ENGINEERING EVALUATION/COST ANALYSIS

Kalaloch Firing Range
Olympic National Park
Kalaloch, Washington

February 24, 2012

Prepared for:

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APPENDICES

1.0 EXECUTIVE SUMMARY

This Engineering Evaluation/Cost Analysis (EE/CA) has been prepared to address lead contamination at the former Kalaloch Firing Range, located in Olympic National Park (ONP). This EE/CA provides supporting documentation for a non-time critical removal action (NTCRA) at the Kalaloch Firing Range (Site). The EE/CA is being conducted in accordance with Guidance on Conducting Non-Time Critical Removal Actions under CERCLA (EPA, 1993).

The EE/CA is a streamlined focused document that provides site characterization data, assesses human health risks, evaluates ecological exposures, evaluates various response alternatives, recommends a preferred response alternative and provides a vehicle for public involvement. This EE/CA was conducted in accordance with the ONP approved EE/CA Work Plan (RMC, 2010a).

A Site Location Map is presented in Figure 1-1.

The sole threat consists of non-industrial lead impacted soils from use of the Site as a firing range. Two sources of contamination have been identified in the EE/CA:

- Lead in soils; and
- Lead in groundwater.

One Remedial Action Objective (RAO) has been established for the Site:

- Minimize the potential for lead impacts to human health and the environment.

The EE/CA analyzed the following response action alternatives:

- Alternative 1 – No Action;
- Alternative 2 – Institutional Controls;
- Alternative 3 – Removal, On-Site Treatment and Offsite Disposal; and
- Alternative 4 – Removal and Offsite Disposal at an Appropriate Disposal Facility.

Alternative 4 was selected as the Preferred Alternative. Alternative 4 consists of excavation, off-site disposal of contaminated soils at an appropriate disposal facility.

2.0 SITE CHARACTERIZATION

This Section describes Site background, characterization of impacts, risk evaluation and the development of Preliminary Remedial Goals (PRGs).

2.1 Site Description and Background Information

The former Kalaloch Firing Range is located approximately 0.25 miles east of Highway 101 in Jefferson County, Washington. A Site Location Map is presented in Figure 1-1. The elevation of the Site is approximately fifty feet above mean sea level (Baker, 2007). The Site is owned by the National Park Service and is within Olympic National Park. The site was used by NPS Law Enforcement Rangers from 1975 until 2001. Various types of small arms were believed to have been used at the range. The range consisted of eleven metal target stands, roughly seven to ten feet apart. There is no backstop or berm present although natural topography presents a significant rise downrange. The area behind the stands is heavily vegetated, overgrown and wet in many places. No visible signs of spent bullets or lead were noted during the site visit documented in the Technical Review Report (Baker, 2007). This is consistent with the results of Site characterization performed as part of this EE/CA (Section 2.3).

2.2 Previous Investigations and Site Activities

One previous Site investigation was conducted and is documented in the Technical Review Report (Baker, 2007). During the Site investigation seven soil samples were collected with reported lead concentrations ranging from 12 to 5,200 parts per million (ppm) (Baker, 2007). Sample locations and results are presented in Appendix A. The concentrations were compared to the USEPA Action Level of 400 ppm for lead in residential settings (Baker, 2007). Four of the samples exceed the USEPA Action Level for residential settings. In addition, the data were also compared to USEPA Ecological Soil Screening Levels (Eco-SSls, USEPA OSWER Directive #9285.7-70, 2005). Eco-SSLs are concentrations of contaminants in soil that are protective of ecological receptors that commonly come into contact with soil or ingest biota that live on or in soil. Total lead concentrations were compared to Eco-SSLs for birds and mammals, of which several of the samples exceed the screening criteria for the following species:

- Avian Herbivore, Dove (46 ppm);
- Avian Ground Insectivore, Woodcock (11 ppm);
- Avian Carnivore, Hawk (510 ppm);
- Mammalian Herbivore, Vole (1,200 ppm);
- Mammalian Ground Insectivore, Shrew (56 ppm); and
- Mammalian Carnivore, Weasel (460 ppm).

Three samples were analyzed to determine if they would be characterized as "hazardous waste" if disposed off-Site using the Toxicity Characteristic Leaching Procedure (TCLP). Two of the three samples had TCLP lead concentrations above the regulatory level of 5 ppm which requires the waste to be treated or disposed of as hazardous waste.

The results from the Site Investigation are provided in Appendix A and the results are summarized in subsequent sections of this EE/CA.

2.3 Source, Nature and Extent of Contamination

This section presents the results of Site characterization activities conducted as part of this EE/CA. All Site activities and data analysis were conducted in accordance with the Sampling and Analysis Plan (SAP, RMC, 2010b). Sample locations are presented in Figure 2-1. Site Characterization sample results are presented in Tables 2-1 through 2-3. Analytical laboratory reports are presented in Appendix B.

2.3.1 Soil

Soil samples were characterized using three methods:

- Real-time lead screening using a field-portable X-Ray fluorescence meter (XRF);
- Analysis for lead by a laboratory certified by the State of Washington; and
- Toxicity characteristic leaching procedure (TCLP) analysis for lead.

XRF data is presented in Table 2-1. Analytical laboratory soil data is presented in Table 2-2. Soil concentrations are compared to State of Washington Model Toxics Control Act (MTCA) soil screening criteria (WaDOE, 2007) of 50 ppm for plants, which are more conservative than the typical EPA human health risk criteria of 400 ppm. Health risk criteria details are presented in Section 2.5.

Twenty-four soil samples were analyzed for lead with the XRF. Samples analyzed by the XRF were collected as surface samples at a depth of 0-2 inches. Lead concentrations range from 36.2 to 7,606 parts per million (ppm). XRF screening was used for comparative purposes, actual clean up limits are based on the laboratory data presented below. XRF screening was conducted in-situ, whereas laboratory samples were collected per the Sampling and Analyses Plan (REMC, 2011) and analyzed according to EPA Method 6010. Soil sampling results can vary between in-situ analyses and total digestion of the same sample. Analytical results can also vary due to the nature of how bullets impact soils, fragmentation, and sample collection methods. It is not uncommon when analyzing soils, specifically for metals, that the analytical results will vary

significantly. This variance between laboratory and XRF results is most pronounced at KSL-2 shown on Figure 2-1 and reported in Tables 2-1 and 2-2.

Fifteen soil samples were collected and submitted to the analytical laboratory. Eleven samples were collected as surface samples at a depth of 0-2 inches. Two samples were collected as at-depth samples with one sample collected at a depth of 0-6 inches and one sample collected at a depth of 2-4 inches. One Quality Assurance/Quality Control (QA/QC) blind duplicate soil sample was submitted to the laboratory. One sample was collected for background analysis, this sample contained 9.8 ppm lead which was the lowest lead concentration recorded in the laboratory samples. Lead concentrations in the laboratory samples ranged from 9.8 to 3,190 ppm. Six surface samples contained lead concentrations greater than the EPA residential screening level of 400 ppm. Thirteen surface samples contained lead concentrations greater than the State of Washington Model Toxics Control Act soil screening criteria for plants of 50 ppm. The two at-depth samples contained lead concentrations of 68.9-138 ppm.

One sample was analyzed to determine if it would be characterized as "hazardous waste" if disposed of off-Site using the Toxicity Characteristic Leaching Procedure (TCLP). The sample had TCLP lead concentrations of 11.2 ppm, which is above the regulatory level of 5 ppm. This concentration requires the waste to be treated or disposed of as hazardous waste. Site soils excavated during removal activities will be characterized prior to disposal.

