Feasibility Study
Saddle Rock Park
Wenatchee, Washington

Prepared for
City of Wenatchee

June 28, 2013
17917-00

HARTCROWSER

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SADDLE ROCK PARK
WENATCHEE, WASHINGTON

1.0 INTRODUCTION

This report presents the results of a Feasibility Study (FS) for Saddle Rock Park in Wenatchee, Washington. This FS was prepared for The City of Wenatchee per the requirements of the Model Toxics Control Act (MTCA; Chapter 70.105D RCW) and its implementing regulations (Chapter 173-340 WAC) under Washington State Department of Ecology (Ecology). This work was funded through Ecology Integrated Planning Grant G1300046

Ecology recently listed the a number of historical prospects and waste rock piles on the property, referred to as Gold Knob Prospects, in their Integrated Site Information System (ISIS) database of confirmed or suspected contaminated sites, and issued an early notice letter to the City.

Hart Crowser completed a Remedial Investigation (RI) in February 2013; the results are presented in the RI Report dated June 19, 2013 (Hart Crowser 2013).

This FS identifies, evaluates, and recommends appropriate remedial actions for the areas of concern (AOCs) to be performed to meet MTCA requirements specified in WAC 173-340-350(8). Specific tasks for this FS included:

- Reviewing existing site information to assess current soil and groundwater conditions and potential exposure pathways;
- Identifying AOCs for remediation;
- Developing remedial action objectives (RAOs) and remediation goals based on the cleanup standards established for the sites;
- Screening applicable remediation technologies and developing remediation alternatives for the AOCs from these technologies;
- Evaluating alternatives following the criteria specified in WAC 173-340-360; and
- Recommending a remedial alternative.

2.0 SETTING AND HISTORICAL ACTIVITIES

Saddle Rock Park is a 325-acre property located on the outskirts of the City of Wenatchee (City) in Chelan County, Washington (Figure 1). For the past 100 years, the property was used primarily as a community recreation area owned by the Washington State Department of Natural Resources (DNR). In 1909, the City began working to acquire the property for preservation as a public park or natural protected area, and in 2011 the City purchased the property with assistance from the Chelan-Douglas Land Trust. The property is operated by the City as a public park.

2.1 Geology, Hydrogeology, and Meteorology

2.1.1 Geology

A detailed description of the site geology is provided in the RI (Hart Crowser 2013). The property contains soil units from the Bjork, Cashmere, and Cowiche series. The dominant soil type is the Bjork silt loam series, which is a mix of clay, silt, and sand found on steep hillsides (45 to 65 percent slope) and formed in material that was deposited by the wind or moved by overland flow or creep to the base of slopes. There is also a Bjork series rock outcrop complex. Most of the samples for this RI were collected from areas of Bjork series soil.

The southeast corner of the property contains soil of the Cashmere sandy loam series. This soil type is fine to coarse sandy loam and is found on glacial outwash terraces or terrace escarpments of variable steepness (0 to 65 percent slope). Only one sample for this RI was collected from the Cashmere series soil unit.

The southwest corner of the property contains soil of the Cowiche silt loam series. This soil type forms in uplands of variable steepness (0 to 70 percent slope) in material that was deposited by the wind or moved by overland flow or creep to the base of hill slopes. None of samples collected for the RI were located in the Cowiche soil unit.

2.1.2 Groundwater, Surface Water, and Meteorology

There are no wells on the property so there is no reliable groundwater elevation data; however, a water well report from 1997 indicates that a certified well driller encountered groundwater at 340 feet below the ground surface at a nearby property. This report is available on the Ecology website. The property does not contain any surface water features.

The Wenatchee climate is characterized as semi-arid; according to the National Weather Service, average annual rainfall is 9 inches, and the maximum and minimum annual rainfalls on record are 14 inches in 1983 and 4.5 inches in 1976. The greatest 24-hour total rainfall on record is 0.73 inch. The average temperature is 52 degrees Fahrenheit, and the maximum and minimum average daily temperatures are 61 and 42 degrees, respectively (NWS 2013).

2.2 Park History

For the past 100 years, the property has been used primarily as a community recreation area; however, discrete areas were exploited by miners who staked claims there in the late 1800s through the mid-1900s.

There is a long documented history of prospecting and mining activity on the property and in the surrounding area. In a cultural resources survey of the area, Reiss-Landreau Research (RLR) identified three mines within the Saddle Rock Park property boundary (Sunrise Mine, Squaw Saddle Mine, and Gold Knob Mine), and one mine (Cannon Mine) adjacent to the property boundary and south of the park entrance (RLR 2013). In addition, RLR found historical mining claims dating back to 1908; in general, each claim area was 20 acres with dimensions of 1,500 feet by 600 feet. Although these claims are in the public record, many of them were never explored or mined.

2.3 Previous Investigations

Cascadia Technical Services (Cascadia) conducted a Phase I Environmental Site Assessment (Phase I) in April 2011. In its Phase I report, Cascadia wrote that soil was highly erodible and could easily migrate with stormwater runoff and through trail use, creating a public exposure risk.

After Ecology reviewed Cascadia's soil analysis, Jason Shira, the Ecology project manager, visited the property and screened seven waste rock piles with a portable X-ray fluorescence (XRF) spectrometer. The XRF screening confirmed that arsenic concentrations were higher than MTCA Method A and reported background levels for the region. Ecology also collected soil samples from the waste rock piles for laboratory analysis. The analytical results confirmed the elevated arsenic concentrations. In addition, seven other metals (aluminum, antimony, barium, mercury, selenium, silver, and vanadium) were detected in excess of the MTCA Method B direct contact cleanup levels or ecological indicator soil concentrations (Shira 2011).

2.4 Remedial Investigation

In February 2013, Hart Crowser completed a Remedial Investigation to collect soil samples from the waste rock piles and background locations, and to measure the waste rock piles and adit features (Hart Crowser 2013).

Twenty background soil samples were collected from across the property to compare waste rock metals concentrations to natural background. Upon receipt and validation of analytical results, statistical evaluation was performed using EPA's ProUCL 4.0 to determine natural background (defined as the 90th percentile). Site-specific background concentrations are presented in Table 1.

Five soil samples were collected from each waste rock pile of less than 1000 cy, and ten soil samples were collected from each waste rock pile of greater than 1000 cy. Ten-point composite soil samples were collected from the area downslope of the toe of each waste rock pile to determine the extent of potential waste rock impacts based on the concentration of the composite sample. A composite sample was collected from each of the following three zones outside the area beyond any visible extent of the waste rock pile: (1) 0 to 20 feet, (2) 20 to 40 feet, and (3) 40 to 60 feet.

Samples from the surface of each waste rock pile and from the area downslope from the toe of the piles had metal concentrations above preliminary screening levels. The only waste rock area metals initially identified by Ecology as potential chemicals of concern that were above natural background concentrations were arsenic, mercury, selenium, and silver.

3.0 CONCEPTUAL SITE MODEL

This section provides a conceptual understanding of the sites based on the results of historical research and investigations, and the RI report (Hart Crowser 2013). A discussion of the chemicals and media of concern, the fate and transport characteristics of the release of hazardous substances, and the potential exposure pathways is included in this section. The conceptual site model (CSM) serves as the basis for developing technically feasible cleanup alternatives and selecting a final cleanup action for the planned redevelopment of the property. The CSM is dynamic and may be refined throughout the cleanup action process as additional information becomes available.

3.1 Media of Concern

As discussed in Section 5.0 of the RI, soil has been identified as the primary affected media, based on the elevated concentrations of metals present in waste rock piles. Surface water and groundwater have not been impacted.

3.2 Constituents of Concern

Eight metals (including arsenic, barium, iron, lead, manganese, mercury, selenium, and silver) exceeded draft screening levels developed as part of the RI and are considered potential chemicals of concern (PCOC).

3.3 Area of Concerns

Eight areas identified by Ecology as waste rock piles from historical mining activities were sampled and analyzed for metals as part of the RI. No features that indicated mining activity were observed at three of the areas (SA-03, SA-06, and SA-07) and it appears that rock in these areas are a result of construction activities from road building and/or power line installation. Additional information about each waste rock pile is presented in the RI.

Samples from the surface of each waste rock pile and from the area downslope from the toe of the piles contained metal concentrations above preliminary human health or ecological screening levels. The areas of concern are presented in Figures 5 through 11 of the RI. At all waste rock piles except for SR-08, the samples collected from the downslope area exceeded screening levels. Therefore, the full extent of the AOCs is unknown. The north waste rock pile at SR-6 is likely associated with native mineralized soil and lower concentrations may not be attained as material is excavated. This area is also very steep and may not be amenable to capping. This area has been included as an AOC in this FS; however, it may be removed during the Draft Cleanup Action Plan (DCAP).

3.4 Release Mechanisms and Transport Processes

The primary release mechanisms and transport processes by which constituents can migrate from sources to receptors are described in Section 6 of the RI. This includes a discussion of the transport mechanisms and environmental fate of metals in the surface and subsurface.

It was concluded that there is low potential for metals to be transported by physical and geochemical processes. Heavy precipitation events could physically transport fine-grained material; however, transport is likely limited to

the area near the waste rock piles. Wind-blown dust is not a significant transport process because of the clayey, cohesive soil. There is also low leachability potential based on Synthetic Precipitation Leaching Procedure testing.

3.5 Receptors

Potential receptors include humans and terrestrial ecological receptors. Terrestrial ecological receptors include plants and animals exposed to impacted media, as well as secondary food chain consumers such as birds and mammals.

Evaluation of risks to human receptors conducted as part of the RI identified the recreational visitor as the maximally exposed individual. Day use of trails on the property by hikers, joggers, bicyclists, and horseback riders are the principal human exposure scenarios.

3.6 Summary of Exposure Pathways

For a PCOC to present a risk to human health and/or the environment, the pathway from the PCOC to the receptor must be completed. The PCOC to receptor pathways are discussed by medium in this section.

3.6.1 Soil

The pathways that may allow PCOCs in soil to reach receptors include: human direct contact with PCOCs in soil within 15 feet of the ground surface via the dermal contact or ingestion pathways, and terrestrial ecological contact with PCOCs in soil within 6 feet of ground surface.

The human inhalation pathway is considered to be a minor pathway because most metals are not volatile and the waste rock piles generally consist of clayey cohesive materials that do not generate significant quantities of wind-blown dust. Human dermal uptake of metals contained in soil is also considered to be a minor pathway.

3.6.2 Groundwater and Surface Water

Incomplete pathways. No surface water bodies are present on the property. Most surface water runoff is likely to evaporate or infiltrate into the soil. Leachate testing conducted as part of the RI indicated that metals associated with the waste rock areas exhibited low mobility. In addition, it is highly unlikely that surface leaching and infiltration would impact groundwater due to the lack of precipitation and depth to groundwater (likely greater than 300 feet).

3.5.3 Air

Incomplete pathway. The inhalation pathway of exposure is considered to be a minor pathway because most metals are not volatile and soil conditions prevent significant contributions to the wind-borne particulate load.

4.0 CLEANUP REQUIREMENTS

The following sections identify remedial action objectives (RAOs) and preliminary cleanup standards, which were developed to address MTCA regulatory requirements for site cleanup. These requirements address conditions relative to potential human and ecological receptor impacts. Together, the RAOs and cleanup standards provide the framework for evaluating remedial alternatives described later in this FS, and for selecting a preferred alternative.

4.1 Remedial Action Objectives

The primary objective for the FS and cleanup action focuses on substantially eliminating, reducing, and/or controlling unacceptable risks to human health and the environment posed by site PCOCs, to the extent practicable.

The terrestrial ecological risk is considered the driver in setting cleanup levels and selecting a remedy.

4.2 Cleanup Standards

Cleanup standards include cleanup levels and points of compliance (POCs) as described in WAC 173-340-700 through WAC 173-340-760. Cleanup standards must also incorporate other state and federal regulatory requirements applicable to the cleanup action and/or its location as appropriate. A list of Applicable or Relevant and Appropriate Requirements (ARARs) is presented in Table 2.

