TERRESTRIAL ECOLOGICAL EVALUATION SAMPLING AND ANALYSIS PLAN

PACIFIC CITY PARK
600 THIRD AVENUE SOUTHEAST
PACIFIC, WASHINGTON

King County

River and Floodplain Management Section
Water and Land Resources Division

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600 THIRD AVENUE SOUTHEAST
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Prepared for

King County

River and Floodplain Management Section
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Alternate Formats Available.

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1. INTRODUCTION AND PURPOSE OF SAP

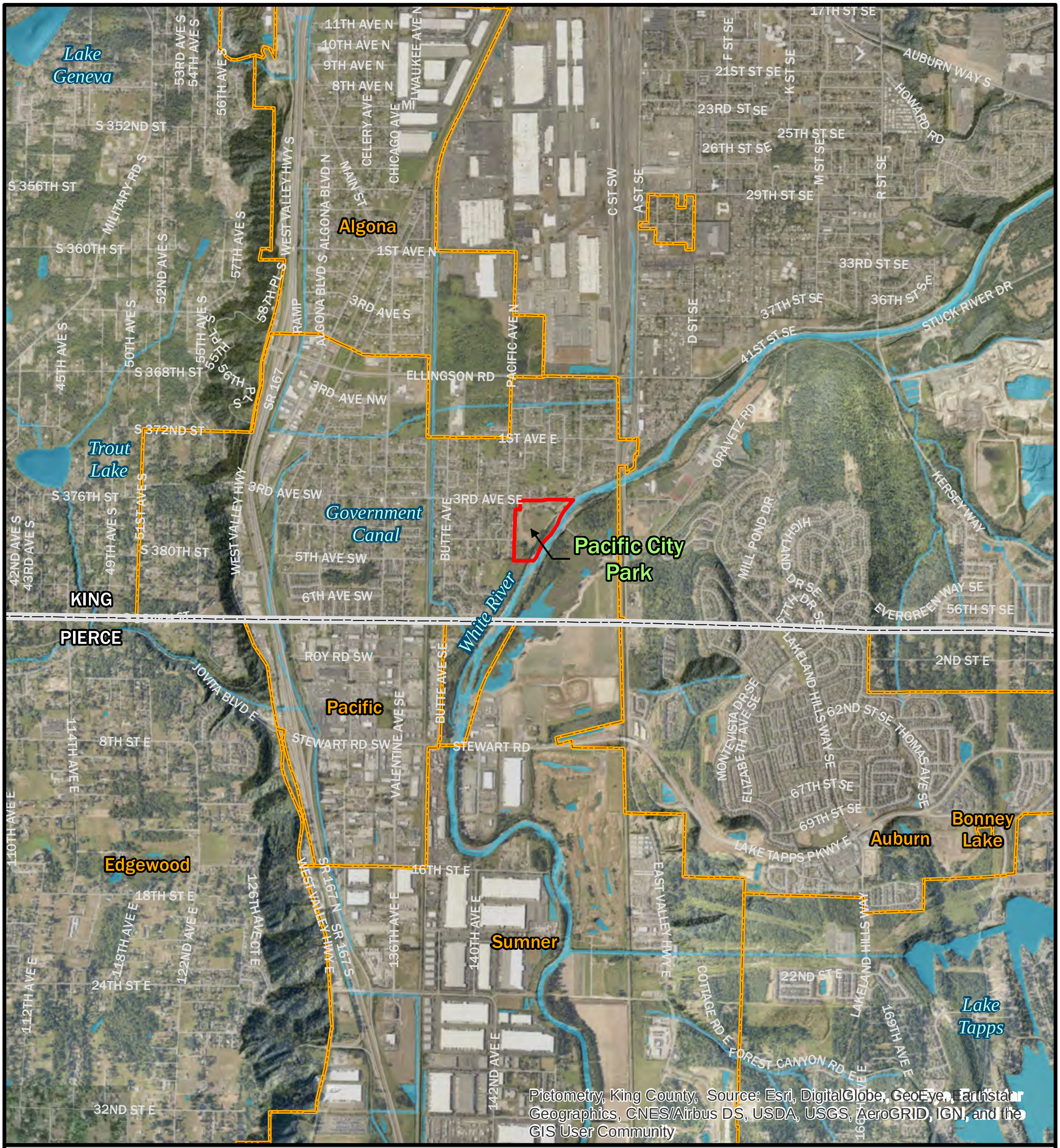
This Sampling and Analysis Plan (SAP) was prepared to guide sampling activities necessary to complete a Site-Specific Terrestrial Ecological Evaluation (TEE) as part of a Feasibility Study (FS) to develop, evaluate, and select remedial alternatives for the Pacific Right Bank Flood Protection Project (Project). The park is located at 600 Third Avenue SE in Pacific, Washington (Figure 1). The work is being completed to meet the requirements of the Washington State Model Toxics Control Act cleanup regulation (MTCA), Chapter 173–340 of the Washington Administrative Code (WAC 173-340) (Ecology 2013). The MTCA Site boundary is depicted on Figure 2, and is defined by locations where refuse is present or where contaminants of potential concern (COPCs) are present in soil, groundwater, surface water or soil vapor at concentrations exceeding the Site Screening Levels (SSLs).

To prepare this SAP, existing data was reviewed from the Remedial Investigation (RI) (Herrera 2019a), Supplemental RI (SRI) (Herrera 2019b), and supplemental monitoring events (Herrera 2019c and 2019d) regarding the nature and extent of hazardous substances in soil, groundwater, surface water, and soil vapor at the Site.

1.1. SITE HISTORY

The park is located on a portion of a 43-acre parcel of land located on the existing west bank of the White River within the City of Pacific (Figure 1). The park property was part of the river channel before it was filled with municipal waste and dredge spoils and used as an informal dumpsite and city dump between the years of approximately 1921 and 1965. The Site was closed for use as a city dump in 1965 and abandoned until 1969 when King County issued a permit to the City of Pacific for a city park that subsequently opened in 1972. Fill soil containing refuse disposed during the 1950s and 1960s was covered with additional fill soil as the park was developed, but dumping continued in the southwest portion of the Site through the early 2000s.

