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Memorandum

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Subject	**Initial Investigation Work Plan Addendum**
Project Name	BNSF Wishram Railyard (Ecology Site Name BNSF Track Switching Facility), Wishram, Washington
Attention	Shane DeGross, BNSF Railway Company
From	Carrie Andrews, Jacobs Engineering Group Inc. (Jacobs)
Date	May 30, 2019

1. Introduction

This Initial Investigation Work Plan Addendum (Work Plan Addendum) presents the scope of work for supplemental sediment investigation activities throughout the expanded study area adjacent to the BNSF Railway Company (BNSF) Wishram Railyard (site), in Wishram, Washington (Attachment 1, Figure 1-1). Petroleum sheening and non-aqueous phase liquid (NAPL) droplets have been observed occasionally along an approximately 300-foot stretch of the Columbia River adjacent to the railyard (Attachment 1, Figure 1-2) (Ecology, 2017). Initial investigation activities identified a NAPL-impacted organic-rich fill interval within the inundated lands between 40 and 130 feet south of the current rip-rap shoreline. Data and observations suggest decaying organic matter associated with the submerged fill and the resulting ebullition are the cause of the observed sheens. While a sample of surface sediments exceeding criteria was identified and the general location of the submerged NAPL was visually assessed, additional data are required as part of the site identification process described in Chapter 2 of the Sediment Cleanup User's Manual II: Guidance for Implementing the Cleanup Provisions of the Sediment Management Standards, Chapter 173-204 WAC (SCUM II) (Ecology, 2015).

The purpose of the investigation described in this Work Plan Addendum is to refine the vertical and lateral extent of NAPL-affected materials, further characterize the surface sediments across the study area, and assess the leaching potential of NAPL-related constituents. This supplemental investigation for the Inundated Lands area will be performed in accordance with the Ecology Model Toxics Control Act (MTCA) regulations published in Washington Administrative Code (WAC) 173 340 (Ecology, 2007) and the cleanup provisions of the Sediment Management Standards (SMS) under WAC 173 204, as described in SCUM II (Ecology, 2015). This work plan addendum serves to supplement the approved Initial Nearshore Sediment Investigation Work Plan (CH2M, 2018) by providing updates to details on the proposed additional scope items and related means and methods that are unique to this work. Updates to the relevant components of the original work plan, including but not limited to the Sampling and Analysis Plan (SAP) (CH2M, 2018; Appendix A) have been included herein and are referenced below.

1.1 Site and Area of Interest

Wishram is in Klickitat County, Washington, approximately 13 miles northeast of The Dalles, Oregon, and 0.75 mile south of Washington State Route 14, within the southwestern quarter of Section 17, Township 2 north, Range 15, east of the Willamette Meridian. A detailed description of the Wishram Railyard site is included in the Initial Nearshore Sediment Investigation Work Plan (CH2M, 2018).

The area of interest associated with this work includes a 360 foot stretch of inundated lands adjacent to the railyard that extends approximately 220 feet south of the riprap shoreline. The southern extent of this area of interest coincides with a drop off in depth as the sediment surface transitions from approximately an 8-percent grade to 20-percent grade. Depths here range from approximately 25 to 30 feet below the water surface. Prior to 1957 this portion of Lake Celilo represented exposed lands adjacent to a free-flowing Columbia River that was 40 to 50 feet lower than the railyard. Following the construction of The Dalles Dam in 1957 the river was impounded and Lake Celilo was formed. The former and current shorelines and prominent site features believed to have existed during some portions of the time between 1910 and the present are shown on Figure 1-3 (Attachment 1) relative to the proposed study area.

1.2 Project Objectives

The purpose of the supplemental sediment investigation is to refine the horizontal and vertical delineation of submerged NAPL and characterize surface sediment throughout and beyond those areas where NAPL is present. The characterization CSM provided in the Initial Sediment Investigation Report (Jacobs, 2019) will be updated in support of the evaluation of potential remedial alternatives for the site.

2. Characterization Stage Conceptual Site Model

This report will use the CSM terminology recommended by EPA in *Environmental Cleanup Best Management Practices: Effective Use of the Project Life Cycle Conceptual Site Model* (EPA, 2011). This terminology is intended to allow the CSM to be refined as additional data are collected. The CSM stages identified are listed below:

1. Preliminary CSM Stage – Project milestone or deliverable based on existing data; developed prior to systematic planning to provide fundamental basis for planning effort.
2. Baseline CSM Stage – Project milestone or deliverable used to document stakeholder consensus/divergence, identify data gaps, uncertainties, and needs; an outcome of systematic planning.
3. Characterization CSM Stage – Iterative improvement of CSM as new data become available during investigation efforts; supports technology selection and remedy decision making.
4. Design CSM Stage – Iterative improvement of CSM during design of the remedy; supports development of remedy design basis and technical detail.
5. Remediation / Mitigation CSM Stage – Iterative improvement of CSM during remedy implementation; supports remedy implementation and optimization efforts, provides documentation for attainment of cleanup objectives.
6. Post Remedy CSM Stage – Comprehensive site physical, chemical, geologic, and hydrogeologic information of CSM supports reuse planning; documents institutional controls and waste left on site; and other key site attributes.

Figure 2-1 (Attachment 1) presents the inundated lands Characterization Stage CSM which was developed by updating the Baseline CSM presented in the Ecology-approved work plan (CH2M, 2018) with the information collected during the Initial Sediment Investigation as well as any relevant findings associated with recent upland investigations. The key components of the Characterization Stage CSM are as follows:

- A black, tacky, viscous NAPL consistent with heavy fuel oil (Bunker C) is present within a distinct 2- to 4-foot-thick fill layer beneath 0.5 to 2.5 feet of generally unimpacted river sediments. This fill layer exhibits little soil structure and significant organic debris and was likely emplaced during grading and filling in upland areas subsequently inundated by the creation of Lake Celilo.
- Occurrences of NAPL within the inundated lands have been observed between 40 and 130 feet south of the current riprap shoreline and appear isolated from upland impacts. Observations for the shoreline upland boreholes, and cores and Darts immediately south of the riprap, show no evidence of NAPL-impregnated soil or sediment in these areas. Of the seven samples collected within the nearshore area and analyzed for total petroleum hydrocarbons diesel range organics (TPH-DRO) and

residual range organics (-RRO) and polycyclic aromatic hydrocarbons (PAHs), only one location had a detection above the Washington Freshwater Sediment Cleanup Objectives (SCO). This was for TPH-DRO in the non-silica gel treatment/cleanup (SGC) sample at location D200 (Figure 1-4). However, the average of the three highest TPH-DRO results across the nearshore area are below the Washington Freshwater Cleanup Screening Level (CSL). TPH-RRO and total PAHs were below their respective SCOs and CSLs in all surface sediment samples from the nearshore area.

- Within the offshore area concentrations of TPH-DRO and TPH-RRO were found at core location J260 (Figure 1-4) in excess of the SCO for both TPH-DRO (340 mg/kg) and TPH-RRO (3,600 mg/kg). This surface sediment sample, collected from 0 to 0.5 foot, was immediately adjacent to an occurrence of the NAPL impacted fill layer that was observed to extend from 0.5 foot to 4 feet below the sediment surface.
- Sheen and odor are observed in nearshore upland soil cores, but these are considered less significant indicators of a NAPL discharge. Furthermore, hydraulic studies performed as part of recent upland work have shown that the river is predominantly a losing water body in which groundwater flows away from the river approximately 10 out of 12 months of the year.
- Observations of sheens at distances of up to 130 feet south of the shoreline and the direction of their movement at the surface toward the shoreline indicates they are originating not from the shoreline, but from the submerged NAPL present farther from shore. This is consistent with the absence of any direct observations of sheens originating along the riprap shoreline.
- Testing of these NAPL-impacted sediments indicates there is no direct hydraulic mobility of NAPL, which is consistent with its viscous and tacky nature. Observations of gas bubbles within the water column, their proximity to the submerged NAPL and outboard extent of observed sheens, as well as the estimates of elevated gas generation potential associated with the sediments collocated with NAPL indicate ebullition is the primary mechanism responsible for the sheens.
- Consistent with the ebullition process, the rate of gas bubble generation and the abundance of sheens appear to increase during periods of lower water observed during the August 2018 field efforts. Analysis of sediment samples indicates the surface sediment has high ebullition potential based on the naturally occurring organics in the inundated lands.

Based on these observations, the characterization stage CSM identifies the source of the sheens observed in offshore inundated lands historically associated with the railroad is likely the isolated NAPL that has been found to be between 0.5 to 2.5 feet below the sediment surface (ft bss) within the submerged fill layer. The intermittent sheening observed is the result of ebullition, with the gases developed by the decaying organic matter associated with the submerged fill. A greater abundance of gas bubbles and sheening occurs during periods of low water and when the temperature of the sediments rises. A combination of the winds and current carry the sheens toward the shoreline where they are seen most often from the shoreline and where globules have been observed to accumulate during relatively warm and calm weather conditions.

3. Project Approach

The data quality objectives (DQOs) for the supplemental investigations will remain consistent with those originally detailed in Section 5 of the approved Nearshore Sediment Initial Investigation Work Plan (CH2M, 2018). However, based on the initial investigation results generated to date, the boundaries of the initial study have been modified to focus on the offshore portions of the inundated lands area south of the railyard (Figure 1-2, Attachment 1). The approach for the supplemental sediment investigation includes the following components:

1. Characterization of the lateral and vertical distribution of the submerged NAPL, including confirmation that the NAPL present in the inundated lands is physically separated from the shoreline and upland areas.
2. Characterization of the lateral distribution of NAPL-related constituents (TPH-DRO, TPH-RRO and total PAHs) in surface sediments, whether they represent an adverse risk to benthic organisms and what their potential for dissolution is.

3. Refine the characterization stage CSM based on interpretation of the supplemental sediment investigation data.

Due to the isolated nature of the submerged NAPL impacts identified beneath the river, the dissolved phase impacts in groundwater that have been identified at the shoreline and that are resulting from separate upland sources will be addressed as part of the upland RI/FS.

