PRE-DESIGN INVESTIGATION EVALUATION REPORT REVISION 2

REMEDIAL DESIGN SERVICES
SWAN ISLAND BASIN PROJECT AREA
CERCLA DOCKET NO. 10-2021-001

PORTLAND HARBOR SUPERFUND SITE
PORTLAND, MULTNOMAH COUNTY, OREGON

Prepared for:
Swan Island Basin Remedial Design Group

Prepared by:

HGL

11107 Sunset Hills Road, Suite 400
Reston, Virginia 20190

With assistance from:

PACIFIC groundwater GROUP MOTT MACDONALD BRIDGEWATER GROUP

December 2024

This page was intentionally left blank.

PRE-DESIGN INVESTIGATION EVALUATION REPORT
REVISION 2

REMEDIAL DESIGN SERVICES
SWAN ISLAND BASIN PROJECT AREA
CERCLA DOCKET NO. 10-2021-001

PORTLAND HARBOR SUPERFUND SITE
PORTLAND, MULTNOMAH COUNTY, OREGON

Contract Number: DT2002

Prepared for:

Swan Island Basin Remedial Design Group

Prepared by:

HydroGeoLogic, Inc.
11107 Sunset Hills Road, Suite 400
Reston, Virginia, 20190

With assistance from:

Mott MacDonald
Pacific Groundwater Group
Bridgewater Group, Inc.

December 2024

This page was intentionally left blank.

PRE-DESIGN INVESTIGATION EVALUATION REPORT
SWAN ISLAND BASIN PROJECT AREA
PORTLAND HARBOR SUPERFUND SITE
PORTLAND, MULTNOMAH COUNTY, OREGON

EXECUTIVE SUMMARY

This Pre-Design Investigation (PDI) Evaluation Report (ER) presents the results of data collection activities conducted as part of the PDI for the Swan Island Basin (SIB) Project Area within the Portland Harbor Superfund Site (PHSS) in Portland, Multnomah County, Oregon. HydroGeoLogic, Inc. (HGL) performed the work on behalf of the SIB Remedial Design (RD) Group based on the requirements of the PHSS Record of Decision (ROD) (EPA, 2017) and the Administrative Settlement Agreement and Order on Consent (ASAOC) (EPA, 2021a).

Swan Island Basin Project Area

The SIB Project Area is the active cleanup area between approximately river mile (RM) 8.1 and RM 9.2 on the northeast side of the Willamette River. A federal navigation channel, with an authorized depth of -40 feet (ft) Columbia River Datum, exists within the Willamette River and extends from the confluence of the Lower Willamette River with the Columbia River to RM 11.6. The U.S. Army Corps of Engineers (USACE) maintains the navigation channel, which does not extend into SIB (Figure 1-1). The SIB Project Area is approximately 1.1 miles in length, 117 acres in size, and includes riverbanks from the top of the bank to the river.

The SIB Project Area is bounded by uplands of Swan Island and Mocks Bottom to the southwest and northeast, respectively. Land uses within and adjacent to the SIB Project Area consist of light and heavy industrial uses and limited commercial uses. SIB is an active navigable industrial waterway, and the shoreline hosts many structures supporting light and heavy industrial activities.

The Portland Harbor reach of the Willamette River, including the SIB Project Area, has been redirected, straightened, filled, and deepened by dredging. Most of the riverbank has been filled, stabilized, and/or engineered for industrial-type operations with riprap, bulkheads, and overwater piers and docks. (City of Portland [City], 2014).

Purpose and Objective of the Pre-Design Investigation

The preliminary design concepts in the remedial technology assignments for the selected remedy published in the PHSS ROD provide a basis to identify the specific data, surveys, and analysis needed to develop the design for the SIB Project Area. The ASAOC specifically identified three applications of the PDI results that support the development of the RD to be presented in the Basis of Design Report (BODR). Those specific applications are:

1. Refinement of the sediment management area (SMA).
2. Refinement of the conceptual site model (CSM).
3. Application of the technology application decision tree (ROD, Figure 28).

The overarching objective of the PDI focuses on compiling a body of data and analysis to inform the development and evaluation of an RD for a robust, sustainable, and effective remedy for the SIB Project Area. The purpose of this PDI ER is to present the narrative interpretation of the data and results of the PDI.

RESULTS OF THE PRE-DESIGN INVESTIGATION

A data gap analysis was performed to identify data gaps to be filled during the PDI to support development of the RD. The following field activities were performed to address the data gaps: sediment-related field sampling, porewater upwelling assessment, stormwater and stormwater solids sampling, riverbank evaluation and riverbank soil sampling, bathymetric surveying, geotechnical investigation, structure inspections and structure condition assessments, utility and debris surveys, hydrodynamics and sediment dynamics surveys, habitat conditions survey, and facility owner/operator interviews.

Chemical Characterization of Surface and Subsurface Sediment

The sediment investigation was conducted to refine the lateral and vertical extent of contaminants of concern (COCs); evaluate the nature and extent of buried contamination; and support the evaluation of potential short-term contaminant releases during dredging operations. The sediment investigation was performed from July 5 through September 7, 2022, and entailed collecting 4 surface grab samples, 170 sediment cores, and 3 bulk sediment and water samples. Sample locations were laid out on a 150-ft square grid.

The results of the chemical characterization of surface and subsurface sediments indicate that total polychlorinated biphenyls (PCBs) exceed the remedial action level (RAL) in more than 60 percent of samples and principal threat waste (PTW) threshold in more than 40 percent of samples. Additionally, dioxins and furans (PeCDD and TCDD) exceed the practical quantitation limit (PQL) in over 20 percent of samples. The depths to RAL exceedances are bounded by 1, 2, or more samples at 127 of 170 locations (75 percent) and the depths to PTW threshold exceedances are bounded by 1, 2, or more samples at 141 of 170 locations (83 percent). Field observations indicate isolated hydrocarbon sheen and some blebs in a small number of shallow sediment samples.

The refined SMA extent for the SIB Project Area, defined by sediments exceeding RAL, PQL, or PTW thresholds (SMA thresholds), is approximately 107 acres (Figure 3-3) within the ROD-defined Sediment Decision Unit boundary. The refined SMA extent is larger than previously depicted in the ROD (89.4 acres), primarily due to additional sediment data collected during the PDI and the inclusion of subsurface sediment data. The extent of surface sediment SMA threshold exceedances is 87.7 acres, which is slightly smaller than the ROD SMA. The depth of contamination is well constrained in the majority of the refined SMA extent with the exception of a central portion of the head of the SIB. The volume of in-situ sediment in the SMA extent is 1,431,000 cubic yards (cy) and the volume of sediment exceeding the SMA thresholds is 1,409,000 cy, which subtracts the clean sediment volume (22,000 cy). These represent in-situ sediment volumes and assume vertical slopes at the boundary of the refined horizontal SMA. These quantities do not represent design-level quantity estimates of final RD extent, depths, and volumes, which will be provided in the BODR following additional technical analysis.

Porewater Upwelling

A porewater upwelling assessment was completed to identify and delineate areas where sediment capping would be potentially feasible and to support the design of sediment caps and their effectiveness. The efforts consisted of two phases: a Trident Probe transition zone water (TZW) screening survey, conducted from March 4 through 12, 2022 and an UltraSeep and differential pressure piezometer (DPZ) survey, conducted from July 6 through July 25, 2023.

The results of the TZW screening survey conducted during the first phase of the work were used to identify the locations where porewater upwelling was most likely occurring within SIB. In the second phase of the work, specific porewater velocity was measured with the UltraSeep system at 21 target stations during a timeframe that corresponds to the maximum groundwater discharge condition in SIB. Average velocities ranged from a recharge of 0.001 centimeters per day (cm/day) to a discharge of 0.22 cm/day, with an overall average discharge of 0.06 cm/day across all stations. Upwelling ranged from low (less than 0.033 cm/day) to moderately high (up to 0.22 cm/day) across SIB. High upwelling (average discharge greater than 1 cm/day) was not observed at any of the surveyed locations.

Tidally averaged vertical hydraulic gradients (VHGs) were measured using DPZs. The highest VHGs were generally observed at stations near the mouth of the basin and the head of the basin, with lower to moderate gradients otherwise observed in the central and southeastern portions of SIB. Porewater upwelling assessment resulted in SIB-wide mapping of porewater upwelling locations, measurements of pressure gradients that drive porewater migration, and the resulting porewater velocities and flow rates at those specific locations. Volumetric flowrates, combined with porewater concentrations estimated from bulk sediment concentrations and partitioning coefficients, will be used to calculate mass flux. This calculation will be used to evaluate the effectiveness of a cap to prevent breakthrough of COCs through a chemical isolation layer of the cap, which will be applied to subsequent location-specific cap design.

Stormwater Outfall and Conveyance System

There are 33 active outfalls, including 5 large-diameter City of Portland (City), and 28 smaller non-City, outfalls on federal (at U.S Coast Guard Marine Safety Unit facility), Port of Portland (Port), and private shoreline parcels that discharge to the SIB Project Area from the surrounding upland areas. PDI activities included collection of stormwater and stormwater solids samples from City conveyance systems (M-1, M-2, M-3, S-1, and S-2 outfall basin conveyance systems) and stormwater samples from six smaller non-City conveyance systems during three storm events meeting criteria established in the Oregon Department of Environmental Quality and U.S. Environmental Protection Agency (EPA) Joint Source Control Strategy (JSCS).

Stormwater samples were collected May 5, 2022, October 21, 2022, and March 9, 2023. Samples from the City systems were collected using high-volume sampling (HVS) systems and samples from the smaller drainage basin outfalls were collected as grabs from autosamplers. In-line sediment (ILS) samplers were also installed in the five City systems and sample mass was retrieved seasonally and composited to be representative of the accumulation of stormwater sediment during the wet and dry seasons.

ROD COCs detected in nearly all of the HVS stormwater and stormwater solids samples collected from City systems include organochlorine pesticides (OCPs) (DDD, DDE, DDT), PCDDs/PCDFs, and PCBs. ROD COCs in bulk stormwater samples from City systems included metals, bis(2-ethylhexyl)phthalate (BEHP), and polycyclic aromatic hydrocarbons (PAHs). ROD COCs in stormwater samples from the smaller drainage basins similarly included metals, OCPs, BEHP, PAHs, TCDD, and PCBs.

Near-continuous water level and velocity measurements were collected over the investigation period, using water-level-velocity loggers in City outfall basins to assess seasonal hydrologic trends and flows during high volume sampling events. The average monthly maximum discharge rates across the 5 monitored outfall basins ranged from 0.07 cubic feet per second (cfs) to the M-3 outfall to 3.55 cfs to the M-1 outfall based on the exclusion of flow measurements during periods of inundation during high-water river stages, sensor malfunctions, and dry periods (where no dry-weather flow has been observed). The concentrations of ROD COCs in all discharging outfalls with available stormwater and/or stormwater solids data will be used along with flow monitoring data[1] to calculate the mass loading and evaluate the fate of COCs in stormwater and solids discharged to the SIB Project Area via discharging outfalls.

Riverbank Characterization

The ROD identified three riverbanks within the SIB Project Area as areas with known contamination that exceed RALs and/or CULs for various ROD COCs. Riverbanks, including the ROD riverbanks, in the SIB Project Area were assessed on transects, spaced at 100-lineal feet across the entire SIB shoreline. Erodibility potential of riverbanks in the SIB Project Area based on Bank Erosion Hazard Index (BEHI), range from low to extreme. The near-bank stress (NBS) risk for all transects was calculated to be low.

Chemical characterization of riverbank soil samples indicates that cleanup level (CUL) exceedances are widespread and estimated to include 650,438 square feet (sq ft) of the riverbank's surface between 0 and 1 ft bgs (100 percent), 476,799 sq ft from 1 to 2 ft bgs (100 percent), and 129,551 sq ft from 2 to 3 ft bgs (100 percent), based on data availability and extent of sample coverage along the riverbank.

COCs concentrations exceed RALs/PQLs at 102 of the 119 transects sampled (86 percent). The areas without exceedances are primarily along the head of the basin and the east side of SIB. RAL exceedances are less widespread than CUL exceedances and include an estimated 419,719 sq ft of the riverbank's surface between 0 and 1 ft bgs (65 percent), 152,576 sq ft from 1 to 2 ft bgs (32 percent), and 78,026 sq ft from 2 to 3 ft bgs (26.4 percent), based on data availability and extent of sample coverage along the riverbank.

PTW threshold exceedances are less widespread than CUL and RAL exceedances and are estimated to include 131,186 sq ft of the riverbank's surface between 0 and 1 ft bgs (20 percent)

[1] Select flow monitoring data are being used for model calibration.

and 12,874 sq ft between 1 and 2 ft bgs (2.7 percent), based on data availability. In the 2- to 3- ft interval, there were no PTW threshold exceedances in the 28 samples analyzed.

The location of ROD COC exceedances detected in riverbank samples dictate how they are to be addressed as part of the RD. In accordance with the guidance, concentrations are used to screen riverbanks, but COC loading estimates (i.e., COC concentrations combined with erosion rates) will be used to determine recontamination risk and inform the selection of remedial technologies for riverbank soils.

Bathymetric Survey

A multibeam bathymetry survey was conducted between April 4 and April 7, 2022 using an R2 Sonic 2024 Multibeam EchoSounder which achieved 175 percent coverage. The survey found that the main channel of the Willamette River has depths up to 57 ft located downstream of the dry dock basin, and approximately 53 ft within the dry dock berth. At the mouth of SIB near the northeast end of Pier A, moving into the SIB towards the southeast end of the SIB, depths decrease from approximately 30 ft to less than 10 ft.

Geotechnical Site Investigation

The geotechnical investigation program entailed advancement of 30 exploratory borings, both in SIB (15 in-water) and the surrounding upland areas (15), from May 12, 2022 through August 14, 2022. The geotechnical investigation was performed to characterize the geotechnical conditions in and around the SIB Project Area and provide the foundational geotechnical data necessary to support RD development and evaluation. Geotechnical testing found that near surface soils consist of artificial fills (both within SIB and at the riverbank and upland areas), sands, silts, and clays. The sediment within SIB is primarily soft elastic silt with variable sand content. The site seismic setting indicates the SIB Project Area may be subject to strong earthquake-induced ground motions during the design life of the selected Remedial Action (RA). Additionally, based on the potential for strong earthquake-induced ground motions, the presence of saturated soils within SIB, and relatively shallow ground water in the areas surrounding SIB, the potential for soil liquefaction and lateral spreading is present.

Index testing results will support soil type characterization and stratigraphic interpretation, identification of geologic and seismic hazards, and the collective interpretation of the complete dataset. Soil strength and consolidation testing results will support the development of total and effective stress strength parameters and consolidation characteristics for use in engineering studies, the BODR, and throughout the RD.

Shoreline and Overwater Structure Inspections and Structure Condition Assessments

Topside, above-water, and underwater inspections were conducted between April and July 2022 to determine the physical condition of the primary structural components of each shoreline/overwater structure in the SIB Project Area. Condition assessments were conducted for the primary structural system components of each overwater structure, based on the results of the structure inspections.

The condition of shoreline and overwater structures was assessed, and the condition ratings ranged from Satisfactory to Serious. Six structures and one outfall are rated in Serious condition, 5 structures and 1 outfall are rated in Poor condition, 12 structures are rated in Fair condition, 3 structures and 2 outfalls are rated in Satisfactory condition, and 1 outfall is rated in Good condition. None of the observed structures were rated in Critical condition. Structures rated in Poor or Serious condition might have a higher probability of being affected by the RA. The shoreline and overwater inspection data and resulting structure condition assessment findings are being used to support functional structure determinations and RD development by evaluating the general condition of shoreline and overwater structures and estimating their present structural capacity.

Utilities and Debris Identification and Surveys

Debris and utility surveys were conducted between April 5 and 9, 2022 to support RD development by providing data for use in PDI engineering studies, using a combination of side-scan sonar, magnetometer, mobile light detection and ranging, and sub-bottom profiling. Objects 1 ft or larger were identified on the riverbed or in the water column and classified as 1,600 individual pieces of debris, consisting of a mix between small debris which is unlikely to affect dredging, and over-sized debris which may obstruct dredging operations and would likely require removal prior to dredging. The magnetometer survey results indicate that there are no large metal debris pieces or other objects present that will need to be managed during RA.

Hydrodynamics and Sediment Dynamics Surveys

The hydrodynamics and sediment dynamics survey program was conducted between February and May 2022 and entailed the collection of SEDflume near-surface sediment cores, Acoustic Doppler Current Profiler (ADCP) measurements, free surface elevation measurements, and turbidity measurements.

Hydrodynamics and sediment dynamics measurements indicate the following:

- Soft surface sediments indicate a quiescent, depositional environment in most of the SIB Project Area;
- Low river current speeds indicate that river flows are not likely to cause resuspension and erosion over most of the SIB Project Area, even during flood events;
- Suspended sediments entering the SIB Project Area from the main river are well mixed and fine-grained, with low settling velocities. Most of the suspended sediments entering SIB are likely to leave prior to depositing on the riverbed, and;
- Wind-waves and boat wakes are small, but likely govern sediment mobility in shallow water and near riverbanks. In these shallow water and riverbank areas, storm waves likely govern cap erosion protection design.

The hydrodynamics and sediment dynamics surveys dataset fulfills the applicable data needs to support the development of the RD and the completion of the source control sufficiency assessment. The measurements were collected to generate data necessary to facilitate analysis of recontamination potential and to demonstrate stability/persistence of the remedy under both river hydrodynamics and anthropogenic hydrodynamic effects.

Habitat Conditions Survey

The habitat conditions survey was conducted to provide qualitative information on the condition and extent of riparian, active channel margin, and main channel habitats in the SIB Project Area. In accordance with EPA guidance, the data compiled as part of the survey are suitable to provide baseline (existing/pre-construction condition) inputs to a Habitat Equivalency Analysis that may be used to evaluate pre-and post-remediation habitat conditions for the purposes of complying with Clean Water Act Section 404 and the Endangered Species Act. The habitat conditions survey provides the baseline for determining the current and future habitat requirements for the purpose of designing and constructing the selected remedy.

Facility Owner/Operator Interviews

The facility owner/operator interviews were conducted to gather information from property owners and operators for facilities located on the SIB shoreline for engineering studies that will inform the RD. Based on the survey responses, the following potential constraints were identified:

- Waterway operations and schedule – Operations occur year-round in SIB and implementation of the RD near each facility will require close coordination and scheduling to support continued operations.
- In-water structures – Structures are present at 7 of the 11 shoreline properties which may affect technology assignments, construction sequencing, and construction techniques.
- Vessel types, maneuverability, frequency – Vessel types and sizes, their maneuverability, and frequency of arrivals/departures in SIB will affect construction sequencing.
- Operational navigation depths – Reported navigational depths ranged from 10 ft to 57 ft. Navigation depths will directly affect the technology assignment and implementation of the RD and, closer to structures, navigation depths may control RD.

Summary

The PDI ER presents and evaluates the results of data collection activities conducted as part of the PDI. The PDI results are being applied to early phases of RD development including refining the SMA, updating the CSM, and applying the technology application decision tree. The resulting PDI datasets also support the analyses needed to demonstrate that the remedy will be robust, sustainable, and effective in the context of the SIB including natural processes and human activities including vessel traffic, waterway maintenance, and activities on the shoreline and adjacent uplands.

Each element of the PDI was evaluated to determine whether data gaps previously identified have been adequately addressed as well as the sufficiency of the results for use in the BODR, Sufficiency Assessment Report, and RD Work Plan. The evaluation concluded that the data generated during the PDI adequately addressed data gaps and is sufficient to inform the development and evaluation of a RD for a robust, sustainable, and effective remedy for the SIB Project Area.

TABLE OF CONTENTS

Section **Page**

TABLE OF CONTENTS (continued)

Page

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
µS/cm	microsiemens per centimeter
cfs	cubic feet per second
cm/day	centimeters per day
cm/m	centimeters of water per meter of vertical distance
cy	cubic yards
ft	feet/foot
mg/L	milligrams per liter
sq ft	square feet
ACM	active channel margin
ADCP	Acoustic Doppler Current Profiler
ASAOC	Administrative Settlement Agreement and Order on Consent
ASCE	American Society of Civil Engineers
BANCS	Bank Assessment for Non-Point Source Consequences of Sediment
BEHI	Bank Erosion Hazard Index
BEHP	bis(2-ethylhexyl)phthalate
BODR	Basis of Design Report
City	City of Portland
COC	contaminant of concern
cPAH	carcinogenic polycyclic aromatic hydrocarbon
CPT	cone penetration test
CRD	Columbia River Datum
CSM	conceptual site model
CTD	conductivity, temperature, and depth
CUL	cleanup level
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
DDx	DDD + DDE + DDT
DEQ	Oregon Department of Environmental Quality
DPZ	differential pressure piezometer
DQO	data quality objective
DRET	dredging elutriate test
EPA	U.S. Environmental Protection Agency
ER	Evaluation Report
FCR	Field Change Request
FSP	Field Sampling Plan

HEA	Habitat Equivalency Analysis
HGL	HydroGeoLogic, Inc.
HVS	high-volume sampling
ILS	in-line sediment
JSCS	Joint Source Control Strategy
LiDAR	light detection and ranging
MBES	Multibeam EchoSounder
MLW	mean low water
MC	Marine Consortium, Inc.
MDL	method detection limit
NAPL	non-aqueous phase liquid
NAVD88	North American Vertical Datum of 1988
NBS	near-bank stress
OCP	organochlorine pesticides
OHW	ordinary high water
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCDD	polychlorinated dibenzodioxins
PCDF	polychlorinated dibenzofurans
PDI	Pre-Design Investigation
PeCDD	1,2,3,7,8-pentachlorodibenzo-p-dioxin
PHSS	Portland Harbor Superfund Site
Port	Port of Portland
PQL	practical quantitation limit
PTW	principal threat waste
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RA	Remedial Action
RAL	remedial action level
RD	Remedial Design
RM	river mile
ROD	Record of Decision

LIST OF ACRONYMS AND ABBREVIATIONS (continued)

SAR	Sufficiency Assessment Report
SIB	Swan Island Basin
SMA	sediment management area
SPT	Standard Penetration Test
SSS	side-scan sonar
TCDD	2,3,7,8-tetrachlorodibenzo-p-dioxin
TOB	top of bank
TOC	total organic carbon
TSS	total suspended solids
TZW	transition zone water
UFP	Uniform Federal Policy
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard

This page was intentionally left blank.

PRE-DESIGN INVESTIGATION EVALUATION REPORT
SWAN ISLAND BASIN PROJECT AREA
PORTLAND HARBOR SUPERFUND SITE
PORTLAND, MULTNOMAH COUNTY, OREGON

1.0 INTRODUCTION

This Pre-Design Investigation (PDI) Evaluation Report (ER) presents the results of data collection activities conducted as part of the PDI for the Swan Island Basin (SIB) Project Area within the Portland Harbor Superfund Site (PHSS) in Portland, Multnomah County, Oregon. HydroGeoLogic, Inc. (HGL) performed the work, on behalf of the SIB Remedial Design (RD) Group, based on the requirements of the PHSS Record of Decision (ROD) (EPA, 2017) and the Administrative Settlement Agreement and Order on Consent (ASAOC) (EPA, 2021a). The work was performed in accordance with the final PDI Work Plan, which the U.S. Environmental Protection Agency (EPA) approved in May 2022 (HGL, 2022a); the Stormwater and Riverbank Assessment and Sampling Plan, which EPA approved in November 2021 (HGL, 2021a); the Riverbank Sampling Plan, which EPA approved in October 2022 (HGL, 2022b); and the Porewater Quantitative Assessment Plan, which EPA approved in June 2023 (HGL, 2023a).

1.1 PRE-DESIGN INVESTIGATION PURPOSE AND OBJECTIVES

The preliminary design concepts in the remedial technology assignments for the selected remedy published in Appendix I of the PHSS ROD provide a basis to identify the specific data, surveys, and analysis needed to develop the design for the SIB Project Area. The ASAOC (EPA, 2021a) specifically identified three applications of the PDI results that support the development of the RD to be presented in the Basis of Design Report (BODR). Those specific applications are:

1. Refinement of the sediment management area (SMA).
2. Refinement of the conceptual site model (CSM).
3. Application of the technology application decision tree (ROD, Figure 28).

The overarching objective of the PDI focuses on compiling a body of data and analysis to inform the development and evaluation of an RD for a robust, sustainable, and effective remedy for the SIB Project Area. The purpose of this PDI ER is to present the narrative interpretation of the data and results of the PDI.

The scope of the PDI is as follows:

- Conduct sampling and laboratory analysis of surface/subsurface sediment to refine the lateral and vertical extent of contamination in relation to cleanup levels (CULs), remedial action levels (RALs)/practical quantitation limits (PQLs), and principal threat waste (PTW) thresholds (EPA, 2017; 2020; 2022a; 2022b) evaluate the nature and extent of buried contamination; and support the evaluation of potential short-term localized contaminant releases during dredging operations.

- Conduct porewater upwelling assessment to identify the potential groundwater discharge zones within the SIB Project Area and measure porewater seepage rates and hydraulic gradient within those zones.
- Conduct sampling and laboratory analysis of stormwater and stormwater solids at outfalls that drain to SIB to complete the source control sufficiency assessment and provide input parameters for modeling to assess the recontamination potential for the SIB.
- Conduct riverbank characterization, sample collection, and laboratory analysis to complete the source control sufficiency assessment; assess the erodibility of riverbank soils; determine the extent of contamination exceeding the ROD CULs, RALs, and PTW thresholds; and provide data necessary to support RD for remediation of contaminated riverbank soils.
- Conduct a bathymetric survey for estimating sedimentation and erosion trends based on comparing previous elevation data, identifying debris, and providing elevation data for completing a sitewide unified elevation model.
- Conduct a geotechnical investigation, sampling, and geotechnical laboratory testing to determine site-specific soil stratigraphy, groundwater elevations, site-specific geotechnical design parameters, and seismic design parameters; and to identify geologic hazards.
- Conduct shoreline and overwater structure inspections and complete structure condition assessments to support functional structure determinations and RA impact analysis as part of RD development.
- Conduct mobile terrestrial light detection and ranging (LiDAR) elevation data collection, side-scan sonar (SSS) imagery collection, magnetometer field measurements, and sub-bottom profiling, to support the development of the RD including material handling requirements and determining if and where large debris must be removed prior to RA, or where existing utilities may exist that should be considered in RD.
- Conduct SEDflume sampling; collected ADCP measurements and turbidity measurements using conductivity, temperature, and depth (CTD) sensors to convert to total suspended solids (TSS) concentrations; and collect free surface elevation measurements using pile-mounted pressure gages to facilitate analysis of wind-waves and vessel wakes to support hydrodynamics and sediment dynamics modeling.
- Conduct a habitat conditions survey to characterize the riparian area, active channel margin (ACM), shallow water area, and deep water area and collect the data needed to inform a Habitat Equivalency Analysis (HEA)-based approach to comparing pre- and post-remediation habitat conditions.
- Conduct facility owner/operator interviews to obtain structural information for potentially affected shoreline and overwater structures, understanding of current and future uses of each facility, and current and future vessel data, navigational depths, and identification of future maintenance dredge areas.

The PDI Work Plan (HGL, 2022a) discusses engineering analyses that rely on a combination of existing data and new data collected during the PDI. Engineering analysis reporting will be expanded upon within the BODR. The following engineering studies rely on the collective PDI dataset are referenced to transparently present the anticipated application of the field data to the RD.

1. Facility future use and RA impact evaluation
2. Facility operations and construction phasing assessment
3. Dredging study
4. Constructability assessment
5. Recontamination potential evaluation
6. Cap stability evaluations
7. Flood impact evaluation

This report presents a narrative interpretation of the results of the individual data collection and engineering study elements of the PDI and evaluates the sufficiency of the results for use in the BODR, Sufficiency Assessment Report (SAR), and RD Work Plan.

1.2 SWAN ISLAND BASIN PROJECT AREA DESCRIPTION

PHSS extends along 9.9 miles of the lower Willamette River in Portland, Oregon, from river mile (RM) 1.9 to RM 11.8. EPA listed PHSS on the National Priorities List in December 2000. The SIB Project Area is the active cleanup area between approximately RM 8.1 and RM 9.2 on the northeast side of the Willamette River. A federal navigation channel, with an authorized depth of -40 feet (ft) Columbia River Datum [2](CRD), extends from the confluence of the Lower Willamette River with the Columbia River to RM 11.6. The U.S. Army Corps of Engineers (USACE) maintains the navigation channel, which does not extend into SIB (Figure 1-1). The SIB Project Area is approximately 1.1 miles in length, 117 acres in size, and includes riverbanks from the top of the bank to the river.

The SIB Project Area is bounded by uplands of Swan Island and Mocks Bottom to the southwest and northeast, respectively. Except for slopes along the riverbanks, land surface with the SIB Project Area is generally flat, with elevations of about 34 to 44 ft North American Vertical Datum of 1988 (NAVD88). Land uses within and adjacent to the SIB Project Area consist of light and heavy industrial uses and limited commercial uses (Figure 1-2). Mixed residential/commercial and residential only land uses are located outside but in close vicinity to the SIB Project Area. SIB is an active navigable industrial waterway, and the shoreline hosts many structures supporting light and heavy industrial activities.

[2] 0 ft CRD = 5.28 ft NAVD88. CRD is used as the nautical chart datum for the Lower Willamette River. CRD is a reference plane that USACE established in 1912 by observing low water elevations at various points along the Columbia and Willamette rivers (USACE, 1966). Consequently, CRD is not a fixed/level datum but slopes upward as one moves upstream. River users can obtain the depth on a chart and apply tide or river-level gauge readings, relative to CRD, to compute actual water depth. Low water values are used for navigation charting to provide conservative depth values in the event accurate tide data are not available to the river user.

1.2.1 Waterway and Riverbanks

The SIB is a lagoon that is backwatered from the main Willamette River channel. Currents within the interior of the SIB move slowly in response to daily tidal cycles and during flooding events when rising river levels raise the water elevation within the SIB. Daily tides can cause water surface elevation to vary typically over a 3- to 4-ft range with a maximum range of approximately 6 ft. The interior waterway is approximately 1 mile long and 650 ft wide. Typical water depths range from 20 to 35 ft with shallowest depths in the interior of the lagoon and deepest areas located at the transition to the main river channel downstream of the end of the Swan Island Peninsula.

The riverbanks within the SIB are predominantly armored with riprap and/or protected from erosion by dense vegetation, bulkheads, or other shoreline structures. The SIB lagoon is roughly rectangular in shape, and the shoreline in its entirety was constructed by fill placement and other modification that occurred over many decades. The shoreline at the head of the lagoon includes a sandy beach consisting of dredge fill with sparse vegetation, and there are more vegetated and bare soil banks in a more natural condition along a larger portion of the Mocks Bottom shoreline than the shoreline of Swan Island.

1.2.2 In-Water and Shoreline Activities

The waterway within the SIB Project Area supports commercial/industrial, recreational, and government vessel traffic related to the ongoing uses of the shoreline. Shoreline facilities support light and heavy industrial uses, vessel mooring, U.S. Coast Guard (USCG) operations, U.S. Navy operations, and public access.

1.2.3 Upland Properties

Upland areas around the SIB Project Area include 11 operating federal, Port of Portland (Port), and private shoreline parcels with stormwater basins that discharge stormwater runoff to the SIB. The SIB upland area includes approximately 588 acres of mostly developed impervious area with primarily light industrial uses. Stormwater discharges from these upland areas to the SIB from five large City of Portland (City) outfall basins (M-1, M-2, M-3, S-1, and S-2) and from most of the shoreline parcels via small non-City outfalls and drainage areas on federal, Port, and private parcels.

1.2.4 Site Development History

The Portland area was first inhabited about 11,000 years ago by small, mobile groups who hunted and fished in the forest, prairies, wetlands and rivers. From these earliest inhabitants came Chinookan-speaking peoples, including the Chinook, Clackamas, Kathlamet, Multnomah, Tualatin Kalapuya, Molalla, and many other tribes and bands. These groups created communities and summer encampments along the Columbia and Willamette rivers and harvested and used the plentiful natural resources of the area for thousands of years. British and American fur companies entered the basin beginning in the 1810s. The Oregon Donation Land Act of 1850 offered free land to white settlers, who quickly laid claim to 2.5 million acres of land, including all of what is now Portland (Oregon Historical Society, 2014; 2023).

Since that time, the Portland Harbor reach of the Willamette River, including the SIB Project Area, has been redirected, straightened, filled, and deepened by dredging. Most of the riverbank has been filled, stabilized, and/or engineered for industrial or Port operations with riprap, bulkheads, and overwater piers and docks. (City of Portland [City], 2014).

The SIB was historically part of the main channel of the Willamette River and Swan Island was not connected to the shoreline area known as Mocks Bottom. A natural bar repeatedly formed at the island, which required maintenance dredging from the 1870s through 1920s to keep the ship channels open (Oregon Historical Society, 2014). The main river channel flowed east of the island adjacent to the marshy lowlands of Mocks Bottom, curving into the base of the high bluff, above which is Mock's Crest.

The Port purchased Swan Island in 1922 and subsequently received permission from Congress to permanently close the north channel of Swan Island and dredge a 35-by-1,155-foot channel on the south side of the island. River sediments dredged as part of the project were deposited on Swan Island to raise the surface elevation and construct a causeway connecting the island to the eastern shore of the river (Oregon Historical Society, 2014). This allowed industrial development of the island as Portland's first airport. By 1940, the airport outgrew the island and was relocated.

The island then became the home of a Kaiser shipyard and associated worker housing. Between 1942 and 1945, 147 T-2 tankers[3] were built on the island (Oregon Historical Society, 2014). Consolidated Builders, a Kaiser affiliate, scrapped decommissioned troop landing ships at Swan Island between 1947 and 1949 and the eight shipways constructed during the military era were filled, or partially filled, with dredged materials between 1950 and 1962 (EPA, 2016). After World War II, Swan Island became the center for Port of Portland operations, including the dry dock and ship repair facilities (Oregon Historical Society, 2014). The current configuration of dry docks at the north end of the island and berths along Swan Island Basin and the Willamette River was largely completed by 1979. Heavy industrial uses continue at the Shipyard Commerce Center on Swan Island (Figure 1-2).

The Mocks Bottom area also was subsequently filled with dredge material for industrial development. About half of Mocks Bottom had been filled by 1961, filling was complete by 1974, and the area was fully developed by 2007 with industries related to truck manufacturing, shipping and transportation, marine salvage, and military uses (EPA, 2016). According to USACE records, between 1962 and 1973, Mocks Bottom was filled with over 5 million yards of material obtained in part from the deepening and widening of the river between RM 7.5 and the Broadway Bridge (Maul Foster and Alongi, 2002). The area was developed for light industrial use in the 1960s through the 1990s (City, 2014).

Since initial development of Swan Island and Mocks Bottom, additional placement of dredge fill has periodically occurred. The fill history of the area surrounding the SIB Project Area is illustrated on Figure 1-3. The history was generated based on a review of historical aerial photos (Maul Foster

[3] The T-2 tanker was a class of oil tanker constructed and produced in large numbers in the U.S. during World War II. They were used to transport fuel oil, diesel fuel, gasoline, and sometimes black oil-crude oil.

and Alongi, 2002; USACE, 1979; EPA, 2016). According to USACE, the upstream end of SIB was used for hydraulic pipeline disposal of material dredged from the main channel of the Willamette and for bottom dumping of material barged from the Portland Harbor berthing areas and that periodic rehandling of the material from the lagoon to Mocks Bottom was done to restore depth required for bottom dumping of sediment from split hull barges (USACE, 1979). The Port completed fill placement at the head of the basin between approximately 1977 and 1989, and other parties are reported to have also placed dredged materials at the head of the basin. In 1977, the Port placed approximately 900,000 cy of material derived from the excavation of the new Swan Island drydock in the northwestern portion of Mocks Bottom (USACE, 1979). Additional dredge material reportedly came from the Portland shipyard berth maintenance dredging and maintenance dredging of the Willamette River. The placement of dredged materials at the head of the basin was conducted in accordance with the 1973 Lower Willamette River Management Plan prepared by the Oregon Division of State Lands (Port, 1999).

1.3 PRE-DESIGN INVESTIGATION EVALUATION REPORT ORGANIZATIONAL OVERVIEW

The report is organized into the following sections:

- Section 1.0 presents an introduction, including the objectives and scope of the PDI;
- Section 2.0 describes the PDI approach;
- Section 3.0 presents a narrative interpretation of the results;
- Section 4.0 summarizes the conclusions of the PDI; and
- Section 5.0 lists the references cited in this PDI ER.

Supporting information is provided in the following appendices:

- Appendix A Surface and Subsurface Sediment Sampling Data Report
- Appendix B Porewater Upwelling Report
- Appendix C Stormwater Sampling Data Report
- Appendix D Riverbank Characterization Data Report
- Appendix E Bathymetric Survey Summary Report
- Appendix F Geotechnical Data Report
- Appendix G Structure Condition Assessment Report Combined with Shore and Overwater Inspections Data Report
- Appendix H Debris and Utility Identification and Survey Report
- Appendix I Hydrodynamics and Sediment Dynamics Survey Report
- Appendix J Habitat Conditions Survey Data Report
- Appendix K Facility Owner/Operator Information Summary Report
- Appendix L Contaminated Sediment 3D Extent Technical Memorandum
- Appendix M Contaminated Riverbank Soil Extent Technical Memorandum

2.0 SUMMARY OF PRE-DESIGN INVESTIGATIONS PERFORMED

A data gap analysis was performed to identify data gaps to be filled during the PDI to support development of the RD (Table 2-1). Data gaps were addressed using a combination of field data collection and engineering analysis. This section summarizes the approach that was utilized in the SIB Project Area for the field sampling efforts and engineering studies. Complete descriptions of the investigations performed and photographs documenting the work conducted are contained in the appendices referenced herein.

The field activities described in this section flow from the data gap evaluations and sampling designs described in the PDI Work Plan and the Field Sampling Plan (FSP) portion of the PDI Work Plan (HGL, 2022a). Field activities include sediment-related field sampling activities, porewater upwelling survey activities, stormwater and stormwater solids sampling, riverbank evaluation and riverbank soil sample collection, bathymetric surveying, geotechnical investigation, structure inspections, utility and debris surveys, hydrodynamics and sediment dynamics surveys, habitat condition survey, and facility owner/operator interviews.

2.1 CHEMICAL CHARACTERIZATION- SURFACE/SUBSURFACE SEDIMENTS

Sediment data requirements for the RD consist of characterization and delineation of PHSS contaminants of concern (COCs) in both surface and subsurface sediments to refine the SMA boundary and identify the depth of contamination. SMA boundaries are defined by surface and subsurface sediment RAL and PTW exceedances. Data gaps in the existing SIB Project Area surface/subsurface sediment dataset were identified in the PDI Work Plan (HGL, 2022a) and are summarized in Table 2-1. The sediment investigation was conducted to refine the lateral and vertical extent of COCs; evaluate the nature and extent of buried contamination; and support the evaluation of potential short-term contaminant releases during dredging operations.

The sediment investigation was performed from July 5 through September 7, 2022. HGL collected 4 surface grab samples, 170 sediment cores, and 3 bulk sediment and water samples during a single field mobilization with five periods of work. Sample locations were laid out on a 150-ft square grid (Figure 2-1).

The 4 grab samples of surface sediment were collected using a hydraulic power grab sampler, and 57 additional surface samples were collected and analyzed from the uppermost foot of sediment cores. A total of 188 subsurface sediment cores from 170 locations were collected using a vessel-deployed vibratory core tube driver (vibracore), processed at 1-ft intervals, and analyzed from 1 ft below mudline to between 6 and 15 ft below mudline depending on target depth. Samples from depth intervals below 6 ft or 15 ft, depending on total core depth, were frozen and archived. A total of 269 archive samples from 170 core locations were selected for chemical analysis to refine the horizontal and vertical extent of contamination, including potential locations of buried contamination, following review of the initial results. Sediment samples were submitted for laboratory analysis of organochlorine pesticides (OCPs), polycyclic aromatic hydrocarbons (PAHs), bis(2-ethylhexyl)phthalate (BEHP), total petroleum hydrocarbons as diesel range and residual range organics, tributyltin, total organic carbon (TOC), PCBs as Aroclors and congeners, metals/mercury, and PCDD/PCDF.

Bulk sediment and water were used to prepare dredging elutriate test (DRET) from three sample locations selected based on results from historical sediment data. Bulk site water samples were collected from the middle of the water column at each location. Prepared DRET samples were analyzed using the same methods as sediment grab and core samples. Additional details on the bulk sediment and water sample collection activities are available in Appendix A, Section 2.3.

The surface and subsurface sediment sampling effort was evaluated against the acceptance criteria described in the Uniform Federal Policy (UFP)-Quality Assurance Project Plan (QAPP), which is included as an appendix to the PDI Work Plan (HGL, 2022a). Compliance with the acceptance criteria is described in detail in Appendix A, Section 2.4, and compliance with the quality assurance/quality control (QA/QC) criteria is described in detail in Appendix A, Sections 3.5 and 3.6. Generally, where discrepancies were identified, the changes were consistent with contingencies described in the FSP, or in Field Change Request (FCR) Forms #8, #11, #12, and #13 (Table 2-1; HGL, 2022c-f). The results of the chemical characterization of surface and subsurface sediments in the SIB Project Area (Appendix A, Section 4.0) are summarized in Section 3.1.