The extents of soil impacts are presented on Figure 2-1. The area of impacted soils encompasses approximately 26,091 ft^2. Elevation varies significantly at the Site (Figure 2-2), there is approximately a 30-foot rise in the ground from the firing line to KSL-2 approximately 200 feet downrange of the targets. Elevated lead concentrations at KSL-2 appear to be fragments of lead or a random ricochet. Nearby sample results at KSL-4, SHT 12, SHT 13 and SHT 14 are more indicative of downrange lead concentrations. The greatest lead concentrations are within 100 feet downrange of the targets. Based on the results of the two at-depth samples, a conservative estimate of the maximum depth required to remove lead contamination is six inches. Based on the area presented in Figure 2-1, the total volume of in-situ soil to be removed is 13,046 ft^3. Soil removal volume calculations will include a swell factor of 25%. Soil tonnage was calculated using a weight of 1.22 tons per yd^3. Soil volume calculations are presented below:

Area (ft^2) * Depth (ft) = Volume (ft^3) = Volume (yd^3)* Swell Factor = Final Volume (yd^3)

26,091 ft^2 (area) * 0.5 foot (depth) = 13,046 ft^3 = 483 yd^3 * 1.25 (swell factor) = 604 yd^3

One cubic yard of moist soil weighs approximately 1.22 tons. 604 yd^3 will weigh approximately 737 tons. This is the estimated soil mass for removal purposes.

2.3.2 Surface and Shallow Groundwater

Surface and groundwater results are presented in Table 2-3. Two surface water and one groundwater sample were collected. One QA/QC blind duplicate sample was submitted to the analytical laboratory. Surface water samples were collected at up and downgradient locations. The groundwater sample was collected downgradient of the firing range. Water samples were originally analyzed using EPA Method 6010. The samples were re-run using EPA method 6020 which provides significantly lower Laboratory Detection Limits (LDLs).

The two surface water samples did not contain detectable concentrations of total or dissolved lead. The total groundwater sample contained 40 parts per billion (ppb) total lead as determined by EPA method 6020 and 57.5 ppb lead as determined by EPA method 6010. Both of these concentrations exceed the Federal and State drinking water standard of 15 ppb. The groundwater sample did not contain detectable quantities of dissolved lead. The total lead may be related to the general turbidity of the sample which was collected in a temporary micropiezometer. The sample was collected at a depth of approximately one to two feet in a shallow groundwater zone that is not used for any consumptive purposes.

2.3.3 Data Validation

A Data Validation Report is presented in Appendix C. The results of the Quality Assurance Review indicate that overall, the analytical data are of good quality and acceptable for use.

2.4 Preliminary Remedial Goals

Preliminary Remedial Goals are based on acceptable screening levels by the State of Washington which are more protective than typical EPA values. These levels are general values that have been determined to be protective of human health and the environment. The PRGs used by this EE/CA are described in subsequent sections.

2.4.1 Soil PRGs

The soil PRG proposed for the Site is 50 ppm lead as based on the State of Washington Model Toxics Control Act (MTCA) soil screening criteria for plants (WaDOE, 2007). The PRG was selected based on the following factors:

- Meets unrestricted use for human health and is protective of ecological receptors. This value is more conservative than the typical EPA criteria of 400 ppm for residential land-use;

- The likelihood of impacting a threatened or endangered species is low. A life-list of plant, animal amphibians and reptiles occurring in the coastal forest of Olympic National Park, as based on information presented on the NPS website, was compared to Federal and State Threatened and Endangered (T&E) listings. The life-list did not contain federal or state listed T&E species; and
- After remediation, no part of the site will exceed MTCA plant and wildlife screening levels.

Further information on screening levels and how they relate to PRGs are provided in Section 2.5.

2.4.2 Groundwater PRGs

Groundwater PRGs are based on EPA and State of Washington Drinking Water Standards of 15 ppb lead.

2.4.3 Surface Water PRGs

Lead was not detected at concentrations above laboratory detection levels, therefore PRGs for surface water are not required.

2.5 Streamlined Risk Evaluation

This Section presents the results of Human Health (HHRE) and Ecological Risk Evaluation (ERE).

2.5.1 Human Health Risk Evaluation

This Streamlined HHRE based human health risk-related criteria for lead on the following:

- EPA Region 9 Residential Preliminary Remediation Goal (PRG) of 400 ppm (EPA, 2010);
- EPA Region 3 Residential Risk-Based Concentration (RBC) of 400 ppm (EPA, 2010);
- Regional Screening Levels (RSL) for Chemical Contaminants at Superfund Sites of 400 ppm (EPA, 2010); and
- State of Washington Model Toxics Control Act (MTCA) soil screening criteria of 250 ppm for unrestricted use (WaDOE, 2007).

This Streamlined HHRE compared onsite concentrations of lead in soils to the above described values. The maximum lead concentration of 3,190 ppm as determined by analytical laboratory methods exceeded all of the above screening values, thus the Site "fails" and it can go directly into the corrective action process.

2.5.2 Ecological Risk Evaluation

This Streamlined ERE based ecological risk-related criteria for lead on the following:

- EPA Region 3 Biological Technical Assistance Group (BTAG) Freshwater Screening Levels of 35.8 ppm for sediments and 0.025 ppm for water (EPA, 2006);
- Oak Ridge National Laboratory (ORNL) Toxicological Benchmarks for Screening Contaminants of Potential Concern of 500 ppm for earthworms and 900 ppm for soil microorganisms and microbial processes (ORNL, 1997); and
- State of Washington Model Toxics Control Act (MTCA) soil screening criteria (WaDOE, 2007) of 50 ppm for plants, 500 ppm for soil biota and 118 ppm for wildlife.

The Streamlined ERE compared on-Site concentrations of lead in soils to values listed in the above-described tables. The maximum lead concentration of 3,190 ppm as determined by analytical laboratory methods exceeded all of the above screening values, thus the site "fails" and it can go directly into the corrective action process.

3.0 IDENTIFICATION OF REMOVAL ACTION OBJECTIVES

This Section describes the objectives of the Removal Action.

3.1 Statutory Limits on Removal Actions

Authority for responding to releases or threats of releases from an impacted site is addressed in Section 104(a) of CERCLA, 42 U.S.C. § 9604(a). CERCLA, Section 104 and Section 300.415 of the NCP, 40 C.F.R. § 300.415, specifically address non time-critical removal actions.

3.2 Scope of the Removal for the Site

The scope of removal will be limited to removal and/or treatment of soils to comply with Site PRGs and attain conditions protective of human health and the environment. The scope will be limited to dealing directly with lead impacts from historic firing range activities.

3.3 Potential Schedules for the Removal at the Site

The schedule for removal activities will be determined by Olympic National Park and will be designed within a time frame that ensures adequate protection of public health and the environment.

3.4 Planned Removal/Remedial Activities

Planned removal activities at the Site will consist of tasks to reduce lead impacts to concentrations protective of human health and the environment. Planned removal activities may include but not be limited to:

- No Action;
- Land use restrictions;
- Excavation of impacted soils;
- Treatment of impacted soils;
- Disposal of impacted soils; and
- Site reclamation.

Potential removal activities are detailed further in Section 4.0.

