FIELD SAMPLING PLAN

UPRIVER REACH BACKGROUND INVESTIGATION
LOWER WILLAMETTE RIVER

Prepared for

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ACRONYMS AND ABBREVIATIONS

cm	centimeter
DEQ	Oregon Department of Environmental Quality
DGPS	differential global positioning system
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
FNU	Formazin nephelometric units
FSP	field sampling plan
HASP	health and safety plan
MFA	Maul Foster & Alongi, Inc.
PHSS	Portland Harbor Superfund Site
QA/QC	quality assurance and quality control
QAPP	quality assurance project plan
RM	river mile
SOP	standard operating procedure
TOC	total organic carbon
USGS	U.S. Geological Survey

1 INTRODUCTION

On behalf of the Oregon Department of Environmental Quality (DEQ), Maul Foster & Alongi, Inc. (MFA) has prepared this field sampling plan (FSP) for investigation activities to be conducted in the Upriver Reach of the Lower Willamette River (see Figure 1-1).

Additional information about the project background and objective is provided in the work plan. This FSP specifies standard field operating procedures for sample collection and processing.

1.1 Project Setting and Overview

The Upriver Reach is located approximately 16.6 to 28.4 miles upstream of the confluence with the Columbia River (Willamette river miles [RMs] 16.6 to 28.4) and upstream of the Portland Harbor Superfund Site (PHSS) and the Downtown Reach. Investigation activities will include collection and analysis of unbiased surface sediment samples to characterize dioxin/furan concentrations present in the Upriver Reach, which are expected to be used to establish background conditions for the PHSS.

1.2 Overview of the Surface Sediment Sampling Field Program

The Pre-RD Group[1] completed sampling in the Upriver Reach in 2018, which included identifying areas of soft or medium sediment hardness, based on grain size using an acoustic sonar tool (BioSonar®), mechanical hand probing, and visual classification/wet sieving (AECOM and Geosyntec, 2018). This stratified random sampling program will include the collection of unbiased surface sediment samples within these soft and medium sediment hardness areas[2] for evaluation of dioxin/furans concentrations within the Upriver Reach.

1.3 Data Quality Objectives

The data quality objectives (DQOs) are used to establish performance and acceptance criteria, which serve as the basis for designing a plan for collecting data of sufficient quality and quantity to support the goals of the study (U.S. Environmental Protection Agency [EPA], 2002). The stratified random surface sediment sampling effort aims to support an updated evaluation of dioxin/furan background conditions that will inform an evaluation of cleanup levels for riverbank soil and sediment established in the PHSS record of decision (EPA, 2016).

[1] The Pre-RD Group consists of Arkema, Inc.; Evraz Oregon Steel; Schnitzer Steel Industries, Inc.; and The Marine Group, LLC.

[2] Soft and medium sediment hardness was defined based on "the probe operator's assessment of bottom substrate resistance to the probe (and confirmed with a visual ponar grab)" (AECOM and Geosyntec, 2018)

2 SAMPLING DESIGN AND APPROACH

2.1 Scope of Work

The purpose of this FSP is to generate data to fulfill the DQOs. Field sampling methods are consistent with EPA-approved sampling plans from the remedial investigation (Integral Consulting, 2002; 2004; 2006), EPA guidance on collecting sediment data (EPA, 2001), and Puget Sound Estuary Program protocols (PSEP, 1986).

Up to 45 three-point composite surface sediment samples over multiple sediment grain size fractions (resulting in an estimated 135 unbiased samples) will be collected between 0 and 30 centimeters (cm), using a pneumatic power grab sampling device (see Figures 2-1 through 2-5). The number of samples was dictated by our scope of work with DEQ and provides adequate spatial coverage for respective numbers of soft and medium sediment hardness polygons. Samples will be submitted for analysis of dioxins/furans, total organic carbon (TOC), and grain size distribution. For each composite sample, dioxin/furan concentrations and TOC will be determined for bulk sediment and two grain-size fractions: sediment that passes a No. 10 sieve (<2,000 micrometers [um]); and sediment that passes a No. 230 sieve (<62 um).

2.1.1 Stratified Random Sample Stations

Sample stations were selected by the stratified random sampling approach, similar to that described by the Pre-RD Group in Appendix C of their surface sediment FSP (AECOM and Geosyntec, 2018). The soft and medium sediment hardness polygons established by the Pre-RD group for the Upriver Reach were also retained for this exercise (AECOM and Geosyntec, 2018). The Pre-RD Group established a grid along these two reaches of the Willamette River where soft sediment hardness polygons are present to stratify sampling locations such that no more than one randomly assigned sample station is placed in any grid cell. This stratifying grid was retained for soft sediment hardness polygons in this exercise; this FSP includes 30 sample stations within soft sediment hardness polygons. Sample stations were developed by MFA's subcontractor, Cascadia Associates.

The soft sediment hardness polygon shapefile, downloaded from the Portland Harbor Data Portal,[3] contains 91 polygons, 50 of which extend upriver from RM 16.6. The polygons that intersect the analysis grid were merged into multipart polygons in ArcGIS by using the Dissolve geoprocessing function and selecting the Analysis Grid ID as the dissolve field. This produced 30 unique soft sediment hardness grids, which were used as the input to assign the 30 random soft sediment hardness sample stations—one sample station per analysis grid cell. Grid cells were numbered from 1S to 30S.

The Pre-RD Group did not sample within medium sediment hardness polygons. Therefore, figures provided in Appendix C of the Pre-RD Group surface sediment FSP do not include a grid for the medium hardness sediment polygons (AECOM and Geosyntec, 2018). As required by DEQ, this FSP

[3] http://ph-public-data.com/document/CDM_2017/

includes 15 samples within medium sediment hardness polygons. The Pre-RD group identified 18 medium polygons in the Upriver Reach. To assign 15 random sample locations within the 18 medium sediment hardness polygons, the 18 polygons were merged into 15 analysis grid cells. Due to the relative abundance of soft sediment grid cells in the lower portion of the Upriver Reach (and corresponding high density of soft sediment sample stations), adjacent medium sediment hardness polygons in the lower portion of the Upriver Reach were merged to reduce the overall number of medium sediment hardness analysis grid cells (to avoid oversampling the lower portion of the reach). These 15 analysis grid cells were used to randomly assign 15 medium sediment random sample stations, one per analysis grid cell.

2.1.2 Process for Identification of Sediments for Grain Size and TOC

As described above, sample stations were randomly placed in areas expected to contain finer-grained sediment, using a standard geospatial randomization algorithm for spatial coverage in GIS (see Figures 2-1 through 2-5). A geologist will visually inspect the grab samples for sample recovery depth and the percentage of fines, sand, and gravel-sized sediment. Visual description will follow the Unified Soil Classification System. Visual inspections will also include recording the presence/absence of organic matter, organic silt, roots, rootlets, and other organic matter that may indicate the presence of TOC. Percent fines will be confirmed with laboratory analysis.

MFA personnel will monitor U.S. Geological Survey (USGS) gauge 14211720 Willamette River at Portland for potentially erosive fluvial events during the course of the fieldwork. The USGS gauge 14211720 provides tidally filtered discharge (flow rate) data at hourly intervals and turbidity as Formazin nephelometric units (FNU) at half-hour intervals. If, for the prior three days of available data, the average tidally filtered flow rate exceeds 50,000 cubic feet per second or the turbidity of surface water exceeds 20 FNU, sampling will be delayed until parameters return to below these thresholds. MFA will also monitor flow rates within drainages to the Willamette River that were impacted by the 2020 Oregon wildfires. These include USGS gauge 14210000 Clackamas River at Estacada, USGS gauge 14189000 Santiam River at Jefferson, and USGS gauge 14165500 McKenzie River at Coburg. If, for the prior five days of available data, the average flow rate exceeds the 90th percentile flow rate established for any of these three gauges, sampling will be delayed until parameters return to below these thresholds.

2.2 Sample Identification

2.2.1 Sample Types, Locations, Depths

Consistent with the previous remedial investigation protocol, samples will be collected between 0 and 30 cm. Proposed surface sediment sampling stations are provided in Figures 2-1 through 2-5. Sample station coordinates and identification numbers are provided in the attached table. All surface grab samples will be three-point composites collected with a pneumatic power grab sampler.

2.2.2 Sample Nomenclature

The field personnel will be responsible for labeling samples and establishing identification. All data will be keyed to the sample's unique designation, which will be used on sample containers and associated field data forms as well as to key the sample identification in the project database.

The field personnel will clearly label each sample container, using permanent ink on a waterproof sample label, as soon as possible following collection. At a minimum, the following information will be written on the sample label:

- Unique sample identification code
- Time and date of collection
- Project number
- Preservative, if appropriate

In order to maintain sample identification consistency in the project database, the unique sample identification code will be assigned according to the following convention: project phase-unique sample number-matrix type. The following codes and information will be included in the sample identification code:

- Project phase: PHUpriverBGPH1
- Station number: 001 to ###
- Matrix type code: SS = surface sediment
- Field duplicate samples will include "DUP" at the end of the ID

For example, a surface sediment sample collected at station 001 would be named PHUpriverBGPH1-001-SS.

The sample nomenclature for the equipment rinsate blank samples will consist of three components: project phase-"RB" for rinsate blank-sampling date.