2.2 POREWATER UPWELLING

Locating porewater upwelling areas is necessary to identify and delineate areas where sediment capping would be potentially feasible, to design sediment caps, and evaluate sediment cap effectiveness. The lack of porewater data in the SIB Project Area to address these needs was identified as a data gap (Table 2-1). The physical configuration of the waterway and surrounding landscape, combined with the history of dredging and filling to form both the landscape and the waterway, suggest that porewater migration is likely a limited process in this setting. That inference is not sufficient for RD, and field data and analysis are necessary to either confirm this or identify and characterize areas where porewater migration could affect RD.

A porewater upwelling assessment was completed to identify and delineate areas where sediment capping would be potentially feasible and to support the design of sediment caps and their effectiveness. The efforts consisted of two phases: a Trident Probe transition zone water (TZW)[4] screening survey and an UltraSeep and differential pressure piezometer (DPZ) survey (Appendix B).

The Trident Probe TZW screening survey was conducted from March 4 through 12, 2022 (Appendix B, Section 2.1). The TZW screening survey included collecting temperature and conductivity measurements in porewater and overlying surface water as screening level indicators of potential upwelling zones. Trident Probe measurements were collected along 21 transects at 127 stations. (Figure 2-2). The results of the first phase of the porewater upwelling study (Appendix B, Section 4.1) are summarized in Section 3.2.

[4] TZW is defined as porewater within the shallow sediment column where interaction between surface water and groundwater would occur.

An UltraSeep and DPZ survey was conducted from July 6 through July 25, 2023 (Appendix B, Section 2.2). The objective of this work was to provide quantitative measurements of groundwater seepage rates based on target upwelling zones identified in the first phase of the porewater upwelling characterization work. A collection of specific seepage rate measurements for a period of approximately 50 hours (two complete tidal cycles) was completed using the UltraSeep system at 21 target stations (Figure 2-2). Then, zonally co-located and temporally overlapping vertical hydraulic gradient measurements were collected using the DPZ system at seven target stations (Figure 2-2). The results of the second phase of the porewater upwelling study (Appendix B, Section 4.2) are summarized in Section 3.2.

2.3 STORMWATER OUTFALL AND CONVEYANCE SYSETM

There are 33 active outfalls, including 5 large City, and 28 small outfalls at federal (at USCG Marine Safety Unit), Port, and private parcels[5] that discharge to the SIB Project Area from the surrounding upland areas (Figure 2-3). Four of the shoreline facilities have active National Pollutant Discharge Elimination System (NPDES) permits, two have No Exposure Certifications, and two have implemented Best Management Practices (Figure 2-3). Six of the shoreline properties with outfalls are listed as current or former Oregon Department of Environmental Quality (DEQ) Cleanup Program sites. Review of the existing data revealed that there was a lack of adequate data to assess potential recontamination chemical loading from public and private outfalls to determine source control sufficiency and complete the source control sufficiency assessment.

Stormwater outfall and conveyance system sampling was conducted to address the data gaps summarized in Table 2-1, and provide data necessary to complete the source control sufficiency assessment and provide input parameters for modeling to assess the recontamination potential for the SIB. PDI activities included collection of stormwater and stormwater solids samples from City conveyance systems including the City M-1, M-2, M-3, S-1, and S-2 outfall basin conveyance systems and stormwater samples from six non-City conveyance systems with direct discharges to SIB (Figure 2-3).

Stormwater samples were collected from City outfall basins using high-volume sampling (HVS) systems to accommodate the detection of ultra-low concentrations of organic compounds during three storm events meeting criteria established in the DEQ and EPA Joint Source Control Strategy (JSCS) (DEQ and EPA, 2005). The spring HVS samples were collected May 5, 2022, the fall HVS samples were collected October 21, 2022, and the winter HVS samples were collected March 9, 2023. Additional details on HVS activities are provided in Appendix C, Section 2.2.1. HVS media samples were analyzed for PCB congeners, PCDD/PCDFs, and OCPs to the particulate and dissolved fraction concentrations, respectively. Bulk water samples were collected concurrently with the HVS media, which were centrifuged, then analyzed for TOC and TSS. Following

[5] There are 15 additional outfalls at the Shipyard Commerce Center that are inactive and discharge only if a precipitation event exceeds the design storm for the conveyance system. The number of outfalls differs from that shown on Map 3.2-22j of the 2016 Remedial Investigation (EPA, 2016) because HGL plotted only those outfalls that had confirmed upland discharges during sampling location reconnaissance described in Section 2.1 of Appendix C, Stormwater Sampling Data Report.

centrifuge, limited mass of centrifuged sediment was available from each bulk stormwater sample for only metals analysis.

During the same three storm events, stormwater samples were collected from one federal, one Port, and four private outfalls via portable autosamplers to provide a "snapshot" of COC concentrations discharging to the SIB during rain events meeting the JSCS criteria. Additional details on automatic stormwater sampling activities are provided in Appendix C, Section 2.2.2. These samples were submitted for laboratory analysis of ethylbenzene, PAHs, BEHP, total petroleum hydrocarbons as diesel range and residual range organics, tributyltin, TOC, total metals, PCBs as Aroclors and congeners, and PCDD/PCDF.

In-line sediment (ILS) samplers were installed in laterals within each of the five City conveyance systems (M-1, M-2, M-3, S-1, and S-2). ILS sample containers were retrieved seasonally, and collected sediment samples were composited to be representative of the accumulation of stormwater sediment during the wet and dry seasons. ILS samples were targeted to be analyzed for the same analytes as the stormwater samples, but actual analyses varied based on the total available mass of the composited sample. One manual grab stormwater solid sample was collected from outfall basin M-2 on June 17, 2023; this was the only instance during the investigation period where sufficient accumulated sediment (8-ounces or more) was observed. The same analyses were performed on the manual grab sample as the stormwater samples.

Near-continuous water level and velocity measurements were collected over the investigation period, using water-level-velocity loggers in City outfall basins, to be converted to flow and volume using the cross-sectional geometry of flow in the pipes. Data retrieval and maintenance for flow meters occurred on approximately 1-month intervals.

The stormwater and stormwater sediment sampling efforts were evaluated against the PDI Work Plan (HGL, 2022a). Deviations or changes are described in detail in Appendix C, Section 2.2. Generally, where discrepancies were identified, the changes were consistent with contingencies described in the FSP or in FCR Forms #1 and #4 (Table 2-1; HGL, 2022g-h). The results of the stormwater outfall and conveyance system investigation (Appendix C, Section 3.0) are summarized in Section 3.3.

2.4 RIVERBANK CHARACTERIZATION

The ROD (EPA, 2017) identified three riverbanks within the SIB Project Area as areas with known contamination that exceed RALs and/or CULs for various ROD COCs. Evaluation of the data gaps identified in the PDI Work Plan (HGL, 2022a), and summarized in Table 2-1, determined that data were not available to characterize riverbank stability and the presence of COCs in riverbank soil. Riverbank characterization was conducted to address data gaps and included a visual inspection of the entire riverbank within the SIB Project Area; collection of bank stability analysis parameters; and grab soil sampling from available top of bank (TOB), ordinary high water (OHW) mark, and at or below mean low water (MLW)[6] locations and depth intervals.

The SIB riverbank was divided into 126 transects (1 per every 100 lineal ft of riverbank) (Figure 2--4). Riverbank characterization was conducted in two phases/mobilizations. The first phase of the riverbank characterization was performed in February and May 2022 and included an assessment survey of the entire riverbank within the SIB Project Area. The data collected during the first phase were used to complete a preliminary bank stability analysis using the Bank Assessment for Non-Point Source Consequences of Sediment (BANCS) model (Rosgen, 2014), including BEHI and NBS determinations (Appendix D, Attachment A).[7]

In October 2022, riverbank soil sampling for chemical characterization was attempted at 3 elevations and 3 depth intervals at each elevation from riverbank transect locations. While 126 transects were targeted, 7 locations did not have sufficient material to sample or were not accessible. Therefore, the samples were collected from 119 transect locations. All transects with accessible, sampleable materials were sampled. Samples were not collected at or below MLW where fine-grained material was not present or where no potentially erodible material was exposed.

The riverbank soil sampling effort resulted in the collection and laboratory analysis of 276 samples from surface intervals (90 TOB, 111 OHW, 75 MLW); 95 samples from 1- to 2-ft depth interval (40 TOB, 31 OHW, 24 MLW); and 28 samples from 2- to 3-ft depth interval (17 TOB, 10 OHW, 1 MLW) (Figure 2-4). Additional details on riverbank soil sampling activities are provided in Appendix D, Section 3.2. Surface samples were submitted for laboratory analysis of OCPs, PAHs, BEHP, total petroleum hydrocarbons as diesel range and residual range organics, tributyltin, TOC, PCBs as Aroclors and congeners, metals/mercury, and PCDD/PCDF. Samples from the 1 to 2 and 2 to 3 ft bgs depth intervals were frozen and archived, and following review of initial sample results, were analyzed to bound contamination on a location-specific basis.

The riverbank soil sampling effort was evaluated against the PDI Work Plan (HGL, 2022a). The riverbank soil analytical testing program was evaluated against the acceptance and performance criteria described in the UFP-QAPP (HGL, 2022a). Generally, where discrepancies were identified, the changes were consistent with contingencies described in the FSP or Riverbank Sampling Plan. Compliance with the QA/QC criteria is described in detail in Appendix D, Section 3.8. The results of the riverbank characterization investigation (Appendix D, Section 4.0) are summarized in Section 3.4.

[6] Figure 3 of *Guidance for River Bank Characterizations and Evaluations at the Portland Harbor Superfund Site* (EPA, 2019) presents riverbank conceptual diagrams as cross sections and includes datum for OHW (20.08 ft NAVD88), mean high water (MHW; 10.14 ft NAVD88), and MLW (7.28 ft NAVD88). These data were used in the planning and execution of SIB riverbank characterization.

[7] Geotechnical and coastal engineers on the SIB RD Project Team are concurrently performing more robust slope stability analyses.

2.5 BATHYMETRIC SURVEY

Bathymetric and topographic survey data support various analyses on hydrodynamics and sediment dynamics, cap stability, riverbank stability, recontamination potential, and overall RD. Several sources of data are available to potentially address RD requirements; however, the data gap analysis identified the need for a new multibeam bathymetry survey to provide the most recent data for RD (Table 2-1). The data gap analysis also determined that a topographic survey was not required for the PDI, but will be needed to ensure dense coverage in specific locations to support the RD.

A multibeam bathymetry survey was conducted between April 4 and April 7, 2022 (Appendix E). The riverbed surface was imaged using an R2 Sonic 2024 Multibeam EchoSounder (MBES). Bathymetry data were acquired in accordance with the USACE Engineer Manual 1110-2-1003 Hydrographic Surveying (USACE, 2013) per the Survey and Quality Control Plan (Mott MacDonald, 2022). Approximately 175 percent coverage with multibeam data was achieved. A statistical test completed with the SIB Project Area data illustrates that 100 percent of the multibeam survey data are in the International Hydrographic Organization Special Order category. Position data were post-processed with inertial processing software using Station PDXA, which allowed the creation of a more accurate and robust Smoothed Best Estimate of Trajectory solution that was applied to the data for positioning corrections and horizontal and vertical control throughout the duration of the survey. Data were gridded at the highest resolution that the data coverage allowed, resulting in a grid cell size of 1 ft by 1 ft. Analysis conducted prior to the survey indicated that slopes were relatively flat in the multibeam survey area and 1-ft by 1-ft gridded data would meet the project objectives. Coverage was optimized at SIB by observing vessel movements in an attempt to survey while vessels were not at berth and revisiting areas when feasible based on the vessel movements and tides, and maneuvering the vessel into the tightest possible areas while maintaining safe operations. The shallowest areas of SIB could not be surveyed due to river stage at the time of the survey. Additional details of the MBES survey, control checks, and calibration, validation, and data processing are included in Appendix E, Section 2.0. The results from the bathymetric survey are summarized in Section 3.5 with additional information available in Appendix E, Section 3.0.

2.6 GEOTECHNICAL SITE INVESTIGATION

Geotechnical site characterization evaluates recontamination potential, cap stability, and overall RD. Evaluation of the data gaps identified in the PDI Work Plan (HGL, 2022a), and summarized in Table 2-1, indicated that a project-specific geotechnical site investigation was required to adequately characterize the SIB Project Area. Specific data gaps identified include site soil stratigraphy, groundwater conditions, geotechnical design parameters, geologic hazards, and seismic design parameters.

A site-specific geotechnical sampling program consisting of soil borings and cone penetration tests (CPTs), and geophysical logging was performed to explore the SIB Project Area's subsurface conditions and to obtain samples for geotechnical laboratory testing program (Appendix F).

The SIB Project Area geotechnical sampling program consists of 30 exploratory borings, advanced both in SIB (in-water) and the surrounding upland areas (Figure 2-5). Geotechnical drilling and sampling activities were performed from May 12, 2022 through August 14, 2022. Fifteen upland geotechnical borings were drilled using a combination of hand auger, hollow stem auger, and rotary wash methods to depths ranging from 71.5 ft to 121.5 ft below adjacent grade (Appendix F, Table 3-1). Fifteen in-water geotechnical borings were drilled within SIB via drill ship, which was equipped with a skid-mounted Mobile B80 drill, a central moon-pool, and hydrostatically controlled spuds capable of holding the vessel in water depths of up to 55 ft. In-water boring depths ranged from 60 ft to 95.5 ft below the adjacent mudline (Appendix F, Table 3-1). At the completion of drilling, open boreholes were abandoned by tremie placement of cement grout. Geotechnical borehole logs were prepared for each completed geotechnical boring (Appendix F, Attachment B). Samplers were driven or pushed at each boring to obtain soil samples for visual-manual soil classification and for geotechnical laboratory testing. Standard Penetration Test (SPT) and modified California samplers were driven into undisturbed soil using a 140-pound automatic hammer, freefalling 30 inches and correction factors were applied, as needed, following calibrations. Pocket penetrometer and handheld torvane tests[8] were performed on select cohesive samples to estimate the values of the unconfined compressive strength and undrained shear strength of cohesive samples. Field tests for plasticity, dry strength, dilatancy, and toughness were also performed on appropriate cohesive samples to characterize the soil in accordance with ASTM D2448, *Standard Practice for Description and Identification of Soils* (Visual-Manual Procedures). Soil classifications were made in the field from samples and auger cuttings. Field classifications were re-evaluated after further examination and laboratory testing. Soil samples obtained from the borings were packaged and sealed in the field to reduce moisture loss and disturbance, then transported to an appropriate geotechnical laboratory for analysis. Additional details on the geotechnical investigation activities are provided in Appendix F, Section 3.0.

The SIB Project Area geotechnical in-situ testing program consisted of CPTs at 13 in-water locations and 3 upland locations from May 12, 2022, through August 10, 2022. Upland CPTs were advanced to a depth of 100 ft and in-water CPTs were advanced to depths ranging from 40 ft to 65 ft below the adjacent mudline. Porewater pressure dissipation testing to evaluate static piezometric pressure was performed at both upland and in-water CPT locations. A detailed description of the methodology, data acquisition and analysis procedures, and instrumentation used is presented in Appendix F, Attachment C.

In situ small-strain stress wave velocity measurements for both compression (P) and shear (S) waves were collected at select upland geotechnical boring locations. Shear-wave velocity measurements were collected at select upland and in-water CPT locations. P and S wave (PS-wave) suspension logging was performed to measure P and S wave velocities through the soils encountered at upland geotechnical boring locations B-04, B-07, B-09, and B-12. PS-wave logging was performed from July 28, 2022, through August 12, 2022. Downhole-type S wave velocity measurements, or sCPT measurements, were collected at all three upland CPT locations and at five in-water CPT with the addition of downhole S wave velocity measurements collected at approximately 3-ft intervals for the full depth of the sounding. A detailed description of the

[8] Pocket penetrometer and the handheld torvane tests provide useful correlations to the shear strength as measured in the laboratory, and while not used directly in design, the data collected will aid in the development of soil profiles and soil strength parameters for use in engineering analyses.

methodology, data acquisition and analysis procedures, and instrumentation used is presented in Appendix F, Attachment C.

Testing was performed on samples obtained during geotechnical sampling to evaluate the physical properties of the soils for material classification and to support the development of geotechnical design parameters. Before geotechnical laboratory testing, each soil sample was inspected and classified according to the visual-manual procedures to backcheck the visual-manual classifications made in the field and to ensure consistency between soil classifications made by different field engineers. Following field classification backchecking and sample review, representative soil samples were identified, and specific geotechnical laboratory tests were assigned. Samples were selected based on color, physical appearance, and structural features. Samples with known discontinuities or signs of disturbance were considered for index tests but not assigned tests to determine soil strength and consolidation characteristics.

Geotechnical laboratory tests to determine basic soil index properties for material classification included moisture content, unit weight, grain size distribution, percent passing No. 200 Sieve, Hydrometer Analysis, Atterberg Liquid Limit, Plastic Limit, and Plasticity Index of Soils, Organic Content, and Specific Gravity. Geotechnical laboratory tests to determine the soil strength and consolidation characteristics included Unconsolidated-Undrained Triaxial Compression Test, Consolidated Undrained Triaxial Compression Test, and Direct Shear Test of Soils Under Consolidated Drained Condition. Soil Consolidation Characteristic Testing was also completed, including Direct Shear Test of Soils Under Consolidated Drained Condition.

The geotechnical investigation program was evaluated against the PDI Work Plan (HGL, 2022a). Deviations or changes are described in Table 2-1. Generally, where discrepancies were identified, the changes were consistent with contingencies described in the FSP or in FCR Forms #7, #10, and #14 (Table 2-1; HGL, 2022i-k). The results from the geotechnical site investigation are summarized in Section 3.6 with additional information available in Appendix F, Section 5.0.

2.7 SHORELINE AND OVERWATER STRUCTURE INSPECTIONS AND STRUCTURE CONDITION ASSESSMENTS

The nature and proximity of the remedial technology specified near or under structures dictates the need to characterize the shoreline and overwater structure to inform RD. Evaluation of the data gaps identified in the PDI Work Plan (HGL, 2022a), and summarized in Table 2-1, indicated that as-built information for all the overwater structures, existing recent condition assessment results, intended future use information, and repair history information was needed.

Topside, above-water, and underwater inspections were conducted to determine the physical condition of the primary structural components of the substructure and superstructure at each shoreline/overwater structure (Appendix G). Structural element inspection included both visual and tactile methods. Inspections followed the American Society of Civil Engineers (ASCE) guidance for the inspection and assessment of waterfront facilities (ASCE, 2015).

The inspections entailed a topside and above-water screening-level visual and tactile inspection of readily accessible, main structural systems, components, and fender piles by foot and by boat, and an underwater dive inspection of all facilities. The topside and above-water screening-level inspections were conducted between April 25 and May 27, 2022. The screening inspections were used to make further inspection recommendations including focus areas for the dive inspections. The inspections were conducted above the deck of each structure, first on foot (topside), and then by boat to observe the above-water components beneath the deck. During the topside and above-water screening-level inspections, physical testing methods including sounding, drilling core measurements, pitting measurements, drilling resistance measurements and steel thickness measurements were used to help inform estimates on remaining structural capacity. Additional details on the topside and above-water screening level inspections are provided in Appendix G, Section 2.1.1.1. Access for the topside and above-water areas to most facilities was unrestricted; however, access to the topside of the U.S. Navy pier was not granted. Topside conditions for the U.S. Navy pier were referenced from Waterfront Facilities Inspections and Assessments at Navy Operation Support Center Portland (Appledore Marine Engineering, LLC, 2019).

Dive inspections were carried out between July 17 and July 28, 2022. During the dive inspections, a visual and tactile inspection was conducted on all structures and sampling and nondestructive testing or partially destructive testing inspections were performed on select structures. An inspection using underwater resistance drilling equipment was performed on portions of the timber substructure elements and water depth soundings were taken off the face of each structure. Additional details on the dive inspections are provided in Appendix G, Section 2.1.1.2.

Condition assessments were conducted for the primary structural system components of each overwater structure, based on the results of the structure inspections described above. The assessments were conducted to describe the extent of observed deterioration and significance of the deterioration on the ability of the structures to carry current and future design loads and those most likely to be negatively impacted by the RA.

Generally, the assessed condition of each component depends on the scope, severity, and distribution of damage, types of components affected (their structural "sensitivity"), location of defect on component (relative to point of maximum moment/shear), and serviceability. Condition assessment ratings were assigned for each structure following ASCE guidelines for the inspection and assessment of waterfront facilities (ASCE, 2015). The overall condition assessment rating for each structure is based on the condition assessment ratings for the individual components that comprise the structure (Appendix G, Table 2-1). The results of the shoreline and overwater structure inspection survey (Appendix G, Section 3.0) are summarized in Section 3.7.

2.8 EXISTING UTILITIES AND DEBRIS IDENTIFICATION SURVEYS

Dredging design requires information characterizing the location and nature of debris to inform selection of dredge equipment, determine material handling requirements, and determine whether large debris must be selectively removed before dredging proceeds. Evaluation of the data gaps identified in the PDI Work Plan (HGL, 2022a), and summarized in Table 2-1, indicated that a survey program was required to locate and document potential obstacles to be encountered and/or removed during RA. The utility and debris surveys were conducted between April 5 and 9, 2022 (Appendix H).

Underwater debris was located and identified to evaluate whether it requires removal as part of the RA and to provide data to assist with interpreting bathymetry data gaps. SSS imagery was collected from a vessel-towed unit on April 5 and 6, 2022, along 28 vessel tracks (Appendix H, Figure 2-2), to provide broader coverage and capture debris in shallower water where MBES could not effectively be collected. The survey included SIB sitewide areas with submerged debris, riverbanks, and marine structures that the RA could potentially affect. The survey boundaries included complete nearshore coverage to the extent feasible based on obstructions encountered in the field.

The RD requires identification of ferrous material both above and below the mudline that could pose a hazard during any dredging or capping activity, including unexploded ordnance. A vessel-towed magnetometer survey was conducted on April 6 and 8, 2022, along track lines (Appendix H, Figure 2-3), to identify magnetic object and/or utility detection.

A vessel-mounted mobile LiDAR survey was conducted on April 7, 2022, along the riverbank area and marine structures (Appendix H, Figure 2-1). The survey collected new location and elevations data for marine structures and emergent debris, as well as riverbank elevations. The survey area was defined by the boundaries of the study area together with riverbanks and marine structures potentially affected by the RA.

The RD requires geological information and identification of buried debris that could pose a hazard during dredging or capping. Sub-bottom profiling (low-frequency sonar) illustrated geological formations, identified the presence of buried debris/utilities, and estimated their locations to determine whether they could affect the RA. Geophysical data were collected from a vessel-mounted sub-bottom profiler on April 7 and 8, 2022, along 30 transects (Appendix H, Figure 2-4).

A desktop study was conducted to identify the presence of buried utilities (water, sewer, electrical, communications, pipelines, etc.). Sub-bottom and magnetometer surveys, navigation chart data, utility locate, and the active stormwater outfall inventory (Appendix H, Table 4-3) were consulted to evaluate the presence of utilities in the project area, for future use in determining potential impacts during the RA.

The results of the debris and utility identification and surveys (Appendix H, Section 4.0) are summarized in Section 3.8.

2.9 HYDRODYNAMICS AND SEDIMENT DYNAMICS

Hydrodynamics and sediment dynamics data collection can confirm the CSM and evaluate sources and pathways of sediment and contaminants, including sediment resuspension as well as transport and deposition of COCs. Hydrodynamics and sediment dynamics studies will be applied during the RD to support evaluation of sediment resuspension and scour, recontamination potential, sediment cap stability, riverbank stability, and other aspects of overall RD. Several sources of data are available to potentially address RD requirements. However, the data gap analysis identified the need for additional current, water level, suspended sediment, wind-wave, and vessel wake measurements data, in addition to desktop studies and numerical modeling to evaluate sediment movements (recontamination potential, cap stability) (Table 2-1).

The data collection program included SEDflume near-surface sediment cores, ADCP measurements, free surface elevation measurements, and turbidity measurements using CTD sensors (Appendix I). ADCP measurements by bottom-mounted and vessel-mounted sensors were used to evaluate water velocities in the SIB and Willamette River. ADCP measurements were performed using two stationary bottom-mounted ADCPs in SIB and a vessel-mounted ADCP along transects in SIB and the Willamette River (Figure 2-6). The ADCPs measured current speed and direction in a prescribed number of bins vertically through the water column. Vessel-mounted current velocity (ADCP) measurements were collected during low flows. Bottom-mounted current velocity (ADCP) measurements were collected during both low flows and flows reaching approximately 90,000 cfs. Wave gages were deployed during a period of low flows and higher flows reaching approximately 112,000 cfs. These higher flows do not represent extreme flows and are typically exceeded annually.

Turbidity measurements were completed, which were used to estimate TSS concentrations, at two bottom-mounted stations and at vertical profiles taken during bottom-mounted sensor deployment and recovery. CTD sensors were mounted on each of the two bottom-mounted ADCP platforms (Appendix I, Figure 2-4). The CTDs recorded near-bottom turbidity levels continuously for approximately 2 months. Real-time CTD vertical profiles (casts) were collected during deployment of the vessel-mounted ADCP transects to measure vertical turbidity profiles at different times and locations, including at the bottom-mounted sensor locations. Fifteen CTD profiles were collected (Appendix I, Figure 2-4), each for approximately 2-minutes and included depth, turbidity, conductivity/salinity, temperature, and pH. CTD sensor measurements were converted to TSS concentrations following laboratory calibration to demonstrate levels of suspended sediment present in SIB.

Four independent logging, non-directional wave gages were deployed to record free surface elevations/gage depths for evaluation of wave conditions (Appendix I, Figure 2-3). The wave gages were deployed on March 24, 2022 and recovered on May 24, 2022. The gages were setup to measure wave periods between 0.5 and 512 seconds, which was sufficient to measure relevant water surface fluctuations including wind-waves, vessel-generated Kelvin wakes (transverse and divergent surface wakes), and vessel-generated long period waves (pressure fields).

SEDflume sampling and a subsequent laboratory study were performed to provide surface sediment erodibility, grain size, and bulk density information. Sediment samples were collected throughout SIB, as well as in the Willamette River channel near the SIB entrance. Samples were collected at 30 locations over a 3-day period from February 21 to February 23, 2022 (Appendix I, Section 2.1). Additional information regarding the SEDflume sampling techniques is provided in Appendix I, Attachment B.

The hydrodynamics and sediment dynamics survey program was evaluated against the PDI Work Plan (HGL, 2022a). Deviations or changes are described in Table 2-1. Generally, where discrepancies were identified, the changes were consistent with contingencies described in the FSP or in FCR Forms #2, #3, #6, and #15 (Table 2-1; HGL, 2022l-o; 2023b). The results of the hydrodynamics and sediment dynamics surveys (Appendix I, Section 3.0) are summarized in Section 3.9.

2.10 HABITAT CONDITIONS SURVEY

A habitat conditions characterization was completed to inform an HEA-based approach to comparing pre- and post-remediation habitat conditions. The data gaps outlined in the PDI Work Plan (HGL, 2022a) and summarized in Table 2-1 indicated that a reconnaissance level survey of the riparian area, active channel margin, and shallow and deep water areas within the SIB Project Area was appropriate.

A field reconnaissance survey was conducted between October 3 and 7, 2022, and April 4 and 5, 2023. The survey encompassed riparian, riverbank, and shallow water areas within the SIB Project Area (Figure 2-7). It qualitatively documented both bank conditions in riparian and riverbank areas and substrate conditions within the shallow nearshore area. Habitat data collection transects were spaced at 100-ft intervals along the shoreline (Appendix J, Figure 2-1), rather than the 150-ft intervals proposed in the PDI Work Plan, to coincide with riverbank characterization transects.

The survey collected characterization data on riparian areas and ACM features that correspond to the HEA-type checklist that used pre-defined habitat types and quantifiable features, as provided in Table B9-1 of EPA's *Remedial Design Guidelines and Considerations* (EPA, 2021b). Data were collected to be sufficient to establish the acreages and conditions of each habitat area where remedial activities will occur.
In addition to field reconnaissance activities, the survey relied upon information obtained from the surface sediment sampling, riverbank conditions survey, bathymetric survey, and the shoreline and overwater structure inspections conducted in the SIB Project Area, in accordance with the PDI Work Plan (HGL, 2022a). Field qualitative data collection was supplemented with desktop review of information collected during the shoreline and overwater structure inspections and grain-size analysis completed on historical surface sediment samples throughout SIB. The desktop review of these sources of information also provided data to support characterization of the deep water areas with the addition of data from the MBES and LiDAR surveys (Appendix E and Appendix H, respectively).

The results of the habitat condition survey (Appendix J, Section 3.0) are summarized in Section 3.10.

2.11 FACILITY OWNER/OPERATOR INTERVIEWS

HGL conducted a survey of property owners and operators for facilities located on the SIB shoreline to fill data gaps associated with structural information for all potentially affected shoreline and overwater structures; current and future uses of each facility; and current and future vessel data, navigational depths, and identification of future maintenance dredge areas. The survey entailed distributing questionnaires to all facility owners/operators and conducting interviews with select owners and operators. The 10 property owners/operators are as follows (Figure 2-8):

- Project Fleet Owner LLC/Shipyard Commerce Center
- Port of Portland
- Freightliner
- Anchor Park, LLC
- City of Portland

- Swan Island Dock Company
- ATC Leasing Co.
- Marine Salvage Consortium, Inc. (MSC)/NRC Environmental Services, Inc.[9]
- United States of America/U.S. U.S. Navy
- United States of America/ USCG

HGL collected written responses from or conducted virtual interviews with representatives of the properties between August 29, 2022 and February 7, 2023. The results of the facility owner/operator survey (Appendix K, Section 3.0) are summarized in Section 3.11.

[9] NRC Environmental Services, Inc. (NRC Group) merged with US Ecology in 2019, and Republic Services acquired US Ecology in 2022.

This page was intentionally left blank

3.0 NARRATIVE INTERPRETATION OF PRE-DESIGN INVESTIGATION RESULTS

The results of the investigations performed are included in the associated appendices to this PDI ER and include tables and graphics summarizing validated analytical data, results of field surveys and other field measurements/observations, data validation reports, and laboratory data reports. This section presents a summary of the results for the following field data collection elements of the PDI:

1. Surface and subsurface sediment contaminant concentrations
2. Porewater upwelling area survey
3. Stormwater outfall and conveyance system sampling
4. Riverbank characterization
5. Bathymetry and topographic surveys
6. Geotechnical investigation
7. Shoreline and overwater structure inspections
8. Existing utilities and debris identification surveys
9. Hydrodynamics and sediment dynamics field measurements
10. Habitat conditions survey results
11. Facility owner/operator interviews

This section also presents a narrative interpretation of the individual data collection and engineering study elements of the PDI and an evaluation of the sufficiency of the results for use in the BODR, SAR, and RD Work Plan.

3.1 CHEMICAL CHARACTERIZATION- SURFACE/SUBSURFACE SEDIMENTS

The surface and subsurface sediment sampling activities described in Section 2.1 were completed by collecting grab and core samples in accordance with the PDI Work Plan (HGL, 2022a). As documented in Appendix A, samples were collected, analyzed, managed, and validated in compliance with field and laboratory testing criteria. The analytical dataset resulting from the sediment investigation satisfied the QA/QC acceptance criteria and the data quality objectives (DQOs) established for the program.

Appendix A, Table 4-1[10] presents a summary of sediment sample exceedances for focused COCs and additional contaminants from ROD Table 21 as well as relevant errata and memorandums (EPA, 2017; 2020; 2022a; 2022b). In this study, 62.3 and 64.9 percent of the total PCBs Aroclor and congener samples, respectively, exceed the RAL and 42.4 and 54.7 percent exceed the PTW thresholds. Of the dioxins and furans, PeCDD and TCDD exceed the PQL in 22.9 percent and 21.9 percent of the samples, respectively. Other focused COC RAL exceedances include 0.8 percent of total DDx samples and 1.5 percent of total PAHs samples. Besides PCBs, PeCDD (0.8 percent) is the only other focused COC or additional contaminant where samples exceed the PTW threshold.

[10] Non-detects are included at the reporting limit value for Appendix A Table 4-1 summary statistics.

Based on analytical results, the depths to RAL/PQL exceedances are bounded by 1, 2, or more samples at 125 of 168 locations (74 percent); whereas the depths to PTW threshold exceedances are bounded by 1, 2, or more samples at 141 of 168 locations (84 percent) (Figures 3-1 and 3-2). RAL/PQL threshold exceedances are bounded by 2 or more consecutive 1-ft samples at 111 of 168 locations (66 percent). PTW threshold exceedances are bounded by 2 or more consecutive 1-ft samples at 127 of 168 locations (76 percent).

Indicator interpolation by the Natural Neighbor algorithm was used to evaluate the horizontal and vertical extents of contamination, refine the SMA, delineate areas of potentially buried contamination, assess the uncertainty of the interpolation, and calculate the total volume of sediment subject to remediation based on the refined SMA horizontal and vertical extents (Appendix L).

The refined SMA extent for the SIB Project Area, defined by sediments exceeding RAL, PQL, or PTW thresholds (SMA thresholds), is approximately 107 acres (Figure 3-3) within the ROD-defined Sediment Decision Unit boundary and the 13 ft NAVD88 elevation contour. The refined SMA extent is larger than previously depicted in the ROD (89.4 acres), primarily due to additional sediment data collected during the PDI and the inclusion of subsurface sediment data. The extent of surface sediment SMA threshold exceedances is 87.7 acres, which is slightly smaller than the ROD SMA. The areas where surface sediment in the SMA is below thresholds but the subsurface sediment exceeds thresholds is defined as a potential zone of buried contamination. Potential areas of buried contamination have at least 1 ft of overlying clean sediment and occur at the head and mouth of SIB. The thickness/depths of clean overburden are shown in Appendix L, Figure 4-8. A buried contamination evaluation, including modeling of the chemical stability of present Table 17 analytes, will be performed during the subsequent RD to delineate the extent of buried contamination.

The depth of contamination exceeding thresholds is presented in Appendix L, Figure 4-5. The depth of contamination is based on observed exceedances sampled from core locations collected on a 150-ft grid. The depth of contamination is well constrained in the majority of the refined SMA extent. However, the depth of contamination in a central portion of the head of the SIB (Project Area grid reference C-F/33-37) is not well constrained as cores did not reach clean confirmation in that area. The maximum depth of the historical mudline[11] was used as a proxy for the depth of contamination in these areas in the refinement of the SMA vertical extent (Appendix L, Figure 4-7). The areas where the maximum depth of the historical mudline is greater than the core sample depths represent a minimum estimated depth of contamination. In the areas where the depth of contamination is not confirmed by two clean confirmation samples, there is a data gap to be delineated if the selected remedy includes dredging and/or NAPL is present. Further, the BODR will present a CSM describing the historical filling of the SIB and uplands and depths to the historical river bottom. While the historical filling does not equate to contamination, the RD team interprets this historical river bottom as the maximum possible extent of contamination. It may not be feasible to remove these areas of deep contamination and capping may be required, as will be evaluated during the RD. The depth of contamination is defined sufficiently to support

[11] The maximum depth of the historical mudline is defined as the deepest elevation from publicly available historical bathymetry surveys.

likely capping or cap and dredge remedies. Areas that are not well constrained and are identified during the RD for dredge to below RALs may require further sampling to support dredging evaluation (e.g., depth of contamination or target core locations that could not be accessed).

The volume of sediment in the SMA extent is 1,431,000 cy and the volume of sediment exceeding the SMA thresholds is 1,409,000 cy, which subtracts the clean sediment volume (22,000 cy). These represent in-situ sediment volumes and assume vertical slopes at the boundary of the refined horizontal SMA. These quantities do not represent design-level quantity estimates of final RD extent, depths, and volumes, which will be provided in the BODR following additional technical analysis. The statements of quantity in this report do not imply relationships with specific remediation technologies that may be applied and are intended to be informational to provide an overall impression of the magnitude of the stated material types.

Sediment core samples were hydrocarbon field screened (visual screening for stains, NAPL, and/or sheens indicative of residual hydrocarbons) during core processing (HGL, 2022a). Core processing observations specific to the field screening are listed in Appendix A, Table 2-5, and mapped within the SIB Project Area in Appendix A, Figure 2-4.

Overall, sheen was not observed in 163 of 188 cores (87 percent), but it was observed in 13 percent of the cores. As shown in Figure 2-4, there is no clear pattern of sheen spatially or by depth. There were no visual observations of NAPL in 178 of 188 cores (95 percent). Visual observations of NAPL occurred at the following locations within the following depths or depth intervals as listed in Appendix A, Table 2-5: C20 (2.6 to 3 ft), C27 (2 to 5.1 ft), D18 (1.6 ft), E24 (8 to 10 ft), E33 (3.5 ft), F21 (4.2 to 5 ft), G07 (1.6 to 2.2 ft), I08 (4.6 to 51 ft), J06 (8.7 ft), and K04 (0.1 to 3 ft). Observations of NAPL were typically appeared as blebs, rather than coated or saturated categories (Appendix A, Table 2-4), although the descriptions from I08 (4.6 to 5.1ft) and J06 (8.7 ft), in the Dry Dock 5 area, are not categorizable as blebs. As shown in Appendix A, Figure 2-4, there is no clear pattern of NAPL spatially or by depth.

Sheen observations outside of the ROD SMA boundary or within clean confirmation samples were noted in grids C27, K03, L03, and O07. NAPL observations outside of the ROD SMA boundary or within clean confirmation samples were noted in grid C27. These locations also had exceedances of RALs/PQLs thresholds and are within the refined SMA boundary presented in Appendix L.

A comparison of DRET results to surface water quality screening levels indicates that several analytes exceed one or more screening levels (Appendix A, Table 4-3). The contaminants that did not exceed water quality screening levels are BEHP, chromium, ethylbenzene, and naphthalene. The results will be used to model the potential for short term water quality impacts at the point of dredging.

Based on the results of the surface and subsurface sediment investigation, the data are sufficient for their intended uses, summarized in Table 3-1. However, two items have been identified for further evaluation and/or investigation: 1) analysis of archived samples along Mocks Bottom near the head of SIB to investigate possible deep contamination and 2) NAPL mobility testing on archived samples with potential resampling of select vertically observed NAPL locations. These activities will be defined in an FCR to be submitted for EPA approval prior to commencing the activity. Further data needs, including inaccessible locations and areas of unbound contamination, will be evaluated for follow-up investigation during RD per requirements of designated remedial technology.

3.2 POREWATER UPWELLING

The porewater upwelling assessment activities described in Section 2.2 were conducted in accordance with the PDI Work Plan (HGL, 2022a) and Porewater Quantitative Assessment Plan (HGL, 2023a). As documented in Appendix B, the qualitative and quantitative measurements of porewater upwelling were completed in accordance with the assessment program acceptance criteria. The data obtained from the porewater upwelling assessment satisfied the QA/QC acceptance criteria for Trident sensor measurements and the DQOs established for the program.

During the first phase of the porewater upwelling assessment, conductivity contrast (calculated as the surface water conductivity subtracted from the subsurface conductivity, see Appendix B, Section 2.1.1) ranged from a low of 7 microsiemens per centimeter (µS/cm) at Station 2A to a high of 1,852 µS/cm at Station 10A. Positive values indicate higher conductivity at the subsurface as compared to the surface conductivity. The spatial pattern and magnitude of conductivity contrast exceeding 750 µS/cm suggested five potential groundwater discharge zones (Appendix B, Figure 4-7). These potential zones include one at the head of the basin, one in the mid-basin portions of transects 5 through 7, one on the northern side of the basin between transects 9 through 10.5; a more diffuse area near the mouth of the basin between transects 12 through 14; and another zone outside the mouth on the western portions of transects 16 through 17. Conductivity contrast was consistently positive across the site (127 of 127 stations). This observation was consistent with the hypothesis that higher conductivity observed in porewater may be influenced by sediment porewater and surface water interaction. The observed contrasts were likely a result of limited porewater/surface water exchange, groundwater upwelling, or both.

Temperature contrast ranged from a low of -0.85 degrees Celsius (°C) at Station 2A to a high of 0.65 °C at Station 6A, where positive values indicate subsurface temperatures greater than surface water temperatures. This observation is consistent with the hypothesis that higher temperatures observed in porewater may be indicative of potential groundwater upwelling. The observed contrast may be interpreted as a result of porewater/surface water exchange, groundwater upwelling, or both. Temperature contrast was low throughout the study area; however, the spatial distribution showed an area of potential discharge near the head of the basin on transects 2 through 4, and other sporadic locations on transects 5 through 7, transect 11, and transect 14 (Appendix B, Figure 4-8).

Because of the low levels of temperature contrast during this study, this parameter was viewed as a secondary indicator and primary weight was given to conductivity in identifying discharge zones. Five primary zones were identified on this basis, with two of the zones showing confirmation by both conductivity and temperature contrast, and three of the zones confirmed only based on conductivity contrast (Figure 3-4). The following are the zones:

- Zone 1 (Project Area grid reference: b-g, 33-37): Head of the basin (conductivity and temperature);

- Zone 2 (Project Area grid reference: a-f, 22-31): Spanning the width of the basin (conductivity and temperature);
- Zone 3 (Project Area grid reference: a-c, 11-14): Along the northern shore of the basin (conductivity only);
- Zone 4 (Project Area grid reference: c-g, 1-7): Patchy areas in the mid basin (conductivity only); and
- Zone 5 (Project Area grid reference: j-o, 0-5): Off the dry docks outside the mouth of the basin (conductivity only).