This work plan describes the approaches and procedures for completing the tasks listed above. Where applicable, components of the Initial Sediment Investigation Work Plan (for example, Sampling and Analysis Plan and Health and Safety Plan), to which this document serves as an addendum, have been updated to cover these additional tasks. The following subsections provide information on the project team and stakeholders, project deliverables, and schedule for completion of the supplemental sediment investigation.

3.1 Project Team and Stakeholders

The project team is composed of BNSF project management staff and Jacobs (formerly CH2M HILL Engineers, Inc.) and Kennedy/Jenks Consultants scientists and engineers, as depicted in Table 3-1. Work will be performed in coordination with Ecology.

Table 3-1. Project Team

Company/Agency	Personnel	Responsibility
BNSF Railway Company	Shane DeGross	Manager Environmental Remediation
Washington State Department of Ecology	John Mefford	Cleanup Project Manager
	Chris Wend	Assistant Cleanup Project Manager
Kennedy/Jenks Consultants	Ryan Hultgren	Project Manager
	Todd Miller	Program Manager
	Alice Robinson	Field Lead/Site Safety Coordinator
Jacobs	Carrie Andrews	Senior Project Manager
	Jeff Gentry, PE	Senior Technical Consultant
	Marilyn Gauthier, PG	Subject Matter Expert, Geology and Sediment
	David Finney	Subject Matter Expert, NAPL
	Jeff Schut	Subject Matter Expert, Ecological Risk/Bioassay
	Jennifer Ulrich	Field Sampling Lead/Site Safety Coordinator
	Bernice Kidd	Project Chemist/Data Validation

3.2 Project Deliverables

The deliverables associated with the supplemental sediment investigation include the Initial Sediment Investigation Work Plan (CH2M, 2018), the Initial Sediment Investigation Report (Jacobs, 2019), this work plan and its associated attachments, and a technical report documenting the results of the investigation. It is expected that the findings of the investigation will be used to determine if the characterization stage CSM is adequate for use in a feasibility study for the inundated lands.

3.3 Schedule

The project schedule will be coordinated once the Work Plan Addendum is approved. The actual schedule may vary depending on field conditions (including weather), subcontractor availability, and a variety of other factors. A tentative project schedule is provided in Table 3-2.

Table 3-2. Tentative Project Schedule

Date	Task
May 2019	Submit Sampling and Analysis Plan to Ecology
3rd and 4th Quarter 2019	Phase 1 - Conduct TarGOST Profiling and Analysis
	Phase 2 - Surface and Subsurface Sediment Characterization
4th Quarter 2019	Complete Laboratory Analyses of Sediment Samples
1st or 2nd Quarter 2020	Submit Sediment Investigation Report to the Ecology for Review
1st or 2nd Quarter 2020	Submit Sediment Investigation Report and Data to Ecology in EIM System

Notes:

Ecology = Washington State Department of Ecology
EIM = Environmental Information Management System

4. Project Tasks

4.1 Field Activities

Supplemental investigation field activities will be conducted in two phases. The findings of Phase 1 will be used to refine the sampling design for Phase 2. A summary of the sampling and analysis to be performed as part of the supplemental investigation work is provided in Table 4-1. Additional details related to this work are provided in the Sampling and Analysis Plan (SAP) (CH2M, 2018; Appendix A) and the updated relevant SAP components provided in Attachment 2.

Table 4-1. Sampling and Analysis Summary for Supplemental Sediment Investigation

Work Plan Element	Number of Locations	Analysis			
		Depth (ft bss)	Quantity	Type	Rationale
Characterization of NAPL Extent	18+	Up to 30 feet	--	TarGOST Profiling	Establish lateral and vertical extent of NAPL
DPT Sediment Cores	6	Up to 30 feet	6	Core logging and field observation Particle size distribution	NAPL delineation confirmation; characterization of subsurface lithology
		Two depths, 6 to 12 inches and sampler discretion[a]	8	Leaching of TPH-diesel, TPH-residual, and PAHs (SIM)	Assess potential for the dissolution of NAPL constituents
Surface Sediment Samples	10	0 to 6 inches	10	TPH-diesel	Chemical characterization of surface sediment to support sediment cleanup site identification
				TPH-residual	
				Total PAH	
				Grain size	Physical characterization of surface sediment to support sediment cleanup site identification
				TOC	

Table 4-1. Sampling and Analysis Summary for Supplemental Sediment Investigation

Work Plan Element	Number of Locations	Depth (ft bss)	Analysis		Rationale
			Quantity	Type	
			1	Bioassays[b,c]	Collect and hold sample for possible bioassays (Figure 4-2[Attachment 1])

[a]Samples will be collected from the top 6-12 inch interval and at depths with visually identified NAPL impacts.

[b]Bioassays will only be performed in the event that all concentrations of chemicals of concern are greater than or equal to the SCO and the average of the three highest measured concentrations for each chemical of concern is greater than the CSL (Figure 4-2 [Attachment 1]).

[c]Bioassay test sediment samples will be collected from a location beyond and upstream (to the east) of extent of the NAPL-affected surface sediments impacts based on TarGOST screening and confirmed through surface sediment sampling results

Notes:

CSL = cleanup screening level
DPT = direct-push technology
L/S = liquid to solid ratio
NAPL = nonaqueous phase liquid
PAH = polycyclic aromatic hydrocarbon
SCO = sediment cleanup objective
SIM = selective ion monitoring
TarGOST = Tar-specific Green Optical Screening Tool
TOC = total organic carbon
TPH = total petroleum hydrocarbons
UV = ultraviolet
UVOST = Ultraviolet Optical Screening Tool

4.1.1 Phase 1 – Characterization of NAPL Extent

To characterize the vertical and lateral extents of the submerged NAPL that has been observed in the offshore area, continuous sediment/soil profiling will be conducted at a minimum of 18 locations across the Study Area using Dakota Technology's Tar-specific Green Optical Screening Tool or TarGOST. TarGOST is a laser-induced fluorescence (LIF) tool developed specifically for the detection of higher molecular weight NAPL contamination (both free- and residual phase). The TarGOST system is used as an in-situ evaluation tool that is advanced using a direct push technology (DPT) drilling rig and provides real-time, semi-quantitative graphical data of the vertical distribution of NAPL saturation in the subsurface. Fluorescence responses are recorded as a percentage of a fixed calibration standard or reference emitter (RE). An example TarGOST log and additional information on the output is provided in Attachment 3.

TarGOST has previously been used in upland portions of the Wishram Railyard. In addition, NAPL-containing sediment cores collected from within the inundated lands area during the initial sediment investigation were scanned at Dakota Technology's facility using TarGOST. The results of these scans indicated peak TarGOST fluorescence responses of between 55 and 229 percent of the reference emitted (%RE) for soils where NAPL saturations were measured to range between 3 and 42 percent pore volume (%PV) (Jacobs, 2019). This work demonstrated the effectiveness of TarGOST at identifying the NAPL that is present in the offshore area.

The LIF/TarGOST equipped DPT unit will be mounted on a spudded barge and the investigation will begin at locations of known NAPL impacts (for example, G200 and G260). Up to six planned TarGOST borings will be extended to a depth of 30 feet bss or refusal, whichever occurs first. These locations will include select locations along the northernmost line of proposed borings as well locations farther offshore within the known NAPL area. Once the elevation of the base of the NAPL-affected interval has been established, the remaining borings may be shortened to depths that are equivalent to the deepest observed TarGOST response indicating the presence of NAPL plus 3 feet. The work will progress from the inside/out to cover and extend beyond the area of observed NAPL. The six primary locations on the E grid line shown on Figure 4-1 will serve to confirm the absence of nearshore NAPL and isolation of the submerged NAPL that is present farther offshore within the inundated lands.

If needed and to the extent practicable additional TarGOST profiles beyond those shown on Figure 4-1 (Attachment 1) will be completed at a spacing of approximately 40 feet to establish the lateral and vertical extents of NAPL. The grid shown on Figure 4-1 (Attachment 1) will be used as a guide to assist in identifying step out locations. Given the results of the ex-situ TarGOST scanning completed by Dakota Technologies a TarGOST fluorescence response threshold of 50 %RE will be used initially in the field to inform the need for further step-outs. It should however be noted that this threshold was developed using ex situ measurements, which may vary from those seen in situ. This threshold may ultimately be revised based on the results of this investigation, and the observed waveform response of the in-situ tooling in areas/intervals of known NAPL presence.

4.1.2 Phase 2 - Surface and Subsurface Sediment Characterization

Phase 2 consists of collecting and analyzing surface and subsurface sediment samples across the study area to:

- Confirm TarGOST results (Phase 1) and characterize the stratigraphy and lithology
- Determine the magnitude and extent NAPL-related constituents in surface sediment and whether affected surface sediments represent an adverse risk to benthic organisms
- Assess the potential for the dissolution of submerged NAPL-related constituents within and at periphery of NAPL affected area

A brief description of sampling activities designed to support these objectives are provided below and summarized in Table 4-1. Additional information is provided in the SAP and its updated components provided in Attachment 2 and referenced below.

Confirmatory Sediment Borings. Following review of the results of the TarGOST profiling, up to six sediment cores will be collected using direct-push technology to confirm TarGOST results and allow for the characterization of stratigraphy across the study area. Cores will be advanced adjacent to TarGOST locations where NAPL is suspected (up to 4 locations) as well as those where it is not suspected (up to 2 locations). In general, borings will be advanced to five feet below the base of the NAPL impacts as indicated in the collocated TarGOST, or to 15 feet bss (where suspected impacts are not present). However, at two locations where deeper TarGOST profiles were advanced (up to 30 ft bss; see above), a final depth of 30 ft bss will also be targeted to allow for the characterization of deeper stratigraphy. At each sediment core location. Cores will be continuously logged and screened using visual, olfactory, and photo-ionization detector observations to confirm NAPL presence or absence at each location. At each core location samples will be collected from each distinct stratigraphic unit for grain-size analysis. Advancement, logging and screening of the sediment borings will be performed in accordance with the Standard Operating Procedures (SOPs) provided as Attachment 2 of the SAP (CH2M, 2018; Appendix A).

