Focused Feasibility Study

L & L Exxon
Richland, Washington

for
Washington State Department of Ecology

March 25, 2014

GeoEngineers
Earth Science + Technology

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INTRODUCTION

This memorandum presents the results of the focused feasibility study (FFS) conducted at the L&L Exxon site located at 1315 Lee Boulevard in Richland, Washington (herein referred to as the "site"). Assessment activities conducted in 2012 and 2013 by GeoEngineers indicate gasoline- and diesel-range petroleum hydrocarbons (GRPH and DRPH, respectively) and associated volatile organic compounds (VOCs) are present in soil and groundwater at the site at concentrations greater than Washington State Model Toxics Control Act (MTCA) Method A cleanup levels. The site location is depicted with respect to adjacent properties on Vicinity Map, Figure 1.

This FFS presents potential remediation alternatives to advance the site to closure; summarizes the benefits, disadvantages, and approximate costs associated with each remediation alternative; and recommends the preferred alternative based on the analysis.

SITE DESCRIPTION AND BACKGROUND

The site was the location of the former L&L Exxon service station, which closed in 1999. Former site features removed at the time of closure included (shown on Historic Site Features, Figure 2):

- Two 6,000-gallon gasoline underground storage tanks (USTs) (designated as UST-1 and UST-2, respectively), installed in the late 1950s, located on the north side of the property;
- One 4,000-gallon gasoline UST (designated as UST-3), installed in 1979, located south of the 6,000-gallon USTs;
- Two 500-gallon USTs (waste oil and heating oil, designated as UST-4 and UST-5 respectively) located near the south side of the building; and
- Four fuel dispensers and associated subsurface piping, located on the north side of the property west of the USTs.

The site is located in a generally commercial area and currently operates as a used car dealership and maintenance shop.

Assessment Summary

GeoEngineers performed subsurface assessment activities in September 2012 by drilling six soil borings (B-1 through B-6) near the locations of the former USTs and dispensers. Three additional borings were advanced approximately 8 to 9 feet below the groundwater table and groundwater monitoring wells MW-1 through MW-3 were constructed. Exploration locations are depicted on Approximate Soil Boring, Test Pit and Monitoring Well Locations, Figure 3.

Supplemental assessment activities were conducted April 2013. Two additional downgradient monitoring wells (MW-4 and MW-5) were installed in Goethals Street located east of the property and five test pits (TP-1 through TP-5) were excavated in the property to further define the extent of soil contamination. Exploration locations with contaminant concentrations in soil samples greater than MTCA Method A cleanup levels are depicted on Soil Chemical Analytical Results, Figure 4.

Groundwater samples were collected from monitoring wells MW-1 through MW-3 during four monitoring events in October 2012, January, April and June 2013. Groundwater samples were collected from monitoring wells MW-4 and MW-5 in May and June 2013. Monitoring wells with groundwater contaminant concentrations greater than MTCA Method A cleanup levels are depicted on Groundwater Chemical Analytical Results, Figure 5.

Geologic Setting

Based on the soil samples collected from the borings and soil excavated from the test pits, subsurface soil conditions consist of sand, gravel and cobbles with varying silt contents. Groundwater was observed during monitoring events at depths ranging between about 15 to 18 feet below ground surface (bgs).

Contaminants of Concern

Table I below summarizes the chemicals analyzed in soil samples obtained either during assessment activities. Analytes detected in at least one soil sample at a concentration greater than the associated MTCA Method A unrestricted land use cleanup level are considered the contaminants of concern (COC). The table also summarizes the chemicals analyzed in groundwater samples obtained during groundwater monitoring events collected between October 2012 and December 2013. Analytes detected in at least one groundwater sample at a concentration greater than the associated MTCA Method A cleanup level are considered the COC.

TABLE I: CONTAMINANTS OF CONCERN

Soil				Groundwater			
Chemicals Analyzed	**Analyte Not Detected**	**Analytes Detected (Concentrations < MTCA Method A)**	**Analytes Detected, COCs (Concentrations > MTCA Method A)**	**Chemicals Analyzed**	**Analyte Not Detected**	**Analytes Detected (Concentrations < MTCA Method A)**	**Analytes Detected, COCs (Concentrations > MTCA Method A)**
GRPH			X	GRPH			X
DRPH		X		DRPH			X
ORPH		X		ORPH	X		
MTBE	X			MTBE	X		
Benzene			X	Benzene			X
Toluene			X	Toluene			X
Ethylbenzene			X	Ethylbenzene			X
Total Xylenes			X	Total Xylenes			X
1,2-Dichloroethane (EDC)	X			1,2-Dichloroethane (EDC)	X		
1,2-Dibromoethane (EDB)	X			1,2-Dibromoethane (EDB)	X		
Hexane		X		Hexane		X	
Benzo(a)anthrancene	X			Benzo(a)anthrancene	X		
Benzo(a)pyrene	X			Benzo(a)pyrene	X		
Benzo(b)fluoranthene	X			Benzo(b)fluoranthene	X		
Benzo(k)fluoranthene	X			Benzo(k)fluoranthene	X		
Chrysene	X			Chrysene	X		
Dibenz(a,h)anthracene	X			Dibenz(a,h)anthracene	X		
Indeno(1,2,3-cd)pyrene	X			Indeno(1,2,3-cd)pyrene	X		
Acenaphthene		X		Acenaphthene		X	

Soil				Groundwater			
Chemicals Analyzed	**Analyte Not Detected**	**Analytes Detected (Concentrations < MTCA Method A)**	**Analytes Detected, COCs (Concentrations > MTCA Method A)**	**Chemicals Analyzed**	**Analyte Not Detected**	**Analytes Detected (Concentrations < MTCA Method A)**	**Analytes Detected, COCs (Concentrations > MTCA Method A)**
Acenaphthylene	X			Acenaphthylene		X	
Anthracene		X		Anthracene		X	
Benzo(ghi)perylene		X		Benzo(ghi)perylene	X		
Fluoranthene		X		Fluoranthene	X		
Fluorene		X		Fluorene		X	
1-Methylnaphthalene			X	1-Methylnaphthalene			X
2-Methylnaphthalene			X	2-Methylnaphthalene			X
Naphthalene			X	Naphthalene			X
Phenanthrene		X		Phenanthrene		X	
Pyrene		X		Pyrene		X	
Lead	X			Lead	X		
PCE	X			PCE			X
TCE	X			TCE			X

Trichloroethene (TCE) and tetrachloroethene (PCE) were not specifically analyzed during the groundwater monitoring events. During analysis of the requested VOCs, the laboratory observed the presence of these chemicals and quantified the results. PCE and TCE likely have migrated from a known upgradient/co-mingled source (New City Cleaners). Though historic uses of the property do not indicate use of chlorinated solvents, each remedial alternative discussed below will evaluate its effectiveness to remediate the PCE and TCE.

In summary, the soil and groundwater COCs include GRPH, DRPH, BTEX and naphthalenes. PCE and TCE also are groundwater COCs.

Contamination Extent

Based on the assessment results, soil contamination is present near the location of the former fuel dispensers and USTs. Soil samples with contaminant concentrations exceeding MTCA Method A cleanup levels were obtained from borings B-1, B-3 and B-5, monitoring wells MW-1 and MW-2, and test pits TP-3 and TP-5. Contaminated samples were obtained from depths ranging between 5 to 16 feet bgs. GRPH and VOCs also have been detected in groundwater samples obtained from monitoring wells MW-1 and MW-2, located near the northeast corner of the site, at concentrations greater than MTCA Method A cleanup levels during each monitoring event since October 2012. Contaminants of concern have not been detected at concentrations greater than MTCA Method A cleanup levels from downgradient monitoring wells MW-4 and MW-5 and upgradient monitoring well MW-3; however, PCE and TCE contamination does extend to downgradient wells MW-4 and MW-5. Based on the locations of samples with contaminant concentrations greater than MTCA Method A cleanup levels, it is possible contaminated soil is located beneath the existing building, though this has not been confirmed.

Exposure Pathways

GRPH-contaminated soil is capped by the asphalt parking area. As a result, human and ecological direct contact with contaminants of concern is unlikely unless construction activities were to occur. GRPH-contaminated groundwater has not been detected in downgradient monitoring wells MW-4 and MW-5. No production wells are present on the site; human or ecological ingestion or direct contact with contaminated groundwater is unlikely.

CLEANUP STANDARDS AND POINTS OF COMPLIANCE

Soil and groundwater cleanup levels are selected to protect human health and the environment. MTCA Method A cleanup levels will be used for soil and groundwater. Groundwater cleanup levels are based on drinking water protection. Soil cleanup levels will be based on MTCA Method A unrestricted land use cleanup levels. Table II below summarizes the specific soil and groundwater cleanup levels for the contaminants of concern:

TABLE II: MTCA METHOD A CLEANUP LEVELS

COC	Soil	Groundwater
GRPH	30 mg/kg (cleanup level when benzene is present).	800 µg/L
DRPH	2,000 mg/kg	500 µg/L
Benzene	0.03 mg/kg	5 µg/L
Toluene	7 mg/kg	1,000 µg/L
Ethylbenzene	6 mg/kg	700 µg/L
Xylenes	9 mg/kg	1,000 µg/L
Naphthalenes[1]	5 mg/kg	160 µg/L
TCE	NA	5 µg/L
PCE	NA	5 µg/L

Note:

mg/kg = milligrams per kilogram; µg/L = micrograms per liter

[1]Napthalenes includes naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene

The point of compliance is the point (horizontal or vertical) where the established cleanup levels must be achieved. The standard soil and groundwater points of compliance will be observed for the remediation alternative selected. Per WAC 173-340-720(8)(b), the standard groundwater point of compliance is from the "…uppermost level of the saturated zone extending vertically to the lowest most depth which could potentially be affected by the site." For the protection of groundwater, the soil point of compliance is the soils throughout the site (WAC 173-340-740[6][b]).