As described in Section 5.2 of the RI, preliminary screening criteria were developed by selecting the lowest criteria of MTCA Method A unrestricted, Method B direct contact, and ecological indicator soil concentrations for protection of terrestrial plants and animals. In cases where screening criteria are less than the natural background concentration, the screening criteria defaulted to natural background. Potential screening levels, calculated natural background concentrations, and selected preliminary screening levels for soil are presented in Table 1.

5.0 DEVELOPMENT OF REMEDIATION ALTERNATIVES

The remediation alternatives combine technologies that are applicable to impacted soil and waste rock material. Candidate remedial technologies were identified and screened to develop potential cleanup alternatives for further evaluation in this FS. The remedial technologies considered in the screening process include methodologies capable of achieving the remedial action objectives. The following sections describe the how the remediation alternatives were developed. A description of each alternative is provided in Section 5.3, and the alternatives are evaluated based on MTCA criteria in Section 6.0.

5.1 Remediation Technology Screening

Potentially applicable technologies are identified based on available site characterization data and known physical site conditions. Technologies identified are then either retained for further consideration or screened out, based on an evaluation of their ability to effectively address site concerns. The remedial technologies that were identified and screened are summarized in Table 3.

The screening of technologies applicable to impacted soil and waste rock remediation included consideration of available methodologies to address contaminants in the various media based on their expected implementability, reliability, and relative cost. Physical conditions that limit or support particular technologies, and contaminant characteristics that limit the effectiveness or feasibility of a technology, were considered for the developed remediation alternatives after the theoretical screening evaluation.

The implementability (i.e., the relative ease of installation and the time required to achieve a given level of performance) of a technology is assessed based on site conditions. Implementability considers: (1) the technology's constructability (i.e., ability to build, construct, or implement the technology under actual site conditions); (2) the time required to achieve the required level of performance as defined by the cleanup levels and points of compliance; (3) the ability of the technology to be permitted; (4) the availability of the technology; and (5) other technology-specific factors.

To assess the reliability of prospective technologies, the EPA states that an evaluator should identify the level of technology development, its performance record, and the inherent construction, operation, and maintenance problems of each technology considered. Technologies that are unreliable, perform poorly, or are not fully demonstrated should be eliminated (EPA 1988).

Table 3 indicates which technologies were retained for further evaluation in the development of the remediation alternatives in the FS, and which technologies were eliminated from consideration based on implementability, reliability, or cost. Technologies that were retained are described below in Section 5.2.

5.2 Retained Technologies

Technologies and associated process options having the highest potential for success were identified for preliminary screening evaluation. Technologies and process options identified as potentially applicable are summarized in Table 3. A brief description and screening determination for each process option is also given. The screening determination identifies whether the given process option will be retained for further consideration in assembling candidate removal action alternatives. A discussion of the rationale used to retain or eliminate technologies and process options is provided in this section.

Institutional controls. Governmental and proprietary controls; enforcement and permit tools; information devices; and physical access restrictions were retained as effective, well-established methodologies and are applicable when used in combination with other technologies.

Containment. Remediation technologies retained for containment include consolidation and capping in-place with a soil cover or a high-density polyethylene (HDPE) liner.

A repository would be one option for consolidating the excavated materials in one location for long-term care. Repositories are typically capped with an engineered low-permeability cover system, and may also be revegetated.

Soil cover or rock from a non-acid-producing source could be used to prevent direct contact with impacted materials to human and ecological receptors, reduce erosion, and provide a media for revegetation. Soil materials at the site are limited in quantity, and any soil to be used as cover material would have to be imported from an off-site borrow source.

HDPE is commonly used as a liner material and a cover for consolidated stockpiled waste rock and impacted materials. It is a reliable method to prevent direct exposure of the materials to the environment or receptors, virtually eliminates infiltration due to precipitation, and significantly reduces the potential for metals leaching.

The capping in-place remedy involves consolidating waste rock at the site, grading these materials into a stable configuration, and covering them with a

constructed cap. The cap would be designed to prevent exposure of the underlying waste, minimize infiltration, prevent erosion from wind and water, sustain native vegetation, accommodate settlement, resist freeze-thaw and desiccation, manage surface water run-on and runoff to prevent erosion or other damage to the cover, and minimize the need for long-term maintenance.

Soil Removal. Excavation techniques employ the physical removal of impacted materials to eliminate future receptor exposure. Excavation technologies typically involve conventional earthmoving construction equipment. Equipment such as hydraulic excavators and dozers would be satisfactory for excavating and moving waste rock-contaminated soil. Excavated soil would be consolidated or sent off-site for disposal.

Off-Site Management. Transportation technologies typically involve the use of conventional materials handling equipment, such as excavators, loaders and trucks to load and transport excavated materials either on site or off site. Trails which were previously used by 4-wheel-drive vehicles could be used for site transportation access. Portions of the trails may need to be stabilized or restored. To access SR-05, a temporary road will need to be constructed from the trail road to the AOC. As with excavation activities, transportation activities would include dust control measures to prevent particulate suspension around the site when equipment is in use. Disposal of impacted soil would take place at an off-site, lined, permitted landfill.

***Ex Situ* Treatment.** Replacing vegetation following disturbance of the ground surface will mitigate soil erosion and surface water infiltration and runoff. Revegetation is typically performed in conjunction with placement of clean fill and soil cover. Establishing vegetation can be effective in enhancing the stability and permanence of cover systems. Roots from cover plants hold the soil in place, protecting against wind and water erosion. Revegetation can also reduce infiltration of water into surface materials through interception of water by plant root systems and transpiration mechanisms.

For this site, revegetation includes topsoil replacement and planting native ground cover. Revegetation would include use of native seed mixtures, and would follow guidance provided by the City of Wenatchee.

5.3 Remediation Alternative Descriptions

The technologies retained in the screening process were combined into three remediation alternatives for further evaluation (Alternatives 1 through 3). The components of the remediation alternatives are summarized below. All alternatives include compliance monitoring to meet WAC 173-340-410. The

layout and components of Alternatives 1 through 3 are depicted on Figures 2 through 4.

Alternative 1 consists of the following components:

- Excavation and off-site disposal of all known impacted waste rock material (SR-01 through SR-08) including impacted areas downslope from the waste rock piles;
- Improvement of the road to SR-04 and SR-06 and construction of an access road to SR-05;
- Transportation and disposal of excavated materials to an off-site, lined, permitted landfill;
- Revegetation of excavated toe areas downslope of waste rock piles and the temporary road area; and
- Compliance monitoring.

Alternative 2 consists of the following components:

- Excavation of impacted waste rock material and material downslope of the toe within SR-01, SR-04, SR-05, SR-06, SR-07, and SR-08;
- Consolidation of impacted materials at on-site locations (near SR-01 and at SR-02);
- Improvement of the road to SR-04 and SR-06 and construction of an access road to SR-05;
- Construction of caps at SR-02, SR-03, and the consolidation area near SR-01;
- Revegetation of excavated toe areas (downslope of excavated waste rock piles), the temporary road area, and consolidated and capped material;
- Institutional controls; and
- Compliance monitoring and maintenance of engineered caps.

Alternative 3 consists of the following components:

- Excavation of impacted waste rock material at SR-01, SR-04, SR-05, SR-06, SR-07, and SR-08;
- Consolidation of impacted materials at on-site locations (near SR-01 and at SR-02);
- Improvement of the road to SR-04 and SR-06 and construction of an access road to SR-05;
- Construction of caps at SR-02, SR-03, and the consolidation area near SR-01;
- Revegetation of the temporary road area and consolidated and capped material;
- Institutional controls; and
- Compliance monitoring and maintenance of engineered caps.

5.3.1 Description of Alternative 1

Alternative 1 consists of excavation and off-site disposal of all known impacted material from the waste rock piles and the areas that exceed preliminary screening levels in the areas downslope of the piles (Figure 2).

Excavation. Alternative 1 includes excavating all the known impacted material exceeding preliminary screening levels. Lateral and vertical excavation limits will ultimately be based on the observed extent of impacted soil within each impacted area and the results of additional soil sampling. For cost estimating purposes, the excavation volume is based on the inferred lateral and vertical extent of impacted soil determined in the field by Hart Crowser personnel during the November 2012 and February 2013 field events.

Based on the conservative lateral and vertical excavation volume estimates, approximately 8,800 cubic yards (cy) of impacted material would be excavated and disposed of in Alternative 1. The calculated volume above includes the toe area of each waste rock pile if the composite sample exceeded the preliminary screening levels. We have assumed a conservative depth of 1 foot in the toe areas. The analytical results for most of these toe of slope locations exceeded the screening criteria and, therefore, the full extent of the impacted area is not known. Additional sampling will be needed during remedial design to properly delineate the extent of impacted material.

Excavated impacted soil will be sent off site for disposal at a regulated landfill facility. For the purposes of this FS, it is assumed (based on TCLP results) that the excavated impacted soil can be characterized as non-hazardous and will be sent to a Subtitle D landfill facility for disposal.

A temporary road will be created to access SR-05 (Figure 2). This road will be restored to the original conditions after the work is complete. Significant road improvements will be required to access SR-04 and SR-06. Minimal road improvements may also be required to allow the existing jeeps roads in other portions of the park to be accessible for construction equipment.

Erosion control measures will be implemented during construction activities. Following construction, the excavated toe areas will be graded to a stable configuration, backfilled with clean topsoil, and revegetated using a dry land seed mixture and fertilizer. Erosion control protection shall also be used. The temporary road will be restored and also revegetated using the dry land seed mixture, fertilizer, and appropriate erosion control protection.

Compliance Monitoring. Under MTCA, all cleanup actions require compliance monitoring. Compliance monitoring includes protection monitoring, performance monitoring, and confirmational monitoring.

Protection monitoring consists of monitoring to confirm that human health and the environment are protected during construction, operation, and maintenance, and would be addressed in a construction health and safety plan.

Performance monitoring would consist of documenting that the full extent of the waste rock and impacted material has been removed from each of the sites. This would include inspecting and collecting samples at the limits of the excavation to verify that no waste materials remained, and would include sampling the underlying soil to verify that preliminary screening levels are met.

Confirmational monitoring, which consists of monitoring to confirm long-term effectiveness of the cleanup action once cleanup standards have been attained, would not be required for this alternative because all material exceeding screening levels would be removed from the sites.

5.3.2 Description of Alternative 2

Alternative 2 consists of excavation and consolidation of impacted materials at waste rock piles and waste rock toe areas at SR-01 and SR-04 through SR-08. This material would be consolidated on site at SR-02 or at the consolidation area near SR-01 (Figure 3). Waste rock piles SR-02 and SR-03 and the consolidation

area will be capped. Institutional controls such as restrictive covenants would be in place to protect the integrity of the cap.

Excavation. Alternative 2 includes excavation and consolidation of the impacted material at SR-01 and SR-04 through SR-08. Lateral and vertical excavation limits are described in Alternative 1. Based on the conservative lateral and vertical excavation volume estimates, approximately 2,200 cy of impacted material would be excavated and consolidated on-site.

A temporary road will be created to access SR-05 (Figure 3). This road will be restored to the original conditions after the work is complete. Significant road improvements will be required to access SR-04 and SR-06. Minimal road improvements may also be required to allow the existing jeeps roads in other portions of the park to be accessible for construction equipment.

Erosion control measures will be implemented during construction activities. Following construction, the excavated toe areas will be graded to a stable configuration, backfilled with clean topsoil, and revegetated using a dry land seed mixture and fertilizer. Erosion control protection shall also be used. The temporary road and consolidated capped areas will be revegetated using the dry land seed mixture, fertilizer, and appropriate erosion control protection.

Containment. An engineered cap will be designed and installed to cap SR-02, SR-03, and the consolidation area near SR-01. Capping involves consolidating waste rock, grading these materials into a stable configuration, and covering them with a 1-foot cap. The volume of cap material required for this alternative is approximately 2,400 cy.

Institutional controls. Since impacted material will remain in place, although it is capped, institutional controls such as a restrictive covenant will be used to maintain the long-term effectiveness of the cap.

Compliance Monitoring and Maintenance. Similar to Alternative 1, Alternative 2 will include compliance monitoring includes protection monitoring, performance monitoring, and confirmational monitoring.

