CLEANUP ACTION PLAN

MAURY ISLAND OPEN SPACE PROPERTY

Prepared by:

Washington State Department of Ecology

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KEY TERMS

µg/kg	micrograms per kilogram
µg/L	micrograms per liter
ARARs	applicable or relevant and appropriate requirements
bgs	below ground surface
BMPs	Best Management Practices
CAP	Cleanup Action Plan
Cleanup Unit	Maury Island Open Space property
COCs	Contaminants of Concern
County	King County
cPAHs	carcinogenic polycyclic aromatic hydrocarbons
DCA	disproportionate cost analysis
DCAP	Draft Cleanup Action Plan
ESLs	ecological screening levels
FS	Feasibility Study
IA	Interim Action
IAP	Interim Action Plan
mg/kg	milligrams per kilogram
MTCA	Model Toxics Control Act
NEBA	Net Environmental Benefit Analysis
NWI	National Wetlands Inventory
O&M	operation and maintenance
PAHs	Polycyclic Aromatic Hydrocarbons
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
SCO	Sediment Cleanup Objective
SCUM II	Sediment User's Cleanup Manual II
TEF	toxicity equivalency factors
TSP	Tacoma Smelter Plume
UCL	upper confidence level
WAC	Washington Administrative Code

EXECUTIVE SUMMARY

This Cleanup Action Plan (CAP) describes the cleanup action selected by the Washington State Department of Ecology (Ecology) for the Maury Island Open Space Cleanup Unit, Facility Site #2901216. The Cleanup Unit is located on the southeast side of Maury Island in unincorporated King County (County), Washington (Figure 1), and lies within the larger Tacoma Smelter Plume Site. The CAP is based on a Remedial Investigation (RI) and Feasibility Study (FS) prepared per the requirements of Agreed Order No. DE 8439 (dated January 31, 2013), between Ecology and King County.

The Cleanup Unit is approximately 266 acres in size and is the former location of a sand and gravel mine operated by CalPortland. The mine was located within the central portion of the Cleanup Unit, most of which is steeply sloped and all of which is now sparsely vegetated, primarily with scotch broom and Pacific madrone. The remainder of the Cleanup Unit consists of over 100-year-old forests, younger forests, blackberry patches, and sea bluffs covered in blackberries, poison oak, and Pacific madrone. The public have created a series of footpaths through the forests and utilize these, as well as former graded dirt roads, as casual walking trails (CDM Smith 2014a).

All of Maury Island lies within the plume fallout area from the former ASARCO Tacoma Smelter. The copper ores used by the ASARCO smelter contained high concentrations of arsenic and other metals. Over the years of operation, metals released from the Tacoma Smelter's smokestack, particularly arsenic and lead, were carried by wind, ultimately settling over a 1,000-square-mile area. As a result of this, surface soils within much of the Tacoma Smelter Plume (TSP) fallout area contain arsenic and lead concentrations that are many times greater than natural background concentrations. The soils on Maury Island are among those most significantly impacted from the TSP, and the Cleanup Unit itself lies within an area most greatly impacted by the TSP on Maury Island.

In June of 2014, CDM Smith Inc. (CDM Smith 2014a) completed a RI for the Cleanup Unit. The RI determined that metal concentrations in forest duff and surface soil throughout the Cleanup Unit, with the exception of recently mined areas and the beach, consistently exceed Model Toxics Control Act (MTCA) cleanup levels. Research of the Cleanup Unit's land use history identified one additional source of contamination – an area that had previously been utilized as a private skeet shooting range (Figure 6). The RI confirmed that former skeet shooting activities resulted in an area of relatively greater lead concentrations than found throughout the rest of the Cleanup Unit, as well as an area where surface soils are impacted by Polycyclic Aromatic Hydrocarbons (PAHs) from skeet shards.

In May 2014, CDM Smith completed a Net Environmental Benefit Analysis (NEBA) for the Cleanup Unit (CDM Smith 2014b.). The NEBA concluded that the bluffs and much of the upland areas are eligible for the application of NEBA because these areas contain "especially valuable habitat." Therefore, a cleanup alternative involving removal of soil

would result in greater environmental harm than an alternative of leaving the contaminated topsoil in place. Ecology concurred with the NEBA determination. Therefore, based on the NEBA, remedial alternatives developed for the Cleanup Unit additionally took into account the protection of the environment for those Units that qualify for the NEBA.

Decision units within the Cleanup Unit that did not qualify for the NEBA included three upland areas that have been cleared in the past and are now vegetated primarily with grass, blackberry bushes, and scotch broom (Units 3c, 3e, and 5; Figure 3). In the fall of 2016, Interim Action (IA) efforts were initiated by the County to clean up a 3-acre section of Decision Unit 3c. The Interim Action consisted of stripping existing vegetation and the installation of 3 inches of compost, landscaping fabric, and native shrubs and trees, to serve as a cap and physical barrier to eliminate or reduce access to soil contamination that would remain in this area consistent with the final proposed cleanup. An 8-foot deer fence was installed around the perimeter of the planting area to protect the new plants.

Following the 2014 RI and NEBA, King County conducted an additional investigation of the wetland soils/sediments in Unit 5 to document the nature and extent of impacts to indicator species from arsenic, lead, and PAHs.

In April 2017, Parametrix completed a Feasibility Study (FS) for the Cleanup Unit (Parametrix 2017). The FS developed and assessed five remedial alternatives that implement a combination of cleanup approaches including limited contaminated soil removal, soil capping, and institutional controls. The alternatives are summarized below:

- **Alternative 1 –** Closure of selected trail spurs. Capping the entire network of forest footpaths. Excavating soils on roads/trails that exceed cleanup levels. Excavating contaminated surface soils in areas that do not pass the NEBA.
- **Alternative 2 –** Same as Alternative 1, except that soils will be contained below grade in two separate areas that did not pass the NEBA, one of which will be capped by a visitor parking lot to be constructed in the portion of the former trap range area that does not pass the NEBA.
- **Alternative 3 –** Closure of selected trail spurs. Capping the entire network of forest footpaths. Conducting soil mixing for soils cleanup levels. In the portion of the former trap range area (Unit 5) that does not pass the NEBA, strip off the organic layer and cap with gravel for use as an equestrian parking lot. Soils in the other two areas that do not pass the NEBA (Decision Units 3c and 3e) will be left in place because both of these areas are heavily vegetated with blackberry bushes and virtually impassible by humans.

- **Alternative 4 –** Same as Alternative 3, except that capping of the footpaths will be limited to a main thoroughfare.
- **Alternative 5 –** Modification of Alternative 4 including revegetation of Units 3c and 3e. Cap graded roads with a minimum of 3 to 4 inches of compacted gravel and a 3-inch-thick layer of mineral soil (or equivalent) to protect a horse's hooves and a dog's feet. In Unit 5, clearing and grubbing will only be performed for an area large enough to construct a 40-to-50-stall gravel parking lot. The cleared area will be graded and a gravel parking lot and driveway will be constructed by placing a minimum of a 6-inch-thick layer of compacted gravel. A post and rail perimeter fence backed by thorny native species will be placed around the perimeter of the gravel parking lot and driveway to discourage visitors from walking into the former skeet range area. Limited remediation in the adjacent wetland will be done where lead exceeds allowed levels.

The result of the FS was selection of Alternative 5 as the preferred alternative. The FS was approved by Ecology on May 18, 2017. This CAP sets out the evaluation and selection of Alternative 5 as the selected cleanup action for the Cleanup Unit, and addresses implementation of the proposed cleanup action, establishing institutional controls, and conducting long-term monitoring to ensure the ongoing effectiveness of the cleanup.

1. INTRODUCTION

This Draft Cleanup Action Plan (CAP) describes the cleanup action selected by the Washington State Department of Ecology (Ecology) for the Maury Island Open Space Cleanup Unit, Facility Site #2901216. The Cleanup Unit is located on the southeast side of Maury Island in unincorporated King County (County), Washington (Figure 1), and lies within the larger Tacoma Smelter Plume Site. The CAP is based on a Remedial Investigation (RI) and Feasibility Study (FS) prepared per the requirements of Agreed Order No. DE 8439 (dated January 31, 2013), between Ecology and King County (CDM Smith 2014a; Parametrix 2016).

1.1 Purpose

This CAP was completed per the Agreed Order and Washington Administrative Code (WAC) 173-340-380, Model Toxics Control Act (MTCA) (Ecology 2007). The purpose of the CAP is to present a general conceptual-level description of the preferred cleanup actions developed under the RI/FS. MTCA requires a CAP to include:

- A summary of RI/FS and IA activities performed at the site.
- Applicable state and federal laws for the proposed cleanup action.
- Cleanup standards for each hazardous substance and each medium of concern.
- A brief summary of the other cleanup alternatives evaluated in the RI/FS.
- A description of the proposed cleanup action.
- A description of the required institutional controls, types and concentration of contaminants left on site, and measures that will be used to prevent contact with these substances.
- A schedule for implementation of the proposed cleanup action.

2. SUMMARY OF CLEANUP UNIT CONDITIONS

2.1 Cleanup Unit Description and History

The Cleanup Unit consists of a 266-acre property located on the southeast side of Maury Island on a sea bluff overlooking Puget Sound. Until 2010 when King County purchased the property, CalPortland operated a sand and gravel mine on the property. The most recent mining operations had been centrally located within the area referred to as the "South Pit." Currently, there are some mine-associated above-and-below-ground conveyor structures existing on the property. A partially reconstructed dock is located at the base of the South Pit. To the northeast of the South Pit is another abandoned gravel pit, referred to as the "North Pit," which had operated in the early 1900s. Most recently mined areas of the South Pit are sparsely vegetated, typically with scotch broom, sparse grasses, seedling Pacific madrone, and blackberry bushes. The North Pit is predominately vegetated with scotch broom, sparse grass, and a few mature trees (Pacific madrone, maple, and Douglas fir).

The majority of the upland areas are undisturbed by mining and covered by mature and semi-mature forest, which includes Pacific madrone, Douglas fir, Red alder, Black cottonwood, Western hemlock, and maple with an understory that includes salal, various ferns, huckleberry, Oceanspray, and Oregon grape. The exceptions to this are an area north of SW 260th Street that was once used as a private skeet range and an area in the northeast corner of the Cleanup Unit; these areas are predominantly covered by blackberry bushes. Large stands of blackberry bushes and scrubby vegetation, such as poison oak, Himalayan blackberries, and scotch broom, cover the sea bluffs. A beach extends along the base of the bluff. The portion of property north of SW 260th Street also contains a wetland that is included in the National Wetlands Inventory (NWI).

A network of trails exists throughout the Cleanup Unit consisting of "footpaths" and "graded roads," which were assessed during the RI. Footpaths consist of the meandering trails throughout the upland forest areas, which were created over time by continued long-term use. The footpaths connect with a larger trail system that extends off the Cleanup Unit. The graded roads are specific to the Cleanup Unit. The roads were originally constructed for mine use and later abandoned. Over time, much of the former graded roads located along the bluff have become narrowed by encroaching vegetation, and in some places are completely overgrown. The graded roads located in the upland area have mostly retained a width suitable for vehicle passage and serve a dual purpose as access for emergency fire suppression. For purposes of the RI and FS discussions, the main access road into the Cleanup Unit from SW 20th Street, which extends down the South Pit to the beach, is not a part of the graded road system.

2.2 Physical Characteristics of the Cleanup Unit

2.2.1 Geologic and Hydrogeologic Conditions

The Cleanup Unit is located within the Puget Sound Lowland underlain primarily by sediments deposited during and between repeated glacial advances and retreats in the Pleistocene Epoch. The upland areas are mantled by Vashon till (a mixture of clay, silt, sand, gravel, and boulders) and recessional outwash (including stratified sand and gravel) ranging from approximately 3 to 12 feet thick. Limited perch water may be present seasonally on a discontinuous basis in areas where till is present.

Groundwater at the site occurs at depths of 20 feet below ground surface with a consistent flow direction towards the Puget Sound. Springs occur at the contact between the Vashon advance outwash and the underlying less-pervious silt and clay of the pre-Vashon unit where exposed near sea level along the beach (AESI 1998). The primary surface water feature is the Puget Sound, which forms the southeastern boundary around the Cleanup Unit at a distance of approximately 4,800 feet.

2.3 Summary of Previous Site Investigations

2.3.1 Remedial Investigation

As a part of the 2014 RI, CDM Smith researched historical land use and divided the property into various "decision units." The decision units, or more briefly referred to as "Units," divide the Cleanup Unit into recent and older mined areas (Units 2a-2c, 3e), older forest (Units 1a, 1b), more recent forests (Units 3a, 3b), a historical dairy farm (Unit 3c), sea bluffs (Units 4a-4c), and an approximately 30-acre forested property that lies north of SW 260th Street that had been utilized as a private skeet shooting range (Unit 5). The RI evaluated the following:

- Metals concentrations in forest duff, surface soil, and subsurface soil across the Cleanup Unit.
- PAH concentrations in forest duff and surface soil associated with the former skeet range.
- Metals concentrations in groundwater and spring water.
- The uptake of metals by various representative plants that grow in the Cleanup Unit.
- The natural environment, including an assessment of anthropogenic changes to the beach and subtidal area as a result of historical mining activities and a terrestrial ecological assessment and wetland survey.

2.3.2 Wetland Investigation

In 2015, King County Department of Natural Resources completed an investigation of sediments from the wetland located near the Former Skeet Range in Decision Unit 5 (King County 2016). Five surface soil samples were collected from the wetland located near the Former Skeet Range. The term "soil" is used because there are no applicable regulations articulating a definition of "wetland sediments." All soil samples were analyzed for conventional parameters, arsenic, lead, and polycyclic aromatic hydrocarbons. Bioassays were also conducted on all samples.

2.3.3 Interim Action

To coincide with available site funding, an IA was conducted in November and December 2016 to implement a portion of site work consistent with the anticipated final cleanup. During this time, limited soil contamination was removed along with existing vegetation in the 3 acres in Unit 3.

After existing vegetation was cleared, a 3-inch layer of coarse compost was placed on the ground surface to act as a physical barrier similar to a gravel cap, and also to provide nutrients and mulch. Temporary landscaping fabric was placed over the compost for plant establishment. Trees and shrubs were densely planted at 4-foot on center through the fabric and compost. The density of the shrubs and trees was designed specifically to limit access to recreational users, as well as to provide beneficial ecological habitat.

An 8-foot-tall deer fence was constructed using timber posts and galvanized steel mesh fencing to protect the plants during establishment. The fence also discourages human access while the plants mature. Plants will be watered using a pressure fed drip irrigation system until the plants become established and no longer require watering.

Consistent with WAC 173-340-430, the IA reduced a threat to human health or the environment by implementing in advance a portion of the final cleanup proposed in this CAP.

2.4 Summary of Environmental Conditions

2.4.1 Soil

Summary statistics for arsenic, lead, and PAHs by decision units property-wide (excluding trails and roads), on trails, and on roads are provided in Table 1 through Table 4. Contaminants that currently exceed cleanup levels in duff and surface soil samples are described below. See Section 3.1 for a discussion of cleanup levels.

Contaminants Exceeding Cleanup Levels:

- Arsenic: Up to 2,600 mg/kg and 2,550 mg/kg in duff and surface soil, respectively (Table 1),
- Lead: Up to 2,600 mg/kg and 2,520 mg/kg in duff and surface soil respectively (Table 2), and
- PAHs (based on benzo(a)pyrene: Up to 112,617 µg/kg in forest duff (Table 4).

Cadmium did not exceed cleanup levels in surface soil samples.

Overall, metal concentrations decline rapidly with depth. The data suggests that when subsurface soils (i.e., 9 inches and deeper) contain elevated metals concentrations, it is because of physical transport mechanisms other than leaching, such as fill, inexact sampling practices that may have caused cross contamination from surface soils, and/or bioturbation (soil disturbance due to organismal movement) (CDM Smith 2014a.).

The beach sands are not contaminated. This is because of the low cation exchange capacity of sand (the result is that the metals have very little ability to adsorb to the sand), combined with the constant movement of beach sands. Samples were collected at the bluff face at the edge of the beach and from slough accumulations along the base of the bluff. Arsenic concentrations ranged from 1.8 to 27 mg/kg. Lead concentrations ranged from 1.5 to 31 mg/kg.

The skeet range was inspected for the presence of shards and an area of shards were identified just to the north and east of the eastern trap station. Samples were collected from this area, specifically for PAH analysis. Several of the prior sample locations were inspected for the possible presence of shot in forest duff and soil. Shot was confirmed at most of the locations, although sometimes it was difficult to ascertain shot from small gravel due to the discoloration that occurs with weathering. These observations substantiate the premise that the relatively higher lead concentrations in a portion of Unit 5 are the result of historical skeet shooting activities (Parametrix 2017).

2.4.2 Groundwater

The results of spring water sampling conducted for the RI and historical sampling data from seeps and on-site observation wells demonstrate that groundwater and spring water have not been impacted by metals and that ingestion of impacted groundwater is not a potential human exposure pathway at the site (Parametrix 2017). Groundwater was not evaluated for the presence of PAHs during the RI because these hazardous substances were not identified as contaminants of concern (COCs) for groundwater.