In addition to these five discharge zones, three locations (stations 4F, 8D, 9F) outside the zones were identified for quantitative assessment to serve as reference points (Figure 3-4). Based on these zones identified during the first phase of the porewater study, 21 target stations were identified for UltraSeep survey and 8 stations out of those 21 were identified for co-located vertical hydraulic gradient measurements using the DPZ system.

During the second phase, porewater quantitative assessment was completed using UltraSeep and DPZs to measure variations in flow rates over two tidal cycles. This approach allowed for the direct calculation of the hydraulic conductivity of sediment to determine changes in flow rates as a function of changes in head (i.e., water pressure difference that drives flow). The timing of the assessment aligned with the period of maximum groundwater discharge condition (Appendix B, Figure 2-3), providing quantitative assessment data of the most conservative flow rates to support the design.

Average 50-hour Darcy velocity measured with UltraSeep ranged from a minimum average recharge of 0.001 centimeters per day (cm/day) at Station 1D to a maximum average discharge of 0.22 cm/day at Station 10A with an overall average discharge of 0.06 cm/day across all stations. Upwelling was considered relatively low (e.g., less than 0.033 cm/day) at Stations 1D, 4F, 10.5C, 16F, 17D, and 17G. Relatively high average upwelling, where the average discharge exceeded 1 cm/day, was not observed at any of the surveyed locations. The highest recorded single discharge of 1.1 cm/day was measured at Station 10A during ebb tide (Appendix B, Table 4-3), and this value will be used in subsequent cap evaluation efforts and in accordance with EPA's Buried Contamination Guidelines. The average specific discharge at Station 10A was 0.22 cm/day.

The spatial distribution of tidally averaged specific discharge from Phase 2 of the study is shown in Figure 3-5, alongside temperature and conductivity contrasts identified in Phase 1 of the study. Moderately high specific discharge (up to 0.218 cm/day) was generally observed along the northern shoreline of the basin (Stations 2D, 3.5C, 6D, 10A, 12E, and 14B), with moderate discharge (up to 0.072 cm/day) in the central to southeastern portion of the basin (Stations 3F, 5A, 5.5AA, 6F, 7I, 8D, and 9F); and lower discharge (up to 0.035 cm/day) near the head of the basin along the central axis (Stations 1D, and 5.5B, and Reference Station 4F), and near the mouth of the basin (Stations 16F, 17D and 17G). The exceptions to this pattern included the relatively higher discharge of 0.073 cm/day at Station 16D near the mouth of the basin, and lower discharge of 0.02 cm/day at Station 10.5C along the northern basin shoreline. Based on site conditions and the spatial distribution of discharge measurements, the surveys completed at SIB appropriately quantified porewater upwelling to inform RD, and the maximum upwelling velocity of 1.1 cm/day recorded during high groundwater discharge conditions will be used in cap evaluation efforts in BODR, as well as in area-specific cap performance evaluation in Draft RD. Phase 2 measurements were captured during the optimal time of year for high groundwater discharge at locations where upwelling was expected based on Phase 1 screening results (Figure 3-5).

Tidally averaged vertical hydraulic gradients (VHGs) measured with DPZ ranged from a low of 1.12 centimeters of water per meter of vertical distance (cm/m) at Station 4F to a high of 7.55 cm/m at Station 16D, with an overall average of 3.96 cm/m. The spatial distribution of tidally averaged VHG is shown in Figure 3-6. Highest VHGs were generally observed at stations near the mouth of the basin (Stations 14B and 16D) and the head of the basin (Station 2D), with lower to moderate gradients otherwise observed in the central and southeastern portions of SIB (Stations 5.5AA and all three reference stations — 4F, 8D, and 9F).

Since reference stations (4F, 8D, and 9F) had both low to moderate discharge measurements, as well as low VHGs, this data confirms that stations identified in the TZW study adequately identified areas of maximum porewater upwelling in the basin. Stations 8D and 9F, which were associated with a high conductivity zone that was observed in Phase 1, showed the same VHG and moderate discharges, as compared to station 4F. As seen in Appendix B, these measurements indicate that the high conductivity zone observed in Phase 1 did not impact the understanding of maximum porewater discharge stations in Phase 2.

Based on the results of the porewater upwelling assessments, the data are sufficient for their intended uses, summarized in Table 3-1.

3.3 STORMWATER OUTFALL AND CONVEYANCE SYSTEM

The stormwater and stormwater solids sampling activities described in Section 2.3 were completed in accordance with the PDI Work Plan (HGL, 2022a) and the Stormwater and Riverbank Assessment and Sampling Plan (HGL, 2021a). As documented in Appendix C, samples were collected, analyzed, managed, and validated in compliance with laboratory testing criteria. The analytical dataset resulting from the stormwater investigation satisfied the QA/QC acceptance criteria and the DQOs established for the program.

Flow monitoring was conducted in the five City outfall basins (M-1, M-2, M-3, S1, and S2) from January 2022 through June 2023. Figure 3-7 illustrates the seasonal variability in discharges from the City outfalls, generated following the extraction of flow data collected during inundation periods, sensor malfunctions, and dry periods. Storm-based stormwater and stormwater solids samples were collected from five City outfall basins and six smaller basins along the shoreline of the SIB (Figure 2-3) in May and October 2022, and March 2023. Precipitation and flow data for the sampling events satisfied JSCS criteria. Additionally, wet and dry season stormwater solids were collected via ILS samplers in City conveyance system laterals and composited for analysis. The following subsections are organized by outfall basin and summarize the stormwater and stormwater sediment results for the City's conveyances systems and smaller drainage basins that discharge directly to the SIB Project Area.

City Outfall Basins

M-1. Based on available flow sensor data, the maximum monthly average discharge rate from manhole AAM-104 to the M-1 outfall during the monitoring period was 3.55 cubic feet per second (cfs). Additionally, discharge was observed during dry periods indicating dry-weather flow into part of the M-1 conveyance system. Figure 3-8 shows ROD COCs detected in M-1 stormwater and stormwater solids.

M-2. Based on available flow sensor data, the maximum monthly average discharge rate from manhole AAM-169 to the M-2 outfall during the monitoring period was 2.10 cfs. Discharge was measured during dry periods indicating dry-weather flow into part of the M-2 conveyance system; for example, it was estimated to be 0.42 cfs during a dry period in February 2022 (Figure 3-7). Figure 3-9 shows ROD COCs detected in M-2 stormwater and stormwater solids.

M-3. Based on available flow sensor data, the maximum monthly average discharge rate into manhole AAQ005 to the M-3 outfall during the monitoring period was 2.30 cfs. Figure 3-10 shows ROD COCs detected in M-**3** stormwater and stormwater solids.

S-1. Based on available flow sensor data, the maximum monthly average discharge rate from manhole AAM-131 to the S-1 outfall during the monitoring period was 0.64 cfs. Figure 3-11 shows ROD COCs detected in S-1 stormwater and stormwater solids.

S-2. Based on available flow sensor data, the maximum monthly average discharge rate from manhole AAP-957 to the S-2 outfall during the monitoring period was 1.51 cfs. Figure 3-12 shows ROD COCs detected in S-2 stormwater and stormwater solids.

Water-level-velocity measurements in M-1, M2, M-3, S-1, and S-2 were impacted by inundation during high-water river stages in February, March, May, June, July and/or December 2022 and May 2023, depending on location (Figure A.7-1 in Attachment A.7 of Appendix C).

Appendix C, Tables 3-1 through 3-4 provide data summaries of the ROD COCs detected from stormwater and stormwater solid samples in the City outfall basins M-1, M-2, M-3, S-1, and S-2, including dissolved, particulate and total fraction calculations using HVS results. Generally, the following COCs were detected in most, if not all, of the samples collected by media/sample type in the City systems.

Stormwater[1]

HVS Dissolved (calculated)	DDD, DDT, DDx, TCDD toxicity equivalent, total PCBs
HVS Whole Water (calculated)	DDD, DDE, DDT, DDx, PCDDs/PCDFs, total PCBs
Bulk water[2]	arsenic, chromium, copper, zinc, BEHP, benzo(a)anthracene, naphthalene, carcinogenic polycyclic aromatic hydrocarbons (cPAHs), total PAHs

[1] Dieldrin was analyzed but not detected above the laboratory method detection limit (MDL) in 100 percent of HVS media samples.

[2] Benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, and indeno(1,2,3-C,D)pyrene were analyzed but not detected above the laboratory MDL in 33 percent of bulk water samples.

Stormwater Solids[1]

HVS Particulate Phase (calculated)	DDD, DDE, DDT, DDx, PCDDs/PCDFs, total PCBs
HVS Centrifuged Sediments[2]	arsenic, cadmium, copper, lead, mercury, zinc
ILS	DDD, DDE, DDT, DDx, PCDDs/PCDFs, total PCBs, tributyltin, BEHP, naphthalene, cPAHs, total PAHs, total petroleum hydrocarbons-diesel range, arsenic, cadmium, copper, lead, mercury, zinc

[1] Dieldrin was analyzed but not detected above the laboratory MDL in 100 percent of HVS media samples.

[2] Limited mass, analyzed for only metals.

Small Non-City Outfalls

During the same three storm events where City outfall basin samples were collected, stormwater samples were collected from six smaller non-City outfall basins discharging from federal, Port, and private parcels to provide a “snapshot” of COC concentrations discharging to the SIB. Figure 3-13 presents the ROD COCs detected in stormwater samples from the non-City outfalls. Appendix C, Table 3-5 provide a complete data summary. The following subsections summarize the detected COCs in stormwater samples from the smaller non-City drainage basins that discharge to SIB Project Area.

U.S. Coast Guard (Tax Parcel R315695) (WR-198). The following COCs were detected in one or more stormwater samples collected from this outfall:

- Arsenic, cadmium, chromium, copper, lead, mercury, zinc, lindane, BEHP, benzo(a)anthracene, benzo(b)fluoranthene, chrysene, indeno(1,2,3-CD)pyrene, naphthalene, total PAHs, cPAHs, hexachlorobenzene, TCDD toxicity equivalent, total PCBs

ATC Leasing (Tax Parcel R315626) (WR-71). The following COCs were detected in one or more stormwater samples collected from this outfall:

- Arsenic, cadmium, chromium, copper, zinc, BEHP, benzo(b)fluoranthene, chrysene, indeno(1,2,3-CD)pyrene, naphthalene, total PAHs, cPAHs, hexachlorobenzene, TCDD toxicity equivalent

Barge Eagle/Swan Island Dock Co (Tax Parcels R673572 and R673573) (WR 186): The following COCs were detected in one or more stormwater samples collected from this outfall:

- Arsenic, cadmium, chromium, copper, lead, zinc, DDT, DDx, BEHP, benzo(a)anthracene, chrysene, naphthalene, total PAHs, cPAHs, hexachlorobenzene, TCDD toxicity equivalent, total PCBs

North Basin Watumull LLC (Parcel R 315725) (WR-15): The following COCs were detected in one or more stormwater samples collected from this outfall:

- Arsenic, cadmium, chromium, copper, lead, zinc, DDE, DDT, DDx, BEHP, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, naphthalene, total PAHs, cPAHs, hexachlorobenzene, TCDD toxicity equivalent, total PCBs

Freightliner (Corp 5/Wind Tunnel) (Parcel R315949) (WR-253): The following COCs were detected in one or more stormwater samples collected from this outfall:

- Arsenic, chromium, copper, lead, zinc, DDE, DDT, DDx, BEHP, benzo(a) anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, indeno(1,2,3-cd)pyrene, naphthalene, cPAHs, hexachlorobenzene, TCDD toxicity equivalent, total PCBs

Port of Portland (Parcels R543792 and R632314) (WR-34): The following COCs were detected in one or more stormwater samples collected from this outfall:

- Arsenic, chromium, copper, lead, zinc, lindane, DDD, DDE, DDx, BEHP, chrysene, naphthalene, total PAHs, cPAHs, hexachlorobenzene, TCDD toxicity equivalent

The concentrations of ROD COCs in stormwater and stormwater solids will be used along with flow monitoring data to calculate the mass loading and evaluate the fate of COCs in stormwater and solids discharged to the SIB Project Area via outfalls.

Based on the results of the stormwater and stormwater solids sampling and data collection activities, the data are sufficient for their intended uses, summarized in Table 3-1.

3.4 RIVERBANK CHARACTERIZATION

Analysis of riverbank soil samples was completed in accordance with the PDI Work Plan (HGL, 2022a) and the Riverbank Sampling Plan (HGL, 2022b). As documented in Appendix D, samples were collected, analyzed, managed, and validated in compliance with field and laboratory testing criteria. The analytical dataset resulting from the riverbank characterization investigation satisfied the QA/QC acceptance criteria and the DQOs established for the program.

To evaluate the BEHI, HGL reviewed available LiDAR elevation data for the riverbank transects in conjunction with the data collected during the visual inspection of the riverbank transects. The total BEHI model ratings indicate spatially variable riverbank erosion probabilities ranging from low to extreme, depending on transect location (Appendix D, Table 2-1; Figure 2-2). HGL generated 15 transects across SIB to estimate NBS risk ratings to calculate erosion rates (Appendix D, Figure 2-3). The cross-section locations were selected to represent the different bathymetric regions adjacent to the riverbank transects in SIB as well as bank morphologies. The calculated NBS values for all SIB transect groups was low.

Riverbank soil sampling transects were evenly spaced at 100-ft intervals across the entire riverbank within the SIB Project Area, allowing for sufficient lateral delineation of COC concentrations. Of the 276 surface (0- to 1-ft interval) samples analyzed, analytical concentrations were less than ROD CULs in 11 samples (4 percent) (Figure 3-14). Of the 123 deeper samples analyzed, analytical concentrations were less than ROD CULs in 10 of 95 samples (11 percent) in the 1- to

2- ft interval and 8 of 28 samples (29 percent) in the 2- to 3-ft interval. CUL exceedances were widespread and estimated to include 650,000 square (sq) ft of the riverbank's surface between 0 and 1 ft below ground surface (bgs) (100 percent) (Appendix M, Figure 4-1). CUL exceedances in the 1- to 2- ft interval were similar to surface soil and estimated to include 477,000 sq ft of the riverbank's surface between 1 and 2 ft bgs (100 percent), based on available data (Appendix M, Figure 4-4).[12] CUL exceedances were also similar in the 2- to 3-ft interval and estimated to include 296,000 sq ft of the riverbank between 2 and 3 ft bgs (100 percent) (Appendix M, Figure 4-5).[13] COCs detected above the CULs included arsenic, mercury, BEHP, chlordanes, DDx, PCBs, PCDDs/PCDFs.

Of the 276 surface soil samples collected, RAL exceedances were detected in 150 samples (61 of 90 TOB, 66 of 111 OHW, and 23 of 75 MLW) (Figure 3-15). RAL exceedances were detected in 34 depth interval samples (1 to 2 ft: 17 of 40 TOB, 7 of 31 OHW, and 2 of 24 MLW; 2 to 3 ft: 6 of 17 TOB, 2 of 10 OHW, and 0 of 1 MLW). ROD COC concentrations exceeded RALs/PQLs at 102 of the 119 transects sampled (86 percent). The areas without exceedances were primarily along the head of the basin and the east side of SIB (Figure 3-15). RAL exceedances were less widespread than CUL exceedances in the 0- to 1-ft interval, and estimated to include 420,000 sq ft of the riverbank's surface between 0 and 1 ft bgs (65 percent) (Appendix M, Figure 4-2). RAL exceedances were less extensive in the 1- to 2- ft interval and estimated to include 153,000 sq ft of the riverbank's surface between 1 and 2 ft bgs (32 percent) (Appendix M, Figure 4-6). RAL exceedances in the 2- to 3-ft interval were limited to 3 areas of the riverbank and estimated to include 78,000 sq ft of the riverbank between 2 and 3 ft bgs (26 percent) (Appendix M, Figure 4-7). COCs detected above the RALs included DDx, PCBs, PeCDD, and TCDD.

PTW threshold exceedances were detected in 65 surface soil (0- to 1-ft interval) samples (21 TOB, 31 OHW, and 13 MLW) (Figure 3-16). PTW threshold exceedances were detected in 6 depth interval samples, all from TOB samples in the 1- to 2- ft interval. No PTW threshold exceedances were detected in samples from the 2- to 3-ft depth interval. PTW threshold exceedances were less widespread than CUL and RAL exceedances in the 0- to 1-ft interval, and were estimated to include 131,000 sq ft of the riverbank's surface between 0 and 1 ft bgs (20 percent) (Appendix M, Figure 4-3). PTW threshold exceedances in the 1- to 2-ft interval were limited to 3 areas and estimated to include 13,000 sq ft of the riverbank's surface between 1 and 2 ft bgs (3 percent) (Appendix M, Figure 4-8). No PTW threshold exceedances were detected in the 2-3 ft bgs interval. COCs detected above the PTW thresholds included PCBs and PCDDs/PCDFs.

The process outlined in Figure 4 of the *Guidance for River Bank Characterizations and Evaluations at the Portland Harbor Superfund Site* (EPA, 2019) will be adhered to for addressing contamination in SIB riverbanks. In accordance with the guidance, concentrations are used to screen riverbanks, but COC loading estimates (i.e., COC concentrations combined with erosion

[12] The interpolated area of subsurface soil impacts in the 1-2 ft bgs interval was less than that for surface soil because fewer samples were collected in the 1-2 ft bgs interval.

[13] The interpolated area of the subsurface 2-3 ft bgs interval was less than the interpolated area for surface soil because fewer samples were collected in this interval.

rates) will be used to determine recontamination risk and inform selection of remedial technologies for riverbank soils.

Based on the results of the riverbank characterization effort, the data are sufficient for their intended uses, summarized in Table 3-1. The PDI needed to determine whether riverbank materials were impacted above risk-based levels and whether impacted materials were erodible and could have or will contaminate in-water sediment. Therefore, the depth of impacts is not as important for the RD as the extent of contamination in surface and near-surface soils and, as such, the lacking depth of contamination data is not considered a data gap. The SIB Project Area comprises numerous shoreline structures within and along the riverbanks that would render significant excavation of large riverbank sections infeasible. Any riverbank treatment will consider the presence of shoreline, overwater, and adjacent structures; existing vegetation; and geotechnical stability. Those factors support prioritization of surficial treatments versus removal in many areas, excepting potential habitat restoration areas. Surficial treatment will eliminate the migration of and exposure to contaminated riverbank soil. Areas identified for excavation to cleanup levels will be further investigated, as needed, to support RD.

3.5 BATHYMETRIC SURVEY

The bathymetric survey activities described in Section 2.5 were conducted in accordance with the PDI Work Plan (HGL, 2022a) and the Survey and Quality Control Plan (Mott MacDonald, 2022). As documented in Appendix E, the survey was completed in accordance with PDI acceptance criteria.

The main channel of the Willamette River has depths up to 57 ft located downstream of the dry dock basin, and approximately 53 ft within the dry dock berth (Appendix E). At the mouth of SIB near the northeast end of Pier A, moving into the SIB towards the southeast end of the SIB, depths decrease from approximately 30 ft to less than 10 ft. Figure 3-17 presents an overview of the bathymetry in the survey area. Appendix E, Figures 3-2 to 3-11 present close-ups of the observed elevations in different zones within the survey area corresponding to zones as labeled in Figure 3-17.

In areas where coverage was limited due to large vessels and structures as well as along the shoreline due to the river stage, a unified elevation model was developed that incorporates other data types/sources. These sources include City of Portland 2019 LiDAR; SIB 2022 mobile LiDAR (Section 3.8); 2018 Bathymetric Survey for the Vigor Shipyard Facility (eTrac, Inc.); and Willamette River, Oregon – River Mile 1.9 to 11.8 Hydrographic Survey (2018 Portland Harbor Bathymetry Data – David Evans and Associates, Inc.). A comparative evaluation of historical (2018) bathymetry data and 2022 bathymetry data will be completed during the BODR development to determine whether the 2018 bathymetry datasets can be used to address data gaps. If there are gaps in the bathymetric data needed to support the RD that cannot be addressed with existing data sources, an additional bathymetric survey may be considered to fill these data gaps.

Based on the results of the bathymetric survey, the data are sufficient for their intended uses, summarized in Table 3-1.

3.6 GEOTECHNICAL SITE INVESTIGATION

The geotechnical data collection and site characterization activities described in Section 2.6 were completed in accordance with the PDI Work Plan (HGL, 2022a). As documented in Appendix F, samples and measurements were collected and managed in compliance with field and laboratory testing criteria. The described geotechnical site investigation was performed to characterize the existing geotechnical conditions in and around the SIB Project Area and provide the foundational geotechnical data necessary to support RD evaluation in accordance with the *Remedial Design Guidelines and Considerations* (EPA, 2021b). The type, quantity, and quality of the geotechnical data collected are appropriate for use in the development of site-specific soil stratigraphy and soil profiles, the development of site-specific geotechnical design parameters, and the development of seismic design parameters.

Published maps and data sources describing the natural geologic conditions in and around SIB indicate the surficial soils in the SIB Project Area consist primarily of artificial fill in the upland portions of the site and along the SIB riverbanks and interbedded younger alluvial sands and silts within the basin. The entire SIB Project Area is underlain by Pleistocene age Missoula flood deposits, thick sequences of alluvial soils, ranging from coarse sand to silt, which were deposited during cataclysmic glacial lake outburst floods known as Missoula Floods. The Missoula flood deposits are underlain by Troutdale Formation bedrock. An assessment of geologic setting is summarized in Appendix F, Section 2.4.

An evaluation of the site seismic setting indicates the SIB Project Area may be subject to strong earthquake-induced ground motions during the design life of the selected RA. The Cascadia Subduction Zone (CSZ) fault and active local crustal faults should be considered when evaluating potential earthquake impacts or ground motions at the SIB Project Area. An assessment of seismic setting is summarized in Appendix F, Section 2.4. Based on the potential for strong earthquake-induced ground motions in and around the SIB Project Area, the presence of saturated soils within SIB, and relatively shallow ground water in the areas surrounding SIB, the potential for soil liquefaction and lateral spreading is present. Identification and assessment of geologic and seismic hazards are summarized in Appendix F, Section 2.5.

Groundwater elevation data collected during geotechnical sampling activities and identified in previous studies indicate that groundwater elevations across the SIB Project Area range from approximately 6 to 27 ft NAVD88. Additionally, localized zones of perched water and variations in soil moisture content should be anticipated during and following the rainy season. Groundwater elevation data collected during geotechnical sampling is presented in Appendix F, Figure 2-9.

The geotechnical data collected during the field investigation and the results of geotechnical laboratory testing program are generally consistent with anticipated subsurface conditions for the SIB Project Area. Near surface soils consist of artificial fills (both within SIB and at the riverbank and upland areas), Holocene age alluvial sands, silts, and clays, and Pleistocene age silts and sands. The sediment within SIB is primarily very soft elastic silt with variable sand content. Upland fill materials are mainly granular, ranging from poorly graded sand to clayey/silty sand, and from loose to dense. Laboratory test results indicate the organic content in SIB Project Area soils is generally less than 15 percent. The areas of highest organic content (between 8 percent and 14 percent) appear to align with the highly plastic elastic silts within the basin.

Borehole logs for in-water and upland geotechnical borings and legend sheets defining the terms and symbols used are presented in Appendix F, Attachment B. Cross-sections depicting the spatial relationship between the boring locations and the ground surface are presented on Appendix F, Figures 5-1b through 5-1k. SPT blow count (N-value) data are presented on Appendix F, Figure 5-2.

Over 800 index tests and 150 soil strength and consolidation tests were performed on the geotechnical soil samples. Results of the tests are summarized in Appendix F, Table 5-1. Dry density and total density versus elevation are illustrated in Appendix F, Figure 5-4. Moisture content and Atterberg limits versus elevation are illustrated in Appendix F, Figure 5-5. Atterberg limits are presented in Appendix F, Figure 5-6. Index testing results will support soil type characterization and stratigraphic interpretation, identification of geologic and seismic hazards, and the collective interpretation of laboratory test results as well as the data collected in the field. Laboratory tests to determine soil index properties were performed in accordance with current ASTM standards.

Soil strength and consolidation testing results will support the development of total and effective stress strength parameters and consolidation characteristics for use in engineering studies, the BODR, and throughout the RD. These tests were performed in accordance with current ASTM standards and satisfy the study objectives. The soil strength and consolidation characteristic tests are summarized in Appendix F, Tables 5-2 through 5-7.

Based on the results of the geotechnical site investigation, the data are sufficient for their intended uses, summarized in Table 3-1.

3.7 SHORELINE AND OVERWATER STRUCTURE INSPECTIONS AND STRUCTURE CONDITION ASSESSMENTS

The shoreline and overwater structure inspections described in Section 2.7 were conducted in accordance with the PDI Work Plan (HGL, 2022a). The data obtained from the shoreline and overwater structure inspection satisfied the DQOs established for the program. The following SIB Project Area structures were inspected:

- Pier D – Berth 312
- East Pier
- West Pier
- Demo Pier
- SCC Floating Dock
- Pier C – Berth 309 and 310
- Pier A – Berth 301
- Quay Wall
- Lagoon Wharf – Berth 302-305
- Berth 306
- Berth 307
- Berth 308
- Wind Tunnel
- The Swan Island Boat Ramp
- Berth 311
- Dredge Base
- MC Pier
- The U.S. Navy Pier
- The USCG Dock and Pier
- City of Portland Stormwater Outfalls:
    - Outfall S1
    - Outfall S2
    - Outfall M1
    - Outfall M2
    - Outfall M3

Inspection data for structures listed above demonstrate that the condition of SIB Project Area shoreline and overwater structures (including the City outfalls) ranges from Good to Serious (Appendix G, Tables 2-1 and Tables 3-1-1 through 3-21). [14]

- Six structures and one outfall are rated in Serious condition, including Berth 301 – Pier A, Quay Wall, Berth 306 Walkways and Dolphins, Berth 307 Walkways and Dolphins, Berth 311 Wharf, Dredge Base, and City Outfall S-1.[15]
- Five structures and one outfall are rated in Poor condition, including West Pier, Berth 302-305 – Lagoon Wharf, Berth 307- Pier, Berth 308 Dolphins and Pier, and City Outfall S2.
- Twelve structures are rated in Fair condition, including Berth 312 – Pier D, East Pier, Demo Pier, Berth 309 and 310 – Pier C, Berth 306 – Pier, Swan Island Boat Ramp, Berth 311 Walkways and Dolphins, MC Pier – T-Pier, MC Pier – Floating Dock, U.S. Navy Pier, USCG Floating Dock and Pier.
- Three structures and two outfalls are rated in Satisfactory condition, including SCC Floating Dock, Wind Tunnel, MC Pier – Dolphins, and City Outfalls M-1 and M-2.
- City Outfall M-3 is rated in Good condition.

None of the observed structures were rated in Critical condition. Figure 3-18 illustrates the condition ratings for all overwater structures.

The structures rated in Fair to Serious condition may have reduced structural capacity due to deterioration or physical damage on the deck, pile caps, or piles. Structures rated in Poor or Serious condition might have a higher probability of being affected by the RA. The magnitude of the reduction in the capacity of these structures will be determined as part of the BODR.

The inspection reports for each overwater/shoreline structure is provided in Appendix G, Attachment A. Based on the results of the shoreline and overwater inspections, the results are sufficient for their intended uses, as summarized in Table 3-1.

3.8 EXISTING UTILITIES AND DEBRIS IDENTIFICATION SURVEYS

The existing utilities and debris identification and survey activities described in Section 2.8 were conducted in accordance with the PDI Work Plan (HGL, 2022a) and the Survey and Quality Control Plan (Mott MacDonald, 2022). As documented in Appendix H, the survey was completed in accordance with PDI acceptance criteria.

Mobile LiDAR data successfully documented the locations and extent of debris, and riverbank topography (Appendix H, Figure 3-1). Structure locations and elevations will be taken from the mobile LiDAR dataset as needed during the RA impact evaluations. Topography data on open

[14] Condition assessments are based on the results of the spring 2022 inspection. Any repairs conducted after the inspection are not reflected in this rating.
[15] Additional information may include repair activities completed since this assessment, such as repair and stabilize the Berth 305 slope and outfall that were reportedly completed in Summer 2023.

riverbanks and riverbanks under wharf structures was processed for inclusion in a sitewide unified elevation model, filling the elevation data gaps identified in the PDI Work Plan.

SSS images show existing pile fields along the riverbank that could not be captured in the MBES survey due to the presence of obstructions (Appendix H, Figure 3-2). The SSS assisted in confirming presence of debris shown in MBES survey data, as well as the lack of debris under various moored floating docks and vessels. Using the SSS data and the MBES, approximately 1,600 objects 1 ft or larger were identified on the riverbed or in the water column (Figure 3-19). Identified targets were manually inspected and classified and identifications were made to the extent feasible with the remote sensing data. The 1,600 individual pieces of debris consist of a mix between small debris which is unlikely to affect dredging, and over-sized debris which may obstruct dredging operations and would likely require removal prior to dredging. Observed debris included submerged platforms, small skiffs, tires, submerged piles, and various other small unidentifiable objects. Much of the debris sitting on the riverbed consists of timber piles, logs/trees, or rock (Appendix H, Figures 4-2a-f). The locations, number of objects, and details on debris accumulation areas are summarized as follows:

Location	Number of Objects	Details
Berth 312 and the Vigorous Dry Dock (Project Area grid reference: m-r/ 0-8)	56	Remnants of former marine shipways are tentatively identified in exposures along the riverbank.
Mouth of SIB (Project Area grid reference: i-m/0-3)	167	Most of the objects are concentrated in a high-density debris field, on the north side of the debris zone.
Berth 301 to the USCG pier and dock Project Area grid reference: b-g/1-7	213	Historically, houseboats as well as log rafts were moored along the northern portion of this area.
Berth 302 across the SIB to portions of the U.S. Navy pier and MC pier Project Area grid reference: b-f,/8-12	254	A debris field near the MC pier includes a small boat, scattered rocks associated with the riprap-covered bank were identified shoreward of the dock, and submerged piles were identified near the U.S. Navy pier.
Berth 303 across the SIB to portions of the MC pier Project Area grid reference: b-f/13-17	287	Historically, timber pile supports for a 1940s pedestrian bridge were located near the MC pier.
Berths 304 and 305 to the Dredge Base Project Area grid reference: b-f/18-22	267	Debris field near the Dredge Base staging area. The area under and shoreward of the Dredge Base was not inventoried; however, the SSS images suggest additional debris in these areas.
Berth 306 across the SIB Project Area grid reference: b-f/23-27	130	Historically, a timber pile supported berthing dock spanned from the end of the current Lagoon Wharf (Berth 302 to Berth 305) past Lay Berth 308.
Berths 307 and 308 across to Berth 311 Project Area grid reference: b-f,/28-32	68	Includes two small boats and one platform, also includes the historical berthing dock.
Head of SIB Project Area grid reference: b-f/33-37	166	Includes four small boats and six platforms, also includes the historical berthing dock.

The magnetometer survey provides magnetic field strength data in units of nanotesla (or Gamma). The results indicate that there are no large metal debris pieces or other objects present that will need to be managed during RA. As anticipated, significant anomalies were measured near vessels, dry docks, and steel dock structures. Gamma values indicative of large unknown ferrous objects were not observed in the survey data. The significant number and size of large ferrous objects (e.g., ships) at SIB limits the capability of the magnetometer technology to identify small adjacent ferrous objects. The challenges of remote detection of small ferrous objects were anticipated and represent an uncertainty that will be addressed during the RD.

The sub-bottom profiler collected acoustic reflections from surface and subsurface materials. Anomalies were identified near the dry dock basin that correspond to surface “drag marks” observed in the MBES. The centerline transect in the SIB interior shows typical conditions of soft sediment over a denser return and a lack of apparent buried debris (Appendix H, Figure 3-8). The transect in the main channel of the Willamette River near Berth 312 shows typical uniform returns, with less apparent stratigraphy, and a lack of apparent buried debris (Appendix H, Figure 3-9). No buried debris or utilities (or other objects) were identified in any of the sub-bottom profile transect data.

No in-water utilities were identified by member operators in the SIB Project Area following the utility location service notification. The 2022 USACE hydrographic survey and historical National Oceanic and Atmospheric Administration navigation charts (2016) identify three “cable areas” in the SIB Project Area; however, no utilities or buried cables were identified from the surveys.

Ongoing changes to the stormwater systems around the SIB will be monitored, additional details will be obtained from private outfall owners, and the inventory will be updated with additional details (e.g., invert elevations). Details for small private outfalls were not obtained during owner/operator interviews. The additional details from private outfall owners will be obtained through outreach to the owners, as needed, during the RD. The outreach will be performed based on the potential for impact to these outfalls during the RA or inclusion of those outfalls in the design. During the RD, the outfall locations, invert elevations, and functionality will provide sufficient data for determining whether the outfalls could be affected by, or could affect, the proposed RA.

Based on the results of the existing utility and debris identification surveys, the data are sufficient for their intended uses, as summarized in Table 3-1.

3.9 HYDRODYNAMICS AND SEDIMENT DYNAMICS MEASUREMENTS

The hydrodynamics and sediment dynamics described in Section 2.9 were conducted in accordance with the PDI Work Plan (HGL, 2022a). As documented in Appendix I, the measurements were collected in accordance with PDI acceptance criteria. The data obtained from the hydrodynamics and sediment dynamics survey satisfied the DQOs established for the program.

SEDflume sampling results indicate that sediment properties vary both horizontally and vertically. Samples in SIB generally consisted of predominantly silt, with small amounts of clay and fine sand with sand content increasing with proximity to the Willamette River. SEDflume cores are relatively shallow (typically less than 1 ft below the riverbed) and analyzed in five vertical intervals. The surface layers (typically 0 to 2 cm) generally have lower critical shear stress for erosion and dry bulk density than the layers below (2 cm to 30 cm). Therefore, the data show bed surface layer properties consistent with a loosely consolidated mud mixture and underlayers with properties consistent with a partially consolidated mud mixture (Appendix I, Attachment B).

ADCP current velocity data support the description of the hydrodynamics of the SIB as quiescent within the interior lagoon with a transition to relatively higher velocities within the Willamette River. Both observations and measurements indicate current velocities generally below 0.1 ft per second in the SIB interior during both low and high river discharges (Appendix I, Figures 3-4, 3-5, and 3-8). Vessel-mounted ADCP data collected within the Willamette River showed downstream directed currents with magnitudes upwards of 1 ft per second during falling tide conditions and weaker currents with mixed directionality during rising tide conditions (Appendix I, Figures 3-6 and 3-7).

TSS concentration measurements showed a background of only roughly 10 milligrams per liter (mg/L) throughout most of the sensor deployment (low flow periods), but with a period of elevated TSS concentration reaching 75 to 80 mg/L inside SIB during a high-discharge event. The similarity in TSS concentrations between the two stations (located 2,100 ft apart) indicate that suspended sediments entering SIB are well-mixed fine material (Appendix I, Figure 3-10).

Maximum wave heights associated with wind-waves and vessel wakes were less than approximately 0.3 ft inside SIB and approximately 1 ft in the Willamette River (Appendix I, Figure 3-14). The free surface measurements indicate that wakes and wind-waves are small during typical conditions and unlikely to cause significant erosion or sediment transport. The potential for erosion during extreme wind events and due to vessel wakes will be assessed in further detail as part of the RD.

Displacement effects are not likely to affect shorelines; however, velocities under the hulls of moving deep-draft vessels (not measured during this program) will be considered for cap stability. Maximum pressure field drawdown of approximately 0.3 ft was observed during a deep-draft passing vessel event in the Willamette River; however, measurements in the SIB interior did not show any significant drawdown effects due to low vessel speeds and limited deep-draft traffic (Appendix I, Figures 3-16 and 3-17).

Hydrodynamics and sediment dynamics measurements indicate the following:

- Soft surface sediments indicate a quiescent, depositional environment in most of the SIB Project Area;
- Low river current speeds indicate that river flows are not likely to cause resuspension and erosion over most of the SIB Project Area, even during flood events;
- Suspended sediments entering the SIB Project Area from the main river are well mixed and fine-grained, with low settling velocities. Most of the suspended sediments entering SIB are likely to leave prior to depositing on the riverbed, and;
- Wind-waves and boat wakes are small, but likely govern sediment mobility in shallow water and near riverbanks. In these shallow water and riverbank areas, storm waves likely govern cap erosion protection design.

The data compiled from the hydrodynamics and sediment dynamics measurements are sufficient for their intended uses, as summarized in Table 3-1.

3.10 HABITAT CONDITIONS SURVEY

The habitat conditions survey was conducted to provide qualitative baseline information on the condition and extent of riparian, ACM, and main channel habitats in the SIB Project Area in accordance with the *Remedial Design Guidance and Considerations* (EPA, 2021b). The data compiled as part of the survey, and presented in Appendix J, provide documentation of the aquatic and terrestrial habitat conditions and will be utilized to provide baseline (existing/pre-construction condition) inputs to an HEA that will evaluate pre-and post-remediation habitat conditions.

The SIB was designed to functionally support the industrial, commercial, and military-type activities that historically and presently occur along the shoreline of the SIB Project Area. The shoreline, in its entirety, was constructed by fill placement and other modifications that occurred over decades. The riparian areas have limited vegetative buffers with substantial development, including structures and large swaths of impervious surfaces, encompassing over 73 percent of the riparian area. Invasive species are prevalent and abundant, composing nearly 100 percent of the understory in the forested riparian areas and more than 50 percent of the vegetated ACM. Up to 50 percent of the ACM is armored with riprap or protected from erosion by other shoreline structures. However, there are a limited number of areas where the riparian and ACM may encompass some functional habitat in the presence of vegetated buffers of mature trees and unarmored ACM with submerged vegetation.

This habitat conditions survey provides the baseline to determine the current and future habitat requirements to design and construct the selected remedy. Projected post-remediation habitat quantity and condition data will be collected, as needed.

The data compiled during the habitat condition survey are sufficient for their intended uses, as summarized in Table 3-1.

3.11 FACILITY OWNER/OPERATOR INTERVIEWS

The facility owner/operator interviews were conducted to gather information from property owners and operators for facilities located on the SIB shoreline for engineering studies that will inform the RD. Information characterizing existing and future facility and waterway use, structures, vessel data, and navigational depths support the development of the RD. Responses to the survey were gathered from the 10 identified shoreline property owners and operators and are summarized in Appendix K, Tables 3-1 and 3-2.

Based on the survey responses, the following potential constraints were identified and will be evaluated during the RD process.

- Waterway operations and schedule – Operations occur year-round in SIB and include ship repair and building, vessel mooring, marine transport, public recreational access, dry and liquid bulk and breakbulk shipping, lay berthing, emergency services, and public safety. Implementation of the RD near each facility will require close coordination and scheduling to allow for continued facility operations, potentially requiring temporary shutdowns or shifting the timing of operations. This will be evaluated during the development of the BODR.

- In-water structures – Structures are present at seven properties, though two of those properties have no active vessel operations (Appendix K, Table 3-1). Structures that are planned to remain in service will undergo a functional structure assessment and impacts to the structure from RA activities will be evaluated in the BODR. Structures that will remain may affect technology assignments, construction sequencing, and construction techniques.
- Vessel types, maneuverability, frequency – Vessels in use in SIB include skiffs, recreational watercrafts, derrick (crane) barges, deck barges, bulk material and liquid barges, military vessels, tugs, a cutter suction dredge, cruise ships, and a range of bulk vessels. Tug assistance, anchor systems, and spuds are also used in SIB. Vessel types and sizes, their maneuverability, and frequency of arrivals/departures in SIB will affect construction sequencing, which will be evaluated as part of the BODR.
- Operational navigation depths – Owner-requested navigation depths were recorded in the survey to represent the minimum depth of water that would, according to responding owners/operators, allow for operations to occur while at berth. The depth depends on the size and draft of a vessel and clearance under the vessel to the mudline. Reported navigational depths ranged from 10 ft to 57 ft for vessels and dry docks. Navigation depths as well as structures will directly affect the technology assignment and implementation of the RD.

Uncertainties remain, primarily associated with missing structural information for existing shoreline and overwater structures. A summary of uncertainties by facility is included in Appendix K, Table 3-3. Given the age of many of the structures and property ownership changes over the years, it is anticipated that this information will not be available for all structures, and it is assumed that all available information has been collected. Design assumptions made in the absence of as-builts will be addressed during the design phase.

The data compiled during the facility owner/operator interviews are sufficient for their intended uses, as summarized in Table 3-1.

This page was intentionally left blank

4.0 CONCLUSIONS

This PDI ER presents and evaluates the results of data collection activities conducted as part of the PDI. The PDI results are being applied to early phases of RD development including updating the CSM and applying the technology application decision tree (ROD, Figure 28). The resulting PDI datasets also support the analyses needed to demonstrate that the remedy will be robust, sustainable, and effective in the context of the SIB including natural processes and human activities including vessel traffic, waterway maintenance, and activities on the shoreline and adjacent uplands.