3.5 Removal Action Objectives

Removal Action Objectives (RAOs) were developed based on the nature and extent of contamination as documented in Section 2.3.

Two sources of contamination have been identified in the EE/CA:

- Lead in soils; and
- Lead in shallow groundwater.

One RAO has been established for the Site:

- Minimize the potential for lead impacts to human health and the environment.

3.6 Applicable or Relevant and Appropriate Requirements

This section presents a summary of applicable or relevant and applicable requirements (ARARs) for the Site. The National Contingency Plan (NCP) requires that fund-financed removal actions under CERCLA Section 104 and removal actions pursuant to CERCLA Section 106 attain applicable or relevant and appropriate requirements (ARARs) under Federal environmental, State environmental or siting laws "to the extent practicable" considering the urgency of the situation and the scope of the removal action (See 40 C.F.R. Part 300.415(j).

3.6.1 Contaminant-Specific, Location-Specific and Action Specific Requirements

ARARs are divided into contaminant-specific, location-specific and action-specific requirements.

Contaminant-specific ARARs govern the release of material containing specific contaminants. In the case of the Kalaloch Firing Range, contaminants are limited to lead.

Location-specific ARARs relate to the geographic or physical location of the Site, rather than the nature of contaminants. These ARARs place restrictions, such as the concentration of hazardous substances or the conduct of cleanup activities, due to their location in the environment.

Action-specific ARARs are usually technology- or activity-based requirements on actions taken with respect to hazardous substances. A particular remedial activity will trigger an action-specific ARAR. Unlike contaminant- or location-specific ARARs, action-specific ARARs do not determine the remedial alternative to be used, but rather how the selected remedy must be achieved.

The removal alternatives presented in this EE/CA were selected based on a combination of contaminant-specific, location-specific and action-specific ARARs.

3.6.2 Definitions of "Applicable" and "Relevant and Appropriate"

Applicable

Applicable requirements are 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 specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Only those State standards that are identified by the State in a timely manner and are more stringent than Federal requirements may be applicable.

Relevant and Appropriate

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 CERCLA site, address problems or situations sufficiently similar to those encountered at a CERCLA site that their use is well suited to the particular site. Only those State standards that are identified in

a timely manner and are more stringent than Federal requirements may be relevant and appropriate.

3.7 Summary of Potential ARARs

A detailed list of ARARs applicable to the Site is presented in Table 3-1. These ARARs were developed to encompass all potentially relevant activities conducted on-Site.

4.0 IDENTIFICATION AND ANALYSIS OF REMOVAL ACTION ALTERNATIVES

This Section presents four removal action alternatives proposed to achieve the RAO identified in Section 3.5.

The proposed removal action alternatives include the following:

- Alternative 1 – No Action;
- Alternative 2 – Institutional Controls;
- Alternative 3 – Removal, On-Site Treatment and Offsite Disposal; and
- Alternative 4 – Removal and Offsite Disposal at an Appropriate Disposal Facility.

4.1 Evaluation Criteria

As specified by EPA guidance (USEPA, 1993), each response alternative is evaluated in terms of three criteria: Effectiveness, Implementability and Cost. These three criteria encompass the elements required to meet NCP removal criteria. The criteria are described below:

Effectiveness: The effectiveness of a proposed alternative refers to the ability to meet the response action objective, and to the degree of protectiveness of the environment as well as public and site worker health, both in the short and long term. The RAO for the Site is:

- Minimize the potential for lead impacts to human health and the environment.

Effectiveness also includes the degree of compliance with ARARs.

Implementability: Implementability addresses the technical and administrative feasibility of implementing an alternative. Technical feasibility includes the difficulty of conducting the proposed response action. Administrative feasibility includes issues such as permitting, availability of services and disposal sites and the likelihood of public and regulatory acceptance.

Cost: The cost of each proposed alternative includes direct and indirect capital costs as well as operations and maintenance (O&M) costs. Estimated costs for Alternatives 2 through 4 are presented in Tables 4-1 through 4-3. There are no costs associated with Alternative 1.

4.2 Alternative 1 - No Action

Alternative 1, No Action, is a baseline alternative by which other alternatives may be compared. No Action involves not taking any further actions to manage environmental concerns at the Site.

Effectiveness: The Site would remain as is. Implementation of the No Action alternative would not achieve the RAO. Impacts to groundwater would not be abated.

Implementability: The No Action alternative is technically feasible to implement.

Cost: As this alternative does not involve taking any actions at the Site, there are no associated costs.

4.3 Alternative 2 - Institutional Controls

Alternative 2 involves implementing institutional controls to control and warn users of hazards that they may encounter while using the Site. Institutional controls will include a set of written agreements for contractors working in impacted areas and land use and shallow groundwater deed restrictions. Institutional controls for recreational users will include the posting of warning and "No Trespassing" signs. In the event that construction is considered at the Site, construction workers would be trained in proper health and safety protocols as well as construction Best Management Practices (BMPs). A five year review program will be implemented to evaluate that the environmental quality of the Site is meeting the objectives of this alternative.

Effectiveness: Implementation of Institutional Controls would only achieve protection of human health and would not provide protection of the environment. The potential for human exposure to metals would be reduced given the assumption that recreational users obeyed posted closures and regulations. Construction worker exposure, although unlikely, would be limited by following health and safety protocols. Risks to the environment would be unabated with this Alternative. Ground water quality would likely not change, however, use restrictions would not allow the withdrawal of shallow groundwater at the Site. This would eliminate human exposure to groundwater. Long term groundwater monitoring would be required as the source would not be eliminated.

Implementability: Institutional Controls are technically feasible with no anticipated difficulties. The Site is located on land wholly owned by ONP, therefore no access agreements are required. Site users would be expected to comply with temporary closures.

Cost: Costs for implementation of Alternative 2 are presented in Table 4-1. The estimated total cost for implementation of Institutional Controls and Site Monitoring is $51,536.00.

4.4 Alternative 3 - Removal, On-Site Treatment and Offsite Disposal

Alternative 3, Waste Removal, On-Site Treatment and Offsite Disposal, involves the on-Site treatment and removal of contaminated soils. Treated soils would be removed from the Site and disposed of at a Subtitle D Landfill facility. Disposal costs for non-hazardous soils would be less than disposal costs for hazardous soils. Soils will be excavated to an on-site staging area for treatment. Soil treatment will consist of mixing the soils with reagents in the Synthetic Metals Mineralization System (SMMS) by ADT Environmental Solutions. A description of this treatment process is included in Appendix D. The SMMS treatment process creates an isomorphic mineral complex that reduces the leachability of lead to non-hazardous concentrations as determined by Toxicity Characteristic Leaching Procedure (TCLP) concentrations less than 5.0 ppm. A treatment area of approximately 0.25 acres will be established. Confirmation samples will be collected to determine that contaminated soil exceeding the Site PRG has been removed and that the soil meets disposal requirements (e.g. TCLP lead < 5 ppm). The soil will then be transported offsite to a licensed Subtitle D Landfill facility. Jefferson County landfills do not accept soils. The Site will be regraded and revegetated.

Effectiveness: Waste removal, on-Site treatment and offsite disposal would achieve the RAO. Groundwater contamination would attenuate after source removal. Groundwater monitoring would be required to document the attenuation rate and compliance with ARAR's.

Implementability: Waste removal with on-site treatment is technically feasible to implement with no anticipated difficulties.