Surface Sediment Samples. Surface sediment samples will be collected from the upper 4 to 6 inches of sediment, which for the purpose of the initial investigation is assumed to be the biologically active zone. A total of ten surface sediment samples will be collected from within and beyond the NAPL footprint as established during Phase 1. It is estimated that a total of 5 samples will be collected within the area of impact while another 5 samples will be collected from the areas outside and to the east, west and south (outboard) of the NAPL-affected sediments footprint. The samples will be collected and processed in accordance with the SOP for Surface Sediment Sampling provided as Attachment 3 of the SAP. Samples will be collected using a Van Veen or similar device deployed from a boat. The samples will be analyzed for TPH-DRO, TPH-RRO total PAHs with SIM, total organic carbon (TOC), and grain size distribution using the methods listed in the updated SAP Table 3-2 provided in Attachment 2. A 4-liter portion of each surface sediment sample will be held at the laboratory to be used for bioassays, if chemical analytical results indicate exceedances of SMS criteria. Descriptions of potential bioassay sampling and testing protocols are provided in the SAP (CH2M, 2018; Appendix A).

Sediment Leaching Samples. To assess the potential for the dissolution of NAPL-related constituents from sediments within and at the periphery of the NAPL affected area, 6 to 12-inch intervals of sediment will be collected for leaching analysis using EPA Method 1316 (EPA, 2017) from up to 4 sediment boring locations. . Method 1316 provides liquid-to-solid partitioning behavior of the tested constituents as a function of the liquid to solid ratio (L/S) using a parallel-batch approach. As described in Method 1316, "the eluate concentrations at a low L/S provide insight into pore solution composition either in a granular bed (e.g., soil column) or in the pore space of low-permeability material (e.g., solidified monolithic or compacted granular fill)". . Sampling will occur concurrently with the confirmatory sediment boring collection described above. At two locations within the extent of NAPL one sample will be collected from the NAPL-impacted interval and one from the top 6 to 12 inches of the sediment core. At two locations beyond the NAPL-affected area, samples will be collected from the top 6-12 inches of the core and from the interval at elevations similar to those where the NAPL was observed within the impacted area. The resulting leachate will be analyzed for TPH-DRO, TPH-RRO and PAHs with selective ion monitoring (SIM). The target analytes, as well as the containers, preservation requirements, and holding times, are listed in updated SAP Table 3-2, included in Attachment 2. If the required sample volume cannot reasonably be achieved from the recovered core material samples from the top 6 to 12 inch intervals may be collected using the surface grab sampling methods as described above.

The eluate concentrations will be used to help evaluate the degree to which leaching of NAPL constituents could potentially be occurring in the vicinity of the affected area, and will enable the assessment of technologies that could be used to address the NAPL if needed.

4.2 Laboratory Analyses and Data Validation

TarGOST, sediment, and other media samples will be submitted under chain-of-custody protocols to the subcontracted laboratories and will be analyzed on a standard turn-around basis. Sample handling, packing, shipping procedures, and data validation procedures are identified in the SAP (CH2M, 2018; Appendix A). Analytical methods, containers, and holding times are provided in updated SAP Table 3-2, included in Attachment 2.

4.3 Data Evaluations and Reporting

During Phase 1, TarGOST data will be reviewed daily by the project team to evaluate if and where further step-out locations may be required to bound the extent of NAPL. Professional judgement will be used by the project team to assess the appropriate fluorescence response threshold and waveforms associated with in situ NAPL using collocated sediment core log observations collected during the initial sediment investigation. BNSF, or Jacobs at the direction of BNSF, will communicate to Ecology the status of step out borings.

Phase 1 of the field investigation will be followed by data evaluation and consultation with the project team to determine the confirmatory sediment boring and surface sediment sampling locations that will provide the necessary coverage both within and adjacent to the estimated extent of NAPL impacts. BNSF or Jacobs at the direction of BNSF will communicate to Ecology the sample locations.

Following the completion of both Phase 1 and Phase 2 activities, the TarGOST data will be presented in table format relative to visual observations, any relevant laboratory data, and observed presence of NAPL or other fluorescent materials will be used to refine the threshold that is appropriate for depicting the extent of NAPL. The TarGOST response data will be processed using a 3D interpolation software program. The model output will be used to depict those areas that exceed an established response threshold. These depictions will be translated in cross sectional view or plan view which will be included in a comprehensive Sediment Investigation Report for the Inundated Lands.

The Sediment Investigation Report for the Inundated Lands will document the investigative approach, data, conclusions, and recommendations based on this investigation as well as any relevant data from prior investigations. In accordance with WAC 173-204-510 through 520 and as described in Chapter 2.2 of SCUM II, the collective data set will be used to identify any station clusters of low or potential concern. This process is illustrated generally on Figure 4-2 (Attachment 1).

The Sediment Investigation Report will present an updated Characterization Stage CSM and outline the approach for satisfying any remaining reporting requirements for completing an RI/FS for the inundated lands in accordance with Chapter 3 of SCUM II (WAC 173-204-510 and 173-204-520).

5. References

CH2M HILL Engineers, Inc. (CH2M). 2018. *Initial Nearshore Sediment Investigation Work Plan, BNSF Wishram Track Switching Facility, Wishram, Washington.*

CH2M HILL Engineers, Inc. (CH2M). 2019. *Initial Nearshore Sediment Investigation Report, BNSF Wishram Track Switching Facility, Wishram, Washington.*

U.S. Environmental Protection Agency (EPA). 2011. *Environmental Cleanup Best Management Practices: Effective Use of the Project Life Cycle Conceptual Site Model.* Office of Solid Waste and Emergency Response (5102G). EPA 542-F-11-011.

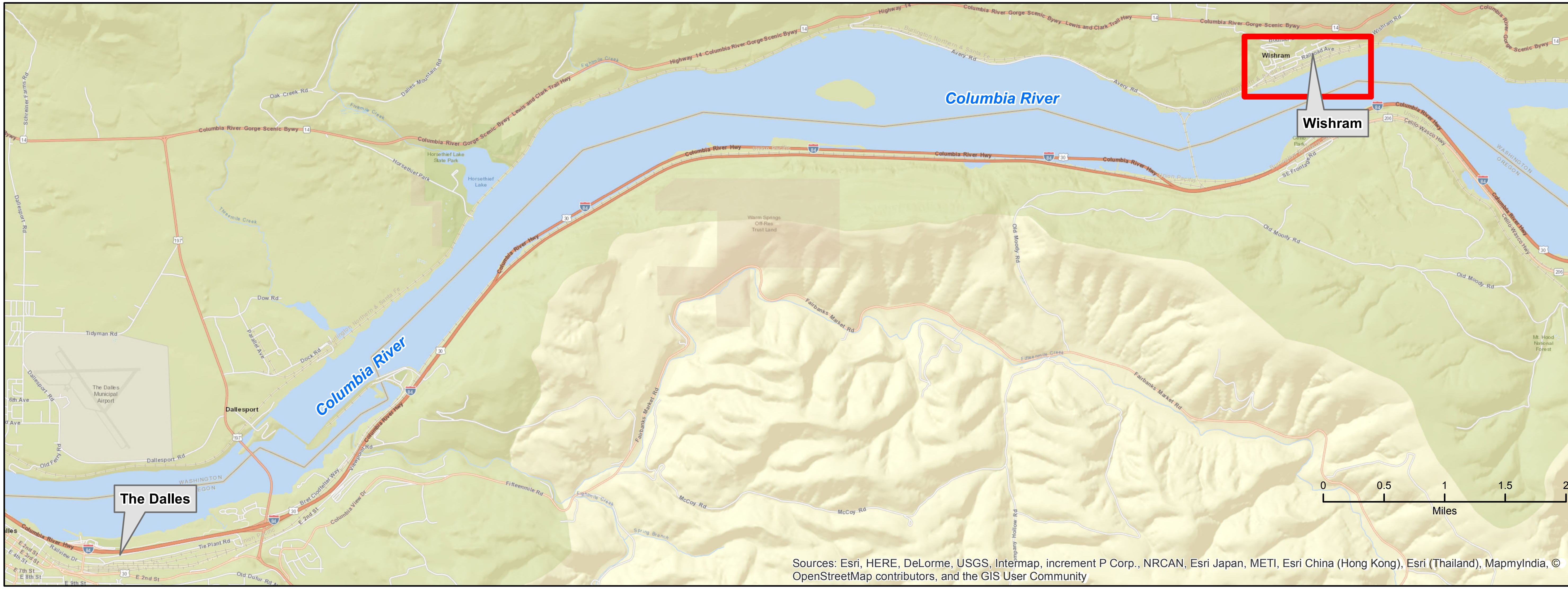
U.S Environmental Protection Agency (EPA). 2017. Liquid-solid partitioning as a function of liquid-to-solid ratio in solid materials using a parallel batch procedure. July.

Washington State Department of Ecology (Ecology). 2007. *Model Toxics Control Act Statute and Regulation. Washington State Department of Ecology. Publication No. 94-06*. November.

Washington State Department of Ecology (Ecology). 2015. *Sediment Cleanup User's Manual II: Guidance for Implementing the Cleanup Provisions of the Sediment Management Standards, Chapter 173-204 WAC.* Publication No. 12-09-057. March.

Washington State Department of Ecology (Ecology). 2017. Letter regarding *Data Gaps Investigation, BNSF Track Switching Facility aka Wishram Railyard*. March 3.