For example, an equipment blank collected during the investigation on January 12, 2021, would have the sample name PHUpriverBGPH1-RB-210112.

2.3 Sampling Schedule

The overall project schedule is outlined in the work plan. Surface sediment sampling is targeted for the fourth quarter of 2020 and/or the first quarter of 2021. DEQ will be notified at least two weeks prior to sampling. Surface sediment sampling is expected to last up to four weeks.

3 PROJECT ORGANIZATION/FIELD TEAM

The following describes the duties and responsibilities of personnel and firms involved in the work, project organization, reporting relationships, lines of communication, and management authorities.

3.1 Team Organization and Responsibilities

MFA will lead the investigation and reporting activities described in the work plan. The MFA program manager, Mr. Michael Pickering, and the MFA project manager, Mr. Josh Elliott, will be responsible for overall project coordination and providing oversight on project deliverables. Phil Wiescher, PhD, will be the senior technical advisor, and Ms. Carolyn Wise and Ms. Meaghan Pollock will be the field coordinators, all three of whom will be responsible for general field quality assurance/quality control (QA/QC) oversight. The project chemist, Ms. Mary Benzinger, will be responsible for coordination with laboratories regarding sample volumes, logistics, schedule, detection limits, and matrix interferences, and for ensuring overall data quality.

MFA will procure subcontractors to provide the sampling vessel and crew and to provide analytical laboratory services. This procurement is expected to occur after this work plan is issued as final. At the request of the State Historic Preservation Office and Tribes, a qualified archaeologist will observe collected sediment for possible archaeological or cultural resources; MFA will procure a subcontractor to provide this archaeological observation. In addition to MFA staff, DEQ, EPA, and MFA's selected subcontractors are responsible for the successful execution of the investigation scope of work and achievement of the DQOs described in the work plan.

3.2 Communication/Information Flow

The communication strategy is described in detail in Section 2 of the quality assurance project plan (QAPP). The field coordinators, Ms. Wise and Ms. Pollock, will be the points of contact for field personnel during the implementation of this FSP. Deviations from this FSP or the QAPP will be reported to Mr. Elliott for consultation. Significant deviations from the FSP or QAPP will be reported to Mr. Mark Pugh (DEQ's project manager). If archaeological and/or cultural resources are encountered during sampling, Mr. Elliott or Dr. Wiescher will notify DEQ, who in turn will notify the Tribes immediately.

3.3 Coordination with DEQ

The MFA project manager, Mr. Elliott, will provide notification to DEQ at least two weeks prior to beginning the investigation activities to accommodate DEQ's need to schedule required oversight activities. DEQ will also be notified by the MFA project manager once the investigation is complete.

3.4 Coordination with EPA

Mr. Pugh, DEQ's project manager, will coordinate with EPA as needed during the project. It is expected that, if significant deviations from the FSP or QAPP are required, DEQ will report these to EPA.

4 SAMPLE COLLECTION PROCEDURES

Samples of surface sediment will be collected and submitted for chemical analysis as described in the following sections. Investigation activities will follow procedures outlined in the health and safety plan (HASP), provided as Appendix C to the work plan. A copy of the HASP will be maintained on site for use by MFA staff during the field activities.

4.1 Sampling Vessels and Equipment

Samples will be collected from a landing-craft-style vessel, or similar, equipped with a crew cabin and a forward working area. The vessel will also include a pneumatic power grab sampler on an articulated A-frame with a custom research winch and a dynamic positioning system. The pneumatic power grab sampler will include a movable cover flap, which will be used to prevent particulate matter from entering the sampler during descent and to protect the sediment sample from washout during ascent. Depending on each day's planned sample stations, the sampling vessel will be launched from the boat launch at either Milwaukie Bay Park or Willamette Park/Bernert Landing in West Linn.

Field equipment and sampling supplies will be provided by MFA and will include equipment for sampling, processing, recording, and shipping. Safety equipment for the vessel, including an air horn, rescue rope, type 4 throwable ring or cushion, type BC fire extinguisher, secondary motor, anchors, and oil booms, will be provided by the vessel subcontractor. The analytical laboratory will provide the required sample containers, preservatives, coolers, and packing material. An equipment checklist is provided in Appendix A.

4.2 Navigation and Station Positioning

A differential global positioning system (DGPS) on the contractor vessel will be used to locate the horizontal sampling position for each proposed station provided in Figures 2-1 through 2-5, using the coordinates listed in the attached table. Coordinates will be programmed into the navigation system on the contractor vessel. Sampling stations will be determined to an accuracy of ±1 meter. Effort will be made to collect sediment from each station; however, some stations may remain inaccessible. DGPS will be used to record the final location of each discrete surface grab sample. The DGPS on the contractor vessel will be subject to a daily position check at least once per day at a surveyed control monument to validate the positions from the DGPS receiver. The DGPS accuracy should be within ±2 meters of the known coordinates for the surveyed control monument.

Vertical positioning will be achieved by referencing the nearest staff gauge to each sampling station. These include USGS gauge 14211720 Willamette River at Portland; USGS gauge 1420770 Willamette River below falls at Oregon City; and USGS gauge 14207740 Willamette River above falls at Oregon City. When gauges are not visible from the sampling station, real-time river levels from the nearest gauge will be downloaded from the Northwest River Forecast Center, where these gauges are identified with the codes PRTO3, ORCO3, and OCUO3, respectively. Gauge height will be converted to the North American Vertical Datum of 1988. Prior to surface sediment sample collection, depth to the mudline will be measured to the nearest one-tenth of a foot, using a fathometer and a lead line.

4.2.1 Utility Locates

Prior to commencing field work, MFA will contact Oregon One Call to locate public underground utilities entering the Site.

4.3 Sample Collection and Processing Methodology

Discrete surface sediment samples will be collected for composite analysis to a depth of 30 cm below mud line, using a pneumatic power grab sampling device. Field sampling and processing methodologies will comply with MFA's standard operating procedures (SOPs) for sediment sampling, lithologic logging, and field decontamination. SOPs are provided as Appendix B. Before deploying the power grab sampler and if water depths allow, field personnel will probe the sediment bottom, using a steel-tipped rod to confirm the presence of fine-grained material[4]. The speed of the grab sampler's descent will be controlled to minimize disturbance of the sediment upon impact. The speed of ascent will also be controlled to minimize loss of sediment from washout. Flappers will be installed on the grab sampler to minimize any sediment or particulate accumulation from the water column on the surface of the sample. The sediment sample will be inspected upon retrieval to ensure that the grab sampler was completely closed and retained all sediment, including any surficial fines. A visual inspection for ash and/or particulate matter will also be performed. The discrete samples will span the entire vertical profile of the collected sediment, not to exceed 30 cm and excluding sediment in contact with the bottom of the grab sampling device. Unbiased samples will be collected using a uniform, hollow, stainless steel cylinder or rectangular tube.

Once the first grab sample is accepted and placed in a stainless-steel bowl by onboard staff, the second and third discrete samples will be collected from the sampling vessel until there is an equal volume of sediment from the three grabs. After processing, sediment grabs will be stored on ice in stainless-steel bowls covered with aluminum foil until ready for compositing and placement in laboratory supplied sample containers. Sufficient sediment quantity (96 ounces) will be provided to the laboratory to facilitate both bulk sediment and grain-size fraction sample dioxin/furan analysis. If adequate composite sample volume is not obtained from the three grab samples, MFA will confer with DEQ on next steps.

[4] In the event that fine-grained sediment is not confirmed, up to two additional attempts will be made within 25 feet of the sampling station. If fine-grained sediment cannot be confirmed after 3 attempts, MFA will confer with DEQ about how to proceed.

4.3.1 Cultural Resources

DEQ is coordinating this sampling work with the State Historic Preservation Office and Tribes. At the request of the Tribes, a qualified archaeologist will be present onboard during surface sediment sampling activities. The archaeologist will inspect surface sediment samples for archaeological and/or cultural resources prior to compositing. If any item of archaeological interest is observed during surface sediment sampling, all sampling activities in the vicinity will cease. MFA will immediately notify DEQ, and DEQ will contact the Tribes immediately by phone.

4.3.2 Sample Acceptance Criteria

After the sampler is secured on the boat, the sediment sample will be inspected carefully to determine if it is acceptable. Each grab sample will be inspected to confirm the following:

- The jaws of the sampler closed completely.
- The grab sampling device did not over penetrate. Sediment should not be coming through the flapper on top of the device.
- The sediment recovery depth meets the minimum requirements described in Section 4.3.4 below.
- Overlying water is present and not excessively turbid.
- The sediment surface is relatively flat, with no winnowing.
- There is no visible layer of ash on the sediment surface.

Field personnel will aim for a minimum recovery depth of 20 cm; however, a minimum recovery depth of 10 cm will be accepted if after six grab attempts none recover deeper than 20 cm. Between grab attempts made and prior to compositing, grabs will be stored on ice in stainless-steel bowls covered with aluminum foil. If recovery is less than 20 cm, field personnel will record the reason for reduced recovery (i.e., debris, hard sediment bottom).