2.4.3 Wetland Soil

Arsenic and lead in most of the wetland soil samples exceeded cleanup screening levels and toxicity was observed in some of the bioassays. The bioassay toxicity appeared to be primarily related to elevated lead levels, but not related to arsenic.

2.5 Human Health and Environmental Concerns

2.5.1 Human Health

The potential human exposure pathways at the Cleanup Unit include: direct contact with soil/sediment; ingestion of soil particles; inhalation of soil particles; ingestion of water (groundwater/spring); ingestion of vegetation; and ingestion of marine organisms exposed to COC.

The primary transport pathways of COCs include: leaching of contaminants from soil to groundwater; discharge of groundwater to surface water; erosion of soil as a result of bluff failures; windblown dust; and via physical transport, such as may occur when soil adheres to pet hair and shoes.

Soil: Because the current and future use of the Cleanup Unit is for passive recreation (e.g., primarily open space with walking trails), the primary concern for human health is direct exposure to contaminants in surface soil and duff. This may include skin contact, direct ingestion by hand-to-mouth contact, or inhalation. The COCs have a low risk of being a skin irritant. The primary risk of exposure is through incidental ingestion as a result of hand to mouth contact, such as from soil particles sticking to clothing, body parts, and pet fur. Children (and sometimes adults in instances of pica disorder) frequently ingest soil directly. Inhalation via dust may be significant if motorized off-road vehicles were to use the property. Bikes and horses may also tend to kick up dust, but to a much lesser extent.

Groundwater: Groundwater is not currently used at the site nor is it likely to be under any potential future site use scenario. In addition, as stated previously, groundwater was not found to be impacted by site contaminants.

Vegetation: Plants growing in metals-enriched soils have an uptake of metals that is greater than in areas not impacted by the TSP. The primary concern of metals in vegetation would be from ingestion. While increased metals uptake in blackberries appears to be relatively low, the significance of this would need to be evaluated with regard to the degree of consumption (CDM Smith 2014a).

Surface Water/Sediment: Risks posed as a result of ingestion of marine organisms appears low as the Puget Sound is not being impacted by metals originating from the Cleanup Unit.

2.5.2 Terrestrial Receptors

MTCA requires evaluation of existing or potential threats to terrestrial plants or animals exposed to hazardous substances. During the RI, conservative ecological screening levels (ESLs) for soil and forest duff were developed from MTCA and other sources. The ESLs were then compared to the 95-percent upper confidence level (UCL) calculated for arsenic, lead, cadmium, and PAHs in soils and forest duff. If the 95-percent UCL concentration exceeded the ESL, the hazardous substance is considered a chemical of ecological concern that may result in ecological risk. Based on the screening (CDM Smith 2014a), arsenic and lead remain chemicals of ecological concern across the Cleanup Unit, but cadmium does not. Multiple PAH are chemicals of ecological concern within a portion of Unit 5.

While these results indicate that the COCs at the Cleanup Unit may pose a threat to the terrestrial environment, terrestrial ecological evaluation procedures should not create an incentive to cause harm through destruction of habitat. WAC 173-340-7490(5) states: "The department may require additional measures to evaluate potential threats to terrestrial ecological receptors notwithstanding the provisions in this and the following sections, when based upon a site-specific review, the department determines that such measures are necessary to protect the environment." (Ecology 2007). The NEBA is a procedure of weighing the advantages of an active cleanup versus the impact that the cleanup might have on potentially valuable ecological receptor habitat.

In May 2014, CDM Smith completed a NEBA for the Cleanup Unit (CDM Smith 2014b.). The NEBA concluded that the bluffs and much of the upland areas are eligible for the application of NEBA because these areas contain "especially valuable habitat." Therefore, a cleanup alternative involving removal of soil would result in greater environmental harm than an alternative of leaving the contaminated topsoil in place. Decision units within the Cleanup Unit that did not qualify for the NEBA included three upland areas that have been cleared in the past and are now vegetated primarily with grass, blackberry bushes, and scotch broom (Units 3c, 3e, and 5; Figure 3). Ecology concurred with the NEBA determination. Therefore, based on the NEBA, remedial alternatives developed for the Cleanup Unit additionally took into account the protection of the environment for those Units that qualify for the NEBA.

3. CLEANUP REQUIREMENTS

3.1 Cleanup Levels

Applicable cleanup levels were established during the RI/FS and are discussed below.

3.1.1 Human Health

3.1.1.1 Soil

The Final Interim Action Plan (IAP) for the Tacoma Smelter Plume (Ecology 2012) established that the MTCA Method A soil cleanup levels for unrestricted land use are applicable within the TSP. As the Cleanup Unit falls within the TSP, MTCA Method A cleanup levels are applicable. Because forest duff is an integral part of the soil matrix, Method A cleanup levels also apply to forest duff. The IAP also determined that arsenic and lead cleanups driven by TSP will also address all other hazardous substances from the smelter emissions. This is because, while other metals sometimes exceed MTCA cleanup levels, the frequency of this is much less. The Method A unrestricted land use soil cleanup levels are 20 mg/kg for arsenic and 250 mg/kg for lead.

The Method A cleanup level for PAHs is based on the toxic equivalency method with the Method A cleanup level for benzo(a)pyrene (0.1 mg/kg) being the basis for comparison. For this method, toxicity equivalency factors (TEF) are used to calculate the toxicity of individual cPAH on an equivalent basis with benzo(a)pyrene. The adjusted concentrations are then summed and compared to the Method A cleanup level for benzo(a)pyrene.

3.1.1.2 Water

There are various drinking water and marine criteria for metals in addition to Method A, including the National Toxics Rule criteria, state groundwater and drinking water standards. Under MTCA, the cleanup standards are based on the most stringent of all regulatory standards or background, whichever is greater. Since the MTCA Method A standard for arsenic is based on background for Washington State, the groundwater cleanup standard defaults to Method A, which is 5 µg/L. For cadmium, the lowest of the groundwater and marine standards is Method A, which is 5 µg/L. For lead, the lowest value is the chronic marine standard for protection of aquatic life, which is 8.1 µg/L. None of these standards were exceeded for groundwater or spring/seep water, so no remedial actions are required for groundwater or spring/seep water.

3.1.2 Terrestrial Ecological

3.1.2.1 Soil

The NEBA concluded that cleanup alternatives involving removal of soil in Units 1a, 1b, 2c, 3a, 4a, 4b, 4c, and a portion of 5 would result in greater environmental harm than an alternative of leaving the contaminated topsoil in place. Therefore, the remedial alternatives developed for the Cleanup Unit considered the protection of the environment for those Units regardless of the arsenic and lead concentrations.

3.1.2.2 Wetlands

Wetland areas that are inundated for more than six or more consecutive weeks per year are regulated under WAC 173-204 (Sediment Management Standards) and should therefore be assessed for toxicity using the Sediment User's Cleanup Manual II (SCUM II). The bioassay analyses conducted for the wetland located in Decision Unit 5 found elevated lead levels as the primary concern. The NEBA already concluded that the non-inundated areas of Decision Unit 5 are applicable for the application of NEBA because these areas contain "especially valuable habitat". For inundated wetland areas, WAC 173-204-560 establishes initial sediment cleanup levels Sediment Cleanup Objective (SCO) of 360 mg/kg for lead in freshwater. An upward adjustment can be made to the SCO of 360 mg/kg (Pb) if it can be shown that by achieving the SCO there will be a net adverse environmental impact on the aquatic environment. However, the limitation is that the upward adjustment may not exceed the Cleanup Screening Level of >1,300 mg/kg

For this reason, inundated wetland areas under 1,300 mg/kg would not be proposed for remediation because, similarly to the terrestrial habitat, it would do more harm to the habitat than good. For areas over 1,300 mg/kg, some level of remediation is required. The soil and duff samples taken as part of the RI and bioassay analysis show that only a portion of the inundated wetland area exceeds this threshold for lead, and in those areas that do exceed the threshold, the high lead levels are primarily found in the upper forest duff layer, not in the soil.

3.2 Points of Compliance

Under MTCA, (WAC 173-340-740(6)), the standard point of compliance for protection of human health from direct contact is 15 feet below ground surface (bgs). The regulation states that this represents a reasonable estimate of the depth of soil that could be excavated and distributed to the soil surface as a result of redevelopment activities. The standard point of compliance for protection of ecological receptors is 6 feet bgs.

As determined during the RI, the contaminants in the Cleanup Unit typically were within the top 24 inches, unless contaminants occur in fill. Therefore, the standard point of compliance for the Cleanup Unit is the maximum depth of contamination. However, MTCA regulations allow for a conditional point of compliance in instances where

cleanup actions involve containment of contaminants, such as use of soil capping. In these instances, the cleanup action may be determined to comply with MTCA standards provided that:

- Cleanup actions are permanent, to the extent feasible;
- Cleanup actions are protective of human health and terrestrial ecological receptors;
- Institutional controls are implemented to protect the integrity of the cleanup actions;
- Compliance monitoring and periodic reviews occur; and,
- The types, levels, and amount of hazardous substances remaining on-site and the measures that will be used to prevent migration and contact with those substances are specified in the Draft Cleanup Action Plan.

3.3 Applicable Regulatory Requirements

Cleanup actions under MTCA (WAC 173-340-710(1)) require the identification of all applicable or relevant and appropriate requirements (ARARs). These requirements are defined as:

> "Applicable" requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a Cleanup Unit.
>
> "Relevant and appropriate" requirements means those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a Cleanup Unit, address problems or situations sufficiently similar to those encountered at the Cleanup Unit that their use is well suited to the particular Cleanup Unit.

The potential ARARs for the Cleanup Unit include three types: chemical-specific, location-specific, and action-specific. Potential ARARs were identified for each medium of potential concern in Table 7.

4. ALTERNATIVES CONSIDERED AND BASIS FOR REMEDY SELECTION

4.1 Alternatives Development

Five remedial cleanup alternatives were investigated and evaluated as part of the FS (Table 5). Appendix A provides detailed cost estimates for each of the proposed alternatives summarized below.

Alternative 1 – Closure of redundant trail spurs. Capping the entire network of forest footpaths per the US Forest Service guidelines. Excavating soils on the graded road/trail that exceeds 40 mg/kg and regrading the road. Excavating contaminated surface soils in all areas that do not pass the NEBA (Figure 7). All excavated soils to be disposed of off-island in a Resource Conservation and Recovery Act (RCRA) Subtitle D landfill.

- Capital Cost: $8,422,304
- O&M Cost: $1,012,053
- **Total Cost: $9,434,357**

Alternative 2 – Alternative 2 is the same as Alternative 1, except that soils will be contained below grade in two separate areas (which did not pass the NEBA), one of which will be capped by a visitor parking lot to be constructed in the portion of the former trap range area that does not pass the NEBA (Figure 7).

- Capital Cost: $5,552,168
- O&M Cost: $1,012,053
- Total Cost: **$6,564,221**

Alternative 3 – Closure of redundant trail spurs. Capping the entire network of forest footpaths per the US Forest Service guidelines. Conducting soil mixing for soils on the graded road/trail that exceed 20 mg/kg and regrading the road. In the portion of the former trap range area that does not pass the NEBA, the organic layer will be stripped off and disposed of at an off-island landfill and capped with gravel for use as an equestrian parking lot. Soils in the other two areas that do not pass the NEBA will remain because both of these areas are heavily vegetated with blackberry bushes and virtually impassible by humans (Figure 8).

- Capital Cost: $2,137,495
- O&M Cost: $187,607
- Total Cost: **$2,325,102**

Alternative 4 – Alternative 4 is the same as Alternative 3, except that capping of the footpaths will be limited to a main thoroughfare (Figure 9).

- Capital Cost: $1,600,844
- O&M Cost: $149,835
- Total Cost: **$1,750,679**

Alternative 5 – Modification of Alternative 4 including revegetation of Units 3c and 3e including limited wetland remediation in Unit 5. Graded roads will be capped with a minimum of 3 to 4 inches of compacted gravel and a 3-inch-thick layer of mineral soil (or equivalent). In Unit 5, clearing and grubbing will only be performed for an area large enough to construct a 40-to-50-stall gravel parking lot. The cleared area will be graded and a gravel parking lot and driveway will be constructed by placing a minimum of a 6-inch-thick layer of compacted gravel with a perimeter fence (Figure 10).

- Capital Cost: $4,324,182
- O&M Cost: $1,244,767
- **Total Cost: $5,568,949**

4.2 Evaluation of Alternatives

The five remedial cleanup alternatives were evaluated according to the process described in WAC 173-340-360 in order to determine if the alternatives met the minimum requirements for cleanup actions. The results of the evaluation are provided below.

4.2.1 Threshold Requirements

MTCA's threshold requirements for cleanup actions are described in WAC 173-340-360, which states that all cleanup actions shall:

- Protect human health and the environment.
- Comply with cleanup standards.
- Comply with applicable state and federal laws.
- Provide for compliance monitoring.
- Use permanent solutions to the maximum extent practical.
- Provide for a reasonable restoration time frame.
- Consider public concerns.

4.2.1.1 Protection of Human Health and the Environment

Overall protectiveness of human health and the environment includes the degree to which existing risks are reduced, time required to reduce risk at the site and attain

cleanup standards, and improvement of the overall environmental quality. Each of the remedial alternatives was developed to strike a balance between protection of human health and the environment. Currently, there are no viable technologies that will remove the metals that exist in the surface soil and duff layer (which is the most biologically active zone in the soil profile) without causing irreparable harm to the existing forest biological system. However, the NEBA demonstrated that, in spite of the high concentrations of metals in the surface soil and duff layer, the site ecology is functioning well with no apparent adverse effects. The following provides an evaluation of the alternatives by the various Cleanup Unit features addressed:

- *Forest Footpaths* – Alternatives 4 and 5 differ from Alternatives 1 through 3 (which are the same) in that a main thoroughfare is capped as opposed to the entire trail system. Having a main thoroughfare tends to encourage the majority of trail users to utilize a specific trail system. The main thoroughfare will be particularly appealing to users with young children (the most sensitive population) for its ease of use. People who frequent a site routinely (e.g., daily jogs or dog walks) tend to be habitual and will follow the same route—the main thoroughfare makes it convenient. With one main thoroughfare, the Parks personnel can focus their maintenance efforts more effectively. Between a capped main thoroughfare for the forest footpath system and the remediation of the graded roads, the additional protectiveness afforded by capping all the forest footpaths versus a main thoroughfare is minimal.
- *Graded Roads* – All of the alternatives will ultimately provide the same level of protection. The only differences are in how the cleanup levels are achieved. It is likely the relatively minor and sporadic cleanup level exceedances found on the graded roads are mainly caused by contaminated soil being conveyed onto the roads from adjacent areas. Since these cleanup level exceedances are sporadic and fairly minor, this does not appear to be occurring on a significant scale. For Alternatives 1 through 4, continued maintenance of these roads through regrading should keep arsenic concentrations below the cleanup level. For Alternative 5, protectiveness is maintained by long-term maintenance of the gravel cap.
- *Former Range Area* – Alternatives 1 through 4 ultimately provide the same level of protection by ultimately achieving Method A cleanup levels at the ground surface where there is a potential for exposure. Alternative 5 provides a similar level of protection by providing a physical barrier (the perimeter fence) between the gravel capped parking lot and the remainder of the former skeet range area.
- *Units 3c and 3e* – While Alternatives 1 and 2 provide for the removal of contaminants and provide for off-site disposal or on-site containment, these units are already covered by blackberry bushes, which provide an effective deterrent for human encroachment. People may pick the blackberries (which were determined not to uptake arsenic and lead to any significant degree), but they do

so from the edges of the graded roads. The brambles are much too dense for people to forage into. In addition, the institutional controls imposed on the Cleanup Unit would ensure that these areas are not disturbed in the future for purposes other than long-term restoration of natural habitat (Alternative 5), which could eventually transform these areas into more productive wildlife habitat and inclusion under the NEBA. Finally, these areas do not contain features that would encourage off-trail excursion, even in the absence of blackberry bushes. For this reason, removal of contaminants in these areas is not, in all practicality, any more protective than simply leaving it as is (Alternatives 3 and 4) or revegetating the units with native plants (Alternative 5). Alternative 2 is the only one that provides for on-site containment of excavated soil. The plan to inter this soil below grade virtually eliminates any potential human health and environmental exposure. For the reasons described above, none of the alternatives afford a strongly greater or lesser overall protection of human health and the environment.

4.2.1.2 Compliance with Cleanup Standards

There is only one type of remedial action that would result in full compliance with cleanup levels across the Cleanup Unit, and that would be to remove all vegetation and scrape off the forest duff and surface soil layer and dispose of it. Obviously, this is not only impractical, it is also inconsistent with the NEBA. Therefore, the primary objective of the remedial alternatives is to reduce park users' exposures to metals to acceptable risk levels.

Each of the alternatives includes actions that will reduce the potential for human exposures in areas that are frequented by park users (i.e., the trail system of footpaths, graded roads, the former trap range area) either by capping or soil mixing (with or without some soil removal). These methods are all consistent with the TSP Model Remedy, where proposed, soil mixing is used only minimally, in that it applies only to small sections of the graded roads where it is likely that the layer of contaminated soil is very thin, and in the former trap range area to further reduce contaminant concentrations following removal of the bulk of contaminated material, which is the organic zone.