DEVELOPMENT OF REMEDIAL ACTION ALTERNATIVES

This section identifies the remedial action objectives and the initial screening of remedial alternatives for the site. The goal of remedial actions at the site is to receive a "no further action" (NFA) designation to achieve regulatory site closure. Each alternative will be evaluated based on its ability to mitigate the COCs identified in the site soil and groundwater. The primary focus of the remediation alternatives will be to remove the source area for the GRPH, DRPH, BTEX, and naphthalene soil and groundwater contamination. A secondary screening objective will be to assess the remediation alternative effectiveness at reducing the PCE and TCE concentrations. Effective remediation of the chlorinated solvents is unlikely because the selected remediation alternatives will not address the offsite (upgradient) source area of these COCs.

Each remediation alternative will be assessed relative to the MTCA requirements referenced below. A more detailed discussion of each requirement and its applicability to the remediation alternatives is discussed in "Evaluation Criteria."

- Threshold Requirements – WAC 173-340-360(a)
- Other Requirements – WAC 173-340-360(b)
- Disproportionate Cost Analysis (DCA) – WAC 173-340-360(e & f)

The primary remedial action objective (RAO) is to mitigate human exposure to soil and groundwater contaminants by dermal contact and ingestion. A secondary, although equally important, RAO is to prevent ecological receptors (plants and animals) from exposure to contaminants.

General Categories of Response Actions and Initial Screening

The general categories of response actions identified for the site include the following:

- No Action
- Institutional Controls
- In-situ Remediation
- Off-site Disposal

Screening of Response Actions and Removal Alternatives, Table 1 presents a summary and comparison of the general categories of response action alternatives identified for the site. Response action alternatives that were retained after the initial screening process were evaluated for the threshold requirements identified in WAC 173-340-360.

No Action

The no action alternative does not achieve the remedial action objectives because it does not protect present and future public health, safety and welfare, and the environment. Therefore, this remedial alternative is eliminated from further consideration.

Institutional Controls

Institutional controls involve the placement of access barriers such as fencing and barricades to motorized and non-motorized travel, as well as withdrawal or restrictions on development of affected lands from future use (i.e., deed restrictions). The primary purpose of these controls is to minimize development and human activities on contaminated areas, provide incentive for final cleanup if inaccessible areas of the site become accessible, and provide protection to an implemented solution. The utilization of institutional controls does not, in itself, achieve the stated goals and objectives of the remedial action, but can protect the remedy that is implemented on site. The institutional controls alternative as a stand-alone alternative has been screened from further consideration, but the implementation of institutional controls in conjunction with other alternatives such as on-site containment or placement of a cover will be considered.

In-Situ Remediation

In-situ remediation involves treating the soil and groundwater on site to reduce contaminants to concentrations less than the established cleanup standards. In-situ soil remediation alternatives include soil-vapor extraction (SVE), multi-phase extraction (MPE) or chemical oxidant applications. Groundwater remediation alternatives include air sparge (AS), MPE, and chemical oxidant injections. In-situ treatment provides a permanent solution because contaminant concentrations are reduced to concentrations less than MTCA Method A cleanup levels in soil and groundwater. In-situ remediation can require several years to reduce the contaminant concentrations to less than MTCA cleanup levels depending on the site conditions and the effectiveness of the treatment system.

Site conditions are expected to be conducive to in-situ soil and groundwater treatment. Soil generally consists of coarse-grained sands, gravels and cobbles. These soil conditions will provide adequate airflow or liquid oxidant infiltration.

Source Removal and Off-site Disposal

Off-site disposal consists of contaminated soil excavation and transport to an engineered, permitted landfill. Excavation and disposal provides the quickest permanent solution. However, because soil contamination extends to the groundwater interface (between 15 to 18 feet bgs), excavation of gasoline-impacted soil to the groundwater interface would likely require extensive shoring systems near the property boundaries and building. Additionally, off-site disposal does not specifically address groundwater contamination except through removal of a continuing contaminant source. In-situ remediation techniques would likely be combined with source removal to remediate groundwater and contaminated soil left in place. Contaminated soil excavated from the site would likely be transported to Allied Waste's Roosevelt Regional Landfill in Roosevelt, Washington, (80 miles from site) which is a Subtitle D facility.

Description of Remedial Alternatives

Based on the initial screening, five remedial alternatives were developed. The five comprehensive remedial alternatives provide an appropriate range of permanent cleanup actions for contaminated soil at the site (refer to Comparison of Remediation Options, Table 2). Each remedial alternative includes two years of quarterly groundwater monitoring. The proposed alternatives are:

- Alternative 1 – Contaminated Soil Excavation: Excavate gasoline-impacted soil from the northeast corner of the site. The area requiring excavation is bounded by boring B-4 to the west and boring B-2 and the building to the south. Goethals Street and Lee Boulevard limit the potential excavation extent to the north and west. This area is about 90 feet (east to west) by 50 feet (north to south) and the estimated excavation volume to the groundwater interface (at about 18 feet bgs) is about 3,000 cubic yards (4,500 tons). Shoring will be required on the north, south and east sides of the excavation to excavate contaminated soil to the depths required. A chemical oxidant (AnoxEA™ or a similar product) will be applied to the bottom of the excavation to remediate groundwater and remaining impacted soil. Excavated soil will be segregated based on field screening evidence of contamination and sampled for characterization. Soil with contaminant concentrations greater than the established cleanup levels will be transported and disposed at a Subtitle D landfill. The excavation will be backfilled with imported structural fill, compacted and re-paved with asphalt. Confirmation samples will be collected from the sidewalls of the excavation and groundwater monitoring will be used to confirm the effectiveness of the oxidant application at reducing the groundwater contaminant concentrations.

  Alternative 1 provides protection of human health and the environment as a permanent cleanup alternative. However, if contamination is located in shallow soils (unaffected by the oxidant application) beneath the building, institutional controls or other in-situ remediation efforts might need to be implemented. According to the vendor, AnoxEA™ can also degrade chlorinated solvents in a co-mingled contaminant plume. The estimated cost for Alternative 1 is $1,012,800.

- Alternative 2 – Install a SVE/AS treatment system: Conduct a SVE/AS pilot test, including drilling pilot SVE extraction wells, AS injection wells and monitoring points, to assess the SVE/AS radius of influence. After calculating the radius of influence, sufficient SVE extraction wells and AS injection wells will be installed to remediate the contaminated area and the remediation system will be constructed. Depending on the soil vapor concentrations observed during the pilot test, the SVE exhaust will be treated using activated carbon. If vapor concentrations lead to breakthrough of the activated carbon relatively quickly, then other exhaust treatment alternatives will be considered, such as a catalytic oxidizer. For the purpose of this study, activated carbon treatment will be assumed to estimate cost and maintenance requirements. Vapor and groundwater sampling will be conducted during system operation to assess the system performance, modify the effectiveness of the SVE remediation and evaluate the carbon treatment efficiency. After vapor and groundwater samples indicate a substantial reduction in COC concentrations, then soil borings will be advanced to collect compliance samples. Trenches excavated to place SVE and AS piping and the existing test pit locations will be backfilled with imported material and paved with hot-mix asphalt (HMA) concrete.

  Alternative 2 provides protection of human health and the environment as a permanent cleanup alternative. This alternative has the capability to remediate soil and groundwater inaccessible by excavation, such as beneath the building, depending on the radius of influence and location of the SVE and AS wells. SVE and AS are proven technologies for remediating chlorinated solvents in groundwater. The estimated cost for Alternative 2 is $553,800.

- Alternative 3 – Infiltration gallery/injection well installation and chemical oxidant application: Install shallow infiltration galleries in the northeast corner of the site and install injection wells to groundwater. Infiltration galleries will be used to dose the vadose zone with oxidants, surfactants and microbes to breakdown gasoline contamination in the soil. Injection wells will be used to dose groundwater with the same products. Initial oxidant application will consist of NoviOx™ (or a similar product) followed by microbial (AM3™) injection about 30 days later. After the initial oxidant and microbe injection, oxidants (AnoxEA-aq™) and surfactants (ReleaSE™) will be injected on a quarterly basis until contaminant concentrations have been reduced to less than MTCA Method A cleanup levels. Infiltration gallery locations will be backfilled with imported fill material and paved with HMA concrete (along with the existing test pit locations). Excess soil excavated from the infiltration galleries and soil not suitable for reuse as backfill, will be disposed according to the soil contaminant concentrations at an appropriate facility. Soil compliance samples, likely collected using air-rotary drilling, will be collected after groundwater contaminant concentrations have decreased to less than MTCA Method A cleanup levels. The estimated cost for Alternative 3 is $249,360.

  Alternative 3 provides protection of human health and the environment as a permanent cleanup alternative. This alternative has some capability to remediate soil and groundwater inaccessible by excavation, depending on the infiltration of the oxidants. According to the vendor, AnoxEA™ can also degrade chlorinated solvents in a co-mingled contaminant plume.