Protection monitoring elements, including dust monitoring during excavation, will be addressed in the health and safety plan for the project.

Performance monitoring will include the collection and analysis of soil samples from the base and side walls of the excavation to confirm that the contaminants have been removed from the waste rock piles that are excavated for consolidation.

Confirmational monitoring will include monitoring the integrity of the cap with annual inspections. A long-term monitoring plan will be used to document the long-term effectiveness and will conform to the general requirements of MTCA (WAC 173-340-410).

5.3.3 Description of Alternative 3

Alternative 3 consists of excavation and consolidation of impacted materials at waste rock piles SR-01 and SR-04 through SR-08. This material would be consolidated on site at SR-02 or at the consolidation area near SR-01 (Figure 4). Waste rock piles SR-02 and SR-03 and the consolidation area will be capped. Under this alternative, downslope areas would not be excavated. Institutional controls such as restrictive covenants would be in place to protect the integrity of the cap and restrict use of downslope areas.

Excavation. Alternative 3 includes excavation and consolidation of the impacted material at SR-01 and SR-04 through SR-08. Lateral and vertical excavation limits are described in Alternative 1. Based on the conservative lateral and vertical excavation volume estimates, approximately 1,030 cy of impacted material would be excavated and consolidated on-site.

A temporary road will be created to access SR-05 (Figure 4). This road will be restored to its original condition after the work is complete. Significant road improvements will be required to access SR-04 and SR-06. Minimal road improvements may also be required to allow the existing jeeps roads in other portions of the park to be accessible for construction equipment.

Erosion control measures will be implemented during construction activities. Following construction, the temporary road and consolidated capped areas will be revegetated using a dry land seed mixture and fertilizer. Appropriate erosion control protection shall also be used.

Containment. An engineered cap will be designed and installed to cap SR-02, SR-03, and the consolidation area near SR-01. Capping involves consolidating waste rock, grading these materials into a stable configuration, and covering them with a 1-foot-thick cap. The volume of cap material required for this alternative is approximately 1,300 cy.

Institutional controls. Since impacted material will remain in place, although it is capped, institutional controls such as a restrictive covenant will be used to maintain the long-term effectiveness of the cap. Institutional controls would also be applied to restrict use of the downslope areas.

Compliance Monitoring and Maintenance. Similar to Alternative 1, Alternative 3 will include compliance monitoring including protection monitoring, performance monitoring, and confirmational monitoring.

Protection monitoring elements, including dust monitoring during excavation, will be addressed in the health and safety plan for the project.

Performance monitoring will include the collection and analysis of soil samples from the base and side walls of the excavation to confirm that the contaminants have been removed from the waste rock piles that are excavated for consolidation.

Confirmational monitoring will include monitoring the integrity of the cap with annual inspections. A long-term monitoring plan will be used to document the long-term effectiveness and will conform to the general requirements of MTCA (WAC 173-340-410).

6.0 EVALUATION OF REMEDIATION ALTERNATIVES

Ecology identifies the criteria that should be used to evaluate remediation alternatives within the MTCA regulation (WAC 173-340-360). The purpose of the evaluation is to identify the advantages and disadvantages of each alternative and, thereby, assist in the decision-making process. The criteria are described in section 6.1 and applied to Alternatives 1 through 3 in Section 6.2.

6.1 MTCA Evaluation Criteria

Four threshold requirements must be met for an alternative to be considered for selection as a remedy. Three "other requirements" are then used to further evaluate those alternatives that satisfy the threshold criteria. Finally, several action-specific or "pertaining to" requirements—which vary depending on the nature of the site and the alternatives being considered—are used to further refine the remedy selection.

The threshold requirements are:

- **Protect human health and the environment.** The alternative must provide for overall protection of human health and the environment.

- **Comply with cleanup standards.** The alternative must comply with cleanup standards (cleanup levels and the points of compliance where such cleanup

levels must be met) as established in WAC 173-340-700 through 173-340-760.

- **Comply with applicable state and federal laws.** The alternative must comply with applicable requirements that are determined to be relevant and appropriate, as defined through WAC 173-340-710.

- **Provide for compliance monitoring.** The alternative must provide for compliance monitoring, as established under WAC 173-340-410 and WAC 173-340-720 through 173-340-760.

The "other requirements" are:

- **Use permanent solutions to the maximum extent practicable.** As outlined in WAC 173-340-360(3), evaluation of this requirement involves conducting a disproportionate cost analysis (DCA) wherein the costs and benefits of each alternative, as defined by several evaluation criteria, are compared and balanced. Our DCA for the alternatives is presented below in Section 6.3.

- **Provide a reasonable restoration time frame.** As laid out in WAC 173-340-360(4), the determination of whether an alternative provides for a reasonable restoration time frame involves balancing site risks against the practicability of achieving a shorter restoration time frame. A longer restoration time frame may be selected if the remedy has a greater degree of long-term effectiveness; however, extending the restoration time frame cannot be used as a substitute for active remedial measures when such actions are practicable.

- **Consider public concerns.** The alternative must meet the requirements outlined in WAC 173-340-600. Public concerns will ultimately be considered during the public comment period for this FS. Public acceptance was not used as a criterion to distinguish among the remediation alternatives evaluated in this FS. Selection of the preferred remediation alternative may be revised based on the results of the public review process.

A number of action-specific or "pertaining to" requirements are also listed in WAC 173-340(2)(c) through (h), although not all of these requirements are applicable. The action-specific requirements are:

- **Groundwater cleanup actions.** This requirement is applicable to situations where cleanup levels for groundwater cannot be achieved within a reasonable restoration time frame. Groundwater has not been impacted at the property and, therefore, this requirement is not relevant.

- **Soil at current or potential future residential areas and child care centers.** Specific requirements pertaining to soil cleanup at current or potential future residential areas and child care centers are found in WAC 173-340-360(2)(b). These requirements relate to soil cleanup levels established for human health protection.

- **Institutional controls.** Institutional controls must comply with the specific requirements of WAC 173-340-440 and should demonstrably reduce risks to ensure a protective remedy. A remedy shall not rely primarily on institutional controls and monitoring where it is technically possible to implement a more permanent cleanup action for all or part of a site. For complete detail, see WAC 173-340-360(2)(e).

- **Releases and migration.** Cleanup actions shall prevent or minimize present and future releases and migration of hazardous substances in the environment. See WAC 173-340-360(2)(f).

- **Dilution and dispersion.** Cleanup actions shall not rely primarily on dilution and dispersion unless the incremental costs of any active remedial measures over the costs of dilution and dispersion grossly exceed the incremental degree of benefits of active remedial measures over the benefits of dilution and dispersion. See WAC 173-340-360(2)(g).

- **Remediation levels.** Remediation levels are defined as the particular concentration of a hazardous substance in any media, above which a particular cleanup action component will be required as part of a cleanup action. See WAC 173-340-200. Specific requirements pertaining to the use of remediation levels are presented in WAC 173-340-360(2)(h). The alternatives being considered in this evaluation do not involve the use of remediation levels; therefore, this requirement is not relevant.

6.2 Evaluation of Alternatives

We evaluated the three alternatives against the MTCA selection requirements outlined above. This evaluation is presented in Table 4. The following sections summarize our evaluation, concentrating on the main differences between the alternatives.

6.2.1 Threshold Requirements

Alternatives 1 and 2 meet the MTCA threshold requirements as described below.

- **Protect human health and the environment.** Alternatives 1 through 3 are protective of human health and the environment. Alternative 1 prevents all exposure to humans through removal of impacted material. Alternative 2 prevents exposure through consolidation and capping. Alternative 3 excavates 1,030 cy of impacted material from the waste rock piles, and contains it under 1,300 cy of protective cap material, however, ecological risk still exists for the downslope areas.

- **Compliance with cleanup standards.** Alternatives 1 and 2 comply with cleanup standards. Alternative 1 meets this requirement by removing and permanently disposing of hazardous substances that exceed cleanup standards.

  Alternative 2 meets this requirement by fulfilling the cleanup standards set out in WAC 173-340-740(6)(f) for containment-based remedies:

  - Cleanup action must be permanent to the maximum extent practicable per WAC 173-340-360: Alternative 2 uses permanent solutions to the maximum extent practicable as described in Section 6.3 and Table 5.

  - Cleanup action must be protective of human health. This alternative is protective under the recreation visitor scenario. Capping minimizes direct contact risks to humans.

  - Cleanup action must be protective of terrestrial ecological receptors per WAC 173-340-7490 through 173-340-7494. Capping reduces exposure to terrestrial ecological receptors.

  - Institutional controls to limit activities that could interfere with the long-term integrity of the containment system must be put in place per WAC 173-340-440. Alternative 2 provides for appropriate institutional controls as described in Section 5.3.

  - Compliance monitoring to ensure the long-term integrity of the containment system and periodic reviews must be implemented per WAC 173-340-410 and WAC 173-340-430. Alternative 2 provides for appropriate compliance monitoring as described in Section 5.3.

  - 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 must be specified in a cleanup action plan (CAP). A CAP will be developed for the preferred alternative and will include the required information.

Alternative 3 does not comply with cleanup standards for the downslope areas.

- **Comply with applicable state and federal laws.** All alternatives would be designed and implemented in accordance with Applicable or Relevant and Appropriate Requirements (ARARs). A list of ARARs is presented in Table 2.

- **Provide for compliance monitoring.** All alternatives provide for compliance monitoring as described in Sections 1.4.1 through 1.4.3.

6.2.2 Other Requirements

Alternative 3 is not protective of ecological receptors and, therefore, does not meet the threshold requirements. This alternative has been dropped from further evaluation. Alternatives 1 and 2 satisfy the MTCA "other requirements."

- **Use permanent solutions to the maximum extent practicable.** As described in the DCA (Section 6.3) Alternatives 1 and 2 are considered to use permanent solutions to the maximum extent practicable.

- **Provide a reasonable restoration time frame.** Alternatives 1 and 2 provide for a reasonable restoration time frame. The proposed alternatives could probably be completed within one construction season and cleanup would be complete at the end of construction with the exception of long-term monitoring. The risk would be reduced after construction was complete.

- **Consider public concerns.** As discussed in Section 6.1, consideration of public concerns was not evaluated in this FS and will be addressed during the public comment period.

6.2.3 Action-Specific Requirements

As discussed in Section 6.1, the MTCA action-specific requirements concerning groundwater cleanup actions and remediation levels are not applicable to the alternatives under consideration. The evaluation of the alternatives against the other action-specific requirements is summarized below.

- **Soil at current or potential future residential areas and child care centers.** The property is currently owned by the City and protected from development by a conservation easement held by the Chelan-Douglas Land Trust and, therefore, it is unlikely that the property will be used as a future residential or child care center. Regardless of future land use, Alternatives 1 and 2 would comply with this requirement; Alternative 1 removes all soil

exceeding preliminary screening levels; Alternative 2 caps soil exceeding preliminary screening levels.

- **Institutional controls.** Alternatives 1 and 2 meet this requirement. Alternative 1 does not use or require institutional controls. Alternative 2 uses institutional controls to maintain the integrity of the cap; however, the protectiveness of this remedy does not rely primarily on institutional controls.

- **Releases and migration.** Alternatives 1 and 2 meet this requirement. Alternative 1 controls releases and migration by removing and permanently disposing of the impacted materials that exceed screening levels. Alternative 2 controls releases and migration through consolidating and capping impacted material.

- **Dilution and dispersion.** Alternatives 1 and 2 meet this requirement; none of the alternatives rely primarily on dispersion and dilution to comply with screening levels.

6.3 Disproportionate Cost Analysis

Under MTCA (WAC 173-340-360[3][b]), preference is given to cleanup actions that are permanent to the maximum extent practicable. A DCA is used for this assessment. The DCA compares the implementation costs versus the environmental benefits of a remedial alternative. Costs are considered to be disproportionate to benefits if the incremental cost of an alternative over that of a lower cost alternative exceeds the incremental degree of benefits achieved by the alternative over that of the other lower cost alternative.