The surface and subsurface sediment dataset provides information on the SMA by defining the lateral and vertical extent of contamination in relation to CULs, RALs/PQLs, and PTW thresholds. The refined SMA extent for the SIB Project Area is approximately 107 acres, which is larger than previously depicted in the ROD (89.4 acres), due to additional sediment data collected during the PDI and the inclusion of subsurface sediment data. The depth of contamination is well constrained in the majority of the refined SMA extent. The volume of sediment exceeding the SMA thresholds is 1,409,000 cy. The surface and subsurface sediment data will be applied to the CSM update as well as to inform effective use of the ROD technology application decision tree in the BODR. Two items have been identified for further investigation: 1) analysis of archived samples near the head of SIB along Mocks Bottom between the SMA boundary and the riverbank that will be analyzed to investigate possible contamination at depth and 2) NAPL mobility testing on archived samples with potential resampling of the few vertically observed NAPL locations.

Data from the porewater upwelling assessment are being used to inform the direct calculation of flow rate for the full potential range of groundwater elevations (seasonal and tidal variability) at the locations where porewater upwelling is occurring. Average velocities in SIB ranged from a recharge of 0.001 cm/day to a discharge of 0.22 cm/day, with an overall average discharge of 0.06 cm/day across all stations. Upwelling ranged from low (less than 0.035 cm/day) to moderately high (up to 0.22 cm/day) across SIB. High upwelling (average discharge greater than 1 cm/day) was not observed at any of the surveyed locations. SIB-wide mapping of porewater upwelling locations, combined with pressure gradients that drive porewater migration and the resulting porewater velocities and flow rates at those specific locations, will be used to inform cap design and evaluate cap effectiveness in the BODR.

ROD COCs were detected in stormwater and stormwater solids samples collected from all outfalls that drain to SIB. The impact of these discharges will be determined by evaluating mass loading and fate of COCs in contaminated stormwater and solids discharging to the SIB Project Area. The data aid in developing input parameters for stormwater loading in the recontamination model. The recontamination potential evaluation will be used to determine whether upland sources have been adequately investigated and sufficiently controlled, or considered such, that the RA can proceed.

Riverbank soils have been sufficiently characterized and indicate that concentrations of COCs in riverbank soils is widespread with CUL exceedances at 100 percent of transects, RAL/PQL exceedances at 86 percent of transects, and PTW threshold exceedances at 48 percent of transects. The data collected as part of the PDI is sufficient to inform the development of an RD that will address the contaminated riverbanks. Though bounding of the vertical extent of COCs was limited, the lateral delineation of COCs will be used in conjunction with other PDI and historical data to develop a compliant RD.

The geotechnical investigation was performed to characterize the geotechnical conditions in and around the SIB Project Area and provide the foundational geotechnical data necessary to support RD development and evaluation. Geotechnical testing found that near surface soils consist of artificial fills (both within SIB and at the riverbank and upland areas), sands, silts, and clays. The sediment within SIB is primarily soft elastic silt with variable sand content. The site seismic setting indicates the SIB Project Area may be subject to strong earthquake-induced ground motions during the design life of the selected RA. Additionally, based on the potential for strong earthquake-induced ground motions, the presence of saturated soils within SIB, and relatively shallow ground water in the areas surrounding SIB, the potential for soil liquefaction and lateral spreading is present. The geotechnical investigation program provides the dataset needed to characterize soil types, complete stratigraphic interpretation, identify and evaluate geologic and seismic hazards, and then interpret the complete dataset for use in engineering studies, the BODR, and throughout the RD.

Structures rated in Poor or Serious condition were identified through structure condition assessments and are likely to have a higher probability of being affected by the RA. The shoreline and overwater inspection data and resulting structure condition assessment findings are being used to support functional structure determinations and RD development by evaluating the general condition of shoreline and overwater structures and estimating their present structural capacity.

Approximately 1,600 pieces of primarily smaller and some larger debris were identified on the SIB riverbed through PDI surveys. The RD will consider the impact of the debris on the RA, and the best approach to mitigating those impacts during construction. Buried in-water utilities and buried debris were not identified in any of the PDI surveys; though potential unidentified debris represents an uncertainty that will be further addressed during the RD. Derelict pile debris in shoreline areas are also being considered in the BODR, where warranted based on proposed RA in those areas.

The data generated by the hydrodynamics and sediment dynamics surveys indicate a quiescent, depositional environment with flows that are not likely to cause resuspension and erosion, even during flood events. Resuspension and erosion during flood events will be further addressed during the RD. Wind-waves and boat wakes are small but could mobilize sediment in shallow water and along the shoreline. The hydrodynamics and sediment dynamics dataset fulfills the applicable data needs to support the development of the RD and the completion of the source control sufficiency assessment. The measurements were collected to generate data necessary to facilitate analysis of recontamination potential and to demonstrate stability/persistence of the remedy under both river hydrodynamics and anthropogenic hydrodynamic effects.

The habitat conditions survey provides qualitative information on the condition and extent of riparian, ACM, and main channel habitats in the SIB Project Area. The data compiled as part of the survey are suitable inputs to a HEA and provide the baseline (existing/pre-construction condition) for determining the current and future habitat requirements for the purpose of designing and constructing the selected remedy.

Finally, information from shoreline property owners/operators in the SIB Project Area included specific details on facility operations. Constraints related to waterway operations and schedule, in-water structures, vessel maneuverability and frequency, and operational navigation depths. The RD will consider facility opportunities and constraints when evaluating technology assignments and implementability factors, and to inform construction sequencing.

This page was intentionally left blank.

5.0 REFERENCES

Appledore Marine Engineering, LLC, 2019. *Waterfront Facilities Inspections and Assessments at NOSC Portland*, CR-NAVFAC EXWC-CIOFP-1919. Prepared for NAVFAC EXWC, Washington Navy Yard, Washington, DC. August.

American Society of Civil Engineers (ASCE), 2015. *ASCE Manuals and Reports on Engineering Practice No. 130 Waterfront Facilities Inspection and Assessment.* American Society of Civil Engineers.

City of Portland Bureau of Environmental Services (City), 2014. Municipal Stormwater Source Control Report for Portland Harbor. Amended February 2014, at URL http://www.portlandoregon.gov/bes/64448.

HydroGeoLogic, Inc. (HGL), 2021a. *Stormwater and Riverbank Assessment and Sampling Plan, Revision 1*, Remedial Design Services, Swan Island Basin Project Area, Portland Harbor Superfund Site, Portland, Multnomah County, Oregon. Revision 2. November.

HGL, 2021b. *Draft Sufficiency Assessment Report*. Remedial Design Services, Swan Island Basin Project Area, Portland Harbor Superfund Site, Portland, Multnomah County, Oregon. June 29.

HGL, 2022a. *Pre-Design Investigation Work Plan, Revision 3*, Remedial Design Services, Swan Island Basin Project Area, Portland Harbor Superfund Site, Portland, Multnomah County, Oregon. Revision 3. May.

HGL, 2022b. *Riverbank Sampling Plan, Revision 1*. Remedial Design Services, Swan Island Basin Project Area, Portland Harbor Superfund Site, Portland, Multnomah County, Oregon. Revision 1. October.

HGL, 2022c. *Field Change Request #8 - Sediment Sampling.* CERCLA Docket No. 10- 2021-001. July 21.

HGL, 2022d. *Field Change Request #11 - Sediment Sampling.* CERCLA Docket No. 10- 2021-001. August 15.

HGL, 2022e. *Field Change Request #12 - Sediment Sampling.* CERCLA Docket No. 10- 2021-001. August 18.

HGL, 2022f. *Field Change Request #13 - Sediment Sampling.* CERCLA Docket No. 10- 2021-001. August 19.

HGL, 2022g. *Field Change Request #1 - Stormwater Outfall and Conveyance System Sampling.* CERCLA Docket No. 10- 2021-001. January 25.

HGL, 2022h. *Field Change Request #4 - Stormwater Outfall and Conveyance System Sampling.* CERCLA Docket No. 10- 2021-001. February 24.

HGL, 2022i. *Field Change Request #7 - Geotechnical Sampling.* CERCLA Docket No. 10- 2021-001. June 22.

HGL, 2022j. *Field Change Request #10 - Geotechnical Sampling.* CERCLA Docket No. 10-2021-001. August 1.

HGL, 2022k. *Field Change Request #14 - Geotechnical Sampling.* CERCLA Docket No. 10-2021-001. October 5.

HGL, 2022l. *Field Change Request #2 - Hydrodynamics and Sediment Dynamics Measurements.* CERCLA Docket No. 10- 2021-001. February 3.

HGL, 2022m. *Field Change Request #3 - Hydrodynamics and Sediment Dynamics Measurements.* CERCLA Docket No. 10- 2021-001. February 17.

HGL, 2022n. *Field Change Request #6 - Hydrodynamics and Sediment Dynamics Measurements.* CERCLA Docket No. 10- 2021-001. May 25.

HGL, 2023a. *Porewater Quantitative Assessment Plan, Revision 3*, Remedial Design Services, Swan Island Basin Project Area, Portland Harbor Superfund Site, Portland, Multnomah County, Oregon. Revision 3. June.

HGL, 2023b. *Field Change Request #15 - Hydrodynamics and Sediment Dynamics Surveys.* CERCLA Docket No. 10- 2021-001. March 15.

Maul Foster and Alongi, Inc., 2002. *Assessment of Parking Lot, Truck Manufacturing Plant, Freightliner LLC, Portland Oregon*. December 17.

Mott MacDonald, 2022. Revised (Version 4) *Survey and Quality Control Plan*. Technical Memorandum. Prepared for the Swan Island Remedial Design Group, Overland Park, Kansas. March.

National Oceanic and Atmospheric Administration, 2016. Booklet Chart, Willamette River – Swan Island Basin, NOAA Chart 18527 at URL: https://www.charts.noaa.gov/OnLineViewer/18527.shtml

Oregon Department of Environmental Quality (DEQ) and U. S. Environmental Protection Agency (EPA), 2005. Portland Harbor Join Source Control Strategy. Oregon Department of Environmental Quality and the U.S. Environmental Protection Agency. December.

Oregon Historical Society, 2014. Oregon Encyclopedia webpage, at URL https://www.oregonencyclopedia.org/articles/swan_island/#.VAYgqMVdXTo.

Oregon Historical Society, 2023. Oregon History Project webpage, at URL https://www.oregonhistoryproject.org/narratives/commerce-climate-and-community-a-history-of-portland-and-its-people/introduction-3/first-peoples-in-the-portland-basin/.

Port of Portland, 1999. Memorandum: Portland Shipyard Maintenance Dredging and Dredge Material Disposal History. December 9.

Rosgen, D., 2014. River Stability Field Guide, Wildland Hydrology.

U.S. Army Corps of Engineers (USACE), 1966. Aerial photograph COE 324 taken February 22, 1966.

USACE, 1979. *Portland-Vancouver Metropolitan Area Water Resources Study – Dredging in Portland Harbor*.

USACE, 2013. Engineer Manual 1110-2-1003 Hydrographic Surveying. November.

U. S. Environmental Protection Agency (EPA), 2016. *Portland Harbor RI/FS, Final Remedial Investigation Report, Portland Oregon*. United States Environmental Protection Agency Region 10, Seattle, Washington. February 8.

EPA, 2017. *Record of Decision*, Portland Harbor Superfund Site, Portland Oregon. United States Environmental Protection Agency Region 10, Seattle, Washington. January.

EPA, 2019. *Guidance for River Bank Characterizations and Evaluations at the Portland Harbor Superfund Site*, Portland, Oregon. September 10.

EPA, 2020. *Errata #2 for Portland Harbor Superfund Site Record of Decision ROD, Table 17*. Memorandum from Sean Sheldrake to Portland Harbor Site File. January 14.

EPA, 2021a. *Administrative Settlement Agreement and Order on Consent for Remedial Design*. Swan Island Basin Project Area, CERCLA Docket No. 10-2021-001 - 7, Region 10. January 20.

EPA, 2021b. *Remedial Design Guidelines and Considerations*, Portland Harbor Superfund Site. Portland, Oregon. April 23.

EPA, 2022a. *Errata #3 for Portland Harbor Superfund Site Record of Decision ROD, Table 6 and Table 21*. Memorandum from Hunter Young to Portland Harbor Site File. September 7.

EPA, 2022b. *Evaluation of consistently and reliably attained practical quantitation limits for 2,3,7,8-TCDD and 1,2,3,7,8-PeCDD for use in Sediment Management Area delineation at the Portland Harbor Superfund Site*. Memorandum from Portland Harbor Remedial Project Managers, Superfund and Emergency Management Division to Portland Harbor Site File. September 16.

This page was intentionally left blank.

TABLES

This page was intentionally left blank.

Table 2-1
Pre-Design Investigation Summary
Pre-Design Investigation Evaluation Report; Swan Island Basin Project Area, Portland, Oregon

<table>
<tr><th>Data Type</th><th>Existing Data</th><th>Data Gap</th><th>PDI Data Collection</th><th>Deviation from PDI Work Plan</th></tr>
<tr>
<td rowspan="2">Surface Sediment Contaminant Concentrations</td>
<td rowspan="3">Existing sediment chemistry data sources include:
• EPA, 2017. Record of Decision, Portland Harbor Superfund Site, Portland, Oregon
• Kleinfelder, 2015. Sediment Sampling Data Report, Portland Harbor, Portland, Oregon. Prepared for de maximis inc. 1 June. (not used to support RD)
• Geosyntec, 2016. Sediment Sampling Data Report, Swan Island Lagoon, Portland, Oregon. Prepared for The Marine Group, LLC and BAE Systems San Diego Ship Repair, Inc. August 12.
• AECOM and Geosyntec, 2019. PDI Evaluation Report, Portland Harbor Pre-Remedial Design Investigation and Baseline Sampling. Prepared for United States Environmental Protection Agency, Region 10.
• Pacific Groundwater Group, 2019. Surface and Subsurface Sediment Field Sampling and Data Report, Swan Island Lagoon, Portland Harbor Superfund Site. Prepared for Daimler Trucks North America LLC.
• Pacific Groundwater Group, 2019. Surface and Subsurface Sediment Field Sampling and Data Report, Swan Island Lagoon, Portland Harbor Superfund Site. Prepared for de maximis, inc.</td>
<td>Gaps in spatial coverage to characterize the horizontal extent of contamination within SMA:
• The ROD SMA for SIB was divided into 70 grid cells, using 150-ft spacing.
• Existing data available for 47 (67 percent)</td>
<td>Collected and analyzed "step out" surface samples to refine delineation of SMA boundary:
• 4 surface grab samples and 56 samples (25 initial and 31 from archive) from 0- to 1-ft interval of selected cores.</td>
<td rowspan="3">EPA approved FCR #8 which revised the equipment blank frequency from 1 per 20 samples to 1 per week.

EPA approved FCR #9 which allowed the use of disposable aluminum bowls for compositing samples.

EPA approved FCR #11 which revised the shipping frequency of samples to CFA to one consolidated shipment, at the end of sampling, to avoid shipping delays that resulted in advancement of cores and re-sampling at 18 core locations.

EPA approved FCR #12 which provided alternative locations for planned sediment cores that could not be advanced within 25-ft of the original locations. In total, 2 grab samples and 24 core sample locations were re-located at more than 25-ft from the target locations.

EPA approved FCR #13 which moved the location of a bulk sediment sample from one “low” concentration location to an alternative “low” concentration location.</td>
</tr>
<tr>
<td>Data needed to support analysis of short-term water quality effects during dredging activities</td>
<td>Collected 3 bulk sediment samples collected for dredge elutriate testing.</td>
</tr>
<tr>
<td>Subsurface Sediment Contaminant Concentrations</td>
<td>Insufficient core data to characterize the vertical extent of contamination within SMA:
• Data needed to delineate areas for technology applications including enhanced natural recovery, dredging, and capping.
• Physical and chemical characterization in areas under docks and other structures.</td>
<td>Conducted in-water coring on a 150-ft grid to collect sediment samples to characterize vertical extent of contamination. Collected samples at 1-foot intervals. Initially analyzed samples from 1- to 6-ft depth for 10-ft cores (160 cores), and 1- to 15-ft depth for 20-ft cores (10 cores), with additional analysis of archive samples:
• Analyzed 1,003 samples (777 initial and 226 from archive) for 10-ft cores, excluding duplicate samples.
• Analyzed 138 samples (130 initial and 8 from archive) for 20-ft cores, excluding duplicate samples.</td>
</tr>
<tr>
<td>Sediment Porewater Characterization</td>
<td>No data</td>
<td>Lack of data to map upward porewater migration within areas of potential sediment capping</td>
<td>Conducted two-phase porewater assessment:
• Trident Probe transition zone water screening survey at 127 stations over 21 transects to identify areas of potential groundwater upwelling.
• UltraSeep survey at 21 target stations to measure seepage rates and DPZ survey at 8 stations, co-located with the UltraSeep stations.</td>
<td>None</td>
</tr>
</table>

Table 2-1 (continued)
Pre-Design Investigation Summary
Pre-Design Investigation Evaluation Report; Swan Island Basin Project Area, Portland, Oregon

Data Type	Existing Data	Data Gap	PDI Data Collection	Deviation from PDI Work Plan
Stormwater Outfall and Conveyance System Sampling	Existing municipal and private outfall stormwater and stormwater solids data sources evaluated and summarized in the Draft Sufficiency Assessment Report (HGL, 2021b).	Lack of adequate data on recontamination potential chemical-loading from municipal and private outfalls to determine source control sufficiency and complete the Sufficiency Assessment Report. Unknown status of discharges from some private outfalls and lack of adequate characterization of PCDDs/PCDFs within the city stormwater conveyance systems, or at the many sites in the upland area around the SIB Project Area.	Conducted stormwater outfall and conveyance system sampling: • Collected and analyzed high-volume, flow-weighted samples to support COC load calculations from 5 municipal stormwater outfalls (M-1, M-2, M-3 S-1, and S-2) during 3 qualifying storm events. • Collected and analyzed stormwater grab samples from 6 private outfall basins concurrent with municipal stormwater sample collection. • Collected stormwater solids samples via manual grab sampling or using ILS samplers at 12 locations in 5 municipal basins, composited wet and dry season samples, and analyzed samples based available sample mass and targeted COCs.	EPA approved FCR #1 which resulted in moving the location of one HVS sampler from the planned location to an alternative location, within the same drainage basin. EPA approved FCR #4 which resulted in the collection of ILS samples from one additional location to support the evaluation of a potential PCB source. During installation of autosamplers in private outfalls, attempts were made to install compatible flow sensors to collect annual flow data; however, due to the configuration of the catch basins and/or outfalls, the flow sensors were unable to be installed. Without the flow sensors installed, the autosamplers were instead remotely triggered via a modem connection to begin sample collection once it was observed that the city conveyance system had elevated flow and the HVS sampling program had been initiated.
Riverbank Characterization	Existing riverbank soil data sources evaluated and summarized in the Draft Sufficiency Assessment Report (HGL, 2021b). Generally, the following sources of existing data were evaluated: • EPA, 2017. Record of Decision, Portland Harbor Superfund Site, Portland, Oregon • Oregon DEQ, Environmental Cleanup Site Information (ECSI) database.	Riverbanks within the SIB Project Area are not adequately characterized to assess source control sufficiency and inform stabilization as part of RD	Conducted two-phased riverbank characterization: • Visual survey of physical bank conditions to evaluate erosion potential and delineate areas of potentially erodible sediments. • Analyzed 276 samples from surface intervals (90 TOB, 111 OHW, 75 MLW); 95 samples from 1- to 2-ft depth interval (40 TOB, 31 OHW, 24 MLW); and 28 samples from 2- to 3-ft depth interval (17 TOB, 10 OHW, 1 MLW), excluding duplicate samples. • Analyzed 123 archive samples based on exceedances in surface interval samples, excluding duplicate samples.	EPA approved FCR #8 which revised the equipment blank frequency from 1 per 20 samples to 1 per week. EPA approved FCR #9 which allowed the use of disposable aluminum bowls for compositing samples.

Table 2-1 (continued)
Pre-Design Investigation Summary
Pre-Design Investigation Evaluation Report; Swan Island Basin Project Area, Portland, Oregon

Data Type	Existing Data	Data Gap	PDI Data Collection	Deviation from PDI Work Plan
Bathymetry and Topography	Existing bathymetry and topography data sources include: • Multibeam Bathymetric Survey of the Lower Willamette River Work Plan. Prepared for Lower Willamette Group. David Evans and Associates, Inc., Portland, Oregon. July 2001. • Lower Willamette River Multibeam Bathymetric Survey Report, December 2001/January 2002. David Evans and Associates, Inc., Portland, Oregon. Draft. April 26, 2002. • Lower Willamette River Summer 2002 Multibeam Bathymetric Survey Report. David Evans Associates, Inc., Portland, Oregon. 2003. • Lower Willamette River Multibeam Bathymetric Survey Report. David Evans Associates, Inc., Portland, Oregon. May 2003 • Lower Willamette River Multibeam Bathymetric Survey Report, David Evans Associates, Inc., Portland, Oregon. February 2004. • Willamette River, Oregon River Mile 1.9 to 11.8 Hydrographic Survey Report. Prepared for the Pre-RD AOC Group on behalf of AECOM and Geosyntec Consultants. David Evans Associates, Inc., Portland, Oregon. 2018. • NOAA, Registry No. H11859. Surveyed by: David Evans Associates, Inc., Portland, Oregon. 2009. • Oregon LiDAR Consortium Metro (OLC), 2009. 2007 - 2009 OLC Lidar DEM: Hood to Coast, OR from 2010-06-15 to 2010-08-15. • OLC, 2012. 2012 OLC Lidar DEM: West Metro, Oregon from 2010-06-15 to 2010-08-15. • OLC, 2014. 2014 Oregon Department of Geology and Mineral Industries Oregon Lidar: Metro Portland, OR from 2010-06-15 to 2010-08-15. • Puget Sound LiDAR Consortium, 2005. 2005 Puget Sound LiDAR Consortium Topographic LiDAR: Lower Columbia River from 2010-06-15 to 2010-08-15. • 2010 USACE Lidar: Columbia River (OR, WA, ID, MT) from 2010-06-15 to 2010-08-15. • Utilities and Structures Swan Island Shipyard, General Technical Memorandum by Cascade General, Inc. Attachment B: 2015 – 2019 Bathymetric Surveys.	Lack of recent multi-beam bathymetry survey of the entire SIB Project Area, needed for use in analysis and RD.	Conducted a sitewide multi-beam bathymetric survey.	The riverbed surface was imaged using an R2 Sonic 2024 Multibeam EchoSounder, which deviated from the proposed R2 Sonic 2020 MBES to provide better imaging resolution.
Geotechnical Site Characterization	Existing data sources on geotechnical site conditions include: • Geotechnical data and reports prepared for previous development in and around the project area. Limited data, including permit records, is available through the City of Portland Bureau of Development Services. • Regional geologic maps and reports are available through both the USGS and the Oregon Department of Geology and Mineral Industries.	Lack of adequate characterization of the existing geotechnical site conditions for development of geologic cross-sections that describe the soil stratigraphy across the site as well as: • Information on groundwater conditions for engineering analyses; • Site stratigraphy and geotechnical design parameters; • Site-specific geologic hazards and seismic design parameters	Conducted a site-specific geotechnical sampling program consisting of soil borings and CPTs, and geophysical logging to define subsurface conditions and to obtain samples for geotechnical laboratory testing program. • 15 upland borings drilled to depths ranging from 71.5 ft to 121.5 ft. • 15 in water borings drilled to depths of 60 ft to 95.5 ft below mudline.	EPA approved FCR #7 which adjusted the location of 1 CPT and 2 soil borings to address private property owner concerns. EPA approved FCR #10 which clarified that drilling equipment would be decontaminated using hand cleaning methods. EPA approved FCR #14 which eliminated an upland boring from the sampling program and instead relied on existing geotechnical data provided by City of Portland.

Table 2-1 (continued)
Pre-Design Investigation Summary
Pre-Design Investigation Evaluation Report; Swan Island Basin Project Area, Portland, Oregon

Data Type	Existing Data	Data Gap	PDI Data Collection	Deviation from PDI Work Plan
Shoreline and Overwater Structures and Activities	Existing shoreline and overwater structure data sources include: • As-built design plans are available for various fixed structures within the shipyard. • The latest condition assessment report available is from 2014 and covers Berths 301-305, 309-310, 312-314, associated finger pier, and sheet piles cell walls of Pier A. • Information is available on impacts of berth deepening on the sheet pile walls of Pier A.	Lack of structural information for all potentially affected shoreline and over-water structures, such as piers, wharves, dolphins, floating docks, retaining walls/bulkheads, boat launch, dry docks, and other structures. Information needed includes as-built structure dimensions and layout, material types, material strengths, design loads, environmental loads, pile embedment depths and capacities, and fill material used in cellular structures. Additional data needs include: • Current condition inspections and assessments of shoreline and over-water structures, and structural evaluation to estimate remaining service life. • Mobile Terrestrial LiDAR survey data to document the locations and elevations of existing structures. • Information from current SIB shoreline owners/operators to understand facility operations and current/future use; obtain data on vehicles, equipment, vessels, and other loads that the structures need to support and are planning to support in the future (if different than the original design); obtain as-built plans of repairs or remodels, including design criteria; and obtain previous navigation channel studies, dredging studies, or berth deepening studies for all affected structures.	Collected information and conducted shoreline and overwater structure assessment activities: • Conducted topside, above-water, and underwater inspections to determine the physical condition of the primary structural components of the substructure and superstructure at each shoreline/overwater structure • Conducted structural element inspection, including both visual and tactile methods. • Conducted vessel-mounted mobile LiDAR survey. • Conducted survey of property owners and operators for facilities located on the SIB shoreline. • Conducted condition assessments for primary structural system components of each overwater structure.	None
Existing Utilities and Debris Identification	Existing information regarding locations and elevations of utilities and marine debris includes: • Existing locations and as-builts are available for the City of Portland's five outfalls in the basin. • Some private outfall locations • Aerial photos of derelict structures in the basin, including earlier time periods that indicate where underwater structures may now be located. • NOAA Nautical Charts identify areas within the SIB Project Area as "abandoned cables".	Lack of surveys identifying the location and types of underwater debris and/or utilities. Data needs include: • Location and identification of underwater debris and ferrous objects. • Mobile Terrestrial LiDAR survey data to document the locations and elevations of in-water debris. • As-built drawings, locations, and details (e.g., invert elevations, functionality) for private outfalls. • Existing underground utilities, pipeline and conduit locations, water utilities, and other pipelines.	Conducted surveys to supplement multi-beam bathymetric survey coverage to characterize the location and nature of underwater debris: • side-scan sonar along 28 vessel tracks; • magnetometer survey along transects; • vessel-mounted mobile LiDAR survey; and • sub-bottom profile survey along 30 transects.	None

Table 2-1 (continued)
Pre-Design Investigation Summary
Pre-Design Investigation Evaluation Report; Swan Island Basin Project Area, Portland, Oregon

Data Type	Existing Data	Data Gap	PDI Data Collection	Deviation from PDI Work Plan
Hydrodynamics and Sediment Dynamics Measurements	Existing currents and water level data sources include: • ADCP transect-based current velocity data near Dry Dock 6 (Stillwater Sciences, 2014). • ADCP transect-based current velocity data in the main river (David Evans Associates, 2002-2004). • NOAA and USGS hydrologic data (flows and water levels) at various locations on the river. Existing wind data includes: • Long-term measurements (1976-2021) for Portland International Airport from the National Climatic Data Center. Historical measurements (1961-1990) are also available from Meteorological Resource Center. • Portland Harbor RI/FS (EPA, 2016) Existing sediment dynamics data includes: • Portland Harbor RI/FS (EPA, 2016) • Pre-Remedial Design sediment investigation grain size and specific gravity. • Total suspended solids measurements from November 2005 to April 2006 are available at multiple locations between RM 2 and RM 21 (WEST Consultants, Inc., 2006). • Short-duration sediment release modeling results are available from evaluation of impacts during maintenance dredging (ERM-West, Inc., 2014). Existing vessel position data includes: • Bureau of Ocean Energy Management and NOAA Marine Cadaster.	Lacking hydrodynamic/transport processes data for conceptual site model refinement, data for model validation, and data for direct use in RD. Data needs include: • Sediment erodibility, grain size, and bulk density data • Current and water level measurements • Suspended sediment measurements • Wind-wave and boat wake measurements • Dry dock information including as-builts, design reports, and typical operations.	Collected hydrodynamics and sediment dynamics data: • Performed SEDflume sampling at 30 locations and conducted laboratory analysis to determine sediment characteristics and develop erodibility parameters. • Conducted ADCP measurements along transects from vessel-mounted and at stationary locations from bottom-mounted instruments. • Deployed CTD sensors at 2 locations to collect near-bottom turbidity measurements and collected real-time CTD vertical profiles at 15 locations. • Recorded free surface elevations over two deployment periods from four independent, non-directional wave gages for evaluation of wave conditions. • Conducted survey of property owners and operators for facilities located on the SIB shoreline.	EPA approved FCRs #2 and #3 which modified wind wave and boat wake sensor locations, prior to deployment, due to accessibility issues. EPA approved FCR #6 which reduced data collection for one of the two bottom-mounted ADCPs from 60-days to 40-days. EPA approved FCR #15 which modified the laboratory method for TSS analysis of water samples from the proposed methods of EPA Method 160.2 and ASTM D 3977-97 to SM2540D due to low sediment concentrations.
Habitat Conditions Survey	Existing habitat conditions data source includes: • Programmatic Biological Assessment, Portland Harbor Superfund Site. Seattle, Washington. July 2021.	Lacking characterization of habitat conditions to support analysis of RD impacts: • Characterization of the riparian area, including vegetation, substrate, location with respect to historical floodplain, slope, presence of buildings, structures, and riprap; • Characterization of the ACM, including depth, substrate, presence of riprap, sheet pile/seawall, pilings, and suspended and floating structures; • Characterization of the shallow water area, including depth, substrate, presence of riprap, sheet pile/seawall, pilings, and suspended and floating structures; and • Characterization of the deep water area, including depth, substrate, presence of riprap, sheet pile/seawall, pilings, and suspended floating structures.	Completed habitat condition survey: • Conducted a reconnaissance-level survey of select riparian, riverbank, and shallow water areas to qualitatively document habitat conditions. • Supplemented field data collection with desktop review and evaluation of shoreline and overwater structure inspection data, grain-size analysis completed on historical surface sediment samples, multi-beam bathymetric and LiDAR surveys to further characterize shallow and deep water areas.	Habitat data collection transects were spaced at 100-ft intervals along the shoreline (Appendix J, Figure 2-1), rather than the 150-ft intervals proposed in the PDI Work Plan

Table 3-1
Pre-Design Investigation Data Sufficiency
Pre-Design Investigation Evaluation Report; Swan Island Basin Project Area, Portland, Oregon

<table>
<tr><td colspan="2">Surface/Subsurface Sediment</td></tr>
<tr><td>SAR
Recontamination Potential Evaluation</td><td>Supports SAR Modeling Efforts:
• SEDCAM
• 3-D hydrodynamic model</td></tr>
<tr><td>BODR
*Narrative interpretation of validated analytical results for application of:
• Refinement of nature and extent of SMA (horizontal/vertical)
• CSM refinement
• Remedial technology evaluation: identify opportunities and constraints in terms of the technology application decision tree.</td><td>Supports BODR Components:
• Updated CSM for RD
• Updated RD Concept
• Dredging Study Report</td></tr>
<tr><td colspan="2">RD Work Plan
*Narrative interpretation of validated analytical results for application of:
• Defining nature and extent based on refined SMA, analysis of archived samples along Mocks Bottom, NAPL mobility testing (with additional sampling performed as needed during RD)
• Refining technology assignment
• Demonstrating removal and/or reliable containment of PTW
• Input to RD considerations
• Input to engineering design analysis</td></tr>
<tr><td colspan="2">Porewater Upwelling</td></tr>
<tr><td colspan="2">SAR
Recontamination Assessment
Recontamination Potential Evaluation</td></tr>
<tr><td>BODR
*Narrative interpretation of data for application of:
• CSM refinement
• Remedial technology evaluation</td><td>Supports BODR Components:
• Updated CSM for RD
• Updated RD Concept
• Constructability Assessment Report
• Cap Stability ER (chemical isolation evaluation)</td></tr>
<tr><td colspan="2">RD Work Plan
* Narrative interpretation of data for application of:
• Refining technology assignment, including characterization of porewater chemistry, as needed, to support application of technology assignment.
• Input to RD considerations
• Input to engineering design analysis</td></tr>
</table>

Table 3-1 (continued)
Pre-Design Investigation Data Sufficiency
Pre-Design Investigation Evaluation Report; Swan Island Basin Project Area, Portland, Oregon

Stormwater Outfall and Conveyance System Sampling	
SAR Recontamination Potential Evaluation	***Supports SAR Modeling Efforts:*** • SEDCAM • 3-D hydrodynamic model
BODR *Narrative interpretation of validated analytical results for application of: • Presentation of physical site setting • CSM refinement • Evaluate impacts related to RD implementability factors • Remedial technology evaluation: identify opportunities and constraints in terms of the technology application decision tree	***Supports BODR Components:*** • Updated CSM for RD • Constructability Assessment Report • Cap Stability ER
RD Work Plan *Narrative interpretation of validated analytical results for application of: • Refining technology assignment • Input to RD considerations • Input to engineering design analysis	

Table 3-1 (continued)
Pre-Design Investigation Data Sufficiency
Pre-Design Investigation Evaluation Report; Swan Island Basin Project Area, Portland, Oregon

<table>
<tr><td colspan="2">Riverbank Characterization</td></tr>
<tr><td>SAR
Recontamination Potential Evaluation</td><td>Supports SAR Modeling Efforts:
• SEDCAM</td></tr>
<tr><td>BODR
*Narrative interpretation of validated analytical results for application of:
• Presentation of site conditions and physical site setting
• Refinement of nature and extent of riverbank contamination
• CSM refinement
• Evaluate impacts related to RD implementability factors
• Remedial technology evaluation: identify opportunities and constraints in terms of the technology application decision tree</td><td>Supports BODR Components:
• Updated CSM for RD
• Updated RD Concept
• Facility Future Use and RA Impact ER
• Dredging Study Report
• Constructability Assessment Report</td></tr>
<tr><td colspan="2">RD Work Plan
*Narrative interpretation of validated analytical results for application of:
• Nature and extent of contamination
• Refining technology assignment
• Input to RD considerations
• Input to engineering design analysis</td></tr>
<tr><td colspan="2">Bathymetric Survey</td></tr>
<tr><td colspan="2">SAR
Recontamination Potential Evaluation</td></tr>
<tr><td>BODR
* Narrative interpretation of survey data for application of:
• Evaluation of impacts related to RD implementability factors
• Remedial technology evaluation: identify opportunities and constraints in terms of the technology application decision tree</td><td>Supports BODR Components:
• Updated RD Concept
• Dredging Study Report
• Constructability Assessment Report</td></tr>
<tr><td colspan="2">RD Work Plan
*Narrative interpretation of survey data for the application of:
• Input to RD considerations
• Input to engineering design analysis</td></tr>
</table>

Table 3-1 (continued)
Pre-Design Investigation Data Sufficiency
Pre-Design Investigation Evaluation Report; Swan Island Basin Project Area, Portland, Oregon

Geotechnical Site Investigation	
SAR Recontamination Potential Evaluation/Slope Stability Assessment	
BODR * Narrative interpretation of results for application of: • Remedial Technology Evaluation	***Supports BODR Components:*** • Facility Future Use and RA Impact ER • Dredging Study Report • Constructability Assessment Report • Cap Stability ER
RD Work Plan *Narrative interpretation of v results for application of: • Input to RD considerations • Input to engineering design analysis	
Shoreline and Overwater Structure Inspections	
SAR Recontamination Potential Evaluation • Overwater pathway • In-water pathway	***Supports SAR Modeling Efforts:*** • 3-D Hydrodynamic Model
BODR *Narrative interpretation of inspection results for application of: • Evaluation of impacts related to RD implementability factors • Remedial technology evaluation: identify opportunities and constraints in terms of the technology application decision tree	***Supports BODR Components:*** • Updated RD Concept • Facility Future Use and RA Impact Evaluation • Dredging Study Report • Construction Sequencing and Phasing Assessment Report • Constructability Assessment Report • Cap Stability ER
RD Work Plan *Narrative interpretation of validated analytical results for application of: • Refining technology assignment • Input to RD considerations	

Table 3-1 (continued)
Pre-Design Investigation Data Sufficiency
Pre-Design Investigation Evaluation Report; Swan Island Basin Project Area, Portland, Oregon

Existing Utilities and Debris Identification Surveys	
BODR *Narrative interpretation of survey results for application of: • Evaluation of impacts related to RD implementability factors • Remedial technology evaluation: identify opportunities and constraints in terms of the technology application decision tree	***Supports BODR Components:*** • Updated RD Concept • Facility Future Use and RA Impact ER • Dredging Study Report • Construction Sequencing and Phasing Assessment Report • Constructability Assessment Report • Debris Removal Plan
RD Work Plan *Narrative interpretation of validated analytical results for the application of: • Input to RD considerations • Input to engineering design analysis	
Hydrodynamics and Sediment Dynamics Measurements	
SAR • Recontamination Potential Evaluation • Hydrodynamics and Sediment Dynamics Modeling Report • Recontamination Potential ER	***Supports SAR Modeling Efforts:*** • SEDCAM • 3-D hydrodynamic model • CSM refinement • Recontamination assessment • Cap stability • Climate change impacts
BODR *Narrative interpretation of validated analytical results for application of: • Update CSM • Remedial technology evaluation: physical compatibility within design parameters, identify opportunities/constraints	***Supports BODR Components:*** • Hydrodynamics and Sediment Dynamics Modeling Report • Updated CSM for RD–- Tech Memo • Constructability Assessment Report • Cap Stability ER
RD Work Plan *Narrative interpretation of validated analytical results for application of: • Site characterization and provide input data • Completion and validation of numerical modeling efforts	

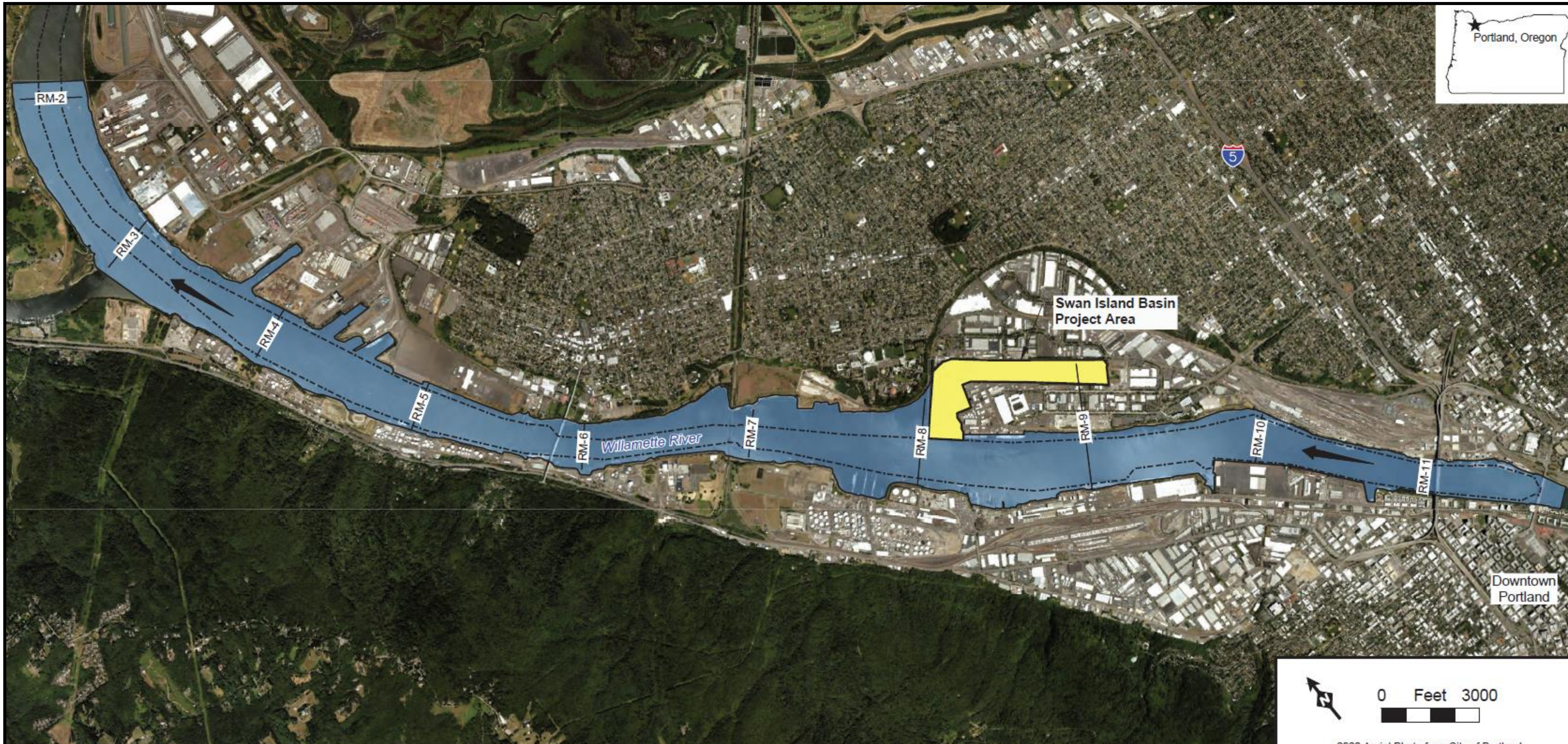
Table 3-1 (continued)
Pre-Design Investigation Data Sufficiency
Pre-Design Investigation Evaluation Report; Swan Island Basin Project Area, Portland, Oregon

<table>
<tr><th colspan="2">Habitat Conditions Survey</th></tr>
<tr><td>BODR
*Narrative interpretation of survey data for application of:
• Remedial technology evaluation: physical compatibility within design parameters, identify opportunities/constraints</td><td>Supports BODR Components:
• Habitat Impact ER</td></tr>
<tr><td colspan="2">RD Work Plan
*Narrative interpretation of survey data for application of:
• Permitting/other regulatory requirements: substantive compliance with applicable or relevant and appropriate requirements</td></tr>
<tr><th colspan="2">Facility Owner/Operator Interviews</th></tr>
<tr><td>BODR
*Narrative interpretation of results for application of:
• Evaluate impacts related to RD implementability factors
• Remedial technology evaluation: opportunities and constraints/synergies and conflicts</td><td>Supports BODR Components:
• Facility Future Use and RA Impact ER
• Dredging Study Report
• Construction Sequencing and Phasing Assessment Report
• Constructability Assessment Report</td></tr>
<tr><td colspan="2">RD Work Plan
*Narrative interpretation of results for application of:
• Refining technology assignment
• Input to RD considerations
• Input to engineering design analysis</td></tr>
</table>

This page was intentionally left blank.

