediment will be conducted on representative composite samples prior to disposal.
[c] Includes *in situ* vane shear, cone penetration testing, and/or laboratory shear strength testing.

X – Additional data required for this sampling/analysis tool.
-- Data not required for the EE/CA.

ATT – aquatic toxicity test
CDF – contained disposal facility
COI – constituent of interest
EE/CA – engineering evaluation/cost analysis
RAA – remedial action area
RCRA – Resource Conservation and Recovery Act
SPT - standard penetration test
TCLP – toxicity characteristic leaching procedure
TOC – total organic carbon

Table 2-3. Proposed Sediment Chemistry Boreholes, Analyses, and Rationale[a]

Station No.	Proposed X Coordinate	Proposed Y Coordinate	Estimated Sediment Thickness (ft)[b]	Proposed Chemistry Sample Intervals and Parameters[c]	Borehole Rationale
WB-30	7628292.80	701945.99	40	Sample and archive every 2' interval from sediment surface to bedrock. Standard analysis on samples from 8 - 10' bgs interval and below.[d]	Inside horizontal extent of nominal 5 ppm DDx plume, placed to define vertical extent.
WB-31	7628273.94	702029.99	25	Sample and archive every 2' interval from sediment surface to bedrock. Standard analysis on samples from 8 - 10' bgs interval and below.[d]	Inside horizontal extent of nominal 5 ppm DDx plume, placed to define vertical extent.
WB-32	7628169.37	702134.57	25	Sample and archive every 2' interval from sediment surface to bedrock. Standard analysis on samples from 10 - 12' bgs interval and below.[d]	Inside horizontal extent of nominal 5 ppm DDx plume, placed to define vertical extent.
WB-33	7628219.08	702223.72	10	Sample and archive every 2' interval from sediment surface to bedrock. Standard analysis on all samples if WB-34 shows DDx > 5 ppm at any interval.	Outside horizontal extent of nominal 5 ppm DDx plume, placed based on Drill Guide analysis to refine horizontal extent if indicated by WB-34. If location is within horizontal RAA, data will also be used to help define vertical extent in that location.
WB-34	7628183.08	702340.30	5	Sample and archive every 2' interval from sediment surface to bedrock. Standard analysis on all samples.	Outside horizontal extent of nominal 5 ppm DDx plume, placed based on Drill Guide analysis to refine horizontal extent. If location is within horizontal RAA, data will also be used to help define vertical extent in that location.
WB-35	7628063.08	702259.72	40	Sample and archive every 2' interval from sediment surface to 20' bgs, and every 3' interval from 20' bgs to bedrock. Composite and archive one sample using samples from 2' intervals from 0 - 10' bgs and from 10 - 20' bgs. Analyze as follows: Standard analysis for each 3' interval from 20' to bedrock. Expanded analysis + Asb on composite samples from 0 - 10' and 10 - 20'.[d]	Inside horizontal extent of nominal 5 ppm DDx plume, placed to define vertical extent and for waste characterization.
WB-36	7627973.93	702285.44	35	Sample and archive every 2' interval from sediment surface to 22' bgs, and every 3' interval from 22' bgs to bedrock. Composite and archive one sample using samples from 2' intervals from 0 - 10' bgs and from 10 - 22' bgs. Analyze as follows: Standard analysis for each 3' interval from 22' to bedrock. Expanded analysis + Asb on composite samples from 0 - 10' and 10 - 22'.[d]	Inside horizontal extent of nominal 5 ppm DDx plume, placed to define vertical extent and for waste characterization.
WB-37	7628018.50	702379.73	25	Sample and archive every 2' interval from sediment surface to 14' bgs, and every 3' interval from 14' bgs to bedrock. Composite and archive one sample using samples from 2' intervals from 0 - 6' bgs and from 6 - 14' bgs. Analyze as follows: Standard analysis for each 3' interval from 14' to bedrock. Expanded analysis + Asb on composite samples from 0 - 6' and 6 - 14'.[d]	Inside horizontal extent of nominal 5 ppm DDx plume, placed to define vertical extent and for waste characterization.
WB-38	7627960.21	702515.16	5	Sample and archive every 2' interval from sediment surface to bedrock. Standard analysis on all samples if WB-40 shows DDx > 5 ppm at any interval.	Outside horizontal extent of nominal 5 ppm DDx plume, placed based on Drill Guide analysis to refine horizontal extent if indicated by WB-40. If location is within horizontal RAA, data will also be used to help define vertical extent in that location.
WB-39	7627869.35	702432.87	35	Sample and archive every 2' interval from sediment surface to 18' bgs, and every 3' interval from 18' bgs to bedrock. Composite and archive one sample using samples from 2' intervals from 0 - 8' bgs and from 8 - 18' bgs. Analyze as follows: Standard analysis for each 3' interval from 18' to bedrock. Expanded analysis + Asb on composite samples from 0 - 8' and 8 - 18'.[d]	Inside horizontal extent of nominal 5 ppm DDx plume, placed to define vertical extent and for waste characterization.