The most practicable permanent solution evaluated is used as the baseline cleanup action alternative against which other alternatives are compared. Of the alternatives under consideration, Alternative 1 (excavation and disposal) is considered the more permanent solution. Therefore, Alternative 1 is the baseline action against which the other alternatives are compared.

6.3.1 DCA Criteria

The following criteria, listed in WAC 173-340-360(3)(f), are used to evaluate and compare cleanup action alternatives when conducting a disproportionate cost analysis:

- **Protectiveness.** Overall protectiveness of human health and the environment, including the degree to which existing risks are reduced, time required to reduce risk at the facility and attain cleanup standards, on-site

and off-site risks resulting from implementing the alternative, and improvement of the overall environmental quality.

- **Permanence.** The degree to which the alternative permanently reduces the toxicity, mobility, or volume of hazardous substances, including the adequacy of the alternative in destroying the hazardous substances, the reduction or elimination of hazardous substance releases and sources of releases, the degree of irreversibility of waste treatment process, and the characteristics and quantity of treatment residuals generated.

- **Cost.** The cost to implement the alternative, including the cost of construction, the net present value of any long-term costs, and agency oversight costs. Long-term costs include operation and maintenance costs, monitoring costs, and the cost of maintaining institutional controls.

- **Effectiveness over the long term**. Long-term effectiveness includes the degree of certainty that the alternative will be successful, the reliability of the alternative while hazardous substances are expected to remain on-site at concentrations that exceed cleanup levels, the magnitude of residual risk with the alternative in place, and the effectiveness of controls required to manage treatment residues or remaining wastes.

  The following cleanup action components may be used as a guide, in descending order, when assessing the relative degree of long-term effectiveness:

  - Reusing or recycling;
  - Destruction or detoxification;
  - Immobilization or solidification;
  - On-site or off-site disposal in an engineered, lined, and monitored facility;
  - On-site isolation or containment with attendant engineering controls; and
  - Institutional controls and monitoring.

- **Management of short-term risks.** The risk to human health and the environment that is associated with the alternative during construction and implementation, and the effectiveness of measures that will be taken to manage such risks.

- **Technical and administrative implementability**. Ability to be implemented including consideration of whether the alternative is technically possible; availability of necessary off-site facilities, services, and materials; administrative and regulatory requirements; scheduling; size; complexity;

monitoring requirements; access for construction and monitoring; and integration with existing facility operations and other current or potential remedial actions.

- **Consideration of public concerns.** As discussed in Section 6.1, consideration of public concerns was not evaluated in this FS and will be address during the public comment period.

6.3.2 DCA Evaluation

We evaluated the Alternatives 1 and 2 against the DCA criteria outlined above. Alternative 3 was not considered because it did not meet the threshold criteria. This evaluation is presented in Table 5. The following sections summarize the results of our DCA evaluation.

Protectiveness. Alternatives 1 and 2 are considered protective of human health and the environment. Alternatives 1 and 2 are considered to be equally protective. Alternative 1 prevents exposure through removal of all impacted material exceeding preliminary screening levels. Alternative 2 prevents exposure through consolidation and capping. Both alternatives would achieve full protectiveness immediately upon completion.

Permanence. None of the alternatives reduce the toxicity or volume of contaminants. Alternatives 1 and 2 control contaminant mobility by removal or capping of 8,800 cy of impacted material, Alternative 2 requires institutional controls and long-term monitoring and maintenance to remain protective while Alternative 1 does not.

Cost. One of the primary goals in developing cost estimates for alternative evaluation is to ensure that costing procedures and assumptions are consistent. Consistency reduces the potential for bias when comparing assumptions and presents a level playing field when evaluating the cost of the alternatives. This cost estimating approach is appropriate for FS costs. However, because of the conservative approach to estimating mass and area, FS cost estimates are not appropriate for use in other applications. Cost estimates that are more accurate will be developed during remedial design as part of the bidding and contractor selection process. The extent of impacted material is likely greater than is estimated in the RI and could significantly increase the costs for Alternatives 1 and 2.

The total cost of implementing Alternatives 1, 2, and 3 (over 50 years) is approximately $1,000,000, $750,000, and $380,000 (–35 to +50 percent),

respectively (Table 6). The components of these costs and assumptions used in the estimate are shown in Tables 7 through 9.

Effectiveness over the long term. Under WAC-173-340 -360(3)(f)(iv), disposal in an engineered, lined, and monitored facility is considered to be one step higher in long-term protectiveness than on-site containment. Institutional controls are considered to offer the lowest level of effectiveness over the long term. Therefore, Alternative 1 is considered the most effective over the long term.

Management of short-term risks. Short-term risks for Alternatives 1 and 2 are expected to be small and to be managed by following a construction health and safety plan and implementing other construction best practices (e.g., dust control and use of licensed material haulers). The off-site disposal component of Alternative 1 is inherently more risky because of its reliance on over-the-road transport of waste material to a landfill.

Technical and administrative implementability. Alternatives 1 and 2 use typical construction practices and equipment. Creating road access to SR-04 and SR-05 presents potential challenges. Excavation areas with steep slopes increase technical implementability challenges. The ability to restore disturbed areas for all alternatives may be low because of the limited rainfall in the area.

7.0 PREFERRED REMEDIATION ALTERNATIVE

Alternatives 1 and 2 comply with the MTCA threshold requirements for consideration as a cleanup action and provide for a reasonable restoration time frame. In addition, Alternatives 1 and 2 comply with the relevant MTCA action-specific criteria concerning soil at residential areas, reliance on institutional controls for protectiveness, contaminant release and migration, and reliance on dilution and dispersion.

As described in Section 6.3, the main differences between the alternatives are how they fulfill the MTCA requirement that cleanup actions be permanent to the maximum extent practicable (that is, the tradeoffs between how they address the DCA criteria). Under MTCA, the most practicable permanent solution is to be used as the baseline against which other alternatives are compared. Alternative 1 is the most permanent practicable solution and was, therefore, the baseline against which the other alternatives were compared.

Although Alternative 1 is the most permanent, Alternative 2 is judged to use permanent solutions to the maximum extent possible. Alternative 1 has

significantly higher costs for the minimal increase in protectiveness. Due to this large incremental cost difference, and the fact that both alternatives adequately address risks to possible receptors based on a recreational use scenario, Alternative 2 is the preferred alternative.

Using the DCA criteria, compared to Alternative 1, Alternative 2 was found to:

- Be equally protective;
- Be somewhat less permanent;
- Be less expensive;
- Be slightly less effective over the long term;
- Involve less short-term risk; and
- Is equally technically and administratively implementable.

The incremental cost of Alternative 1 was determined to be less than the additional benefits that it would provide over Alternative 2.

The conceptual level (–35 to +50 percent) total estimated cost for Alternative 2, including capital and long-term compliance monitoring costs, is estimated to be approximately $750,000 for an operating period of 50 years.

8.0 REFERENCES

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Table 1 - Preliminary Screening Criteria for Soil

Constituents of Concern (mg/kg)	**Draft Screening Levels (not lower than background)**	Site-Specific Background Concentration	Ecology-Reported Natural Background[a]	Lowest Potential Soil ARAR[b]	MTCA Method B Soil Cleanup Levels		Ecological Indicator Screening Criteria[g]		
					MTCA Method A Soil Cleanup Levels[c]	Soil Ingestion[d]	Groundwater Protection[e]	Protection of Plants[f]	Protection of Soil[f]	Protection of Wildlife[f]
Aluminum (Al)	**22,524**	22,524	37,200	50	--	80000	--	50	--	--
Antimony (Sb)	**5**	--	--	5	--	32	5.42[i]	5	--	--
Arsenic (As)	**14.4**	14.4	7	0.67	20	0.67	5.84[i]	-- / 10[h]	-- / 60[h]	7 / 132 (h)
Barium (Ba)	**160**	160	--	102	--	16,000	1650[j]	500	--	102
Chromium III (Cr III)	**42**	17.3	42 (i)	42	2,000	120,000	2000[j]	42[i]	42[i]	67 (i)
Chromium VI (Cr VI)	**19**	--		19	19	240	19.2[i]			
Iron (Fe)	**29,324**	29,324	42,100	91.2	--	56,000	91.2[i]	--	--	--
Lead (Pb)	**50**	17.4	50	17	250	--	--	50	500	118
Manganese (Mn)	**753**	753	1,100	522	--	11,200	522[j]	1,100	--	1,500
Mercury (Hg, inorganic)	**0.10**	0.048	0.07	0.10	2	--	2.09[i]	0.3	0.10	5.5
Selenium (Se)	**0.3**	--	--	0.3	--	400	5.2[j]	1	70	0.3
Silver (Ag)	**2**	0.33	--	2	--	400	13.6[i]	2	--	--
Vanadium (Va)	**44.9**	44.9	--	2	--	5.6	22.4[i]	2	--	--

Notes:

(a) Data from Natural Background Soil Metals Concentrations in Washington State (Ecology 1994).

(b) Shaded cells correspond to lowest potential chemical-specific ARAR.

(c) WAC 173-340-740(2), WAC 173-340-900 (Table 740-1), Model Toxics Control Act (MTCA) Method A

(d) WAC 173-340-740(3). MTCA Method B unrestricted land use soil cleanup standards. For carcinogenic constituents, the value presented is the lower of the non-carcinogenic and carcinogenic levels calculated using Equations 740-1 and 740-2 for ingestion only. Equations 740-4 and 740-5 are for ingestion and dermal contact. Information from CLARC 3.1 was used unless otherwise noted.

(e) WAC 173-340-740(3)(b)(iii)(A); MTCA Method B unrestricted land use soil cleanup standards, groundwater protection. Values calculated using the MTCA three-phase partitioning model WAC 173-340-747(4).

(f) MTCA 173-340-900 (Table 749-3)

(g) EPA Ecological Soil Screening Levels (ECO-SSL) are found at http://www.epa.gov/ecotox/ecossl/

(h) Based on Arsenic III / Arsenic V

(i) Based on total Chromium

(j) Based on drinking water MCL

-- Not established or not applicable

Table 2 - Applicable or Relevant and Appropriate Requirements

Authority	Resource	Implementing Laws/Regulation	ARAR?	Applicability
Chemical-Specific ARARs				
State	Soil	Washington State Model Toxics Control Act [RCW 70.105D; Chapter 173-340 WAC]	Yes	The Model Toxics Control Act (MTCA) soil cleanup levels are applicable.
Action-Specific ARARs				
Federal/ State	Surface Water	Federal Water Pollution Control Act--National Pollution Discharge Elimination System [Clean Water Act; 33 U.S.C. § 1342, Section 402] and Implementing Regulations Washington State Construction Stormwater General Permit Chapter 90.48 RCW	Yes	The NPDES program establishes requirements for point source discharges, including stormwater runoff. These requirements would be applicable for any point source discharge of stormwater during construction or following cleanup.
Federal	Surface Water	Federal Water Pollution Control Act--Water Quality Certification [Clean Water Act; 33 U.S.C. § 1341, Section 401] and Implementing Regulations	No	Section 401 of the CWA provides that applicants for a permit to conduct any activity involving potential discharges into waters or wetlands shall obtain certification from the state that discharges will comply with applicable water quality standards. No discharges expected to waters or wetlands of the state.
State	Surface Water	Hydraulic Code [RCW 77.55; Chapter 220-110 WAC]	No	The Hydraulic Code requires that any construction activity that uses, diverts, obstructs, or changes the bed or flow of state waters must be done under the terms of a Hydraulics Project Approval permit issued by Washington State Department of Fish and Wildlife (WDFW). These activities are not expected for the proposed alternatives.
Federal	Surface Water and Wetlands	Federal Water Pollution Control Act--Discharge of Dredge and Fill Materials [Clean Water Act; 33 U.S.C. § 1344, Section 404] and Implementing Regulations	No	Section 404 of the CWA establishes a program to regulate the discharge of dredged and fill materials into the waters of the United States, including wetlands. These activities are not expected for the proposed alternatives.
Federal	Solid Waste	Resource Conservation and Recovery Act [42 U.S.C. § 6901 et seq.], Subtitle D - Managing Municipal and Solid Waste [40 C.F.R. Parts 257 and 258]	Yes	Subtitle D of RCRA establishes a framework for management of non-hazardous solid waste. These regulations establish guidelines and criteria from which states develop solid waste regulations. These requirements are applicable to Alternatives 1 and 3 because they involve the disposal of waste in a Subtitle D landfill.
State	Solid Waste	Washington State Solid Waste Handling Standards [RCW 70.95; Chapter 173-350 WAC]	Yes	Washington State Solid Waste Handling Standards apply to facilities and activities that manage solid waste. The regulations set minimum functional performance standards for proper handling and disposal of solid waste; describe responsibilities of various entities; and stipulate requirements for solid waste handling facility location, design, construction, operation, and closure. These requirements are applicable to Alternatives 1 and 3 because they involve the disposal of waste in a Subtitle D landfill. They are relevant and appropriate to Alternatives 2 and 4 because the cap is based on the presumptive limited-purpose landfill cover specified in Chapter 173-350 WAC.