If these sample acceptance criteria are not met for three grab samples, a composite sample will be prepared from those grabs which meet the criteria (i.e., one or two grab samples). Field personnel will record the field conditions that prevented collection of a three-point composite sample. If the sample volume of a composite is limited, analysis of the bulk sediment for dioxins/furans will be prioritized, followed by grain size distribution, TOC, and sediment fraction analyses (dioxins/furans followed by TOC) If none of the six grab attempts meet the sample criteria, the sample material will be discarded and returned to the Willamette River and the station will be resampled as described below. Material will be disbursed at the water surface to avoid interference with the collection of other samples at the same sampling station.

4.3.3 Documentation of Substrate Types

When a sample is determined to be acceptable, the overlying water will be removed with a decontaminated baster once sufficient time has passed for suspended sediment to settle out

(approximately three minutes). A photograph of the grab surface will be taken, and descriptive notes will be taken to assist in characterizing the sediment (e.g., color, odor, sediment texture, percentage of fines, presence of debris, presence of sheen, distinct color change in shallow sediments [apparent redox potential discontinuity depth], presence of woodwaste). Visual description will follow the Unified Soil Classification System and will be recorded in a field logbook or field sampling data sheet (see Appendix A).

4.3.4 Sample Compositing and Handling

After each of the three sediment samples from each sampling station are collected, samples will be composited for analysis. The discrete samples will span the entire vertical profile of the collected sediment, not to exceed 30 cm and excluding sediment in contact with the bottom of the grab sampling device. The three discrete grab samples will be composited in a clean stainless-steel vessel (e.g., bowl). Composited sediment will be homogenized using stainless steel tools (e.g., spoon and bowl) until uniform in color and texture, yielding a composite made of sediment from the three discrete samples.

4.3.5 Contingency Plan for Field Condition Impediments to Sample Collection

During the sediment sampling effort, field personnel may encounter field conditions that preclude collection of grab samples at the planned stations (e.g., limited access, poor recovery, safety concerns, debris/rock/bedrock causing refusal). Up to six attempts will be made to obtain the three discrete samples within a 25-foot radius of the planned station. If, after six attempts, three acceptable discrete samples cannot be obtained within 25 feet, up to six more attempts will be made within a 50-foot-radius of the station. The sampling crew will not deviate more than 50 feet from the randomly assigned sample station to collect acceptable samples near that location. If, upon completion of the sampling effort, suitable composite samples are collected from fewer than 30 of the 45 randomly assigned sampling stations, MFA will confer with DEQ to discuss next steps.

4.4 Field Quality Control

QC samples will be collected to ensure that field samples and quantitative field measurements are representative of the media collected. The field QA/QC sample summary is provided in Table 4-3 of the QAPP and summarized below:

- Equipment Rinsate Blanks—To ensure that decontamination procedures are sufficient, an equipment rinsate blank will be collected when nondedicated equipment is used. Equipment rinsate blank collection consists of passing laboratory-provided deionized/distilled water through or over sampling equipment and submitting for chemical analyses. The rinsate blank results will be evaluated during data quality review. One equipment rinsate blank will be collected per day.
- Field Duplicate—Field duplicates will be collected to measure sampling and laboratory precision. One field duplicate per 20 samples will be collected. Field duplicate results will be evaluated during data quality review.

- Split samples—At DEQ's request, split samples will be collected to measure laboratory precision. Samples will be submitted to both the primary laboratory and a secondary laboratory.

4.5 Sample Handling and Transport

Sample container, preservation, and holding-time requirements are summarized in section 4.4 of the QAPP. All sediment chemistry samples will be collected in glass jars. Each sample will have an adhesive plastic or waterproof paper label affixed to the container and will be labeled at the time of collection. Samples will be uniquely identified with a sample identification that, at a minimum, specifies sample name, sample station, and sample date/time. Sample containers, sample coolers, and packing materials will be supplied by the laboratory. The laboratory will maintain documentation certifying the cleanliness of containers provided. The samples will be stored in iced coolers at 4° +/- 2° Celsius unless otherwise noted in the QAPP.

Samples will be submitted to the chosen laboratory under chain-of-custody procedures. Sample custody, packaging, and shipping details are provided in the QAPP.

4.6 Equipment Decontamination Procedures

Non-disposable and non-dedicated sampling equipment that comes in direct contact with the sample (e.g., scoops, bowls) will be decontaminated before use for each sample, according to the following procedure:

- Distilled-water rinse
- Wash with scrub brush and Liquinox™ soap and distilled water solution
- Distilled-water rinse
- Methanol solution rinse (1:1 solution with distilled water)
- Final distilled-water rinse

The grab sampler will be decontaminated before use for each discrete sampling attempt according to the following procedure:

- Rinse with site (river) water
- Wash with scrub brush and Liquinox soap and distilled water solution
- Rinse with distilled water

The thoroughness of equipment decontamination will be verified by collection and analysis of equipment rinsate samples. Furthermore, field personnel will wear clean, disposable gloves while collecting samples. Gloves will be changed between sampling stations.

4.7 Disposal of Investigation-Derived Waste

Any unused sediment will be returned to the Willamette River as described in Section 4.3.2. Decontamination fluids will be collected and stored in sealed plastic buckets and disposed of through a permitted service provider. Personal protective equipment will be disposed of in a sanitary landfill.

5 LABORATORY ANALYSES

Laboratory-tested parameters for sediment samples include dioxin and furans, TOC, and grain size distribution (see Table 4-4 of the QAPP). Samples will be placed in laboratory-supplied sample containers and preserved according to analytical protocols. Sample containers, preservation requirements, and holding times are provided in Table 4-3 of the QAPP.

6 DOCUMENTATION AND DATA MANAGEMENT

6.1 Field Logbooks and Forms

Field investigation personnel will be responsible for maintaining a daily record of significant events, observations, and measurements during field investigations. Field records may be recorded in a bound logbook or on paper or electronic field data sheets. A separate entry will be made for each sample. Specific field recording procedures are identified in the work plan as needed. Field logbooks and forms will be included in the project files at the end of field activities to provide a record of sampling.

6.2 Field Data Management

The following data management procedures will be performed in the field:

- Samples will be given a unique identifier.
- Samples will be collected and transported under chain-of-custody procedures.
- Field QA/QC samples will be collected according to the QAPP.
- Field notes and data sheets will be maintained.

6.3 Post-Fieldwork Data Management

Handwritten field records will be scanned or photographed and uploaded to MFA's server at the end of each field day. Electronic field records will be saved and submitted to MFA's online database at the end of each field day. Field logbooks and forms will be included in the project files at the end of field activities to provide a record of sampling. Field sampling data sheets and boring logs will be digitized from their handwritten forms.

6.4 Post-Analysis Data Management and Reporting

Analytical laboratories will be required to adhere to all QA/QC procedures outlined in the QAPP. Laboratories will provide all data for field investigations in electronic format and QA/QC reports, including a narrative of the standard QA/QC protocols. Data validation and data management will be performed according to the QAPP. Following data validation, all data, supplementary information, and validator qualifiers will be compiled into an SQL Server database for the project. Data summary files will be provided to DEQ as they become available after data validation and database management.

Results from the implementation of this FSP will be used to support the study goals described in the work plan. Data summaries and evaluations will be included in the data report.

LIMITATIONS

The services undertaken in completing this plan were performed consistent with generally accepted professional consulting principles and practices. No other warranty, express or implied, is made. These services were performed consistent with our agreement with our client. This plan is solely for the use and information of our client unless otherwise noted. Any reliance on this plan by a third party is at such party's sole risk.

Opinions and recommendations contained in this plan apply to conditions existing when services were performed and are intended only for the client, purposes, locations, time frames, and project parameters indicated. We are not responsible for the impacts of any changes in environmental standards, practices, or regulations subsequent to performance of services. We do not warrant the accuracy of information supplied by others, or the use of segregated portions of this plan.

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TABLE

Table
Station Location Coordinates
Upriver Reach Background Investigation
Oregon Department of Environmental Quality
Willamette River, Oregon