The RI, SRI, and monitoring reports have described in detail where contaminants of potential concern are present at the Site in soil, groundwater, surface water, and/or soil vapor at concentrations exceeding the media-specific SSLs defined for the RI/FS process.



Legend

- Study area
- County boundary
- City limits
- Waterbody
- Stream (King County)
- Roads

Figure 1.
Vicinity Map, Pacific City Park, Pacific, Washington.

0 1,500 3,000 6,000
Feet

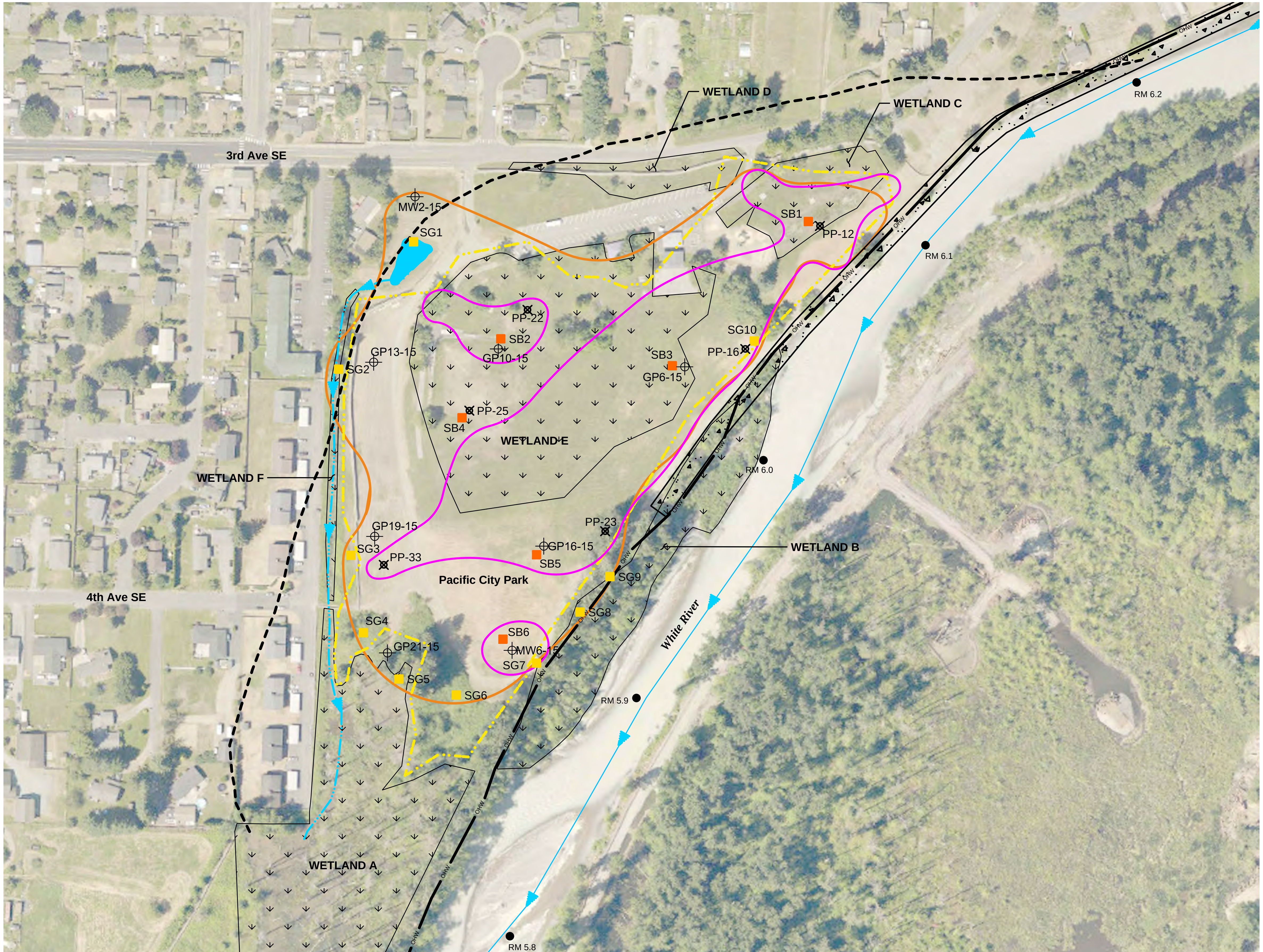
King County

N

Aerial: King County (2017)
Prepared for King County by Herrera

K:\Projects\Y2017\17-06520-000\Project\Report\RfFig1_GWVicinityMap_letter.mxd (1/7/2019)

Figure 2.
Proposed Sampling Locations for Terrestrial Ecological Evaluation, Pacific City Park, Pacific, Washington.



Legend

- Historical edge of river channel based on 1936 aerial photograph (source: King County)
- Pacific City Park MTCA site boundary
- Approximate lateral extent of fill at Pacific City Park
- Approximate lateral extent of refuse
- Existing stormwater ditch
- OHW Approximate OHWM from GPS points taken June and October 2018
- Existing concrete revetment
- Existing stormwater pond
- Existing wetland
- RM 6.0 River mile (10th)
- Probe/well/test pit location (Shannon & Wilson, 9-2015)
- Probe location (Herrera 2-2018, 3-2018)
- Proposed TEE freshwater aquatic sediment grab (SG) sample, 0-10 centimeter depth
- Proposed TEE soil boring (SB), 0-24 inch depth

0 100 200 400 Feet

N

King County

Aerial source: King County (2017)

O:\proj\Y2017\17-06520-000\CAD\Dwg\Figures\TEE Proposed sample locations.dwg

1.2. PURPOSE

Based on the requirements of MTCA and a review of Site characteristics, it was determined that a site-specific TEE is required for the Site under WAC 173-340-7493. The site-specific TEE is intended to identify and characterize any contaminant-related exposures to sensitive terrestrial ecological "receptors" from organic, metal, or conventional contaminants of potential ecological concern (COPECs). Potential ecological receptors at the Site include soil-dwelling mammals, birds, including raptors, herpetofauna, benthic (i.e., for sediment samples) and terrestrial invertebrates, plants, and other species. Once COPECs are identified for the Site, a key objective of the site-specific TEE is to define ecologically protective, contaminant-specific benchmark (i.e., cleanup) values to support the FS remedial alternatives evaluation.