Table 2 - Applicable or Relevant and Appropriate Requirements

Authority	Resource	Implementing Laws/Regulation	ARAR?	Applicability
Federal	Air	Clean Air Act [42 U.S.C. § 7401 et. seq.; 40 C.F.R. Part 50]	Yes	The federal Clean Air Act creates a national framework designed to protect ambient air quality by limiting air emissions.
State	Air	Washington Clean Air Act and Implementing Regulations [WAC 173-400-040(8)]	Yes	These regulations require the owner or operator of a source of fugitive dust to take reasonable precautions to prevent fugitive dust from becoming airborne and to maintain and operate the source to minimize emissions. These regulations are applicable to all alternatives during construction.
State	Groundwater	Minimum Standards for Construction and Maintenance of Water Wells [RCW 18.104; Chapter 173-160 WAC]	No	Washington State has developed minimum standards for constructing water and monitoring wells, and for the decommissioning of wells. Drilling or abandoning wells are not present in the alternatives.
Federal	Endangered Species	Endangered Species Act [16 U.S.C. §§ 1531 - 1544] and Implementing Regulations	No	The Endangered Species Act (ESA) protects species of fish, wildlife, and plants that are listed as threatened or endangered with extinction. It also protects designated critical habitat for listed species. The ESA outlines procedures for federal agencies to follow when taking actions that may jeopardize listed species, including consultation with resource agencies. No threatened or endangered species or habitat areas are expected to be impacted by the alternatives.
Location-Specific ARARs				
State	Aquatic Lands	Aquatic Lands Management - Washington State [RCW 79.90; Chapter 332-30 WAC]	No	The Aquatic Lands Management law develops criteria for managing state-owned aquatic lands. Aquatic lands are to be managed to promote uses and protect resources as specified in the regulations. The Site is not on aquatic lands.
Federal	National Forest System Lands	National Forest Management Act of 1976 [16 U.S.C. §§ 1600 – 1614] (NFMA) and Land Management Plans established thereunder	No	The NFMA requires national forests to develop Land Management Plans (forest plans). These plans establish management requirements (standards and guidelines) and management areas that address resources and activities such as vegetation management, timber, wilderness, fish and wildlife habitat, grazing, recreation, mineral exploration and development, water and soils, cultural and historic resources, research natural areas, and diversity of plant and animal communities. The Site is no located on National Forest System Lands.
Federal	Wilderness Areas	Wilderness Act [16 U.S.C. §§ 1131 - 1136] and Implementing Regulations	No	The Wilderness Act established the National Wilderness Preservation System, which consists of federal and designated by Congress as wilderness areas, and administered to leave the land unimpaired for future use as a wilderness. The Site is not designated under the Wilderness Act.
Federal	Roadless Areas	Roadless Area Conservation Rule 2001 [66 Fed. Reg. 3244, January 12, 2001]	No	This rule limits road construction, reconstruction, and timber harvest in inventoried roadless areas because they have the greatest likelihood of altering and fragmenting landscapes, resulting in immediate, long-term loss of roadless area values and characteristics. The Site is not in an inventoried roadless area.

Table 3 - Remediation Technology Screening for Soil

General Response Action	Remediation Technology	Description	Implementability	Reliability	Relative Cost	Screening Comments	Technology Retained?
Institutional Controls	Governmental and proprietary controls; enforcement and permit tools; information devices	Physical and administrative measures to control access or exposure to contaminated soil. Placement of an environmental covenant on the property.	Technically implementable.	Reliable conventional administrative measures.	Low capital and O&M cost.	Applicable in combination with other technologies.	Yes
	Physical Access Restrictions	Physical access restrictions prevent access for recreational users or other site visitors to impacted areas of the site using signage and/or fencing.	Technically implementable.	Reliable method of controlling accidental direct human contact with physical and chemical site hazards.	Low capital and O&M cost.	Applicable in combination with other technologies.	Yes
Containment	Capping In Place - Soil Cover	Placement of a surface cap over impacted soil areas to minimize transport and mobilization of contaminants, and to minimize direct-contact risk for human and ecological receptors. Soil or rock from a non-acid producing source could be used to prevent direct contact with impacted materials to human and ecological receptors, reduce erosion, and provide a media for revegetation.	Technically implementable. Soil materials at the site are limited in quantity, and any soil to be used as cover material would have to be imported from an off-site borrow source.	Effective for minimizing access, direct-contact risk, and mobility of contaminants. Less effective than source removal.	Low to moderate capital and O&M cost.	Applicable in locations where contaminants remain in place. Soil covers from a certified clean imported source are retained for further consideration.	Yes
	Capping In Place - Clay Cover	A clay cover consists of low permeability clay layer(s) approximately 6 to 12 inches thick. Clay covers are commonly specified instead of soil covers to further minimize surface water infiltration.	Clay covers are typically used in landfill cover designs where strict control of leaching constituents of concern into the subsurface environment is desired.	Effective for minimizing access, direct-contact risk, and mobility of contaminants. Less effective than source removal.	Low to moderate capital and O&M cost.	Since adequate infiltration control could be achieved by other means, clay covers are not retained for further consideration.	No
	Capping In Place - HDPE Liner and Cover	Conceptually, a cap may consist of a geotextile separation layer over the impacted areas followed by earthen materials. High-density polyethylene (HDPE) is commonly used as a liner material and a cover for consolidated stockpiled waste rock and impacted materials.	Technically implementable.	Reliable method to prevent direct exposure of the materials to the environment or receptors, virtually eliminates infiltration due to precipitation, and significantly reduces the potential for metals leaching.	Moderate to high capital and O&M costs.	Leachate collection systems are often a component of an HDPE liner system. However, since leaching is not a concern at the Site, a leachate collection system is not required.	Yes
	Consolidation, Waste Rock Repository Stockpile	A repository would be one option for consolidating the materials in one location for long-term care. Repositories are typically capped with an engineered low-permeability cover system, and may also be revegetated.	Technically implementable.	Reliable method to prevent direct exposure of the materials to the environment or receptors.	Moderate to high capital and O&M costs.	Consolidation in a waste rock repository allows for maintaining waste rock and materials above cleanup levels in a controlled environment and, with an appropriate cover, can minimize or eliminate exposure pathways to potential human and ecological receptors.	Yes
	Stabilization	Chemicals are introduced to physically bind or enclose contaminants, or to induce chemical reactions between the stabilizing agent and contaminants to reduce their mobility.	Technically implementable.	Most metals are amenable to cement-based stabilization, which tend to form insoluble hydroxides in the basic pH ranges commonly found in cement. This option may be combined with a cover option to further reduce potential exposure pathways.	Moderate to high capital cost. Low O&M cost.	Although this technology is viable, it is not retained for further consideration because leaching tests conducted on the waste rock piles do not indicate that the waste is particularly susceptible to leaching. Elements of other technologies would still be needed such as a repository with a liner. Stabilization would only increase the volume of materials requiring disposal. Furthermore, stabilized materials are subject to weathering, so a protective cover would still be required.	No

Table 3 - Remediation Technology Screening for Soil

General Response Action	Remediation Technology	Description	Implementability	Reliability	Relative Cost	Screening Comments	Technology Retained?
Natural Recovery	Monitored natural attenuation (MNA)	Naturally occurring physical, chemical, and biological processes that reduce contaminant mobility or concentration. Natural attenuation processes are commonly used for remediation of contaminated sites. A variety of natural processes occur without human intervention at all sites at varying rates and degrees of effectiveness to attenuate (i.e., decrease) the mass, toxicity, mobility, volume, or concentrations of organic and inorganic contaminants in soil, groundwater, and surface water systems.	Technically implementable. MNA requires more complex and costly site characterization prior to implementation, long-term monitoring, and potential of continued migration, and/or cross-media transfer of contaminants. Cleanup time frame longer than for other remedial options for soil.	Metals do not degrade over time and natural attenuation of the waste rock at the site has not been observed so it is not expected to occur to a significant degree in the foreseeable future.	Negligible capital cost. Low O&M cost.	Inadequate effectiveness for treatment of metals. Slow restoration time frame compared to other applicable technologies. Although not retained as a possible remedy based on other suitable technologies, natural attenuation is considered complementary to the other engineered remedial technologies.	No
Soil Removal	Excavation / Soil removal	Removal of impacted soil using common excavation techniques. Excavation techniques employ the physical removal of impacted materials to eliminate future receptor exposure. Excavation technologies typically involve conventional earthmoving construction equipment. Equipment such as hydraulic excavators and dozers would be satisfactory for excavating and moving waste rock contaminated soils. Excavated soil treated on site or sent off site for disposal.	Technically implementable.	Effective for all site soil contaminants.	Moderate capital cost. Negligible O&M cost.	Commonly used established technology effective for all site soil contaminants. Excavation techniques used at the site may require dust control measures in disturbed areas to prevent particulate inhalation. Dust control typically involves using water sprays to suppress particulate suspension.	Yes
Off-Site Management	Land disposal	Disposal of impacted soil at an off-site, lined, permitted landfill.	Technically implementable. Impacted soil requires profiling and must meet land disposal requirements.	Effective for site soil contaminants.	Moderate capital cost, depending on type of contaminant. Negligible O&M cost.	Common disposal option for excavated soil.	Yes
	Transportation	Transportation technologies typically involve the use of conventional materials handling equipment, such as excavators, loaders and trucks to load and transport excavated materials either on-site or off-site. Contractors may consider conveyor belts or other technologies as part of the transportation options.	Technically implementable. Necessary component of each of the removal options.	There are trails which were previously used by 4-wheel-drive vehicles. This trail will be used for site transportation access. Portions of this trail may need to be stabilized, restored, etc. To access SR-05, a temporary road will need to be constructed from the trail road to the AOC.	Moderate to high capital and O&M costs.	As with excavation activities, transportation activities would include dust control measures to prevent particulate suspension around the site when equipment is in use.	Yes
***Ex Situ* Treatment**	Soil washing	Removal of leachable contaminants from excavated soil using water and surfactants in an aboveground reactor with subsequent treatment of residual fluids.	Difficult to implement. Complex mixtures of contaminants would make formulation of washing liquid difficult. Residuals that are difficult to extract from the soil matrix may require additional treatment. Limited space on site for treatment system.	Effective for site soil contaminants. A water source would have to be identified or water would have to be transported to the site. A soil washing unit would require a large footprint to operate. Any oversized contaminated material that could not be processed through the unit would still have to be treated or disposed of in another manner. The separated contaminants, sludge, and wastewater would have to be treated and/or disposed.	High capital and O&M costs.	Because of the logistical difficulties of transporting in a unit and obtaining suitable washwater, problems and costs associated with disposal of spent washwater and sludge, overall costs, as well as significant time constraints due to the need for a treatability study, this technology has not been retained for further consideration.	No
	Chemical treatment	Treatment of impacted soil in aboveground reactor to degrade contaminants into nonhazardous or less toxic compounds.	Potentially difficult to implement. Limited space on site for treatment system. Presence of organic material in soil may increase required chemical application rates.	Effective for site soil contaminants.	High capital and O&M costs.	High cost relative to other *ex situ* treatment technologies. May not provide added incremental benefit.	No