- Alternative 4 – Multi-phase Extraction: Install pilot test extraction wells and monitoring points. A pilot test will be conducted to determine the radius of influence of multi-phase extraction at the site. The pilot test will consist of installing an extraction well and monitoring points and conducting multi-phase extraction on the extraction well. The influence at the monitoring points and existing monitoring wells will be measured and recorded. Additional extraction wells will be installed based on the results of the pilot test and a vactor truck will be subcontracted to remove impacted water and vapors from the wells monthly. Impacted groundwater will be disposed at a permitted facility. If pilot testing indicates vapor contaminant concentrations will exceed applicable regulatory levels, carbon treatment will be provided. Compliance soil samples will be collected, using air-rotary drilling techniques, after groundwater samples indicate the COC concentrations have decreased to less than MTCA Method A cleanup levels. The estimated cost to implement Alternative 4 is $242,200.

Alternative 4 provides protection of human health and the environment as a permanent cleanup alternative. This alternative has the capability to remediate soil and groundwater inaccessible by excavation, such as beneath the building. However, as the remediation efforts (impacted-water and vapor extraction) will be focused on the groundwater interface, shallow soil remediation might not be as effective. This alternative might also require longer remediation duration as a permanent remediation system is not installed (a permanent MPE system is not feasible because collecting, treating, and disposing extracted groundwater will be difficult given the site space limitations and cost). Like SVE, the primary removal mechanism for MPE is volatilization of the contaminants. As a result, MPE is effective to remediate the co-mingled PCE and TCE plume.

- Alternative 5 – Combination of Alternatives 3 and 4: This alternative combines the installation of infiltration galleries and injection wells, chemical oxidant application and multi-phase extraction. The injection wells and infiltration galleries will be installed first and a dose of oxidant (NoviOx™) will be applied to mobilize vadose zone contamination. After about 30 days, a vactor truck will be used to remove water, product, and vapors from the injection wells and existing monitoring wells MW-1 and MW-2. Product and water will be disposed at a permitted facility. Vapor treatment is not likely to be needed because of the low frequency of proposed MPE events. After the initial multi-phase extraction event, microbe, oxidant and surfactant dosing will continue as described in Alternative 3. Multi-phase extraction events will be repeated just prior to each subsequent oxidant and surfactant application. Impacted water removed during each multi-phase extraction event will be disposed at a permitted facility. A pilot test is not needed to assess the MPE effectiveness because the existing monitoring wells and the proposed oxidant injection wells will be used for water and vapor extraction. The purpose of MPE in this combined alternative is not to provide remediation to the entire contaminant impacted area, but to supplement the chemical oxidant injection. Soil compliance samples will be collected, using air-rotary drilling techniques, after groundwater sampling results indicate contaminant concentrations have decreased to concentrations less than MTCA Method A cleanup levels. The estimated cost to implement Alternative 5 is $249,840.

  Alternative 5 provides protection of human health and the environment as a permanent cleanup alternative. This alternative has some capability to remediate soil and groundwater inaccessible by excavation, such as beneath the building, depending on the oxidant infiltration and the MPE radius of influence. This alternative (like Alternatives 3 and 4) is likely effective to remediate chlorinated solvents.

EVALUATION CRITERIA

This section presents a description of the threshold requirements for cleanup actions under MTCA and the additional criteria used in this FFS to evaluate the cleanup action alternatives.

Threshold Requirements

Cleanup actions performed under MTCA must comply with several basic requirements. Cleanup action alternatives that do not comply with these criteria are not considered suitable cleanup actions. As provided in WAC 173-340-360(2)(a), the four threshold requirements for cleanup actions must:

- Protect human health and the environment;
- Comply with cleanup standards (WAC 173-340-700 through -760);
- Comply with applicable state and federal laws (WAC 173-340-710); and
- Provide for compliance monitoring (WAC 173-340-410 and WAC 173-340-720 through -760).

Protection of Human Health and the Environment

The results of cleanup actions performed under MTCA must ensure that both human health and the environment are protected.

Compliance with Cleanup Standards

Compliance with cleanup standards requires, in part, that cleanup levels are met at the applicable points of compliance. If a remedial action does not comply with cleanup standards, the remedial action is an interim action, not a cleanup action. When a cleanup action involves containment of soils with hazardous substance concentrations exceeding cleanup levels at the point of compliance, the cleanup action may be determined to comply with cleanup standards, provided the requirements specified in WAC 173-340-740(6)(f) are met.

Cleanup alternatives must also comply with applicable or relevant and appropriate requirements (ARARs) in accordance with WAC 173-340-710. An evaluation of the ARARs potentially applicable to each remedial alternative was completed and is summarized in Summary of ARARs, Table 3. The remedial alternatives evaluated in this FFS comply with the intent of these laws and statutes and are protective of human health and the environment.

Compliance with Applicable State and Federal Laws

Cleanup actions conducted under MTCA must comply with applicable state and federal laws. The term "applicable state and federal laws" includes legally applicable requirements and those requirements that Ecology determines to be relevant and appropriate as described in WAC 173-340-710.

Provision for Compliance Monitoring

The cleanup action must allow for compliance monitoring in accordance with WAC 173-340-410. Compliance monitoring consists of protection monitoring, performance monitoring and confirmation sampling. Protection monitoring is conducted to confirm that human health and the environment are adequately protected during construction and the operation and maintenance period of a cleanup action. Performance monitoring is conducted to confirm that the cleanup action has attained cleanup standards and, if appropriate, remediation levels or other performance standards. Confirmation monitoring (groundwater and/or soil) is conducted to confirm the long-term effectiveness of the cleanup action once cleanup standards and, if appropriate, remediation levels or other performance standards have been attained.

Other MTCA Requirements

Under MTCA, when selecting from the alternatives that meet the minimum requirements described above, the alternatives shall be further evaluated against the following additional criteria defined in WAC 172-340-360(2)(b):

Use permanent solutions to the maximum extent practicable [WAC 173-340-360(2)(b)(i)].

MTCA requires that when selecting from cleanup action alternatives that fulfill the threshold requirements, the selected action shall use permanent solutions to the maximum extent practicable [WAC 173-340-360(2)(b)(i)]. MTCA specifies that the permanence of these qualifying alternatives shall be evaluated by balancing the costs and benefits of each of the alternatives using a “disproportionate cost analysis” in accordance with WAC 173-340-360(3)(e). The criteria for conducting this analysis are described below.

Provide a reasonable restoration time frame [WAC 173-340-360(2)(b)(ii)].

In accordance with WAC 173-340-360(2)(b)(ii), MTCA places a preference on those cleanup action alternatives that, while equivalent in other respects, can be implemented in a shorter period of time. MTCA includes a summary of factors to be considered in evaluating whether a cleanup action provides for a reasonable restoration time frame [WAC 173-340-360(4)(b)].

Consideration of public concerns [WAC 173-340-360(2)(b)(iii)].

Ecology will consider public concerns as described in WAC 173-340-600This cleanup action selected will be subject to public review and comment when the proposed remedy is published in the draft cleanup action plan (CAP).

MTCA Disproportionate Cost Analysis

The MTCA disproportionate cost analysis (DCA) is used to evaluate which of the alternatives that meet the threshold requirements are permanent to the maximum extent practicable. This analysis involves comparing the costs and benefits of alternatives and selecting the alternative with incremental costs that are not disproportionate to the incremental benefits. The evaluation criteria for the disproportionate cost analysis are specified in WAC 173-340-360(2) and WAC 173-340-360(3), and include protectiveness, permanence, cost, long-term effectiveness, management of short-term risks, implementability and consideration of public concerns.

As outlined in WAC 173-340-360(3)(e), MTCA provides a methodology that uses the criteria below to determine whether the costs associated with each cleanup alternative are disproportionate relative to the incremental benefit of the alternative above the next lowest-cost alternative. The comparison of benefits relative to costs may be quantitative, but will often be qualitative. When possible for this FFS, quantitative factors such as mass of contaminant removed or percentage of area of impacts remaining were compared to costs for the alternatives evaluated, but many of the benefits associated with the criteria described below were necessarily evaluated qualitatively. Costs are disproportionate to benefits if the incremental costs of the more permanent alternative exceed the incremental degree of benefits achieved by the other lower-cost alternative [WAC-173-340-360(e)(i)]. Where two or more alternatives are equal in benefits, Ecology selects the less costly alternative [WAC 173-340-360(e)(ii)(c)].

Each of the MTCA criteria used in the DCA is described below.

Protectiveness

The overall protectiveness of each alternative is evaluated based on several factors. First, the extent to which human health and the environment are protected and the degree to which overall risk at a site is reduced are considered. Both on-site and off-site risk reduction resulting from implementing the alternative are considered.

Permanence

MTCA specifies that when selecting a cleanup action alternative, preference shall be given to actions that are “permanent solutions to the maximum extent practicable.” Evaluation criteria include the degree to which the alternative permanently reduces the toxicity, mobility or mass of hazardous substances; the effectiveness 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 processes; and the characteristics and quantity of treatment residuals generated.

Cost

The analysis of cleanup action alternative costs under MTCA includes costs associated with implementing an alternative including design, construction, long-term monitoring and institutional controls. Costs are intended to be comparable among different alternatives to assist in the overall analysis of relative costs and benefits of the alternatives. The costs to implement an alternative include 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, equipment replacement costs and the cost of maintaining institutional controls. Unit costs used to develop overall remediation costs for this FFS were derived using a combination of construction cost estimates solicited from applicable vendors and contractors; a review of actual costs incurred during similar applicable projects; and professional judgment.