Attachment 1
Figures



N
0 375 750 1,500
Feet
1:9,000
1 inch = 750 feet

Figure 1-1. Site Location Map
BNSF Wishram Railyard
Wishram, Washington

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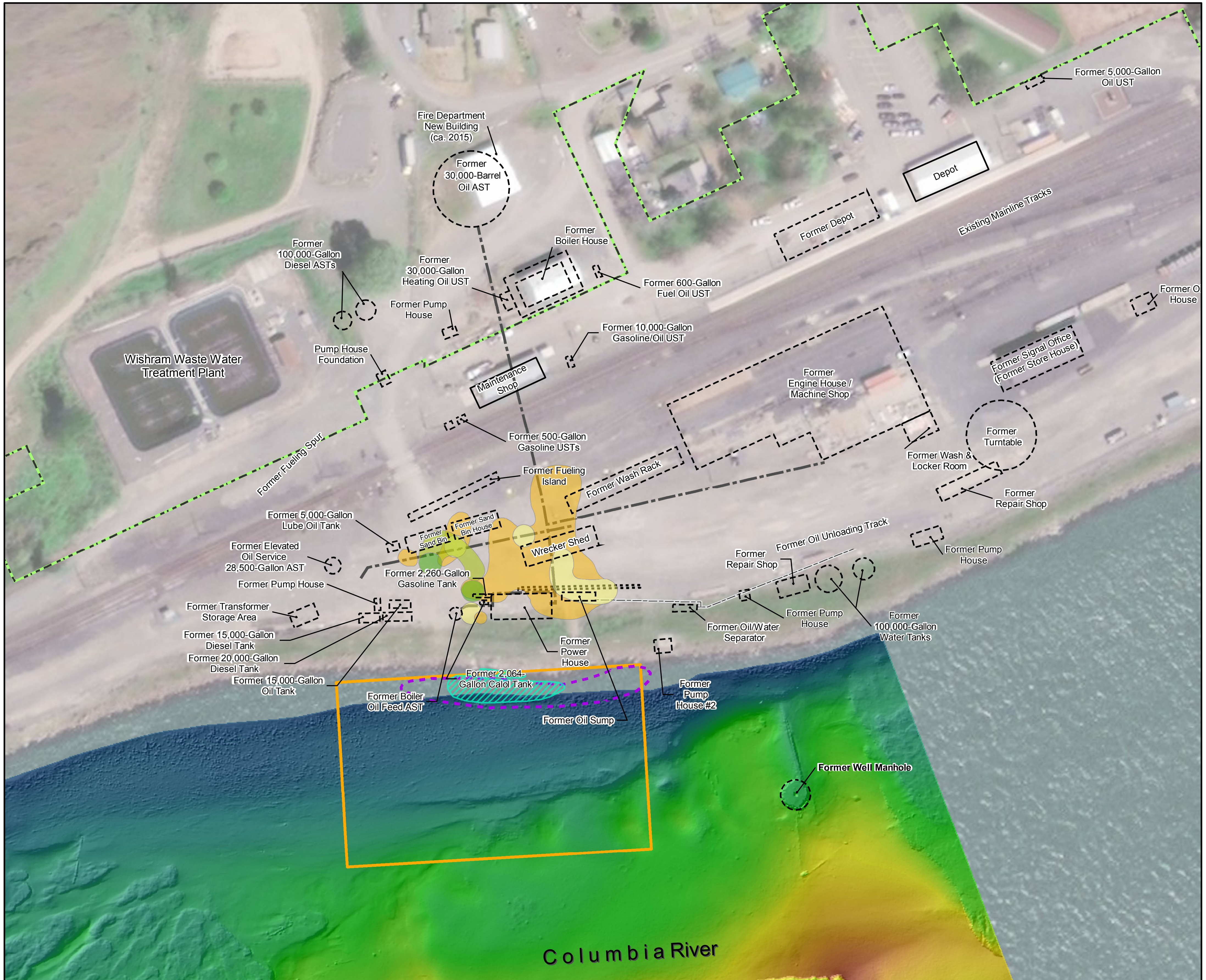

VICINITY MAP

LEGEND

- Existing Site Feature
- Former Site Feature
- Inferred Lateral Extent of Smear Zone Diesel Impacts
- Inferred Lateral Extent of Submerged Diesel Impacts
- Inferred Lateral Extent of Smear Zone Oil Impacts
- Inferred Lateral Extent of Submerged Oil Impacts
- Study Area
- Former Bunker Fuel / Oil Pipeline
- Former Oil Drain
- Former Oil Trough
- Former Sewer Line (Potential)
- Stormwater Underdrain
- Stormwater Underdrain
- Area of Intermittent NAPL Sheening
- Small-extent NAPL Sheens Observed (Ecology, 2017)
- Approximate BNSF Property Line

Bathymetry (ft NAVD88) (2017)

High : 158

Low : 93

Notes:
[1]Inferred lateral extent of Diesel- or Oil-Like LNAPL based on interpretation of LIF waveforms (July 2013) and soil boring logs (KJ, 2019).
ft = feet
NAPL = nonaqueous phase liquid
NAVD88 = North American Vertical Datum 1988
µg/L = microgram(s) per liter
MTCA = Model Toxics Control Act

N

0 62.5 125 250
Feet
1:1,500 1 inch = 125 feet

Figure 1-2. Wishram Railyard and Study Area
BNSF Track Switching Facility
Wishram, Washington

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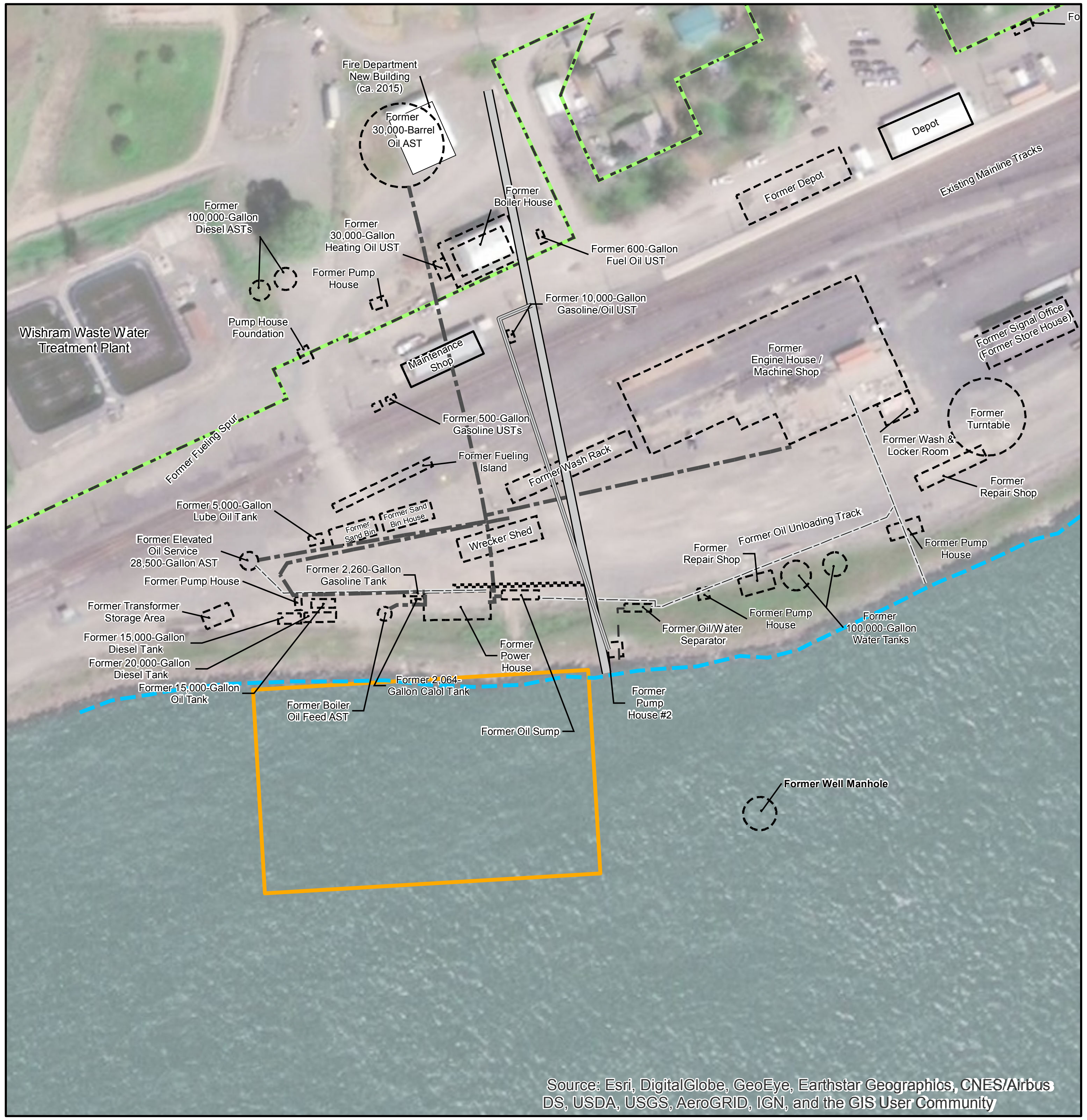
\\PDXFPP01\PROJ\BNSFRAILWAYCOMPANY\693282WISHRAMRIFS\GIS\MAPFILES\WORKPLANADDENDUM_MAR19\FIGURE1-2_RAILYARD_AND_STUDYAREA.MXD GGEE 3/25/2019 10:51:49

Current Features with Former Feature Footprints (Aerial Date: 2015)



Former Features (Aerial Date: 1951)

LEGEND

- Study Area
- Current Shoreline
- Former Bunker Fuel / Oil Pipeline
- Former Oil Drain
- Former Oil Trough
- Former Sewer Line (Potential)
- Stormwater Underdrain (A portion removed from service circa 1960)
- Stormwater Underdrain (Rerouted portion circa 1960)
- Approximate BNSF Property Line
- Former Site Feature

N

0 75 150 300
Feet
1:1,800
1 inch = 150 feet

Figure 1-3. Current and Former Site Features
BNSF Wishram Railyard
Wishram, Washington