Table 2-3. Proposed Sediment Chemistry Boreholes, Analyses, and Rationale[a]

Station No.	Proposed X Coordinate	Proposed Y Coordinate	Estimated Sediment Thickness (ft)[b]	Proposed Chemistry Sample Intervals and Parameters[c]	Borehole Rationale
WB-40	7627855.64	702616.31	5	Sample and archive every 2' interval from sediment surface to bedrock. Standard analysis on all samples.	Outside horizontal extent of nominal 5 ppm DDx plume, placed based on Drill Guide analysis to refine horizontal extent. If location is within horizontal RAA, data will also be used to help define vertical extent in that location.
WB-41	7627799.06	702576.88	20	Sample and archive every 2' interval from sediment surface to 14' bgs, and every 3' interval from 14' bgs to bedrock. Composite and archive one sample using samples from 2' intervals from 0 - 6' bgs and from 6 - 14' bgs. Analyze as follows: Standard analysis for each 3' interval from 14' to bedrock. Expanded analysis + Asb on composite samples from 0 - 6' and 6 - 14'.[d]	Inside horizontal extent of nominal 5 ppm DDx plume, placed to define vertical extent and for waste characterization.
WB-42	7627725.34	702520.30	35	Sample and archive every 2' interval from sediment surface to 14' bgs, and every 3' interval from 14' bgs to bedrock. Composite and archive one sample using samples from 2' intervals from 0 - 6' bgs and from 6 - 14' bgs. Analyze as follows: Standard analysis for each 3' interval from 14' to bedrock. Expanded analysis + Asb on composite samples from 0 - 6' and 6 - 14'.[d]	Inside horizontal extent of nominal 5 ppm DDx plume, placed to define vertical extent and for waste characterization.
WB-43	7627682.48	702642.03	20	Sample and archive every 2' interval from sediment surface to 18' bgs, and every 3' interval from 18' bgs to bedrock. Composite and archive one sample using samples from 2' intervals from 0 - 8' bgs and from 8 - 18' bgs. Analyze as follows: Standard analysis for each 3' interval from 18' to bedrock. Expanded analysis + Asb on composite samples from 0 - 8' and 8 - 18'.[d]	Inside horizontal extent of nominal 5 ppm DDx plume, placed to define vertical extent and for waste characterization.
WB-44	7627744.20	702739.74	10	Sample and archive every 2' interval from sediment surface to bedrock. Standard analysis on all samples if WB-40 or WB-45 show DDx > 5 ppm at any interval.	Outside horizontal extent of nominal 5 ppm DDx plume, placed based on Drill Guide analysis to refine horizontal extent if indicated by WB-40 or WB-45. If location is within horizontal RAA, data will also be used to help define vertical extent in that location.
WB-45	7627696.20	702796.32	5	Sample and archive every 2' interval from sediment surface to bedrock. Standard analysis on all samples.	Outside horizontal extent of nominal 5 ppm DDx plume, placed based on Drill Guide analysis to refine horizontal extent. If location is within horizontal RAA, data will also be used to help define vertical extent in that location.
WB-46	7627564.19	702727.74	20	Sample and archive every 2' interval from sediment surface to bedrock. Standard analysis on samples from 8 - 10' bgs interval and below.[d]	Inside horizontal extent of nominal 5 ppm DDx plume, placed to define vertical extent.
WB-47	7627456.19	702688.31	30	Sample and archive every 2' interval from sediment surface to bedrock. Standard on all samples.	Between horizontal extent of nominal 5 ppm DDx plume and shoreline, placed to define horizontal and vertical extent.
WB-48	7627593.34	702827.18	15	Sample and archive every 2' interval from sediment surface to bedrock. Standard analysis on samples from 2 - 4' bgs interval and below.[d]	Inside horizontal extent of nominal 5 ppm DDx plume, placed to define vertical extent.
WB-49	7627480.19	702837.46	25	Sample and archive every 2' interval from sediment surface to bedrock. Standard analysis on samples from 6 - 8' bgs interval and below.[d]	Inside horizontal extent of nominal 5 ppm DDx plume, placed to define vertical extent.
WB-50	7627478.47	702972.90	15	Sample and archive every 2' interval from sediment surface to bedrock. Standard analysis on all samples.	Outside horizontal extent of nominal 5 ppm DDx plume, placed based on Drill Guide analysis to refine horizontal extent. If location is within horizontal RAA, data will also be used to help define vertical extent in that location.