Long-Term Effectiveness

Long-term effectiveness is a parameter that expresses the degree of certainty that the alternative will be successful in maintaining compliance with cleanup standards over the long-term performance of the cleanup action. The MTCA regulations contain a specific preference ranking for different types of technologies that will be considered as part of the comparative analysis. The ranking places the highest preference on technologies such as reuse/recycling, treatment, immobilization/solidification, and disposal in an engineered, lined and monitored facility. Lower preference rankings are applied for technologies such as on-site isolation/containment with attendant engineered controls, and institutional controls and monitoring.

Management of Short-term Risks

Evaluation of this criterion considers the relative magnitude and complexity of actions required to maintain protection of human health and the environment during implementation of the cleanup action. Cleanup actions carry short-term risks such as potential mobilization of contaminants during construction or safety risks typical of large construction projects. Some short-term risks can be managed through best practices during project design and construction, while other risks are inherent to project alternatives and can offset the long-term benefits of an alternative.

Implementability

Implementability is an overall metric expressing the relative difficulty and uncertainty of implementing the cleanup action. Evaluation of implementability includes consideration of technical factors such as the availability of mature technologies and experienced contractors to accomplish the cleanup work. It also includes administrative factors associated with permitting and completing the cleanup.

Consideration of Public Concerns

The public involvement process under MTCA is used to identify potential public concerns regarding cleanup action alternatives. The extent to which an alternative addresses those concerns is considered as part of the evaluation process. This includes concerns raised by individuals, community groups, local governments, tribes, federal and state agencies, and other organizations that may have an interest in or knowledge of the site. In particular, public concerns for this site generally would be associated with environmental issues and cleanup action performance, which are addressed under other criteria such as protectiveness and permanence.

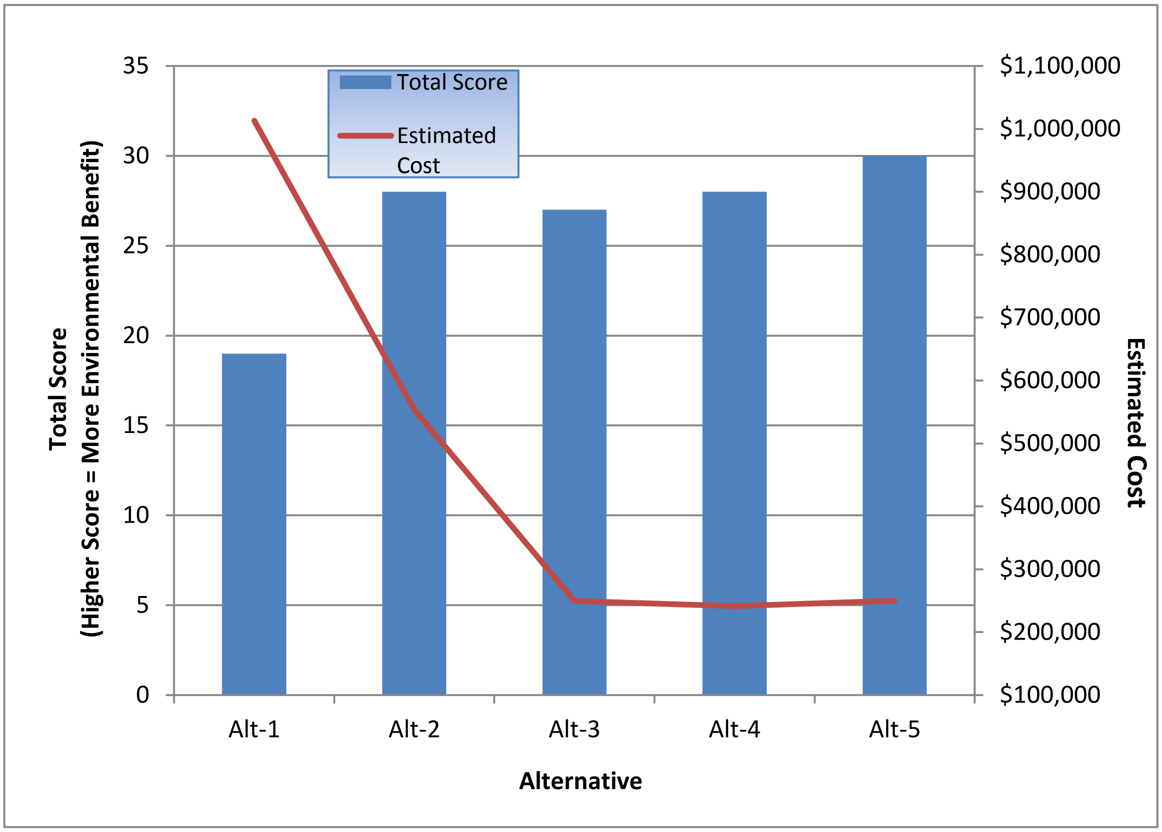
EVALUATION, COMPARISON AND RECOMMENDATION OF CLEANUP ALTERNATIVES

This section provides an evaluation and comparative analysis of cleanup action alternatives developed for the site. The alternatives are evaluated with respect to the MTCA evaluation criteria described in above and then compared to each other relative to its expected performance under each criterion. The components of the five remedial alternatives are described above and summarized in Table 2. Detailed evaluation of the alternatives is presented in Evaluation of Cleanup Action Alternatives, Table 4, and the results of the evaluation are summarized in Summary of MTCA Evaluation and Ranking of Cleanup Action Alternatives, Table 5.

In order to evaluate reasonableness of costs, planning level estimates were developed for each remedial alternative. While adequate for decision making purposes, final cost estimates will depend on the scope of the final remedial design. Please note that (1) the estimated costs for each alternative are considered to be within a margin of +/- 20 percent; (2) unit costs were derived from recent similar projects or from local vendors; (3) long-term monitoring and maintenance costs beyond 2 years are not included in the estimates; and (4) costs are based on 2013 dollars.

Figure I compares the DCA analysis total score and the estimated cost to implement each alternative. The DCA analysis is presented in Table 4 and summarized in Table 5. Estimated costs for each alternative are presented in Tables 6 through 10.

FIGURE I: DISPROPORTIONATE COST ANALYSIS SUMMARY



Based on the Minimum Threshold, Other Criteria and Disproportionate Cost Analysis, remedial Alternative 5 is the preferred alternative. Alternatives 1 and 2 had the highest costs without a proportional increase in environmental benefits. Alternative 4 had the lowest costs, but was least protective of Alternatives 3 through 5. Alternative 5 also requires minimal maintenance (like Alternatives 3 and 4) because there is no active remediation system to operate and maintain. Alternative 5 had the highest total environmental benefit score (both including and excluding costs). In compliance with MTCA [WAC 173-340-360(3)(e)(ii)(c)], Alternative 5 should be the preferred remedial alternative.

Alternative 5 provides both soil and groundwater remediation through enhanced bioremediation. Like Alternative 3, chemical oxidants, bacteria and surfactants are injected in wells and infiltration galleries to dose both the vadose zone and groundwater. Alternative 5 adds MPE to Alternative 3 to increase the effectiveness, particularly beneath the building. MPE will be conducted from the oxidant injection wells and existing monitoring wells. However, depending the frequency, duration, and effectiveness of MPE, contamination might remain beneath the building. Alternative 5 also is an effective method for addressing the chlorinated solvents.

REFERENCES

EPA, 1998. “Guidance for Conducting Remedial Investigation and Feasibility Studies under CERCLA.”

GeoEngineers, 2013. “Supplemental Soil and Groundwater Assessment, L & L Exxon, Richland, Washington.” August 20, 2013.

GeoEngineers, 2013. “Soil and Groundwater Assessment, L & L Exxon, Richland, Washington.” March 6, 2013.

Model Toxics Control Act Cleanup Regulation Chapter 173-340 of the Washington Administrative Code, Revised November 2007.

TABLES

Table 1

Screening of Response Actions and Removal Alternatives

Former L&L Exxon

Richland, Washington

General Response Action	Alternative	Description	Screening Comments
No Action		No action	Current condition, no risk reduction.
Institutional Controls	No Alternatives (Alternatives 1 and 3 might require deed restrictions if contaminated soil remains beneath the building).	Placement of access barriers, deed restriction	Does not accomplish remedial action objective as a stand-alone alternative. Might be used in conjunction with other alternatives.
In-situ Remediation	Alternatives 2, 3, 4, & 5	Install SVE/AS treatment system.	Eliminates on-site risk, permanent solution, high cost, regular maintenance required, remediation might require extended period of time.
		Install infiltration galleries and injection wells; inject chemical oxidants,	Eliminates on-site risk, permanent solution, moderate cost. Potential contaminated soil beneath the building might not be remediated.
		Multi-phase extraction (MPE); install additional extraction wells; contract a vactor truck to remove water, product, and vapors. Dispose water and product at a permitted facility.	Eliminates on-site risk, permanent solution, moderate cost, remediation might require extended period of time and might leave shallow soil contamination in place.
Off-Site Disposal	Alternative 1	Excavate and dispose contaminated soil at a subtitle D landfill. Excavate soil to the groundwater table and apply a oxidant to the water surface.	Eliminates on-site risk, permanent solution, high cost to shore excavation, excavation safety next to an arterial is a concern. Impacted soil beneath the building left in place.