Alternatives 1 and 2 result in the greatest amount of land that will meet Method A cleanup levels because these two remedial alternatives include cleanup of all areas that do not pass the NEBA. However, for Units 3c and 3e, practically speaking, there is no significant reduction in potential human exposure by the removal of surface soils in these areas because of the thick blackberry brambles cover, which effectively discourages human trespass, particularly when there is nothing in these blackberry-covered areas that would cause people to wander off trail.

4.2.1.3 Compliance with State and Federal Laws

All of the laws discussed in Section 3.4 that need to be satisfied during implementation (e.g., grading permits, dust control, stormwater discharge Best Management Practices [BMPs] during construction, soil profiling before off-site disposal) can and will be satisfied for all of the remedial alternatives.

4.2.1.4 Compliance Monitoring

Compliance monitoring must be performed such that protection of human health and the environment can be confirmed during implementation of the remedial alternative and that cleanup levels or remediation levels have been attained at completion of the cleanup action, as may be applicable, and that the engineering design specifications are being met. All of the alternatives will include several forms of compliance monitoring appropriate to the individual technologies being applied. Confirmation sampling will be conducted as a part of any of the remedial actions that involve excavation and/or soil mixing to ensure that cleanup levels are being met. Health and safety compliance monitoring includes monitoring during excavation activities to ensure that any necessary actions to control discharges of dust are taken before it poses a potential health/environmental issue. Finally, compliance monitoring will be conducted to ensure that the constructed portions of the remedial alternatives will meet design specifications (e.g., gravel caps).

A compliance monitoring plan will govern activities necessary to ensure continued environmental performance after the cleanup. The plan will address sampling requirements and appropriate intervals necessary to maintain compliance with cleanup standards. For example, on a regular basis, organics will be blown off the trail cap regularly and its condition inspected. Monitoring for and removal of any new-hoc social trails will continue. All necessary repairs to the trail cap will be made promptly.

4.2.1.5 Permanence

None of the remedial alternatives can offer a full cleanup, and contaminants will remain throughout much of the upland areas and bluffs for every alternative. Soil excavation and disposal, while it is the only permanent method of cleaning up metals in any given area of the Cleanup Unit, does not in any way reduce toxicity, mobility, or volume of the hazardous substance. It simply moves the contaminant from one place to another, but to an area where the potential for human health and ecological exposure is no longer a consideration. Even so, there is no guarantee that, once any individual area has been cleaned up to Method A cleanup levels, whether by capping or excavation, it will remain completely free of contaminants. Natural processes, including the shedding of foliage (i.e., Douglas fir needles), burrowing and migratory animals, human traffic, and windblown dust will tend to move top soils. Some soils containing high concentrations of metals, are likely to end up in areas that have been previously excavated and capped.

4.2.1.6 Restoration Time Frame

Alternative 4 will require the least amount of time to implement, with Alternatives 3, 5, 2, and 1 requiring successively greater amounts of time to implement. The construction phase of Alternative 1 is estimated to require 10 months to complete due to the inefficiency of trucking soil off island for disposal. Alternatives 1, 2, and 5 will require many years in order to re-establish vegetation in Units 3c and 3e.

4.2.1.7 Consideration of Public Concerns

This criterion includes concerns from individuals, community groups, local governments, tribes, federal and state agencies, or any other organization that may have an interest in or knowledge of the site. While the potential public concerns are difficult to predict, it is known that the public has a strong interest in maintaining this property as a natural park. The public have been using the Cleanup Unit as a park for decades, well before King County purchased the property, and have been educated regarding the presence of arsenic and lead in surface soils as a result of the TSP. It was due to the vehement objections of the public over the proposed mine expansion that King County ultimately decided to purchase the property. Based on this, it is evident that: a) the public is not overly concerned about possible adverse health impacts, and b) would object vehemently about any actions that would interrupt their continued enjoyment of the property.

4.3 Disproportionate Cost Analysis

MTCA specifies that preference be given to cleanup actions that use permanent solutions to the maximum extent practicable. Identifying an alternative that is permanent to the maximum extent practicable requires weighing the costs and benefits of each, which under MTCA is known as a disproportionate cost analysis (DCA). According to MTCA, "costs are disproportionate to benefits if the incremental costs of the alternative over that of a lower cost alternative exceed the incremental degree of benefits achieved by the alternative over that of the other lower cost alternative" (WAC 173-340-360(3)(e)(i)). The following factors are used in the disproportionate cost analysis:

- Protectiveness.
- Permanence.
- Long-term effectiveness.
- Management of short-term risks.
- Technical and administrative implementability.
- Consideration of public concerns.
- Cost.

Table 6 lists the evaluation criteria described above and provides a numeric ranking from 1 to 6 for each criterion for each alternative. Scores range from 1 to 6. In general, a score of 1 represents poor performance and a score of 6 represents optimal performance for that metric. The alternatives do not necessarily cover the full range of numbers. The scoring of the benefit of each metric for each remedial alternative is somewhat subjective and based on best professional judgment. Each of the criteria were also weighted using percentages between 5 percent and 30 percent to emphasize the core purpose of protecting human health and the environment. The justification provided for each of the weighting values are as follows:

- "Protectiveness" represents the ultimate objective of implementing the remedial alternative, so it was weighted relatively high at 25 percent.
- "Permanence" was weighted as 20 percent. MTCA focuses on the degree that the toxicity, mobility, or volume of hazardous substances is reduced and considers the extent to which contamination is removed, rather than leaving it in place.
- "Effectiveness over the long term" addresses how well the remedy reduces risk; for example, whether the contamination is removed or left in place to be managed over the long term and whether controls are adequate to maintain protection against exposures to contamination left in place. Because of its importance, this criterion was weighted at 30 percent.
- "Management of short-term risks" considers risks incurred during the implementation of the remedial action. For most sites, this is a finite period. However, for the Cleanup Unit short-term risks are, in reality, in perpetuity due to the ongoing maintenance of the trail caps. A weighting factor of 15 percent was assigned for this criterion.
- "Technical and administrative implementability" was assigned a weighting factor of 5 percent to reflect the fact that implementability is less associated with environmental concerns than with the relative difficulty and uncertainty of implementing the project.
- "Consideration of public concerns" was assigned a weighting factor of 5 percent to reflect that most public concerns are embodied by the other criteria.

Cost was not weighted, but was used in the DCA to evaluate the benefit of each alternative relative to its cost.

Table 6, presents weighted benefit scores for the five alternatives ranging from 3.4 (Alternative 4) to 4.3 (Alternative 1). Alternatives 2 and 5 received the same score of 4.1. In accordance with the MTCA DCA procedure, the weighted benefit scores were used to rank the alternatives from most permanent (Alternative 1) to least permanent (Alternative 4). As most permanent, Alternative 1 was the baseline against which the other alternatives were compared. Alternatives 3 and 4 are the least permanent alternatives, do not provide a similar benefit as the other alternatives, and were not

considered further in the DCA. Alternative 2 scored the same as Alternative 5 but its cost is much higher and it was eliminated from further consideration under the DCA. A benefit versus cost comparison for Alternatives 1 and 5 and selection of the preferred alternative is provided below.

Alternative 1 received a slightly higher score than Alternative 5 in the evaluation of benefits shown in Table 6. However, protection of human health and reduction in health risks under each alternative are essentially the same. The much higher costs for Alternative 1 ($9,434,357) as compared to Alternative 5 ($5,568,949) are disproportionate to the marginal, if any, increase in benefit. Therefore, Alternative 5 was selected as the preferred alternative.

5. CLEANUP ACTION

5.1 Proposed Cleanup Action

The proposed cleanup action (Alternative 5) involves limited soil and vegetation removal, capping contamination that remains with compost or gravel, and revegetation to limit access.

Limited soil removal will occur in Units 3c and 3e, along with the clearing of invasive plants. The area will then be covered with 3 inches of a compost cap, and revegetated with native plants in phases every 2 to 3 years. The density of the mature native plantings will provide a physical barrier that will discourage foot traffic, and also provide especially valuable habitat through these units. The compost layer will provide a physical barrier that will reduce the potential for direct contact with underlying soils.

The work will include removal of non-historic obstructions including a chain link fence along SW 260th Street. Other structures, such as the old mining apparatus, may be completely or partially removed if it is deemed necessary for safety reasons. Any removal of structures will only be done after an appropriate health and safety plan is developed and after required data is gathered for historical documentation of the structure.

For graded roads and existing trails, instead of using soil mixing to reduce concentrations, these areas will be capped with a minimum of 3 to 4 inches of compacted gravel. A 3-inch-thick layer of mineral soil (or equivalent) will be placed on the gravel to protect a horse's hooves and a dog's feet. Temporary erosion control methods may be added over the soil, on an as needed basis, until it is compact enough to be erosion resistant.

At King County's request, the proposed cleanup involves capping all the existing maintained trails and maintenance access roads for park-use related benefits:

- It encourages trail users to utilize a specific trail system.
- It is appealing to users with young children (the most sensitive population) for its ease of use.
- It may be observed from the above that Alternative 5 provided a relatively high benefit to cost ratio as compared to other alternatives.

Institutional controls in the form of signage will be placed at trail junctions and main trail access points informing park users to stay on the maintained capped trails due to high levels of arsenic and lead in uncapped forest areas.

Benches, picnic tables, picnic shelters, signage, and kiosks will be located adjacent to the capped trails at several locations. Historical markers or signage may be added in this

area to document the farm. These amenities will be located on pads constructed of 3 to 4 inches of the same compacted gravel used for the trail cap.

In Unit 5, clearing and grubbing will only be performed for an area large enough to construct a 40-to-50-stall gravel parking lot which will accommodate both cars and equestrian trailers. Vegetation, duff, and organic topsoil removed during this operation will be disposed of at an off-site landfill. The cleared area will be graded and a gravel parking lot and driveway will be constructed by placing a cap that will be a minimum of a 6-inch-thick layer of compacted gravel.

A barrier fence will be placed around the perimeter of the gravel parking lot and driveway to discourage visitors from walking through the former skeet range area. Additional planting will be done to create a vegetated buffer for stormwater management. Some additional trails may be constructed to connect the parking lot to the existing trail network. New trails would be constructed using the same treatment described above for the capped trails. Existing trails to be maintained in Unit 5 will also receive the same cap treatment.

Additional testing will be done in the inundated areas of the Area 5 wetland to determine where lead levels exceed the Cleanup Screening Level of >1,300 mg/kg. Remediation would be done in these areas to bring lead levels below 1,300 mg/kg. Based on existing data, this remediation can likely be achieved by removing the duff layer and surface soil in select locations only. Any remediation performed would be the minimum necessary to meet cleanup requirements while protecting the existing habitat. This remediation would be coordinated with the phased revegetation of Units 3c and 3e.

Reclamation activities specific to the gravel mining may be required by King County Department of Permitting and Environmental Review; however, because such activities would be required in areas actively worked as part of the gravel mining operation, it is not expected that contamination levels in these areas would exceed cleanup standards. The old mining apparatus may be completely or partially removed for safety reasons, but that work would also be outside the contaminated area. Additional shoreline or planting restoration activities also may occur on the property, but these activities are also not expected to occur in areas where contamination levels would exceed cleanup standards.

5.2 Institutional Controls Plans and Environmental Covenant

The County anticipates that future work for the Cleanup Unit includes providing the following submittals:

- An Institutional Control Plan to help ensure protection of human health and the environment.

- An environmental covenant to limit activities and land use of the site.

Each of these elements is described in further detail below.

WAC 173-340-360(2)(e) requires cleanup actions to use institutional controls to limit or prohibit activities that may interfere with the integrity of a cleanup action or that may result in exposure of hazardous substances at a Cleanup Unit. These cleanup actions are required to ensure the continued protection of human health and the environment and the integrity of the cleanup. Institutional controls may include physical measures (such as fences), restrictions on the use of the property, maintenance requirements for engineering controls (e.g., maintenance of caps), education programs, and financial assurances. These measures, along with future planning and development, will be described in an Institutional Controls Plan developed by the County.

The following institutional controls are proposed for the Cleanup Unit:

- Institutional Control Measures:
  - **Physical Measures:** Dense vegetation will be planted and maintained to discourage access to off-trail areas in Units 3c and 3e. A barrier fence will be installed to discourage access to Unit 5 from the gravel parking lot.
  - **Educational Measures:** Warning signs will be posted and maintained to educate users to potential exposure risk.
  - **Land Use Restrictions:** A restrictive covenant will be executed and recorded with the register of deeds for King County. At a minimum, the restrictive covenant will describe procedures to be followed during any future Cleanup Unit excavation activities that could result in worker exposure or the transfer of contaminated soils to the ground surface. Such procedures shall include worker health and safety training requirements and contaminated soil management procedures. Future Cleanup Units use shall be restricted to that of an outdoor recreation area. The restrictive covenant will also require that Ecology be notified of the County's intent to convey any interest in the Cleanup Unit or to change land use from an outdoor recreational park to some other use. Final requirements for the restrictive covenant (or equivalent) will be negotiated by Ecology and the County.

5.3 Schedule

The Cleanup Acton Plan will be implemented in phases as follows:

- Phase 1A: Trail/maintaince road capping throughout site.
- Phase 1B: Capping to create a parking area over the former skeet range area in Unit 5. Clearing 5 more acres of invasive vegetation in Area 3C.
- Phase 2: Revegetation of 5 more acres of Area 3C and wetland remediation in Unit 5.

- Phase 3: Revegetation of 4 more acres of Area 3C.
- Phase 4: Revegetation of Area 3E.

Implementation in phases is necessary because it is not practicable to revegetate more than a few acres at a time. Performing revegetation of all acres simultaneously could potentially cause erosion and stormwater runoff impacts. In addition, active maintenance of the revegetated areas is necessary for the first few years until plants are established. Trying to maintain more than a few acres at a time potentially reduces successful establishment of the plants. Construction/implementation of Phase 1 is estimated to begin Q3 of 2019. Phase 4 would be completed in 2028. A detailed project schedule is provided in Table 8.

5.4 Five-Year Review

Due to the implementation of land use restrictions as part of the CAP, it is anticipated that the Cleanup Unit will be entered in to Ecology's Environmental Covenant registry; this registry consists of Cleanup Units with land use restrictions that are subject to review by Ecology every 5 years. The purpose of the review here would be to verify the effectiveness of soil containment and land use restrictions. Cleanup Units remain on the registry as long as the land use restrictions are required to protect human health and the environment.

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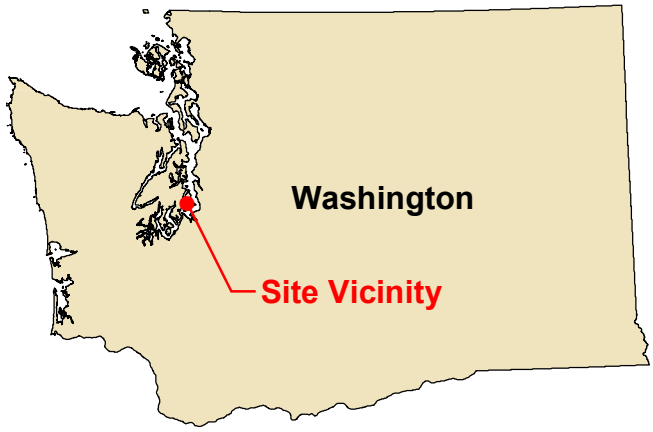
Figures



CDM Smith

Parametrix

FIGURE 1
VICINITY AND LOCATION MAP
Maury Island Open Space Property DCAP

Source:
Georeferenced aerial photograph and topography provided by King County.

Note: Details indicated are based on King County parcel map and wetland survey, aerial photographs, site observations and/or GPS survey data.