A data gaps (data needs) analysis was conducted by reviewing existing environmental Site data (e.g., soil, surface water, groundwater, and soil vapor) and it was determined that additional surface soil and/or freshwater aquatic sediment sampling in or adjacent to wetlands and the stormwater pond on site is required to address potential terrestrial ecological exposures to specific COPECs. The purpose of this SAP, then, is to present the overall technical approach and results of the data gaps analysis, and describe the proposed sampling activities including locations, sample depths, and rationale for selection of each sample location. This document also presents a summary of sample handling, QA/QC requirements for both field and laboratory activities, laboratory analytical methods, and an overview of data requirements.

2. OVERVIEW OF TECHNICAL APPROACH

This section describes the technical approach and rationale used to perform the data needs assessment, define the COPECs and their associated TEE numerical benchmarks, describe site features such as wetlands, sediments, and terrestrial soils, and define wetlands and ecological receptors for the Site.

2.1. Data Needs Assessment

The TEE-based data needs assessment was conducted based on a review of a large volume of existing site-specific environmental data, including quarterly site groundwater and surface water monitoring data, collected as part of the RI (Herrera 2019a), SRI (Herrera 2019b), and monitoring activities (Herrera 2019c and 2019d). The RI Report provided this data under MTCA requirements to adequately characterize the Site for the purpose of developing a site-specific Conceptual Site Model (CSM) and evaluating potential remedial action alternatives. The SRI was completed to evaluate the nature and extent of contaminants in soil and groundwater to the south-southwest of the Site.

A detailed review of existing soil data, collected from varying depths around the Site as part of the RI and SRI, was conducted both to assess the nature and extent of contamination and to identify the COPECs to be carried forward to the site-specific TEE. Data for soil samples collected from both test pits and soil borings were reviewed, and based on this review, several potentially toxic metals and organic compounds were identified as COPECs.

2.2. Identifying COPECs

To identify COPECs, maximum soil concentrations for each constituent were compared to the most appropriate benchmark (proposed TEE) value for soil or freshwater aquatic sediment, and if the maximum concentration exceeded this value, the constituent was carried forward into the TEE as a COPEC. Section 3.2 provides a detailed discussion of this evaluation as well as the identified COPECs to be carried forward. It also discusses which samples would be regarded as surface soils and which as freshwater aquatic sediments.

Barium and total chromium frequently exceeded soil SSLs of 41.3 milligrams per kilogram (mg/kg, also equivalent to parts per million, or ppm) and 48 mg/kg, respectively, with concentrations as high as 631 mg/kg (barium) and 314 (chromium), but both generally occurred at moderate concentrations below 80 mg/kg and 50 mg/kg, respectively. Both of these metals exhibit moderate ecotoxicity. Moderate exceedances were also identified with other MTCA metals, including cadmium, mercy and silver. Lead, however, which is both toxic and potentially bioaccumulative, occurred more widely in Site soils at elevated concentrations up to

3,320 mg/kg (ppm), greatly exceeding the SSL of 25 mg/kg. Maximum concentrations for each of these COPECs are shown on Table 1.

No other metals occurred at concentrations approaching those of lead in soils. Most of the elevated lead concentrations generally occurred toward the center, southern, and northeastern portions of the Site, which is consistent with historical landfill disposal and related activities. Accordingly, a key focus of the TEE will be on characterizing the potential for ecological effects from lead throughout the Site.

With regard to organic COPECs, RI data shows a few exceedances of diesel-range and lube-oil range petroleum hydrocarbons in soils (SSLs of 200 mg/kg and 2,000 mg/kg, respectively). These exceedances are relatively minor, but these specific petroleum hydrocarbons will be carried forward in the TEE as COPECs. Regarding polychlorinated biphenyls (PCBs) as Aroclors (i.e., rather than specific congeners), which are both ecotoxic and bioaccumulative, approximately six exceedances of SSL values (0.05 mg/kg total PCBs) in soil were identified, mostly in the central and eastern portions of the Site. These will be carried forward in the TEE, but are regarded as low to moderate concentrations.

Polycyclic aromatic hydrocarbons (PAHs) and a carcinogenic subset of PAHs (i.e., cPAHs) are toxic to both humans and ecological receptors (further discussed in Section 3.2), although the carcinogenic response or endpoint is not considered in evaluating ecological toxicity. Numerous exceedances of SSLs for PAHs and cPAHs were identified in soil at the Site, many at concentrations greatly exceeding their respective SSL values in soil (maximum concentrations shown on Table 1). PAHs including cPAHs will be carried forward in the TEE to evaluate whether ecological exposures to soil or sediment could be occurring.

Other organic COPECs identified based on this process included several semi-volatile organics (e.g., two phthalate esters and pentachlorophenol), but concentrations of these compounds only marginally exceeded their respective SSL values. Four organochlorine insecticides marginally exceeded their SSL values, (4.4'-DDD, endosulfan I and II, and methoxychlor), but these too were only detected at minimal concentrations. VOCs, including toluene, methylene chloride, and tetrachloroethene, were also detected at minimal concentrations in subsurface soil (Table 1), but because they didn't exceed their respective TEE values, they were not carried forward as COPECs.

Surface Water Data. Surface water data is important to understanding and assessing the potential for adverse exposures to terrestrial ecological receptors. Surface soils, freshwater aquatic sediments, groundwater, and surface water are in dynamic equilibrium at the Site, provide critical habitat to wildlife and other "receptors," and adverse contaminant-mediated exposures can occur directly in association with surface water, even to terrestrial ecological receptors. Thus, the data needs assessment included a review of surface water data from the monitoring that has been conducted at the stormwater pond and stormwater ditch (also delineated as Wetland F) (SW-1, SW-2, and SW-3). Conclusions from this assessment of surface water data are presented in Section 3.1.

Table 1. Soil and Freshwater Aquatic Sediment COPECs and Screening Levels Evaluated for the Pacific City Park TEE (all units in mg/kg, or ppm).