Notes:

Shading represents remedial actions eliminated from consideration

Table 2

Comparison of Remediation Options

Former L&L Exxon

Richland, Washington

Remedial Method	Conceptual Description	Benefits	Limitations	Relative Cost	Construction Feasibility	Duration of Groundwater Monitoring and O&M	Impacts to Future Development, Adjacent Land Uses	Recommended for Further Consideration
Remedial Alternatives Eliminated from Further Consideration								
No Action	No change to existing conditions.	Low cost.	Provides no active source control or waste volume reduction. Does not address downgradient migration of contaminants. Does not address community concerns Unlikely to provide restoration.	Low	Easy	Very long (greater than 20 years)	High. Vadose zone contamination remains on-site and potential for groundwater contaminant migration.	**NO** - Does not meet MTCA requirements for cleanup
Institutional Controls (as a stand-alone alternative)	Institutional controls, including a restrictive covenant and re-paving the existing test pits, would be established for the remedial area to mitigate dermal contact exposure to petroleum-contaminated soil and restrict groundwater removal from the site. In this scenario, there would be no active remedial measures.	Non-invasive and relatively low cost. Provides some control on potential exposure to contaminated media.	Provides no active source control or waste volume reduction. Does not address downgradient migration of contaminants. Unlikely to provide restoration.	Low	Easy	Very long (greater than 20 years)	High. Vadose zone contamination remains on-site and potential for groundwater contaminant migration.	**NO** - Lowest MTCA preference, doesn't treat source
Remedial Alternatives Retained for Further Evaluation								
Alternative 1: Excavate gasoline-contaminated soil to the groundwater table and transport to a Subtitle D landfill; apply a chemical oxidant to groundwater.	Excavate about 3,000 cubic yards of contaminated soil from the northeast corner of the site to about 18 feet bgs. Install shoring as needed to excavate to the desired depth. Apply AnoxEA™ (or similar product) to the groundwater table to remediate residual contamination. Backfill, compact and pave excavated area. Groundwater monitoring for 2 years.	Permanent cleanup option with little to no long-term on-site liability. No restrictive covenant unless residual contamination observed beneath the building. Oxidant application to groundwater remediates residual downgradient soil and groundwater contamination.	Expensive (shoring and contaminated soil disposal). Safety Concerns (open excavation on an occupied property adjacent to an arterial). Significant disturbance to tenant operations. Potential for residual contamination remaining in areas inaccessible by excavation which might require a restrictive covenant. Site space limitations will cause difficulties staging construction equipment, stockpiling impacted soil, and loading trucks.	High	Difficult	Short (2 years)	Low	**YES** - High MTCA Preference, However, very difficult to implement.
Alternative 2: Install a soil vapor extraction (SVE) and air sparge (AS) remediation system.	Conduct a pilot test to determine SVE/AS efficiency. Install SVE extraction and AS injection wells. Design and construct remediation system. Collect performance vapor samples and optimize system operations after startup. SVE exhaust will be treated by activated carbon or catalytic oxidizer. Maintenance and exhaust monitoring will continue for the duration of the remediation system operation (estimated to be one year). Re-pave remediation trenches and existing test pit locations. Groundwater monitoring for 2 years.	Permanent cleanup option with little to no long-term on-site liability. No restrictive covenant unless residual contamination remains beneath the building.	Moderate to high capital costs to install system. Moderate to high long-term costs for carbon exchange, performance sampling, and system operation and maintenance. Remediation time relatively long.	High	Moderate	Short (2 years)	Low	**YES** - High MTCA Preference, However, moderately difficult to Implement

Remedial Method	Conceptual Description	Benefits	Limitations	Relative Cost	Construction Feasibility	Duration of Groundwater Monitoring and O&M	Impacts to Future Development, Adjacent Land Uses	Recommended for Further Consideration
Alternative 3: Install infiltration galleries and injection wells. Apply chemical oxidants, surfactants, and microbes.	Install infiltrations galleries at about 5 feet bgs in the contaminated area. Install injection wells to groundwater. Apply an initial oxidant dose (NoviOX™). After 30 days apply microbes (AM3™) and apply oxidant (AnoxEA-aq™) quarterly until contaminant concentrations in groundwater reduce to less than MTCA Method A cleanup levels (estimated to be one year). Re-pave infiltration gallery and existing test pit locations. Groundwater monitoring for 2 years.	Permanent cleanup option with little to no long-term on-site liability. No restrictive covenant unless residual contamination remains beneath the building. Relatively easy implementation and little or no maintenance requirements.	Requires multiple oxidant applications. Might require a restrictive covenant if contamination is left beneath the building	Moderate	Moderate	Short (2 years)	Low	**YES** - High MTCA preference, relatively easy to implement.
Alternative 4: Install multi-phase extraction wells and subcontract a vactor truck to remove impacted water and vapors.	Install pilot test extraction well and monitoring points. Conduct a pilot test by subcontracting a vactor truck to apply a vacuum to the extraction well and monitor the influence on existing monitoring wells and monitoring points. Install extraction wells in the contaminated areas and subcontract a vactor truck to remove impacted water and vapors. Extraction will be repeated monthly until groundwater sampling indicates contaminant levels have dropped to less than MTCA Method A cleanup levels (estimated to be one year). Water extracted from the wells will be disposed at a permitted facility. Vapors will be treated with activated carbon, if necessary. Re-pave existing test pit locations. Groundwater monitoring for 2 years.	Permanent cleanup option with little to no long-term on-site liability. Low to moderate cost. Easily implemented.	Potential for long remediation time frame and large water quantities requiring disposal. Might not effectively remediate shallow soil contamination. Vapor treatment (using activated carbon) might be required.	Low to Moderate	Easy to Moderate	Short (2 years)	Low	**YES** - High MTCA preference, relatively easy to implement.
Alternative 5: Install infiltration galleries and injection wells and apply chemical oxidants. Subcontract a vactor truck to extract impacted water and vapors from the injection wells.	Install infiltrations galleries at about 5 feet bgs in the contaminated area. Install injection wells to groundwater. Apply an initial oxidant dose (NoviOX™). After 30 days subcontract a vactor truck to remove impacted water and vapors from the injection wells and infiltration galleries. Apply microbes (AM3™) and apply oxidant (AnoxEA-aq™) quarterly until contaminant concentrations reduce to less than MTCA Method A cleanup levels (estimated to be one year). Repeat vactor truck extraction before each quarterly injection. Re-pave infiltration gallery trenches and existing test pit locations. Groundwater monitoring for 2 years.	Permanent cleanup option with little to no long-term on-site liability. No restrictive covenant. Relatively easy implementation and little or no maintenance requirements.	Requires multiple oxidant applications. Vapor treatment (using activated carbon) might be required. Might require a restrictive covenant if contamination is left beneath the building	Moderate	Easy to Moderate	Short (2 years)	Low	**YES** - High MTCA preference, relatively easy to implement.

Table 3

Summary of ARARs

Former L&L Exxon

Richland, Washington

ARAR	Regulated Activity	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Evaluation
Richland City Codes							
Municipal Code 10.04	Public Nuisances	Applies	Applies	Applies	Does Not Apply	Applies	Protect open excavations from creating a hazard
Municipal Code 12.08	Construction Right-of-Way	Applies	Does Not Apply	Does Not Apply	Does Not Apply	Does Not Apply	Construction activities in city ROWs
Municipal Code 16.06	Stormwater Management Regulations	Applies	Applies	Applies	Applies	Applies	Construction stormwater requirements
Municipal Code 9.16	Public Nuisance - Noise	Applies	Applies	Applies	Applies	Applies	Construction actions will meet the requirements of this chapter.
Benton Clean Air Agency	Emissions	Applies	Applies	Does Not Apply	Applies	Applies	Notice of Construction required for new potential emission sources.
Washington State							
Washington Administrative Code 173-201A	Water Quality Standards for Surface Waters	Applies	Applies	Applies	Applies	Applies	MTCA requires cleanup actions comply with applicable regulations.
Washington Administrative Code 173-218	Underground Injection Controls	Does Not Apply	Does Not Apply	Applies	Does Not Apply	Applies	UIC regulations apply to oxidant injection galleries and wells
Washington Administrative Code 173-303	Dangerous Waste Management	Does Not Apply	Does Not Apply	Does Not Apply	Does Not Apply	Does Not Apply	It is unlikely impacted soil and/or groundwater will designate as a dangerous waste.
Washington Administrative Code 173-340	Toxic Waste Cleanup (MTCA)	Applies	Applies	Applies	Applies	Applies	The remedial action will be conducted under MTCA. Remedial alternatives will comply with MTCA regulations.
Washington Administrative Code 197-11 and 173-802	State Environmental Policy Act	Applies	Applies	Applies	Applies	Applies	A SEPA review is required for projects with potential significant environmental impacts.
RCW 90.48	Water Pollution Control (Construction Stormwater Permit)	Applies	Does Not Apply	Does Not Apply	Does Not Apply	Does Not Apply	A Stormwater Pollution Prevention Plan (SWPPP) is required for the applicable remediation alternatives.
Federal Regulations							
Title 40 Code of Federal Regulations 131	Water Quality Standards (National Toxics Rule)	Applies	Applies	Applies	Applies	Applies	MTCA requires cleanup actions comply with applicable regulations.
Title 40 Code of Federal Regulations 141	Drinking Water Regulations	Applies	Applies	Applies	Applies	Applies	MTCA requires cleanup actions comply with applicable regulations.
Title 40 Code of Federal Regulations 260-268	Hazardous Waste (RCRA)	Applies	Applies	Applies	Applies	Applies	MTCA requires cleanup actions comply with applicable regulations.
Title 33 of United States Code, Chapter 26	Water Pollution Control (Clean Water Act)	Applies	Applies	Applies	Applies	Applies	MTCA requires cleanup actions comply with applicable regulations.