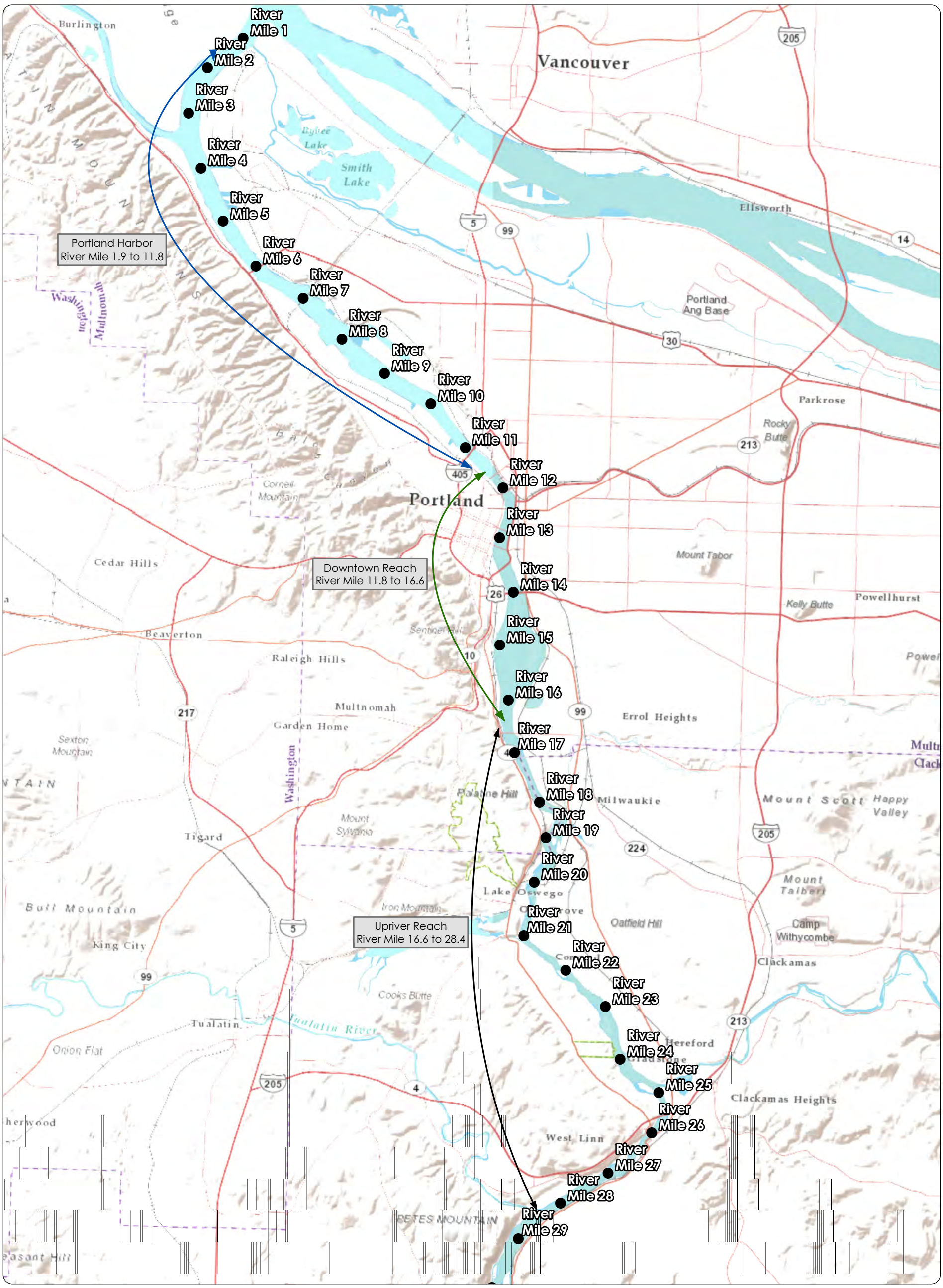
Sample Type	Sample ID	Sediment Polygon	Proposed Location Coordinates (WGS84; Degrees)[a]		Sequential Station Count
			Latitude	Longitude	
Stratified Random Sample	MFA-001-SS	Soft	45.461282	-122.66094	001
	MFA-002-SS	Soft	45.460652	-122.660713	002
	MFA-003-SS	Soft	45.457061	-122.662652	003
	MFA-004-SS	Soft	45.451576	-122.655673	004
	MFA-005-SS	Soft	45.447682	-122.653394	005
	MFA-006-SS	Soft	45.446951	-122.652021	006
	MFA-007-SS	Soft	45.443631	-122.649446	007
	MFA-008-SS	Soft	45.441163	-122.646804	008
	MFA-009-SS	Soft	45.439608	-122.643813	009
	MFA-010-SS	Soft	45.435991	-122.646899	010
	MFA-011-SS	Soft	45.433035	-122.650893	011
	MFA-012-SS	Soft	45.43158	-122.650303	012
	MFA-013-SS	Soft	45.427651	-122.650691	013
	MFA-014-SS	Soft	45.423661	-122.657483	014
	MFA-015-SS	Soft	45.417916	-122.656629	015
	MFA-016-SS	Soft	45.394395	-122.627727	016
	MFA-017-SS	Soft	45.388664	-122.626522	017
	MFA-018-SS	Soft	45.387657	-122.626263	018
	MFA-019-SS	Soft	45.375239	-122.619729	019
	MFA-020-SS	Soft	45.373997	-122.614975	020
	MFA-021-SS	Soft	45.363043	-122.603451	021
	MFA-022-SS	Soft	45.360974	-122.605012	022
	MFA-023-SS	Soft	45.351003	-122.623682	023
	MFA-024-SS	Soft	45.347596	-122.624804	024
	MFA-025-SS	Soft	45.347044	-122.630815	025
	MFA-026-SS	Soft	45.344512	-122.637301	026
	MFA-027-SS	Soft	45.344217	-122.638253	027
	MFA-028-SS	Soft	45.339478	-122.64174	028
	MFA-029-SS	Soft	45.337434	-122.646346	029
	MFA-030-SS	Soft	45.334676	-122.65081	030
	MFA-031-SS	Medium	45.460862	-122.666447	031
	MFA-032-SS	Medium	45.454563	-122.657443	032
	MFA-033-SS	Medium	45.449906	-122.654848	033
	MFA-034-SS	Medium	45.444227	-122.652076	034
	MFA-035-SS	Medium	45.44424	-122.644091	035
	MFA-036-SS	Medium	45.442556	-122.647872	036

Table
Station Location Coordinates
Upriver Reach Background Investigation
Oregon Department of Environmental Quality
Willamette River, Oregon

Sample Type	Sample ID	Sediment Polygon	Proposed Location Coordinates (WGS84; Degrees)[a]		Sequential Station Count
			Latitude	Longitude	
	MFA-037-SS	Medium	45.426278	-122.652276	037
	MFA-038-SS	Medium	45.411645	-122.659508	038
	MFA-039-SS	Medium	45.406424	-122.649611	039
	MFA-040-SS	Medium	45.399801	-122.63987	040
	MFA-041-SS	Medium	45.39143	-122.627738	041
	MFA-042-SS	Medium	45.380165	-122.61938	042
	MFA-043-SS	Medium	45.366539	-122.605287	043
	MFA-044-SS	Medium	45.362597	-122.607018	044
	MFA-045-SS	Medium	45.340689	-122.639077	045

[a]World Geodetic System (WGS) 1984.

FIGURES



Legend

● River Mile Marker

Figure 1-1
Willamette Upriver Reach Background Investigation
DEQ
Portland, Oregon

Source:
Basemap obtained from ArcGIS Online.

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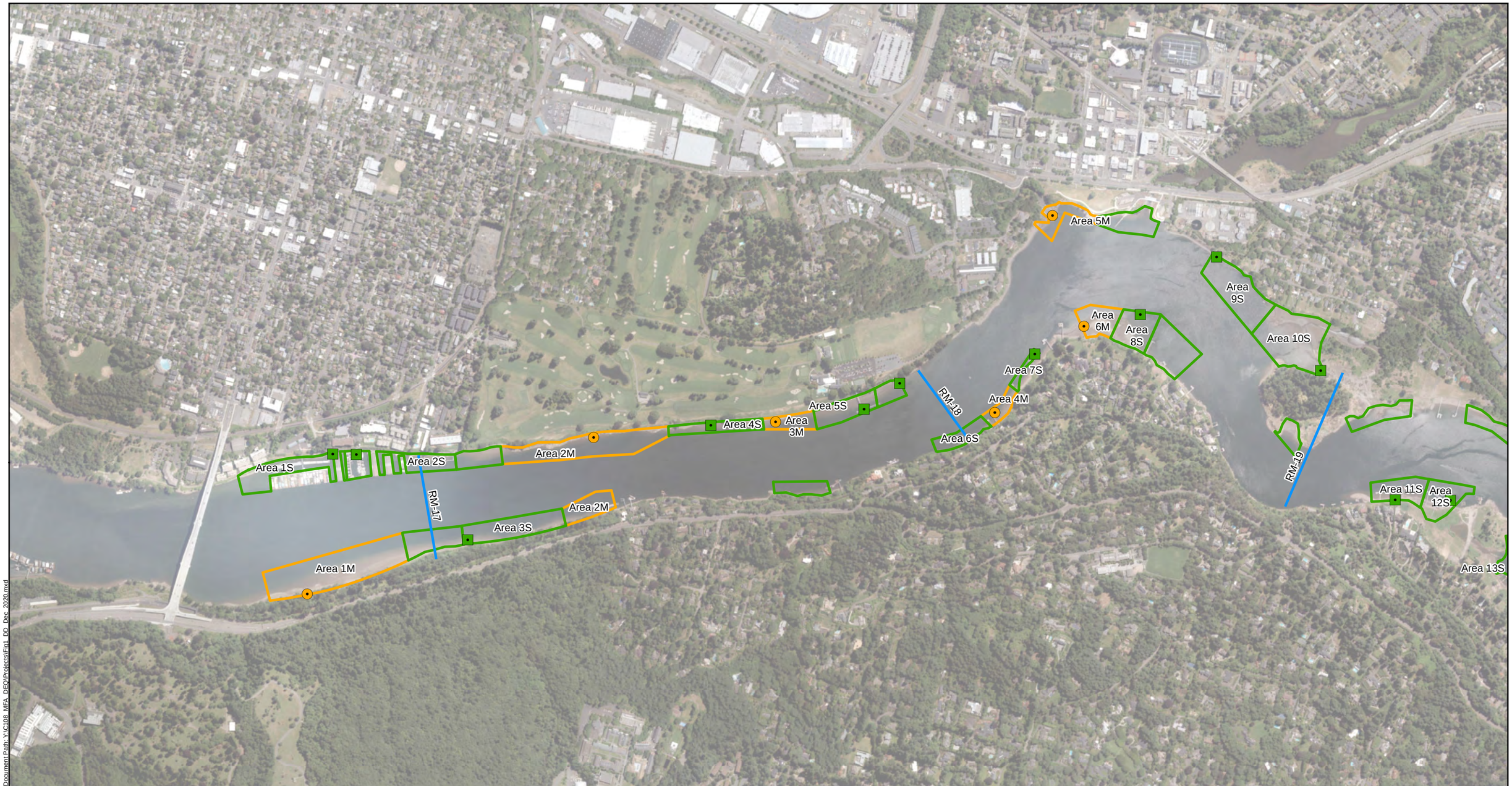
0 4,500 9,000
Feet

Path: X:\0785_13\Projects\Fig_Willamette_River_DEQ_p2.mxd
Print Date: 9/23/2020
Approved By:
Produced By: jelliott
Project:



Proposed Soft Sediment FSP Grab Sample Location (n = 30)

Proposed Medium Sediment FSP Grab Sample Location (n =15)

Soft Sediment Analysis Grid

Medium Sediment Analysis Grid

River Mile (RM)

0 250 500 1,000 Feet

NOTE:
Points were generated randomly inside the Hand Probe Polygons in each of the Analysis Grids using the Create Random Points tool in ArcGIS 10.x.