Constituent[a]	Maximum Soil Concentration (sample location)	Freshwater Sediment Values from WAC 173-204-340[b]	Site Soil Screening Level from RI/SRI[c]	TEE Value for Plants (Ecology 2019)[d]	TEE Value for Soil Biota (Ecology 2019)[d]	TEE Value for Wildlife (Ecology 2019)[d]	"Final" TEE Value from Ecology (2019)[e]	Practical Quantitation Limit (PQL)	Proposed TEE Value[de]	Carried Forward as Ecological COPC (COPEC)?
Petroleum Hydrocarbons										
diesel range organics	1,800 (PP-21)	340	200	1,600	260	2,000	260	25	260	Yes
lube oil range organics	12,000 (PP-33)	–	2,000	–	–	–	–	5	2,000	Yes
Metals										
arsenic	102 (GP-3-15)	14	20	10	60	132	10	10	20	Yes
barium	631 (GP-6-15)	–	41.3	–	–	–	–	2.5	41.3	Yes
cadmium	37 (GP-6-15)	2.1	1	4	20	14	4	0.1	4	Yes
chromium	430 (B-05)	72	48	42	42	67	42	0.1	42	Yes
lead	3,320 (GP-10-15)	360	25	50	500	188	50	5	50	Yes
mercury	9.1 (GP-6-15)	0.66	0.07	0.3	0.1	1	0.1	0.025	0.1	Yes
silver	2.6 (GP-6-15)	0.57	0.61	2	–	4.2	2	0.5	2	Yes
Volatile Organic Compounds (VOCs)										
toluene	0.025 (PP-2)	–	0.01	200	–	5.45	5.45	0.005	5.45	No
methylene chloride	0.02 (GP-19-15)	–	0.02	–	–	–	–	0.005	0.02	No
tetrachloroethene (PCE)	0.023 (GP-7-15)	–	0.001	–	–	9.92	9.92	0.005	9.92	No
Semi-Volatile Organic Compounds (SVOCs)										
bis(2-ethylhexyl)phthalate	1.6 (GP-10-15)	–	0.11	–	–	–	–	0.033	0.11	Yes
butyl benzylphthalate	0.27 (GP-19-15)	–	0.033	–	–	–	–	0.033	0.033	Yes
pentachlorophenol	0.2 (GP-2-15)	1.2	0.17	–	–	–	–	0.17	0.17	Yes
Polycyclic Aromatic Hydrocarbons (PAHs)										
acenaphthene	29.2 (GP-10-15)	–	0.156	20	29	100	20	0.5	20	Yes
anthracene	106 (GP-10-15)	–	0.0067	–	29	100	29	0.5	29	Yes
benzo(a)anthracene	162 (GP-10-15)	–	0.0067	–	18	1.1	1.1	0.05	1.1	Yes

Table 1(continued). Soil and Freshwater Aquatic Sediment COPECs and Screening Levels Evaluated for the Pacific City Park TEE (all units in mg/kg, or ppm).

Constituent[a]	Maximum Soil Concentration (sample location)	Freshwater Sediment Values from WAC 173-204-340[b]	Site Soil Screening Level from RI/SRI[c]	TEE Value for Plants (Ecology 2019)[d]	TEE Value for Soil Biota (Ecology 2019)[d]	TEE Value for Wildlife (Ecology 2019)[d]	"Final" TEE Value from Ecology (2019)[e]	Practical Quantitation Limit (PQL)	Proposed TEE Valued[e]	Carried Forward as Ecological COPC (COPEC)?
Polycyclic Aromatic Hydrocarbons (PAHs) (continued)										
benzo(a)pyrene	91 (GP-10-15)	–	0.010	–	18	12	12	0.05	12	Yes
benzo(b)fluoranthene	186 (GP-10-15)	–	0.012	–	18	1.1	1.1	0.05	1.1	Yes
benzo(j,k)fluoranthene	28 (GP-10-15)	–	0.012	–	18	1.1	1.1	0.05	1.1	Yes
chrysene	193 (GP-10-15)	–	0.0067	–	18	1.1	1.1	0.05	1.1	Yes
dibenz(a,h)anthracene	53 (GP-10-15)	–	0.137	–	18	1.1	1.1	0.05	1.1	Yes
fluoranthene	365 (GP-8-15)	–	0.494	–	18	1.1	1.1	0.5	1.1	Yes
fluorene	37.5 (GP-8-15)	–	0.0067	–	30	100	30	0.5	30	Yes
2-methylnaphthalene	3.1 (GP-10-15)	–	0.236	–	29	100	29	0.5	29	No
1-methylnaphthalene	6.1 (GP-10-15)	–	0.236	–	29	100	29	0.5	29	No
naphthalene	4.4 (GP-10-15)	–	0.236	–	29	100	29	0.5	29	No
indeno(1,2,3-cd)pyrene	62 (GP-8-15)	–	0.0067	–	18	1.1	1.1	0.05	1.1	Yes
phenanthrene	317 (GP-10-15)	–	0.0067	–	29	100	29	0.5	29	Yes
pyrene	345 (GP-10-15)	–	0.0067	–	18	1.1	1.1	0.5	1.1	Yes
total PAHs		17,000	–	–	–	–	–	0.5	17,000	No
total cPAHs (TEQ)	213 (GP-10-15)	–	0.01	–	–	–	–	0.05	–	No
Polychlorinated Biphenyls (PCBs)										
total PCBs	1.33 (PP-21 multiple depths)	110	0.05	40	–	0.65	0.65	0.04	0.65	Yes

Constituent[a]	Maximum Soil Concentration (sample location)	Freshwater Sediment Values from WAC 173-204-340[b]	Site Soil Screening Level from RI/SRI[c]	TEE Value for Plants (Ecology 2019)[d]	TEE Value for Soil Biota (Ecology 2019)[d]	TEE Value for Wildlife (Ecology 2019)[d]	"Final" TEE Value from Ecology (2019)[e]	Practical Quantitation Limit (PQL)	Proposed TEE Valued[e]	Carried Forward as Ecological COPC (COPEC)?
Organochlorine Pesticides										
4,4′-DDD	0.074 (GP-7-15)	0.31	0.01	–	–	–	–	0.01	0.01	Yes
endosulfan I	0.063 (GP-7-15)	–	0.01	–	–	–	–	0.005	0.01	Yes
endosulfan II	0.056 (GP-11-15)	–	0.005	–	–	–	–	0.005	0.005	Yes
methoxychlor	0.127 (GP-11-15)	–	0.01	–	–	–	–	0.01	0.01	Yes

Table 1(continued). Soil and Freshwater Aquatic Sediment COPECs and Screening Levels Evaluated for the Pacific City Park TEE (all units in mg/kg, or ppm).