Table 4

Evaluation of Cleanup Action Alternatives

Former L&L Exxon

Richland, Washington

Alternative Numbers	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Alternative Descriptions	Alternative 1: Excavate gasoline-contaminated soil to the groundwater table and transport to a Subtitle D landfill; apply a chemical oxidant to groundwater.	Alternative 2: Install a soil vapor extraction (SVE) and air sparge (AS) remediation system.	Alternative 3: Install infiltration galleries and injection wells. Apply chemical oxidants, surfactants, and microbes.	Alternative 4: Install multi-phase extraction wells and subcontract a vactor truck to remove impacted water and vapors.	Alternative 5: Install infiltration galleries and injection wells and apply chemical oxidants. Subcontract a vactor truck to extract impacted water and vapors from the injection wells.
	Excavate about 3,000 cubic yards of contaminated soil from the northeast corner of the site to about 18 feet bgs. Install shoring as needed to excavate to the desired depth. Apply AnoxEA™ (or similar product) to the groundwater table to remediate residual contamination. Backfill, compact and pave excavated area. Groundwater monitoring for 2 years.	Conduct a pilot test to determine SVE/AS efficiency. Install SVE extraction and AS injection wells. Design and construct remediation system. Collect performance vapor samples and optimize system operations after startup. SVE exhaust will be treated by activated carbon or catalytic oxidizer. Maintenance and exhaust monitoring will continue for the duration of the remediation system operation (estimated to be one year). Re-pave remediation trenches and existing test pit locations. Groundwater monitoring for 2 years.	Install infiltrations galleries at about 5 feet bgs in the contaminated area. Install injection wells to groundwater. Apply an initial oxidant dose (NoviOX™). After 30 days apply microbes (AM3™) and apply oxidant (AnoxEA-aq™) quarterly until contaminant concentrations in groundwater reduce to less than MTCA Method A cleanup levels (estimated to be one year). Re-pave infiltration gallery and existing test pit locations. Groundwater monitoring for 2 years.	Install pilot test extraction well and monitoring points. Conduct a pilot test by subcontracting a vactor truck to apply a vacuum to the extraction well and monitor the influence on existing monitoring wells and monitoring points. Install extraction wells in the contaminated areas and subcontract a vactor truck to remove impacted water and vapors. Extraction will be repeated monthly until groundwater sampling indicates contaminant levels have dropped to less than MTCA Method A cleanup levels (estimated to be one year). Water extracted from the wells will be disposed at a permitted facility. Vapors will be treated with activated carbon, if necessary. Re-pave existing test pit locations. Groundwater monitoring for 2 years.	Install infiltrations galleries at about 5 feet bgs in the contaminated area. Install injection wells to groundwater. Apply an initial oxidant dose (NoviOX™). After 30 days subcontract a vactor truck to remove impacted water and vapors from the injection wells and infiltration galleries. Apply microbes (AM3™) and apply oxidant (AnoxEA-aq™) quarterly until contaminant concentrations reduce to less than MTCA Method A cleanup levels (estimated to be one year). Repeat vactor truck extraction before each quarterly injection. Re-pave infiltration gallery trenches and existing test pit locations. Groundwater monitoring for 2 years.
Approximate Volume of Contaminated Soil Removed (cubic yards)	3,000	30 (trench spoils from pipe installation. Might be reusable as trench backfill).	45 (spoils from infiltration gallery installation. Might be reusable as backfill).	None	45 (spoils from infiltration gallery installation. Might be reusable as backfill).
Alternative Ranking Under MTCA					
1. Compliance with MTCA Threshold					
Protection of Human Health and the Environment	Yes- Alternative will protect human health and the environment. Complete contaminant removal in excavated areas. Residual contamination capped by the existing building.	Yes- Alternative will protect human health and the environment	Yes - Alternative will protect human health and the environment.	Unlikely - High possibility of residual contamination in shallow soils.	Yes - Alternative will protect human health and the environment.
Compliance with Cleanup Standards	Yes - contaminated soil will be removed from the site. Chemical oxidant applied to groundwater will remediate impacted groundwater and soil left in place.	Yes - impacted soil and groundwater will be remediated in-place.	Yes - impacted soil and groundwater will be remediated in-place. Contaminated soil potentially will be left in place beneath the building.	Unlikely - High possibility of residual shallow soil contamination.	Yes - impacted soil and groundwater will be remediated in-place.
Compliance with Applicable State and Federal Regulations	Yes - Alternative complies with applicable state and federal regulations	Yes - Alternative complies with applicable state and federal regulations	Yes - Alternative complies with applicable state and federal regulations	Yes - Alternative complies with applicable state and federal regulations	Yes - Alternative complies with applicable state and federal regulations
Provision for Compliance Monitoring	Yes - Alternative includes provision for compliance monitoring (i.e., soil confirmation sampling during remedial excavation).	Yes - Alternative includes provision for compliance monitoring (i.e., vapor and groundwater sampling during system operation). Soil compliance samples collected using air-rotary drilling.	Yes - Alternative includes provision for compliance monitoring (i.e. Groundwater monitoring). Soil compliance samples will be collected using air-rotary drilling techniques.	Yes - Alternative includes provision for compliance monitoring (i.e. Groundwater monitoring). Soil compliance samples will be collected using air-rotary drilling techniques.	Yes - Alternative includes provision for compliance monitoring (i.e. Groundwater monitoring). Soil compliance samples will be collected using air-rotary drilling techniques.

Alternative Numbers	Alternative 1		Alternative 2		Alternative 3		Alternative 4		Alternative 5	
2. Other MTCA Requirements - WAC 172-340-360(2)(b)										
Use permanent solutions to the maximum extent practicable [WAC 173-340-360(2)(b)(i)].	See **Permanence** below		See **Permanence** below		See **Permanence** below		See **Permanence** below		See **Permanence** below	
Provide a reasonable restoration time frame [WAC 173-340-360(2)(b)(ii)].	Initial restoration timeframe is relatively short. Cleanup implementation would take less than one month. Groundwater monitoring expected for 2 years.		Initial remediation timeframe is relatively long (estimated at about 12 months, might be longer depending on effectiveness of the remediation). Groundwater monitoring expected for 2 years.		Initial remediation timeframe is relatively long (estimated at about 12 months, might be longer depending on effectiveness of the remediation). Groundwater monitoring expected for 2 years.		Initial remediation timeframe is relatively long (estimated at about 12 months, might be longer depending on effectiveness of the remediation). Groundwater monitoring expected for 2 years.		Initial remediation timeframe is relatively long (estimated at about 12 months, might be longer depending on effectiveness of the remediation). Groundwater monitoring expected for 2 years.	
Consideration of public concerns [WAC 173-340-360(2)(b)(iii)].	See **Consideration of Public Concerns** below		See **Consideration of Public Concerns** below		See **Consideration of Public Concerns** below		See **Consideration of Public Concerns** below		See **Consideration of Public Concerns** below	
3. Disproportionate Cost Analysis - Relative Benefits Ranking[1]		**Score**		**Score**		**Score**		**Score**		**Score**
Protectiveness	High level of protectiveness; impacted soil removed from the site. Chemical oxidant will be applied to the groundwater table to remediate residual impacted soil and groundwater. Residual soil contamination might remain beneath the existing building.	4	Highest level of protectiveness. SVE radius of influence likely will extend beneath the building to remediate impacted soils.	5	High level of protectiveness. Soil and groundwater remediation by oxidant application. Oxidant infiltration might not remediate impacted soil and groundwater beneath the building.	3	Achieves overall protectiveness. MPE focuses remediation efforts at the groundwater interface and might not effectively remediate shallow impacted soil.	3	High level of protection, Soil and groundwater remediation by oxidant application. MPE will physically remove impacted water, increase oxygen flow for enhanced biological degradation combined with the applied oxidants. MPE effctiveness likely will extend beneath the building, though the MPE frequency is reduced compared to Alternative 4 and contamination might still remain.	4
Permanence	Permanent contaminant reduction by source removal and oxidant application to groundwater. Residual contamination might remain beneath the existing building. Residual contamination might provide a source for future groundwater contamination.	3	Achieves highest level of permanence. SVE/AS permanently reduces contaminant concentrations in soil and groundwater. Alternative will influence	5	Achieves moderately high level of permanence. Chemical oxidant injections permanently reduce contaminant concentration in soil and groundwater. Oxidant infiltration might not effectively remediate contaminated soils beneath the building (if any).	3	Achieves permanent contaminant reduction. Impacted water removed from the site. Focused primarily at the groundwater interface. Shallow soil contamination might not achieve contaminant reduction and could eventually leach to groundwater	3	Achieves high level of permanence. Chemical oxidant injections permanently reduce contaminant concentration in soil and groundwater. MPE and oxidant injections might not remediate some impacted soil beneath the building. Impacted water removed from the site.	4
Long-Term Effectiveness	Impacted soil permanently removed from the site. Chemical oxidant application remediates residual soil and groundwater contamination in the excavation area. If residual soil contamination remains beneath the building, it likely will be unaffected by the remediation.	4	Permanently remediates soil and groundwater to concentrations to less than MTCA Method A cleanup levels. SVE radius of influence likely will remediate soil beneath the building	5	Permanently remediates soil and groundwater to concentrations to less than MTCA Method A cleanup levels. Oxidant infiltration might not effectively remediate contaminated soil located beneath the building.	4	Permanently remediates soil and groundwater in radius of influence. Might not be effective at remediating shallow soil contamination.	3	Permanently remediates soil and groundwater to concentrations to less than MTCA Method A cleanup levels. MPE will likely extend beneath the building, but might leave some soil contamination.	5