Table 2-3. Proposed Sediment Chemistry Boreholes, Analyses, and Rationale[a]

Station No.	Proposed X Coordinate	Proposed Y Coordinate	Estimated Sediment Thickness (ft)[b]	Proposed Chemistry Sample Intervals and Parameters[c]	Borehole Rationale
WB-51	7627391.04	702909.47	25	Sample and archive every 2' interval from sediment surface to bedrock. Standard analysis on all samples if WB-50 shows DDx > 5 ppm at any interval.	Outside horizontal extent of nominal 5 ppm DDx plume, placed based on Drill Guide analysis to refine horizontal extent if indicated by WB-50. If location is within horizontal RAA, data will also be used to help define vertical extent in that location.
WB-52	7627325.89	702846.04	30	Sample and archive every 2' interval from sediment surface to bedrock. Standard analysis on all samples if WB-51 shows DDx > 5 ppm at any interval.	Outside horizontal extent of nominal 5 ppm DDx plume, placed based on Drill Guide analysis to refine horizontal extent if indicated by WB-51. If location is within horizontal RAA, data will also be used to help define vertical extent in that location.
WB-53	7627380.75	703096.33	15	Sample and archive every 2' interval from sediment surface to bedrock. Standard analysis on all samples.	Outside horizontal extent of nominal 5 ppm DDx plume, placed based on Drill Guide analysis to refine horizontal extent. If location is within horizontal RAA, data will also be used to help define vertical extent in that location.
WB-54	7627296.75	703029.47	25	Sample and archive every 2' interval from sediment surface to bedrock. Standard analysis on all samples if WB-53 or WB-63 show DDx > 5 ppm at any interval.	Outside horizontal extent of nominal 5 ppm DDx plume, placed based on Drill Guide analysis to refine horizontal extent if indicated by WB-53 or WB-63. If location is within horizontal RAA, data will also be used to help define vertical extent in that location.
WB-55	7627224.75	702972.90	30	Sample and archive every 2' interval from sediment surface to bedrock. Standard analysis on all samples if WB-54 shows DDx > 5 ppm at any interval.	Outside horizontal extent of nominal 5 ppm DDx plume, placed based on Drill Guide analysis to refine horizontal extent if indicated by WB-54. If location is within horizontal RAA, data will also be used to help define vertical extent in that location.
WB-56	7628380.23	701855.13	35	Sample and archive every 2' interval from sediment surface to bedrock. Standard analysis on all samples.	Outside horizontal extent of nominal 5 ppm DDx plume, placed based on Drill Guide analysis to refine horizontal extent. If location is within horizontal RAA, data will also be used to help define vertical extent in that location.
WB-57	7628393.95	701983.71	15	Sample and archive every 2' interval from sediment surface to bedrock. Standard analysis on all samples.	Outside horizontal extent of nominal 5 ppm DDx plume, placed based on Drill Guide analysis to refine horizontal extent. If location is within horizontal RAA, data will also be used to help define vertical extent in that location.
WB-58	7628387.09	702086.57	10	Sample and archive every 2' interval from sediment surface to bedrock. Standard analysis on all samples.	Outside horizontal extent of nominal 5 ppm DDx plume, placed based on Drill Guide analysis to refine horizontal extent. If location is within horizontal RAA, data will also be used to help define vertical extent in that location.
WB-59	7628402.28	701762.98	35	Sample and archive every 2' interval from sediment surface to bedrock. Standard analysis on all samples if WB-56 shows DDx > 5 ppm at any interval.	Outside horizontal extent of nominal 5 ppm DDx plume, placed based on Drill Guide analysis to refine horizontal extent if indicated by WB-56. If location is within horizontal RAA, data will also be used to help define vertical extent in that location.
WB-60	7627695.64	702903.53	10	Sample and archive every 2' interval from sediment surface to bedrock. Standard analysis on all samples.	Outside horizontal extent of nominal 5 ppm DDx plume, placed based on Drill Guide analysis to refine horizontal extent. If location is within horizontal RAA, data will also be used to help define vertical extent in that location.