Vacant

Residential (Gold Beach)

Vacant

Former Skeet Range

Vacant

Dockton Natural Area/Forest

Skeet Throwers and Driveway

Cell tower lease area

Dockton Forest Lease Site

Foundations

Above Ground Conveyor Structures

Underground Conveyor Tunnels

Shipping Container

Dock

Horse Acreage (Residential)

Sandy Shores (Residential)

Former Graded Road, Now a Trail

Existing Footpaths

Main Access Road

25-Foot Contours (ft amsl)

Wetland, as mapped by King County 2013

Cleanup Unit Boundary

Parcel Boundary

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0 250 500 1,000 Feet

FIGURE 2
CLEANUP UNIT AND VICINITY FEATURES
Maury Island Open Space Property DCAP

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Sources:
1) Georeferenced aerial photograph and topography provided by King County.
2) Georeferenced prior soil sample and well locations provided by Aspect Consulting

OBW-1
OBW-2
OBW-5
OBW-6
OBW-7
OBW-8
OBW-9

1a
1b
2a
2b
2c
3a
3b
3c
3e
4a
4b
4c
5

OBW-6

25-Foot Contours (ft amsl)
Main Access Road
1b Decision Unit and ID
Existing Footpaths
Former Graded Road, Now a Trail
Cleanup Unit Boundary

Decision Unit Description
1a = Western Forest
1b = Northern Forest
2a = South Pit
2b = Southern edge of South Pit
2c = North Pit
3a = Logged, potentially graded
3b = Grading associated with North Pit
3c = Historic rural residence area and grading
3e = Possible topsoil stockpile
4a = South Bluff
4b = Middle Bluff
4c = North Bluff
5 = Former Skeet Range

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Parametrix

0 250 500 1,000 Feet

FIGURE 3
DECISION UNITS AND MONITORING WELL LOCATIONS
Maury Island Open Space Property DCAP

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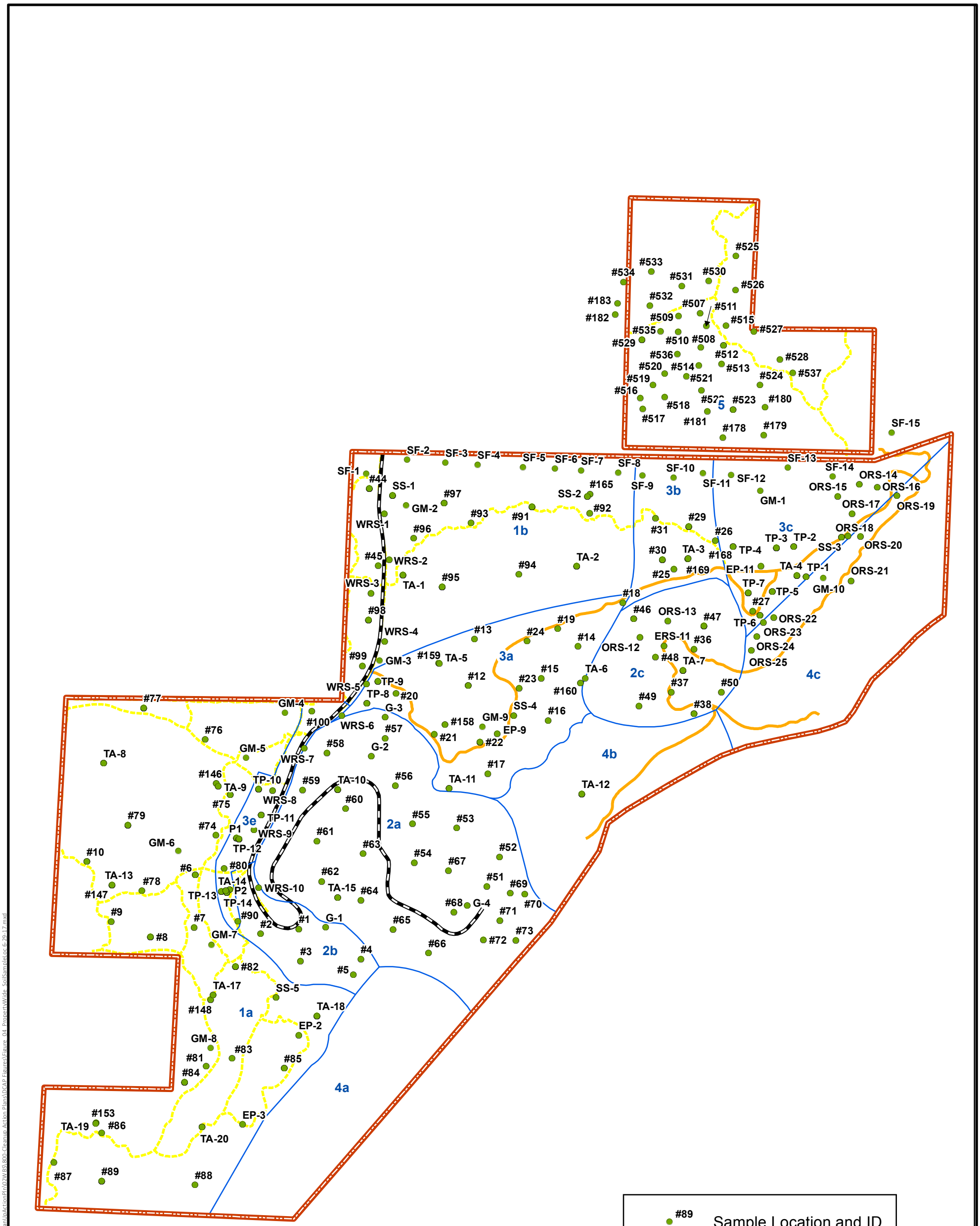

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0 250 500 1,000 Feet

FIGURE 4
PROPERTY-WIDE
SOIL SAMPLE LOCATIONS
Maury Island Open Space Property DCAP

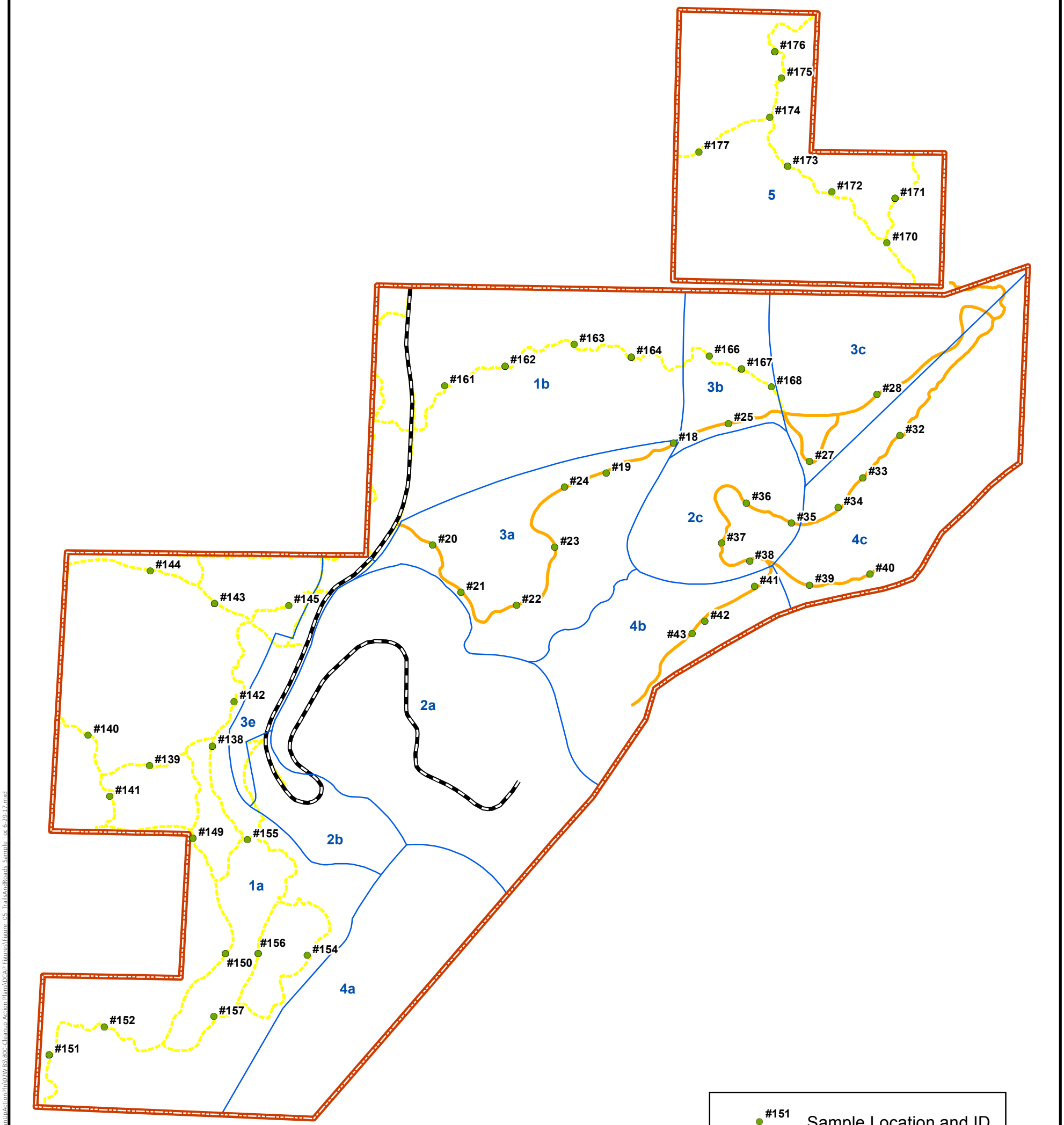
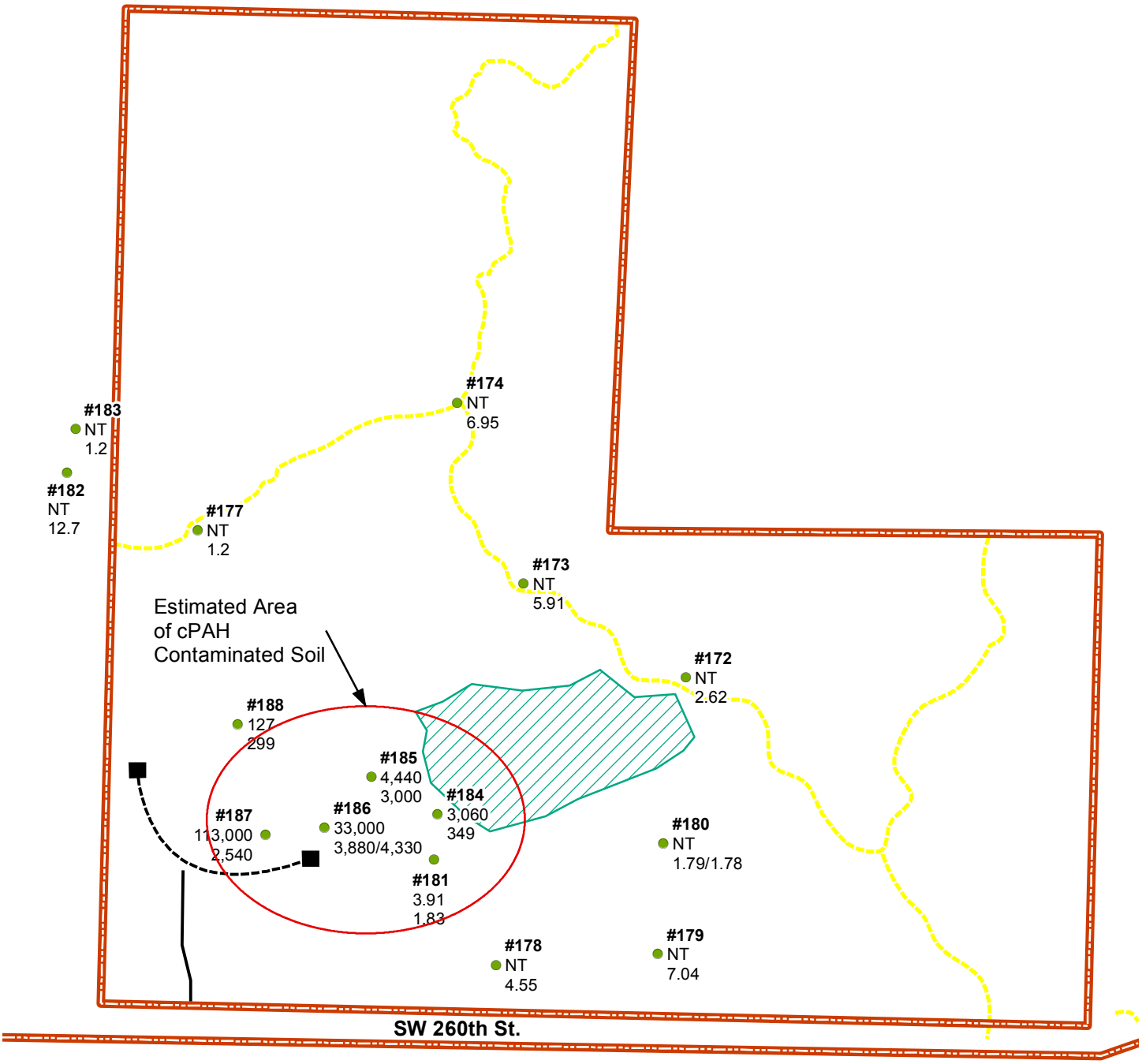


FIGURE 5
SAMPLE LOCATIONS ON TRAIL AND ROADS
Maury Island Open Space Propoerty DCAP



Sample Key:
#186 Sample ID
33,000 cPAH TEQ concentration in forest duff
3,880 cPAH TEQ concentration in soil at 0-2" depth

Notes:
1) Data presented below sample ID number is in descending order of depth. Only sampled depths shown unless a preceding depth was not sampled; then NT (Not Tested) was used as a place holder.
2) Concentration in micrograms per kilogram adjusted for dry weight basis and TEQ.
3) Concentrations may differ slightly from the summary tables due to rounding.

/ # - Results of duplicate analyses
TEQ - Toxic equivalency
cPAH - Carcinogenic polycyclic aromatic hydrocarbons

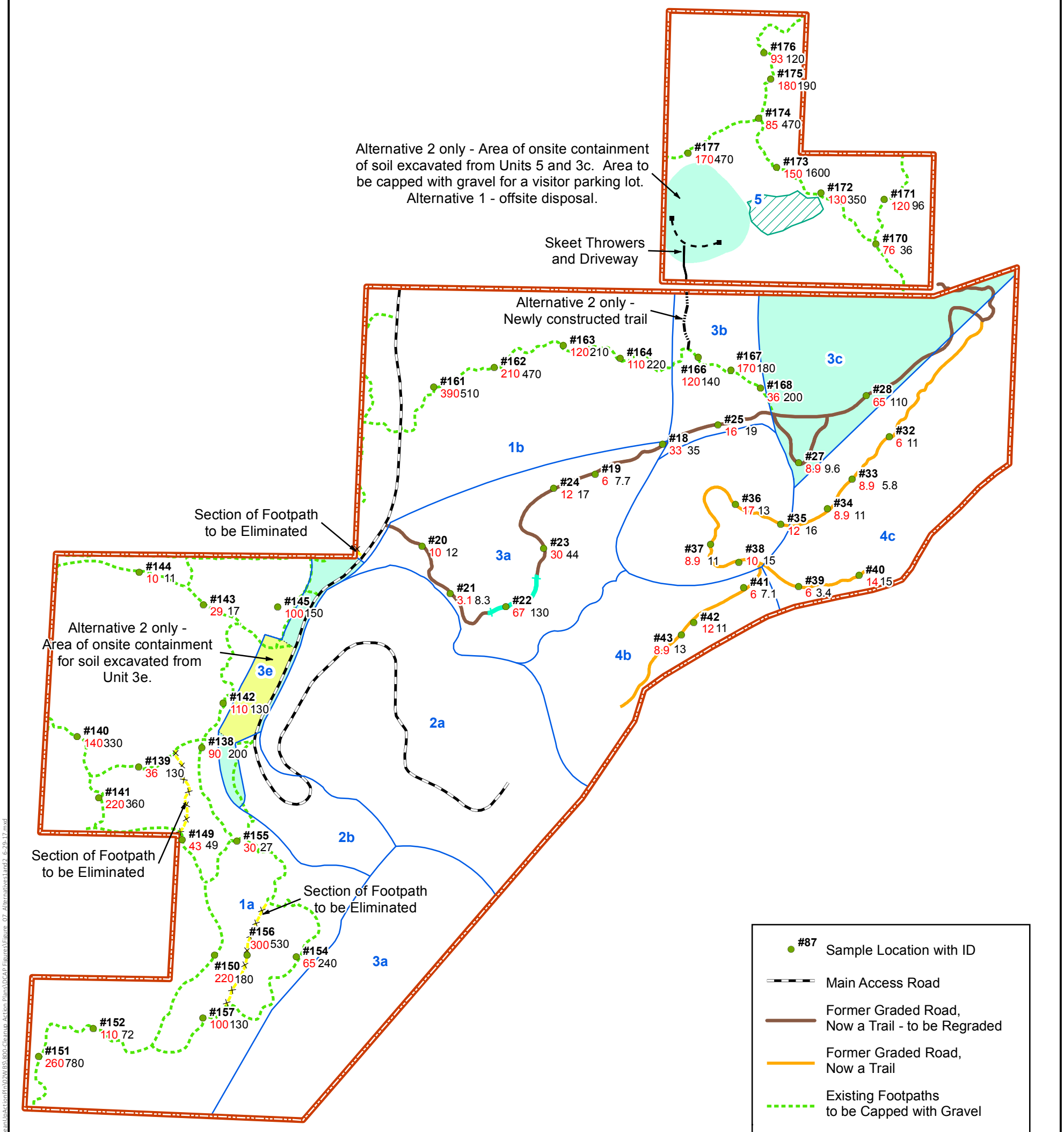
#186 Sample Location and ID
Existing Footpaths
Cleanup Unit Boundary
Wetland, as mapped by King County 2013