Alternative Numbers	Alternative 1		Alternative 2		Alternative 3		Alternative 4		Alternative 5	
Management of Short-Term Risks	This alternative involves excavation to the groundwater interface at about 15-18 feet bgs. A large, shored excavation adjacent to an arterial and a building is a safety risk. Site space limitations restrict staging construction equipment and managing incoming trucks. Traffic control likely required.	2	Moderate short-term risks associated with installation, operation and maintenance of the treatment system.	3	Low short -term risks associated with installation of infiltration galleries and injection wells.	4	Lowest short-term risks associated with installation of additional extraction wells and subcontracted vactor truck services.	5	Low short -term risks associated with installation of infiltration galleries and injection wells and subcontracted vactor truck services.	4
Technical and Administrative Implementability	Implementable, technically possible, off-site disposal facilities are available, access for earthwork and transportation equipment is poor. Excavation to the groundwater will require shoring the excavation. Likely requires right-of-way permits and construction traffic control. Stormwater construction management likely required.	3	Implementable, technically possible. Requires pilot test prior to implementation to determine effective radius of influence. Requires regular maintenance and performance sampling during the operation of the system. Carbon treatment likely required to treat exhaust and carbon requires exchange. Likely permitting requirements to discharge SVE exhaust.	3	Implementable, technically feasible. Minimal long term maintenance. Permits are not likely required.	5	Implementable, technically feasible. Minimal long-term maintenance. Air discharge permits likely are not required because MPE only conducted monthly. Profiling for impacted water disposal required.	5	Implementable, technically feasible. Minimal long-term maintenance. Air discharge permits likely are not required because MPE only conducted quarterly. Profiling for impacted water disposal required.	5
Consideration of Public Concerns	Likely public concerns regarding excavation safety and impact to adjacent right-of-ways. Additional public concerns regarding impacted soil left in place beneath the building.	2	Public acceptance of this alternative is likely because contaminated soil is remediated. Potential public concerns regarding treatment system noise and exhaust.	4	Public acceptance of this alternative is likely because contaminated soil is remediated. Potential public concerns regarding transportation and application of chemical oxidants.	3	Public acceptance of this alternative is likely because contaminated soil is remediated. Potential public concerns regarding ineffectiveness of this alternative to remediate shallow soil contamination. Additional concerns possible regarding noise and vapors associated with vactor truck operation.	4	Public acceptance of this alternative is likely because contaminated soil is remediated. Potential public concerns regarding transportation and application of chemical oxidants. Additional concerns possible regarding noise and vapors associated with vactor truck operation.	3
4.Cost	$ 1,012,800.00	1	$ 553,800.00	3	$ 249,360.00	5	$ 241,200.00	5	$ 249,840.00	5
Total Score		19		28		27		28		30

Notes

[1]Alternatives were scored using a scale of 1 to 5 with a score of 1 being the least amount of benefits provided by the alternative and a score of 5 being the most amount of benefits provided by the alternative.

Table 5

Summary of MTCA Evaluation and Ranking of Cleanup Action Alternatives

Former L&L Exxon

Richland, Washington

	Alternative 1: Excavate Impacted Soil to Groundwater; Apply oxidant to Groundwater	Alternative 2: Install SVE/AS Remediation System	Alternative 3: Install Infiltration Galleries and Injection Wells; Apply Chemical Oxidants	Alternative 4: Install Extraction Wells; Subcontract a Vactor Truck to Remove Impacted Groundwater and Vapors (Multiphase Extraction)	Alternative 5: Install Infiltration Galleries and Injection Wells; Apply Chemical Oxidants; Multiphase Extraction
Alternative Ranking Under MTCA					
1. Compliance with MTCA Threshold Criteria[1]	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
2. Restoration Time Frame	Initial restoration time frame for soil is relatively short (likely less than a month). Soil cleanup levels would be achieved at the point of compliance (ground surface to 15 feet deep) at completion of cleanup activities. Potential for impacted soil remaining beneath building. Groundwater compliance monitoring would extend about 2 years.	Initial restoration time frame for soil is relatively long (likely more than year). Soil cleanup levels would be achieved at the point of compliance (ground surface to 15 feet deep) at completion of cleanup activities. Groundwater compliance monitoring would extend about 2 years.	Initial restoration time frame for soil is relatively long (likely more than year). Soil cleanup levels would be achieved at the point of compliance (ground surface to 15 feet deep) at completion of cleanup activities, though contaminated soil might remain beneath the building. Groundwater compliance monitoring would extend about 2 years.	Initial restoration time frame for soil is relatively long (likely more than year). Soil cleanup levels would be achieved at the point of compliance (ground surface to 15 feet deep) at completion of cleanup activities. Potential impacted soil remaining at shallow soil depths. Groundwater compliance monitoring would extend about 2 years.	Initial restoration time frame for soil is relatively long (likely more than year). Soil cleanup levels would be achieved at the point of compliance (ground surface to 15 feet deep) at completion of cleanup activities. Groundwater compliance monitoring would extend about 2 years.
3. Disproportionate Cost Analysis Relative Benefits Ranking					
Protectiveness	4	5	3	3	4
Permanence	3	5	3	3	4
Cost[2]	1	5	4	3	5
Long-Term Effectiveness	4	3	4	5	4
Management of Short-Term Risks	2	3	5	5	5
Technical and Administrative Implementability	3	4	3	4	3
Consideration of Public Concerns	2	3	5	5	5
Total of Scores	**19**	**28**	**27**	**28**	**30**
4. Disproportionate Cost Analysis					
	$1,012,800	**$553,800**	**$249,360**	**$241,200**	**$249,840**
Costs Disproportionate to Incremental Benefits	Yes	Yes	No	No	No
Restrictive Covenant	Possible beneath the building footprint	None	Possible beneath the building footprint	None	None
Practicability of Remedy	Least Practicable	Less Practicable	Practicable	Practicable	Practicable
Overall Alternative Ranking	**5th**	**3rd**	**4th**	**2nd**	**1st**

Notes:

[1]WAC 173-340-360(2)(a)

[2]Low cost is a benefit

Table 6

Alternative 1: Excavate Gasoline-impacted Soil to the Groundwater Interface and Apply Chemical Oxidant to Groundwater

Former L&L Exxon
Richland, Washington

Scope Item	Unit	Unit Cost[1]	Quantity	Extended
Permitting/Design/Regulatory Oversight				
Permitting[2]	lump	$5,000.00	1	$5,000
Design, work plan and procurement	lump	$30,000.00	1	$30,000
Regulatory oversight costs	lump	$10,000.00	1	$10,000
			Task Sub-Total	**$45,000**
Field Oversight				
Construction monitoring/oversight	day	$1,500.00	15	$22,500
Closure samples	ea	$300.00	25	$7,500
			Task Sub-Total	**$30,000**
Excavate and Transport Impacted Soil to an approved Subtitle D Landfill[3]				
Temporary facilities, TESC, and shoring	lump	$300,000.00	1	$300,000
Excavation, loading, transportation and disposal	tons	$55.00	4,500	$247,500
			Task Sub-Total	**$547,500**
Apply Chemical Oxidant to Groundwater				
Purchase AnoxEA™	lbs	$4.00	1,500	$6,000
Apply chemical oxidant to groundwater	lump	$5,000.00	1	$5,000
			Task Sub-Total	**$11,000**
Site Restoration				
Purchase, transport, place, and compact gravel/quarry spalls	tons	$25.00	4,500	$112,500
Asphaltic concrete re-paving of excavated areas	sf	$5.00	5,000	$25,000
			Task Sub-Total	**$137,500**
Groundwater Monitoring (2 Years)				
8 quarters groundwater monitoring (quarterly)[4]	event	$6,000.00	8	$48,000
IDW Disposal (bi-annually)	event	$2,500.00	4	$10,000
			Task Sub-Total	**$58,000**
Reporting				
Remedial action report	lump	$15,000.00	1	$15,000
			Task Sub-Total	**$15,000**
	Total Estimated Costs for Alternative 1			**$844,000**
Contingency	20%	$844,000.00	1	$168,800
Total Estimated Costs including Contingency - Alternative 1				**$1,012,800**

Notes:

[1]Unit costs derived from either recent similar project experience or estimates from local vendors. Estimated costs are considered to be within a margin of +/- 20 percent.

[2]Permitting for this alternative likely includes right-of-way obstruction and construction stormwater permits and SEPA review.

[3]Assumes disposal at Roosevelt Regional Landfill located near Roosevelt, Washington.