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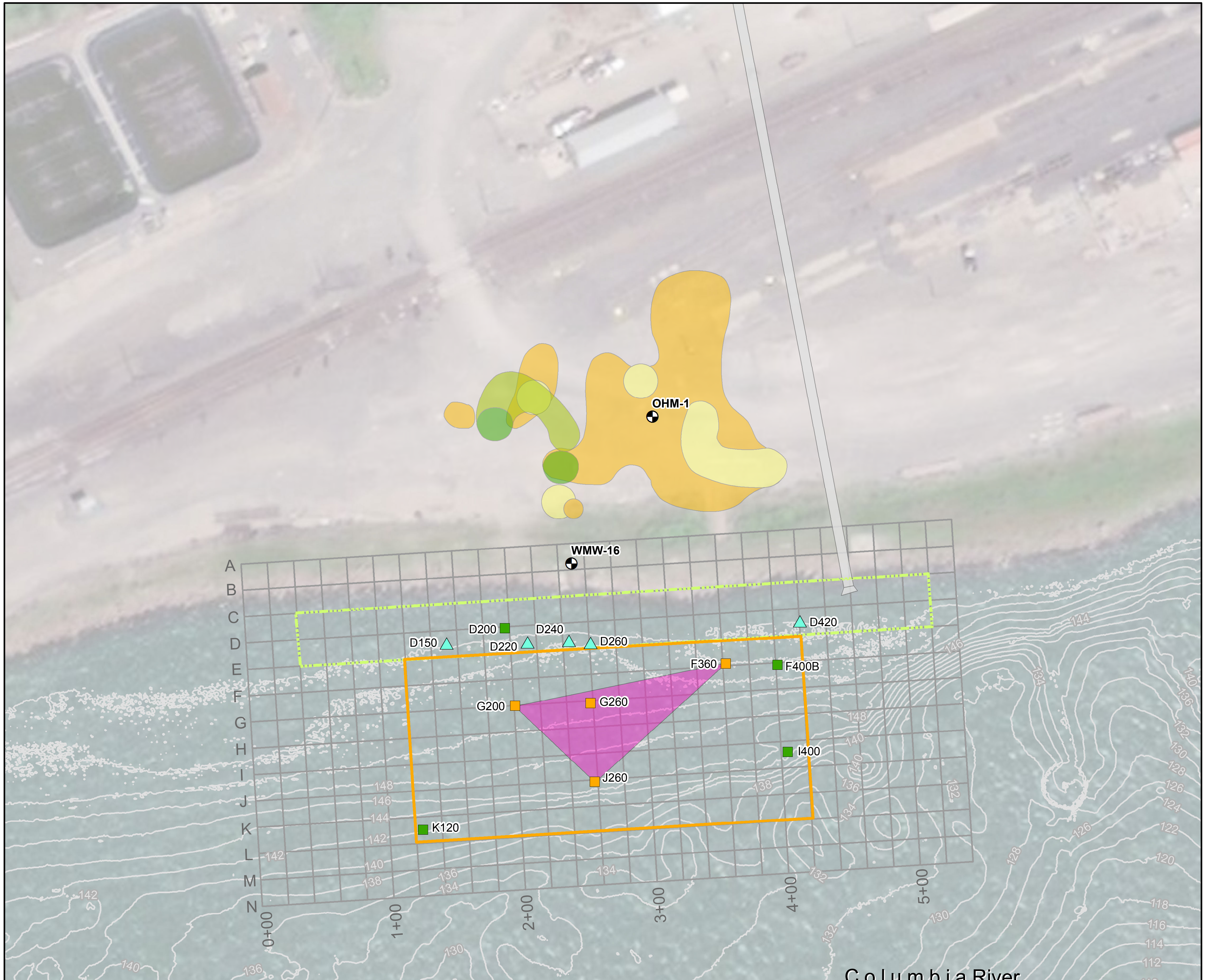
SLC \\PDXFPP01\PROJ\BNSFRAILWAYCOMPANY\693282WISHRAMRIFS\GIS\MAPFILES\WORKPLANADDENDUM_MAR19\FIGURE1-3_CURRENT_AND_FORMER_SITE_FEATURES.MXD GGEE 3/25/2019 10:59:30



VICINITY MAP

LEGEND

- Surface Sediment Grab Sample Location
- Core Location with NAPL Observed
- Core Location with no NAPL Observed
- Existing Monitoring Well
- Sampling Grid
- Initial Study Area
- Expanded Study Area
- Area of Observed Offshore LNAPL
- Inferred Lateral Extent of Smear Zone Diesel Impacts
- Inferred Lateral Extent of Submerged Diesel Impacts
- Inferred Lateral Extent of Smear Zone Oil Impacts
- Inferred Lateral Extent of Submerged Oil Impacts
- Bathymetric Contour (ft NAVD88, 2 ft Contour Interval)

Notes:
ft = feet
LNAPL = light nonaqueous phase liquid
NAPL = nonaqueous phase liquid

N

0 40 80 160
Feet
1:960 1 inch = 80 feet

Figure 1-4. Existing Surface Sediment Sampling and Core Locations
BNSF Wishram Railyard
Wishram, Washington

JACOBS

SLC \\PDXFPP01\PROJ\BNSFRAILWAYCOMPANY\693282WISHRAMRIFS\GIS\MAPFILES\WORKPLANADDENDUM_MAR19\FIGURE1-4_EXISITNG INVESTIGATION_LOCATIONS.MXD GGEE 4/25/2019 11:44:19

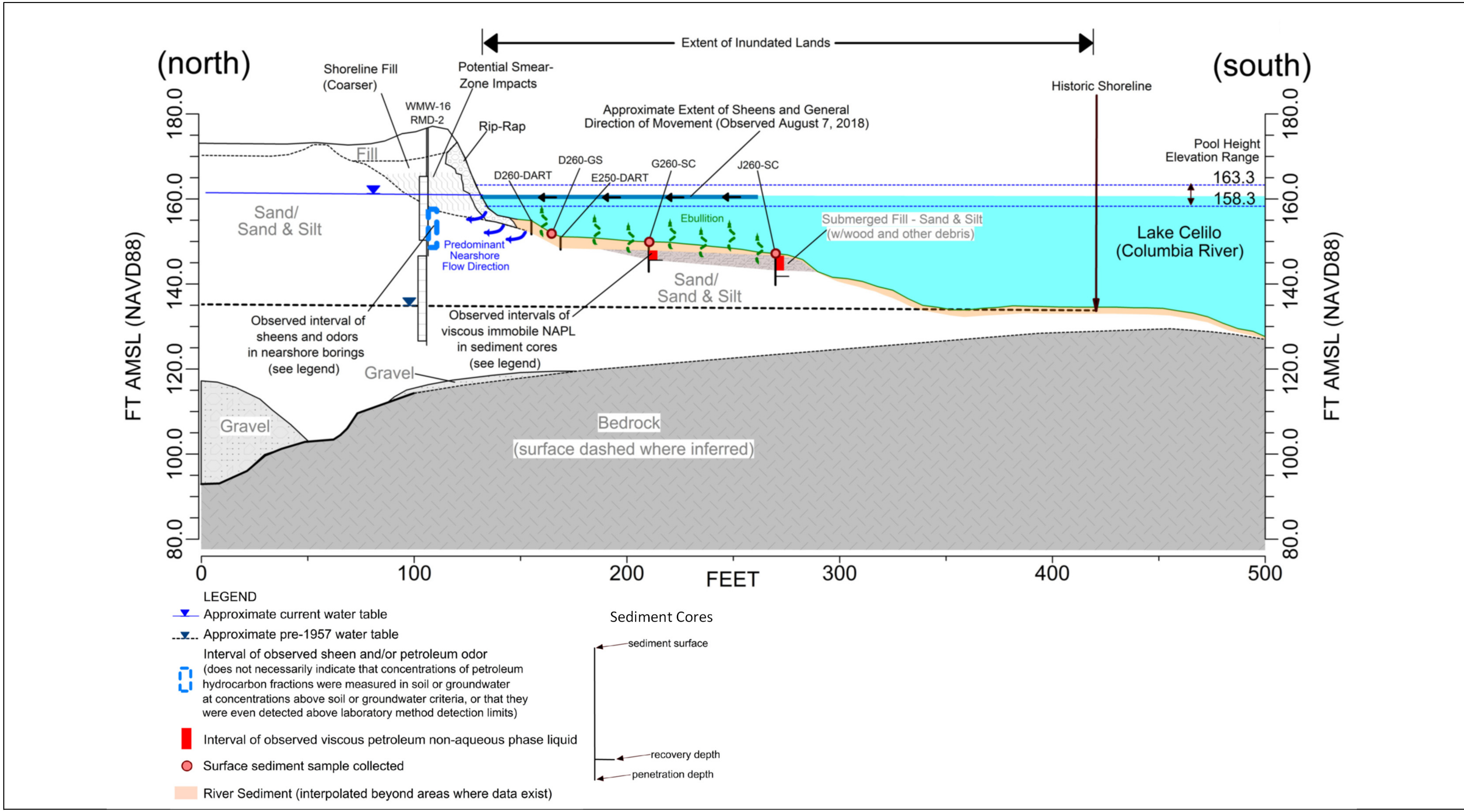
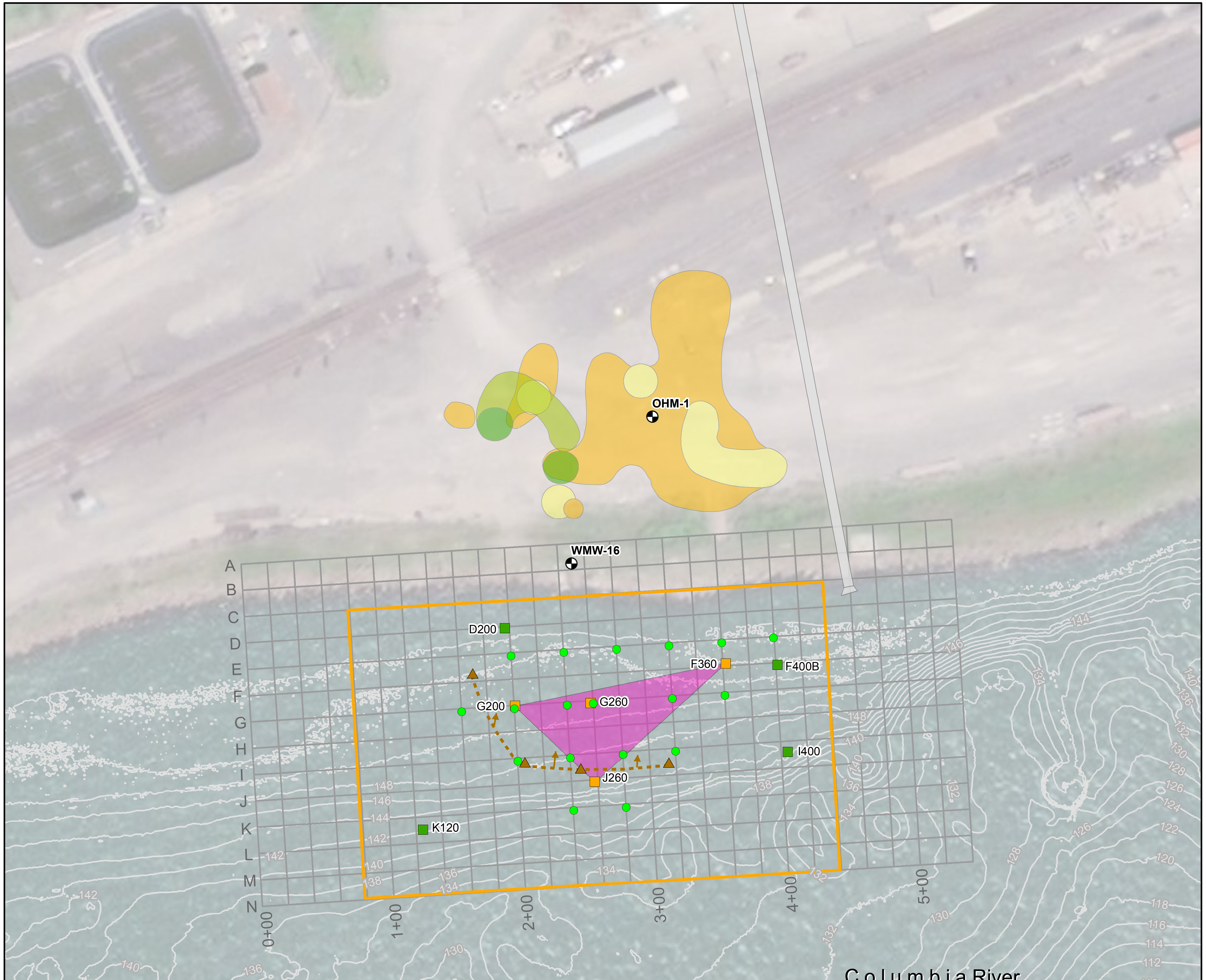