Table 2-3. Proposed Sediment Chemistry Boreholes, Analyses, and Rationale[a]

Station No.	Proposed X Coordinate	Proposed Y Coordinate	Estimated Sediment Thickness (ft)[b]	Proposed Chemistry Sample Intervals and Parameters[c]	Borehole Rationale
WB-61	7627730.35	702995.27	20	Sample and archive every 2' interval from sediment surface to bedrock. Standard analysis on all samples if WB-60 or WB-62 show DDx > 5 ppm at any interval.	Outside horizontal extent of nominal 5 ppm DDx plume, placed based on Drill Guide analysis to refine horizontal extent if indicated by WB-60 or WB-62. If location is within horizontal RAA, data will also be used to help define vertical extent in that location.
WB-62	7627591.50	703002.71	15	Sample and archive every 2' interval from sediment surface to bedrock. Standard analysis on all samples if WB-50 or WB-60 show DDx > 5 ppm at any interval.	Outside horizontal extent of nominal 5 ppm DDx plume, placed based on Drill Guide analysis to refine horizontal extent if indicated by WB-50 or WB-60. If location is within horizontal RAA, data will also be used to help define vertical extent in that location.
WB-63	7627246.85	703084.53	30	Sample and archive every 2' interval from sediment surface to bedrock. Standard analysis on all samples.	Outside horizontal extent of nominal 5 ppm DDx plume, placed based on Drill Guide analysis to refine horizontal extent. If location is within horizontal RAA, data will also be used to help define vertical extent in that location.
WB-64	7626969.15	703151.48	30	Sample and archive every 2' interval from sediment surface to bedrock. Standard analysis on all samples if WB-65 shows DDx > 5 ppm at any interval.	Outside horizontal extent of nominal 5 ppm DDx plume, placed based on Drill Guide analysis to refine horizontal extent if indicated by WB-65. If location is within horizontal RAA, data will also be used to help define vertical extent in that location.
WB-65	7627006.34	703235.78	30	Sample and archive every 2' interval from sediment surface to bedrock. Standard analysis on all samples.	Outside horizontal extent of nominal 5 ppm DDx plume, placed based on Drill Guide analysis to refine horizontal extent. If location is within horizontal RAA, data will also be used to help define vertical extent in that location.
WB-66	7627186.51	703210.09	30	Sample and archive every 2' interval from sediment surface to bedrock. Standard analysis on all samples.	Outside horizontal extent of nominal 5 ppm DDx plume, placed based on Drill Guide analysis to refine horizontal extent. If location is within horizontal RAA, data will also be used to help define vertical extent in that location.

Notes:

[a] Separate boreholes will be advanced for geotechnical sampling (see Table 2-4).

[b] Sediment thicknesses are estimated based on nearby historical sample stations.

[c] Cores will be divided into 2' sections to bedrock or refusal, except for the surface sample that will be collec ted from 0 - 1'. Composite samples representing the whole length of the 2 - 3' core segments will be collected, mixed to homogeneity (as is possible), and analyzed. In addition, if any field indications of contamination within core sections are noted, discrete samples will be obtained from that portion of core segments that show staining, have odors, show "hits" on a field instrument, etc. All samples that are not analyzed will be archived for possible future analysis.

[d] DDx analysis in 2' samples above designated depth interval is not required as it is assumed the upper sediments are within the RAA boundary and will be evaluated in the EE/CA.

Analytes:

Chemistry Standard Analyte List = DDx, conventionals (grain size, total solids, TOC).
Expanded Analyte List = Standard List + SVOCs, PCBs, Dioxins/Furans (D/F), VOCs; full suite of organochlorine pesticides.
Asb = Asbestos

bgs - below ground/sediment surface
DDx - total of 2,4'- and 4,4'-DDD, DDE, and DDT
EE/CA - engineering evaluation/cost analysis
PCB - polychlorinated biphenyl
RAA - removal action area
SVOC - semivolatile organic compound
TOC - total organic carbon
VOC - volatile organic compound