[a] Constituents shown are those that were detected in the RI and then subsequently evaluated in the data needs analysis (described Sections 2 and 3 of the SAP document). Maximum soil concentrations are also shown, along with specific sample locations.

[b] Based on Ecology's Sediment Management Standards (SMS) for freshwater, promulgated on Table VI of WAC 173-204. Also consistent with Ecology's Sediment Cleanup User's Manual (SCUM II, Ecology 2019b), and Development of Benthic Sediment Quality Values for Freshwater Aquatic Sediments in WA, OR, and ID (Michelsen 2011).

[c] SSL values incorporate Ecology's compound-specific MTCA requirements, including: Method A values; Method B calculated for the protection of groundwater discharging to surface water (CLARC values used where available); and Method B direct contact where appropriate. These values also consider natural background concentrations for metals from Washington State Background Concentrations for Metals in Soil (cited as Ecology 1994). Background levels used for this evaluation, in ppm, were: 20 (arsenic); 1 (cadmium); 48 (total chromium); 24 (lead); 0.07 (mercury); 0.61 (silver). SSL values are also referred to as preliminary cleanup levels (PCULs) for the RI; these terms are synonymous.

[d] These ecotoxicity-based values are ecological indicator screening concentrations (EISCs), provided in WAC 173-340-7490 through 7494, Table 5.1 (cited as Ecology 2017), or provided by Ecology (2019a).

[e] TEE values are calculated as the lowest (i.e., most ecologically protective) of the appropriate exposure pathways. If no viable exposure pathway is present, that pathway and its associated SSL or TEE values would not be further considered or evaluated.

2.3. IDENTIFYING WETLANDS

Six wetlands (Wetlands A through F) were delineated within or directly adjacent to the MTCA Site boundary (Herrera 2018b, shown on Figure 2). During a site visit on October 18, 2019, each identified wetland was independently evaluated by an Ecology scientist and a determination made as to whether substrate from each wetland would be designated as terrestrial soil or freshwater aquatic sediment. This determination was made based on visual examination of the nature of surface substrate and the presence or absence of aquatic plant communities.

Different numerical compound-specific SSL or Sediment Management Standards (SMS, see WAC 173-204) apply depending on whether materials are designated as terrestrial soil or aquatic sediment. Section 3.2 provides a detailed discussion of the results of this analysis. Surface soil or aquatic sediment will be sampled and analyzed at five of these wetlands (Wetland D will not be sampled because it lies outside of the MTCA Site boundary). In addition, an aquatic sediment sample will be collected at the stormwater detention pond, also shown on Figure 2.

3. RESULTS OF EVALUATION

This section identifies the results of the overall data needs assessment, process for identifying COPECs, including terrestrial soils and freshwater aquatic sediments on the Site, the numerical benchmark (proposed TEE) values for each COPEC, determining the status of soils or sediment in wetlands, and identifying potentially vulnerable and exposed ecological receptors. These results were incorporated into the overall sampling design of the SAP, as discussed below.

3.1. Results of Data Needs Assessment

As discussed in Section 2.1, a data needs assessment was conducted for this SAP by reviewing existing data collected at the Site before and during the RI (Herrera 2019a), SRI (Herrera 2019b), and March and June/July 2019 Monitoring activities (Herrera 2019b and 2019c). In addition, in August 2019, Ecology issued an opinion letter stating that the RI adequately characterized the nature and extent of contamination at the Site to enable evaluation of cleanup alternatives in the Feasibility Study (Ecology 2019d). Based on the data review and Ecology's opinion, it was determined that previously collected groundwater and subsurface soil data are adequate to characterize site conditions, and not directly relevant to assessing adverse terrestrial ecological exposures. No further groundwater or subsurface soil sampling is recommended for the TEE.

3.1.1. Overview of Sampling Design

The data needs assessment indicated the need for additional surface samples at 16 locations, including 6 surface soil boring locations and 10 aquatic sediment grab sample locations. These samples will help to identify potential contaminant-related exposures to soil-dwelling ecological receptors such as soil macroinvertebrates, burrowing mammals, soil-feeding birds, raptors, susceptible plants, and other ecological receptors potentially exposed at the Site. For sediments, the focus will be on protection of benthic invertebrates, both individually and at the community level. No surface soil data were collected as part of the earlier RI, supplemental RI, or other efforts, thus additional soil and sediment data collection is warranted and will be conducted from within the MTCA-delineated boundaries of the Site to support the site-specific TEE.

Samples at the 6 surface soil boring locations and 10 aquatic sediment sample locations will be collected at specific depths that reflect representative and commonly accepted zones of biological activity for a wide variety of plant and animal species. Based on discussions and consensus with Ecology, for soils, the proposed sampling depth will be 24 inches, while for surface aquatic sediments, the proposed depth will be 10 centimeters (cm). These soil and freshwater aquatic sediments samples will be collected from areas located within and slightly outside of delineated wetlands at the Site, depending on sampling site accessibility.

Other considerations for the sampling design, described in more detail in Section 4, include:

- Number of samples required to ensure sufficient statistical robustness and power.
- Spatial distribution of samples (including surface soils and surface sediments), to ensure coverage for all portions of the site within the MTCA Site boundary, based on consultation with Ecology and best professional judgment.
- Suite of COPECs analytes to be analyzed by the laboratory.
- Selection of the most appropriate numerical benchmark values (i.e., TEE values) for ecological protection. These values will consider COPEC-specific ecological indicator screening concentrations (EISCs) and/or soil SSLs, sediment management standards (SMS), MTCA Method A or B values, regional background concentrations or other toxicity-based benchmark values, against which soil or sediment data will be compared.
- Volume of soil to be collected for each sample, to include the full suite of COPECs as well as numerous other compounds analyzed for as part of standard EPA analytical methods (further discussed in Section 4.3 and Table 3).