Figure 2-1. Nearshore/Offshore Conceptual Site Model

BNSF Wishram Railyard

Wishram, Washington

JACOBS



VICINITY MAP

LEGEND

- Proposed Primary TarGOST Locations
- Core Location with NAPL Observed
- Core Location with no NAPL Observed
- Location of Farthest Offshore Sheens Observed (August 7, 2018)
- Existing Monitoring Well
- Sampling Grid
- Study Area
- Southernmost Extent of Sheens Observed August 7, 2018 (Arrows Represent the Observed General Direction of Sheen Movement)
- Area of Observed Offshore LNAPL
- Inferred Lateral Extent of Smear Zone Diesel Impacts
- Inferred Lateral Extent of Submerged Diesel Impacts
- Inferred Lateral Extent of Smear Zone Oil Impacts
- Inferred Lateral Extent of Submerged Oil Impacts
- Bathymetric Contour (ft NAVD88, 2 ft Contour Interval)

Notes:
ft = feet
LNAPL = light nonaqueous phase liquid
NAPL = nonaqueous phase liquid

N
0 40 80 160
Feet
1:960 1 inch = 80 feet

Figure 4-1. Proposed Primary TarGOST Locations
BNSF Wishram Railyard
Wishram, Washington

JACOBS

SLC \\PDXFPP01\PROJ\BNSFRAILWAYCOMPANY\693282WISHRAMRIFS\GIS\MAPFILES\WORKPLANADDENDUM_MAR19\FIGURE4-1_PROPOSED_LIF_LOCATIONS.MXD GGEE 4/25/2019 11:55:35

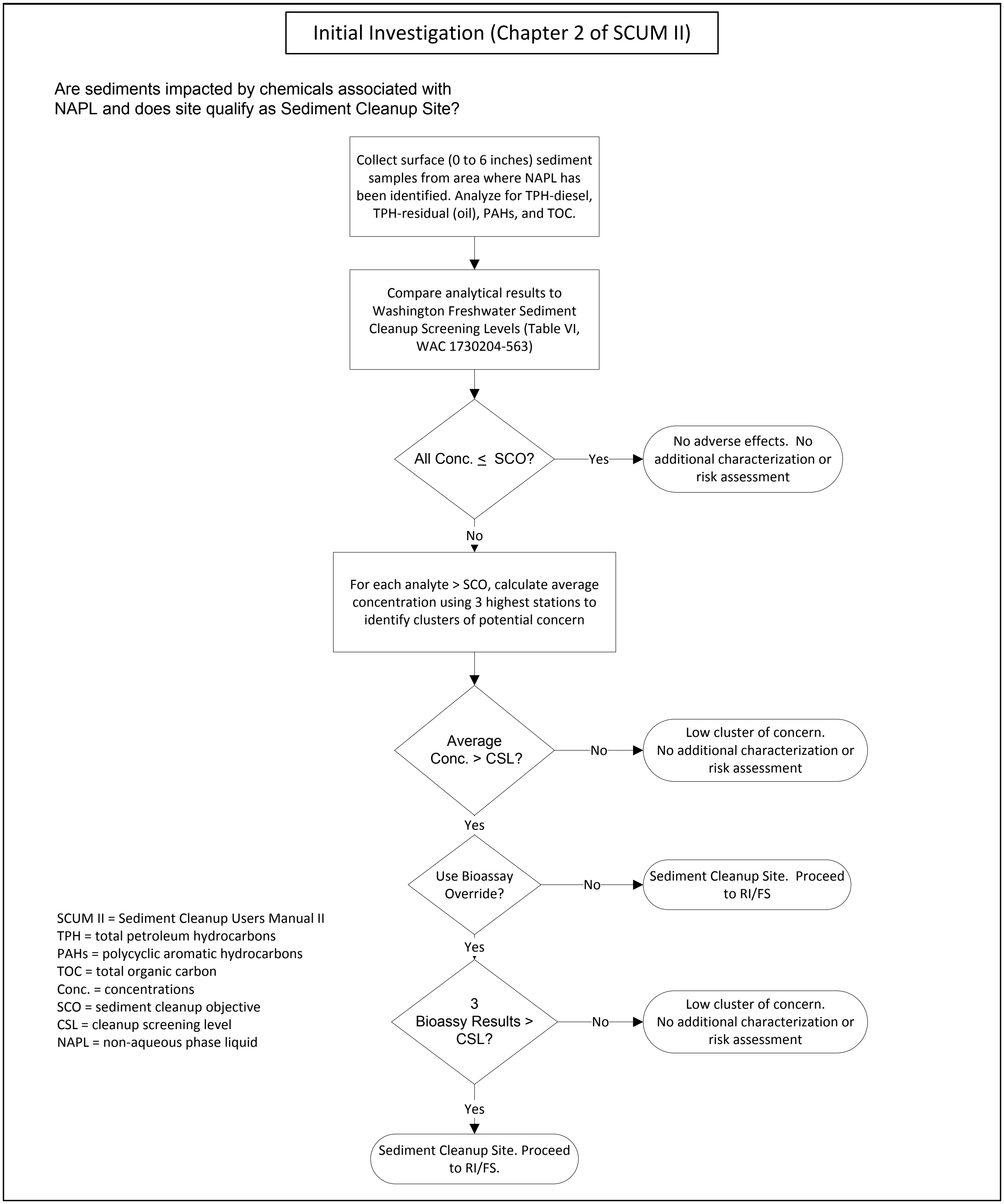


Figure 4-2. Sediment Chemistry and Bioassay Evaluation
BNSF Wishram Railyard
Wishram, Washington

Attachment 2
Sampling Analysis Plan Table Updates

Table 2-2. Applicable SMS Freshwater Sediment Chemical Criteria for Protection of the Benthic Community

Analyte	SCO	CSL
Polycyclic Aromatic Hydrocarbons (PAHs) (µg/kg dw)		
Total PAHs	17,000	30,000
Bulk Petroleum Hydrocarbons (mg/kg dw)		
TPH-Diesel	340	510
TPH-Residual	3,600	4,400

Notes:
Porewater assessment is another line of evidence in a weight-of-evidence approach for evaluating whether there are adverse impacts to aquatic life.

All values are dry weight normalized.

µg/kg = microgram(s) per kilogram
CSL = cleanup screening level
dw = dry weight
mg/kg = milligram(s) per kilogram
PAH(s) = polycyclic aromatic hydrocarbons
SCO = sediment cleanup objective
TPH = total petroleum hydrocarbon

Table 2-3. Applicable SMS Freshwater Biological Criteria for Biological Tests (Bioassays)

Biological Test Endpoint	Performance Standard Control[a]	SCO[c] Reference[b]	CSL[c]	Performance Standard
Hyalella azteca				
10-day mortality	M_C < 20%	M_R < 25%	M_T – MC > 15%	M_T – MC > 25%
28-day mortality	M_C < 20%	M_R < 30%	M_T – MC > 10%	M_T – MC > 25%
28-day growth	MIG_C > 0.15 mg/ individual	MIG_R > 0.15 mg/ individual	MIG_T / MIG_C < 0.75	MIG_T / MIG_C < 0.6
Chironomus dilutus				
10-Day mortality	M_C < 30%	M_R < 30%	M_T – MC > 20%	M_T – MC > 30%
10-Day growth[e]	MIG_C > 0.48 mg/individual	RF / CF > 0.8	MIG_T / MIGC < 0.8	MIG_T / MIG_C < 0.7
20-Day mortality	M_C < 32%	M_R < 35%	M_T – M_C > 15%	M_T – M_C > 25%
20-Day growth[e]	MIG_C > 0.60 mg/individual[d]	RF / CF > 0.8	MIG_T / MIG_C < 0.75	MIG_T / MIG_C < 0.6

[a]These tests and parameters were developed based on the most updated American Society for Testing and Materials (ASTM International) protocols.

[b]Reference performance standards are provided for sites where Ecology has approved a freshwater reference sediment site(s) and reference results will be substituted for control in comparing test sediment to criteria.

[c]An exceedance of the SCO and CSL requires statistical significance at $p = 0.05$.