Cost: Costs for implementation of Alternative 3 are presented in Table 4-2. The estimated total cost for implementation of Waste removal, on-site treatment and offsite disposal is $256,781.39.

4.5 Alternative 4 - Removal and Offsite Disposal at an Appropriate Disposal Facility

Alternative 4, Waste Removal and Offsite Disposal at an Appropriate Disposal Facility, involves the removal of contaminated soils exceeding the PRG. Soils will be excavated and stockpiled to an on-site staging area or direct-loaded onto trucks for transport to an appropriate disposal

facility. Confirmation samples will be collected to determine that all contamination has been removed. Jefferson County Landfills do not accept hazardous soils. The Site will be regraded and revegetated.

Effectiveness: Waste removal and offsite disposal at an appropriate disposal facility is technically feasible with no anticipated difficulties. Waste removal would achieve the RAO. Groundwater contamination would attenuate after source removal. Groundwater monitoring would be required to document attenuation rate and compliance with ARARs.

Implementability: Waste removal is technically feasible to implement with no anticipated difficulties.

Cost: Costs for implementation of Alternative 4 are presented in Table 4-3. The estimated total cost for implementation of waste removal and offsite disposal at an appropriate disposal facility is $287,994.28.

5.0 COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES

This section provides a comparative analysis of the four proposed response action alternatives discussed in Section 4.0. The ability of each proposed response action alternative to meet the criteria of effectiveness, implementability and cost is compared. Table 5-1 presents a comparison of the four proposed alternatives

5.1 Effectiveness Criteria

Each of the alternatives were comparatively analyzed to determine which alternative(s) are the most effective in obtaining compliance with the RAO.

The RAO is:

- Minimize the potential for lead impacts to human health and the environment.

Alternative 1 (No Action): This alternative would not be consistent with the RAO.

Alternative 2 (Institutional Controls): This alternative would be protective of human health. Under certain exposure scenarios this alternative may not be effective in achieving protection of the environment.

Of the two alternatives that address removal of lead-contaminated soils (Alternatives 3 and 4), both provide the same level of exposure reduction and therefore would be effective at meeting the RAO. The difference in the alternatives is related to the disposal of the material. Both

alternatives entail the offsite transport of lead-contaminated soils, however, the soils transported offsite as part of Alternative 3 will have been treated to reduce the leachability of lead to non-hazardous concentrations (as determined by TCLP testing). Alternative 3, Waste Removal, Onsite Treatment and Offsite Disposal would achieve the response objective most cost-effectively but with a slightly higher degree of Site disturbance and on-Site activities.

5.2 Implementability Criteria

Technical Feasibility: All of the alternatives are technically feasible to implement, with varying degrees of difficulty. All of the alternatives use well-established methods and protocols.

The difficulty of implementation increases from Alternative 1 to 2. Alternative 4 is easier to implement than Alternative 3. This is due to the on-site treatment of waste and disturbance of an additional 0.25-acre area for soil treatment in Alternative 3. Groundwater contamination would attenuate after source removal in both Alternative 3 and Alternative 4.

5.3 Costs

Estimated costs for alternatives 1 through 4, from least expensive to most are provided below:

Alternative	Estimated Cost
Alternative 1 - No Action	None
Alternative 2 - Institutional Controls	$51,536.00
Alternative 3 - Waste Removal, On-Site Treatment and Offsite Disposal	$256,781.39
Alternative 4 - Waste Removal, Offsite Disposal at a Hazmat Facility	$287,994.28

5.4 Comparisons

Table 5-1 presents a comparison of the four proposed alternatives. Implementing Alternatives 1 and 2 would not reduce lead concentrations in soils or shallow groundwater. Alternative 2 would reduce human health risks by use restrictions.

Alternatives 3 and 4 provide a similar level of protection to human health and the environment. The difference in these alternatives is mainly concerned with logistics, disposal options and costs. Each of these alternatives would achieve identical on-Site goals. However, the soils transported offsite as part of Alternative 3 will have been treated to reduce the leachability of lead to non-hazardous concentrations (as determined by TCLP testing). The treatment area would require 0.25 acres of additional ground disturbance and a longer time period for temporary on-Site storage. Both alternatives address groundwater impacts by source removal.

6. 0 RECOMMENDED REMOVAL ACTION ALTERNATIVE

This section provides a recommendation for the preferred Removal Action Alternative for the Site.

The Recommended Removal Action is Alternative 4 - waste removal and offsite disposal at an Appropriate Disposal Facility. This alternative involves the removal of contaminated soils and was selected due to effectiveness and implementability. The soils will be excavated and transported to an appropriate disposal facility. The following work tasks will be conducted:

1. The site will be cleared of vegetation (some large trees may be left in place);
2. Contaminated soil will be excavated;
3. Soils will be disposed of at an appropriate disposal facility;
4. Confirmation sampling (to confirm that all contaminated soils have been removed); and
5. Site reclamation.

7.0 REFERENCES

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Freshwater Screening Benchmarks,
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Notes:
1. Map Source - State of Washington Department of Transportation.