Evaluation of Surface Water Data. As noted above, the data needs assessment included a review of surface water data from the monitoring that has been conducted at the stormwater pond and stormwater ditch (SW-1, SW-2, and SW-3). Multiple (five) rounds of surface water monitoring data, including both dissolved and total metals data, have been collected, and this surface water monitoring data was regarded as adequate to assess any water-related ecological exposures at the Site. Based on the data, the only exceedances of SSLs, based on water quality standards (WQS; found at WAC 173-201C), were minor exceedances of lube oil. No exceedances of WQS values for metals or organic COPCs (including PAHs, volatile organic compounds [VOCs], PCBs, or other organics) were measured. In addition, the RI concluded that although groundwater may discharge to surface water in some areas of the Site, the surface water monitoring results do not indicate any evidence of migration of COPCs to surface water. Recent (2018) quarterly surface water sampling from the west side of the stormwater ditch again confirmed no SSL exceedances for Site COPCs.

This supports the overall conclusion that sufficient information has been collected to support development of remedial alternatives for the Site in the Feasibility Study, and no additional surface water data is needed to support the site-specific TEE.

3.2. Identified COPECs and Numerical Benchmarks (TEE values)

Section 2.2 summarized the process for identifying COPECs to be carried forward to the site-specific TEE, and this section provides a more detailed discussion on the results of that evaluation. Table 1 lists metal and organic COPCs that have been detected in Site media at concentrations above laboratory reporting limits based on the results of the RI and the SRI. The maximum reported concentration of each COPC in Site soil was compared to SSLs developed for the RI/SRI, Sediment Management Standard (SMS) values where appropriate, and proposed TEE values provided by Ecology.

Each of the maximum reported concentrations in soil (shown on Table 1) were compared to the numerical SSL values for soil as well as other regulatory guidelines shown below. This process ensured that the most applicable and ecologically protective values were selected for ecological COPCs (COPECs) moving forward. Specific guidelines included:

- Standard MTCA Method A and B criteria for human health, assuming direct contact with soil, and soil leaching to groundwater; these were incorporated into the SSL values developed for the RI
- Ecologically protective indicator soil guidelines (EISCs) for plants, soil biota, and wildlife, and including those updated values provided by Ecology (Ecology 2019a)
- Natural background concentrations for specific metals (Ecology 1994)
- Practical Quantitation Limits (PQLs) for each COPC
- Updated freshwater aquatic sediment concentrations from Ecology (published at WAC 173-204-340 Table VI), as represented by SCUM II (Ecology 2019b) and Sediment Quality Values (SQVs) developed by Michelsen (2011)

TEE values shown on Table 1 were calculated as the lowest (i.e., most ecologically protective) for the appropriate exposure pathways. If no viable exposure pathway was identified, it was determined unnecessary that that specific pathway and associated SSL or TEE value would be evaluated further. Proposed TEE values are expected to be protective of ecological receptors at the Site and help eliminate hazardous substances from further consideration as required by WAC 173-340-7493(2)(a)1). If these values are exceeded, various options are available, including soil toxicity bioassays, to demonstrate whether the COPEC poses a threat to ecological receptors at the Site. Both soil and sediment values were included in this evaluation because it was not yet specifically known which COPECs would designate as being present in terrestrial soils or as freshwater aquatic sediments.

The Sediment Quality Standard (SQS) values, which are most restrictive of the SQVs, are shown in Table 1 for comparison with soil data, and are consistent with WAC 173-204 requirements for freshwater sediments. In addition, the laboratory Method Detection Limits (MDLs) and Practical Quantitation Limits (PQLs) for each of the analytical methods to be run were compared to the SSLs, SMS, EISC, or other TEE values, and each were found to be protective (i.e., lower than each of the compound-specific SSL/EISC values evaluated). These values are shown on Table 1, along with the proposed numerical benchmark (TEE value) for each COPEC.

To determine whether a COPC would move forward into the site-specific TEE as an COPEC, a comparison was made between the maximum concentration measured and the designated SSL value. Based on this comparison, each potential COPEC was shown as Yes (i.e., a designated COPC to move forward in the TEE), or No (i.e., that the COPC would "off-ramp" and not be included in the TEE evaluation). This comparison is conservative and believed to be highly ecologically protective, because it only includes the maximum measured concentrations in soils anywhere on the Site, and it is used to help identify COPECs to move forward in the TEE evaluation. The lower (more restrictive) of the two sets of values (i.e., either the upland SSL and TEE values, or the freshwater aquatic sediment values) were used for purposes of comparison where specific pathways had been identified. Groundwater and surface water data were not considered in this analysis, because groundwater is not considered to be a viable ecological pathway based on the quarterly monitoring data collected for the RI.

3.3. Site Wetlands and Ecological Receptors

Six wetlands are located partially or wholly within the designated MTCA Site (Herrera 2018c) and shown on Figure 2. Wetlands A and B are classified as riverine, as they adjoin the White River, and Wetlands C, D, E, and F are classified as depressional. Surface soil and/or freshwater aquatic sediment from five of the six wetlands will be sampled as part of the data collection effort, although no samples will be collected from Wetland D, as it is located outside the MTCA Site boundary. In addition, freshwater aquatic sediment from the stormwater detention pond will be sampled, as discussed below and shown on Figure 2.

The wetlands and stormwater pond on site provide critical habitat for a wide variety of species, including fish, invertebrates, herpetofauna, plants, many bird species, and others; sampling within these areas will help determine the risk of potential exposure to receptors from Site contaminants. A data download from the Washington Department of Fish and Wildlife's (WDFW) Priority Habitats and Species (PHS, found at <https://wdfw.wa.gov/species-habitats/at-risk/phs>) has been completed for the Site, and will be provided as part of the site-specific TEE. In addition, data from the Washington Department of Natural Resources (WDNR) Natural Heritage Program, found at <https://www.dnr.wa.gov/natural-heritage-program>, will be used to identify potential plant receptors of concern. These data will provide a detailed resource inventory for the types of plant and animal species known or believed to occur in the vicinity of the Site.