Proposed Upriver Reach Surface Grab Locations RM 16.6-19.0

DEQ – Willamette Upriver Reach Background Investigation
Portland, Oregon

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Figure 2-1

12/10/2020	Project No.: 0108-003-001	Drawn by: ES	Checked by: JE

Document Path: X:\C108_MFA_DEQ\Projects\Fig1_DD_Dec_2020.mxd

Proposed Soft Sediment FSP Grab Sample Location (n = 30)

Proposed Medium Sediment FSP Grab Sample Location (n =15)

Soft Sediment Analysis Grid

Medium Sediment Analysis Grid

River Mile (RM)

0 250 500 1,000 Feet

NOTE:
Points were generated randomly inside the Hand Probe Polygons in each of the Analysis Grids using the Create Random Points tool in ArcGIS 10.x.

Proposed Upriver Reach Surface Grab Locations RM 19.0-21.0

DEQ – Willamette Upriver Reach Background Investigation
Portland, Oregon

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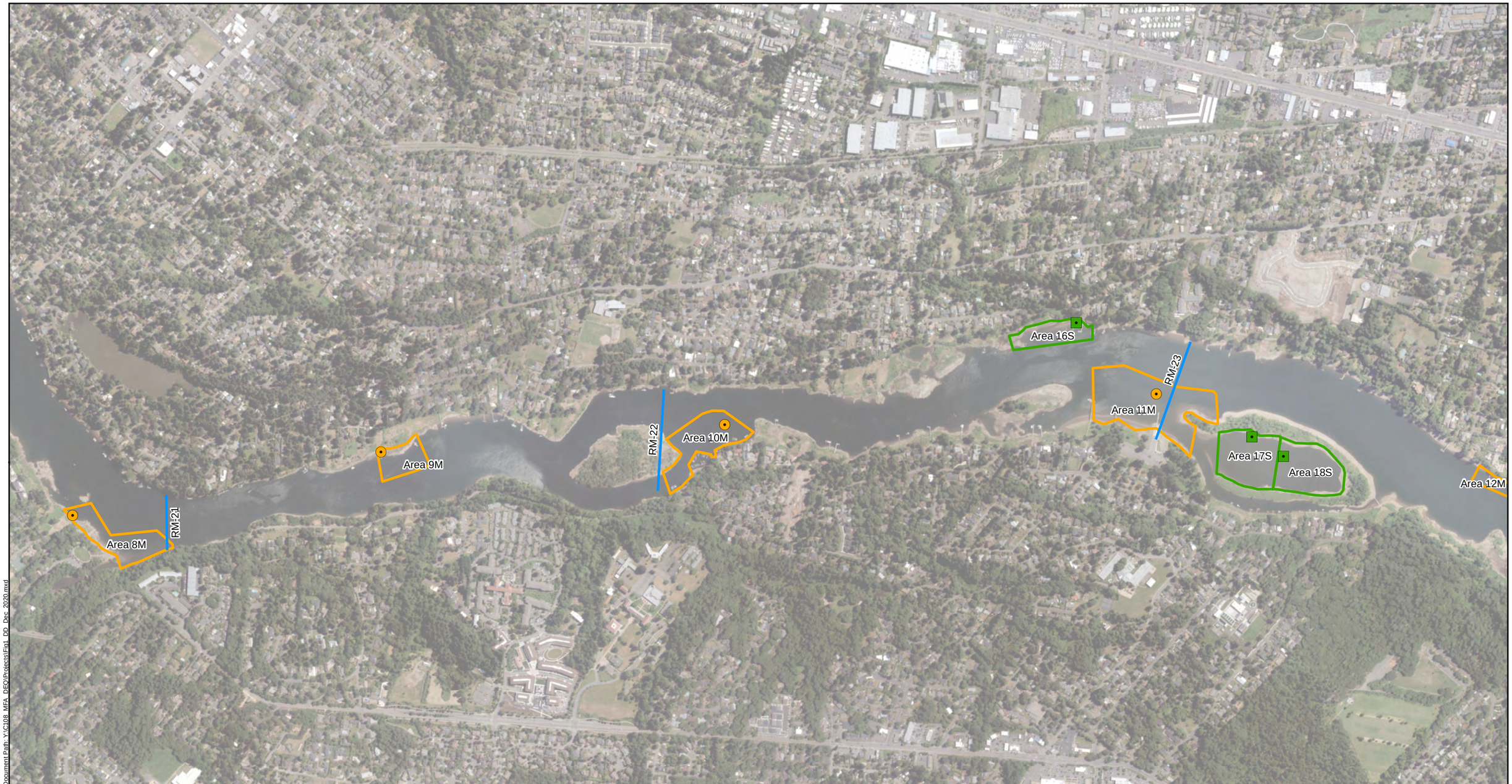
Figure 2-2

12/10/2020	Project No.: 0108-003-001	Drawn by: ES	Checked by: JE

Document Path: Y:\G108_MFA_DEQ\Projects\Fig1_DP_Dec_2020.mxd



Proposed Soft Sediment FSP Grab Sample Location (n = 30)

Proposed Medium Sediment FSP Grab Sample Location (n =15)

Soft Sediment Analysis Grid

Medium Sediment Analysis Grid

River Mile (RM)

0 250 500 1,000 Feet

NOTE:
Points were generated randomly inside the Hand Probe Polygons in each of the Analysis Grids using the Create Random Points tool in ArcGIS 10.x.

Proposed Upriver Reach Surface Grab Locations RM 21.0-23.0

DEQ – Willamette Upriver Reach Background Investigation
Portland, Oregon

MAUL FOSTER ALONG | Cascadia Associates, LLC

Figure 2-3

12/10/2020	Project No.: 0108-003-001	Drawn by: ES	Checked by: JE

Document Path: X:\C108_MFA_DEQ\Projects\Fig1_DD_Dec_2020.mxd

Proposed Soft Sediment FSP Grab Sample Location (n = 30)

Proposed Medium Sediment FSP Grab Sample Location (n =15)

Soft Sediment Analysis Grid

Medium Sediment Analysis Grid

River Mile (RM)

0 250 500 1,000 Feet

NOTE:
Points were generated randomly inside the Hand Probe Polygons in each of the Analysis Grids using the Create Random Points tool in ArcGIS 10.x.

Proposed Upriver Reach Surface Grab Locations RM 23.0-26.0

DEQ – Willamette Upriver Reach Background Investigation
Portland, Oregon

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Figure 2-4

12/10/2020	Project No.: 0108-003-001	Drawn by: ES	Checked by: JE

Document Path: Y:\G108_MFA_DEQ\Projects\Fig1_DD_Dec_2020.mxd

Proposed Soft Sediment FSP Grab Sample Location (n = 30)

Proposed Medium Sediment FSP Grab Sample Location (n =15)

Soft Sediment Analysis Grid

Medium Sediment Analysis Grid

River Mile (RM)

0 250 500 1,000 Feet

NOTE:
Points were generated randomly inside the Hand Probe Polygons in each of the Analysis Grids using the Create Random Points tool in ArcGIS 10.x.