N

NOT TO SCALE

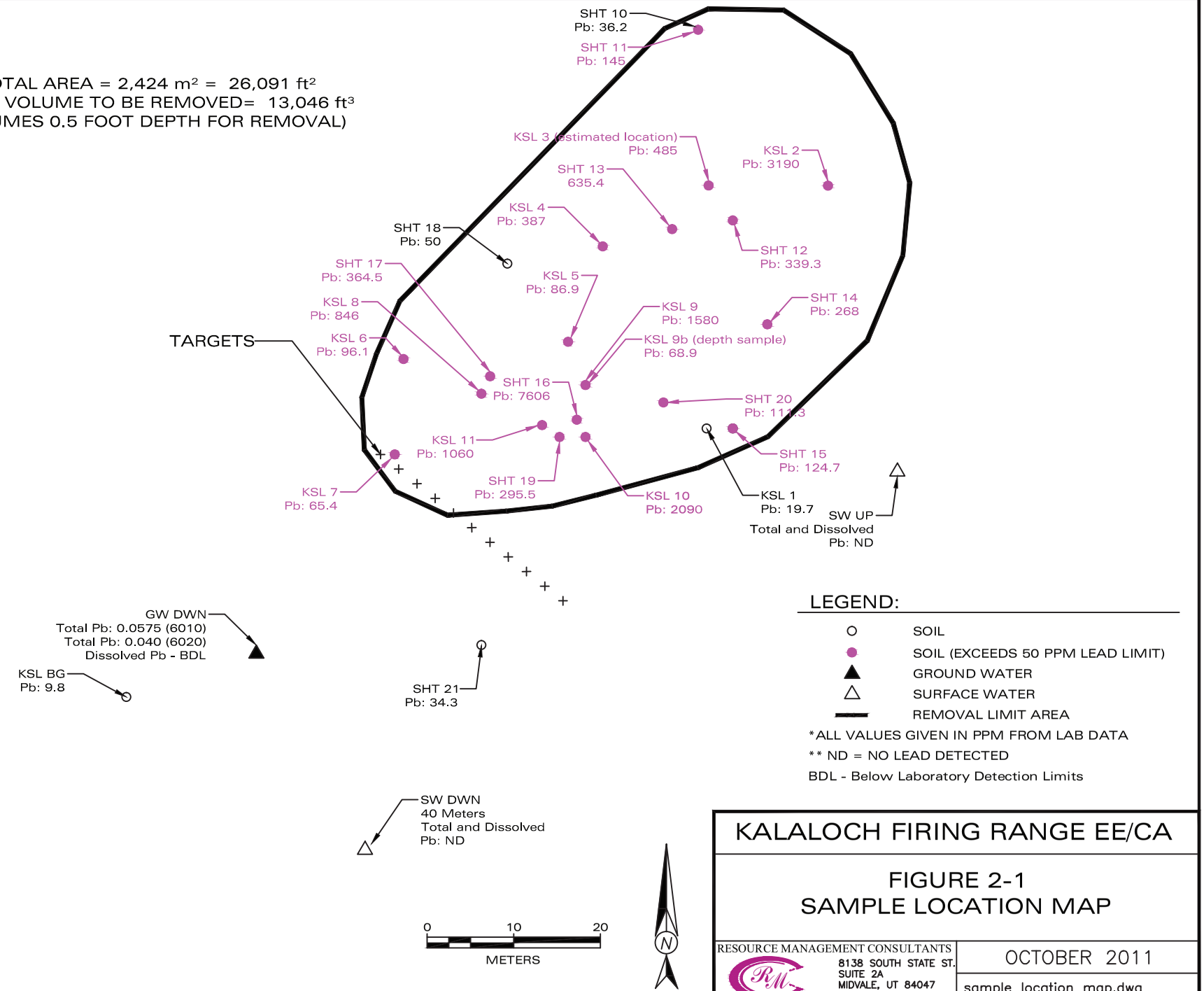
KALALOCH FIRING RANGE EE/CA

FIGURE 1-1
SITE LOCATION MAP

RESOURCE MANAGEMENT CONSULTANTS
8138 SOUTH STATE ST.
SUITE 2A
MIDVALE, UT 84047
801-255-2626

MAY 2011

oly np sap fig 1-1.dwg



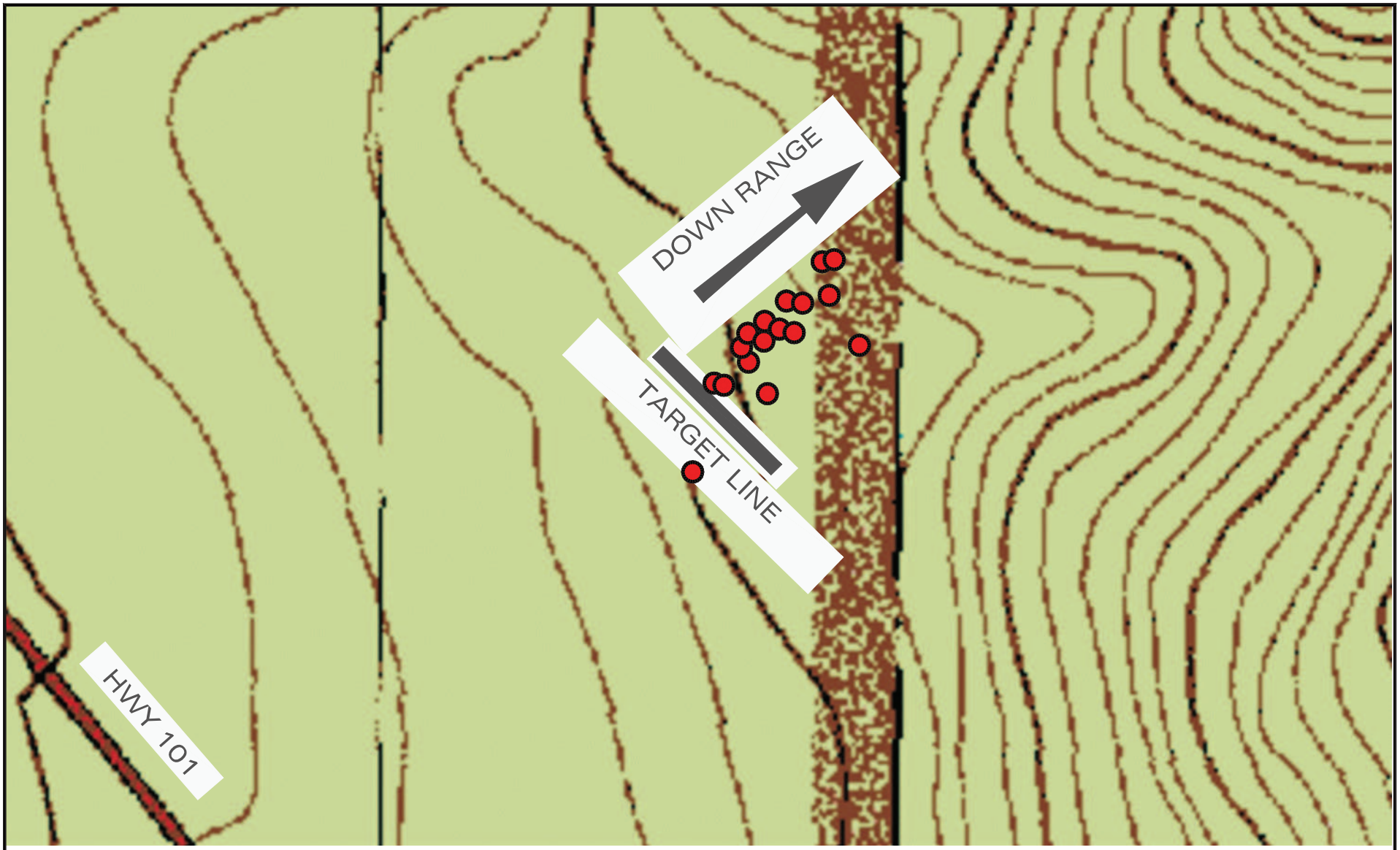
KALALOCH FIRING RANGE EE/CA

FIGURE 2-1
SAMPLE LOCATION MAP

RESOURCE MANAGEMENT CONSULTANTS
8138 SOUTH STATE ST.
SUITE 2A
MIDVALE, UT 84047
801-255-2626

OCTOBER 2011

sample location map.dwg



LEGEND

GPS POINT

CONTOUR INTERVAL = 20 FEET

MAP SOURCE: U.S.G.S DESTRUCTION ISLAND WASH. 7.5 MINUTE QUADRANGLE

0 60 120

METERS

N

KALALOCH FIRING RANGE EE/CA

FIGURE 2-2
SITE TOPOGRAPHY
AND GPS DATA

RESOURCE MANAGEMENT CONSULTANTS
8138 SOUTH STATE ST.
SUITE 2A
MIDVALE, UT 84047
801-255-2626

NOVEMBER 2011

sample location map.dwg

Table 2-1
XRF Field Soil Screening Results

XRF Sample ID	Lead (PPM) from XRF	Field Note
2610	36.2	Shot 10
2611	145	Shot 11
2612	339.3	Shot 12
2613	635.4	Shot 13
2614	268	Shot 14
2615	124.7	Shot 15
2616	7606	Shot 16
2617	364.5	Shot 17
2619	50	Shot 18
2621	295.5	Shot 19
2623	111.3	Shot 20
2624	34.3	Shot 21
2630	167.4	KSL-2
2635	44	KSL-4
2636	107.6	KSL-5
2637	52.5	KSL-6
2638	78	KSL-7
2639	296.9	KSL-8
2640	932.4	KSL-9
2643	191.2	KSL-9b
2653	1533	KSL-10