FIGURES

This page was intentionally left blank.



Federal Navigation Channel (USACE 2020)

River Flow Direction

Swan Island Basin Project Area

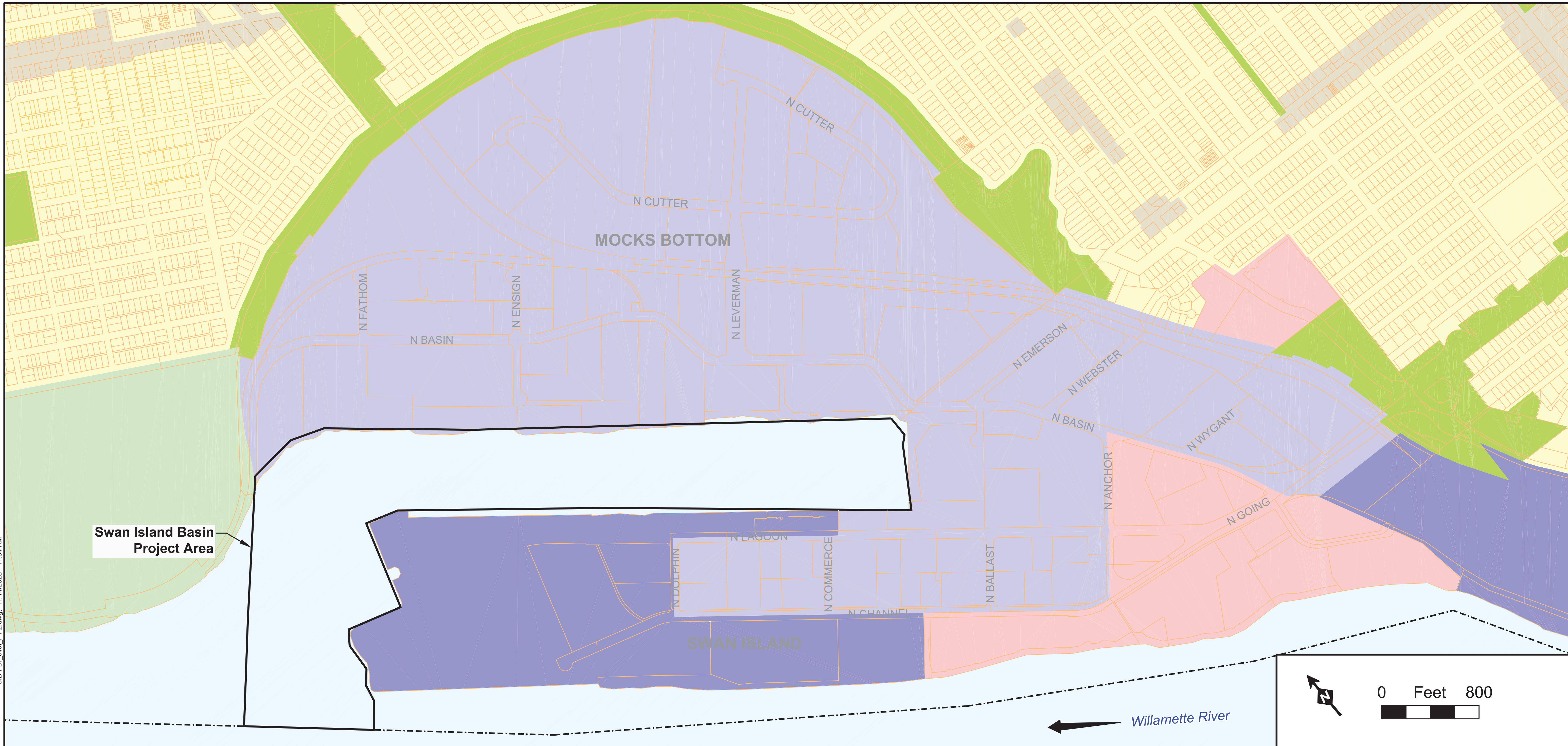
Portland Harbor Superfund Site Boundary (River Mile 1.9 to 11.8)

Notes:
NOAA - National Oceanic and Atmospheric Administration
PDI - Pre-Design Investigation
RM - River Mile
SIB - Swan Island Basin
USACE - U.S. Army Corps of Engineers
Source:
NOAA, 2016. Booklet Chart, Willamette River – Swan Island Basin, NOAA Chart 18527 at URL:
https://www.charts.noaa.gov/BookletChart/18527_BookletChart.pdf
- Navigation Channel

Figure 1-1
SIB Project Area Location Map

Prepared on: 09/25/2023
PDI Evaluation Report
Swan Island Basin

PACIFIC groundwater GROUP
HGL
MOTT MACDONALD
BRIDGEWATER GROUP



Federal Navigation Channel (USACE 2020)

River Flow Direction

Tax Lot Boundary

Zoning

- Heavy Industrial
- General Industrial
- General Employment
- Commercial
- Residential
- Campus Institutional
- Open Space

Notes:
NOAA - National Oceanic and Atmospheric Administration
PDI - Pre-Design Investigation
SIB - Swan Island Basin
USACE - U.S. Army Corps of Engineers

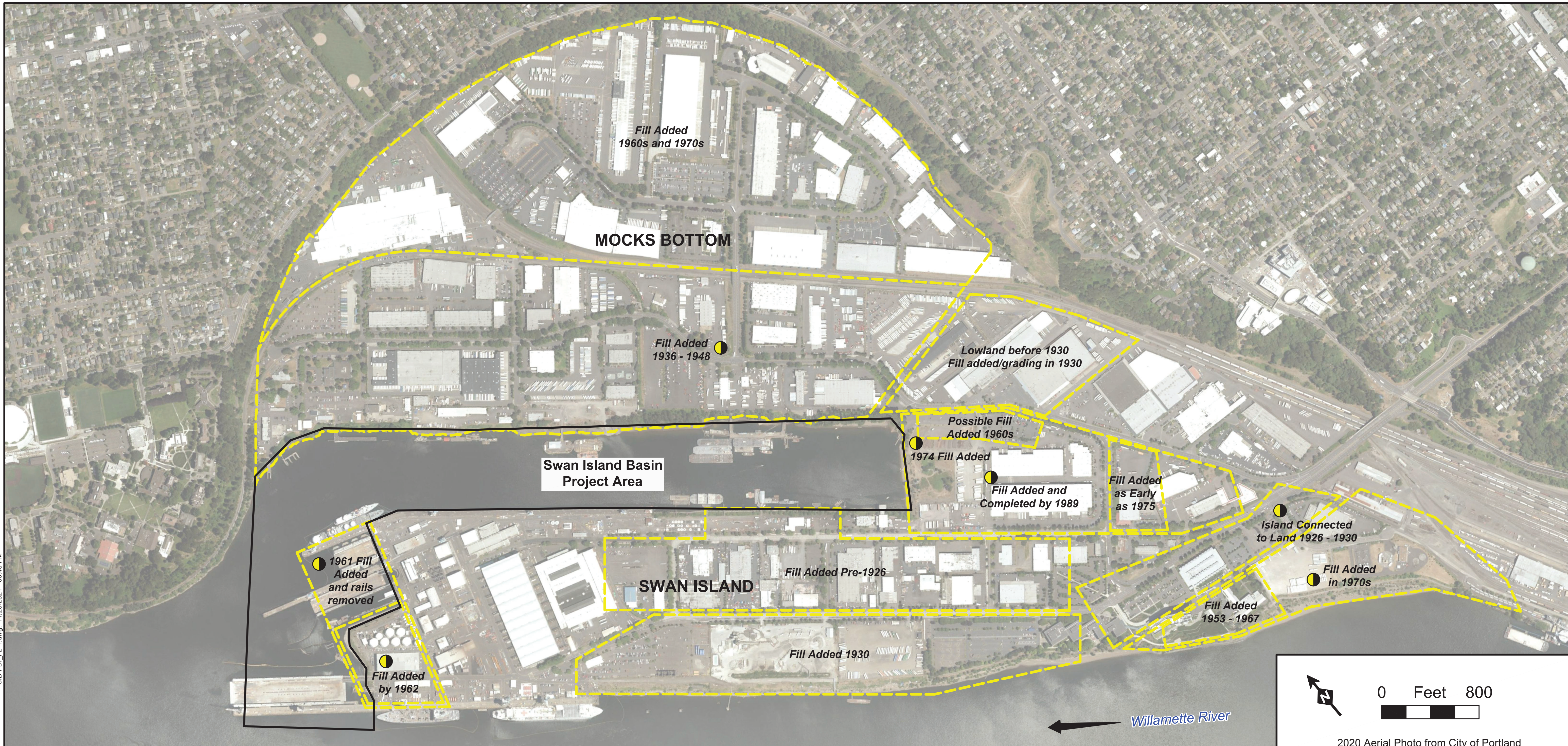
Sources:
(1) City of Portland Bureau of Environmental Services
- Collection Lines
(2) Oregon Metro Regional Land Information System
- Tax Lots (July 23, 2020)
(3) Portland Maps - Open Data
- Zoning (September 12, 2023)
(4) NOAA, 2016. Booklet Chart, Willamette River – Swan Island Basin, NOAA Chart 18527 at URL: https://www.charts.noaa.gov/BookletChart/18527_BookletChart.pdf
- Navigation Channel

Figure 1-2
SIB Upland Area Zoning

Prepared on: 11/14/2023
PDI Evaluation Report
Swan Island Basin

PACIFIC groundwater GROUP
HGL
MOTT MACDONALD
BRIDGEWATER GROUP

SIB-PDI_eval_F1-2.dwg, 11/14/2023 - 11:54 AM



Fill Placement (Approximate)
Areas of Change (Approximate)
River Flow Direction

Notes:
PDI - Pre-Design Investigation
SIB - Swan Island Basin

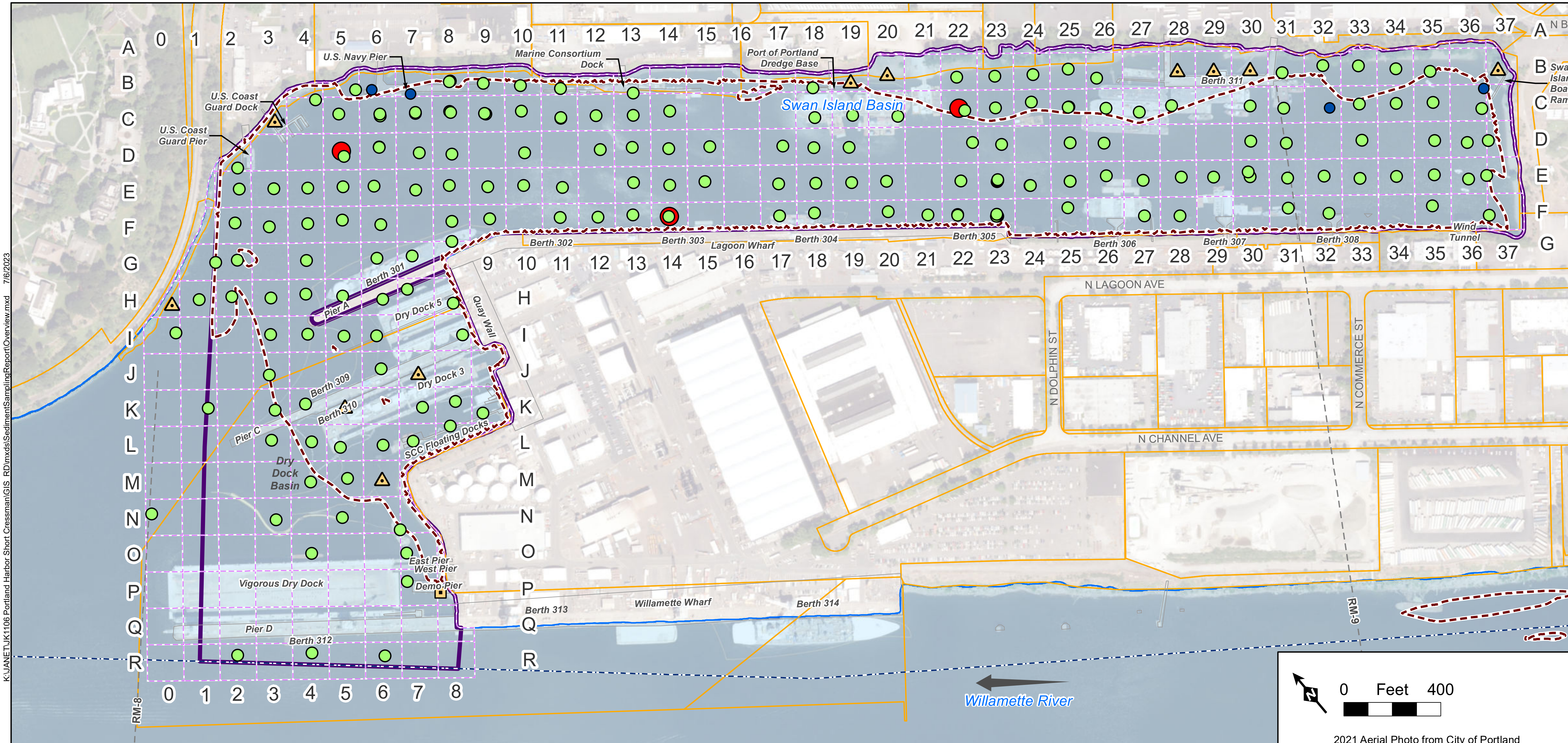
Source:
Figure 3-1, Historical Fill Placement in Swan Island/Mocks Bottom Georegion, Maul Foster Alongi (citing Integral et al., 2011), November 2011.

Figure 1-3
SIB Fill History

Prepared on: 8/31/2023
PDI Evaluation Report
Swan Island Basin

PACIFIC groundwater GROUP
HGL
MOTT MACDONALD
BRIDGEWATER GROUP

SIB-PDI_F2-1.dwg, 11/29/2021 - 03:40 PM



K:\JANET\JK1106 Portland Harbor Short Cressman\GIS_RD\mxds\SedimentSamplingReportOverview.mxd 7/6/2023

Project Area Grid
River Mile (RM)
Swan Island Sediment Decision Unit (SDU)
ROD Sediment Management Area (SMA)
Federal Navigation Channel (USACE, 2020)
Docks and Structures
Tax Lot Boundary
Ordinary High Water (City of Portland, 2013)
M Project Area Grid Label
River Flow Direction

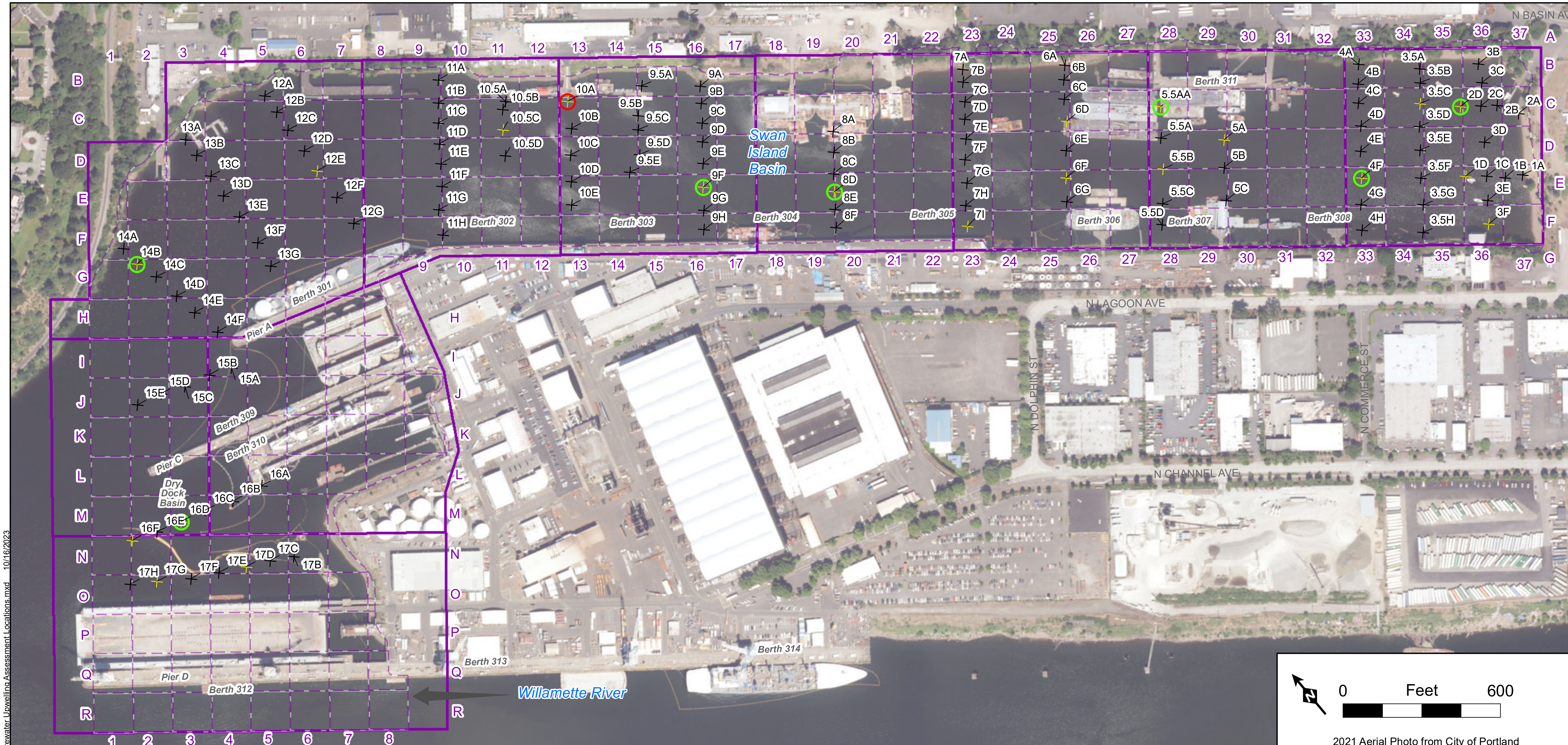
Sediment Investigation Sample Locations
- Core
- Grab
- Bulk Sediment and Water
- Target Grab Location Not Sampled
- Target Core Location Not Sampled

Notes:
ROD – Record of Decision
SCC – Shipyard Commerce Center
USACE – U.S. Army Corps of Engineers

Figure 2-1
Sediment Investigation Sample Locations

Prepared on: 7/6/2023
PDI Evaluation Report
Swan Island Basin

PACIFIC groundwater GROUP
HGL
MOTT MACDONALD
BRIDGEWATER GROUP



UltraSeep Location

Trident Survey Mapping Station

DPZ Location

DPZ Location with Sensor Failure (no data collected)

River Flow Direction

Project Area Grid Cell Boundary

Project Area Grid Boundary

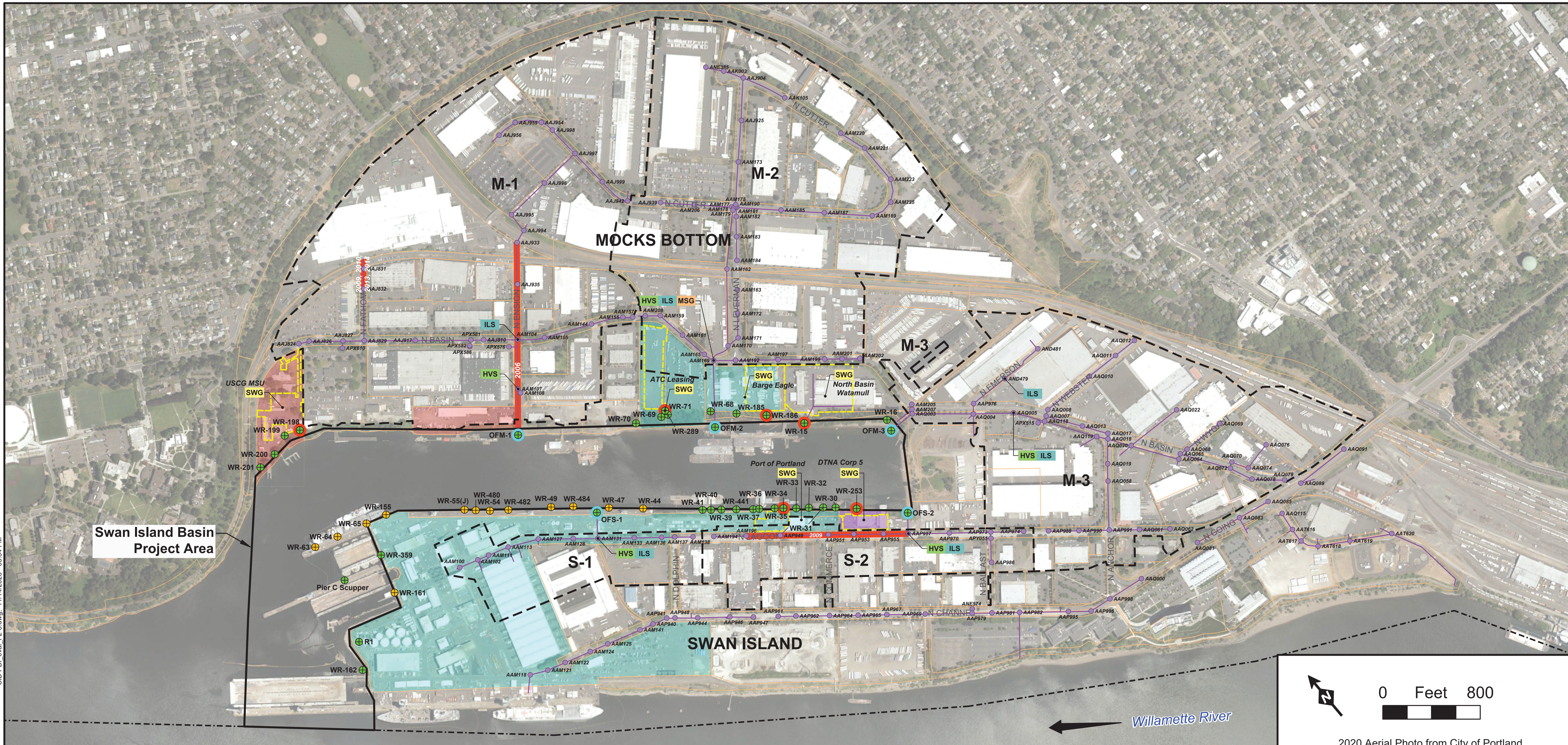
Notes:
DPZ = differential pressure piezometer

Figure 2-2
Porewater Upwelling Assessment Locations

Prepared on: 10/16/2023
PDI Evaluation Report
Swan Island Basin

PACIFIC groundwater GROUP
HGL
MOTT MACDONALD
BRIDGEWATER GROUP

\\srv-gst-01\HGL\GIS\Portland_Harbor_DT2002\SIB\PDI_ER\Figure 2-2 Porewater Upwelling Assessment Locations.mxd 10/16/2023



Stormwater Line
Stormwater Line Cleaning
Manhole
Tax Lot Boundary
Drainage Basin
Federal Navigation Channel (USACE 2020)
River Flow Direction

Sampling Methods

SWG Stormwater Grab
HVS High Volume Stormwater Sample
ILS In-Line Sediment
MSG Manual Sediment Grab

Outfalls

Active
Inactive, Overflow Only
Active - City of Portland Municipal Outfalls (M-1, M-2, M-3, S-1 and S-2)
Sampled Active Non-City Outfall
Estimated drainage areas for smaller outfalls included in stormwater sampling program

Notes:
EPA - U.S. Environmental Protection Agency
HVS - High Volume Sampling
NOAA - National Oceanic and Atmospheric Administration
NPDES - National Pollutant Discharge Elimination System
PDI - Pre-Design Investigation
USACE - U.S. Army Corps of Engineers

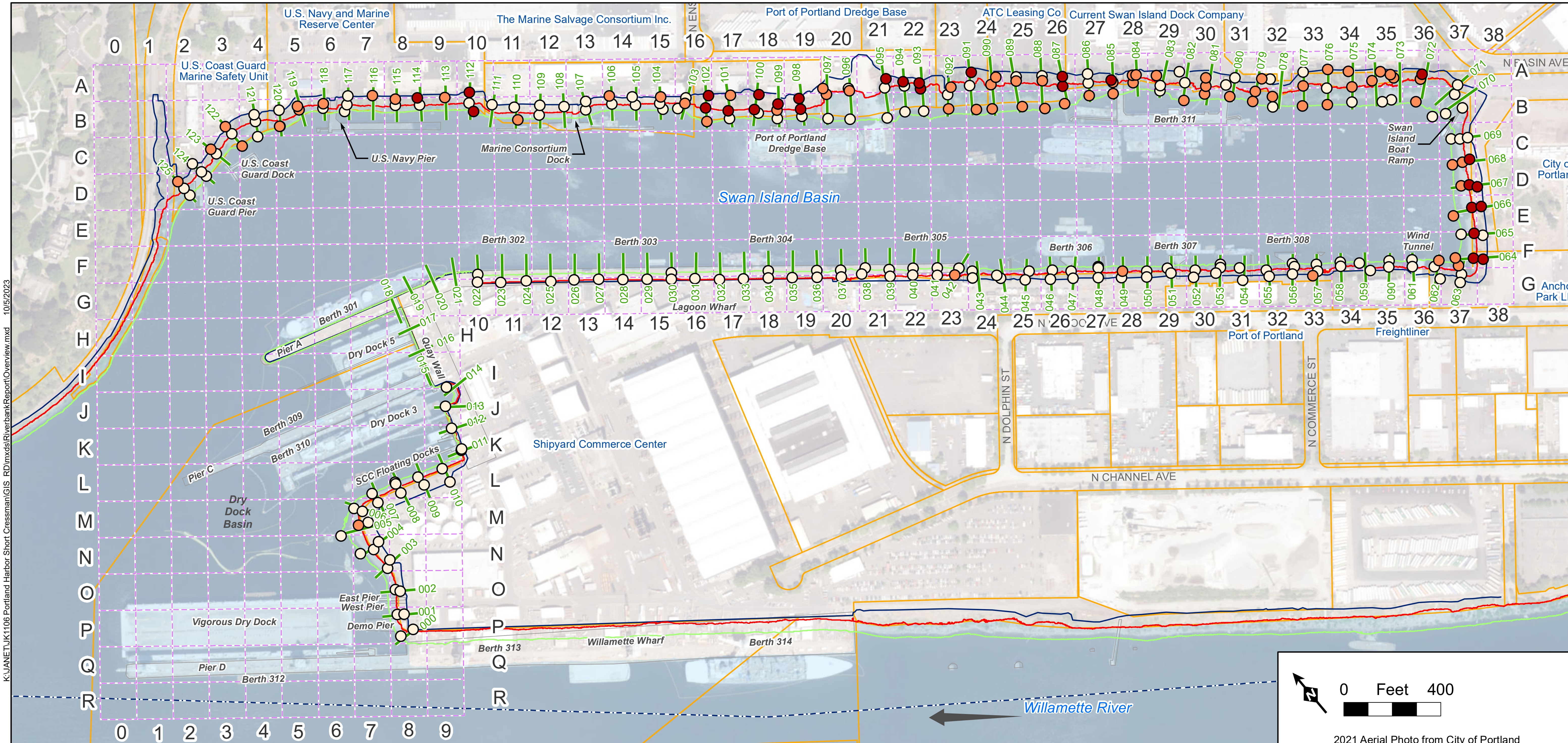
Stormwater Program

NPDES 1200 Z Permit
No Exposure Certification
Best Management Practices

Sources:
(1) City of Portland Bureau of Environmental Services
- Outfalls
- Drainage Basins
- Collection Lines
- Manholes
(2) Vigor Stormwater Program Staff
- Portland Shipyard Outfalls (August 30, 2023)
(3) Oregon Metro Regional Land Information System
- Tax Lots (July 23, 2020)
(4) NOAA, 2016. Booklet Chart, Willamette River – Swan Island Basin, NOAA Chart 18527 at URL: https://www.charts.noaa.gov/BookletChart/18527_BookletChart.pdf
- Navigation Channel

Figure 2-3
Stormwater and Stormwater Solids Sampling Locations

Prepared on: 11/14/2023
PDI Evaluation Report
Swan Island Basin



Project Area Grid
Federal Navigation Channel (USACE, 2020)
Docks and Structures
Tax Lot Boundary

Shoreline Inspection Transects
Top of Bank (TOB)
Ordinary High Water (OHW)
Mean Low Water (MLW)
River Bank Sample Locations
Sample Depths (feet)
0-1
0-2
0-3

M Project Area Grid Label

River Flow Direction

Notes:
SCC – Shipyard Commerce Center
USACE – U.S. Army Corps of Engineers

TOB Source – City of Porland Lidar, 2019
OHW and MLW Source – EPA, 2019

Sample Summary/Depth			
Depth/ Elevation	0-1 feet	1-2 feet	2-3 feet
TOB	90	40	17
OHW	111	31	10
MLW	75	24	1
Total (399)	276	95	28

Figure 2-4
Riverbank Sample Locations and Intervals

Prepared on: 10/05/2023
PDI Evaluation Report
Swan Island Basin

PACIFIC groundwater GROUP
HGL
MOTT MACDONALD
BRIDGEWATER GROUP

K:\JANET\JK1106 Portland Harbor Short Cressman\GIS_RD\mxds\RiverbankReport\Overview.mxd 10/5/2023

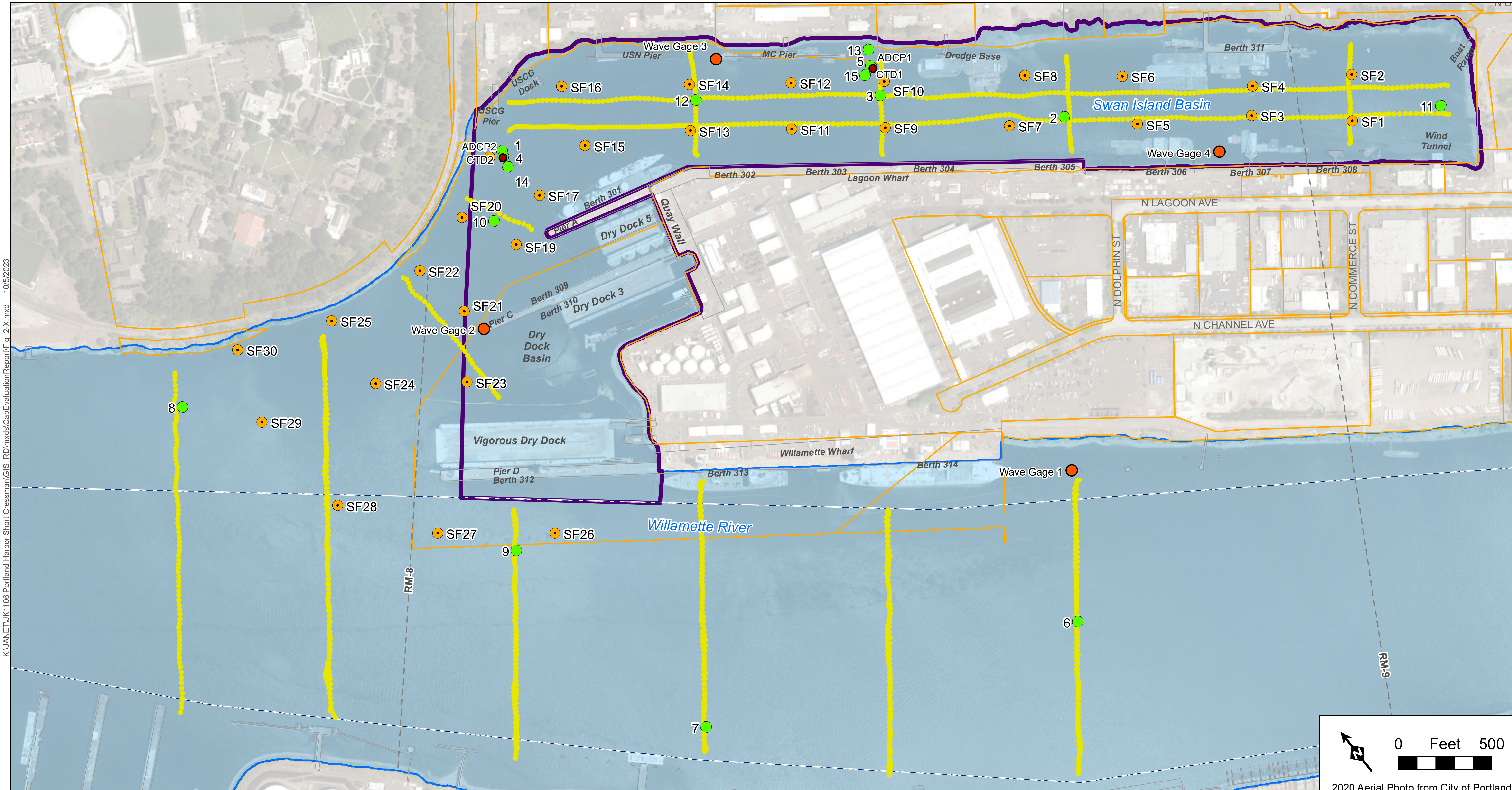
Geotechnical Boring
Geotechnical Boring with PS-Logging
Cone Penetration Test
Seismic Cone Penetration Test
River Mile (RM)
Federal Navigation Channel (USACE, 2020)
River Flow Direction

Note:
CPT - cone penetration test
HGL - HydroGeoLogic
MM - Mott MacDonald
RM - River Mile
SIB - Swan Island Basin
USACE - U.S. Army Corps of Engineers
USGS - U.S. Geological Survey

Figure 2-5
Geotechnical Investigation Locations

Prepared on: 10/12/2023
PDI Evaluation Report
Swan Island Basin

PACIFIC groundwater GROUP
HGL
MOTT MACDONALD
BRIDGEWATER GROUP



K:\JANET\JK1106 Portland Harbor Short Cressman\GIS_RD\mxds\CapEvaluationReport\Fig_2-X.mxd 10/5/2023

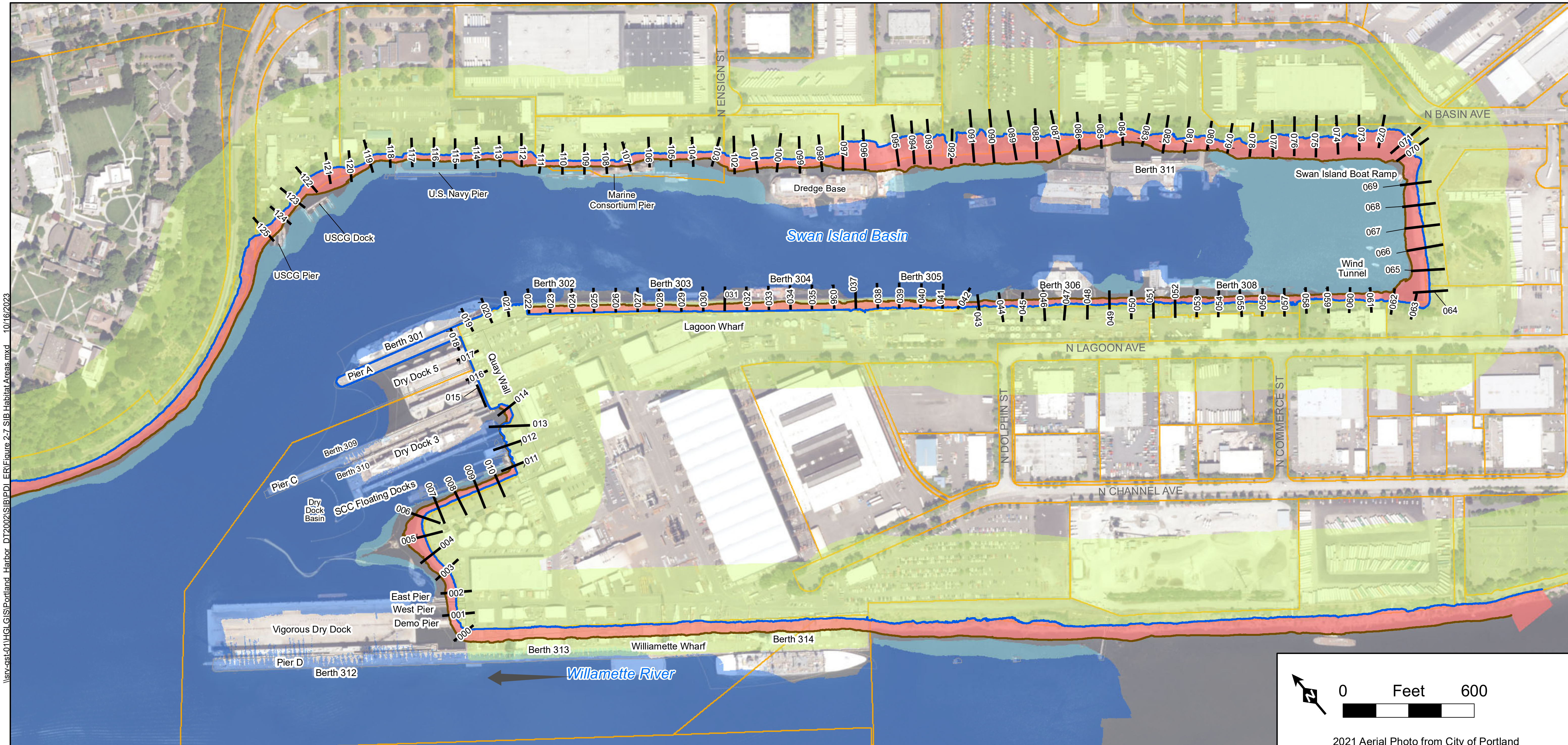
- Bottom-Mounted ADCP
- Wave Gage
- Vessel-Mounted ADCP Transect
- CTD Profiles (Casts)
- SEDflume Sample
- CTD Turbidity Sensors
- River Mile (RM)
- Swan Island Sediment Decision Unit (SDU)
- Federal Navigation Channel (USACE, 2020)
- Docks and Structures
- Tax Lot
- Ordinary High Water (City of Portland, 2013)

Notes:
ADCP – Acoustic Doppler Current Profiler
CTD – Conductivity, Temperature, and Depth
MC – Marine Consortium
USACE – U.S. Army Corps of Engineers
USCG – U.S. Coast Guard
USN – U.S. Navy

Figure 2-6
Hydrodynamics and Sediment Dynamics Data Collection Locations

Prepared on: 10/16/2023
PDI Evaluation Report
Swan Island Basin

PACIFIC groundwater GROUP
HGL
MOTT MACDONALD
BRIDGEWATER GROUP



\\srv-gst-01\HGL GIS\Portland_Harbor_DT2002\SIB\PDI_ER\Figure 2-7 SIB Habitat Areas.mxd 10/16/2023