Proposed Upriver Reach Surface Grab Locations RM 26.0-28.4

DEQ – Willamette Upriver Reach Background Investigation
Portland, Oregon

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Figure 2-5

12/10/2020	Project No.: 0108-003-001	Drawn by: ES	Checked by: JE

Document Path: Y:\G108_MFA_DEQ\Projects\Fig1_DD_Dec_2020.mxd

APPENDIX A

SURFACE SEDIMENT LOGGING KEYS AND FIELD FORMS

FIELD LOGGING CHECKLIST

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Guide for Sample Description

1. Depth interval of lithologic unit encountered in sample, in feet below ground surface
2. USCS classification GROUP NAME and (SYMBOL)
3. Color
4. Grain size distribution, as percentages of fines, sand, and gravel including plasticity of fines, particulate shapes, lithology, and mineral composition, if identifiable
5. Relative density or consistency
6. Trace material
7. Additional information, i.e., structures, odors, organic or manmade material (include %)
8. Moisture conditions
9. Geologic interpretation (e.g., FILL, ALLUVIUM)

Example: 5.0 to 6.5 feet; SILTY SAND (SM); yellowish brown; 20% fines; 75% sand, fine to medium; 5% gravel, medium, subangular to rounded; loose; trace woody debris; petroleum hydrocarbon-like odor; damp, (ALLUVIUM)

Unified Soil Classifications System				**Group Symbol**	**Group Names**
Coarse-Grained Soils > 50% larger than #200 sieve (0.075 mm)	GRAVEL coarse = 1-1/2 to 3 in 38 to 75 mm medium = ¾ to 1-1/2 in 19 to 38 mm fine = 3/16 to ¾" 5 to 19 mm	50 % of particles are 5 mm to 75 mm	≤ 5% fines	GW	GRAVEL (well graded)
				GP	GRAVEL (poorly graded)
			> 5% to ≤ 15% fines > 15% to < 50% sand, add sandy mod.	GW-GM	GRAVEL WITH SILT
				GP-GM	
				GW-GC	GRAVEL WITH CLAY
				GP-GC	
			> 15% to < 50% fines	GM	SILTY GRAVEL
				GC	CLAYEY GRAVEL
			> 15% to < 50% sand and < 5% fines	GP or GW	SANDY GRAVEL
	SAND coarse = 2 to 5 mm #10 to #4 sieve medium = 0.4 to 2 mm #40 to #10 sieve fine = 0.075 to 0.4 mm #200 to #40 sieve	50 % of particles are 0.075 to 5 mm	≤ 5% fines	SW	SAND (well graded)
				SP	SAND (poorly graded)
			> 5% to ≤ 15% fines > 15% to < 50% gravel, add gravelly mod.	SW-SM	SAND WITH SILT
				SP-SM	
				SW-SC	SAND WITH CLAY
				SP-SC	
			> 15% to < 50% fines	SM	SILTY SAND
				SC	CLAYEY SAND
			> 15% to < 50% gravel and < 5% fines	SP or SW	GRAVELLY SAND
Fine-Grained Soils > 50% smaller than #200 sieve (0.075 mm)	SILT	Generally non- to low plasticity	None to low dry strength Slow to rapid dilatancy None to low toughness < 15% coarse 15 to 30% coarse > 30% coarse	ML	SILT SILT WITH SAND OR GRAVEL SANDY OR GRAVELLY SILT
			Low to med. dry strength None to slow dilatancy Low to med. toughness < 15% coarse 15 to 30% coarse > 30% coarse	MH	SILT SILT WITH SAND OR GRAVEL SANDY OR GRAVELLY SILT
	CLAY	Generally medium to high plasticity	Med. to high dry strength None to slow dilatancy Med. toughness < 15% coarse 15 to 30% coarse > 30% coarse	CL	CLAY CLAY WITH SAND OR GRAVEL SANDY OR GRAVELLY CLAY
			High-very high dry strength No dilatancy High toughness < 15% coarse 15 to 30% coarse > 30% coarse	CH	CLAY CLAY WITH SAND OR GRAVEL SANDY OR GRAVELLY CLAY
	High percentage of organic material	Enough organic material to affect soil properties		OL/OH	ORGANIC SOIL
		Predominantly organic material		PT	PEAT

Note: Oversize material grain size: boulders > than 12-in diameter; cobbles 3 to 12-in diameter.
Note that well graded material means diversified particle sizes and poorly graded means uniform particle sizes.
Fines recognition: the #200 sieve size (0.075 mm) is about the smallest grain visible to the unaided eye.

Condition

1. Relative density for sand or gravel
   a. Using Standard Penetration Test, blows per foot

Blows/ft (N)	Relative Density	Estimated (no blow counts)
0-4	very loose	Loose – sand and/or gravel can be excavated with a shovel
5-10	loose	
11-30	medium	Compact – sand and/or gravel require use of a pick for removal
31-50	dense	
> 50	very dense	

2. Consistency for fines (note whether blow counts or tactile tests were used)

Blows/ft (N)	Relative Consistency	Tactile Test
< 2	very soft	Sample sags or slumps
2-4	soft	Sample can be pinched in two
5-8	firm	Sample easily imprinted to 1" by thumb
9-15	stiff	Sample readily indented by thumb with pressure
16-30	very stiff	Sample readily indented by thumbnail
> 30	hard	Sample cannot be imprinted with thumb, can pierce with a pencil

Miscellaneous Descriptive Terms (use with discretion; estimate percentages if possible)

Trace	Particles are present but < 5%
Few	5 to 15%
Little	15 to 25%
Some	25 to 45%

Plasticity

Describe the plasticity based on the following criteria.

Description	Criteria
Nonplastic	A thread cannot be rolled at any water content
Low	A thread is barely rolled; a lump can't be formed after reaching the plastic limit
Medium	The easily rolled thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	Much time is required to reach the plastic limit and the thread can be rerolled afterwards. The lump can be formed when drier than the plastic limit.

Moisture Content

Description	Criteria
Dry	No discernible moisture present, dusty, dry to the touch
Moist	Will moisten the hand, squeezes tight and maintains shape
Wet	Visible free water; plastic materials will leave sticky residue in hand when remolded

Structures

Description	Criteria
Stratified	Alternating 6 mm or thicker layers of varying material or color
Laminated	Alternating 6 mm or thinner layers of varying material or color
Fissured	Breaks along definite planes of fracturing
Lensed	Inclusions of lens shaped masses of soil within matrix
Homogeneous	Same color and appearance throughout, no structure

Surface Sediment Field Sampling Form
Upriver Reach Background Investigation
Oregon Department of Environmental Quality
Portland, Oregon

MAUL FOSTER ALONGI

Sampling Date:		**Sampling Location:**	
Vessel:		**Sampling Personnel:**	
Weather Conditions:		**Subcontractor Personnel:**	
Depth Sounding Method:		**Captain:**	
Gage Source (circle one)**:**		**Deckhand:**	
Gage Height and Datum:	ft PRD Time:	**Sampling Equipment:**	Powergrab, Stainless Steel Bowls & Spoons
Horizontal Coordinate Datum:			
Proposed Coordinates:		**General River Location:**	
Latitude:			
Longitude:			

Attempt Summary

Attempt #:	Radius (ft)	Time	Coordinates		Water Depth	Recovery Depth	JC?	OLW?	Accepted?	Photo?	Additional Comments	Sample Interval	In 3-PT?
			Latitude:	Longitude:									

Notes: JC = Jaws Closed; OLW = overlying water, In 3-PT? = sediment used in 3-Point composite.

Homogenized 3-Point Composite Sample Description

3x Attempts #s:	Color, Minor/Major Constituent %, Density:

Sample Information

Sample ID	Sample Time	Sample Type (Primary, Duplicate, MS/MSD)	# of Containers

Additional Comments

Surface Sediment Field Sampling Form
Upriver Reach Background Investigation
Oregon Department of Environmental Quality
Portland, Oregon

Sampling Date:		**Sampling Location:**	
Sediment Description:			
Attempt #:	Redox Potential Disxontinuity (RPD):		cm
Structure:			
Density, Color, Minor/Major Constituent %:			
Odor/Sheen:			
Organics, Biota, or Other:			

Sediment Description:		
Attempt #:	Redox Potential Disxontinuity (RPD):	cm
Structure:		
Density, Color, Minor/Major Constituent %:		
Odor/Sheen:		
Organics, Biota, or Other:		

Sediment Description:		
Attempt #:	Redox Potential Disxontinuity (RPD):	cm
Structure:		
Density, Color, Minor/Major Constituent %:		
Odor/Sheen:		
Organics, Biota, or Other:		

Notes:

Typical Structure Descriptions: stratified, laminated, fissured, lensed, and homogeneous.

Equipment Checklist

Project Name: Upriver Reach Background Investigation
Project Number: 0785.13.01
Project Manager: Josh Elliott

PERSONAL SUPPLIES
Cell phone (with camera)
Chemical-resistant, steel toe boots
Cloth face covering or N95 mask
Drinking water/food
Eyewash bottle and solution
First Aid Kit and AED
Gloves
Hard hat
Hearing protection
Nitrile gloves
Rainwear
Respirator w/cartridges
Safety glasses
Safety vest
U.S. Coast Guard approved Type III or V personal flotation device
Warm/dry clothes
INSTRUMENTATION
GPS unit (fully charged)
GENERAL SAMPLING
Aluminum foil
Drum labels (Haz, Non-Haz, "Caution ") (as needed)
Duct tape
AA and AAA batteries (extra for various meters)
Extra cooler
Flashlight(s) w/extra batteries
Garbage bags
Hand sanitizer
Ice for samples
Indelible ink pens (rite in the rain or similar)
Liqui-Nox soap (spray bottle or sprayer)
Metal clipboard
Methanol (50/50) (spray bottle or sprayer)
Packaging tape
Paper towels
Stainless steel bowls (6)
Stainless steel spoons (6)
Sharpie (various colors)
Tape measure (with decimal-feet increments)
Waterproof paper or notebook (as needed)
White board and dry-erase markers
Ziploc bags (gallon- and quart-size)
Zip-ties (as needed)

DECON
Bucket and brush
Distilled water (5 gallons)
Extra Liqui-Nox (for making more solution)
Extra methanol (for making more solution)
Hand sprayer with (50/50 Methanol/DI H20)
Hand sprayer with (DI water)
Hand sprayer with (Liqui-Nox, DI H20 mix)
PAPERWORK
Field notebook (waterproof paper)
Field sampling data sheets on waterproof paper
Work plan (including appendices and figures on waterproof paper)
Sample labels (weatherproof)

APPENDIX B

STANDARD OPERATING PROCEDURES

SCOPE AND APPLICATION

This standard operating procedure (SOP) describes the decontamination procedure for field equipment that may come in contact with contaminated media and may be reused at multiple sample locations or sites by Maul Foster & Alongi, Inc. (MFA) staff. Decontamination is performed to reduce the potential for cross-contamination of samples that will be collected using multi-use equipment and will undergo physical or chemical analyses. Other equipment that is multi-use but is not specifically used for sample collection (e.g., water level meter, pump used for well development), also requires decontamination. Finally, decontamination is necessary to minimize the potential for chemical exposure to MFA staff.