[d]The control performance standard for the 20-day test (0.60 mg/individual) is more stringent than for the 10-day test and Ecology may consider, on a case-by-case basis, a 20-day control has met QA/QC requirements if the mean individual growth is at least 0.48 mg/individual.

[e]Results should be reported on an Ash Free Dry Weight basis.

Notes:
C = Control
CSL = cleanup screening level
F = Final
M = Mortality
mg = milligram(s)
MIG = Mean Individual Growth at time final
R = Reference
SCO = sediment cleanup objective
T = Test

Table 3-1. Sediment Sample Containers, Preservation, and Holding Time Requirements

Parameter	Analytical Method	Container	Preservation	Maximum Holding Time
Dart sampler analysis	UVOST	Wrap in foil	N/A	N/A
Total organic carbon	SW9060 (with guidance from the SCUM II Manual)	4-oz glass jar	Cool, ≤ 6°C	28 days
Chemical oxygen demand	EPA 410.4	4-oz glass jar	Cool, ≤ 6°C	28 days
Total petroleum hydrocarbons (TPH) -diesel and oil ranges (speciation may be requested)	NWTPH-Dx	4-oz glass jar	Cool, ≤ 6°C	14 days to extraction, 40 days to analysis
Polycyclic aromatic hydrocarbons (PAH)	SW8270C or D-SIM	4-oz glass jar	Cool, ≤ 6°C	14 days to extraction, 40 days to analysis
Leaching for TPH and PAH	EPA 1316	Collect 5 kg (approximately 1 kg of sample per leaching test in HDPE jar or pail; 5 tests per sample)	Cool, ≤ 6°C	N/A for leaching Post-leaching, follow holding times for NWTPH-Dx and SW8270C or D-SIM as listed in this table
Freshwater Bioassay (if needed) ***Hyalella azteca* 10-day mortality**	ASTM E1706-05/ EPA Method 100.1	1 x 5-gallon bucket[a]	Cool, 4°C, nitrogen	8-weeks
***Chironomus dilutus* 20-day mortality**	20-day mortality EPA Method 100.5			
***Chironomus dilutus* 20-day growth**	EPA Method 100.5			
Core photography (visible and UV light)	N/A	1 x DPT nominal 1.25-inch stainless steel Macro-Core tube	Frozen on dry ice	N/A
LIF frozen core analysis with TarGOST	N/A			
Pore fluid saturation (water, oil) (includes bulk density, total porosity, particle density)	Dean-Stark API (1998) Sec. 4.3			
Core sample screening using Dart system and UVOST	N/A			
Grainsize (particle size including hydrometer)	ASTM D422			
Product mobility by water/ NAPL flooding	ASTM 6836			

[a] Samples will be collected and held by the laboratory without further action until it is determined if bioassays are necessary (see Figure 4). The maximum holding time allowed for sediment samples held at 4°C in the dark and under a nitrogen atmosphere is up to 8 weeks before bioassay testing.

Notes:
°C = degree(s) Celsius
DPT = direct-push technology
EPA = U.S. Environmental Protection Agency
N/A = Not applicable
NAPL = non-aqueous phase liquid
oz = ounce

Table 3-1. Sediment Sample Containers, Preservation, and Holding Time Requirements

Parameter	Analytical Method	Container	Preservation	Maximum Holding Time

LIF = laser-induced fluorescence
UV = ultraviolet

Table 3-2. Water (Equipment Blank) Sample Containers, Preservation, and Holding Time Requirements

Parameter	Analytical Method	Container	Preservation	Maximum Holding Time
Total petroleum hydrocarbons (diesel and oil ranges)	NWTPH-Dx	2 x 1-liter amber glass	Cool, ≤ 6°C, HCl to pH<2	7 days to extraction, 40 days to analysis
Polycyclic aromatic hydrocarbons	SW8270C or D-SIM	2 x 1-liter amber glass	Cool, ≤ 6°C	7 days to extraction, 40 days to analysis

Notes:
NWTPH-Dx Analysis to be run with and without silica gel cleanup as a sample preparation method

Total PAH analyte list is the full list included in Table 2c - Region 4 Step 3a Sediment Refinement Screening Values for Polycyclic Aromatic Hydrocarbons (PAHs) at Hazardous Waste Sites of the Region 4 Ecological Risk Assessment Supplemental Guidance (March 2108 Update)

C = Celsius
HCl = hydrogen chloride
pH = hydrogen (ion) concentration

Table 4-1. Laboratory Methods and Target Detection Limits

Analyte	Preparation Method	Analytical Method	Mean Reporting Limit
Dart Analysis			
LIF using UVOST	N/A	N/A	N/A
Total organic carbon (%)	Per the analytical method	SW9060	10
Chemical oxygen demand (mg/L)	DI Water	EPA 410.4	10
Polycyclic Aromatic Hydrocarbons (µg/kg)			
Total PAHs	SW3550B	SW8270C or D SIM	6
Bulk Petroleum Hydrocarbons (mg/kg) (speciation may be required for some samples)			
TPH-Diesel	SW3630, SW3665	NW-TPH-Dx	4
TPH-Residual	SW3630, SW3665	NW-TPH-Dx	10
NAPL Mobility Core Analysis			
Core photography (visible and UV light)	N/A	N/A	N/A
LIF frozen core analysis using TarGOST	N/A	N/A	N/A
Pore fluid saturation (water, oil) (includes bulk density, total porosity, particle density)	N/A	Dean-Stark API (1998) Sec. 4.3	N/A
Core sample screening using Dart system and UVOST	N/A	N/A	N/A
Grainsize (particle size including hydrometer)	N/A	ASTM D422	N/A
Product mobility by water/NAPL flooding	N/A	ASTM 6836	N/A

Notes:
NWTPH-Dx Analysis to be run with and without silica gel cleanup as a sample preparation method

LIF = laser-induced fluorescence
mg/kg = milligram(s) per kilogram
mg/L = milligram(s) per liter
N/A = not applicable
NAPL = non-aqueous phase liquid
PAH(s) = polycyclic aromatic hydrocarbon(s)
TPH = total petroleum hydrocarbon
UV = ultraviolet
UVOST = Ultra Violet Optical Screening Tool

Table 4-2. Bioassay Test Conditions (if needed): *Hyalella azteca and Chironomus dilutus*

	Performance Standard		Control Samples		Control Limits		Water Quality Monitoring Frequency	
Biological Test Endpoint	**Control[a]**	**Reference[b]**	**Negative**	**Positive**	**Temp[c] °C**	**DO[d]**	**Temp/DO**	**Hardness Alkalinity Conductivity Sulfides Ammonia**
Hyalella azteca								
10-day mortality	MC < 20%	MR < 25%	Clean sediment	Reference toxicant in freshwater	23 ± 1	40–100	Daily	pH = Daily Others at start/end of test
28-day mortality	MC < 20%	MR < 30%						
28-day growth	MIG_C > 0.15 mg/ individual	MIG_R > 0.15 mg/ individual						
Chironomus dilutus								
10-Day mortality	MC < 30%	MR < 30%	Clean sediment	Reference toxicant in freshwater	23 +/- 1	40 -100	Daily	pH = Daily Others at start/end of test
10-Day growth	MIG_C > 0.48 mg/individual	RF / CF > 0.8						
20-Day mortality	MC < 32%	MR < 35%						

[a]These tests and parameters were developed based on the most updated American Society for Testing and Materials (ASTM International) protocols.

[b]Reference performance standards are provided for sites where Ecology has approved a freshwater reference sediment site(s) and reference results will be substituted for control in comparing test sediment to criteria.

[c]Water bath or exposure chamber temperature should be continuously monitored. The daily mean temperature should be within ± 1 °C of the desired temperature. The instantaneous temperature should be within ± 3 °C of the desire temperature.

[d]Percent saturation

Notes:
C = Control
DO = dissolved oxygen
F = Final
M = Mortality
mg = milligram(s)
MIG = Mean Individual Growth at time final
pH = hydrogen (ion) concentration
R = Reference

Attachment 3
Example TarGOST Log and Additional Output Information

Dakota Technologies
TarGOST® Reference Log

Main Plot:
Signal (total fluorescence) versus depth where signal is relative to the Reference Emitter (RE). The total area of the waveform is divided by the total area of the Reference Emitter yielding the %RE. This %RE scales with the NAPL fluorescence. The fill color is based on relative contribution of each channel's area to the total waveform area (see callout waveform). The channel-to-color relationship and corresponding wavelengths are given in the upper right corner of the main plot.

Callouts:
Waveforms from selected depths or depth ranges showing the multi-wavelength waveform for that depth. The four peaks are due to fluorescence at four wavelengths and referred to as "channels." Each channel is assigned a color.

Various NAPLs will have a unique waveform "fingerprint" due to the relative amplitude of the four channels and/or broadening of one or more channels. Basic waveform statistics and any operator notes are given below the callout.