Table 3 - Remediation Technology Screening for Soil

General Response Action	Remediation Technology	Description	Implementability	Reliability	Relative Cost	Screening Comments	Technology Retained?
***Ex Situ* Treatment (conintued)**	Metals recovery	Metals recovery from mine waste materials may be achieved using various reprocessing techniques including pyrometallurgical and hydrometallurgical processes. Pyrometallurgical processes expose materials to elevated temperatures under controlled conditions to recover pure metals or metal oxides. Hydrometallurgical processes involve the dissolution of target metal species in the solid materials into a solution using pH control, followed by their precipitation as elemental or other commercially acceptable chemical forms.	Technically implementable.	Both pyrometallurgical and hydrometallurgical processes are commercially available, and well understood.	Moderate to high capital and O&M costs.	Metals recovery from site waste materials is not retained for further consideration because metals concentrations in the waste rock are below concentrations necessary for cost-effective use of the technology.	No
	Revegetation	Replacing vegetation following disturbance of the ground surface will mitigate soil erosion and surface water infiltration and runoff. Establishing vegetation can also be effective in enhancing the stability and permanence of cover systems. Roots from cover plants hold the soil in place, and protect against wind and water erosion. Revegetation can also reduce infiltration of water into surface materials through interception of water by plant root systems and transpiration mechanisms.	Potentially difficult to implement due to site conditions and low amounts of precipitation. Revegetation is typically performed in conjunction with placement of clean fill and soil covers. For this site, revegetation includes topsoil replacement and planting native ground cover. Revegetation would include use of native seed mixtures, and would follow guidance provided by the City of Wenatchee.	Established technology.	Moderate capital and O&M costs.	Potentially difficult to implement due to site conditions and low amounts of precipitation. May not be effective and cost effective.	Yes

Table 4 – Alternative Evaluation

Selection Criteria	Alternative 1: Excavation and Off-Site Disposal	Alternative 2: Consolidation and Capping in Place	Alternative 3: Limited Excavation and Capping in Place
Threshold Requirements: WAC 173-340-360(2)(a)			
Protect Human Health and the Environment	Protective. Removal of contaminated material eliminates direct contact risks to humans and terrestrial ecological receptors. Removal would also eliminate exposure to airborne dust and erosion. Approximately 8,800 cy of material will be removed under this alternative.	Protective. Capping prevents direct contact risks to humans and terrestrial ecological receptors. Capping would also control exposure to airborne dust and erosion. Approximately 8,800 cy of material will be capped under this alternative.	Protective for human health. The Human Health Risk Assessment indicates the risk to human health is below a level of concern under the recreational visitor scenario. Removal of contaminated material at waste rock piles SR-01, SR-04, SR-05, SR-06, SR-07, and SR-08 eliminates direct contact risks in these more accessible areas and removes approximately 1,050 cy of impacted material from the property. SR-02 and SR-03 will be capped in place. Approximately 1,300 cy of material will be capped under this alternative. However, this alternative would not adequately protect environmental receptors since the downslope areas would not be addressed.
Comply with Cleanup Standards	Would comply. Following removal, no hazardous substances exceeding the draft cleanup levels would remain.	Would comply. The material left in place above draft cleanup levels will be capped (contained). Cleanup actions that involve containment can be deemed to meet cleanup standards if requirements set out in WAC 173-340-740(6)(f) are met (see Section 6.2.1).	Would not comply. The downslope areas would not be addressed and therefore Alternative 3 does not comply with cleanup standards as specified in requirements set out in WAC 173-340-740(6)(f) are met (see Section 6.2.1).

Table 4 – Alternative Evaluation

Selection Criteria	Alternative 1: Excavation and Off-Site Disposal	Alternative 2: Consolidation and Capping in Place	Alternative 3: Limited Excavation and Capping in Place
Comply with Applicable State and Federal Law	Would comply. ARARs are judged to be attainable and do not affect the alternative selection process.	Would comply. ARARs are judged to be attainable and do not affect the alternative selection process.	Would comply. ARARs are judged to be attainable and do not affect the alternative selection process.
Provide for Compliance Monitoring	Provides for compliance monitoring in accordance with WAC 173-340-410 as described in Section 5.3.1.	Provides for compliance monitoring in accordance with WAC 173-340-410 as described in Section 5.3.2.	Provides for compliance monitoring in accordance with WAC 173-340-410 as described in Section 5.3.3.
Other Requirements: WAC 173-340-360(2)(b)			
Use Permanent Solutions to the Maximum Extent Practicable	Uses permanent solutions to the maximum extent practicable as described in Section 6.3 and Table 4.	Uses permanent solutions to the maximum extent practicable as described in Section 6.3 and Table 4.	Since Alternative 3 is not protective of ecological receptors it does not meet the threshold requirements. Therefore, this Alternative has been dropped from further evaluation. Not evaluated.
Provide for a Reasonable Restoration Time Frame	Provides reasonable restoration time frame. The work could be completed within one construction season.	Provides reasonable restoration time frame. The work could be completed within one construction season.	Not evaluated.
Consider Public Concerns	This criterion will be addressed during the public comment period for the RI/FS.		

Selection Criteria	Alternative 1: Excavation and Off-Site Disposal	Alternative 2: Consolidation and Capping in Place	Alternative 3: Limited Excavation and Capping in Place
Action-Specific Requirements: WAC 173-340-360(2)(c) through (h)			
Groundwater Cleanup Actions, WAC 173-340-360(2)(c)	Not applicable. There are not known groundwater impacts at the site.		
Cleanup Actions for Soils at Current or Potential Future Residential Areas and for Soils at Schools and Child Care Centers, WAC 173-340-360(2)(d)	Complies. Alternative 1 meets the requirement because soils exceeding draft cleanup levels will be removed.	Complies. Alternative 2 meets the requirement because soils exceeding draft cleanup levels contained.	Not evaluated.
Institutional Controls WAC 173-340-360(2)(e)	Not applicable. Institutional controls are not a component of Alternative 1.	Complies. Alternative 2 only uses institutional controls (restrictive covenant) to maintain the protectiveness of caps; it does not rely primarily on institutional controls and monitoring.	Not evaluated.
Releases and Migration WAC 173-340-360(2)(f)	Complies. Alternative 1 eliminates releases and migration of hazardous substances by excavation and disposal.	Complies. Alternative 2 minimizes releases and migration of hazardous substances through the use of consolidation and capping.	Not evaluated.

Table 4 – Alternative Evaluation

Selection Criteria	Alternative 1: Excavation and Off-Site Disposal	Alternative 2: Consolidation and Capping in Place	Alternative 3: Limited Excavation and Capping in Place
Dilution and Dispersion WAC 173-340-360(2)(g)	Complies. Alternative 1 does not rely primarily on dilution and dispersion.	Complies. Alternative 2 does not rely primarily on dilution and dispersion.	Not evaluated.
Remediation Levels WAC 173-340-360(2)(h)	Not applicable. The alternatives do not involve remediation levels.		

Table 5 - Disproportionate Cost Analysis

DCA Criteria	Alternative 1: Excavation and Off-Site Disposal	Alternative 2: Consolidation and Capping in Place
Protectiveness	Removal of hazardous substances would eliminate direct contact risks to humans and terrestrial ecological receptors. Protectiveness would be achieved immediately upon completion of remedy. Alternative 1 is considered as protective as Alternative 2.	Capping would prevent direct contact risks to humans and terrestrial ecological receptors. Protectiveness would be achieved immediately upon completion of remedy. Alternative 2 is considered as protective as Alternative 1.
Permanence	Provides no reduction in toxicity or volume of contaminants. Risk of contaminant mobility would be greatly reduced by removing 8,800 CY of waste and placing it in an off-site engineered, lined, and monitored facility. Alternative 1 is considered more permanent than Alternative 2.	Provides no reduction in toxicity or volume of contaminants. Capping controls mobility of contaminants. Long-term monitoring and maintenance required. Alternative 2 is considered somewhat less permanent than Alternative 1.
Cost	$1,000,000	$750,000
Effectiveness over the Long Term	Subtitle D landfills are proven and expected to be highly effective over the long term. Alternative 1 is considered somewhat more effective over the long term than Alternative 2.	Capping is a proven technology that is expected to be highly effective over the long term. However, long-term effectiveness relies on maintenance, monitoring, and institutional controls. Alternative 2 is considered somewhat less effective over the long term than Alternative 1.
Management of Short-Term Risks	Short-term risks expected to be manageable and primarily associated with creating road access, waste excavation, and over-the-road transport to landfill. Risks will be managed by following construction health and safety plan, implementing dust suppression measures, using properly licensed material haulers, etc. Alternative 1 is expected to have somewhat greater short-term risks than Alternative 2.	Short-term risks expected to be minimal and primarily associated with creating road access and construction of the cap. Risk will be managed by following construction health and safety plan, implementing dust suppression measures, etc. Alternative 2 is expected to have fewer short-term risks as Alternative 1.

Table 5 - Disproportionate Cost Analysis

DCA Criteria	Alternative 1: Excavation and Off-Site Disposal	Alternative 2: Consolidation and Capping in Place
Technical and Administrative Implementability	Uses typical construction practices and equipment. Creating road access to SR-04 and SR-05 presents potential challenges. The ability to restore disturbed areas may be limited because of limited rainfall in the area. Excavation areas with steep slopes also present increase technical implementability challenges. Alternative 1 is considered equally implementable as Alternative 2.	Uses typical construction practices and equipment. Creating road access to SR-04 and SR-05 presents potential challenges. The ability to restore disturbed areas may be limited because of limited rainfall in the area. Excavation areas with steep slopes also present increase technical implementability challenges. Alternative 2 is considered equally implementable as Alternative 1.
Consideration of Public Concerns	This criterion will be addressed during the public comment period for the RI/FS.	

Table 6 - Summary of Remediation Alternative Estimated Costs

Location:	Saddle Rock Park Wenatchee, WA	**Description:** Cost comparison of the total costs of Alternatives 1 through 3.
Phase:	Feasibility Study (-35% to +50%)	
Base Year:	2013	
Date:	June 2013	

DESCRIPTION	TOTAL NET PRESENT VALUE	INCREMENTAL COST	COST TABLE REFERENCE
Alternative 1	$1,000,000	Baseline Cost	Table 7
Alternative 2	$750,000	-$250,000	Table 8
Alternative 3	$380,000	-$620,000	Table 9

Table 7 - Remediation Alternative 1 Estimated Cost Summary

Location:	Saddle Rock Park Wenatchee, WA
Phase:	Feasibility Study (-35% to +50%)
Base Year:	2013
Date:	June 2013

Description: Alternative 1 involves the excavation, transportation, and disposal of waste material at a permitted, engineered, lined, and monitored landfill. A temporary haul road will need to be constructed. This cost estimate assumes that the material will be disposed of at a Subtitle D Landfill. Downslope areas and haul road will be restored using seeding. There are no operation and maintenance costs associated with this remedy.