Table 2-2
Analytical Laboratory Soil Sample Results

Sample ID	6010 MET ICP Lead (PPM)	Depth	TCLP	Notes
KSL-1	19.7	0-2"		
KSL-2	3190	0-2"		
KSL-3	485	0-2"		
KSL-3b	138	0-6"		At-Depth Sample
KSL-4	387	0-2"		
KSL-5	86.9	0-2"		
KSL-6	96.1	0-2"		
KSL-7	65.4	0-2"		
KSL-8	846	0-2"		
KSL-9	1580	0-2"		
KSL-9b	68.9	2-4"		At-Depth Sample
KSL-10	2090	0-2"	11.2	
KSL-11	1060	0-2"		
KSL-511	1420	0-2"		QA/QC Duplicate of KSL-11
KSL-BG	9.8	0-2"		Background Sample

PPM = mg/kg

Table 2-3
Field and Analytical Laboratory Water Sample Results

Sample ID	Field Data			Laboratory Data				Notes
	pH	Cond. (uS/cm)	Temperature (°C)	6010 MET ICP Total Lead (PPB)	6010 MET ICP Dissolved Lead (PPB)	6020 MET ICP Total Lead (PPB)	6020 MET ICP Dissolved Lead (PPB)	
KSW-DWN	5.8	58	11	<10	<10	<0.1	<0.1	Surface water, downgradient
KSW-51DWN				<10	<10	<0.1	<0.1	QA/QC Duplicate of KSW-DWN
KSW-UP	5.9	60	10.9	<10	<10	<0.1	<0.1	Surface water, upgradient
KSW-GW				57.5	<10	40	<0.1	Groundwater

PPB = ug/L

Table 3-1
Potential Chemical Specific ARARs

Requirement	Citation	Description	Determination	Comment
Site Cleanup	Chapter 173-350 WAC	Model Toxics Control Act (MTCA)	Applicable	MTCA establishes administrative processes and standards to identify, investigate, and clean up facilities where hazardous substances have come to be located
Washington Surface Water Quality Standards	Chapter 173-201A WAC	Establishes surface water quality standards. Washington has received approval from EPA to adopt standards more stringent than federal standards.	Potentially Applicable	Potentially applicable for Site surface water and discharges.
Groundwater Quality Standards	Chapter 173-201A WAC	Establishes state groundwater quality standards.	Potentially Relevant and Appropriate	Potentially relevant and appropriate to any discharges of contaminants to ground water (if any).
Storm Water Rules - Water Pollution Control Act	Chapter 90.48 RCW	Establishes state storm water requirements.	Applicable	Applicable during any Removal Action that requires construction.

Table 3-1 (continued)
Potential Location Specific ARARs

Requirement	Citation	Description	Determination	Comment
Protection of Wetlands	33 USC § 1344	Prohibits discharge of dredged or fill materials into waters of the United States.	Potentially Applicable	Measures will be developed to avoid, restore, or mitigate impacts to jurisdictional wetlands, if any.
Historic Sites, Building and Antiquities Act	16 USC §§ 461-467	Requires protection of landmarks listed on National Registry	Applicable	Proposed activities will not adversely affect natural landmarks
National Historic Preservation	16 USC § 470	Requires protection of district, site, building, structure or object eligible for inclusion in national register of historic places	Applicable	Proposed activities will not adversely affect any such district, site, building, structure or object
Archeological and Historic Preservation Act	16 USC § 469	Requires preservation of significant historical and archeological data	Applicable	Proposed activities will not adversely affect archeological data or landmarks
Fish and Wildlife Coordination Act	16 USC § 1531 *et seq*	Requires that actions taken in areas that may affect streams and rivers be undertaken in a manner that protects fish and wildlife	Applicable	USFWS will be contacted if required.
Endangered Species Act	16 USC § 1531	Requires protection of endangered and threatened species	Applicable	USFWS will be contacted if required.
Migratory Bird Treaty Act	16 USC § 703 *et seq*	Requires protection of migratory nongame birds	Applicable	USFWS will be contacted if required.
Solid Waste Handling Standards	Chapter 173-350 WAC	Establishes requirements for handling of solid wastes.	Applicable	Applicable to material handling and treatment.

Table 3-1 (continued)
Potential Action Specific ARARs

Requirement	Citation	Description	Determination	Comment
Site Cleanup	Chapter 173-350 WAC	Model Toxics Control Act (MTCA)	Applicable	MTCA establishes administrative processes and standards to identify, investigate, and clean up facilities where hazardous substances have come to be located
Air Pollution	Chapter 173-470 WAC	General requirements for compliance with National Ambient Air Quality Standards (NAAQS)	Potentially Applicable	Potentially applicable to earth moving, grading, and excavating activities that may result in release of contaminants to air.
Fugitive Dust Control	Chapter 173-400 WAC	Establishes requirements for fugitive dust, construction activities, and roadways associated with Site cleanup.	Potentially Applicable	Potentially applicable to earth moving, grading, and excavating activities that may result in dust.
Solid Waste Handling Standards	Chapter 173-350 WAC	Establishes requirements for handling of solid wastes.	Applicable	Applicable to material handling and treatment.

TABLE 4-1
COST ESTIMATE
ALTERNATIVE 2, INSTITUTIONAL CONTROLS

	Quantity	Unit	Cost	Total Cost	
Direct Capitol Costs					
Signs	4	Sign	$50.00	$ 200.00	
Site Monitoring Plan	1	Plan	$2,000.00	$ 2,000.00	
Health and Safety Plan	1	Plan	$1,000.00	$ 1,000.00	
Develop Institutional Controls	1		$5,000.00	$ 5,000.00	
		Subtotal		**$ 8,200.00**	
Long-Term Operation and Maintenace Costs					
Operation and Maintenance	5	Year	$1,000.00	$ 5,000.00	
Annual Sampling - 5 Year Review	1	Event	$5,000.00	$ 5,000.00	
Reporting - 5 Year Review	1	Report	$2,000.00	$ 2,000.00	
Institutional Controls Monitoring and Repair	30	Year	$500.00	$ 15,000.00	
		Subtotal		**$ 27,000.00**	
			Total Direct Costs		**$ 35,200.00**
Indirect Capitol Costs					
Project Administration				$ 10,000.00	
Contingency (15% of Direct Capitol Costs)				$ 5,280.00	
Health and Safety (3% of Direct Capitol Costs				$ 1,056.00	
		Subtotal		**$ 16,336.00**	
			Total Indirect Costs		**$ 16,336.00**
		Total Costs			**$ 51,536.00**