Typically, decontamination is not necessary for field equipment that is disposable, and intended to be used only once (e.g., disposable bailer). Additionally, this SOP does not apply to equipment used by subcontractors, such as drilling equipment. However, MFA staff should confirm that subcontractors are implementing appropriate decontamination procedures to minimize the potential for cross-contamination of samples or chemical exposure to MFA staff.

EQUIPMENT AND MATERIALS REQUIRED

The following materials are necessary for this procedure:

- Non-phosphate detergent solution (e.g., Alconox, Liquinox).
- Distilled and potable water.
- Personal protective equipment (as specified in the site-specific health and safety plan).
- Buckets to contain rinsate, brushes, paper towels.

Depending on the site conditions and the types of contaminants that may be present, the use of other decontamination materials, such as deionized water, methanol, hexane, or isopropyl alcohol, may be necessary. The need for other materials should be determined prior to field work. The decontamination procedures using other materials should be described in a site-specific sampling and analysis plan (SAP).

METHODOLOGY

When the site-specific SAP specifies additional or other requirements for decontamination, it takes precedence over this SOP. In the absence of a SAP, the following procedures shall be used.

General Procedure:

1. Rinse the equipment with potable water to remove visible soil, petroleum sheen, or contamination.
2. Scrub the equipment with a brush and solution of distilled water and non-phosphate detergent.
3. Rinse the equipment with distilled water.
4. Allow equipment to air dry or use paper towels.
5. At all times, ensure the decontaminated equipment is stored in a manner the prevents it from becoming contaminated while not in use. Depending on the size of the equipment, it can be wrapped with new aluminum foil or placed in a new plastic bag.

Rinsate Storage:

All fluids resulting from equipment decontamination shall be initially contained in a bucket and then transferred to a Department of Transportation (DOT)-approved container (e.g., 55-gallon drum) stored on site at a

location that does not interfere with on-site activities (e.g., vehicle traffic, pedestrian areas). Place a label on each container and include the following information:

- Date fluids placed in the container.
- Contents (e.g., "water from equipment decontamination").
- Contact information, including MFA staff or client phone number.

Note that labels on containers exposed to sunlight or precipitation are prone to fading. Use a waterproof, indelible ink pen (e.g., Sharpie®) whenever possible. In the field notebook, keep a detailed inventory of all containers, including the number of containers, the approximate quantity of liquids generated, and a description of the source of the fluids. Provide this information to the MFA project manager. Take photographs of 1) each drum label, 2) the drum(s), and 3) the vicinity of where the drums are stored on-site for future reference.

Note that some clients or site owners have specific requirements for labeling and storage of containers. The requirements should be determined in advance of the field work.

SCOPE AND APPLICATION

This standard operating procedure (SOP) describes the methods to be used to observe and document the physical characteristics of unconsolidated geologic materials (soil and sediment) encountered during field investigations. If a Maul Foster & Alongi, Inc. (MFA) project requires hard rock drilling and description of rock core or cuttings, procedures for describing rock should be specified in a project-specific sampling and analysis plan (SAP).

EQUIPMENT AND MATERIALS REQUIRED

The following materials are necessary for this procedure:

- Blank field forms (e.g., boring log) for documenting observations
- Dry-erase board
- Camera
- Munsell soil color chart (where required)
- MFA field logging checklist

METHODOLOGY

When the project-specific SAP specifies additional or other requirements for lithologic logging, it takes precedence over this SOP. In the absence of a SAP, the procedures in this SOP shall be used. MFA utilizes a combination of the Unified Soil Classification System (USCS) and the ASTM International method D2487 for describing and classifying soil and sediment by visual and manual examination. Prior to implementing field work, verify with the project manager the logging standard to be used.

Logging Process:

The objective of lithologic logging is to document the physical characteristics of soil and sediment encountered and the changes in characteristics with depth. Typically, changes with depth will define the strata encountered. Therefore, each stratum encountered should be identified and the following characteristics described in the order given:

- Depth interval of each stratum to the nearest tenth of a foot below ground surface
- USCS classification Group Name and Symbol
- Color using the Munsell color chart
- Grain size distribution, as percentages of fines (silt and clay combined), sand, and gravel
- Percentages of larger gravels (cobbles and boulders) if present.
- Consistency when the content of fines is 50% or greater
- Density when the combined percentage of sand and gravel is 50% or greater
- Grain shape of sands and gravels
- Chemical odors, if noticeable
- Structures if present (e.g., laminae, pores)
- Presence of organic matter (e.g., roots, leaves, twigs, wood fragments)
- Presence of anthropogenic material (e.g., metal, brick, glass, plastic, wood fragments); include the approximate percentage
- Moisture content as "dry," "moist," or "wet"
- If possible, describe the origin of each stratum (e.g., fill, alluvium)

SCOPE AND APPLICATION

This standard operating procedure (SOP) describes the methods used for obtaining sediment samples for physical and/or chemical analysis. Sediment samples will be collected using a tool appropriate for the site and sediment conditions (i.e., grain size and plasticity of sediment, depth of water).

EQUIPMENT AND MATERIALS REQUIRED

The following materials are necessary for this procedure:

- Personal protective equipment (as specified in the health and safety plan).
- Sampling equipment, as appropriate:
  - Hand-operated sediment sampler or similar (e.g., Russian peat borer).
  - Power grab sampler or similar (e.g., van Veen grab sampler)
  - Vibracore sampler
- Stainless steel spoons, scoops, and trowels
- Stainless steel bowls
- Tape measure with increments in feet and tenths of a foot
- Laboratory-supplied sample containers
- Laboratory chain-of-custody and cooler with ice
- Equipment decontamination supplies if sampling equipment will be reused between sample locations (see SOP 1 for equipment decontamination procedures)
- Personal flotation vest
- Field forms or notebook for documenting the sampling procedures

OTHER CONSIDERTIONS

Sediment sampling may require local, state, and/or federal agency approvals. Confirm with the MFA project manager whether any agencies approvals are necessary, and if so, ensure you have paperwork with you documenting the approvals (e.g., access agreements, in-water work permits, etc.).

If MFA staff will be operating a boat, ensure the staff have appropriate operator licenses. If subcontractors will be used to provide boats or barges, ensure the subcontractors are appropriately licensed.

METHODOLOGY

When the project-specific sampling and analysis plan (SAP) specifies additional or other requirements for sediment sampling, it takes precedence over this SOP. In the absence of a SAP, the procedures in this SOP shall be used.

General Sample Collection Procedure:

Depending on water depth, the sampling locations will be accessed through a combination of water vessels and/or wading. If obstructions are encountered or locations are otherwise inaccessible, then locations will be field-adjusted and documented. Don gloves as specified in the Health and Safety Plan; replace gloves with new gloves after each sample is collected.

Russian Peat Borer or similar.

Typically, this tool is only suitable for collecting shallow samples in soft, organic sediments, and in wadable water depths.

Manually advance to the target depth (up to 50 cm) and then rotate the tube 180 degrees to collect a relatively undisturbed semi-cylindrical sediment core. Withdraw the sampling device and the chamber containing the sediment core will be opened. If sample recovery is limited (i.e., less than approximately 75 percent), discard the sample and resample within a few feet of the original location. Additional deployments may be necessary to obtain the required sample volume for laboratory analysis. Describe and document the sediment lithology in accordance with SOP 2.

Power Grab Sampler or similar.

This tool is only suitable for collecting samples of surface sediments that are relatively free of rock, large organic matter (e.g., wood, twigs), or other debris (e.g., anthropogenic material such as metal and glass).

Surface sediment will be collected for discrete or composite analysis from a boat-mounted pneumatic power grab sampling device or by wading. The speed of the grab sampler's descent will be controlled by a winch or crane to minimize disturbance of the sediment. The speed of ascent will also be controlled to minimize loss of sediment from washout. The sediment sample will be inspected upon retrieval to ensure that the grab sampler was completely closed and retained all sediment, including any surficial fines.

After the sampler is secured on the boat, the sediment sample will be inspected carefully before determining if the sample is acceptable. Each grab sample will be inspected to ensure the following:

- Jaws of the sampler closed completely.
- Grab sampling device did not over penetrate, as indicted by sediment extruding over the top edge or doors of the sampler.
- That target sampling depth was achieved.
- A layer of water overlying the sediment sample is retained in the sampling device.
- The sediment surface is relatively flat with no winnowing or rilling, which would otherwise indicate loss of fine sediment at the top of the sample.