CAPITAL COSTS

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Excavation and Disposal					
Mobilization/Demobilization	1	LS	$ 10,000	$ 10,000	Engineer's estimate
Temporary Erosion and Sediment Control Measures	1	LS	$ 5,000	$ 5,000	Engineer's estimate
Waste Excavation and Loading	8,792	CY	$ 5.23	$ 45,958	0.5 CY wheel mounted excavator, RSMeans 31 23 16.42 0020 and 31 23 16.42 0310
Waste Transportation and Disposal	13,188	ton	$ 30	$ 389,964	Greater Wenatchee Landfill and Recycling Center, Subtitle D MSW (7.4 miles from site).
Grading	11,900	SY	$ 2.69	$ 32,050	Grade subgrade for base course, small irregular areas. RSMeans 31 22 16.10 1050.
Confirmation Sampling and Analysis	1	LS	$ 42,840	$ 42,840	Analytical cost only, labor assumed to be part of construction management, 1 sample/50 SY.
Restoration	2,730	CY	$ 53	$ 143,864	Backfill toe-of-slope area with 1' soil cover. RSMeans 02 56 13.10 1100, hazardous waste, ballast cover with common borrow material
Excavation and Disposal Subtotal				**$ 669,677**	
Restoration and Revegetation					
Seeding	1.9	AC	$ 3,000	$ 5,800	Revegetate toe-of-slope area and temporary road with dry -land seeding mixture. Includes fertilizer and erosion control protection. Unit cost provided by City of Wenatchee.
Restoration and Revegetation Subtotal				**$ 5,800**	
Road Construction and Improvement					
Temporary Road and Road Repair	444	SY	$ 9.05	$ 4,022	Roads, gravel fill, no surfacing, 4" gravel depth. RS Means 01 55 23.50 0050
Temporary Road Removal	39	SY	$ 9.05	$ 352	RS Means 02 41 13.17 5050
Road Restoration	7	CY	$ 43.90	$ 327	Cover temporary road with 6 inches of topsoil and seed
Seeding	0.24	AC	$ 1,198	$ 289	Mechanical seeding for topsoil cover. RS Means 32 92 19.13 0020
Road Construction Subtotal				**$ 4,989**	
Contingency	15%	--	--	**$ 102,070**	Scope and bid contingency. Percentage of capital costs.
Professional/Technical Services					
Project Management	6%	--	--	$ 46,952	Percentage of capital cost + contingency. EPA 540-R-00-002.
Remedial Design	12%	--	--	$ 93,904	Percentage of capital cost + contingency. EPA 540-R-00-002.
Construction Management	8%	--	--	$ 62,603	Percentage of capital cost + contingency. EPA 540-R-00-002.
Professional/Technical Services Subtotal				**$ 203,459**	
TOTAL CAPITAL COST				**$ 985,995**	

Table 7 - Remediation Alternative 1 Estimated Cost Summary

Location:	Saddle Rock Park Wenatchee, WA
Phase:	Feasibility Study (-35% to +50%)
Base Year:	2013
Date:	June 2013

Description: Alternative 1 involves the excavation, transportation, and disposal of waste material at a permitted, engineered, lined, and monitored landfill. A temporary haul road will need to be constructed. This cost estimate assumes that the material will be disposed of at a Subtitle D Landfill. Downslope areas and haul road will be restored using seeding. There are no operation and maintenance costs associated with this remedy.

ANNUAL O&M COSTS

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
TOTAL ANNUAL O&M COST					No O&M costs for Alternative 1

PERIODIC COSTS

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Site Restoration Monitoring					
Site Inspections	1	YR	$ 1,000	$ 1,000	Years 1 through 3
Site Maintenance	1	YR	$ 3,044	$ 3,044	50% of cover and seeding costs. Years 1 through 3
Site Restoration Monitoring Subtotal				**$ 4,044**	
Contingency	10%	--	--	**$ 404**	Scope and bid contingency. Percentage of periodic costs.
Professional/Technical Services					
Project Management	10%	--	--	$ 445	Percentage of O&M costs + contingency. EPA 540-R-00-002.
Technical Support	10%	--	--	$ 445	Percentage of O&M costs + contingency. EPA 540-R-00-002.
Reporting	1	EA	$ 1,000	$ 1,000	Engineer's estimate
Professional/Technical Services Subtotal				**$ 1,890**	

PRESENT VALUE ANALYSIS

Discount Rate 1.1%
Total Years 50

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR	NET PRESENT VALUE	NOTES
Capital	0	$ 985,995	$ 985,995	1.000	$ 985,995	
Annual O&M		$ -	$ -	38.301	$ -	No O&M costs for Alternative 1
Periodic	1	$ 6,338	$ 6,338	0.989	$ 6,269	
Periodic	2	$ 6,338	$ 6,338	0.978	$ 6,201	
Periodic	3	$ 6,338	$ 6,338	0.968	$ 6,134	
		$ 1,005,010			$ 1,004,599	
TOTAL NET PRESENT VALUE OF ALTERNATIVE 1					**$ 1,004,599**	

Notes:
Present value analysis uses a 50-year discount rate of 1.1 percent.

Table 8 - Remediation Alternative 2 Estimated Cost Summary

Location: Saddle Rock Park
Wenatchee, WA
Phase: Feasibility Study (-35% to +50%)
Base Year: 2013
Date: June 2013

Description: Alternative 2 involves excavating and consolidating waste rock at the site, grading material into a stable configuration, and covering the waste rock with a cap. A temporary haul road will need to be constructed. Downslope areas, haul road, and capped material will be seeded. The cap will be monitored for the length of the remedy (50 years). Alternative 2 included institutional controls to maintain effectiveness of the cap

CAPITAL COSTS

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Excavation					
Mobilization/Demobilization	1	LS	$ 10,000	$ 10,000	Engineer's estimate
Temporary Erosion and Sediment Control Measures	1	LS	$ 5,000	$ 5,000	Engineer's estimate
Waste Excavation and Loading	2,198	CY	$ 5.23	$ 11,492	0.5 CY wheel mounted excavator, RSMeans 31 23 16.42 0020 and 31 23 16.42 0310
Waste Transportation	3,298	ton	$ 0.66	$ 2,176	Transportation costs to haul excavated material 1-mile for consolidation.
Grading	4,812	SY	$ 2.69	$ 12,961	Grade subgrade for base course, small irregular areas. RSMeans 31 22 16.10 1050.
Confirmation Sampling and Analysis	1	LS	$ 17,334	$ 17,334	Analytical cost only, labor assumed to be part of construction management, 1 sample/50 SY.
Restoration	1,167	CY	$ 53	$ 61,503	Backfill toe-of-slope area with 1' soil cover. RSMeans 02 56 13.10 1100, hazardous waste, ballast cover with common borrow material
Excavation Subtotal				**$ 120,467**	
Restoration and Revegetation					
Seeding	2.46	AC	$ 3,000	$ 7,380	Revegetate toe-of-slope area, temporary road, and consolidated capped areas with dry-land seeding mixture. Includes fertilizer and erosion control protection. Unit cost provided by City of Wenatchee.
Restoration and Revegetation Subtotal				**$ 7,380**	
Road Construction					
Temporary Road and Road Repair	444	SY	$ 9.05	$ 4,022	Roads, gravel fill, no surfacing, 4" gravel depth. RS Means 01 55 23.50 0050
Temporary Road Removal	39	SY	$ 9.05	$ 352	RS Means 02 41 13.17 5050
Road Restoration	7	CY	$ 44	$ 327	Cover temporary road with 6 inches of topsoil and seed
Seeding	0.24	AC	$ 1,198	$ 289	Mechanical seeding for topsoil cover. RS Means 32 92 19.13 0020
Road Construction Subtotal				**$ 4,989**	

Table 8 - Remediation Alternative 2 Estimated Cost Summary

Location: Saddle Rock Park
Wenatchee, WA
Phase: Feasibility Study (-35% to +50%)
Base Year: 2013
Date: June 2013

Description: Alternative 2 involves excavating and consolidating waste rock at the site, grading material into a stable configuration, and covering the waste rock with a cap. A temporary haul road will need to be constructed. Downslope areas, haul road, and capped material will be seeded. The cap will be monitored for the length of the remedy (50 years). Alternative 2 included institutional controls to maintain effectiveness of the cap

Capping in Place					
Mobilization/Demobilization	1	LS	$ 10,000	$ 10,000	Engineer's estimate
Waste Consolidation and Grading	4,812	SY	$ 2.96	$ 14,257	Grade subgrade for base course, small irregular areas. RSMeans 31 22 16.10 1050. Increase by 10% for consolidation.
Soil Cover (min 1 feet)	2,413	CY	$ 53	$ 127,130	RSMeans 02 56 13.10 1100, hazardous waste, ballast cover with common borrow material
Hauling material	2,774	LCY	$ 7.03	$ 19,493	RS Means 31 23 23.20 0048, 8 CY truck, 8 miles
Capping in Place Subtotal				**$ 170,881**	
Institutional Controls					
Preparation of restrictive covenant	1	EA	$10,000	$10,000	Engineer's estimate.
Institutional Controls Subtotal				**$10,000**	
Contingency	15%	--	--	**$ 47,058**	Scope and bid contingency. Percentage of capital costs.
Professional/Technical Services					
Project Management	8%	--	--	$ 28,062	Percentage of capital cost + contingency. EPA 540-R-00-002.
Remedial Design	15%	--	--	$ 52,616	Percentage of capital cost + contingency. EPA 540-R-00-002.
Construction Management	10%	--	--	$ 35,077	Percentage of capital cost + contingency. EPA 540-R-00-002.
Professional/Technical Services Subtotal				**$ 115,756**	
TOTAL CAPITAL COST				**$ 476,530**	

ANNUAL O&M COSTS

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Annual O&M					
Site Inspections	1	YR	$ 1,000	$ 1,000	Engineer's estimate.
Site Maintenance	1	YR	$ 3,037	$ 3,037	1% of construction costs
Annual O&M Subtotal				**$ 4,037**	
Contingency	15%	--	--	**$ 606**	Scope and bid contingency. Percentage of periodic costs.
Professional/Technical Services					
Project Management	10%	--	--	$ 464	Percentage of O&M costs + contingency. EPA 540-R-00-002.
Technical Support	10%	--	--	$ 464	Percentage of O&M costs + contingency. EPA 540-R-00-002.
Reporting	1	YR	$ 1,000	$ 1,000	Engineer's estimate
Professional/Technical Services Subtotal				**$ 1,929**	
TOTAL ANNUAL O&M COST				**$ 6,571**	

Table 8 - Remediation Alternative 2 Estimated Cost Summary

Location: Saddle Rock Park
Wenatchee, WA
Phase: Feasibility Study (-35% to +50%)
Base Year: 2013
Date: June 2013

Description: Alternative 2 involves excavating and consolidating waste rock at the site, grading material into a stable configuration, and covering the waste rock with a cap. A temporary haul road will need to be constructed. Downslope areas, haul road, and capped material will be seeded. The cap will be monitored for the length of the remedy (50 years). Alternative 2 included institutional controls to maintain effectiveness of the cap

PERIODIC COSTS

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Site Restoration Monitoring					
Site Inspections	1	YR	$ 1,000	$ 1,000	Years 1 through 3
Site Maintenance	1	YR	$ 3,834	$ 3,834	50% of cover and seeding costs. Years 1 through 3
Site Restoration Monitoring Subtotal				**$ 4,834**	
Contingency	10%	--	--	**$ 483**	Scope and bid contingency. Percentage of periodic costs.
Professional/Technical Services					
Project Management	10%	--	--	$ 532	Percentage of O&M costs + contingency. EPA 540-R-00-002.
Technical Support	10%	--	--	$ 532	Percentage of O&M costs + contingency. EPA 540-R-00-002.
Reporting	1	EA	$ 1,000	$ 1,000	
Professional/Technical Services Subtotal				**$ 2,064**	

PRESENT VALUE ANALYSIS

Discount Rate 1.1%
Total Years 50

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR	NET PRESENT VALUE	NOTES
Capital	0	$ 476,530	$ 476,530	1.000	$ 476,530	
Annual O&M	1 - 50	$ 328,565	$ 6,571	38.301	$ 251,689	
Periodic	1	$ 7,381	$ 7,381	0.989	$ 7,301	
Periodic	2	$ 7,381	$ 7,381	0.978	$ 7,221	
Periodic	3	$ 7,381	$ 7,381	0.968	$ 7,143	
		$ 827,238			$ 749,884	

TOTAL NET PRESENT VALUE OF ALTERNATIVE 2 **$ 749,884**

Notes:
Present value analysis uses a 50-year discount rate of 1.1 percent.

Table 9 - Remediation Alternative 3 Estimated Cost Summary

Location: Saddle Rock Park, Wenatchee, WA
Phase: Feasibility Study (-35% to +50%)
Base Year: 2013
Date: June 2013

Description: Alternative 3 involves excavating and consolidating waste rock at the site, grading material into a stable configuration, and covering the waste rock with a cap. A temporary haul road will need to be constructed. Downslope areas will not be removed. Haul road and capped material will be seeded. The cap will be monitored for the length of the remedy (50 years).