Table 2-4. Proposed Geotechnical Explorations, Analyses, and Rationale

Station No.[a]	Proposed X Coordinate	Proposed Y Coordinate	Estimated Sediment Thickness (ft)[b]	Proposed Geotechnical Parameters	Borehole Rationale
CPT-1	7627443.59	703002.76	20	CPT-tip resistance, sleeve friction, and pore pressure.	Geotechnical evaluation for EE/CA including sheet pile structure & CDF feasibility.
CPT-2	7627675.20	703040.27	10	CPT-tip resistance, sleeve friction, and pore pressure.	Geotechnical evaluation for EE/CA including sheet pile structure & CDF feasibility.
CPT-3	7627431.88	702862.93	25	CPT-tip resistance, sleeve friction, and pore pressure.	Geotechnical evaluation for EE/CA including sheet pile structure & CDF feasibility.
CPT-4	7627583.38	702843.54	20	CPT-tip resistance, sleeve friction, and pore pressure.	Geotechnical evaluation for EE/CA including sheet pile structure & CDF feasibility.
CPT-5	7627902.10	702919.88	10	CPT-tip resistance, sleeve friction, and pore pressure.	Geotechnical evaluation for EE/CA including sheet pile structure & CDF feasibility.
CPT-6	7627771.95	702619.08	20	CPT-tip resistance, sleeve friction, and pore pressure.	Geotechnical evaluation for EE/CA including sheet pile structure & CDF feasibility.
CPT-7	7627997.09	702618.77	5	CPT-tip resistance, sleeve friction, and pore pressure.	Geotechnical evaluation for EE/CA including sheet pile structure & CDF feasibility.
CPT-8	7627939.33	702436.36	25	CPT-tip resistance, sleeve friction, and pore pressure.	Geotechnical evaluation for EE/CA including sheet pile structure & CDF feasibility.
CPT-9	7627998.35	702273.97	35	CPT-tip resistance, sleeve friction, and pore pressure.	Geotechnical evaluation for EE/CA including sheet pile structure & CDF feasibility.
CPT-10	7628070.62	702291.73	30	CPT-tip resistance, sleeve friction, and pore pressure.	Geotechnical evaluation for EE/CA including sheet pile structure & CDF feasibility.
CPT-11	7628300.58	702488.28	10	CPT-tip resistance, sleeve friction, and pore pressure.	Geotechnical evaluation for EE/CA including sheet pile structure & CDF feasibility.
CPT-12	7628334.82	702256.31	10	CPT-tip resistance, sleeve friction, and pore pressure.	Geotechnical evaluation for EE/CA including sheet pile structure & CDF feasibility.
CPT-13	7628260.78	702136.63	20	CPT-tip resistance, sleeve friction, and pore pressure.	Geotechnical evaluation for EE/CA including sheet pile structure & CDF feasibility.
SPT-1	7627905.47	702438.77	25	Various geotechnical tests. See FSP text.[c]	Geotechnical evaluation for EE/CA. Collocated with CPT-8 for development of site-specific correlations of CPT parameters with design soil parameters. Rock coring to 20 ft below bedrock contact to determine rock quality.

Table 2-4. Proposed Geotechnical Explorations, Analyses, and Rationale

Station No.[a]	Proposed X Coordinate	Proposed Y Coordinate	Estimated Sediment Thickness (ft)[b]	Proposed Geotechnical Parameters	Borehole Rationale
SPT-2	7627970.42	702309.76	35	Various geotechnical tests. See FSP text.[c]	Geotechnical evaluation for EE/CA. Collocated with CPT-9 for development of site-specific correlations of CPT parameters with design soil parameters.
SPT-3	7628241.09	702126.03	20	Various geotechnical tests. See FSP text.[c]	Geotechnical evaluation for EE/CA. Collocated with CPT-13 for development of site-specific correlations of CPT parameters with design soil parameters.

Notes:
[a] SPT borings will be advanced with mud-rotary equipment. CPTs will be performed with CPT equipment.
[b] Sediment thicknesses were estimated based on nearby historical sample stations.
[c] Geotechnical tests will be assigned based on conditions encountered during the field program.