CDM Smith

Parametrix

Feet
0 50 100 200

FIGURE 6
CPAH IN FOREST DUFF AND SOIL
Maury Island Open Space Property DCAP



Sample Key:
#151 Sample ID
260 Arsenic concentration 780 Lead concentration

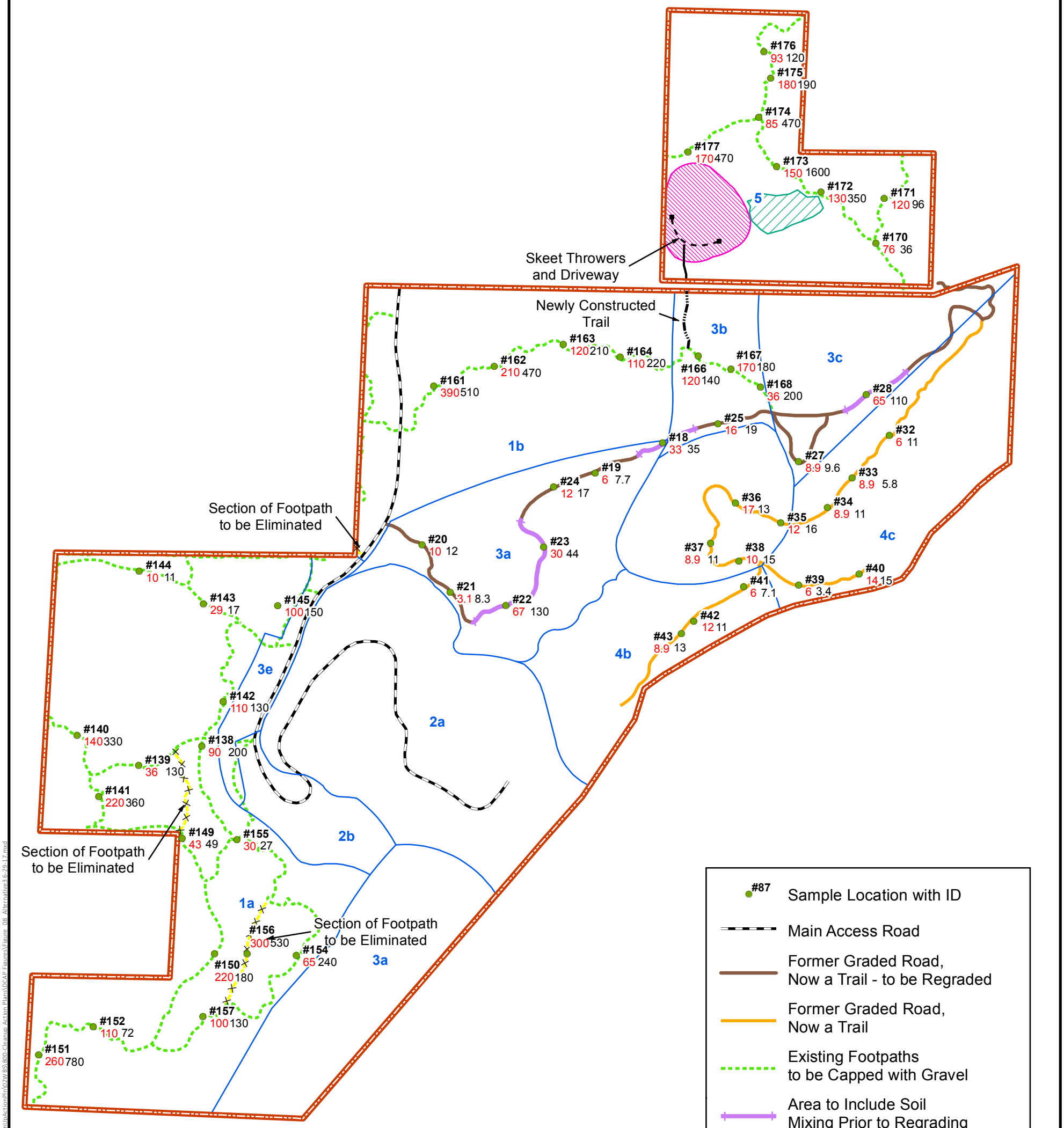
Notes:
1) Concentration in milligrams per kilogram adjusted for dry weight basis
2) Concentrations may differ slightly from the summary tables due to rounding.

CDM Smith

Parametrix

0 250 500 1,000 Feet

FIGURE 7
REMEDIAL ALTERNATIVES 1 AND 2
Maury Island Open Space Property DCAP



Sample Key:
#151 Sample ID
260 Arsenic concentration 780 Lead concentration

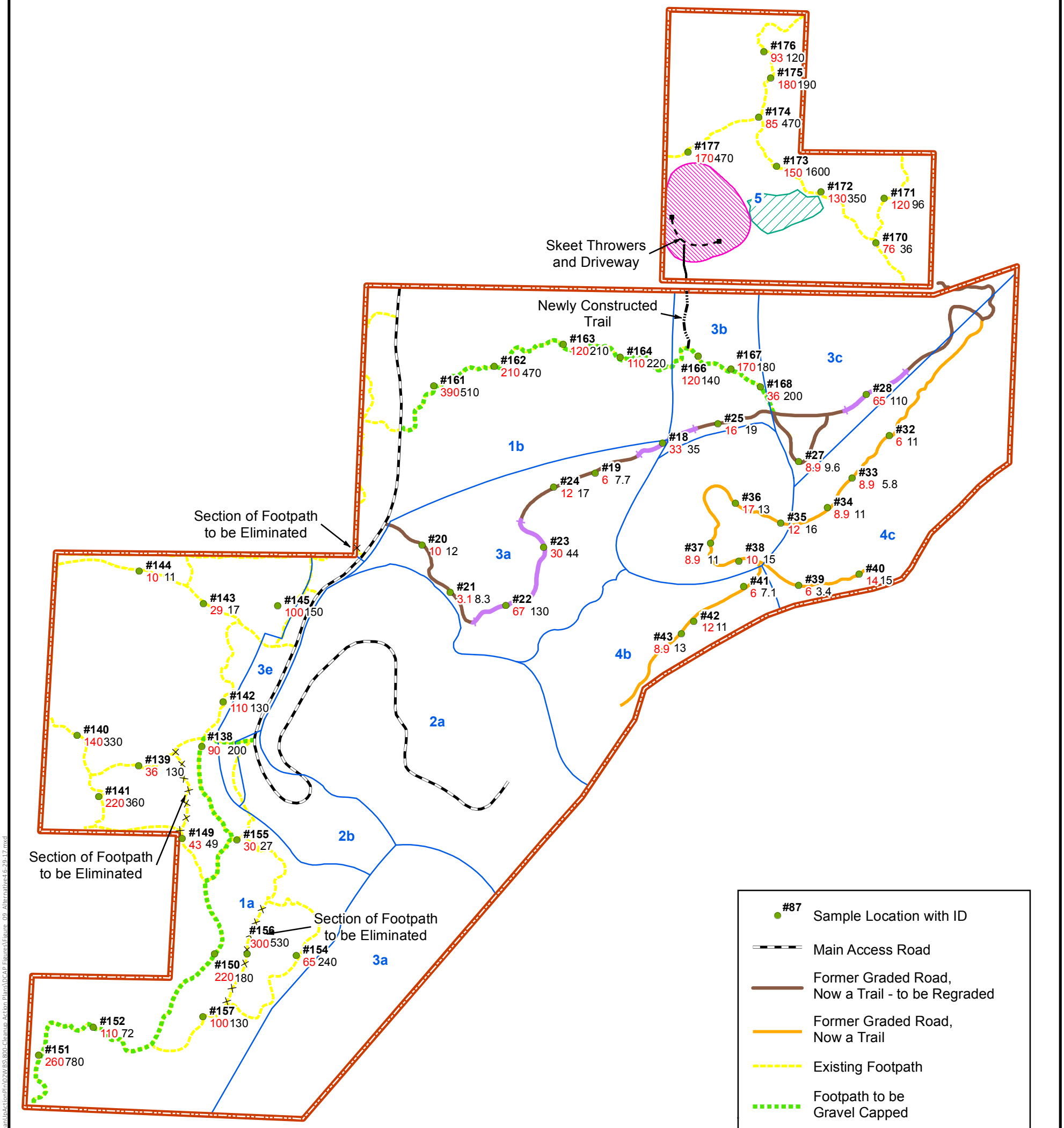
Notes:
1) Concentration in milligrams per kilogram adjusted for dry weight basis
2) Concentrations may differ slightly from the summary tables due to rounding.

CDM Smith

Parametrix

0 250 500 1,000 Feet

FIGURE 8
REMEDIAL ALTERNATIVE 3
Maury Island Open
Space Property DCAP



Sample Key:
#151 Sample ID
260 Arsenic concentration 780 Lead concentration

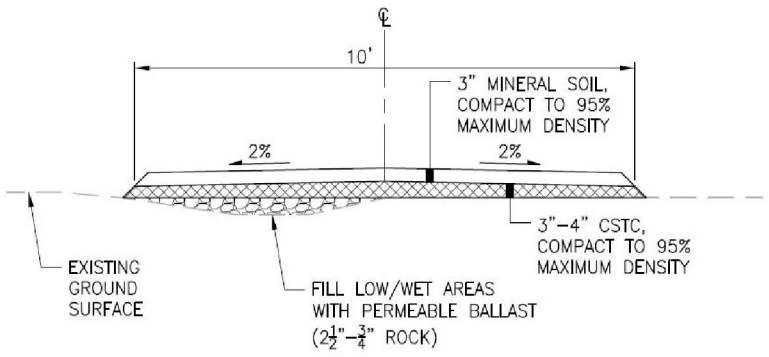
Notes:
1) Concentration in milligrams per kilogram adjusted for dry weight basis
2) Concentrations may differ slightly from the summary tables due to rounding.

CDM Smith

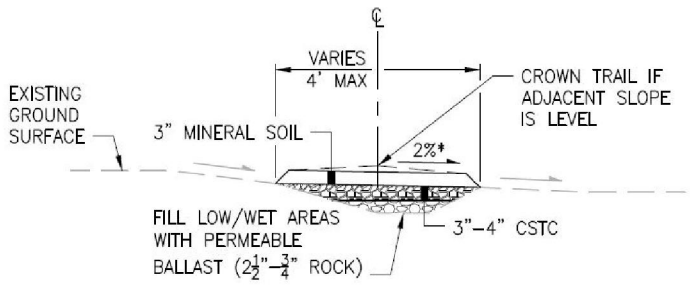
Parametrix

0 250 500 1,000 Feet

FIGURE 9
REMEDIAL ALTERNATIVE 4
Maury Island Open
Space Property DCAP



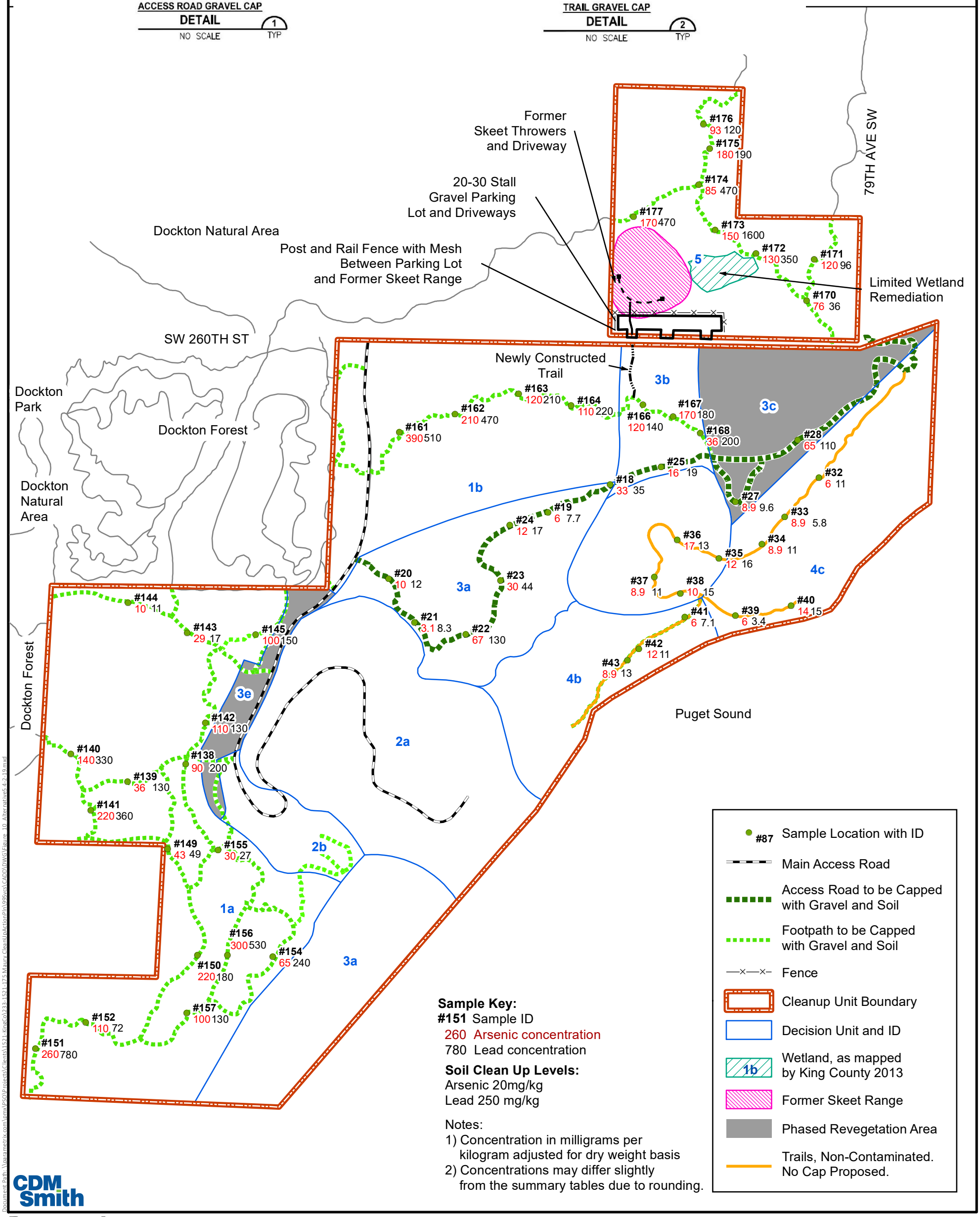
ACCESS ROAD GRAVEL CAP DETAIL 1 TYP
NO SCALE



NOTE:
COMPACT CAP MATERIALS BY WETTING AND WHEEL ROLLING WITH POWER EQUIPMENT

*SLOPE TRAIL IN DIRECTION OF ADJACENT SLOPE

TRAIL GRAVEL CAP DETAIL 2 TYP
NO SCALE



Sample Key:
#151 Sample ID
260 Arsenic concentration
780 Lead concentration

Soil Clean Up Levels:
Arsenic 20mg/kg
Lead 250 mg/kg

Notes:
1) Concentration in milligrams per kilogram adjusted for dry weight basis
2) Concentrations may differ slightly from the summary tables due to rounding.

- #87 Sample Location with ID
- Main Access Road
- Access Road to be Capped with Gravel and Soil
- Footpath to be Capped with Gravel and Soil
- Fence
- Cleanup Unit Boundary
- Decision Unit and ID
- 1b Wetland, as mapped by King County 2013
- Former Skeet Range
- Phased Revegetation Area
- Trails, Non-Contaminated. No Cap Proposed.