CAPITAL COSTS

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Excavation					
Mobilization/Demobilization	1	LS	$ 10,000	$ 10,000	Engineer's estimate
Temporary Erosion and Sediment Control Measures	1	LS	$ 5,000	$ 5,000	Engineer's estimate
Waste Excavation and Loading	1,031	CY	$ 5.23	$ 5,391	0.5 CY wheel mounted excavator, RSMeans 31 23 16.42 0020 and 31 23 16.42 0310
Waste Transportation	1,547	ton	$ 0.66	$ 1,021	Transportation costs to haul excavated material 1-mile for consolidation.
Grading	1,311	SY	$ 2.69	$ 3,531	Grade subgrade for base course, small irregular areas. RSMeans 31 22 16.10 1050.
Confirmation Sampling and Analysis	1	LS	$ 4,734	$ 4,734	Analytical cost only, labor assumed to be part of construction management, 1 sample/50 SY.
Excavation Subtotal				**$ 29,677**	
Restoration and Revegetation					
Seeding	1.04	AC	$ 3,000	$ 3,115	Revegetate temporary and consolidated capped areas road with dry-land seeding mixture. Includes fertilizer and erosion control protection Unit cost provided by City of Wenatchee.
Restoration and Revegetation Subtotal				**$ 3,115**	
Road Construction					
Temporary Road and Road Repair	444	SY	$ 9.05	$ 4,022	Roads, gravel fill, no surfacing, 4" gravel depth. RS Means 01 55 23.50 0050
Temporary Road Removal	39	SY	$ 9.05	$ 352	RS Means 02 41 13.17 5050
Road Restoration	7	CY	$ 44	$ 327	Cover temporary road with 6 inches of topsoil and seed
Seeding	0.24	AC	$ 1,198	$ 289	Mechanical seeding for topsoil cover. RS Means 32 92 19.13 0020
Road Construction Subtotal				**$ 4,989**	
Capping in Place					
Mobilization/Demobilization	1	LS	$ 10,000	$ 10,000	Engineer's estimate
Waste Consolidation and Grading	1,311	SY	$ 2.96	$ 3,884	Grade subgrade for base course, small irregular areas. RSMeans 31 22 16.10 1050. Increase by 10% for consolidation.
Soil Cover (min 1 feet)	1,287	CY	$ 53	$ 67,795	RSMeans 02 56 13.10 1100, hazardous waste, ballast cover with common borrow material
Hauling material	1,480	LCY	$ 7.03	$ 10,395	RS Means 31 23 23.20 0048, 8 CY truck, 8 miles
Capping in Place Subtotal				**$ 92,074**	

Table 9 - Remediation Alternative 3 Estimated Cost Summary

Location: Saddle Rock Park
Wenatchee, WA
Phase: Feasibility Study (-35% to +50%)
Base Year: 2013
Date: June 2013

Description: Alternative 3 involves excavating and consolidating waste rock at the site, grading material into a stable configuration, and covering the waste rock with a cap. A temporary haul road will need to be constructed. Downslope areas will not be removed. Haul road and capped material will be seeded. The cap will be monitored for the length of the remedy (50 years).

Institutional Controls					
Preparation of restrictive covenant	1	EA	$10,000	$10,000	Engineer's estimate.
Institutional Controls Subtotal				**$10,000**	
Contingency	15%	--	--	**$ 20,511**	Scope and bid contingency. Percentage of capital costs.
Professional/Technical Services					
Project Management	8%	--	--	$ 12,029	Percentage of capital cost + contingency. EPA 540-R-00-002.
Remedial Design	15%	--	--	$ 22,555	Percentage of capital cost + contingency. EPA 540-R-00-002.
Construction Management	10%	--	--	$ 15,037	Percentage of capital cost + contingency. EPA 540-R-00-002.
Professional/Technical Services Subtotal				**$ 49,621**	
TOTAL CAPITAL COST				**$ 209,988**	

ANNUAL O&M COSTS

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Annual O&M					
Site Inspections	1	YR	$ 1,000	$ 1,000	Engineer's estimate.
Site Maintenance	1	YR	$ 1,299	$ 1,299	1% of construction costs
Annual O&M Subtotal				**$ 2,299**	
Contingency	15%	--	--	**$ 345**	Scope and bid contingency. Percentage of periodic costs.
Professional/Technical Services					
Project Management	10%	--	--	$ 264	Percentage of O&M costs + contingency. EPA 540-R-00-002.
Technical Support	10%	--	--	$ 264	Percentage of O&M costs + contingency. EPA 540-R-00-002.
Reporting	1	YR	$ 1,000	$ 1,000	Engineer's estimate
Professional/Technical Services Subtotal				**$ 1,529**	
TOTAL ANNUAL O&M COST				**$ 4,172**	

Table 9 - Remediation Alternative 3 Estimated Cost Summary

Location: Saddle Rock Park
Wenatchee, WA
Phase: Feasibility Study (-35% to +50%)
Base Year: 2013
Date: June 2013

Description: Alternative 3 involves excavating and consolidating waste rock at the site, grading material into a stable configuration, and covering the waste rock with a cap. A temporary haul road will need to be constructed. Downslope areas will not be removed. Haul road and capped material will be seeded. The cap will be monitored for the length of the remedy (50 years).

PERIODIC COSTS

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Site Restoration Monitoring					
Site Inspections	1	YR	$ 1,000	$ 1,000	Years 1 through 3
Site Maintenance	1	YR	$ 1,702	$ 1,702	50% of cover and seeding costs. Years 1 through 3
Site Restoration Monitoring Subtotal				**$ 2,702**	
Contingency	10%	--	--	**$ 270**	Scope and bid contingency. Percentage of periodic costs.
Professional/Technical Services					
Project Management	10%	--	--	$ 297	Percentage of O&M costs + contingency. EPA 540-R-00-002.
Technical Support	10%	--	--	$ 297	Percentage of O&M costs + contingency. EPA 540-R-00-002.
Reporting	1	EA	$ 1,000	$ 1,000	
Professional/Technical Services Subtotal				**$ 1,594**	

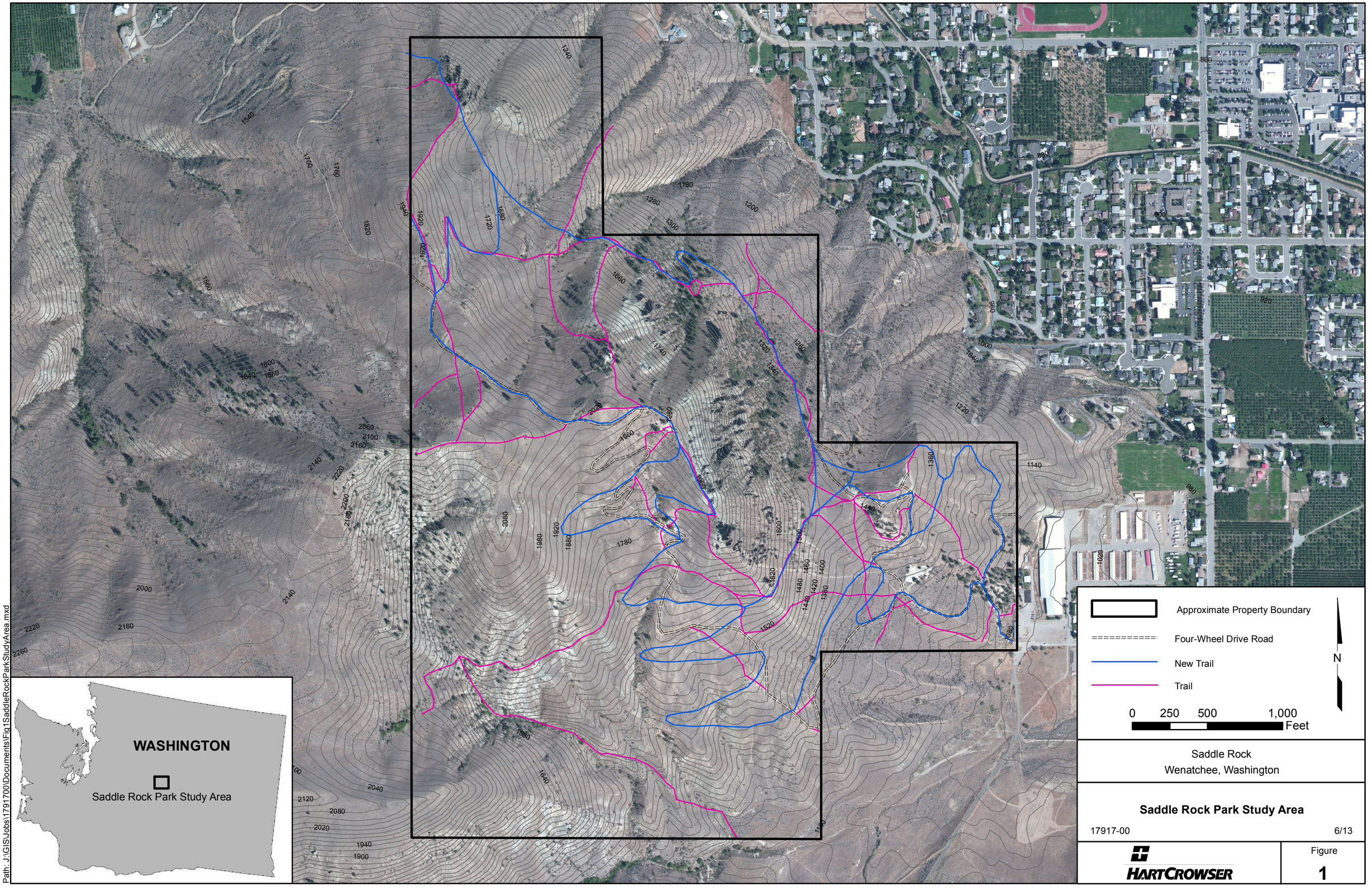
PRESENT VALUE ANALYSIS

Discount Rate 1.1%
Total Years 50

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR	NET PRESENT VALUE	NOTES
Capital	0	$ 209,988	$ 209,988	1.000	$ 209,988	
Annual O&M	1 - 50	$ 208,601	$ 4,172	38.301	$ 159,794	
Periodic	1	$ 4,567	$ 4,567	0.989	$ 4,517	
Periodic	2	$ 4,567	$ 4,567	0.978	$ 4,468	
Periodic	3	$ 4,567	$ 4,567	0.968	$ 4,419	
		$ 432,289			$ 383,186	

TOTAL NET PRESENT VALUE OF ALTERNATIVE 3 **$ 383,186**

Notes:
Present value analysis uses a 50-year discount rate of 1.1 percent.



Saddle Rock
Wenatchee, Washington

Saddle Rock Park Study Area

17917-00 6/13

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Figure 1

Path: J:\GIS\Jobs\1791700\Documents\Fig1SaddleRockParkStudyArea.mxd

SR04
SR05
SR06
SR03
SR08
SR07
SR02
SR01

Approximate Property Boundary
Waste Rock Piles (and Toe) to be Consolidated
Access/Haul Routes
Roads to be Improved for Vehicle Access
Temporary Access Road

N

0 250 500 1,000 Feet

Saddle Rock
Wenatchee, Washington

Remediation Alternative 1 - Conceptual Layout

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Figure 2

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SR04
SR05
SR06
SR03
SR08
SR07
SR02
SR01

Approximate Property Boundary
Waste Rock Piles (and Toe) to be Capped in Place
Waste Rock Piles (and Toe) to be Consolidated
Consolidation Area (to be Capped)
Access/Haul Routes
Roads to be Improved for Vehicle Access
Temporary Access Road

N

0 250 500 1,000 Feet

Saddle Rock
Wenatchee, Washington

Remediation Alternative 2 - Conceptual Layout

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Figure 3

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SR04
SR05
SR06
SR03
SR08
SR07
SR02
SR01

Approximate Property Boundary
Waste Rock Piles (and Toe) to be Capped in Place
Waste Rock Piles (and Toe) to be Consolidated
Consolidation Area (to be Capped)
Access/Haul Routes
Temporary Access Road
Roads to be Improved for Vehicle Access

N

0 250 500 1,000 Feet

Saddle Rock
Wenatchee, Washington

Remediation Alternative 3 - Conceptual Layout

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Figure 4

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