CDF - confined disposal facility
CPT - cone penetration testing
EE/CA - engineering evaluation/cost analysis
FSP - field sampling plan
SPT - standard penetration testing

Table 3-1. Sample Containers and Preservation Requirements

Analysis	Laboratory	Container Type	Container Size	Preservation	Holding Time
Sediment Quality Characteristics					
Grain size	TestAmerica Tacoma or Burlington	WMG	16 oz.	4 ± 2°C	6 months
Total organic carbon	TestAmerica Tacoma	WMG	8 oz.	4 ± 2°C	28 days
Semivolatile organic compounds	TestAmerica Tacoma	WMG	inc.	4 ± 2°C	14 days/40 days [a]
PCBs	TestAmerica Tacoma	WMG	inc.	4 ± 2°C	14 days/40 days [a]
Total solids	TestAmerica Tacoma	WMG	inc.	4 ± 2°C	6 months
Volatile organic compounds	TestAmerica Tacoma	WMG with Septa	2 oz.	No headspace, 4 ± 2°C Do not freeze	14 days
Organochlorine pesticides	TestAmerica Burlington or Knoxville	WMG	8 oz.	4 ± 2°C	14 days/40 days [a]
Chlorinated dioxins/furans	TestAmerica West Sacramento	WMG	8 oz.	4 ± 2°C	1 year
Archive	TestAmerica Tacoma	WMG	16 oz.[b]	Deep frozen (-20°C)	TBD
Physical and Engineering Characteristics					
Subsurface Sediments					
Physical Characteristics					
Grain size	Kleinfelder	WMG	16 oz.[c]	4 ± 2°C	6 months
Atterberg limits	Kleinfelder	WMG		4 ± 2°C	--
Specific gravity	Kleinfelder	WMG		4 ± 2°C	--
Moisture content/density	Kleinfelder	WMG		4 ± 2°C	--
Engineering Characteristics					
Consolidation	Kleinfelder	Sealed Shelby Tube	--	4 ± 2°C	--
Unconsolidated undrained triaxial shear stress	Kleinfelder	Sealed Shelby Tube	--	4 ± 2°C	--
Consolidated undrained triaxial shear stress	Kleinfelder	Sealed Shelby Tube	--	4 ± 2°C	--
Hydraulic conductivity	Kleinfelder	Sealed Shelby Tube	--	4 ± 2°C	--
Torvane shear strength testing	Kleinfelder	Sealed Shelby Tube	--	4 ± 2°C	--
Unconfirmed compressive strength (Rock)	Kleinfelder Redmond	TBD	--	NA	--
Point load index (Rock)	Kleinfelder Redmond	TBD	--	NA	--

Table 3-1. Sample Containers and Preservation Requirements

Analysis	Laboratory	Container		Preservation	Holding Time
		Type	Size		
Sediments for Waste Characterization					
Toxicity Characteristic Leaching Procedure					
TCLP testing [d]	TestAmerica Tacoma	WMG	8 oz.	4 ± 2°C	14 days
Asbestos					
Asbestos	TBD	WMG	8 oz.	--	180 days
Field Blanks					
Total organic carbon	TestAmerica Tacoma	HDPE	250 mL	4 ± 2°C; H_2SO_4 to pH < 2	28 days
Organochlorine pesticides	TestAmerica Burlington or Knoxville	AG	2 x 1 L	4 ± 2°C	7 days/40 days[e]
PCB Aroclors	TestAmerica Tacoma	AG	1 L	4 ± 2°C	7 days/40 days[e]
Semivolatile organic compounds	TestAmerica Tacoma	AG	2 x 1 L	4 ± 2°C	7 days/40 days[e]
Volatile organic compounds	TestAmerica Tacoma	VOA vial	3 x 40 oz. w/ septum	No headspace; HCl to pH < 2; 4 ± 2°C	14 days
Chlorinated dioxins/furans	TestAmerica West Sacramento	AG	2 x 1 L	4 ± 2°C in the dark	1 year

Notes:
[a] Holding time is 14 days to extraction and extracts must be analyzed within 40 days from extraction.
[b] Two 16 oz jars will be collected for sample intervals chosen for archive.
[c] One 16 oz. jar will be collected for all physical characteristics.
[d] For standard TCLP VOCs, SVOCs, metals, pesticides, and herbicides (42 individual chemicals) using EPA SW-846 methods.
[e] The holding time is 7 days from collection to extraction and 40 days from extraction to analysis.

AG - amber glass
HDPE - high density polyethylene
NA - not applicable
PCB - polychlorinated biphenyl
SVOC - semivolatile organic compound
TBD - to be determined
TCLP - toxicity characteristic leaching procedure
VOA - volatile organic analysis
VOC - volatile organic compound
WMG - wide mouth glass