TABLE 4-2
COST ESTIMATE
ALTERNATIVE 3, EXCAVATION, ONSITE TREATMENT AND OFFSITE DISPOSAL

	Quantity	Unit	Cost	Total Cost	
Direct Capitol Costs					
Excavation Mob/Demob	1	Unit	$ 5,000.00	$ 5,000.00	
Clearing and grubbing (range and stockpile areas)	1.25	Acre	$4,000.00	$ 5,000.00	
Excavation Contractor - Trackhoe	53	Hour	$175.00	$ 9,275.00	
Excavation Contractor -Trackhoe - Mixing/Loading	53	Hour	$175.00	$ 9,275.00	
Excavation Contractor - Skid Steer	53	Hour	$125.00	$ 6,625.00	
Soil Treatment - Mob/Demob	1	Unit	$4,500.00	$ 4,500.00	
Soil Treatment	737	Ton	$60.00	$ 44,220.00	
Standby waiting for TCLP/confirmation results 3 days minimum	1	unit	$4,500.00	$ 4,500.00	
Offiste Disposal - Hauling to Railhead Transfer Station	737	Ton	$31.20	$ 22,994.40	
Offiste Disposal - Non Hazardous	737	Ton	$40.00	$ 29,480.00	
Site Reclamation - Revegetate with Grass	1.25	Acre	$2,500.00	$ 3,125.00	
Enviornmental Samples - Treatment, 24 hour turnaround	8	TCLP Sample	$160.00	$ 1,280.00	
Enviornmental Samples - Confirmation - 24 hour turnaround	20	Sample	$40.00	$ 800.00	
Enviornmental Samples - Water - 24 hour turnaround	3	Sample	$140.00	$ 420.00	
XRF rental	5	day	$300.00	$ 1,500.00	
Install three monitoring wells	3	unit	$2,056.89	$6,170.67	
Survey wells	3	lump sum		$ 1,200.00	
		Subtotal		**$ 147,994.40**	
Long-Term Operation and Maintenace Costs					
Operation and Maintenance - Confirm Reclamation	1	Year	$5,000.00	$ 5,000.00	
Monitor wells quarterly for five years (analytical and labor)	60	sample	$60.00	$ 3,600.00	
Decommission three monitoring wells					
		Subtotal		**$ 8,600.00**	
			Total Direct Costs		**$ 156,594.40**
Indirect Capitol Costs					
Project Design - Remedial Action Work Plan				$ 40,000.00	
Project Oversite and Administration				$ 20,000.00	
Health and Safety Plan				$ 2,000.00	
Environmental Oversight				$ 10,000.00	
Contingency (15% of Direct Capitol Costs)				$ 23,489.16	
Health and Safety (3% of Direct Capitol Costs)				$ 4,697.83	
		Subtotal		**$ 100,186.99**	
			Total Indirect Costs		**$ 100,186.99**
		Total Costs			**$ 256,781.39**

TABLE 4-3
COST ESTIMATE
ALTERNATIVE 4, EXCAVATION, OFFSITE DISPOSAL

	Quantity	Unit	Cost	Total Cost	
Direct Capitol Costs					
Excavation Mob/Demob	1	Unit	$4,000.00	$4,000.00	
Clearing and grubbing (range and stockpile areas)	1	Acre	$4,000.00	$4,000.00	
Excavation Contractor - Trackhoe	43	Hour	$175.00	$7,525.00	
Excavation Contractor - Skid Steer	43	Hour	$125.00	$5,375.00	
Standby waiting for confirmation results 2 days minimum	1	unit	$3,000.00	$3,000.00	
Offiste Disposal - Hauling	737	Ton	$73.00	$53,801.00	
Offiste Disposal - Hazardous	737	Ton	$125.00	$92,125.00	
Site Reclamation - Revegetate with Grass	1	Acre	$2,500.00	$2,500.00	
Enviornmental Samples - Confirmation - 24 hour turnaround	20	Sample	$40.00	$800.00	
Enviornmental Samples - Water - 24 hour turnaround	3	Sample	$140.00	$420.00	
XRF rental	3	day	$300.00	$900.00	
Install and decommission three monitoring wells	3	unit	$2,056.89	$6,170.67	
Survey wells	3	lump sum		$1,200.00	
		Subtotal		**$174,446.00**	
				$0.00	
Long-Term Operation and Maintenace Costs				$0.00	
Operation and Maintenance - Confirm Reclamation	1	Year	$5,000.00	$5,000.00	
Monitor wells quarterly for five years (analytical and labor)	60	sample	$60.00	$3,600.00	
		Subtotal		**$8,600.00**	
			Total Direct Costs		**$ 183,046.00**
Indirect Capitol Costs					
Project Design - Remedial Action Work Plan				$40,000.00	
Project Oversite and Administration				$20,000.00	
Environmental Oversight				$10,000.00	
Health and Safety Plan				$2,000.00	
Contingency (15% of Direct Capitol Costs)				$27,456.90	
Health and Safety (3% of Direct Capitol Costs)				$5,491.38	
		Subtotal		**$104,948.28**	
			Total Indirect Costs		**$ 104,948.28**
		Total Costs			**$ 287,994.28**

Table 5-1
Comparison of Action Alternatives

Criteria	Alternative 1	Alternative 2	Alternative 3	Alternative 4
	No Action	**Institutional Controls and Site Monitoring**	**Removal, On-Site Treatment and Offsite Disposal**	**Removal and Offsite Disposal at an Appropriate Disposal Facility**
Effectiveness				
RAO Objective: Minimizing the potential for lead impacts to human health and the environment.	Not effective, baseline conditions.	Partially effective - Would achieve a portion of the RAO. The potential for human exposure to metals would be reduced given the assumption that recreational users obeyed posted closures and regulations. Construction worker exposure would be limited by following health and safety protocol. Ground water quality would likely not change, howeve use restrictions would not allow the withdrawal of shallow groundwater at the Site. This would eliminate human exposure to groundwater.	Effective - Waste removal would achieve the RAO. Groundwater contamination would likely be removed with the source.	Effective - Waste removal would achieve the RAO. Groundwater contamination would likely be removed with the source.
Implementabilty				
Technically feasible	Yes	Yes	Yes	Yes
Availibility of Goods and Services	No services required	All goods and services are availible.	All goods and services are availible.	All goods and services are availible.
Difficulty	Nothing to implement.	Not difficult, Fence installtion and signage. Retrictive use covenats are not difficult to prepare for a single federal agency.	More difficult of the two removal options due to onsite treatment logistics. Soil will be treated to non hazadous levels prior to transport.	Least difficult of the two removal options. Contaminated material will have to be transported through Olympic National Park.
Impacts to Site Users and Public	Impacts remains as is.	Impacts to site users will contolled by fencing and will depend on users abiding by posted regualtion. Groudwater impacts to humans helth will be eliminanted by use restrictions. Groundwater impacts to the environment will not be mitigated.	Impacts to Site users are eliminated. Site is not currently in use, hence ther are no users to impact during the removal. Truck traffic will not be significant enough to impact ONP roads	Impacts to Site users are eliminated. Site is not currently in use, hence ther are no users to impact during the removal. Truck traffic will not be significant enough to impact ONP roads
Administrative Feasibility				
Public Acceptance	Not likely	Possible	Likely	Likely
Regulatory Acceptance	Not likely	Not likely	Likely	Likely
Cost	**$0.00**	**$51,536.00**	**$256,781.39**	**$287,994.28**

Appendix A

Technical Review Report

November 2007

FINAL

Technical Review Report
Kalaloch Firing Range

ECL Site No. 1478
Olympic National Park
Port Angeles, Washington

Prepared for

National Park Service
Washington Office
Boulder, Colorado

Prepared by

Baker

Michael Baker Jr., Inc.
Moon Township, PA

TECHNICAL REVIEW – KALALOCH FIRING RANGE
OLYMPIC NATIONAL PARK

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FINAL TECHNICAL REVIEW OF KALALOCH FIRING RANGE

PREPARED FOR: Greg Nottingham/NPS, Environmental Management Program

PREPARED BY: Richard Bonelli, PMP/ Baker Task Manager –West Region
QC Review Robert Roselius, PG/Senior Geologist

DATE: Document: 11/16/2007

SECTION 1.0 - BACKGROUND

Michael Baker Jr. Inc. (Baker) has been tasked by National Park Service (NPS) Washington, D.C., Boulder Office (WASO) to produce a detailed Technical Review for the Environmental Cleanup Liability (ECL) file. This document has been prepared to provide information on the site conditions and issues, and provide appropriate technical recommendations for the former Kalaloch Firing Range (ECL Site # 1478) located at Olympic National Park (OLYM) about 60 miles southwest of Port Angeles, Washington. Furthermore, this document is designed to assist the NPS with determining the future allocation of resources for this site to support the ECL Program.