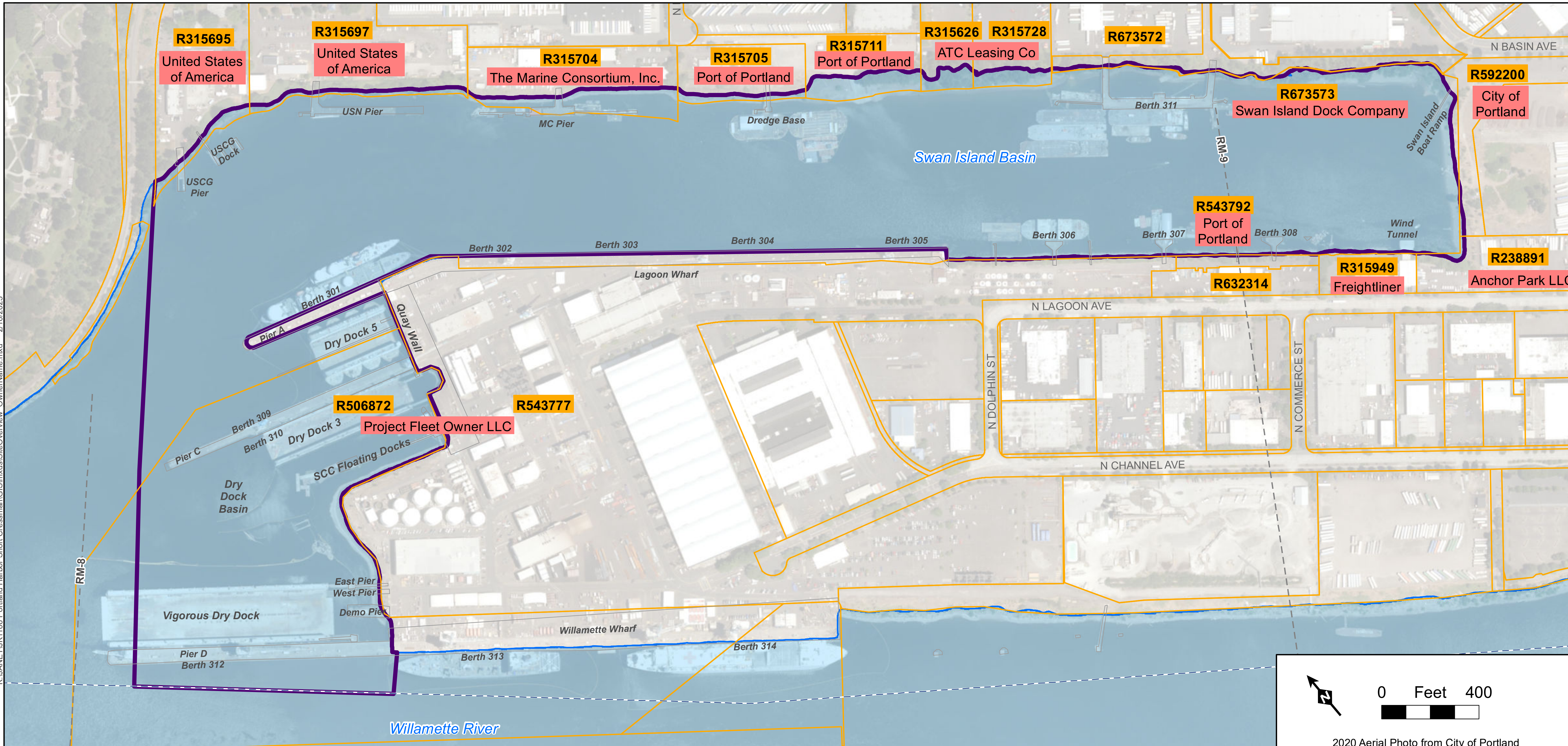
- Survey Transect
- Ordinary Low Water
- Ordinary High Water
- River Flow Direction
- Docks and Structures
- Tax Lot Boundary
- Active Channel Margin
- Riparian
- Shallow Water Zone (<-10 ft NAVD88)
- Deep Water Zone (>-10 ft NAVD88)

Notes:
NAVD88 - North American Vertical Datum of 1988
SIB - Swan Island Basin
USCG - U.S. Coast Guard

Figure 2-7
SIB Habitat Areas

Prepared on: 10/16/2023
PDI Evaluation Report
Swan Island Basin

PACIFIC groundwater GROUP
HGL
MOTT MACDONALD
BRIDGEWATER GROUP



Property ID

Owner Name

Swan Island Sediment Decision Unit (SDU)

River Mile (RM)

Federal Navigation Channel (USACE, 2020)

Docks and Structures

Tax Lot Boundary

Ordinary High Water (City of Portland, 2013)

Notes:
MC – Marine Consortium
SCC – Shipyard Commerce Center
USACE – U.S. Army Corps of Engineers
USCG – U.S. Coast Guard
USN – U.S. Navy

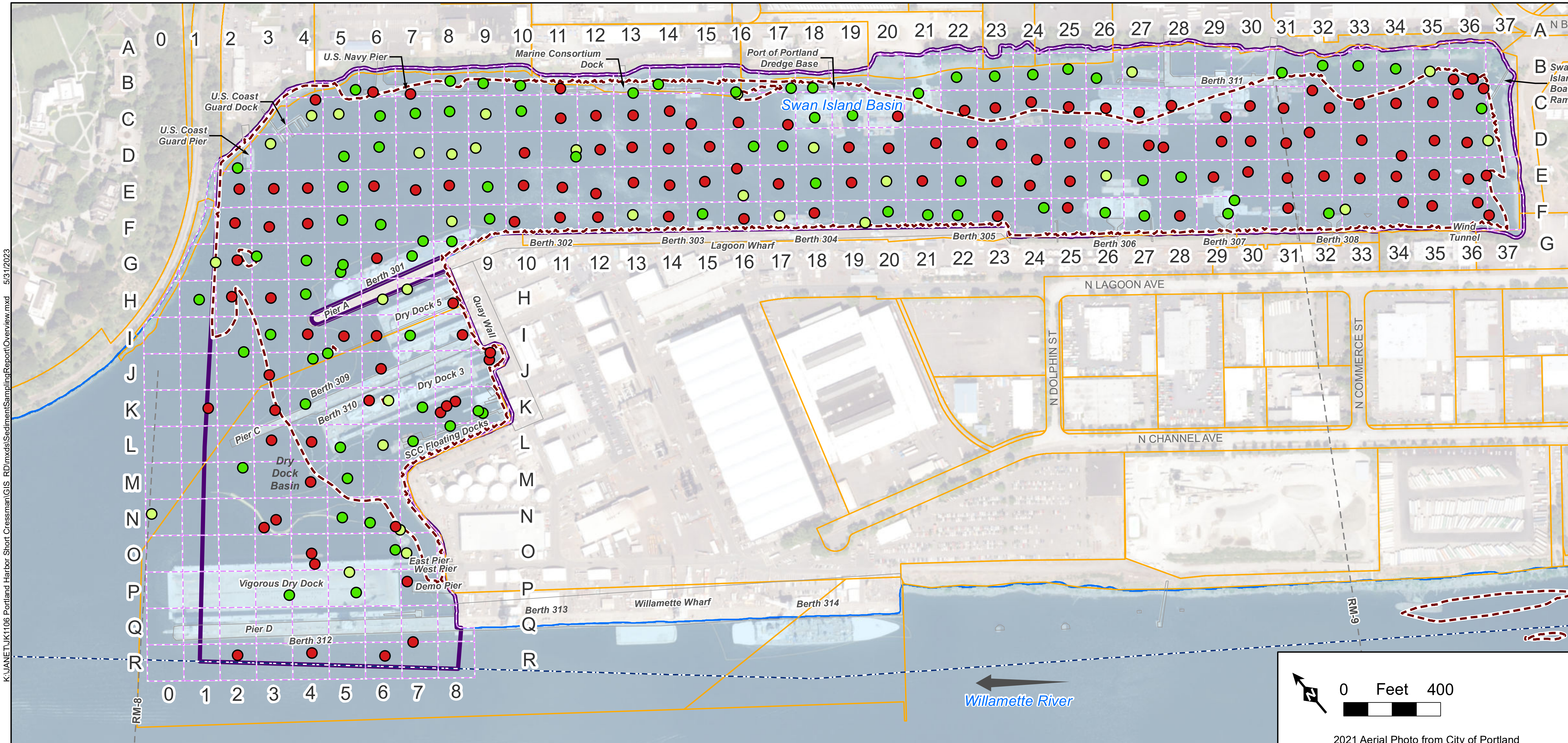
Figure 2-8

Property Owners Included in Survey

Prepared on: 2/16/2023
PDI Evaluation Report
Swan Island Basin

PACIFIC groundwater GROUP HGL MOTT MACDONALD BRIDGEWATER GROUP

K:\JANET\JK1106 Portland Harbor Short Cressman\GIS\mxds\SiteOverview_OwnerName.mxd 2/16/2023



Project Area Grid
River Mile (RM)
Swan Island Sediment Decision Unit (SDU)
ROD Sediment Management Area (SMA)
Federal Navigation Channel (USACE, 2020)
Docks and Structures
Tax Lot Boundary
Ordinary High Water (City of Portland, 2013)
M Project Area Grid Label
River Flow Direction

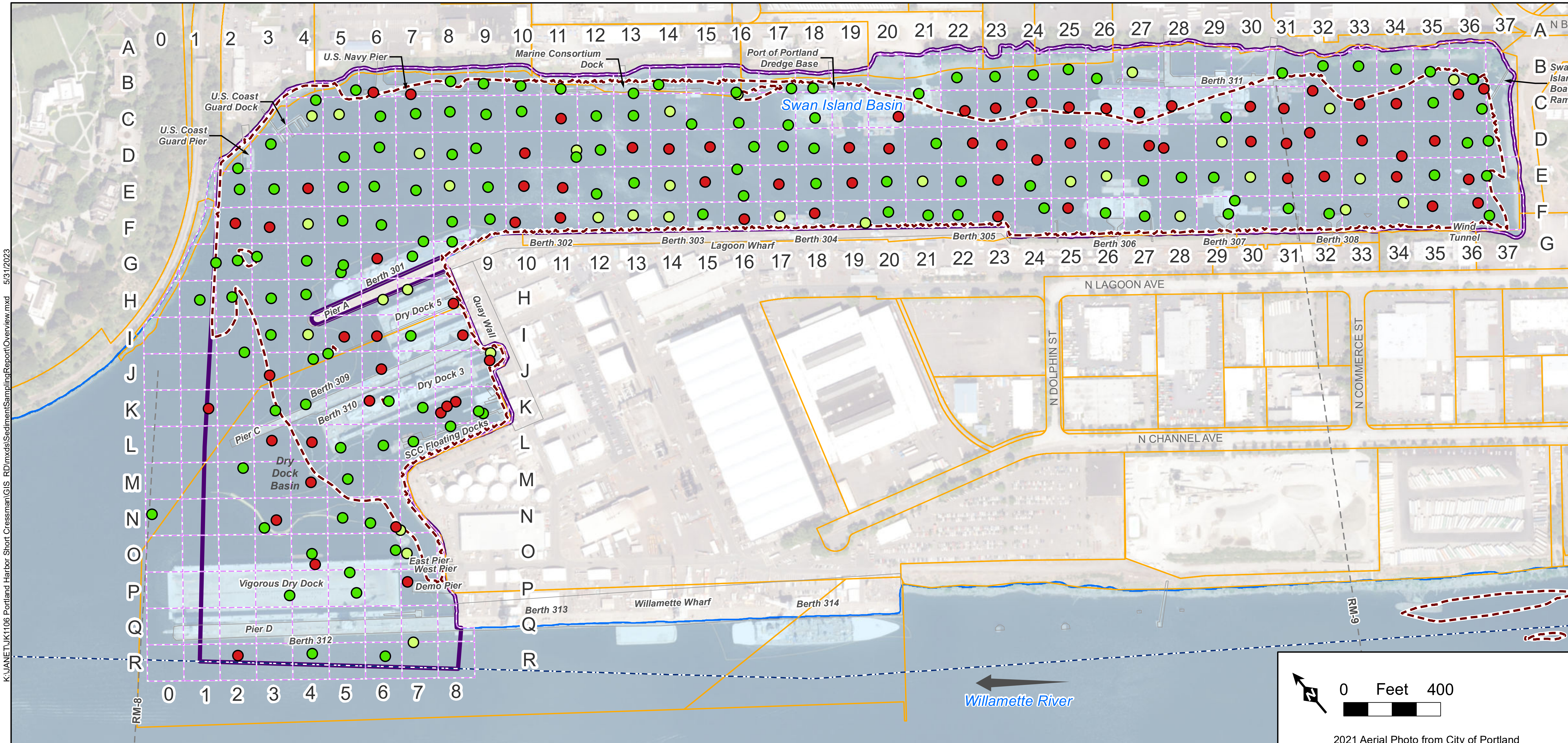
Number of Clean Confirmation Samples
- 0
- 1
- ≥2

Notes:
RAL – Remedial Action Level
ROD – Record of Decision
SCC – Shipyard Commerce Center
USACE – U.S. Army Corps of Engineers

Figure 3-1
Clean Confirmation on a 150-foot Grid – RAL Exceedances

Prepared on: 5/31/2023
PDI Evaluation Report
Swan Island Basin

PACIFIC groundwater GROUP
HGL
MOTT MACDONALD
BRIDGEWATER GROUP



Project Area Grid
River Mile (RM)
Swan Island Sediment Decision Unit (SDU)
ROD Sediment Management Area (SMA)
Federal Navigation Channel (USACE, 2020)
Docks and Structures
Tax Lot Boundary
Ordinary High Water (City of Portland, 2013)
M Project Area Grid Label
River Flow Direction

Number of Clean Confirmation Samples
- 0
- 1
- ≥2

Notes:
PTW – Principal Threat Waste
ROD – Record of Decision
SCC – Shipyard Commerce Center
USACE – U.S. Army Corps of Engineers

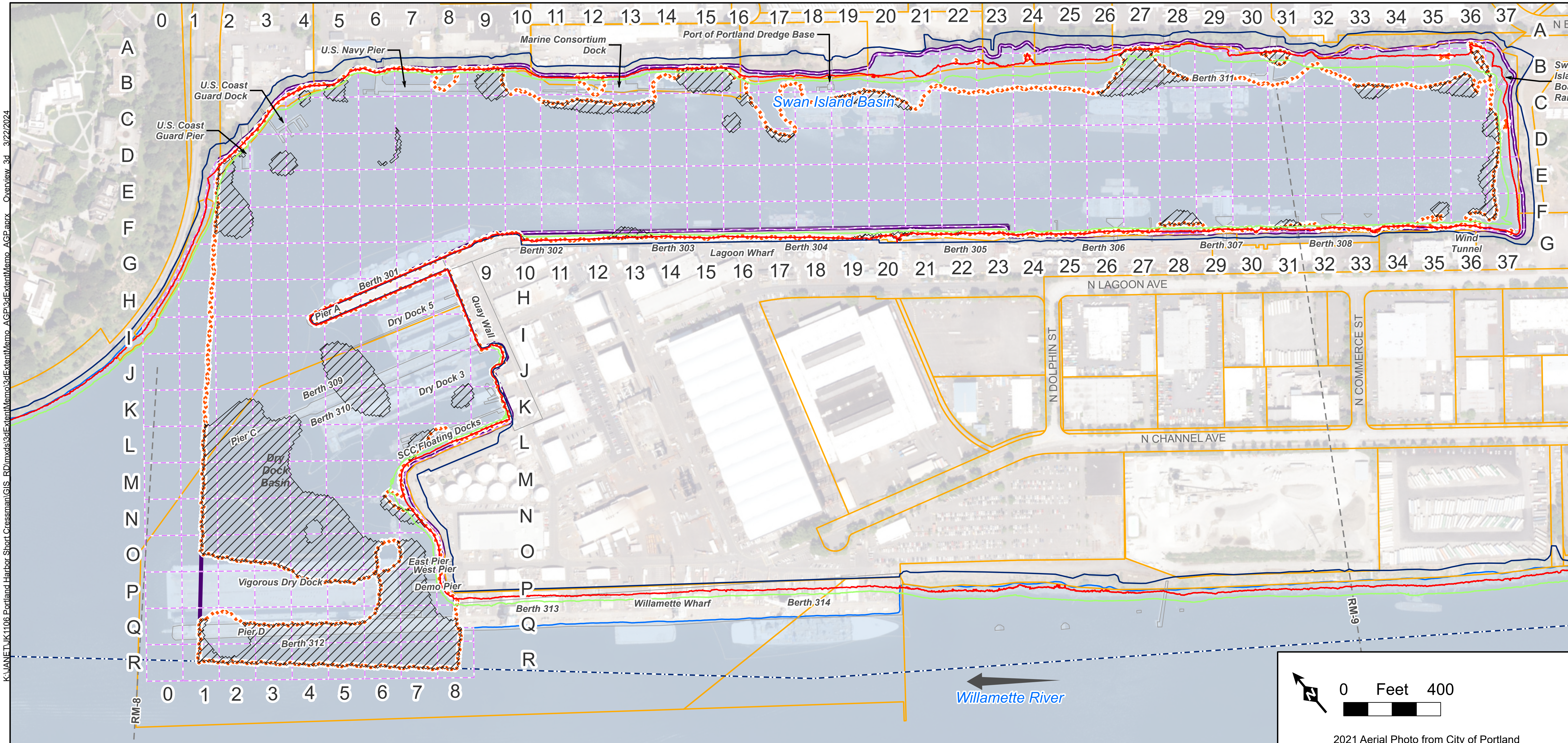
Figure 3-2

Clean Confirmation on a 150-foot Grid – PTW Exceedances

Prepared on: 5/31/2023
PDI Evaluation Report
Swan Island Basin

PACIFIC groundwater GROUP
HGL
MOTT MACDONALD
BRIDGEWATER GROUP

K:\JANET\JK1106 Portland Harbor Short Cressman\GIS_RD\mxds\SedimentSamplingReportOverview.mxd 5/31/2023



K:\JANETVK1106 Portland Harbor Short Cressman\GIS_RD\mxds\3dExtentMemo\3dExtentMemo_AGP\3dExtentMemo_AGP.aprx Overview_3d 3/22/2024

- Project Area Grid
- River Mile (RM)
- Swan Island Sediment Decision Unit (SDU)
- Federal Navigation Channel (USACE, 2020)
- Docks and Structures
- Tax Lot Boundary
- Top of Bank (TOB)
- Ordinary High Water (City of Portland, 2013)
- +13-foot NAVD88 Contour
- Mean Low Water (MLW)
- Refined SMA Horizontal Extent
- Areas Pending Buried Contamination Evaluation
- M Project Area Grid Label
- River Flow Direction

Notes:
NAVD88 – North American Vertical Datum of 1988
SCC – Shipyard Commerce Center
SMA – Sediment Management Area
USACE – U.S. Army Corps of Engineers

The boundary of the SMA corresponds to 50% probability of exceeding SMA threshold.
Buried contamination is defined as 1 ft or more of clean sediment overlying contaminated sediment (i.e., where the horizontal extent of subsurface contamination extends beyond horizontal extent of surface contamination).
Interpolations are clipped to the Project Area

Figure 3-3
Refined SMA Horizontal Extent

Prepared on: 3/22/2024
PDI Evaluation Report
Swan Island Basin

PACIFIC groundwater GROUP
HGL
MOTT MACDONALD
BRIDGEWATER GROUP

- Target Station for Quantitative Assessment
- Trident Survey Mapping Station
- River Flow Direction
- Conductivity Contrast exceeding 750 µS/cm
- Temperature Contrast exceeding 0.25 °C
- Project Area Grid Cell Boundary

Notes:
°C = degrees Celsius
µS/cm = microsiemens per centimeter

Figure 3-4

Potential Groundwater Discharge Zones Using Conductivity and Temperature Contrast

Prepared on: 10/16/2023
PDI Evaluation Report
Swan Island Basin

PACIFIC groundwater GROUP HGL MOTT MACDONALD BRIDGEWATER GROUP

Tidally Averaged Specific Discharge (cm per day):

- -0.001 to 0.035
- 0.035 to 0.072
- 0.072 to 0.218

+ Trident Survey Mapping Station

River Flow Direction

Conductivity Contrast exceeding 750 µS/cm

Temperature Contrast exceeding 0.25 °C

Project Area Grid Cell Boundary

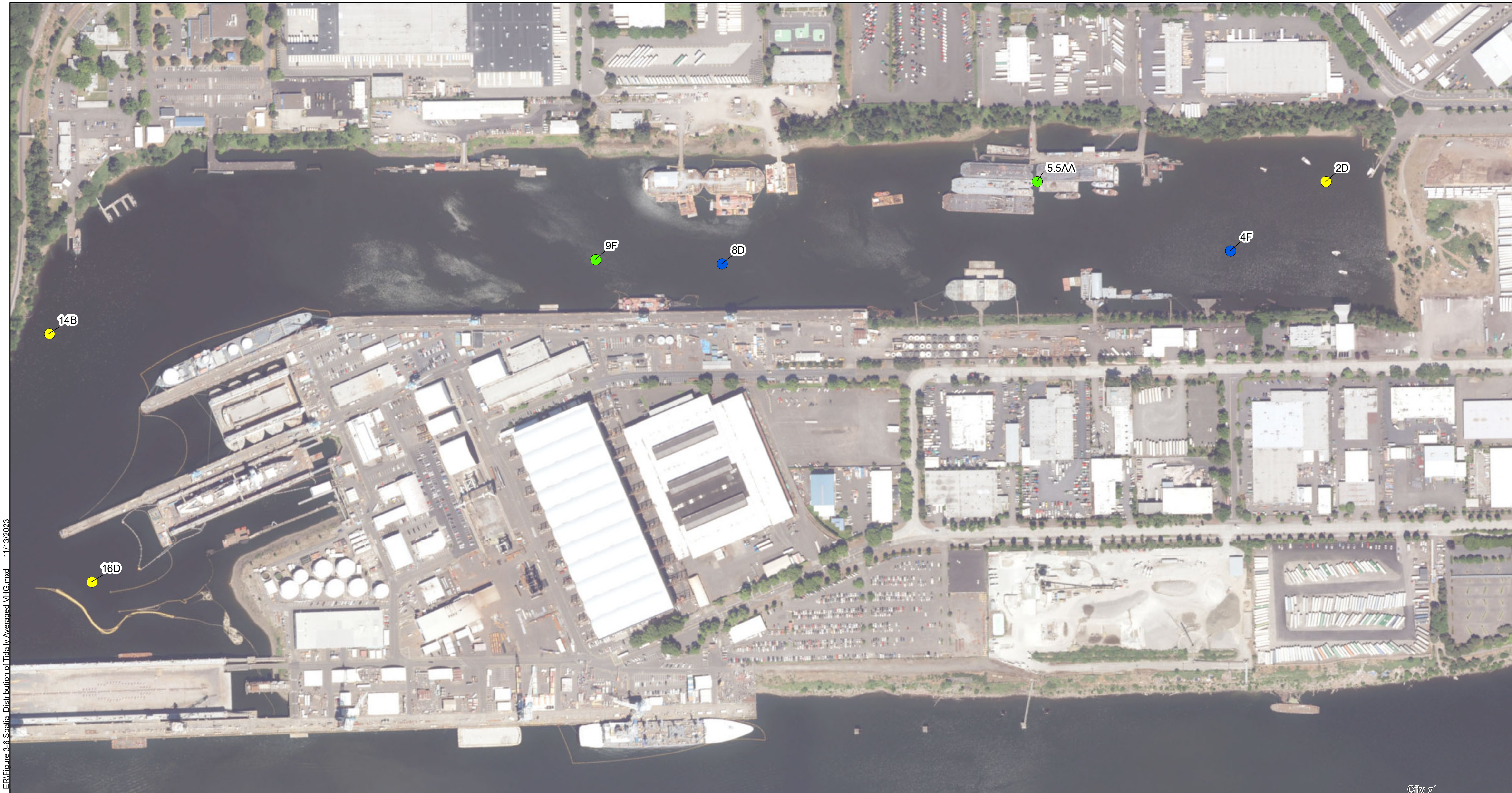
Notes:
°C = degrees Celsius
µS/cm = microsiemens per centimeter
cm=centimeters
Positive discharge indicates upwelling, negative discharge indicates downwelling.

Figure 3-5

Spatial Distribution of Phase 2 Tidally Averaged Specific Discharge with Phase 1 Conductivity and Temperature Contrast

Prepared on: 11/13/2023
PDI Evaluation Report
Swan Island Basin

PACIFIC groundwater GROUP
HGL
MOTT MACDONALD
BRIDGEWATER GROUP



Tidally Averaged Vertical Hydraulic Gradient (cm per meter):
- 1.1 to 3.2
- 3.2 to 4.5
- 4.5 to 7.6

Note:
cm=centimeters
A positive hydraulic gradient indicates upwelling conditions (e.g., subsurface head is greater than the surface water head).

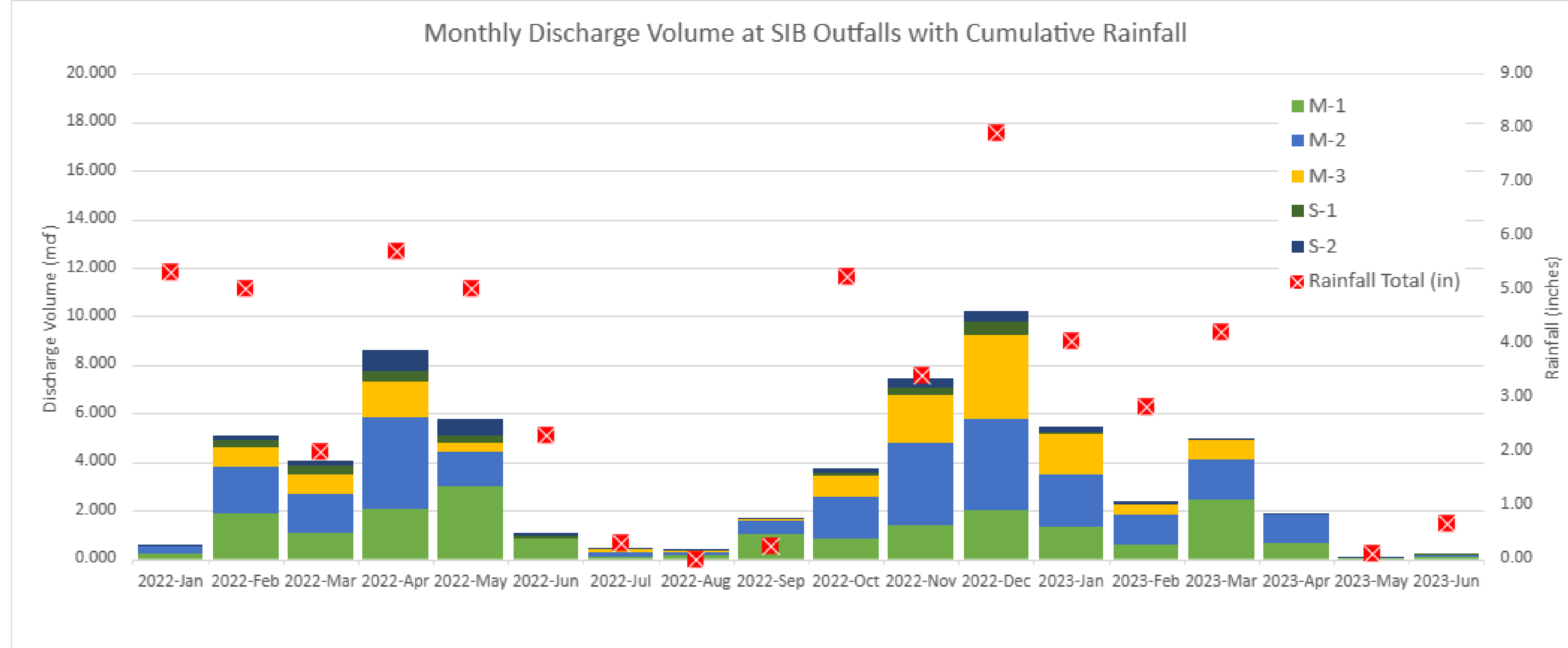
Figure 3-6
Spatial Distribution of Tidally Averaged VHG

Prepared on: 11/13/2023
PDI Evaluation Report
Swan Island Basin

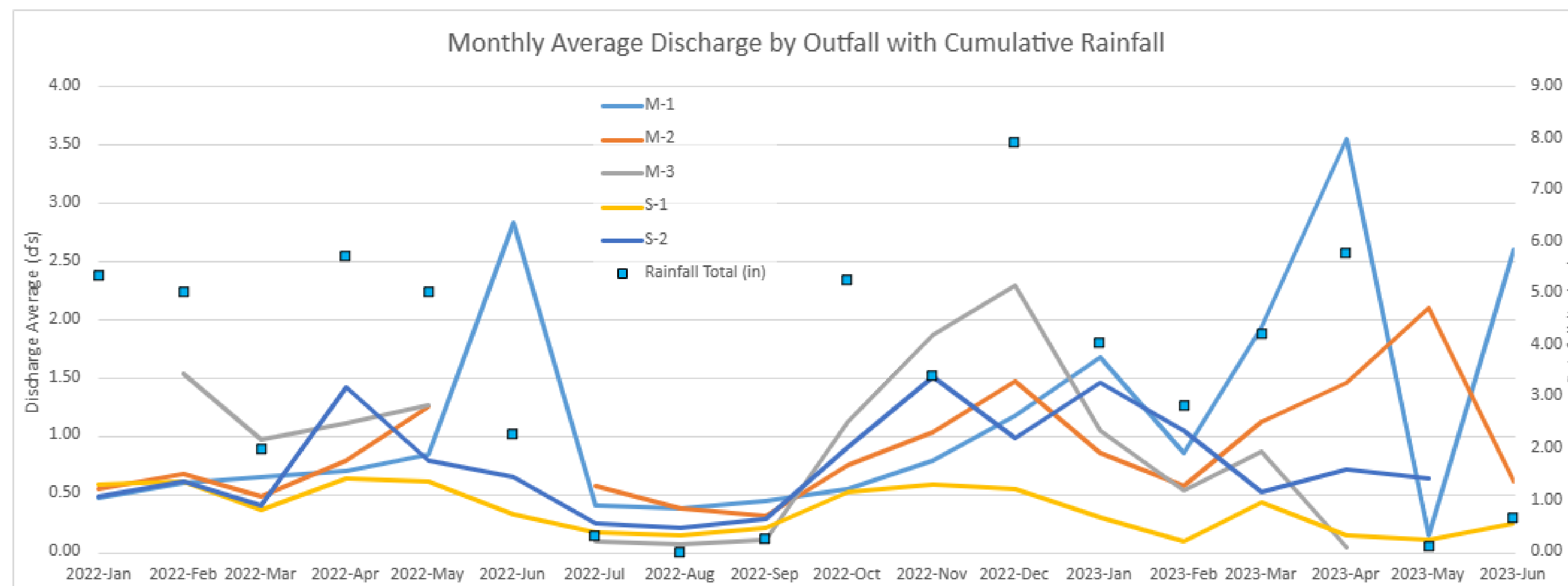
PACIFIC groundwater GROUP
HGL
MOTT MACDONALD
BRIDGEWATER GROUP

\\Srv-gst-01\hglgis\Portland_Harbor_DT2002\SIB\PDI_ER\Figure 3-6 Spatial Distribution of Tidally Averaged VHG.mxd 11/13/2023

Monthly Discharge Volume by Outfall (mcf)						
Month	M-1	M-2	M-3	S-1	S-2	Rainfall Total (in)
2022-Jan	0.198	0.304		0.017	0.012	5.35
2022-Feb	1.872	1.903	0.809	0.306	0.214	5.03
2022-Mar	1.1	1.584	0.808	0.344	0.236	2.01
2022-Apr	2.049	3.801	1.495	0.414	0.882	5.74
2022-May	3.018	1.406	0.347	0.353	0.642	5.03
2022-Jun	0.859			0.096	0.098	2.31
2022-Jul	0.103	0.183	0.122	0.009	0.016	0.32
2022-Aug	0.148	0.122	0.047	0	0.007	0.01
2022-Sep	1.025	0.531	0.052	0.017	0.018	0.27
2022-Oct	0.834	1.709	0.901	0.101	0.179	5.27
2022-Nov	1.373	3.411	1.95	0.345	0.386	3.42
2022-Dec	2.021	3.766	3.435	0.559	0.438	7.93
2023-Jan	1.336	2.181	1.666	0.037	0.25	4.05
2023-Feb	0.572	1.273	0.419	0	0.109	2.85
2023-Mar	2.453	1.648	0.777	0.011	0.055	4.24
2023-Apr	0.657	1.159	0	0.013	0.075	5.8
2023-May	0.005	0.006		0.002	0.011	0.12
2023-Jun	0.104	0.07		0.014		0.67



Monthly Average Discharge Rate by Outfall (cfs)						
Month	M-1	M-2	M-3	S-1	S-2	Rainfall Total (in)
2022-Jan	0.47	0.54		0.58	0.48	5.35
2022-Feb	0.6	0.68	1.54	0.61	0.61	5.03
2022-Mar	0.65	0.49	0.98	0.37	0.41	2.01
2022-Apr	0.7	0.8	1.12	0.64	1.42	5.74
2022-May	0.85	1.25	1.27	0.61	0.79	5.03
2022-Jun	2.84			0.33	0.65	2.31
2022-Jul	0.41	0.58	0.1	0.18	0.26	0.32
2022-Aug	0.39	0.39	0.07	0.15	0.21	0.01
2022-Sep	0.44	0.32	0.11	0.22	0.29	0.27
2022-Oct	0.55	0.75	1.13	0.53	0.91	5.27
2022-Nov	0.79	1.04	1.87	0.58	1.51	3.42
2022-Dec	1.18	1.48	2.3	0.55	0.99	7.93
2023-Jan	1.68	0.85	1.05	0.31	1.46	4.05
2023-Feb	0.85	0.57	0.54	0.1	1.05	2.85
2023-Mar	1.94	1.12	0.87	0.44	0.52	4.24
2023-Apr	3.55	1.46	0.05	0.15	0.72	5.8
2023-May	0.16	2.1		0.12	0.64	0.12
2023-Jun	2.61	0.61		0.26		0.67



Notes:
cfs - cubic feet per second
mcf - million cubic feet
in - inches

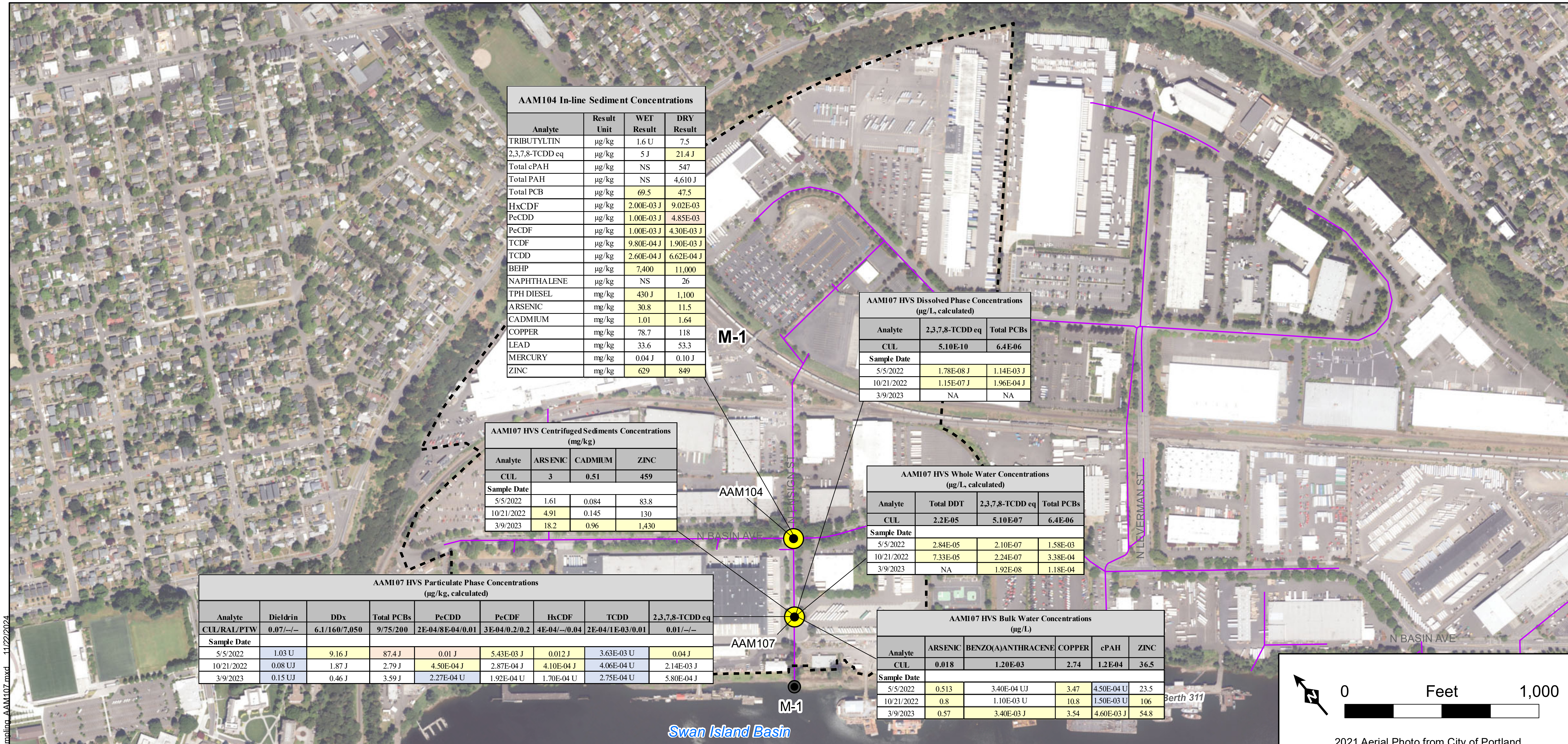
Flow data from water-level-velocity sensors deployed in city of Portland conveyance systems with inundation periods removed (see Attachment A.7)

Precipitation data from Shipyard Rain Gage: (or.water.usgs.gov/non-usgs/bes/shipyard.rain)

Figure 3-7
City of Portland Conveyance System Flows February 2022 - June 2023

Prepared on: 3/8/2024
PDI Evaluation Report
Swan Island Basin

PACIFIC groundwater GROUP · HGL · MOTT MACDONALD · BRIDGEWATER GROUP



AAM104 In-line Sediment Concentrations			
Analyte	Result Unit	WET Result	DRY Result
TRIBUTYLTIN	µg/kg	1.6 U	7.5
2,3,7,8-TCDD eq	µg/kg	5 J	21.4 J
Total cPAH	µg/kg	NS	547
Total PAH	µg/kg	NS	4,610 J
Total PCB	µg/kg	69.5	47.5
HxCDF	µg/kg	2.00E-03 J	9.02E-03
PeCDD	µg/kg	1.00E-03 J	4.85E-03
PeCDF	µg/kg	1.00E-03 J	4.30E-03 J
TCDF	µg/kg	9.80E-04 J	1.90E-03 J
TCDD	µg/kg	2.60E-04 J	6.62E-04 J
BEHP	µg/kg	7,400	11,000
NAPHTHALENE	µg/kg	NS	26
TPH DIESEL	mg/kg	430 J	1,100
ARSENIC	mg/kg	30.8	11.5
CADMIUM	mg/kg	1.01	1.64
COPPER	mg/kg	78.7	118
LEAD	mg/kg	33.6	53.3
MERCURY	mg/kg	0.04 J	0.10 J
ZINC	mg/kg	629	849

AAM107 HVS Dissolved Phase Concentrations (µg/L, calculated)		
Analyte	2,3,7,8-TCDD eq	Total PCBs
CUL	5.10E-10	6.4E-06
Sample Date		
5/5/2022	1.78E-08 J	1.14E-03 J
10/21/2022	1.15E-07 J	1.96E-04 J
3/9/2023	NA	NA

AAM107 HVS Centrifuged Sediments Concentrations (mg/kg)			
Analyte	ARSENIC	CADMIUM	ZINC
CUL	3	0.51	459
Sample Date			
5/5/2022	1.61	0.084	83.8
10/21/2022	4.91	0.145	130
3/9/2023	18.2	0.96	1,430

AAM107 HVS Whole Water Concentrations (µg/L, calculated)			
Analyte	Total DDT	2,3,7,8-TCDD eq	Total PCBs
CUL	2.2E-05	5.10E-07	6.4E-06
Sample Date			
5/5/2022	2.84E-05	2.10E-07	1.58E-03
10/21/2022	7.33E-05	2.24E-07	3.38E-04
3/9/2023	NA	1.92E-08	1.18E-04

AAM107 HVS Particulate Phase Concentrations (µg/kg, calculated)								
Analyte	Dieldrin	DDx	Total PCBs	PeCDD	PeCDF	HxCDF	TCDD	2,3,7,8-TCDD eq
CUL/RAL/PTW	0.07/--/--	6.1/160/7,050	9/75/200	2E-04/8E-04/0.01	3E-04/0.2/0.2	4E-04/--/0.04	2E-04/1E-03/0.01	0.01/--/--
Sample Date								
5/5/2022	1.03 U	9.16 J	87.4 J	0.01 J	5.43E-03 J	0.012 J	3.63E-03 U	0.04 J
10/21/2022	0.08 UJ	1.87 J	2.79 J	4.50E-04 J	2.87E-04 J	4.10E-04 J	4.06E-04 U	2.14E-03 J
3/9/2023	0.15 UJ	0.46 J	3.59 J	2.27E-04 U	1.92E-04 U	1.70E-04 U	2.75E-04 U	5.80E-04 J

AAM107 HVS Bulk Water Concentrations (µg/L)					
Analyte	ARSENIC	BENZO(A)ANTHRACENE	COPPER	cPAH	ZINC
CUL	0.018	1.20E-03	2.74	1.2E-04	36.5
Sample Date					
5/5/2022	0.513	3.40E-04 UJ	3.47	4.50E-04 U	23.5
10/21/2022	0.8	1.10E-03 U	10.8	1.50E-03 U	106
3/9/2023	0.57	3.40E-03 J	3.54	4.60E-03 J	54.8

Manhole Stormwater Sample Location

City of Portland Stormwater Outfall

Stormwater Line

Outfall Basin M-1

CUL Exceedance

RAL/PQL Exceedance

PTW Exceedance

MDL exceeds CUL

DRY = Dry season in-line sediment samples collected between May 2022 and November 2022

WET = Wet season in-line sediment samples were collected between January and May 2022 and November 2022 and June 2023

Notes:
Sample results are listed by the sample date.