Using Surrogate Ecological Receptors. The site-specific TEE will include an evaluation of potential ecological effects to defined "surrogate" receptors representing specific ecological niches or guilds, as recommended by Ecology (Ecology 2017). Findings from this evaluation will be incorporated into the TEE. Examples of these surrogate species include:

- American robin (*T. migratorius*), representing avian predation
- Shrew (*Sorex* sp.) representing a terrestrial mammalian predator
- Earthworm (*L. terrestris*), presenting a common soil-dwelling invertebrate
- Vole (*Microtus* sp.), representing a soil-dwelling mammalian herbivore

4. PROPOSED SAMPLING LOCATIONS AND ANALYSES TO BE PERFORMED

This section provides a detailed description regarding the locations selected and rationale used to develop the overall strategy for sampling 16 surface terrestrial soil and freshwater aquatic sediment locations.

4.1. PROPOSED LOCATIONS, RATIONALE FOR PLACEMENT, AND SPATIAL CONSIDERATIONS

Figure 2 shows the locations where 6 surface soil borings and 10 sediment grab samples will be collected. Figure 2 also shows the locations of soil probes and borings where concentrations of one or more COPEC detected in subsurface soils exceeded SSLs; this was a guiding principle in developing the overall sampling strategy. Per agreement with Ecology, surface soil borings will be advanced to a depth of 24 inches to reflect the active zone of biological activity in surface soils. They will also be discretely sampled at two depths, which are 0 to 1 foot and 1 to 2 feet for each soil boring. This discrete sampling approach will allow for a detailed evaluation of whether any potential exposures are occurring in the uppermost (e.g., upper 1-foot layer) terrestrial soils, or whether they could be occurring in subsurface soils (e.g., in the 1-to 2-foot layer).

Freshwater aquatic sediment grab samples will be collected to a depth of 10 cm to reflect the emphasis on protecting benthic organisms and communities in aquatic sediment. Sediment grab sampling in both freshwater and marine sediment often uses a standard sampling depth of 10 cm to reflect the most appropriate zone of biological activity for benthic organisms, which are the ecoreceptors of greatest concern for this site-specific TEE.

Sampling locations were placed both inside and around the vicinity of five wetlands, and to adjoin known areas of contamination in Site soils. No samples will be collected from Wetland D, as it is located outside the MTCA Site boundary. Each of the soil and sediment sampling locations are shown on Figure 2 and described in Table 2. Of the 16 total proposed sampling locations, 6 are designated as terrestrial surface soils, and 10 are designated as freshwater aquatic sediments. In general, sampling locations were selected both within and outside of the wetlands in areas where COPCs exceeded SSLs based on data from RI, SRI, and quarterly monitoring investigations.

Table 2. Soil Boring and Freshwater Aquatic Sediment Grab Sample Locations and Rationale for Placement, Pacific City Park TEE.			
Surface Soil Boring Designations (proposed depth)[a]	**Northing**	**Easting**	**Location and Rationale[c]**
SB1 (24 in)	99602.44	1292337	Within Wetland C, near PP-12 where elevated lead and PCBs were detected in subsurface soils
SB2 (24 in)	99372.88	1291734.93	Within Wetland E, near GP10-15 and PP-22 where elevated lead, lube oil, and/or cPAHs were detected in subsurface soils
SB3 (24 in)	99323.45	1292030.28	Within Wetland E, near GP6-15 where elevated lead and cPAHs were detected in subsurface soils
SB4 (24 in)	99218.34	1291659.0	Within Wetland E, near PP-25 where elevated lead, diesel-range petroleum hydrocarbons and PCBs were detected in subsurface soils
SB5 (24 in)	98950.23	1291805.06	Near GP16-15, where elevated lead, cPAHs, and PCBs were detected in subsurface soils
SB6 (24 in)	98786.66	1291762.36	Near MW6-15, where elevated lube oil was detected in subsurface soils
Surface Sediment Grab Designations (proposed depth)[b]	**Northing**	**Easting**	**Location and Rationale[c]**
SG1 (10 cm)	99562.61	1291564	Within the stormwater pond, south of MW2-15 where elevated cPAHs were detected in subsurface soils
SG2 (10 cm)	99313.34	1291417.43	Within Wetland F (stormwater ditch), west of GP13-15 where elevated lead and cPAHs were detected in subsurface soils
SG3 (10 cm)	98949.06	1291441.52	Adjacent to Wetland F (stormwater ditch), near GP19-15 and PP-33 where elevated cPAHs and lube oil, respectively, were detected in subsurface soils
SG4 (10 cm)	98797.57	1291465.92	North of Wetland A, near GP21-15 where elevated cPAHs were detected in subsurface soils
SG5 (10 cm)	98706.83	1291535.46	Within Wetland A, near GP21-15 where elevated cPAHs were detected in subsurface soils
SG6 (10 cm)	98675.54	1291647.73	At far south end of MTCA Site boundary to fill a data gap for surface soils
SG7 (10 cm)	98741.12	1291798.86	At edge of Wetland B and MTCA Site boundary, near MW6-15 where elevated lube oil was detected in subsurface soils
SG8 (10 cm)	98838.0	1291890.19	Within Wetland B at edge of MTCA Site boundary to fill a data gap for surface soils
SG9 (10 cm)	98907.34	1291948.76	At edge of Wetland B and MTCA Site boundary, southeast of PP-23 and GP16-15 where elevated lead, cPAHs, and PCBs were detected in subsurface soils
SG10 (10 cm)	99368.46	1292231.07	North of Wetland B, near PP-16 where elevated lead, lube oil, and cPAHs were detected in subsurface soils

a 24 inch depth for all soil borings (SB samples), including discrete sampling and analysis for the two vertical 1-foot intervals (i.e., 0 to 1 foot and 1 to 2 feet; see discussion in text).

b 10 cm depth for all sediment grab (SG) samples; see discussion in text.

c Refer to Figure 2 for specific proposed locations of soil boring (SB) and sediment grab (SG) locations.