CDM Smith

Parametrix

Feet
0 250 500 1,000

Document Path: \\parametrix.com\ppnx\PSOVP\projects\Clients\1521-KingCo\233-1521-175 Maury CleanUpActionPln\995vcs\CADD\DWG\Figure_10_Alternative5_4-2-19.mxd

FIGURE 10
REMEDIAL ALTERNATIVE 5
Maury Island Open Space Property DCAP

Tables

Table 1. Summary Statistics for Arsenic in Forest Duff and Soil

	Unit and Media (Forest Duff or Soil at Specified Depth)											
	1a				1b				2a/2b	Unit 2c/4b/4c		
	Forest Duff	0-2"	9"	18"	Forest Duff	0-2"	9"	18"	0-2"	0-2"	9"	18"
Count (n)	20	32	19	16	10	30	9	9	35	21	5	5
Count (nd)	0	0	0	0	0	0	1	2	2	0	0	0
Min	10	11	5.8	4.5	13	19	<0.8	<0.8	<0.8	1.8	6.2	5.7
Max	170	477	119	19	163	379	48	43	19	148	111	29
Mean	84	164	34	8	73	105	26	11	5.9	37	43	14
Median	93	151	19	8	65	88	22	7	6.0	18	19	13
Standard Dev	50	95	34	4	45	85	15	13	3.6	44	45	10
UCL95	112	203	53	10	111	142	40	23	7.4	61	114	29

	Unit and Media (Forest Duff or Soil at Specified Depth)														
	3a				3b			3c					3e	5	
	Forest Duff	0-2"	9"	18"	Forest Duff	0-2"	9&18"	Forest Duff	0-2"	9"	18"	24"	All Depths	Forest Duff	0-2"
Count (n)	13	22	9	5	5	9	6	5	20	10	9	4	40	31	37
Count (nd)	0	0	1	1	0	0	0	0	1	1	1	1	1	0	0
Min	9	1.9	<0.8	<0.8	23	53	4.5	70	<0.8	<0.8	<0.8	<0.8	<0.8	11	12
Max	154	280	75	22	82	190	19	148	199	19	10	4.5	138	310	200
Mean	40	63	22	9.9	43	123	9.2	97	70	8.3	5.1	2.7	36	123	87
Median	26	57	8.7	4.5	34	111	8.0	82	69	6.0	4.6	2.8	29	110	90
Standard Dev	41	58	27	9.6	24	54	5.1	31	55	5.7	2.7	1.5	30	75	52
UCL95	69	92	47	25	80	173	16	146	100	13	7.6	5.9	47	155	107

	Location/Unit and Media (Forest Duff or Soil at Specified Depth)						
	Trails					Roads	Units 1a,1b,3a, 3b, 5
	All Trail	1a	1b/3b	5	9" (all)		Property-Wide
	0-2"	0-2"	0-2"	0-2"	9"	0-2"	Forest Duff and 0-2"
Count (n)	31	16	7	8	12	22	209
Count (nd)	0	0	0	0	0	0	0
Min	10	10	36	76	2.8	3.1	1.9
Max	394	297	394	182	26	67	477
Mean	130	117	165	125	8.5	17	101
Median	114	102	122	121	6.7	10	82
Standard Dev	85	88	114	40	6.7	17	76
UCL95	166	171	293	165	13	26	113

Notes:

Concentrations are in milligrams per kilogram

Count (n) – Number of samples

Count (nd) – Number of samples nondetect for arsenic

UCL95 – Upper 95% confidence limit

Table 2. Summary Statistics for Lead in Forest Duff and Soil

	Unit and Media (Forest Duff or Soil at Specified Depth)										
	1a				1b				2a/2b	Unit 2c/4b/4c	
	Forest Duff	0-2"	9"	18"	Forest Duff	0-2"	9"	18"	0-2"	0-2"	9"
Count (n)	20	27	19	16	10	20	9	9	35	20	5
Count (nd)	0	0	1	1	0	0	0	1	6	0	1
Min	33	7.1	<0.5	<0.5	9.6	1.0	8.3	<0.5	<0.5	2.0	<0.5
Max	817	710	102	12	576	930	87.4	23	17	423	112
Mean	364	220	19	6.6	220	195	26	11	5.8	55	42
Median	377	167	11	7.1	230	54	19	9.6	5.8	13	18
Standard Dev	218	185	23	2.7	158	268	25	6.3	3.9	98	48
UCL95	483	305	31	8.3	354	341	48	17	7.4	108	117

	Unit and Media (Forest Duff or Soil at Specified Depth)												
	3a				3b			3c					3e
	Forest Duff	0-2"	9"	18"	Forest Duff	0-2"	9&18"	Forest Duff	0-2"	9"	18"	24"	All Depths
Count (n)	13	21	9	5	5	6	6	5	15	10	9	4	40
Count (nd)	0	1	1	1	0	0	0	0	0	0	1	1	0
Min	11	<0.5	<0.5	<0.5	67	83	7.1	161	9.0	4.6	<0.5	<0.5	3.0
Max	636	330	110	45	196	224	25	487	450	40	37	8	403
Mean	119	68	35	18	102	173	11	309	118	14	9	5	61
Median	51	45	7.1	12	89	201	8.3	323	90	10	5	5	38
Standard Dev	182	68	45	18	54	60	7.1	127	123	11	11	3	81
UCL95	249	104	77	45	186	251	20	507	198	24	19	12	90

	Location/Unit and Media (Forest Duff or Soil at Specified Depth)									
	Unit 5		Trails 0-2"				Trails 9"	On Road	Units 1a,1b,3a, 3b, 5 Property-Wide	Units 1a,1b,3a, 3b Property-Wide
	Forest Duff	0-2"	All Trail	1a	1b and 3b	5			Forest Duff and 0-2"	Forest Duff and 0-2"
Count (n)	31	37	31	16	7	8	12	22	190	122
Count (nd)	0	0	0	0	0	0	0	0	1	1
Min	48	13	11	11	135	36	2.7	3.4	0.5	0.5
Max	2,600	2,520	1,590	776	510	1,590	17	130	2,600	930
Mean	898	312	277	208	275	415	7.8	24	333	196
Median	620	150	193	142	215	271	7.1	13	186	103
Standard Dev	762	472	304	206	148	503	4.3	33	475	202
UCL95	1,221	493	405	336	442	921	11	41	411	237

Notes:

Concentrations are in milligrams per kilogram

Count (nd) – Number of samples nondetect for lead

Count (n) – Number of samples

UCL95 – Upper 95% confidence limit

Table 3. Summary Statistics for Cadmium in Forest Duff and Soil

	Unit and Media (Forest Duff or Soil at Specified Depth)						
	Unit 1a, 1b, 2c, 3a	Unit 1a, 1b	Unit 3a,3b,3c	Unit 3e	Unit 2a, 4b,4c	All (1a, 1b, 2a, 2c, 3a, 3c, 3e, 4b)	All (1a, 1b, 2a, 2c, 3a, 3b, 3c, 3e, 4b)
	Forest Duff	0-2"	0-2"	(all)	0-2"	9"	18"
Count (n)	9	26	14	29	13	16	22
Count (nd)	0	7	5	16	12	7	14
Min	1.2	<0.281	<0.281	<0.281	<0.2	<0.281	<0.19
Max	5.4	11	9.3	7.9	0.28	2.2	1.5
Mean	3.3	3.3	1.7	1.7	0.27	0.80	0.52
Median	3.6	2.3	0.89	0.93	0.28	0.78	0.28
Standard Dev	1.4	3.1	2.5	1.7	0.02	0.58	0.37
UCL95	4.6	4.8	3.4	2.4	0.29	1.2	0.71

Notes:

Concentrations are in milligrams per kilogram

Count (nd) – Number of samples nondetect for cadmium

Count (n) – Number of samples

UCL95 – Upper 95% confidence limit

Table 4. PAHs in Soil – Unit 5 (page 1 of 4)

Compound	PEF	Sample Location, Media, Sample ID, and Units					
		#172	#173	#174	#177	#178	
		Soil, 0-2″ 5-S-172-0[a] µg/kg	Soil, 0-2″ 5-S-173-0[a] µg/kg	Soil, 0-2″ 5-S-174-0[a] µg/kg	Soil, 0-2″ 5-S-177-0[a] µg/kg	Forest Duff 5-FD-178-0[a] µg/kg	Soil, 0-2″ 5-S-178-0[a] µg/kg
1-Methylnaphthalene	0.1	<7.3	<7.3	<8.9	<6.4	<8.4	<7.2
2-Methylnaphthalene		<7.3	<7.3	<8.9	<6.4	<8.4	<7.2
Acenaphthene		<7.3	<7.3	<8.9	<6.4	<8.4	<7.2
Acenaphthylene		<7.3	<7.3	<8.9	<6.4	<8.4	<7.2
Anthracene		<7.3	<7.3	<8.9	<6.4	<8.4	<7.2
Benzo(a)anthracene*		<7.3	<7.3	<8.9	<6.4	<8.4	7.4
Benzo(a)pyrene*	1	<7.3	<7.3	<8.9	<6.4	<8.4	<7.2
Benzo(b,j,k)fluoranthene*	0.1	26.2	59.1	69.5	12	<8.4	36.4
Benzo(g,h,i)perylene		<7.3	<7.3	<8.9	<6.4	<8.4	<7.2
Chrysene*	0.01	<7.3	<7.3	<8.9	<6.4	<8.4	16.8
Dibenzo(a,h)anthracene*	0.4	<7.3	<7.3	<8.9	<6.4	<8.4	<7.2
Fluoranthene		17.7	27.7	36.7	<6.4	22	19.2
Fluorene		<7.3	<7.3	<8.9	<6.4	<8.4	<7.2
Indeno(1,2,3-cd)Pyrene*	0.1	<7.3	<7.3	<8.9	<6.4	<8.4	<7.2
Naphthalene		<7.3	<7.3	<8.9	<6.4	<8.4	<7.2
Phenanthrene		<7.3	10	15	<6.4	13	7.5
Pyrene		11	16.5	18.5	<6.4	20	15
TEQ cPAH		**2.62**	**5.91**	**6.95**	**1.20**	**N/A**	**4.55**

Notes:

* Carcinogenic PAHs

a Sample extracted out of holding time

b Duplicate sample

J Estimated concentration

N/A – not applicable - no cPAHs detected

µg/kg - micrograms per kilogram

PAHs – polycyclic aromatic hydrocarbons

cPAHs - carcinogenic PAHs

TEQ – toxic equivalency

PEF – potency equivalency factor

< – analyte not detected at or greater than listed concentration

Sample Locations shown on Figure 30.

Shaded value exceeds the Model Toxics Control Act Method A Cleanup Level of 100 µg/kg.

Table 4. PAHs in Soil – Unit 5 (page 2 of 4)

Compound	PEF	Sample Location, Media, Sample ID, and Units						
		#179		#180			#181	
		Forest Duff 5-FD-179-0[a] µg/kg	Soil, 0-2″ 5-S-179-0[a] µg/kg	Forest Duff 5-FD-180-0[a] µg/kg	Soil, 0-2″ 5-S-180-0[a] µg/kg	Soil, 0-2″ 5-S-180-D6[a,b] µg/kg	Forest Duff 5-FD-181-0[a] µg/kg	Soil, 0-2″ 5-S-181-0[a] µg/kg
1-Methylnaphthalene	0.1	<12	<7.2	<11	<6.8	<6.7	<9.8	<6.6
2-Methylnaphthalene		<12	<7.2	<11	<6.8	<6.7	<9.8	<6.6
Acenaphthene		<12	<7.2	<11	<6.8	<6.7	<9.8	<6.6
Acenaphthylene		<12	<7.2	<11	<6.8	<6.7	<9.8	<6.6
Anthracene		<12	<7.2	<11	<6.8	<6.7	<9.8	<6.6
Benzo(a)anthracene*		<12	<7.2	<11	<6.8	<6.7	<9.8	<6.6
Benzo(a)pyrene*	1	<12	<7.2	<11	<6.8	<6.7	<9.8	<6.6
Benzo(b,j,k)fluoranthene*	0.1	<12	70.4	<11	17.9	17.8	39.1	17.5
Benzo(g,h,i)perylene		<12	<7.2	<11	<6.8	<6.7	<9.8	<6.6
Chrysene*	0.01	<12	<7.2	<11	<6.8	<6.7	33.6	7.9
Dibenzo(a,h)anthracene*	0.4	<12	<7.2	<11	<6.8	<6.7	<9.8	<6.6
Fluoranthene		19	24.6	16	<6.8	<6.7	19	8.5
Fluorene		<12	<7.2	<11	<6.8	<6.7	<9.8	<6.6
Indeno(1,2,3-cd)Pyrene*	0.1	<12	<7.2	<11	<6.8	<6.7	<9.8	<6.6
Naphthalene		<12	<7.2	<11	<6.8	<6.7	<9.8	<6.6
Phenanthrene		<12	8.4	<11	<6.8	<6.7	<9.8	<6.6
Pyrene		<12	16.2	11	<6.8	<6.7	13	7.1
TEQ cPAH		**N/A**	**7.04**	**N/A**	**1.79**	**1.78**	**3.91**	**1.83**

Notes:

* Carcinogenic PAHs

a Sample extracted out of holding time

b Duplicate sample

J Estimated concentration

N/A – not applicable - no cPAH detected

µg/kg - micrograms per kilogram

PAHs – polycyclic aromatic hydrocarbons

cPAHs - carcinogenic PAHs

TEQ – toxic equivalency

PEF – potency equivalency factor

< – analyte not detected at or greater than listed concentration

Sample Locations shown on Figure 30.

Shaded value exceeds the Model Toxics Control Act Method A Cleanup Level of 100 µg/kg.

Table 4. PAHs in Soil – Unit 5 (page 3 of 4)

Compound	PEF	Sample Location, Media, Sample ID, and Units					
		#182		#183		#184	
		Forest Duff 5-FD-182-0[a] µg/kg	Soil, 0-2″ 5-S-182-0[a] µg/kg	Forest Duff 5-FD-183-0[a] µg/kg	Soil, 0-2″ 5-S-183-0[a] µg/kg	Forest Duff 5-FD-184-0 µg/kg	Soil, 0-2″ 5-S-184-0 µg/kg
1-Methylnaphthalene	0.1	<18	<12	<12	<7.7	<7.6	<6.7
2-Methylnaphthalene		<18	<12	<12	<7.7	9.6[J]	<6.7
Acenaphthene		<18	<12	<12	<7.7	64.9	6.8[J]
Acenaphthylene		<18	<12	<12	<7.7	<7.6	<6.7
Anthracene		<18	<12	<12	<7.7	125	12[J]
Benzo(a)anthracene*		<18	<12	<12	<7.7	1,410	160
Benzo(a)pyrene*	1	<18	<12	<12	<7.7	2,210	252
Benzo(b,j,k)fluoranthene*	0.1	<18	127	<12	12	4,050	488
Benzo(g,h,i)perylene		<18	<12	<12	<7.7	1,270	137
Chrysene*	0.01	<18	<12	<12	<7.7	1,820	209
Dibenzo(a,h)anthracene*	0.4	<18	<12	<12	<7.7	328	33.2
Fluoranthene		<18	28.7	<12	<7.7	2,000	232
Fluorene		<18	<12	<12	<7.7	80.9	7.5[J]
Indeno(1,2,3-cd)Pyrene*	0.1	<18	<12	<12	<7.7	1,520	166
Naphthalene		<18	<12	<12	<7.7	26.6	<6.7
Phenanthrene		<18	<12	<12	<7.7	694	74.7
Pyrene		<18	24.5	<12	<7.7	2,180	240
TEQ cPAH		**N/A**	**12.70**	**N/A**	**1.20**	**3,057**	**349**

Notes:

* Carcinogenic PAHs
a Sample extracted out of holding time
b Duplicate sample
J Estimated concentration
N/A – not applicable - no cPAH detected
µg/kg – micrograms per kilogram
PAHs – polycyclic aromatic hydrocarbons
cPAHs – carcinogenic PAHs
TEQ – toxic equivalency
PEF – potency equivalency factor
< – analyte not detected at or greater than listed concentration
Sample Locations shown on Figure 30.
Shaded value exceeds the Model Toxics Control Act Method A Cleanup Level of 100 µg/kg.

Table 4. PAHs in Soil – Unit 5 (page 4 of 4)

Compound	PEF	Sample Location, Media, Sample ID, and Units	
		#188	
		Forest Duff 5-FD-188-0 µg/kg	Soil, 0-2″ 5-S-188-0 µg/kg
1-Methylnaphthalene	0.1	<6.6	<6.3
2-Methylnaphthalene		<6.6	<6.3
Acenaphthene		<6.6	11 J
Acenaphthylene		<6.6	6.3
Anthracene		<6.6	16.7
Benzo(a)anthracene*		52.7	138
Benzo(a)pyrene*	1	97.8	223
Benzo(b,j,k)fluoranthene*	0.1	165	353
Benzo(g,h,i)perylene		29.3	99
Chrysene*	0.01	78.3	179
Dibenzo(a,h)anthracene*	0.4	6.7 J	29.5
Fluoranthene		77.8	211
Fluorene		<6.6	<6.3
Indeno(1,2,3-cd)Pyrene*	0.1	39.9	130
Naphthalene		<6.6	<6.3
Phenanthrene		21.5	82.5
Pyrene		88.1	233
TEQ cPAH		**N/A**	**127**

Notes:

* Carcinogenic PAHs

a Sample extracted out of holding time

b Duplicate sample

J Estimated concentration

N/A – not applicable - no cPAHs detected

µg/kg – micrograms per kilogram

PAHs – polycyclic aromatic hydrocarbons

cPAH – carcinogenic PAHs

TEQ – toxic equivalency

PEF – potency equivalency factor

< – analyte not detected at or greater than listed concentration

Sample Locations shown on Figure 30.

Shaded value exceeds the Model Toxics Control Act Method A Cleanup Level of 100 µg/kg.