µg/L - micrograms per liter
µg/kg - micrograms per kilogram
BEHP - bis(2-Ethylhexyl) phthalate
cPAH - carcinogenic polycyclic aromatic hydrocarbons
COC - contaminants of concern
CUL - cleanup level
DDD - dichlorodiphenyldichloroethane
DDE - dichlorodiphenyldichloroethylene
DDT - dichlorodiphenyltrichloroethane
DDx - DDD + DDE + DDT
HVS - high-volume sampling
HxCDF - 1,2,3,4,7,8-hexachlorodibenzofuran
J - estimated value
K - estimated maximum possible concentration
MDL - method detection limit
mg/kg - milligrams per kilogram
PCB - polychlorinated biphenyl
PeCDD - 1,2,3,7,8-pentachlorodibenzo-p-dioxin
PeCDF - 2,3,4,7,8-pentachlorodibenzofuran
PQL - practical quantitation limit
PTW - principal threat waste
RAL - remedial action level
ROD - Record of Decision
TCDD - 2,3,7,8-tetrachlorodibenzo-p-dioxin
TCDF - 2,3,7,8-tetrachlorodibenzofuran
TPH - total petroleum hydrocarbons
U - analyte not detected

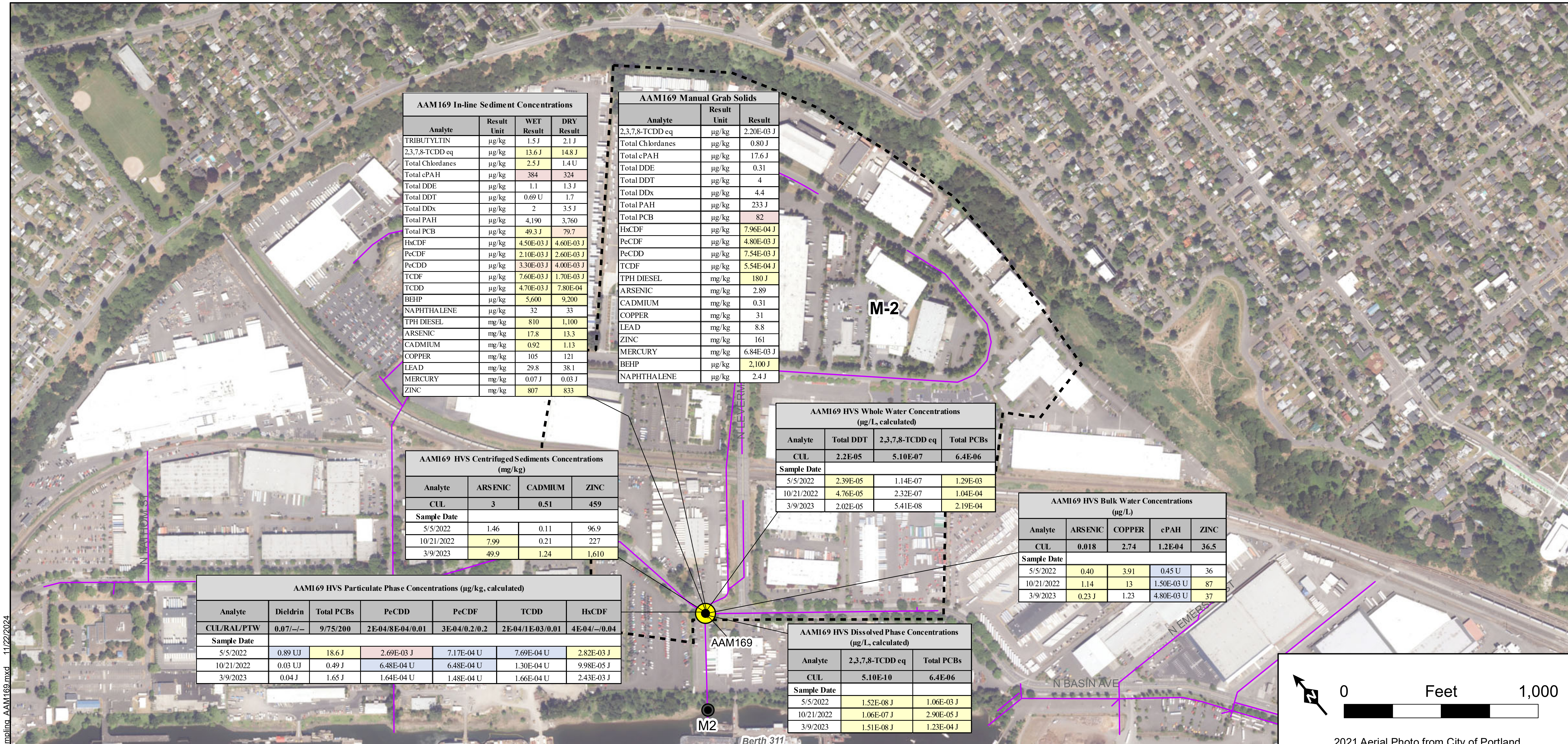
Figure 3-8

City Outfall Basin M-1 ROD COC Detections

Prepared on: 11/22/2024
PDI Evaluation Report
Swan Island Basin

PACIFIC groundwater GROUP
HGL
MOTT MACDONALD
BRIDGEWATER GROUP

\\srv-gst-01\HGL\GIS\Portland_Harbor_DT2002\SIB\PDI_ER\(3-08)HVS_Sampling_AAM107.mxd 11/22/2024



AAM169 In-line Sediment Concentrations			
Analyte	Result Unit	WET Result	DRY Result
TRIBUTYLTIN	µg/kg	1.5 J	2.1 J
2,3,7,8-TCDD eq	µg/kg	13.6 J	14.8 J
Total Chlordanes	µg/kg	2.5 J	1.4 U
Total cPAH	µg/kg	384	324
Total DDE	µg/kg	1.1	1.3 J
Total DDT	µg/kg	0.69 U	1.7
Total DDx	µg/kg	2	3.5 J
Total PAH	µg/kg	4,190	3,760
Total PCB	µg/kg	49.3 J	79.7
HxCDF	µg/kg	4.50E-03 J	4.60E-03 J
PeCDF	µg/kg	2.10E-03 J	2.60E-03 J
PeCDD	µg/kg	3.30E-03 J	4.00E-03 J
TCDF	µg/kg	7.60E-03 J	1.70E-03 J
TCDD	µg/kg	4.70E-03 J	7.80E-04
BEHP	µg/kg	5,600	9,200
NAPHTHALENE	µg/kg	32	33
TPH DIESEL	mg/kg	810	1,100
ARSENIC	mg/kg	17.8	13.3
CADMIUM	mg/kg	0.92	1.13
COPPER	mg/kg	105	121
LEAD	mg/kg	29.8	38.1
MERCURY	mg/kg	0.07 J	0.03 J
ZINC	mg/kg	807	833

AAM169 Manual Grab Solids		
Analyte	Result Unit	Result
2,3,7,8-TCDD eq	µg/kg	2.20E-03 J
Total Chlordanes	µg/kg	0.80 J
Total cPAH	µg/kg	17.6 J
Total DDE	µg/kg	0.31
Total DDT	µg/kg	4
Total DDx	µg/kg	4.4
Total PAH	µg/kg	233 J
Total PCB	µg/kg	82
HxCDF	µg/kg	7.96E-04 J
PeCDF	µg/kg	4.80E-03 J
PeCDD	µg/kg	7.54E-03 J
TCDF	µg/kg	5.54E-04 J
TPH DIESEL	mg/kg	180 J
ARSENIC	mg/kg	2.89
CADMIUM	mg/kg	0.31
COPPER	mg/kg	31
LEAD	mg/kg	8.8
ZINC	mg/kg	161
MERCURY	mg/kg	6.84E-03 J
BEHP	µg/kg	2,100 J
NAPHTHALENE	µg/kg	2.4 J

AAM169 HVS Whole Water Concentrations (µg/L, calculated)			
Analyte	Total DDT	2,3,7,8-TCDD eq	Total PCBs
CUL	2.2E-05	5.10E-07	6.4E-06
Sample Date			
5/5/2022	2.39E-05	1.14E-07	1.29E-03
10/21/2022	4.76E-05	2.32E-07	1.04E-04
3/9/2023	2.02E-05	5.41E-08	2.19E-04

AAM169 HVS Centrifuged Sediments Concentrations (mg/kg)			
Analyte	ARSENIC	CADMIUM	ZINC
CUL	3	0.51	459
Sample Date			
5/5/2022	1.46	0.11	96.9
10/21/2022	7.99	0.21	227
3/9/2023	49.9	1.24	1,610

AAM169 HVS Bulk Water Concentrations (µg/L)				
Analyte	ARSENIC	COPPER	cPAH	ZINC
CUL	0.018	2.74	1.2E-04	36.5
Sample Date				
5/5/2022	0.40	3.91	0.45 U	36
10/21/2022	1.14	13	1.50E-03 U	87
3/9/2023	0.23 J	1.23	4.80E-03 U	37

AAM169 HVS Particulate Phase Concentrations (µg/kg, calculated)						
Analyte	Dieldrin	Total PCBs	PeCDD	PeCDF	TCDD	HxCDF
CUL/RAL/PTW	0.07/–/–	9/75/200	2E-04/8E-04/0.01	3E-04/0.2/0.2	2E-04/1E-03/0.01	4E-04/–/0.04
Sample Date						
5/5/2022	0.89 UJ	18.6 J	2.69E-03 J	7.17E-04 U	7.69E-04 U	2.82E-03 J
10/21/2022	0.03 UJ	0.49 J	6.48E-04 U	6.48E-04 U	1.30E-04 U	9.98E-05 J
3/9/2023	0.04 J	1.65 J	1.64E-04 U	1.48E-04 U	1.66E-04 U	2.43E-03 J

AAM169 HVS Dissolved Phase Concentrations (µg/L, calculated)		
Analyte	2,3,7,8-TCDD eq	Total PCBs
CUL	5.10E-10	6.4E-06
Sample Date		
5/5/2022	1.52E-08 J	1.06E-03 J
10/21/2022	1.06E-07 J	2.90E-05 J
3/9/2023	1.51E-08 J	1.23E-04 J

Manhole Stormwater Sample Location

City of Portland Stormwater Outfall

Stormwater Line

Outfall Basin M-2

CUL Exceedance
RAL/PQL Exceedance
PTW Exceedance
MDL exceeds CUL

DRY = Dry season in-line sediment samples collected between May 2022 and November 2022
WET = Wet season in-line sediment samples were collected between January and May 2022 and November 2022 and June 2023

Notes:
Sample results are listed by the sample date.

µg/kg - micrograms per kilogram
µg/L - micrograms per liter
BEHP - bis(2-Ethylhexyl) phthalate
cPAH - carcinogenic polycyclic aromatic hydrocarbons
COC - contaminants of concern
CUL - cleanup level
DDD - dichlorodiphenyldichloroethane
DDE - dichlorodiphenyldichloroethylene
DDT - dichlorodiphenyltrichloroethane
DDx - DDD + DDE + DDT
HVS - high-volume sampling
HxCDF - 1,2,3,4,7,8-hexachlorodibenzofuran
J - estimated value
K - estimated maximum possible concentration
MDL - method detection limit
mg/kg - milligrams per kilogram
PCB - polychlorinated biphenyl
PeCDD - 1,2,3,7,8-pentachlorodibenzo-p-dioxin
PeCDF - 2,3,4,7,8-pentachlorodibenzofuran
PQL - practical quantitation limit
PTW - principal threat waste
RAL - remedial action level
ROD - Record of Decision
TCDD - 2,3,7,8-tetrachlorodibenzo-p-dioxin
TCDF - 2,3,7,8-tetrachlorodibenzofuran
TPH - total petroleum hydrocarbons
U - analyte not detected

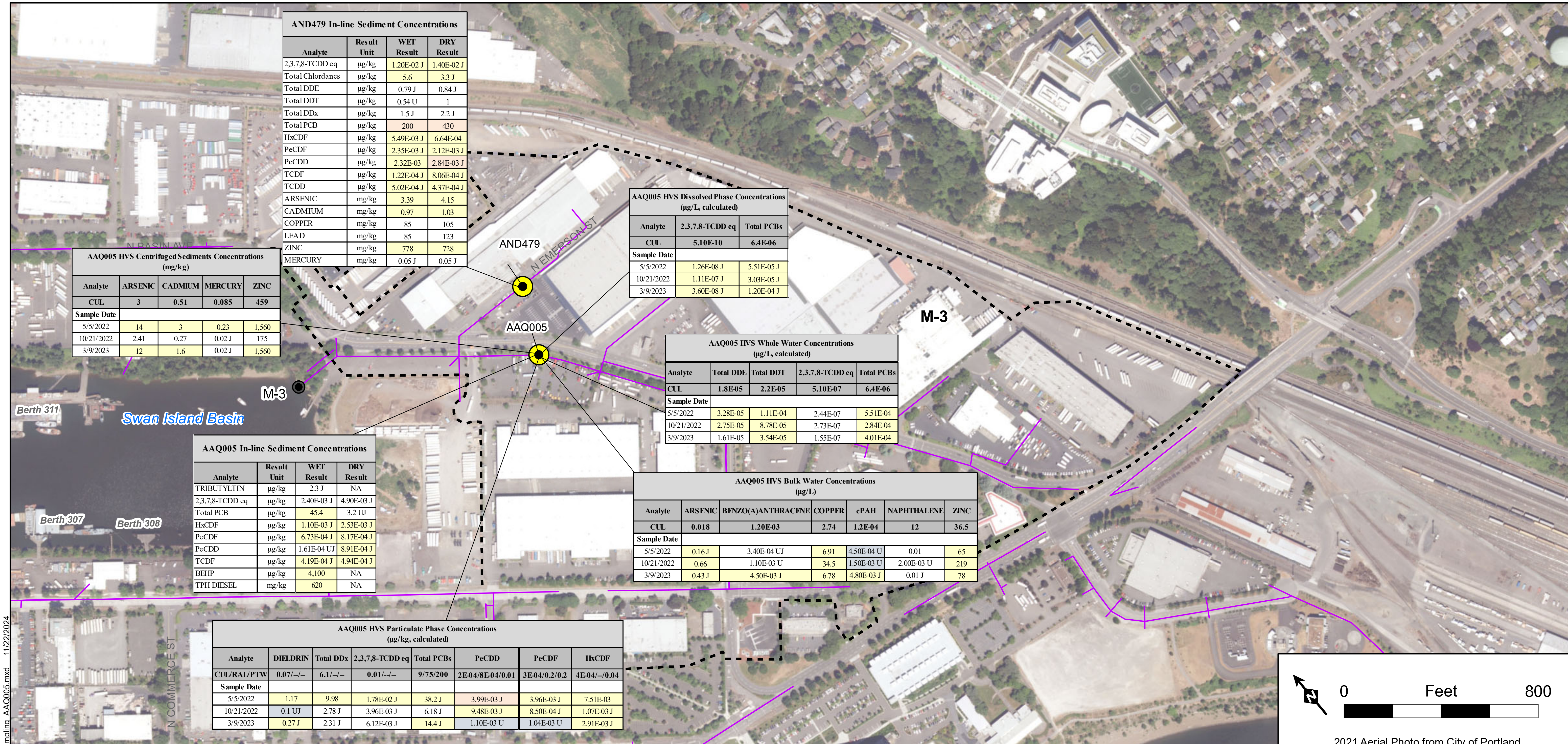
Figure 3-9

City Outfall Basin M-2 ROD COC Detections

Prepared on: 11/22/2024
PDI Evaluation Report
Swan Island Basin

PACIFIC groundwater GROUP
HGL
MOTT MACDONALD
BRIDGEWATER GROUP

\\srv-gst-01\HGL\GIS\Portland_Harbor_DT2002\SIB\PDI_ER\(3-09)HVS_Sampling_AAM169.mxd 11/22/2024



AND479 In-line Sediment Concentrations

Analyte	Result Unit	WET Result	DRY Result
2,3,7,8-TCDD eq	µg/kg	1.20E-02 J	1.40E-02 J
Total Chlordanes	µg/kg	5.6	3.3 J
Total DDE	µg/kg	0.79 J	0.84 J
Total DDT	µg/kg	0.54 U	1
Total DDx	µg/kg	1.5 J	2.2 J
Total PCB	µg/kg	200	430
HxCDF	µg/kg	5.49E-03 J	6.64E-04
PeCDF	µg/kg	2.35E-03 J	2.12E-03 J
PeCDD	µg/kg	2.32E-03	2.84E-03 J
TCDF	µg/kg	1.22E-04 J	8.06E-04 J
TCDD	µg/kg	5.02E-04 J	4.37E-04 J
ARSENIC	mg/kg	3.39	4.15
CADMIUM	mg/kg	0.97	1.03
COPPER	mg/kg	85	105
LEAD	mg/kg	85	123
ZINC	mg/kg	778	728
MERCURY	mg/kg	0.05 J	0.05 J

AAQ005 HVS Centrifuged Sediments Concentrations (mg/kg)

Analyte	ARSENIC	CADMIUM	MERCURY	ZINC
CUL	3	0.51	0.085	459
Sample Date				
5/5/2022	14	3	0.23	1,560
10/21/2022	2.41	0.27	0.02 J	175
3/9/2023	12	1.6	0.02 J	1,560

AAQ005 HVS Dissolved Phase Concentrations (µg/L, calculated)

Analyte	2,3,7,8-TCDD eq	Total PCBs
CUL	5.10E-10	6.4E-06
Sample Date		
5/5/2022	1.26E-08 J	5.51E-05 J
10/21/2022	1.11E-07 J	3.03E-05 J
3/9/2023	3.60E-08 J	1.20E-04 J

AAQ005 HVS Whole Water Concentrations (µg/L, calculated)

Analyte	Total DDE	Total DDT	2,3,7,8-TCDD eq	Total PCBs
CUL	1.8E-05	2.2E-05	5.10E-07	6.4E-06
Sample Date				
5/5/2022	3.28E-05	1.11E-04	2.44E-07	5.51E-04
10/21/2022	2.75E-05	8.78E-05	2.73E-07	2.84E-04
3/9/2023	1.61E-05	3.54E-05	1.55E-07	4.01E-04

AAQ005 In-line Sediment Concentrations

Analyte	Result Unit	WET Result	DRY Result
TRIBUTYLTIN	µg/kg	2.3 J	NA
2,3,7,8-TCDD eq	µg/kg	2.40E-03 J	4.90E-03 J
Total PCB	µg/kg	45.4	3.2 UJ
HxCDF	µg/kg	1.10E-03 J	2.53E-03 J
PeCDF	µg/kg	6.73E-04 J	8.17E-04 J
PeCDD	µg/kg	1.61E-04 UJ	8.91E-04 J
TCDF	µg/kg	4.19E-04 J	4.94E-04 J
BEHP	µg/kg	4,100	NA
TPH DIESEL	mg/kg	620	NA

AAQ005 HVS Bulk Water Concentrations (µg/L)

Analyte	ARSENIC	BENZO(A)ANTHRACENE	COPPER	cPAH	NAPHTHALENE	ZINC
CUL	0.018	1.20E-03	2.74	1.2E-04	12	36.5
Sample Date						
5/5/2022	0.16 J	3.40E-04 UJ	6.91	4.50E-04 U	0.01	65
10/21/2022	0.66	1.10E-03 U	34.5	1.50E-03 U	2.00E-03 U	219
3/9/2023	0.43 J	4.50E-03 J	6.78	4.80E-03 J	0.01 J	78

AAQ005 HVS Particulate Phase Concentrations (µg/kg, calculated)

Analyte	DIELDRIN	Total DDx	2,3,7,8-TCDD eq	Total PCBs	PeCDD	PeCDF	HxCDF
CUL/RAL/PTW	0.07/--/--	6.1/--/--	0.01/--/--	9/75/200	2E-04/8E-04/0.01	3E-04/0.2/0.2	4E-04/--/0.04
Sample Date							
5/5/2022	1.17	9.98	1.78E-02 J	38.2 J	3.99E-03 J	3.96E-03 J	7.51E-03
10/21/2022	0.1 UJ	2.78 J	3.96E-03 J	6.18 J	9.48E-03 J	8.50E-04 J	1.07E-03 J
3/9/2023	0.27 J	2.31 J	6.12E-03 J	14.4 J	1.10E-03 U	1.04E-03 U	2.91E-03 J

Manhole Stormwater Sample Location

City of Portland Stormwater Outfall

Stormwater Line

Outfall Basin M-3

CUL Exceedance

RAL/PQL Exceedance

PTW Exceedance

MDL exceeds CUL

DRY = Dry season in-line sediment samples collected between May 2022 and November 2022

WET = Wet season in-line sediment samples were collected between January and May 2022 and November 2022 and June 2023

Notes:

Sample results are listed by the sample date.

µg/kg - micrograms per kilogram
µg/L - micrograms per liter
BEHP - bis(2-Ethylhexyl) phthalate
cPAH - carcinogenic polycyclic aromatic hydrocarbons
COC - contaminants of concern
CUL - cleanup level
DDD - dichlorodiphenyldichloroethane
DDE - dichlorodiphenyldichloroethylene
DDT - dichlorodiphenyltrichloroethane
DDx - DDD + DDE + DDT
HVS - high-volume sampling
HxCDF - 1,2,3,4,7,8-hexachlorodibenzofuran
J - estimated value
MDL - method detection limit
mg/kg - milligrams per kilogram
NA - not analyzed
PCB - polychlorinated biphenyl
PeCDD - 1,2,3,7,8-pentachlorodibenzo-p-dioxin
PeCDF - 2,3,4,7,8-pentachlorodibenzofuran
PQL - practical quantitation limit
PTW - principal threat waste
RAL - remedial action level
ROD - Record of Decision
TCDD - 2,3,7,8-tetrachlorodibenzo-p-dioxin
TCDF - 2,3,7,8-tetrachlorodibenzofuran
TPH - total petroleum hydrocarbons
U - analyte not detected

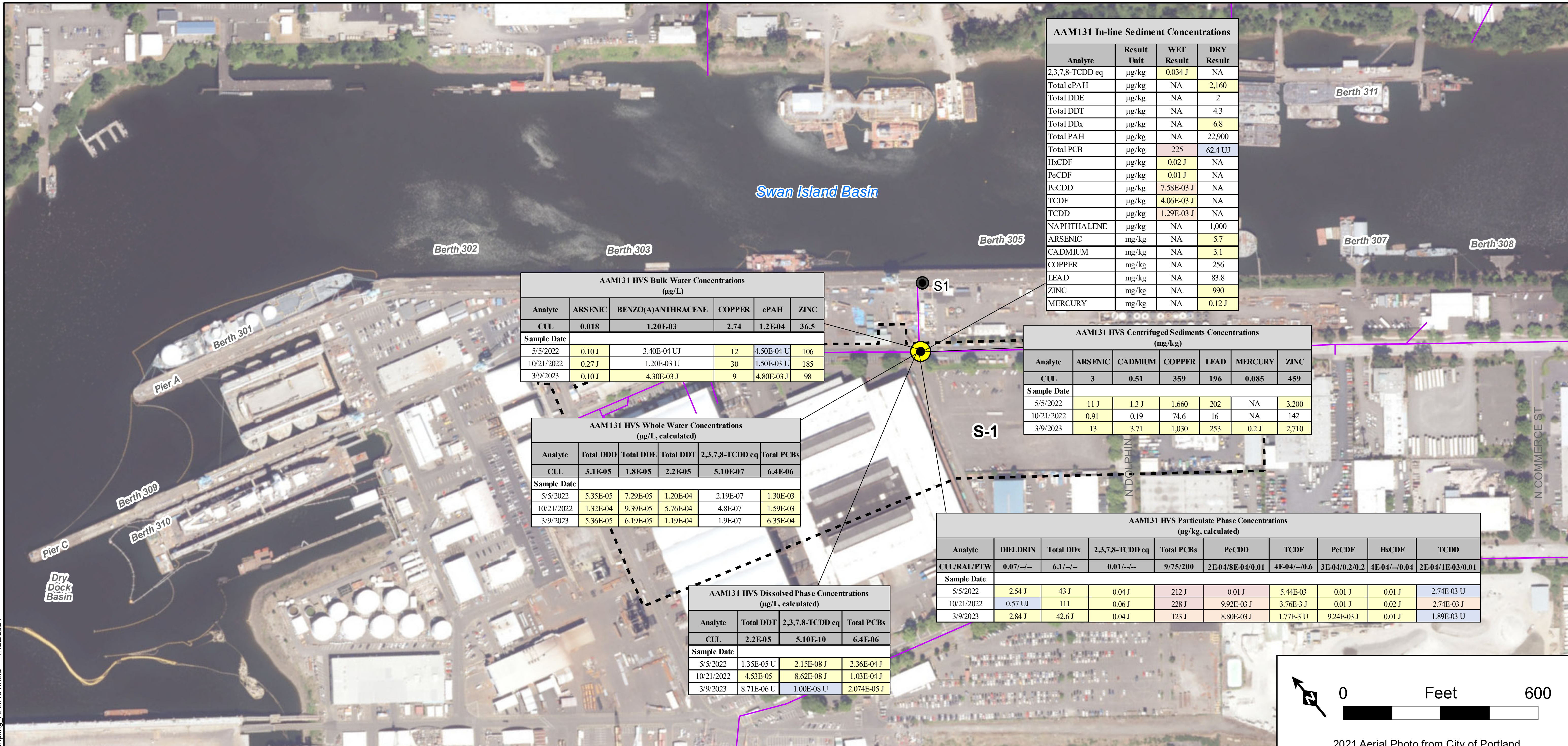
Figure 3-10

City Outfall Basin M-3 ROD COC Detections

Prepared on: 11/22/2024
PDI Evaluation Report
Swan Island Basin

PACIFIC groundwater GROUP
HGL
MOTT MACDONALD
BRIDGEWATER GROUP

\\srv-gst-01\HGLGIS\Portland_Harbor_DT2002\SIB\PDI_ER\(3-10)HVS_Sampling_AAQ005.mxd 11/22/2024



AAM131 In-line Sediment Concentrations			
Analyte	Result Unit	WET Result	DRY Result
2,3,7,8-TCDD eq	µg/kg	0.034 J	NA
Total cPAH	µg/kg	NA	2,160
Total DDE	µg/kg	NA	2
Total DDT	µg/kg	NA	4.3
Total DDx	µg/kg	NA	6.8
Total PAH	µg/kg	NA	22,900
Total PCB	µg/kg	225	62.4 UJ
HxCDF	µg/kg	0.02 J	NA
PeCDF	µg/kg	0.01 J	NA
PeCDD	µg/kg	7.58E-03 J	NA
TCDF	µg/kg	4.06E-03 J	NA
TCDD	µg/kg	1.29E-03 J	NA
NAPHTHALENE	µg/kg	NA	1,000
ARSENIC	mg/kg	NA	5.7
CADMIUM	mg/kg	NA	3.1
COPPER	mg/kg	NA	256
LEAD	mg/kg	NA	83.8
ZINC	mg/kg	NA	990
MERCURY	mg/kg	NA	0.12 J

AAM131 HVS Bulk Water Concentrations (µg/L)					
Analyte	ARSENIC	BENZO(A)ANTHRACENE	COPPER	cPAH	ZINC
CUL	0.018	1.20E-03	2.74	1.2E-04	36.5
Sample Date					
5/5/2022	0.10 J	3.40E-04 UJ	12	4.50E-04 U	106
10/21/2022	0.27 J	1.20E-03 U	30	1.50E-03 U	185
3/9/2023	0.10 J	4.30E-03 J	9	4.80E-03 J	98

AAM131 HVS Centrifuged Sediments Concentrations (mg/kg)						
Analyte	ARSENIC	CADMIUM	COPPER	LEAD	MERCURY	ZINC
CUL	3	0.51	359	196	0.085	459
Sample Date						
5/5/2022	11 J	1.3 J	1,660	202	NA	3,200
10/21/2022	0.91	0.19	74.6	16	NA	142
3/9/2023	13	3.71	1,030	253	0.2 J	2,710

AAM131 HVS Whole Water Concentrations (µg/L, calculated)					
Analyte	Total DDD	Total DDE	Total DDT	2,3,7,8-TCDD eq	Total PCBs
CUL	3.1E-05	1.8E-05	2.2E-05	5.10E-07	6.4E-06
Sample Date					
5/5/2022	5.35E-05	7.29E-05	1.20E-04	2.19E-07	1.30E-03
10/21/2022	1.32E-04	9.39E-05	5.76E-04	4.8E-07	1.59E-03
3/9/2023	5.36E-05	6.19E-05	1.19E-04	1.9E-07	6.35E-04

AAM131 HVS Particulate Phase Concentrations (µg/kg, calculated)									
Analyte	DIELDRIN	Total DDx	2,3,7,8-TCDD eq	Total PCBs	PeCDD	TCDF	PeCDF	HxCDF	TCDD
CUL/RAL/PTW	0.07/--/--	6.1/--/--	0.01/--/--	9/75/200	2E-04/8E-04/0.01	4E-04/--/0.6	3E-04/0.2/0.2	4E-04/--/0.04	2E-04/1E-03/0.01
Sample Date									
5/5/2022	2.54 J	43 J	0.04 J	212 J	0.01 J	5.44E-03	0.01 J	0.01 J	2.74E-03 U
10/21/2022	0.57 UJ	111	0.06 J	228 J	9.92E-03 J	3.76E-3 J	0.01 J	0.02 J	2.74E-03 J
3/9/2023	2.84 J	42.6 J	0.04 J	123 J	8.80E-03 J	1.77E-3 U	9.24E-03 J	0.01 J	1.89E-03 U

AAM131 HVS Dissolved Phase Concentrations (µg/L, calculated)			
Analyte	Total DDT	2,3,7,8-TCDD eq	Total PCBs
CUL	2.2E-05	5.10E-10	6.4E-06
Sample Date			
5/5/2022	1.35E-05 U	2.15E-08 J	2.36E-04 J
10/21/2022	4.53E-05	8.62E-08 J	1.03E-04 J
3/9/2023	8.71E-06 U	1.00E-08 U	2.074E-05 J

Manhole Stormwater Sample Location

City of Portland Stormwater Outfall

Stormwater Line

Outfall Basin S-1

CUL Exceedance

RAL/PQL Exceedance

PTW Exceedance

MDL exceeds CUL

DRY = Dry season in-line sediment samples collected between May 2022 and November 2022

WET = Wet season in-line sediment samples were collected between January and May 2022 and November 2022 and June 2023

Notes:
Sample results are listed by the sample date.

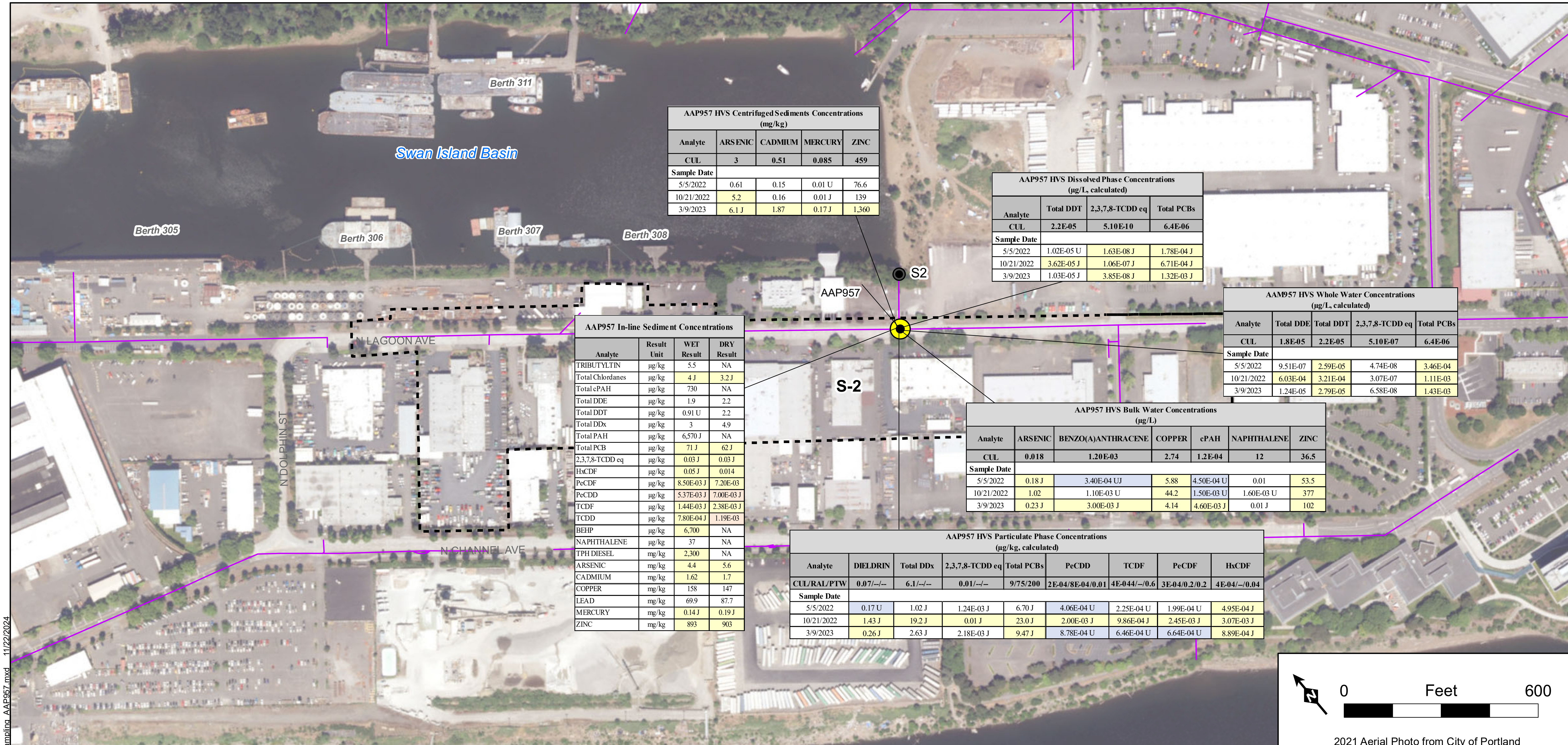
µg/kg - micrograms per kilogram
µg/L - micrograms per liter
BEHP - bis(2-Ethylhexyl) phthalate
cPAH - carcinogenic polycyclic aromatic hydrocarbons
COC - contaminants of concern
CUL - cleanup level
DDD - dichlorodiphenyldichloroethane
DDE - dichlorodiphenyldichloroethylene
DDT - dichlorodiphenyltrichloroethane
DDx - DDD + DDE + DDT
HVS - high-volume sampling
HxCDF - 1,2,3,4,7,8-hexachlorodibenzofuran
J - estimated value
MDL - method detection limit
mg/kg - milligrams per kilogram
NA - not analyzed
PCB - polychlorinated biphenyl
PeCDD - 1,2,3,7,8-pentachlorodibenzo-p-dioxin
PeCDF - 2,3,4,7,8-pentachlorodibenzofuran
PQL - practical quantitation limit
PTW - principal threat waste
RAL - remedial action level
ROD - Record of Decision
TCDD - 2,3,7,8-tetrachlorodibenzo-p-dioxin
TCDF - 2,3,7,8-tetrachlorodibenzofuran
TPH - total petroleum hydrocarbons
U - analyte not detected

Figure 3-11
City Outfall Basin S-1 ROD COC Detections

Prepared on: 11/22/2024
PDI Evaluation Report
Swan Island Basin

PACIFIC groundwater GROUP
HGL
MOTT MACDONALD
BRIDGEWATER GROUP

\\srv-gst-01\HGL\GIS\Portland_Harbor_DT2002\SIB\PDI_ER\(3-11)HVS_Sampling_AAM131.mxd 11/22/2024



AAP957 HVS Centrifuged Sediments Concentrations (mg/kg)

Analyte	ARSENIC	CADMIUM	MERCURY	ZINC
CUL	3	0.51	0.085	459
Sample Date				
5/5/2022	0.61	0.15	0.01 U	76.6
10/21/2022	5.2	0.16	0.01 J	139
3/9/2023	6.1 J	1.87	0.17 J	1,360

AAP957 HVS Dissolved Phase Concentrations (µg/L, calculated)

Analyte	Total DDT	2,3,7,8-TCDD eq	Total PCBs
CUL	2.2E-05	5.10E-10	6.4E-06
Sample Date			
5/5/2022	1.02E-05 U	1.63E-08 J	1.78E-04 J
10/21/2022	3.62E-05 J	1.06E-07 J	6.71E-04 J
3/9/2023	1.03E-05 J	3.85E-08 J	1.32E-03 J

AAM957 HVS Whole Water Concentrations (µg/L, calculated)

Analyte	Total DDE	Total DDT	2,3,7,8-TCDD eq	Total PCBs
CUL	1.8E-05	2.2E-05	5.10E-07	6.4E-06
Sample Date				
5/5/2022	9.51E-07	2.59E-05	4.74E-08	3.46E-04
10/21/2022	6.03E-04	3.21E-04	3.07E-07	1.11E-03
3/9/2023	1.24E-05	2.79E-05	6.58E-08	1.43E-03

AAP957 In-line Sediment Concentrations

Analyte	Result Unit	WET Result	DRY Result
TRIBUTYLTIN	µg/kg	5.5	NA
Total Chlordanes	µg/kg	4 J	3.2 J
Total cPAH	µg/kg	730	NA
Total DDE	µg/kg	1.9	2.2
Total DDT	µg/kg	0.91 U	2.2
Total DDx	µg/kg	3	4.9
Total PAH	µg/kg	6,570 J	NA
Total PCB	µg/kg	71 J	62 J
2,3,7,8-TCDD eq	µg/kg	0.03 J	0.03 J
HxCDF	µg/kg	0.05 J	0.014
PeCDF	µg/kg	8.50E-03 J	7.20E-03
PeCDD	µg/kg	5.37E-03 J	7.00E-03 J
TCDF	µg/kg	1.44E-03 J	2.38E-03 J
TCDD	µg/kg	7.80E-04 J	1.19E-03
BEHP	µg/kg	6,700	NA
NAPHTHALENE	µg/kg	37	NA
TPH DIESEL	mg/kg	2,300	NA
ARSENIC	mg/kg	4.4	5.6
CADMIUM	mg/kg	1.62	1.7
COPPER	mg/kg	158	147
LEAD	mg/kg	69.9	87.7
MERCURY	mg/kg	0.14 J	0.19 J
ZINC	mg/kg	893	903

AAP957 HVS Bulk Water Concentrations (µg/L)

Analyte	ARSENIC	BENZO(A)ANTHRACENE	COPPER	cPAH	NAPHTHALENE	ZINC
CUL	0.018	1.20E-03	2.74	1.2E-04	12	36.5
Sample Date						
5/5/2022	0.18 J	3.40E-04 UJ	5.88	4.50E-04 U	0.01	53.5
10/21/2022	1.02	1.10E-03 U	44.2	1.50E-03 U	1.60E-03 U	377
3/9/2023	0.23 J	3.00E-03 J	4.14	4.60E-03 J	0.01 J	102

AAP957 HVS Particulate Phase Concentrations (µg/kg, calculated)

Analyte	DIELDRIN	Total DDx	2,3,7,8-TCDD eq	Total PCBs	PeCDD	TCDF	PeCDF	HxCDF
CUL/RAL/PTW	0.07/--/--	6.1/--/--	0.01/--/--	9/75/200	2E-04/8E-04/0.01	4E-044/--/0.6	3E-04/0.2/0.2	4E-04/--/0.04
Sample Date								
5/5/2022	0.17 U	1.02 J	1.24E-03 J	6.70 J	4.06E-04 U	2.25E-04 U	1.99E-04 U	4.95E-04 J
10/21/2022	1.43 J	19.2 J	0.01 J	23.0 J	2.00E-03 J	9.86E-04 J	2.45E-03 J	3.07E-03 J
3/9/2023	0.26 J	2.63 J	2.18E-03 J	9.47 J	8.78E-04 U	6.46E-04 U	6.64E-04 U	8.89E-04 J

Manhole Stormwater Sample Location

City of Portland Stormwater Outfall

Stormwater Line

Outfall Basin S-2

CUL Exceedance

RAL/PQL Exceedance

PTW Exceedance

MDL exceeds CUL

DRY = Dry season in-line sediment samples collected between May 2022 and November 2022
WET = Wet season in-line sediment samples were collected between January and May 2022 and November 2022 and June 2023

Notes:
Sample results are listed by the sample date.