The soil and sediment sampling design satisfies the key requirements of the site-specific TEE and FS including:

- Spatial distribution of sample locations
- Appropriate depths for both soil borings and freshwater aquatic sediment grabs, which are reflective of zones of biological activity, where vulnerable ecoreceptors are most likely to be present
- Robust number of samples adequate to characterize surface soils and freshwater aquatic sediment throughout the site
- Appropriate representation of metal and organic COPECs
- Defensible PQLs/MDLs for all COPECs that will be toxicologically meaningful and useful for ecological protections
- Appropriate protection of key terrestrial and sediment-dwelling ecological receptors
- Appropriate levels of QA/QC to ensure that all data collected will be adequate to satisfy their intended uses

4.2. COPECs to be Analyzed

Section 3.2 focused on identifying COPECs requiring analysis in surface soils/sediments, and Table 1 provides a list of the COPECs. As described in Section 3.2, a conceptual site exposure model was developed based on existing data, including soil, groundwater, surface water, and soil vapor monitoring, and this list of COPECs will address each of these potential exposure pathways. The sources of COPCs identified in the RI and SRI reports consisted of fill soil, consistently containing metals (especially lead), cPAHs, and trace levels of semi-volatile hydrocarbons (SVOCs), as well as trace levels of organochlorine pesticides. Fill soil mixed with refuse also indicated the presence of TPH, PCBs and VOCs. As shown on Table 1, these COPECs will be carried forward and addressed in the site-specific TEE.

Based on these findings, the suites of COPECs to be sampled and analyzed, including their formal EPA or other method designations, include:

- PAHs by EPA Method 8270D SIM
- Semi-volatiles by EPA Method 8270D
- Chlorinated pesticides by EPA Method 8081A
- PCB Aroclors by EPA Method 8082

- NWTPH-Gx (PID and FID) by Method 8015M
- NWTPH-Gx by GC/MS
- MTCA metals by EPA Methods 6010D/7471B (mercury only)

Soil Toxicity Bioassays. In the event that chemical results are elevated above TEE values and would warrant soil or sediment bioassay testing to derive chemical-specific soil or sediment benchmark values, additional volume of soil or sediment would need to be collected. The soil or sediment bioassays to be considered would include the following bioassays, each of which is widely accepted by Ecology:

- For soils, a 14-day chronic earthworm test (*L. terrestris*) test for soil toxicity (Ecology 1996a)
- Also for soils, a 14-day early seedling growth test (e.g., *Lactuca* sp., for lettuce) for plant toxicity (Ecology 1996b)
- For freshwater sediments, widely accepted acute tests would include a daphnid (usually *D. magna*) or midge larva (e.g., *C. tentans*)
- A chronic test (e.g., using a 7-day exposure to the daphnid *C. dubia*)

Any or all these tests could be conducted to determine site-specific acute or chronic toxicity for Site soils or sediments and could be instrumental in calculating site-specific soil or sediment benchmark values to be adopted in the final TEE.

Bioaccumulation testing was also considered (e.g., the 28-day earthworm bioaccumulation test; ASTM Method 1767-04), but in light of site data indicating insignificant or negligible potential for bioaccumulation from COPECs, additional material for bioaccumulation testing was not regarded as necessary and will not be collected. The decision on whether to run any of these additional soil toxicity bioassays will be based on potential exceedance of soil SSL or sediment SMS values (shown on Table 1), and made in accordance with Ecology recommendations and guidelines.

4.2.1. Data Quality Assurance and Analysis

The analytical laboratory to be used for the surface soil samples will be the same as the laboratory used for the RI and SRI, which is OnSite Environmental Laboratory, a Washington-State and Ecology-accredited laboratory. Example laboratory reports and chain of custody forms are provided in Appendix C, and data quality assurance review will be completed by Herrera for all analyses performed. Data will be verified and validated based on the following:

- Sample custody, preservation, holding times, and completeness
- Laboratory reporting limits

- Method blank analysis
- Laboratory control sample analysis
- Surrogate compound analysis
- Matrix spike analysis
- Laboratory duplicate analysis

Table 3 below summarizes the requirements for containers, storage, and holding times for each parameter to be tested.

Table 3. Requirements for Containers, Storage, and Holding Times for Specific Analytical Methods, Pacific City Park TEE.

Parameter	Method	Container/Preservative and Storage	Holding Time
ORGANICS			
PAHs	EPA 8270	One 4-ounce clean wide-mouth jar (CWM), ≤6°C	14 days to extract, 40 days to analyze after extraction
Chlorinated Pesticides	EPA 8081	One 4-ounce CWM, ≤6°C	14 days to extract, 40 days to analyze after extraction
PCBs	EPA 8082	One 4-ounce CWM, ≤6°C	None
PETROLEUM HYDROCARBONS			
Gasoline-Range Organics	NWTPH-Gx	One 4-ounce CWM, ≤6°C field preservation kit	14 days to analyze
Diesel-and Lube-Oil Range Organics	NWTPH-Dx	One 4-ounce CWM, ≤6°C	14 days to extract, 40 days to analyze after extraction
TRACE METALS			
Metals (except Mercury)	EPA 6010/6020	One 4-ounce CWM, ≤6°C	6 months to analyze
Mercury	EPA 7471	One 4-ounce CWM, ≤6°C	6 months to analyze

4.2.2. Soil Sampling Protocols

As discussed above, a total of 22 surface soil borings and freshwater sediment grab samples will be collected from the Site and submitted to the analytical laboratory (i.e., two samples each from the six soil borings and one sample each from the sediment grabs). All sampling procedures will be conducted in accordance with the Sampling and Analysis Plan (Herrera 2018a), which was used for all previous soil collection activities. All standard protocols and procedures will be followed to ensure that data quality and integrity is maintained during each step of sampling, analysis, and data interpretation.

5. PROJECT PERSONNEL AND SCHEDULE

5.1. PROJECT SCHEDULE

The anticipated project schedule for sampling, analysis, and completing the site-specific TEE is as follows:

October 2019: Conduct site visit with County and Ecology staff to review existing conditions.

November 2019: Submit proposed TEE Sampling Strategy Memorandum for Ecology review, followed by submittal of draft TEE SAP for Ecology review.

December 2019: Collect TEE samples at the Site and submit for laboratory analysis.

January–February 2020: Perform data validation, make decision on conducting soil toxicity bioassays, submit final TEE SAP, and begin writing draft site-specific TEE section in the FS document to support evaluation of remedial alternatives.

March 2020: Submit draft FS with site-specific TEE section to Ecology for review.

5.2. PROJECT TEAM AND RESPONSIBILITIES

Personnel involved with the TEE and their respective roles and responsibilities are listed below.

Mark Ewbank: Project Manager, general project oversight and QA
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