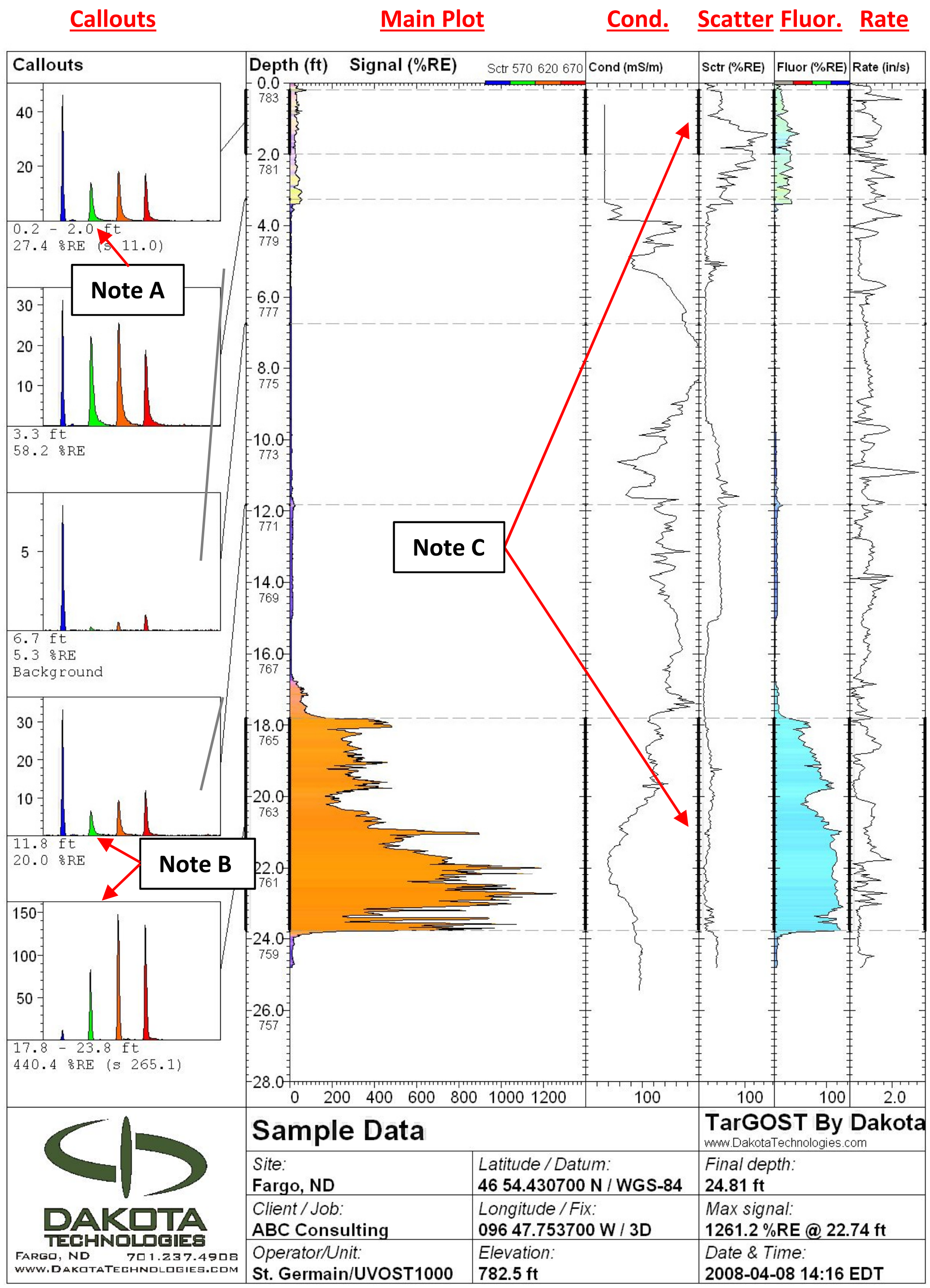
Conductivity Plot:
The Electrical Conductivity (EC) of the soil can be logged simultaneously with the TarGOST data. EC often provides insight into the stratigraphy.

Scatter Plot:
Scatter versus depth where intensity is relative to the scatter level of the Reference Emitter.

Fluorescence Plot:
A plot of the fluorescence signal alone versus depth. The scatter channel is not used in the calculation of signal intensity or coloring. Note the coloring key at the top of the plot. Intensity unit is percent of Reference Emitter fluorescence.

Varying soil or product can often be visually pulled-out from the background based on the fill color of this plot if scatter dominates the color of the main plot.

Rate Plot:
The rate of probe advancement. Approx. 0.8 inches (2cm) per second is preferred. A noticeable decrease in the rate of advancement may be indicative of difficult probing conditions (gravel, angular sands, etc.) such as that seen here at approx. 5 ft.



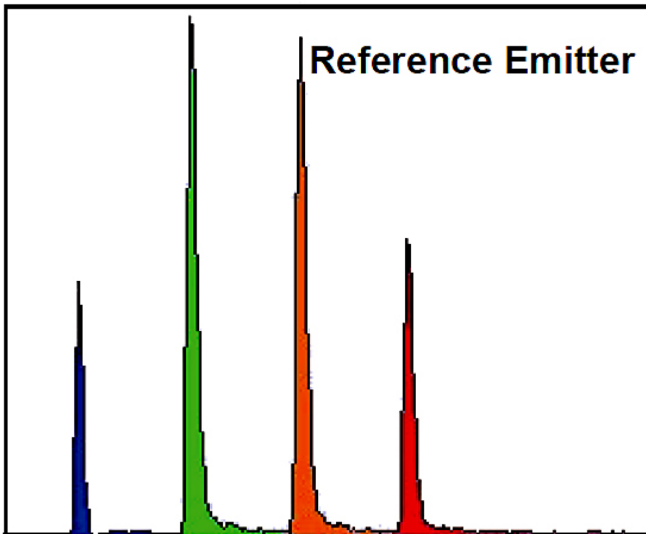
Note A:
Time is along the x axis. No scale is given on callouts, but it is constant and is 250ns wide. The y axis is in mV and directly corresponds to the amount of light striking the photodetector.

Note B:
These two waveforms show two different products, each with a unique waveform.

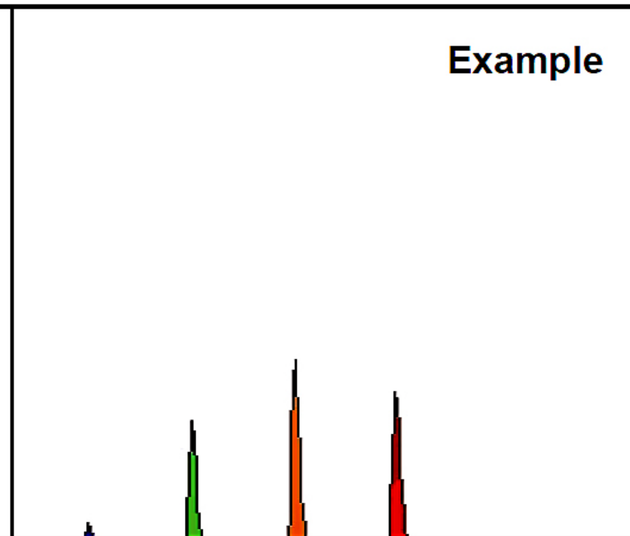
Note C:
The top zone has moderate fluorescence, but high scatter while the bottom zone has high fluorescence and low scatter. Note how this impacts the main signal plot.

Dakota Technologies TarGOST® Reference Log

Waveform Signal Calculation



Channel	Sctr		CH2	+	CH3	+	CH4	=	Fluor	»	Total%
Area (pVs)	255	¦	785	+	772	+	462	=	2019	»	100/100
Percent RE	100	¦	38.9		38.2		22.9		100		100%



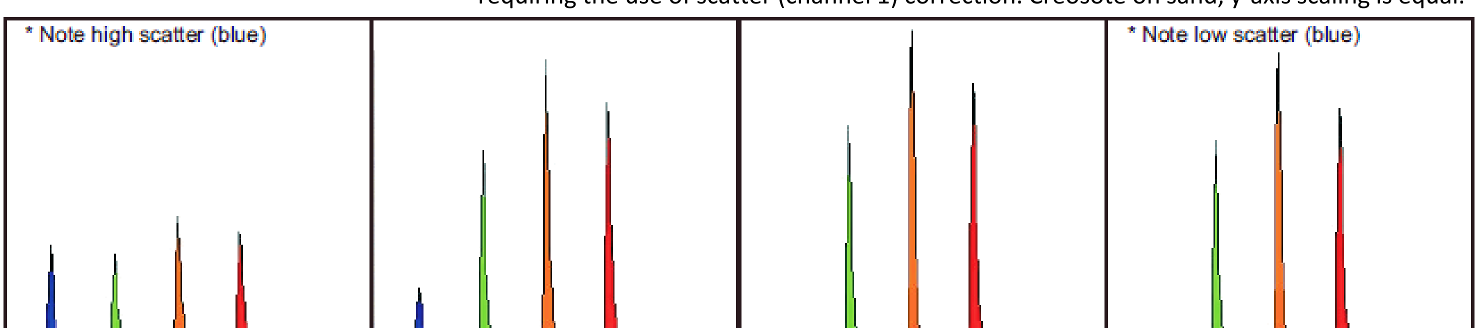
Channel	Sctr		CH2	+	CH3	+	CH4	=	Fluor	»	Total%
Area (pVs)	36	¦	153	+	244	+	226	=	623	»	31/14
Percent RE	14.1	¦	7.6		11.1		11.2		31		219%

Data Files

***.lif.raw.bin**	Raw data file. Header is ASCII format and contains information stored when the file was initially written (e.g. date, total depth, max signal, GPS, etc., and any information entered by the operator). All Raw waveforms are appended to the bottom of the file in a binary format.
***.lif.plt**	Stores the plot scheme history (e.g. callout depths) for associated Raw file. Transfer along with the Raw file in order to recall previous plots.
***.lif.jpg**	A .jpg image of the OST log including the main signal vs. depth plot, callouts, information, etc.
***.lif.dat.txt**	Data export of a single Raw file. Tab delimited format. No string header is provided for the columns to make importing into some programs easier. Each row is a unique depth reading. The columns are: 1-Depth; 2-Total Signal (%RE); 3-CH1%; 4-Ch2%; 5-CH3%; 6-Ch4%; 7-Rate; 8-EC Depth; 9-EC Signal; 10-Hammer Rate Depth; 11-Hammer Rate; 12-Color (RRGGBB). Summing channels 1 to 4 yields the Total Signal.
***.lif.sum.txt**	A summary file for a number of Raw files. ASCII tab delimited format. The file contains a string header. The summary includes one row for each Raw file and contains information for each filed including: the file name, GPS coordinates, max depth, max signal, and depth at which the max signal occurred.
***.lif.log.txt**	An activity log generated automatically is located in the OST application directory in the 'log' subfolder. Each OST unit the computer operates will generate a separate log file per month. A log file contains much of the header information contained within each separate Raw file, including: data rate, total depth, max signal, etc.

Non Linear Fluorescence

Due to self-absorption, fluorescence levels (channels 2-4) are not linear with concentration, requiring the use of scatter (channel 1) correction. Creosote on sand, y-axis scaling is equal.



1,000ppm (60%RE) | 10,000ppm (215%RE) | 100,000ppm (935%RE) | Neat (1925%RE)