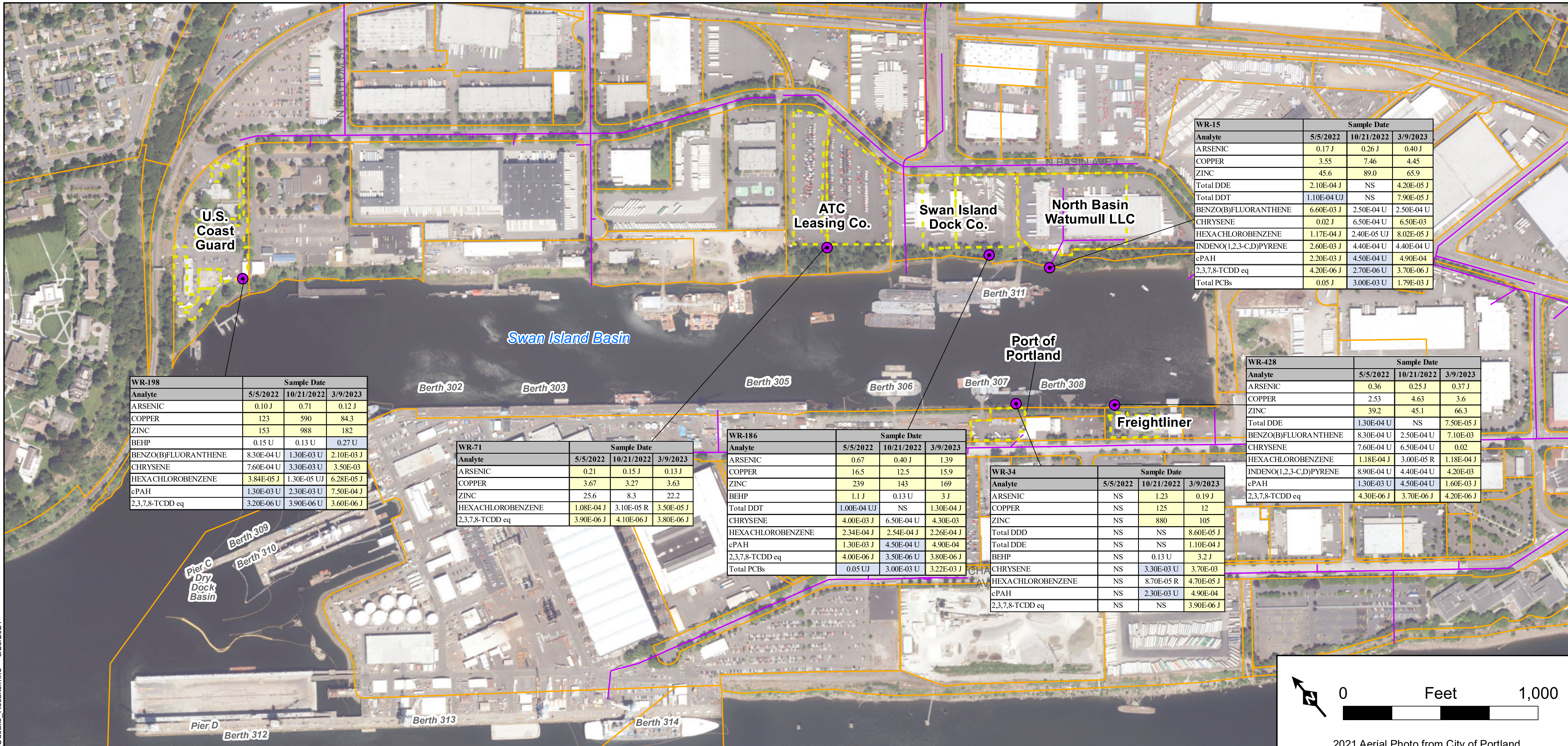
µg/kg - micrograms per kilogram
µg/L - micrograms per liter
BEHP - bis(2-Ethylhexyl) phthalate
cPAH - carcinogenic polycyclic aromatic hydrocarbons
COC - contaminants of concern
CUL - cleanup level
DDD - dichlorodiphenyldichloroethane
DDE - dichlorodiphenyldichloroethylene
DDT - dichlorodiphenyltrichloroethane
DDx - DDD + DDE + DDT
HVS - high-volume sampling
HxCDF - 1,2,3,4,7,8-hexachlorodibenzofuran
J - estimated value
MDL - method detection limit
mg/kg - milligrams per kilogram
NA - not analyzed
PCB - polychlorinated biphenyl
PeCDD - 1,2,3,7,8-pentachlorodibenzo-p-dioxin
PeCDF - 2,3,4,7,8-pentachlorodibenzofuran
PQL - practical quantitation limit
PTW - principal threat waste
RAL - remedial action level
ROD - Record of Decision
TCDD - 2,3,7,8-tetrachlorodibenzo-p-dioxin
TCDF - 2,3,7,8-tetrachlorodibenzofuran
TPH - total petroleum hydrocarbons
U - analyte not detected

Figure 3-12
City Outfall S-2 ROD COC Detections

Prepared on: 11/22/2024
PDI Evaluation Report
Swan Island Basin

PACIFIC groundwater GROUP
HGL
MOTT MACDONALD
BRIDGEWATER GROUP

\\srv-gst-01\HGLGIS\Portland_Harbor_DT2002\SIB\PDI_ER\(3-12)HVS_Sampling_AAP957.mxd 11/22/2024



WR-198	Sample Date		
Analyte	5/5/2022	10/21/2022	3/9/2023
ARSENIC	0.10 J	0.71	0.12 J
COPPER	123	590	84.3
ZINC	153	988	182
BEHP	0.15 U	0.13 U	0.27 U
BENZO(B)FLUORANTHENE	8.30E-04 U	1.30E-03 U	2.10E-03 J
CHRYSENE	7.60E-04 U	3.30E-03 U	3.50E-03
HEXACHLOROBENZENE	3.84E-05 J	1.30E-05 UJ	6.28E-05 J
cPAH	1.30E-03 U	2.30E-03 U	7.50E-04 J
2,3,7,8-TCDD eq	3.20E-06 U	3.90E-06 U	3.60E-06 J

WR-71	Sample Date		
Analyte	5/5/2022	10/21/2022	3/9/2023
ARSENIC	0.21	0.15 J	0.13 J
COPPER	3.67	3.27	3.63
ZINC	25.6	8.3	22.2
HEXACHLOROBENZENE	1.08E-04 J	3.10E-05 R	3.50E-05 J
2,3,7,8-TCDD eq	3.90E-06 J	4.10E-06 J	3.80E-06 J

WR-186	Sample Date		
Analyte	5/5/2022	10/21/2022	3/9/2023
ARSENIC	0.67	0.40 J	1.39
COPPER	16.5	12.5	15.9
ZINC	239	143	169
BEHP	1.1 J	0.13 U	3 J
Total DDT	1.00E-04 UJ	NS	1.30E-04 J
CHRYSENE	4.00E-03 J	6.50E-04 U	4.30E-03
HEXACHLOROBENZENE	2.34E-04 J	2.54E-04 J	2.26E-04 J
cPAH	1.30E-03 J	4.50E-04 U	4.90E-04
2,3,7,8-TCDD eq	4.00E-06 J	3.50E-06 U	3.80E-06 J
Total PCBs	0.05 UJ	3.00E-03 U	3.22E-03 J

WR-34	Sample Date		
Analyte	5/5/2022	10/21/2022	3/9/2023
ARSENIC	NS	1.23	0.19 J
COPPER	NS	125	12
ZINC	NS	880	105
Total DDD	NS	NS	8.60E-05 J
Total DDE	NS	NS	1.10E-04 J
BEHP	NS	0.13 U	3.2 J
CHRYSENE	NS	3.30E-03 U	3.70E-03
HEXACHLOROBENZENE	NS	8.70E-05 R	4.70E-05 J
cPAH	NS	2.30E-03 U	4.90E-04
2,3,7,8-TCDD eq	NS	NS	3.90E-06 J

WR-15	Sample Date		
Analyte	5/5/2022	10/21/2022	3/9/2023
ARSENIC	0.17 J	0.26 J	0.40 J
COPPER	3.55	7.46	4.45
ZINC	45.6	89.0	65.9
Total DDE	2.10E-04 J	NS	4.20E-05 J
Total DDT	1.10E-04 UJ	NS	7.90E-05 J
BENZO(B)FLUORANTHENE	6.60E-03 J	2.50E-04 U	2.50E-04 U
CHRYSENE	0.02 J	6.50E-04 U	6.50E-03
HEXACHLOROBENZENE	1.17E-04 J	2.40E-05 UJ	8.02E-05 J
INDENO(1,2,3-C,D)PYRENE	2.60E-03 J	4.40E-04 U	4.40E-04 U
cPAH	2.20E-03 J	4.50E-04 U	4.90E-04
2,3,7,8-TCDD eq	4.20E-06 J	2.70E-06 U	3.70E-06 J
Total PCBs	0.05 J	3.00E-03 U	1.79E-03 J

WR-428	Sample Date		
Analyte	5/5/2022	10/21/2022	3/9/2023
ARSENIC	0.36	0.25 J	0.37 J
COPPER	2.53	4.63	3.6
ZINC	39.2	45.1	66.3
Total DDE	1.30E-04 U	NS	7.50E-05 J
BENZO(B)FLUORANTHENE	8.30E-04 U	2.50E-04 U	7.10E-03
CHRYSENE	7.60E-04 U	6.50E-04 U	0.02
HEXACHLOROBENZENE	1.18E-04 J	3.00E-05 R	1.18E-04 J
INDENO(1,2,3-C,D)PYRENE	8.90E-04 U	4.40E-04 U	4.20E-03
cPAH	1.30E-03 U	4.50E-04 U	1.60E-03 J
2,3,7,8-TCDD eq	4.30E-06 J	3.70E-06 J	4.20E-06 J

Manhole Stormwater Sample Location

Stormwater Line

Estimated Drainage Areas for Private Outfalls Included in Stormwater Sampling Program

Tax Lot Boundary

CUL Exceedance
RAL/PQL Exceedance
PTW Exceedance
MDL exceeds CUL

Notes:
All results are stormwater samples reported in micrograms per liter (µg/L).

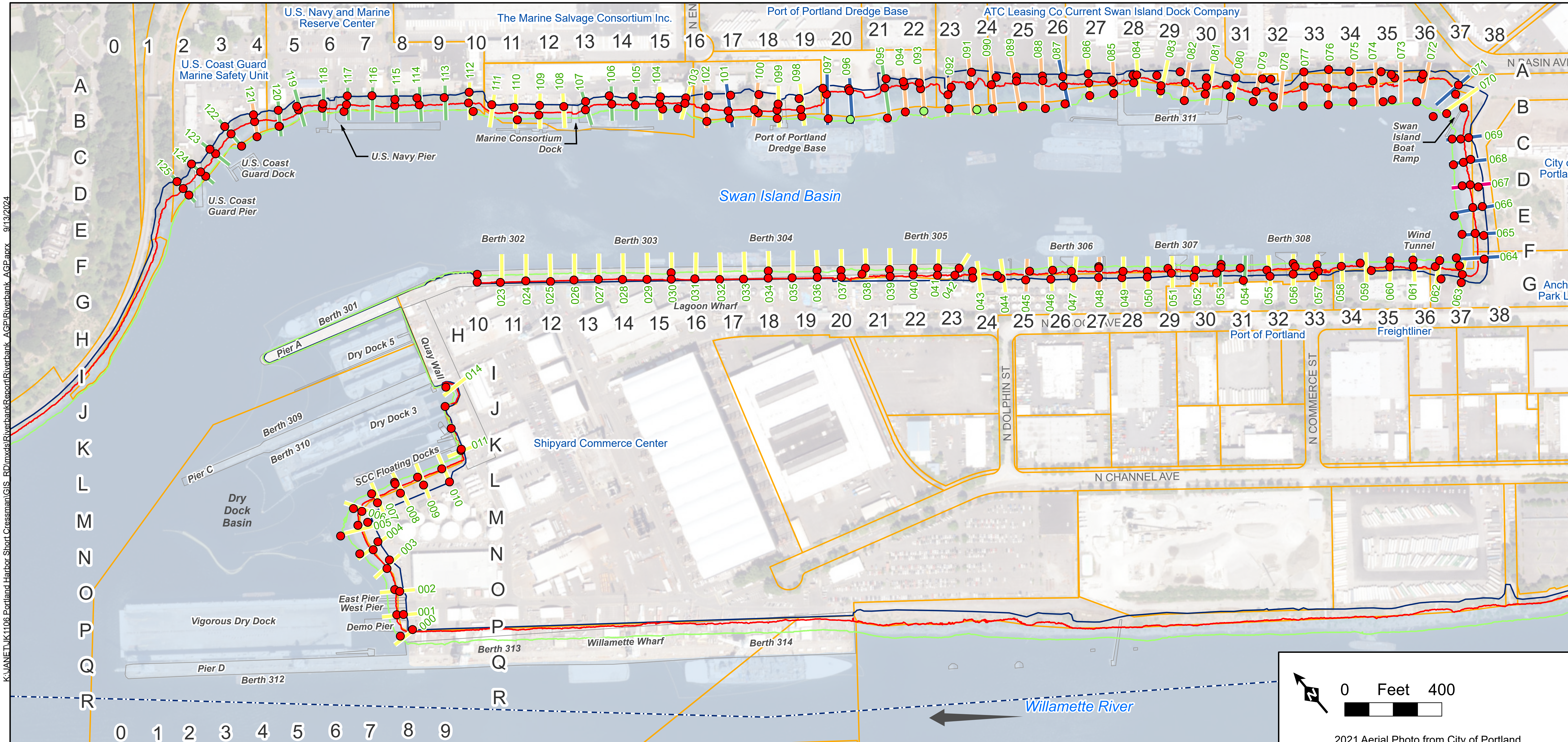
BEHP - bis(2-Ethylhexyl) phthalate
cPAH - carcinogenic polycyclic aromatic hydrocarbons
COC - contaminants of concern
CUL - cleanup level
DDD - dichlorodiphenyldichloroethane
DDE - dichlorodiphenyldichloroethylene
DDT - dichlorodiphenyltrichloroethane
DDx - DDD + DDE + DDT
HVS - high-volume sampling
HxCDF - 1,2,3,4,7,8-hexachlorodibenzofuran
J - estimated value
MDL - method detection limit
ND - analyte was not detected above reporting limit
NS - not sampled
PCB - polychlorinated biphenyl
PeCDD - 1,2,3,7,8-pentachlorodibenzo-p-dioxin
PeCDF - 2,3,4,7,8-pentachlorodibenzofuran
PQL - practical quantitation limit
PTW - principal threat waste
R - rejected
RAL - remedial action level
ROD - Record of Decision
TCDD - 2,3,7,8-tetrachlorodibenzo-p-dioxin
TCDF - 2,3,7,8-tetrachlorodibenzofuran

Figure 3-13
Non-City Outfall ROD COC Detections

Prepared on: 8/23/2024
PDI Evaluation Report
Swan Island Basin

PACIFIC groundwater GROUP
HGL
MOTT MACDONALD
BRIDGEWATER GROUP

\\srv-gst-01\HGLGIS\Portland_Harbor_DT2002\SIB\PDI_ER\(3-13)Noncity_Outfalls_Results.mxd 8/23/2024



Federal Navigation Channel (USACE, 2020)
Docks and Structures
Tax Lot Boundary
Top of Bank (TOB)
Ordinary High Water (OHW)
Mean Low Water (MLW)

M Project Area Grid Label

River Flow Direction

Riverbank Sample Location
- At least one ROD COC Above CUL
- No ROD COCs Above CUL

Bank Erosion Hazard Index (BEHI) Rating
- Extreme
- Very High
- High
- Moderate
- Low

Notes:
COC – Contaminants of Concern
CUL – Cleanup Level
ROD – Record of Decision
SCC – Shipyard Commerce Center
USACE – U.S. Army Corps of Engineers

TOB Source – City of Porland Lidar, 2019
OHW and MLW Source – EPA, 2019

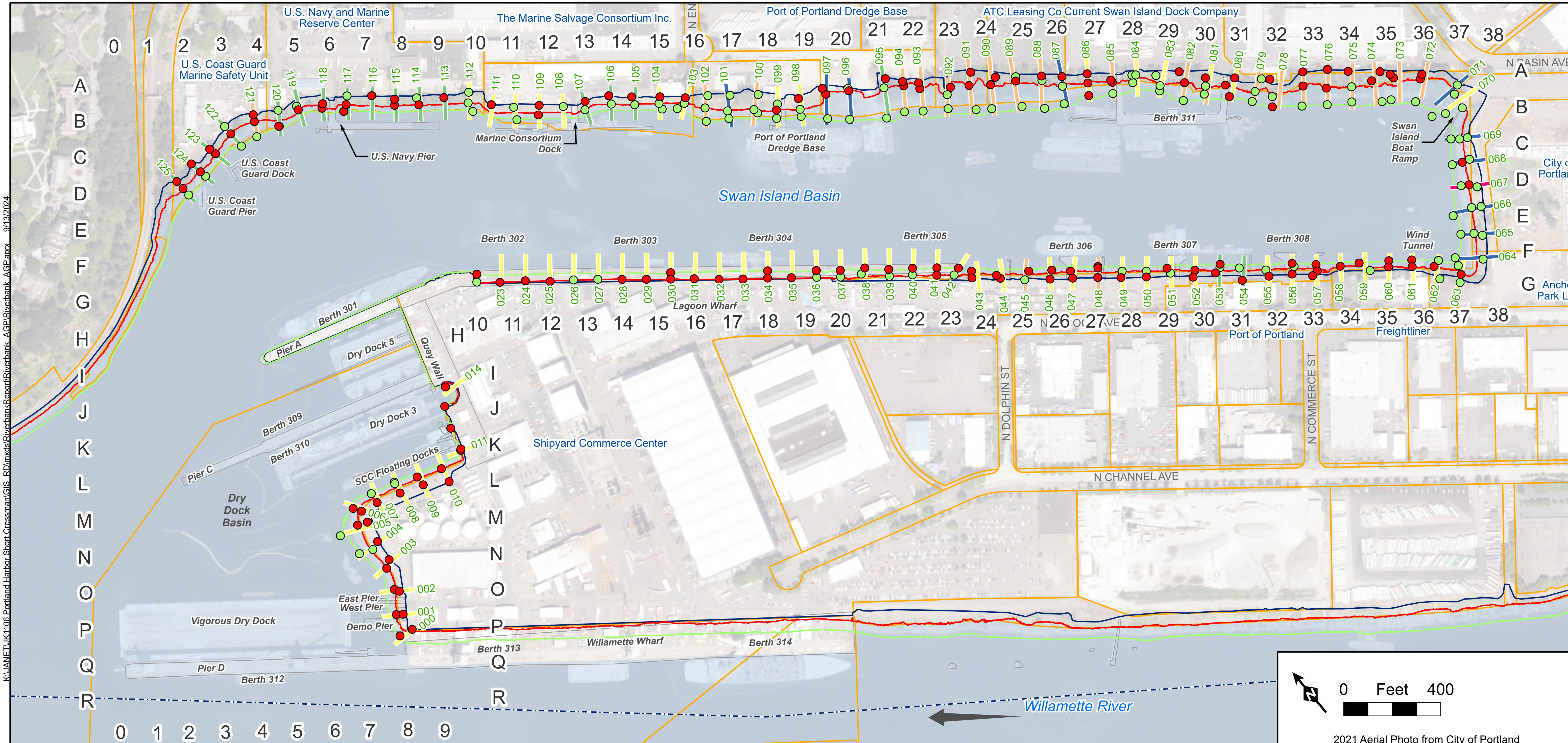
Sample Summary/Depth			
Depth/ Elevation	0-1 feet	1-2 feet	2-3 feet
TOB	90	40	17
OHW	111	31	10
MLW	75	24	1
Total (399)	276	95	28

Figure 3-14

Riverbank Soil Sample CUL Exceedances

Prepared on: 09/13/2024
PDI Evaluation Report
Swan Island Basin

PACIFIC groundwater GROUP
HGL
MOTT MACDONALD
BRIDGEWATER GROUP



- Federal Navigation Channel (USACE, 2020)
- Docks and Structures
- Tax Lot Boundary
- Top of Bank (TOB)
- Ordinary High Water (OHW)
- Mean Low Water (MLW)

Riverbank Sample Location

- At least one ROD COC Above RAL
- No ROD COCs Above CUL

Bank Erosion Hazard Index (BEHI) Rating

- Extreme
- Very High
- High
- Moderate
- Low

M Project Area Grid Label

River Flow Direction

Notes:
COC – Contaminants of Concern
RAL – Remedial Action Level
ROD – Record of Decision
SCC – Shipyard Commerce Center
USACE – U.S. Army Corps of Engineers

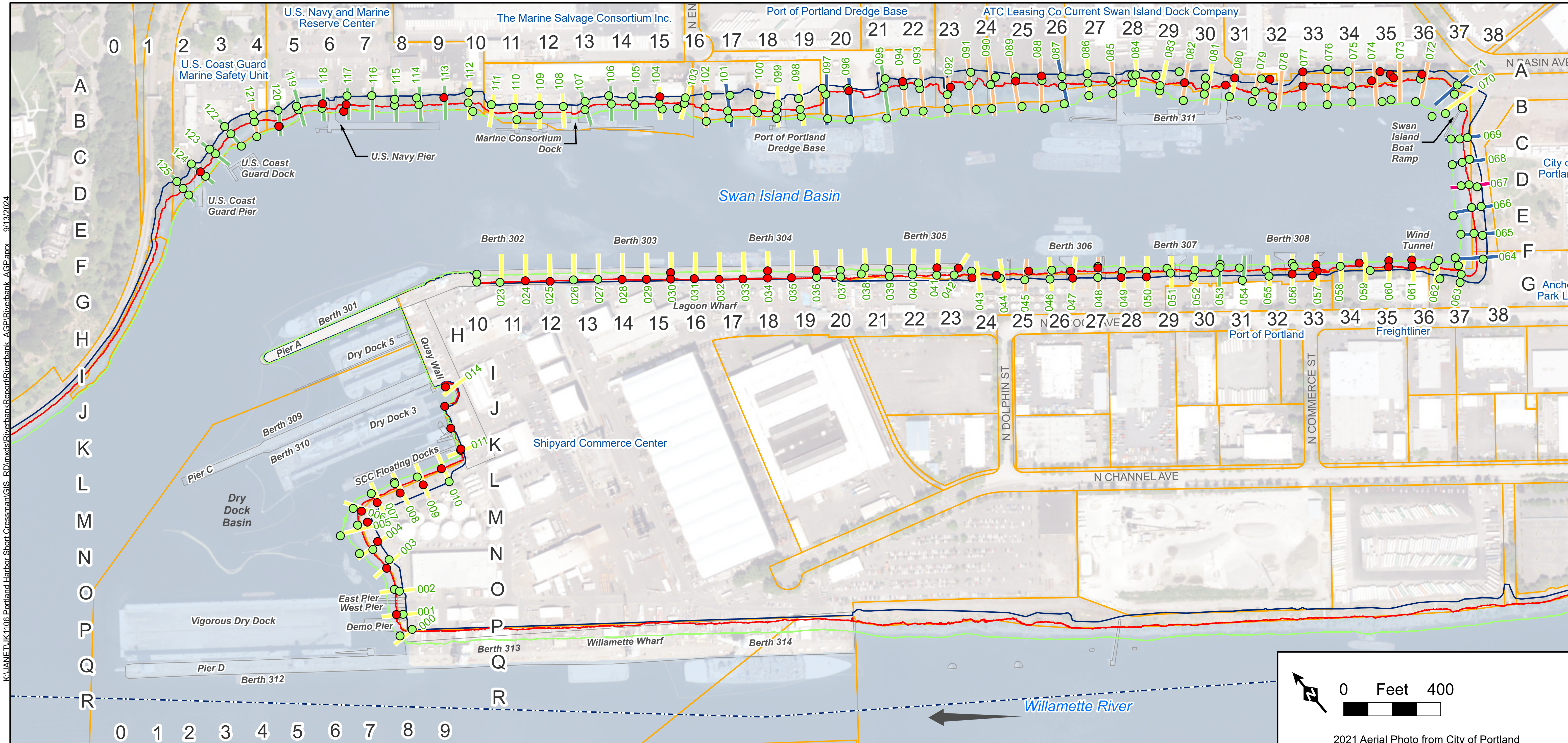
TOB Source – City of Porland Lidar, 2019
OHW and MLW Source – EPA, 2019

Sample Summary/Depth			
Depth/ Elevation	0-1 feet	1-2 feet	2-3 feet
TOB	90	40	17
OHW	111	31	10
MLW	75	24	1
Total (399)	276	95	28

Figure 3-15
Riverbank Soil Sample RAL Exceedances

Prepared on: 09/13/2024
PDI Evaluation Report
Swan Island Basin

PACIFIC groundwater GROUP
HGL
MOTT MACDONALD
BRIDGEWATER GROUP



Federal Navigation Channel (USACE, 2020)
Docks and Structures
Tax Lot Boundary
Top of Bank (TOB)
Ordinary High Water (OHW)
Mean Low Water (MLW)

M Project Area Grid Label

River Flow Direction

Riverbank Sample Location
- At least one ROD COC Above PTW
- No ROD COCs Above PTW

Bank Erosion Hazard Index (BEHI) Rating
- Extreme
- Very High
- High
- Moderate
- Low

Notes:
COC – Contaminants of Concern
PTW – Cleanup Level
ROD – Principal threat waste
SCC – Shipyard Commerce Center
USACE – U.S. Army Corps of Engineers

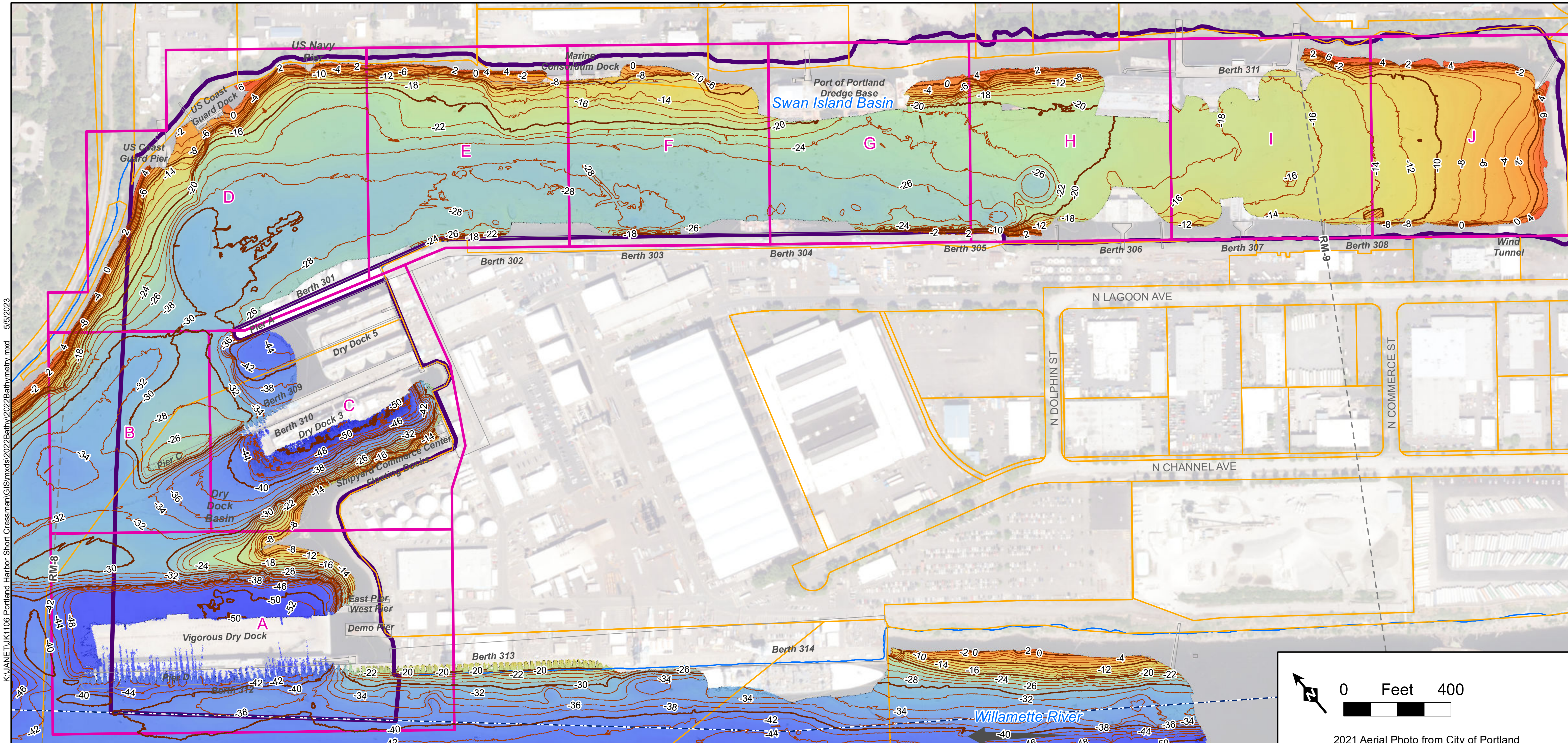
TOB Source – City of Porland Lidar, 2019
OHW and MLW Source – EPA, 2019

Sample Summary/Depth			
Depth/ Elevation	0-1 feet	1-2 feet	2-3 feet
TOB	90	40	17
OHW	111	31	10
MLW	75	24	1
Total (399)	276	95	28

Figure 3-16
Riverbank Soil Sample PTW Exceedances

Prepared on: 09/13/2024
PDI Evaluation Report
Swan Island Basin

PACIFIC groundwater GROUP
HGL
MOTT MACDONALD
BRIDGEWATER GROUP



Bathymetry Zones
River Mile (RM)
Swan Island Sediment Decision Unit (SDU)
Federal Navigation Channel (USACE, 2020)
Docks and Structures
Tax Lot Boundary
Ordinary High Water (City of Portland, 2013)
River Flow Direction

2022 Bathymetry (Feet NAVD88)
High : 8
0
-10
-20
-30
-40
-50
Low : -60

10-foot Contours 2022 Bathymetry (Feet NAVD88)
2-foot Contours 2022 Bathymetry (Feet NAVD88)

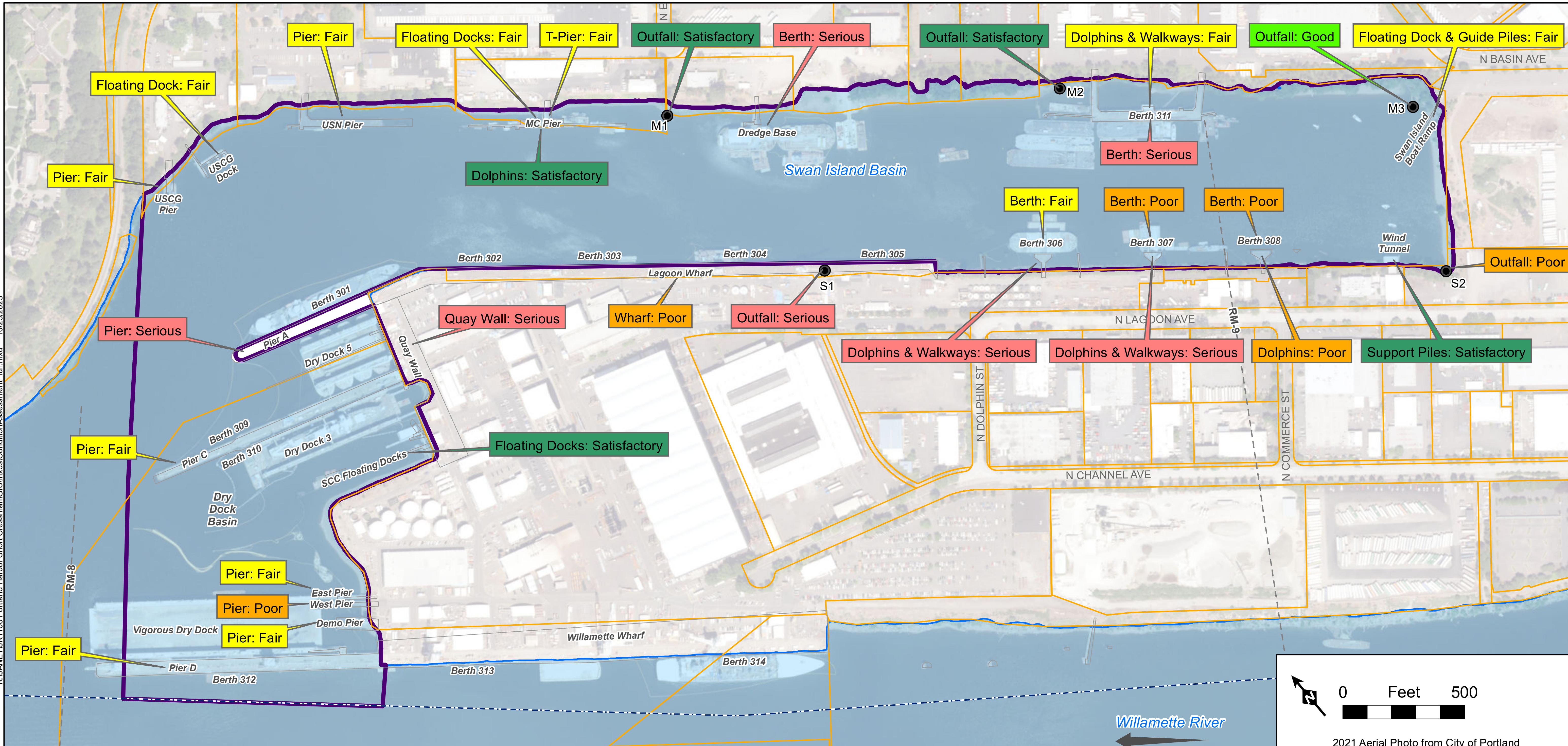
Notes:
NAVD88 – North American Vertical Datum of 1988
USACE – U.S. Army Corps of Engineers

Figure 3-17
Bathymetry Overview

Prepared on: 5/5/2023
PDI Evaluation Report
Swan Island Basin

PACIFIC groundwater GROUP
HGL
MOTT MACDONALD
BRIDGEWATER GROUP

K:\JANET\JK1106 Portland Harbor Short Cressman\GIS\mxds\2022Bathy\2022Bathymetry.mxd 5/5/2023



K:\JANET\JK1106 Portland Harbor Short Cressman\GIS\mxds\ConditionAssessment_full.mxd 10/23/2023

- City of Portland Stormwater Outfall
- River Mile (RM)
- Swan Island Sediment Decision Unit (SDU)
- Federal Navigation Channel (USACE, 2020)
- Docks and Structures
- Tax Lot Boundary
- Ordinary High Water (City of Portland, 2013)
- River Flow Direction

Condition Assessment Rating
Good
Satisfactory
Fair
Poor
Serious
Critical
Not Inspected

Notes:

MC – Marine Consortium
SCC – Shipyard Commerce Center
USACE – U.S. Army Corps of Engineers
USCG – U.S. Coast Guard
USN – U.S. Navy

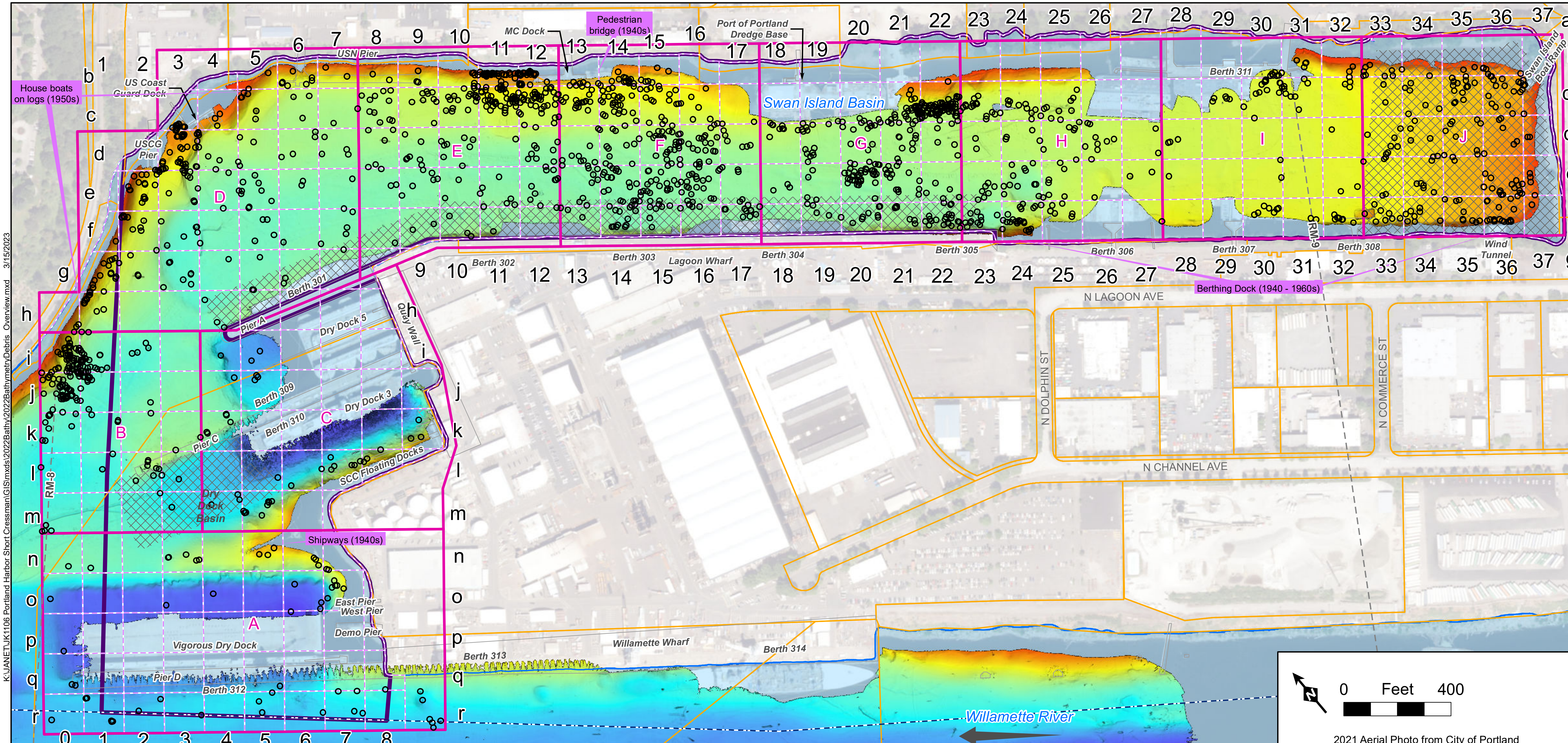
Condition assessments are based on the results of the spring 2022 inspection. Any repairs conducted after the inspection are not reflected in these ratings.

Figure 3-18

Shoreline and Overwater Structures Condition Rating

Prepared on: 11/13/2023
PDI Evaluation Report
Swan Island Basin

PACIFIC groundwater GROUP
HGL
MOTT MACDONALD
BRIDGEWATER GROUP



- Debris Zones
- Project Area Grid
- Cable Areas (USACE, 2022)
- River Mile (RM)
- Swan Island Sediment Decision Unit (SDU)
- Federal Navigation Channel (USACE, 2020)
- Docks and Structures
- Tax Lot Boundary
- Ordinary High Water (City of Portland, 2013)
- River Flow Direction
- Debris Inventory Feature
- Historical structure identification for informational purposes only, and is not intended as debris identification.
- B Debris Zone Label
- m Project Area Grid Label

Notes:
MC – Marine Consortium
SCC – Shipyard Commerce Center
USACE – U.S. Army Corps of Engineers
USCG – U.S. Coast Guard
USN – U.S. Navy

Figure 3-19
Surface Debris Inventory Overview

Prepared on: 3/15/2023
PDI Evaluation Report
Swan Island Basin

PACIFIC groundwater GROUP · HGL · MOTT MACDONALD · BRIDGEWATER GROUP

K:\JANET\JK1106 Portland Harbor Short Cressman\GIS\mxds\2022Bathy\2022BathymetryDebris_Overview.mxd 3/15/2023

APPENDICES

This page was intentionally left blank.

APPENDIX A

SURFACE AND SUBSURFACE SEDIMENT SAMPLING DATA REPORT

A Surface and Subsurface Sediment Sampling Data Report

This page was intentionally left blank.

APPENDIX B
PoreWater Upwelling Report
B Porewater Upwelling Report

This page was intentionally left blank.

APPENDIX C
STORMWATER SAMPLING DATA REPORT

C Stormwater Sampling Data Report

This page was intentionally left blank.

APPENDIX D
RIVERBANK CHARACTERIZATION DATA REPORT

D Riverbank Characterization Data Report

This page was intentionally left blank.

APPENDIX E
BATHYMETRIC SURVEY SUMMARY REPORT

E Bathymetric Survey Summary Report

This page was intentionally left blank.

APPENDIX F
GEOTECHNICAL DATA REPORT

F Geotechnical Data Report

APPENDIX G
STRUCTURE CONDITION ASSESSMENT REPORT (COMBINED WITH SHORE AND OVERWATER INSPECTIONS DATA REPORT)

G Structure Condition Assessment Report

This page was intentionally left blank.

APPENDIX H

DEBRIS AND UTILITY IDENTIFICATION AND SURVEY REPORT

H Debris and Utility Identification and Survey Report

This page was intentionally left blank.

APPENDIX I

HYDRODYNAMICS AND SEDIMENT DYNAMICS SURVEY REPORT

I Hydrodynamics and Sediment Dynamics Survey Report

This page was intentionally left blank.

APPENDIX J
HABITAT CONDITIONS SURVEY REPORT
J Habitat Conditions Survey Report

This page was intentionally left blank.

APPENDIX K

FACILITY OWNER/OPERATOR INFORMATION SUMMARY REPORT

K Facility Owner/Operator Information Summary Report

This page was intentionally left blank.

APPENDIX L

CONTAMINATED SEDIMENT 3D EXTENT TECHNICAL MEMORANDUM

L Contaminated Sediment 3D Extent Technical Memorandum

This page was intentionally left blank.

APPENDIX M

CONTAMINATED RIVERBANK SOIL EXTENT TECHNICAL MEMORANDUM

M Contaminated Riverbank Soil Extent Technical Memorandum

This page was intentionally left blank.