For this effort, Baker conducted a site visit on March 8, 2007. Mr. Steve Valadez, the Environmental and Safety Officer at OLYM, was interviewed and accompanied Baker during the visit. A copy of the Field Notes is included as Attachment A.

SECTION 2.0 – SITE HISTORY AND SETTING

The former Kalaloch Firing Range is located approximately 1/4 miles east of Highway 101 (Figure 1). The elevation of the site is approximately 50 feet above mean sea level (msl). Photographs of the firing range area are shown in Attachment B.

According to Mr. Valadez, the range has been closed for about six years. Various types of small arms and rifles were believed to have been used at the range. The range consists of ten metal target stands, roughly seven to ten feet apart. There is no backstop or berm present. The area behind the stands is heavily vegetated, overgrown, and wet in many places. No visible signs of spent lead bullets were noted.

SECTION 3.0 – SAMPLING INVESTIGATION

Baker conducted a limited sampling investigation at the firing range on March 8, 2007. Seven locations were selected for composite soil samples, including six behind the target stands and one up range which served as a background location (Figure 2). The six locations behind the target stands were selected based on where the bullets were believed to have impacted surrounding property. Sample numbers FRSS02 and FRSS04 were collected behind the target stands where runoff appears to drain into a low spot. Each composite sample was composed of five grab

samples, which were collected at the corners and in the center of the sampling grid. The samples were collected from roughly four to ten inches below ground surface (bgs).

The samples were sent to the STL Laboratory in Seattle, Washington, for analysis of Total Lead (EPA Method 6010B). Samples FRSS02, FRSS04, and FRSS07 also were analyzed for Toxicity Characteristic Leaching Procedure (TCLP) Lead to determine whether the soils, if excavated, would likely be classified as Resource Conservation and Recovery Act (RCRA) hazardous waste for disposal purposes only. Each location was staked and surveyed using a Global Positioning System (GPS) unit capable of measuring within +/- 10 feet. Chain-of-Custody and laboratory data sheets are provided in Attachment C.

SECTION 4.0 – RESULTS

Results of the soil data are provided on Tables 1, 2, and 3 with comparisons to several United States Environmental Protection Agency (USEPA) screening criteria. All seven samples had detections of Total Lead ranging from 12 (FRSS07 – background sample) milligrams per kilograms (mg/kg) to 5,200 mg/kg (FRSS04). Four of the samples exceeded the USEPA Action Level for lead of 400 mg/kg for residential settings (USEPA, Office of Solid Waste and Emergency Response [OSWER] Directive #9355.4-12, 1996).

In addition, the data also were compared to USEPA Ecological Soil Screening Levels (Eco-SSLs) (USEPA, OSWER Directive # 9285.7-70, 2005). Eco-SSLs are concentrations of contaminants in soil that are protective of ecological receptors that commonly come into contact with soil or ingest biota that live in or on soil. Eco-SSLs are derived separately for four groups of ecological receptors: plants, soil invertebrates, birds, and mammals. As such, these values are presumed to provide adequate protection of terrestrial ecosystems. Total Lead concentrations were compared to the Eco-SSLs for birds and mammals, of which several of the samples exceeded these screening criteria (Tables 2 and 3).

As noted on Table 4, two of the three TCLP Lead samples had concentrations above the RCRA regulatory level of 5 milligrams/liter (mg/L), including samples FRSS02 (16 mg/L) and FRSS04 (20 mg/L). Accordingly, these samples would be considered "hazardous waste," if excavated, and would require disposal at a permitted RCRA hazardous waste facility.

Table 1 –
Soil Results vs. USEPA Action Levels

Sample Number	Results (mg/kg)	USEPA Action Level (400 mg/kg)
FRSS01	870	**Above**
FRSS02	1,500	**Above**
FRSS03	160	Below
FRSS04	5,200	**Above**
FRSS05	410	**Above**
FRSS06	79	Below
FRSS07 (Background)	12	Below

Table 2 –
Soil Results vs. USEPA Eco-SSLs for Birds

Sample Number	Results (mg/kg)	Avian Herbivore (Dove) (46 mg/kg)	Avian Ground Insectivore (Woodcock) (11 mg/kg)	Avian Carnivore (Hawk) (510 mg/kg)
FRSS01	870	**Above**	**Above**	**Above**
FRSS02	1,500	**Above**	**Above**	**Above**
FRSS03	160	**Above**	**Above**	Below
FRSS04	5,200	**Above**	**Above**	**Above**
FRSS05	410	**Above**	**Above**	Below
FRSS06	79	**Above**	Below	Below
FRSS07 (Background)	12	Below	Below	Below

Table 3 –
Soil Results vs. USEPA Eco-SSLs for Mammals

Sample Number	Results (mg/kg)	Mammalian Herbivore (Vole) (1,200 mg/kg)	Mammalian Ground Insectivore (Shrew) (56 mg/kg)	Mammalian Carnivore (Weasel) (460 mg/kg)
FRSS01	870	Below	**Above**	**Above**
FRSS02	1,500	**Above**	**Above**	**Above**
FRSS03	160	Below	**Above**	Below
FRSS04	5,200	**Above**	**Above**	**Above**
FRSS05	410	Below	**Above**	Below
FRSS06	79	Below	**Above**	Below
FRSS07 (Background)	12	Below	Below	Below

Table 4 –
TCLP Lead Soil Results vs. RCRA Regulatory Criteria

Sample Number	Results (mg/L)	RCRA Level (5 mg/L)
FRSS02	16	**Above**
FRSS04	20	**Above**
FRSS07 (Background)	0.054	Below

SECTION 5.0 – CONCLUSIONS AND RECOMMENDATIONS

Based on the available background information and the results of the sample collection, the following conclusions and recommendations are provided.

Conclusions

- Soils behind the target stands at the firing range are significantly impacted by lead, presumably from the use of lead ammunition. The extent of contamination, impacts to other media (e.g., groundwater), and potential migration off site are unknown at this time.

- The estimated area behind the former target stands potentially impacted by lead is approximately 100 feet by 200 feet based on visual observations of the current land features. Accordingly, this area is assumed to be the "Lower Limit" of the site (i.e., the minimum area of likely impact).

- Soil samples exhibited Total Lead concentrations above the various lead screening criteria, including the USEPA Action Level and USEPA Ecological SSLs.

- Two of the samples exhibited concentrations above the RCRA regulatory level for hazardous waste.

Recommendations

- A complete site characterization as part of an Engineering Evaluation/Cost Analysis (EE/CA) is recommended to further delineate the vertical and horizontal extent of contaminated media, evaluate impacts to human health and the environment, and determine if contaminants have migrated off site.

- An EE/CA, as part of a CERCLA removal action, is recommended to evaluate potential removal options. The EE/CA should consider whether removal actions (e.g., soil excavation/stabilization and removal) will potentially impact sensitive environments and ecosystems.

Figures