Table 5. Remedial Alternatives

Applicable Decision Units	Area Addressed	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
All	Cleanup Unit in General	Signage, public notices, public meetings, hygiene stations, ongoing maintenance of trail system, land use covenant	Signage, public notices, public meetings, hygiene stations, ongoing maintenance of trail system, land use covenant	Signage, public notices, public meetings, hygiene stations, ongoing maintenance of trail system, land use covenant	Signage, public notices, public meetings, hygiene stations, ongoing maintenance of trail system, land use covenant	Signage, public notices, public meetings, hygiene stations, ongoing maintenance of trail system, land use covenant
1a, 1b, 3a, 3b, 5	Forest Footpaths	Close redundant trail spurs in Unit 1a. Cap remaining trail system with the U.S. Forest Service-type cap.	Close redundant trail spurs in Unit 1a. Cap remaining trail system with the U.S. Forest Service-type cap. Construct short spur of trail to connect the visitor parking lot with the trail in Unit 3b (contaminated soils to be excavated prior to placement of gravel cap).	Close redundant trail spurs in Unit 1a. Cap remaining trail system with the U.S. Forest Service-type cap. Construct short spur of trail to connect the visitor parking lot with the trail in Unit 3b (trail to be capped the same as the extisting trail system, no soil excavation prior to capping).	Close redundant trail spurs. Cap a main thoroughfare with a U.S. Forest Service-type cap. Construct short spur of trail to connect the visitor parking lot with the trail in Unit 3b (trail to be capped with gravel, no soil excavation prior to capping).	Decommision side trails. Cap a main thoroughfare with a U.S. Forest Service-type cap. Construct short spur of trail to connect the visitor parking lot with the trail in Unit 3b (trail to be capped with gravel, no soil excavation prior to capping).
3a, 3b, 3c	Graded Roads	Excavate soils exceeding 40 mg/kg arsenic and regrade the road. (Note - the graded road in Unit 3c will already fall within the area of excavation described below)	Excavate soils exceeding 40 mg/kg arsenic and regrade the road. (Note - the graded road in Unit 3c will already fall within the area of excavation described below)	Conduct soil mixing in areas exceeding 20 mg/kg arsenic and regrade.	Conduct soil mixing in areas exceeding 20 mg/kg arsenic and regrade.	Cap with gravel and mineral soil similar to trails.
5	Former Range Area - portion that fails NEBA. Wetland	Excavate contaminated soils to meet MTCA Method A cleanup levels for arsenic, lead and cPAH.	Excavate contaminated soils to meet MTCA Method A cleanup levels for arsenic, lead and cPAH. Contain excavated soils from Units 5 and 3c and the graded road in a below grade cell. Cap with gravel for future use as a parking area.	Strip off organics. Conduct soil mixing and regrading. Cap a portion o f the area with crushed gravel for future use as a parking area. Revegetate the remainder of the area.	Strip off organics. Conduct soil mixing and regrading. Cap a portion o f the area with crushed gravel for future use as a parking area. Revegetate the remainder of the area.	Strip off organics in a limited area for a new parking lot. Cap parking lot area with crushed gravel. Place a 6-foot chain link fence between parking lot and remainder of Unit 5. Remediate wetland areas with lead concentrations >1,300 mg/kg.
3c, 3e	Formerly disturbed areas, primarly covered in blackberries - failing NEBA	Excavate contaminated soils to meet MTCA Method A cleanup levels for arsenic and lead. Unit 3c to be reforested. Unit 3e to be hydroseeded.	Excavate contaminated soils to meet MTCA Method A cleanup levels for arsenic and lead. Unit 3c to be reforested. Unit 3e to be hydroseeded.	Area to remain covered in blackberries.	Area to remain covered in blackberries.	Clear and grub, place 3-inches of compost and revegetate with native species.
Soil Disposal ⟶		Offsite Landfill	Contain soils in a below grade cell, covered with geotextile and a 2 foot soil cap.	Offsite Landfill	Offsite Landfill	Offsite Landfill

Notes:

Cells with the same colors are the same technology.

Table 6. Evaluation of Remedial Action Alternatives for Disproportionate Cost Analysis

Alternative	Description	Disproportionate Cost Analysis Criteria	Protectiveness	Permanence	Long-term Effectiveness	Management of Short-Term Risks	Technical and Administrative Implementability	Consideration of Public Concerns	Total Weighted Benefit	Cost (in millions)	Ranking (1 = most permanent, 4 = least permanent)	Overall Recommendation
	Weighting Criteria		25%	20%	30%	15%	5%	5%				
1	Close redundant trail spurs in Unit 1a. Cap remaining trails per USFS guidelines. Excavate soils exceeding 40 mg/kg arsenic on dirt roads and regrade. In the area that fails the NEBA in Unit 5 excavate contaminated soils to Meet MTCA Method A cleanup levels for arsenic, lead and cPAH. In Units 3c and 3e excavate soil to meet MTCA Method A cleanup levels for arsenic and lead. Revegetate the area. Implement institutional controls.		5	4	5	2.5	3	4	4.3	8.8	1	No
2	The same as Alternative 1, except that all excavated soils would be contained by direct burial in a subsurface cell onsite.		4.5	3.5	5	3.5	2	3	4.1	5.9	2	No
3	Close redundant trail spurs in Unit 1a. Cap remaining trails per USFS guidelines. Conduct soil mixing in areas on dirt roads that exceed 20 mg/kg and regrade. In the area that fails the NEBA in Unit 5 strip off organics. Conduct soil mixing and regrading. Cap a portion of the area with crushed gravel for future use as a parking area. Revegetate the remainder of the area. Leave Units 3 an 3e as is, as contaminated soils are covered in blackberry bushes, which act as a barrier for direct human exposure. All excavated soils to be disposed of at an offsite landfill. Implement institutional controls.		3	3	4	4	4	5	3.6	2.3	3	No
4	Close redundant trail spurs in Unit 1a. Cap a main thoroughfare per USFS guidelines. Conduct soil mixing in areas on dirt roads that exceed 20 mg/kg and regrade. In the area that fails the NEBA in Unit 5 strip off organics. Conduct soil mixing and regrading. Cap a portion of the area with crushed gravel for future use as a parking area. Revegetate the remainder of the area. Leave Units 3 an 3e as is, as contaminated soils are covered in blackberry bushes, which act as a barrier for direct human exposure. All excavated soils to be disposed of at an offsite landfill. Implement institutional controls.		2	3	3	6	5	5	3.4	1.8	4	No
5	Decommission side trails and install warning signs and hygiene stations. Cap main thoroughfare trails per USFS guidelines. Cap dirt roads that exceed 20 mg/kg with gravel. In a portion of the area that fails the NEBA in Unit 5, strip off duff and organic soils and cap the area with crushed gravel for use as a parking area. Install 6-foot chain lnk fence between parking area and remainder of Unit 5. Remediate wetland. Remove chain link fence along SW 260th Street. Revegetate Units 3c and 3e with 3-inches of compost and native vegetation. All excavated soils to be disposed of at an offsite landfill. Implement institutional controls.		4	3.5	4.5	4	3.5	4.5	4.1	4.4	2	Yes

Disproportionate Cost Analysis Scoring Criteria

6	Ideal/excellent favorability
5	High benefit/very favorable
4	Reasonable benefit/favorable
3	Some benefit/moderate favorability
2	Slight benefit/low favorability
1	Virtually no benefit/not favorable

Table 7. Potential Applicable or Relevant and Appropriate Requirements (ARARs)

Table 5. Potential Applicable or Relevant and Appropriate Requirements (ARARs)

ARAR	Description	Applicability
Soil		
Model Toxics Control Act (WAC 173-340-740, -747)	MTCA regulates the investigation and cleanup of releases to the environment that may pose a threat to human health or the environment. Establishes cleanup levels for soil, including derivation of soil concentrations protective of groundwater.	MTCA cleanup levels are applicable to site soil.
Groundwater		
Safe Drinking Water Act, Primary Drinking Water Regulations (40 Code of Federal Regulations [CFR] 141.50 and 141.61[a])	These regulations protect the quality of public drinking water supplies through regulation of chemical parameters and constituent concentrations as maximum concentration limits (MCLs).	MCLs are potentially relevant and appropriate where groundwater is a potential source of drinking water.
Model Toxics Control Act (WAC 173-340-720)	MTCA regulates the investigation and cleanup of releases to the environment that may pose a threat to human health or the environment. Establishes cleanup levels for groundwater.	MTCA cleanup levels are applicable to site groundwater.
Surface Water		
Clean Water Act, Section 304, National Recommended Water Quality Criteria, EPA Office of Science and Technology (4304T, 2004).	Establishes ambient water quality criteria for surface water.	Surface water quality criteria are potentially applicable to site surface water.
Clean Water Act's National Toxics Rule (NTR) (40 CFR 131.36)	Establishes ambient water quality criteria for surface water.	Surface water quality criteria are potentially applicable to site surface water.
Washington State Water Quality Standards for Surface Waters (WAC 173-201A)	Establishes ambient water quality criteria for surface water.	Surface water quality criteria are potentially applicable to site surface water.
Model Toxics Control Act (WAC 173-340-730)	MTCA regulates the investigation and cleanup of releases to the environment that may pose a threat to human health or the environment. Establishes cleanup levels for surface water.	MTCA cleanup levels may be applicable to the site.
Air		
National Emission Standards for Hazardous Air Pollutants (NESHAPs) (40 CFR Part 261)	Establishes specific emissions levels allowed for toxic air pollutants.	Applicable to treatment alternatives that may emit toxic pollutants to the air.
Model Toxics Control Act (WAC 173-340-750)	MTCA regulates the investigation and cleanup of releases to the environment that may pose a threat to human health or the environment. Establishes cleanup levels for air.	MTCA cleanup levels may be applicable to the site.
Miscellaneous		
State Environmental Policy Act (SEPA) Chapter 43.21C RCW.	The SEPA requires all governmental agencies to consider the environmental effects of a proposal (such as a remedial action) before making decisions. An environmental impact statement (EIS) must be prepared for all proposals with probable significant adverse effects on the quality of the environment.	At minimum, a SEPA checklist is required for site act activities requiring a grading permit.
Native American Graves Protection and Repatriation Act (43 CFR Part 10)	Native American Graves Protection and Repatriation Act regulations protect Native American burials from desecration through the removal and trafficking of human remains and "cultural items," including funerary and sacred objects.	This Act is potentially applicable to remedial actions at the site because it is possible that the disturbance of Native American materials could occur as a result of excavation activities.
Washington Hazardous Waste Management Act (WAC 173-303)	Establishes standards for the generation, transport, treatment, storage, or disposal of designated dangerous waste in the state.	This regulation is potentially applicable to alternatives that would involve handling of contaminated media at the site. The area of contamination policy allows contaminated media to be consolidated within the same area of a site without triggering Resource Conservation and Recovery Act or Washington dangerous waste regulations.
Department of Transportation Hazardous Wastes Rules (49 CFR 105–180)	Establishes specific U.S. Department of Transportation rules and technical guidelines for the off-site transport of hazardous materials.	Applicable to remedial activities that involve the off-site transportation of hazardous waste.
Washington Solid Waste Handling Standards (WAC 173-350)	Establishes standards for handling and disposal of solid non-hazardous waste in Washington.	These regulations are potentially applicable to solid nonhazardous wastes and are potentially relevant and appropriate to on-site remedial actions governing contaminated media management.
Washington Water Well Construction Act Regulations (WAC 173-160)	Provides requirements for water well construction.	These regulations are potentially applicable to the installation, operation, or closure of monitoring and treatment wells at the Site.

Table 8. Proposed Schedule*

Work Element	Period or Completed By
Draft Final DCAP Public Comment Period	Q3 2018
DCAP Approved By Ecology	Q2 2019
Phase 1 Construction Contract Documents Ready to Advertise	Q2 2019
Compliance Monitoring	Q2 2019
Phase 1 Implementation/Construction	Q3 2019 – Q3 2020
Phase 2 Construction Contract Documents Ready to Advertise	2022
Phase 2 Implementation/Construction	2023
Phase 3 Implementation/Construction	2025
First 5-Year Summary Monitoring Report	Q3 2023
First 5-Year Review	Q4 2023
Phase 4 Implementation/Construction	2028

* Phase 1 includes trail/road capping and parking lot construction

Phase 2 includes revegetation of 5 acres cleared in Phase 1 of Area 3C and Wetland Remediation. Clear and cover 4 more acres in 3C.

Phase 3 includes revegetation of 4 more acres of Area 3C. Clear and cover Area 3E.

Phase 4 includes revegetation of Area 3E.

Appendix A

Cost Estimates

Table A-1
Alternative 1 - Construction Estimate
Maury Island Open Space Property FS
Maury Island, Washington

Estimated field duration:	3 months active site; 7 months hauling and trails
Project Name:	Maury Island Cleanup - Engineers Estimate
Location:	Maury Island, Washington
Date:	4/10/2017
Contractor:	
Prepared By:	David Dinkuhn, P.E.
Approved By:	

Rev: 2

Item #	Item Description	Quantity	Unit	Unit Price	Total
	Engineering				
1	Work Plans	1	LS	$ 100,000	$ 100,000
2	Design Engineering for KC and Ecology Review, Stamped	1	LS	$ 125,000	$ 125,000
3	Engineering and oversight during Construction	1	LS	$ 126,300	$ 126,300
4	Project management support	1	LS	$ 50,000	$ 50,000
	Engineering Subtotal				$ 401,300
	General				
5	General Conditions/Permits	1	EA	$ 150,000	$ 150,000
6	Mobilization/Demobilization	1	LS	$ 25,000	$ 25,000
7	Decontamination Facilities, Equipment	1	EA	$ 15,000	$ 15,000
8	Decontamination Facilities, Personnel	1	EA	$ 8,000	$ 8,000
9	Surveying	1	EA	$ 25,000	$ 25,000
10	TESC	1	EA	$ 35,000	$ 35,000
11	Hazwoper Training/Medical Monitoring	4	staff	$ 2,500	$ 10,000
	General Subtotal				$ 268,000
	Trail Work				
12	Close redundant spurs	3	ea	$ 1,000.00	$ 3,000
13	Gravel trails	151,811	sf	$ 2.39	$ 362,829
14	Excavate soil from one section	39	ton	$ 20.00	$ 770
15	Grade section of trail	12,721	sf	$ 0.82	$ 10,415
	Trail Subtotal				$ 377,015
	Units 3c, 3e and 5				
16	Clear and grub 3c and 3e	16.5	Acre	$ 1,000	$ 16,480
17	Clear 5 - light vegetation	3.9	Acre	$ 500	$ 1,950
18	Soil excavation, stockpile, and load Units 3c, 3e, 5	28,831	CY	$ 12	$ 345,972
19	Off-site Transport of affected soil	40,617	Ton	$ 32	$ 1,294,660
20	Off-site Disposal of affected soil at Subtitle D	40,617	Ton	$ 42	$ 1,705,905
21	Place 6-in layer of topsoil at Unit 3c	10,003	CY	$ 40	$ 400,107
22	Gravel at Unit 5	7,786	Ton	$ 15	$ 116,795
23	Place and compact gravel at Unit 5	5,191	CY	$ 5	$ 25,955
24	Regrade Units 3c and 3e	16.5	Acre	$ 1,000	$ 16,480
25	Water truck for dust control, operator and truck	6.0	month	$ 15,000	$ 90,000
26	Revegetate 3c	12.4	Acre	$ 10,000	$ 124,000
27	Hydroseed 3e	4.1	AC	$ 2,000	$ 8,160
				$ -	$ -
	Subtotal, Unit 3c, 3e and Unit 5				$ 4,146,464
	Testing				
28	Total Metals	200	EA	$ 60	$ 12,000
29	TCLP Metals	20	EA	$ 160	$ 3,200
30	XRF Field Testing	1	LS	$ 30,000	$ 30,000
	Subtotal Testing				$ 45,200

Table A-1

Alternative 1 - Construction Estimate

Maury Island Open Space Property FS

Maury Island, Washington

Estimated field duration:	3 months active site; 7 months hauling and trails
Project Name:	Maury Island Cleanup - Engineers Estimate
Location:	Maury Island, Washington
Date:	4/10/2017
Contractor:	
Prepared By:	David Dinkuhn, P.E.
Approved By:	

Rev: 2

Item #	Item Description	Quantity	Unit	Unit Price	Total
	Reports				
31	Closure report	1	LS	$ 30,000	$ 30,000
	Subtotal, Reports				$ 30,000
	Subtotal				$ 5,267,979
32	Contingency 25%	1	LS	$ 1,316,995	$ 1,316,995
	Subtotal, with contingency	1	LS		$ 6,584,973
	Misc				
33	Contractor markup 15%	1	LS	$ 987,746	$ 987,746
34	*Insurance 1.5%*	1	LS	$ 98,775	$ 98,775
35	*B&O Tax .65%*	1	LS	$ 42,802	$ 42,802
36	*Ecology Costs*	1	LS	$ 10,000	$ 10,000
37	*Bond 2%*	1	LS	$ 131,699	$ 131,699
38	*Tax 8.6%*	1	LS	$ 566,308	$ 566,308
	Grand Total				**$ 8,422,304**

Table A-2
Alternative 2 - Construction Estimate
Maury Island Open Space Property FS
Maury Island, Washington

Estimated field duration: 6 months - 4 months active at site for cell construction, hauling; extra 2 mo for concurrent trails and restoration

Project Name:	Maury Island Cleanup - Engineers Estimate
Location:	Maury Island, Washington
Date:	4/10/2017
Contractor:	
Prepared By:	David Dinkuhn, P.E.
Approved By:	

Rev: 2

Item #	Item Description	Quantity	Unit	Unit Price	Total
	Engineering				
1	Work Plans	1	LS	$ 100,000	$ 100,000
2	Design Engineering for KC and Ecology Review, Stamped	1	LS	$ 125,000	$ 125,000
3	Engineering and oversight during Construction	1	LS	$ 132,000	$ 132,000
4	Project management support	1	LS	$ 50,000	$ 50,000
	Engineering Subtotal				$ 407,000
	General				
5	General Conditions/Permits	1	EA	$ 150,000	$ 150,000
6	Mobilization/Demobilization	1	LS	$ 25,000	$ 25,000
7	Decontamination Facilities, Equipment	1	EA	$ 15,000	$ 15,000
8	Decontamination Facilities, Personnel	1	EA	$ 8,000	$ 8,000
9	Surveying	1	EA	$ 30,000	$ 30,000
10	TESC	1	EA	$ 35,000	$ 35,000
11	Hazwoper Training/Medical Monitoring	4	staff	$ 2,500	$ 10,000
	General Subtotal				$ 273,000
	Trail Work				
12	Close redundant spurs	3	ea	$ 1,000.00	$ 3,000
13	Gravel trails	151,811	sf	$ 2.39	$ 362,829
14	Excavate soil from one section	39	ton	$ 20.00	$ 770
15	Grade section of trail	12,721	sf	$ 0.82	$ 10,415
16	New trail construction	1,443	sf	$ 7.36	$ 10,623
	Trail Subtotal				$ 387,637
	Units 3c and 5				
17	Clear and grub 3c	12.4	Acre	$ 1,000	$ 12,400
18	Clear 5 - light vegetation	3.9	Acre	$ 500	$ 1,950
19	Soil excavation and stockpile affected soil at Unit 5	4,719	CY	$ 5	$ 23,595
20	Create containment cell at Unit 5 location (cover soil and volume for 3c soil)	28,846	CY	$ 10	$ 288,464
21	Soil excavation from Unit 3c, haul to Unit 5, bury and compact at Unit 5	15,004	CY	$ 16	$ 240,064
22	Fill/compact Unit 5 cell with affected soil from 5 (stockpile built earlier)	4,719	CY	$ 10	$ 47,190
23	Geofabric Unit 5 cell	186,872	sf	$ 0.10	$ 18,687
24	Cover Unit 5 cell with clean soil	13,842	CY	$ 10	$ 138,424
25	Gravel at Unit 5	7786	Ton	$ 15	$ 116,795
26	Place and compact gravel at Unit 5	5,190.9	CY	$ 5	$ 25,955
27	Backfill Unit 3c with clean spoils from Unit 5 (load, haul, place/compact)	15,004	CY	$ 16	$ 240,064
28	Place 6-in layer of topsoil at Unit 3c	10,003	CY	$ 40	$ 400,107
29	Water truck for dust control, operator and truck	4.0	month	$ 15,000	$ 60,000
30	Revegetation/restoration Unit 3c	12.4	AC	$ 10,000	$ 124,000