If all of these conditions are not met, then the sample will be discarded and resampled within a few feet of the original location.

- Discrete surface sediment samples will be collected and submitted individually for analysis.
- After the sediment has been photographed, it will be removed from the grab sampler using a stainless-steel spoon and placed in a decontaminated stainless-steel bowl.
- Sediments in direct contact with the grab sampler will not be collected for analysis.
- Discrete samples will be placed directly into sample collection jars. Additional sediment will be collected from each discrete sampling location where composited samples are needed. This additional sediment will be composited in a stainless steel bowl (or equivalent) and homogenized using clean tools (e.g., stainless steel spoon).
- Samples collected for the analysis of potentially volatile chemicals will be placed in appropriate sample containers immediately after retrieval to minimize volatilization.

- When a sample is determined to be acceptable, the overlying water will be removed and then a photograph of the grab surface will be taken.
- Describe and document the sediment lithology in accordance with SOP 2.

Vibracore Sampler.

Subsurface sediment core collection will be performed as follows:

- The sampling vessel will navigate to the target position. The GPS position will be recorded from the vessel at the vibracore location when the vibracore first rests on the sediment surface.
- The vibracore will be advanced without power (under its own weight), then vibration will be applied until the core tube is advanced to the target depth or to refusal.
- After a brief pause, the core tube will be extracted from the sediment, using only the minimum vibratory power needed for extraction.

The core will be accepted, rejected, or stored on the vessel pending one additional drive attempt. Field protocols are outlined below:

- Percent recovery is calculated by dividing the height of the recovered sediment by the penetration depth. A minimum of 75 percent recovery is targeted.
- If the core was not able to penetrate to target depth a second attempt will be made. If similar core refusal is met, consideration will be made as to whether the target depth is achievable. If it is determined to be unachievable, then a description of sediments encountered, and potential causes of refusal will be recorded.
- Core sampling intervals or depths will not be corrected for under recovery. Best professional judgment will be used to stop the core sampler from collecting material before significant sediment compaction would occur.

The core will be inspected for the following acceptance criteria:

- A layer of water overlying the sediment surface is retained in the core barrel.
- The core has 75 percent target recovery versus penetration (or document why recovery is less after two attempts).
- The core tube is in good condition (not excessively bent).
- The core appears representative of sediment in the surrounding area.
- The target penetration depth has been achieved or bedrock is encountered. If the target depth is not reached because of cobbles, debris, refusal, or other difficult coring conditions, an additional core will be attempted as described in the contingency plan.

After core acceptance, water will be carefully decanted from the top of the core tube to minimize sediment disturbance. Cores may be cut into segments for handling and storage. Core tubes will be capped and inscribed on the sidewalls with core and segment identification and "up" arrow.

Actual core penetration will be determined using a tape measure attached to the vibracore head. The core will be driven a minimum of one foot deeper than the lower boundary of intended depth or until refusal. The tape measure will be used to measure total core length by comparing the start and end measurements of a tape. After the coring equipment is safely onboard the vessel, the core liner with the intact core inside will be extruded. Recovery will be determined by comparing the penetration with the height of the material in the extracted core.

The subsurface sediment cores for chemistry analysis may be processed on the vessel or on land, as described below:

- The core tube will be split open lengthwise to preserve the material stratigraphy inside, using a table saw, handheld circular saw, radial saw, shearing tool, X-ACTO® knife (if liner used), or similar device.
- Cores will be photographed prior to sampling. The sample ID, date, and orientation of the core will be included in each photograph.
- Describe and document the sediment lithology in accordance with SOP 2.
- Subsurface sample intervals will be two feet unless field conditions indicate otherwise (e.g., a change in lithology, odor, sheen). Intervals will be collected more frequently if changes are observed in the core are observed more frequently than every two feet.

While on the vessel, personnel will record the following core collection data in the field notes and on a boring log or sediment log form.

- Date/time. Local date and time when the vibracoring began at each location.
- Total Drive Length. Core tube length and the depth of the core tube penetration into the subsurface.
- Recovered Length. Thickness of the sediment column retained in the core tube before sectioning and removal of the core catcher.

Sampling Procedure:

After the cores have been described and the sample intervals have been determined, sediment will be collected within the determined sample interval, homogenized until uniform in color and texture, and placed into appropriate sample containers for laboratory analysis. Samples collected for the analysis of potentially volatile chemicals will be placed in appropriate sample containers immediately after retrieval to minimize volatilization. Aquatic organisms, large rocks, and debris will be removed from the sample and noted in the field notes.

Decontamination of the sampling device and field equipment will take place between sample stations in accordance with SOP 1.

SCOPE AND APPLICATION

This standard operating procedure (SOP) describes the practices for locating underground utilities. Refer to the MFA Health and Safety Plan (HASP) for additional information regarding communication procedures when an inadvertent utility strike occurs, and methods for mitigating hazards during a utility strike.

EQUIPMENT AND MATERIALS REQUIRED

The following materials are necessary for this procedure:

- Personal protective equipment (as specified in the HASP)
- Marking materials (e.g., marking paint, stakes, flags)
- Field documentation materials

METHODOLOGY

When the project-specific sampling and analysis plan (SAP) specifies additional or other requirements for underground utility locates, it takes precedence over this SOP. In the absence of a SAP, the procedures in this SOP shall be used.

Before Conducting Utility Locates:

- Ensure the locate will be conducted reasonably soon before the excavation work begins, e.g., within 48 hours. There may be project-specific conditions, e.g., weather and/or ground features that could cause markings to fade, which would require the excavation work to be scheduled sooner than 48 hours after the locate.
- Clearly define the boundary of the work and the locations of all proposed excavations. Prepare a map of the project area showing the excavation locations.
- Interview site managers/property owners and obtain plans or drawings showing on-site utilities, if available.
- For project work that will not occur within the public right-of-way, ensure that the nearest public right-of-ways to the project are identified and communicated during the one-call notification.
- Identify the township and range of the project area. This information can be easily attained by a quick email to MFA's GIS Exchange.
- If feasible, conduct a site visit to identify site conditions that could cause marking paint to fade or be disrupted. Such conditions could include gravel or ground sensitive to erosion and high traffic areas.
- Check the weather forecast to assess the potential for snow or rain to make marking utilities difficult or cause the markings to fade.

One-Call Utility Notification:

- If possible, initiate the one-call utility notification at least one week before to the proposed work.
- Include a map or GPS coordinates when submitting the notification.
- Confirm with each public utility that the utility locate is complete before conducting any excavation activities.
- On remote or complicated sites consider meeting public locators on site.
- Document the one-call ticket number and results in the project files.
- Provide the one-call ticket number to subcontractors who will be doing the excavations.

Private Utility Locate:

- Conduct the private utility locate only after confirmation that the public utility locate has been completed and all public utilities have been marked and the results reviewed by MFA staff who will be overseeing the excavations.
- Meet the private locator on site and participate in the entire private utility locate. Be engaged in the process, ask questions, and take time to walk the site thoroughly with the locator.
- Bring a copy of the one-call utility ticket and results of the one-call utility locater to check against the utility markings on the ground.
- If possible, have a site/property representative knowledgeable of on-site utilities participate in the private utility locate.
- If paint alone may not suffice to ensure clear marking of utilities, add vertical markers such as stakes or flags.
- Visually assess the area of the proposed excavation(s) to identify features potentially indicative of buried utilities. Have the private utility locator examine each feature identified below to assess the presence of buried utilities.
    - Examine adjacent public right-of-ways where public utilities have been marked for evidence of utilities that may extend onto the project site.
    - Identify nearby light poles, telephone poles, electrical utility poles, or other overhead utility poles with wires or conduct that run from the overhead utility, down the pole, and into the ground.
    - Identify the location of gas meters, water meters, or other above-ground junction boxes for evidence of utilities extending from the features into the ground.
    - Examine asphalt and concrete ground surfaces for discontinuities in the surface indicative of utility installations. Discontinuities may include recent patches of asphalt or concrete inlaid within older concrete or asphalt surface.
    - Identify manholes and catch basins indicative of buried storm or sanitary sewer pipes. Open manholes to examine the orientation of associated pipes to assess whether the utilities may be present near proposed excavations.
    - Identify tank ports or vent pipes.
    - Identify irrigation systems and associated features such as valve boxes and controllers.
    - Identify any other signs indicating the presence of buried utilities.
    - Be wary of utility marks that suddenly begin or dead end.

Preparing to Perform Subsurface Activities after a Locate:

- Ensure the markings are still visible when the work begins.
- Adjust locations, as needed, to avoid identified utilities, or use alternative methods such non-mechanical excavations means (i.e., manual excavation or air-knifing) to a minimum depth of 5 feet.

Table

APWA UNIFORM COLOR CODE[1]

	WHITE - Proposed Excavation
	PINK - Temporary Survey Markings
	RED - Electric Power Lines, Cables, Conduit and Lighting Cables
	YELLOW - Gas, Oil, Steam, Petroleum or Gaseous Materials
	ORANGE - Communication, Alarm or Signal Lines, Cables or Conduit
	BLUE - Potable Water
	PURPLE - Reclaimed Water, Irrigation and Slurry Lines
	GREEN - Sewers and Drain Lines

[1]Uniform Color Codes, ANSI Standard Z535.1. American Public Works Association. Revised 1999.