Table A-2
Alternative 2 - Construction Estimate
Maury Island Open Space Property FS
Maury Island, Washington

Estimated field duration: 6 months - 4 months active at site for cell construction, hauling; extra 2 mo for concurrent trails and restoration

Project Name:	Maury Island Cleanup - Engineers Estimate
Location:	Maury Island, Washington
Date:	4/10/2017
Contractor:	
Prepared By:	David Dinkuhn, P.E.
Approved By:	

Rev: 2

Item #	Item Description	Quantity	Unit	Unit Price	Total
	Unit 3e				
31	Clear and grub 3e (blackberries)	4.1	Acre	$ 500	$ 2,040
32	Excavate, stockpile, and cover mound material	2,500.0	CY	$ 15	$ 37,500
33	Manage presumed debris	400.0	Ton	$ 100	$ 40,000
34	Test and excavate additional affected soil	6,582	CY	$ 11	$ 72,406
35	Create containment cell at Unit 3e location (cover soil)	14,481	CY	$ 10	$ 144,811
36	Fill/compact Unit 3e cell with affected soil from 3e and mounds (stockpile built earlier)	9,082	CY	$ 10	$ 90,823
37	Geofabric Unit 3e cell	195,495	sf	$ 0.10	$ 19,550
38	Cover Unit 3e cell with clean soil	14,481	CY	$ 10	$ 144,811
39	Water truck for dust control, operator and truck	2.0	month	$ 15,000	$ 30,000
40	Hydroseed Unit 3e	4.1	AC	$ 2,000	$ 8,160
				$ -	$ -
	Subtotal, Unit 3c and Unit 5				$ 2,327,796
	Testing				
41	Total Metals	200	EA	$ 60	$ 12,000
42	TCLP Metals	20	EA	$ 160	$ 3,200
43	XRF Field Testing	1	LS	$ 30,000	$ 30,000
	Subtotal Testing				$ 45,200
	Reports				
44	Closure report	1	LS	$ 30,000	$ 30,000
	Subtotal, Reports				$ 30,000
	Subtotal				$ 3,470,634
45	Contingency 25%	1	LS	$ 867,658	$ 867,658
	Subtotal, with contingency	1	LS		$ 4,338,292
	Misc				
46	Contractor markup 15%	1	LS	$ 650,744	$ 650,744
47	*Insurance 1.5%*	1	LS	$ 65,074	$ 65,074
48	*B&O Tax .65%*	1	LS	$ 28,199	$ 28,199
49	*Ecology Costs*	1	LS	$ 10,000	$ 10,000
50	*Bond 2%*	1	LS	$ 86,766	$ 86,766
51	*Tax 8.6%*	1	LS	$ 373,093	$ 373,093
	Grand Total				**$ 5,552,168**

Table A-3
Alternative 3 - Construction Estimate
Maury Island Open Space Property FS
Maury Island, Washington

Estimated field duration:	2 months for soil excavation and disposal; 4 more months for trail work
Project Name:	Maury Island Cleanup - Engineers Estimate
Location:	Maury Island, Washington
Date:	4/10/2017
Contractor:	
Prepared By:	David Dinkuhn, P.E.
Approved By:	

Rev: 2

Item #	Item Description	Quantity	Unit	Unit Price	Total
	Engineering				
1	Work Plans	1	LS	$ 75,000	$ 75,000
2	Design Engineering for KC and Ecology Review, Stamped	1	LS	$ 75,000	$ 75,000
3	Engineering and oversight during Construction	1	LS	$ 78,600	$ 78,600
4	Project management support	1	LS	$ 40,000	$ 40,000
	Engineering Subtotal				$ 268,600
	General				
5	General Conditions/Permits	1	EA	$ 100,000	$ 100,000
6	Mobilization/Demobilization	1	LS	$ 15,000	$ 15,000
7	Decontamination Facilities, Equipment	1	EA	$ 10,000	$ 10,000
8	Decontamination Facilities, Personnel	1	EA	$ 4,000	$ 4,000
9	Surveying	1	EA	$ 15,000	$ 15,000
10	TESC	1	EA	$ 15,000	$ 15,000
11	Hazwoper Training/Medical Monitoring	4	staff	$ 2,500	$ 10,000
	General Subtotal				$ 169,000
	Trail Work				
12	Close redundant spurs	3	ea	$ 1,000.00	$ 3,000
13	Gravel trails	155,479	sf	$ 2.39	$ 371,595
14	Soil Mix section of trail	6,008	sf	$ 1.31	$ 7,870
15	Grade section of trail	14,771	sf	$ 0.33	$ 4,838
16	New Trail	1,443	sf	$ 7.36	$ 10,623
	Subtotal, Trails				$ 397,926
	Unit 5				
17	Clear 5 - light vegetation	3.9	Acre	$ 500	$ 1,950
18	Soil excavation and stockpile, and stockpile top 6 inches of Unit 5	3,135	CY	$ 12	$ 37,618
19	Off-site Transport of affected soil	3,448	Ton	$ 32	$ 109,916
20	Off-site Disposal of affected soil at Subtitle D	3,448	Ton	$ 42	$ 144,831
21	Gravel at Unit 5	7759	Ton	$ 15	$ 116,382
22	Place and compact gravel at Unit 5	5,172.5	CY	$ 5	$ 25,863
23	Water truck for dust control, operator and truck	2.0	month	$ 15,000	$ 30,000
				$ -	$ -
	Subtotal, Unit 5				$ 466,561
	Testing				
24	Total Metals	50	EA	$ 60	$ 3,000
25	TCLP Metals	20	EA	$ 160	$ 3,200
26	XRF Field Testing	1	LS	$ 4,000	$ 4,000
	Subtotal Testing				$ 10,200

Table A-3
Alternative 3 - Construction Estimate
Maury Island Open Space Property FS
Maury Island, Washington

Estimated field duration:	2 months for soil excavation and disposal; 4 more months for trail work
Project Name:	Maury Island Cleanup - Engineers Estimate
Location:	Maury Island, Washington
Date:	4/10/2017
Contractor:	
Prepared By:	David Dinkuhn, P.E.
Approved By:	

Rev: 2

Item #	Item Description	Quantity	Unit	Unit Price	Total
	Reports				
27	Closure report	1	LS	$ 20,000	$ 20,000
	Subtotal, Reports				$ 20,000
	Subtotal				$ 1,332,286
28	Contingency 25%	1	LS	$ 333,072	$ 333,072
	Subtotal, with contingency	1	LS		$ 1,665,358
	Misc				
29	Contractor markup 15%	1	LS	$ 249,804	$ 249,804
30	*Insurance 1.5%*	1	LS	$ 24,980	$ 24,980
31	*B&O Tax .65%*	1	LS	$ 10,825	$ 10,825
32	*Ecology Costs*	1	LS	$ 10,000	$ 10,000
33	*Bond 2%*	1	LS	$ 33,307	$ 33,307
34	*Tax 8.6%*	1	LS	$ 143,221	$ 143,221
	Grand Total				**$ 2,137,495**

Table A-4
Alternative 4 - Construction Estimate
Maury Island Open Space Property FS
Maury Island, Washington

Estimated field duration:	2 months excavation and disposal; 2 months for trail work
Project Name:	Maury Island Cleanup - Engineers Estimate
Location:	Maury Island, Washington
Date:	4/10/2017
Contractor:	
Prepared By:	Matthew Schultz
Approved By:	

Rev: 2

Item #	Item Description	Quantity	Unit	Unit Price	Total
	Engineering				
1	Work Plans	1	LS	$ 75,000	$ 75,000
2	Design Engineering for KC and Ecology Review, Stamped	1	LS	$ 75,000	$ 75,000
3	Engineering and oversight during Construction	1	LS	$ 61,800	$ 61,800
4	Project management support	1	LS	$ 40,000	$ 40,000
	Engineering Subtotal				$ 251,800
	General				
5	General Conditions/Permits	1	EA	$ 100,000	$ 100,000
6	Mobilization/Demobilization	1	LS	$ 15,000	$ 15,000
7	Decontamination Facilities, Equipment	1	EA	$ 10,000	$ 10,000
8	Decontamination Facilities, Personnel	1	EA	$ 4,000	$ 4,000
9	Surveying	1	EA	$ 15,000	$ 15,000
10	TESC	1	EA	$ 15,000	$ 15,000
11	Hazwoper Training/Medical Monitoring	4	staff	$ 2,500	$ 10,000
	General Subtotal				$ 169,000
	Trail Work				
12	Close redundant spurs	3	ea	$ 1,000	$ 3,000
13	Gravel trails	21,896	sf	$ 2.39	$ 52,332
14	Soil Mix section of trail	6,008	sf	$ 1.31	$ 7,870
15	Grade section of trail	14,771	sf	$ 0.33	$ 4,838
16	New Trail	1,443	sf	$ 7.36	$ 10,623
17					
	Subtotal, Trails				$ 78,662
	Unit 5				
18	Clear 5 - light vegetation	3.9	Acre	$ 500	$ 1,950
19	Soil excavation and stockpile top 6 inches of Unit 5	3,135	CY	$ 12	$ 37,618
20	Off-site Transport of affected soil	3,448	Ton	$ 32	$ 109,916
21	Off-site Disposal of affected soil at Subtitle D	3,448	Ton	$ 42	$ 144,831
22	Gravel at Unit 5	7759	Ton	$ 15	$ 116,382
23	Place and compact gravel at Unit 5	5,173	CY	$ 5	$ 25,863
24	Water truck for dust control, operator and truck	2.0	month	$ 15,000	$ 30,000
				$ -	$ -
	Subtotal, Unit 5				$ 466,561
	Testing				
25	Total Metals	50	EA	$ 60	$ 3,000
26	TCLP Metals	20	EA	$ 160	$ 3,200
27	XRF Field Testing	1	LS	$ 4,000	$ 4,000
	Subtotal Testing				$ 10,200

Table A-4
Alternative 4 - Construction Estimate
Maury Island Open Space Property FS
Maury Island, Washington

Estimated field duration:	2 months excavation and disposal; 2 months for trail work
Project Name:	Maury Island Cleanup - Engineers Estimate
Location:	Maury Island, Washington
Date:	4/10/2017
Contractor:	
Prepared By:	Matthew Schultz
Approved By:	

Rev: 2

Item #	Item Description	Quantity	Unit	Unit Price	Total
	Reports				
28	Closure report	1	LS	$ 20,000	$ 20,000
	Subtotal, Reports				$ 20,000
	Subtotal				$ 996,223
29	Contingency 25%	1	LS	$ 249,056	$ 249,056
	Subtotal, with contingency	1	LS		$ 1,245,279
	Misc				
30	Contractor markup 15%	1	LS	$ 186,792	$ 186,792
31	*Insurance 1.5%*	1	LS	$ 18,679	$ 18,679
32	*B&O Tax .65%*	1	LS	$ 8,094	$ 8,094
33	*Ecology Costs*	1	LS	$ 10,000	$ 10,000
34	*Bond 2%*	1	LS	$ 24,906	$ 24,906
35	*Tax 8.6%*	1	LS	$ 107,094	$ 107,094
	Grand Total				**$ 1,600,844**

Table A-5
Alternative 5 - Construction Estimate
Maury Island Open Space Property FS
Maury Island, Washington

Estimated field duration:	8 months
Project Name:	Maury Island Cleanup - Engineers Estimate
Location:	Maury Island, Washington
Date:	4/6/2017
Contractor:	
Prepared By:	David Dinkuhn
Approved By:	

Rev: 1

Item #	Item Description	Quantity	Unit	Unit Price	Total
	Engineering				
1	Work Plans	1	LS	$ 75,000	$ 75,000
2	Design Engineering for KC and Ecology Review, Stamped	1	LS	$ 75,000	$ 75,000
3	Engineering and oversight during Construction	1	LS	$ 100,000	$ 100,000
4	Project management support	1	LS	$ 45,000	$ 45,000
	Engineering Subtotal				$ 295,000
	General				
5	General Conditions/Permits	1	EA	$ 100,000	$ 100,000
6	Mobilization/Demobilization	1	LS	$ 15,000	$ 15,000
7	Decontamination Facilities, Equipment	1	EA	$ 10,000	$ 10,000
8	Decontamination Facilities, Personnel	1	EA	$ 4,000	$ 4,000
9	Surveying	1	EA	$ 15,000	$ 15,000
10	TESC	1	EA	$ 15,000	$ 15,000
11	Hazwoper Training/Medical Monitoring	4	staff	$ 2,500	$ 10,000
	General Subtotal				$ 169,000
	Trail and Graded Road Work				
12	Signs and hygiene stations	1	LS	$ 10,000	$ 10,000
13	Gravel trails	23,500	sf	$ 2.39	$ 56,165
14	Gravel graded road	52,000	sf	$ 0.55	$ 28,600
15	3-inches mineral soil trails and graded road	75,500	sf	$ 1.00	$ 75,500
16	New Trail	1,443	sf	$ 7.36	$ 10,620
	Subtotal, Trails and Graded Road				$ 180,885
	Units 3c, 3e, and 5				
17	Clear and grub 3c and 3e	16.5	Acre	$ 1,000	$ 16,500
18	Area 3c remove obstructions including chain link fence	1	LS	$ 10,000	$ 10,000
19	Clear 5 - light vegetation	1.0	Acre	$ 5,000	$ 5,000
20	Removed Cont. Soil/Duff Wetland	200	Ton	$ 200	$ 40,000
21	Off-site transport of mixed vegetation/soil (17 Acre)	3,400	Ton	$ 32	$ 108,375
22	Off-site disposal of mixed vegatation/soil (17 Acre)	3,400	Ton	$ 42	$ 142,800
23	Gravel for parking lot and driveway	5810	Ton	$ 15	$ 87,150
24	6-foot chain link fence	725	lf	$ 50.00	$ 36,250
25	Place and compact gravel at Unit 5	3,140	CY	$ 5	$ 15,700
26	Regrade Units 3c and 3e	16.5	Acre	$ 1,000	$ 16,480
27	3-inches compost 3c and 3e	6,655	CY	$ 60	$ 399,300
28	Revegetate 3c and 3e	16.5	Acre	$ 66,000	$ 1,089,000
29	Water truck for dust control, operator and truck	4.0	month	$ 15,000	$ 60,000
	Subtotal, Units 3c, 3e, and 5				$ 2,026,555
	Testing				
30	Total Metals	50	EA	$ 60	$ 3,000
31	TCLP Metals	20	EA	$ 160	$ 3,200
32	XRF Field Testing	1	LS	$ 4,000	$ 4,000

Table A-5
Alternative 5 - Construction Estimate
Maury Island Open Space Property FS
Maury Island, Washington

Estimated field duration:	8 months
Project Name:	Maury Island Cleanup - Engineers Estimate
Location:	Maury Island, Washington
Date:	4/6/2017
Contractor:	
Prepared By:	David Dinkuhn
Approved By:	

Rev: 1

Item #	Item Description	Quantity	Unit	Unit Price	Total
	Subtotal Testing				$ 10,200
	Reports				
33	Closure report	1	LS	$ 20,000	$ 20,000
	Subtotal, Reports				$ 20,000
	Subtotal				$ 2,701,640
34	Contingency 25%	1	LS	$ 675,410	$ 675,410
	Subtotal, with contingency	1	LS		$ 3,377,051
	Misc				
35	Contractor markup 15%	1	LS	$ 506,558	$ 506,558
36	*Insurance 1.5%*	1	LS	$ 50,656	$ 50,656
37	*B&O Tax .65%*	1	LS	$ 21,951	$ 21,951
38	*Ecology Costs*	1	LS	$ 10,000	$ 10,000
39	*Bond 2%*	1	LS	$ 67,541	$ 67,541
40	*Tax 8.6%*	1	LS	$ 290,426	$ 290,426
	Grand Total				**$ 4,324,182**