[4]Actual sampling frequency will depend on when groundwater cleanup levels are achieved.

ea = each unit; sf = square feet; lbs = pounds; lump = lump sum estimate

Table 7

Alternative 2: Install Soil Vapor Extraction and Air Sparge Treatment System

Former L&L Exxon
Richland, Washington

Scope Item	Unit	Unit Cost[1]	Quantity	Extended
Permitting/Design/Regulatory Oversight				
Permitting[2]	lump	$5,000.00	1	$5,000
Design, work plan and procurement	lump	$30,000.00	1	$30,000
Regulatory oversight costs	lump	$10,000.00	1	$10,000
			Task Sub-Total	**$45,000**
Pilot Test				
Install pilot test SVE, AS, and monitoring point wells	lump	$15,000.00	1	$15,000
Vapor samples	ea	$250.00	2	$500
Subcontracted pilot test	lump	$3,000.00	1	$3,000
Pilot test observation	day	$1,500.00	1	$1,500
Report preparation	lump	$5,000.00	1	$5,000
			Task Sub-Total	**$25,000**
Remediation System Installations and Construction Field Oversight				
Construction monitoring/oversight	day	$1,500.00	15	$22,500
Install SVE/AS wells	lump	$25,000.00	1	$25,000
Purchase and install SVE/AS treatment system (includes trenching, piping, soil disposal, backfill, trench and test pit paving and equipment purchase)[3]	lump	$175,000.00	1	$175,000
			Task Sub-Total	**$222,500**
Treatment System Operaton and Maintenance				
Weekly operation visits (1 month)	day	$1,500.00	4	$6,000
Bi-monthly operation visits (2 month)	day	$1,500.00	4	$6,000
Monthly visits (9 months)	day	$1,500.00	9	$13,500
Unplanned visits (system shutdowns and maintenance)	day	$1,500.00	10	$15,000
Vapor performance samples (one inlet and one outlet sample per planned visit)	ea	$250.00	34	$8,500
Carbon exchange	lump	$12,000.00	1	$12,000
Quarterly O&M reporting	event	$2,500.00	4	$10,000
			Task Sub-Total	**$71,000**
Groundwater Monitoring (2 Years)				
8 quarters groundwater monitoring (quarterlyl)[4]	event	$6,000.00	8	$48,000
IDW Disposal and knockout tank water disposal (bi-annually)	event	$2,500.00	4	$10,000
			Task Sub-Total	**$58,000**
Compliance Monitoring and Reporting				
Advance soil borings and collect compliance samples	lump	$20,000.00	1	$20,000
Remedial action report	lump	$20,000.00	1	$20,000
			Task Sub-Total	$40,000
	Total Estimated Costs for Alternative 2			$461,500
Contingency	20%	$461,500.00	1	$92,300
Total Estimated Costs including Contingency - Alternative 2				**$553,800**

Notes:

[1]Unit costs derived from either recent similar project experience or estimates from local vendors. Estimated costs are considered to be within a margin of +/- 20 percent.

[2]Permitting for this alternative might include air discharge permits and SEPA review.

[3]Assumes trench spoils will be disposed at Roosevelt Regional Landfill located near Roosevelt, Washington.

[4]Actual sampling frequency will depend on when groundwater cleanup levels are achieved.

ea = each unit; sf = square feet; lbs = pounds; lump = lump sum estimate

Table 8

Alternative 3: Install Infiltration Galleries and Injection Wells; Apply Chemical Oxidants

Former L&L Exxon

Richland, Washington

Scope Item	Unit	Unit Cost[1]	Quantity	Extended
Permitting/Design/Regulatory Oversight				
Permitting[2]	lump	$5,000.00	1	$5,000
Design, work plan and procurement	lump	$10,000.00	1	$20,000
Regulatory oversight costs	lump	$5,000.00	1	$5,000
			Task Sub-Total	**$30,000**
Infiltration Gallery and Injection Well Installation				
Install Infiltration Galleries (trenching, piping, soil disposal, and backfill)[3]	ea	$2,500.00	4	$10,000
Install Injection Wells	lump	$25,000.00	1	$25,000
Construction monitoring/oversight	day	$1,500.00	5	$7,500
			Task Sub-Total	**$42,500**
Purchase and Application of Chemical Oxidants				
Purchase NoviOX	lump	$3,000.00	1	$3,000
Purchase AnoxEA-Aq	lbs	$4.00	5,000	$20,000
Purchase ReleaSE	lump	$1,300.00	1	$1,300
Purchase AM3	lump	$500.00	1	$500
Apply Oxidants to Injection Wells and Infiltration Galleries	day	$2,000.00	5	$10,000
			Task Sub-Total	**$34,800**
Restoration and Groundwater Monitoring (2 Years)				
8 Quarters Groundwater Monitoring (Quarterlyl)[4]	event	$6,000.00	8	$48,000
IDW Disposal (bi-annually)	event	$2,500.00	4	$10,000
Pave test pit locations and infiltration gallery	sf	$5.00	500	$2,500
			Task Sub-Total	**$60,500**
Compliance Sampling and Reporting				
Compliance Sampling	lump	$20,000.00	1	$20,000
Remedial action report	lump	$20,000.00	1	$20,000
			Task Sub-Total	**$40,000**
	Total Estimated Costs for Alternative 3			**$207,800**
Contingency	20%	$207,800.00	1	$41,560
Total Estimated Costs including Contingency - Alternative 3				**$249,360**

Notes:

[1]Unit costs derived from either recent similar project experience or estimates from local vendors. Estimated costs are considered to be within a margin of +/- 20 percent.

[2]Permitting for this alternative might include a SEPA review and underground injection control (UIC) registration.

[3]Assumes infiltration gallery trench spoils will be disposed at Roosevelt Regional Landfill located near Roosevelt, Washington.

[4]Actual sampling frequency will depend on when groundwater cleanup levels are achieved.

ea = each unit; sf = square feet; lbs = pounds; lump = lump sum estimate

Table 9

Alternative 4: Install Extraction Wells; Subcontract A Vactor Truck to Remove Impacted-Water and Vapors

Former L&L Exxon
Richland, Washington

Scope Item	Unit	Unit Cost[1]	Quantity	Extended
Permitting/Design/Regulatory Oversight				
Permitting[2]	lump	$3,000.00	1	$3,000
Design, work plan and procurement	lump	$10,000.00	1	$20,000
Regulatory oversight costs	lump	$5,000.00	1	$5,000
			Task Sub-Total	**$28,000**
Pilot Test				
Install pilot test wells and monitoring wells	lump	$15,000.00	1	$15,000
Subcontract vactor truck	lump	$2,000.00	1	$2,000
Impacted water disposal	gal	$0.60	500	$300
Report preparation	lump	$4,000.00	1	$4,000
			Task Sub-Total	**$21,300**
Install Additional Extraction Wells and Subcontract Multiphase Extraction				
Install extraction wells	lump	$25,000.00	1	$25,000
Subcontract vactor truck (monthly for one year)	ea	$2,500.00	12	$30,000
Impacted water disposal[3]	gal	$0.60	12,500	$7,500
			Task Sub-Total	**$62,500**
Maintenance and Monitoring (2 Years)				
Annual groundwater monitoring (Quarterly)	event	$6,000.00	8	$48,000
Re-pave existing test pits	sf	$5.00	240	$1,200
			Task Sub-Total	**$49,200**
Reporting				
Remedial action report	lump	$20,000.00	1	$20,000
Remedial action report	lump	$20,000.00	1	$20,000
			Task Sub-Total	**$40,000**
Total Estimated Costs for Alternative 4				**$201,000**
Contingency	20%	$201,000.00	1	$40,200
Total Estimated Costs including Contingency - Alternative 4				**$241,200**

Notes:

[1]Unit costs derived from either recent similar project experience or estimates from local vendors. Estimated costs are considered to be within a margin of +/- 20 percent.

[2]Permitting for this alternative might include a SEPA review.

[3]Impacted water disposal includes water removed from the extraction wells and IDW.

[4]Actual sampling frequency will depend on when groundwater cleanup levels are achieved.

ea = each unit; sf = square feet; lbs = pounds; lump = lump sum estimate

Table 10

Alternative 5: Infiltration Gallery and Injection Well Installation; Chemical Oxidant Application and Multiphase Extraction

Former L&L Exxon

Richland, Washington

Scope Item	Unit	Unit Cost[1]	Quantity	Extended
Permitting/Design/Regulatory Oversight				
Permitting[2]	lump	$5,000.00	1	$5,000
Design, work plan and procurement	lump	$15,000.00	1	$20,000
Regulatory oversight costs	lump	$5,000.00	1	$5,000
			Task Sub-Total	**$30,000**
Infiltration Gallery and Injection Well Installation				
Install infiltration galleries[3]	ea	$2,500.00	4	$10,000
Install injection wells	lump	$25,000.00	1	$25,000
Construction monitoring/oversight	day	$1,500.00	5	$7,500
			Task Sub-Total	**$42,500**
Purchase and Application of Chemical Oxidants				
Purchase NoviOX	lump	$3,000.00	1	$3,000
Purchase AnoxEA-Aq	lbs	$4.00	5,000	$20,000
Purchase ReleaSE	lump	$1,300.00	1	$1,300
Purchase AM3	lump	$500.00	1	$500
Apply oxidants to injection wells and infiltration galleries	day	$2,000.00	5	$10,000
			Task Sub-Total	**$34,800**
Multiphase Extraction				
Subcontract vactor truck (quarterly before oxidant injection)	ea	$2,000.00	4	$8,000
Impacted water disposal	gal	$0.60	4,000	$2,400
			Task Sub-Total	**$10,400**
Maintenance and Monitoring (2 Years)				
8 quarters groundwater monitoring (quarterly)[4]	event	$6,000.00	8	$48,000
Pave infiltration gallery and test pit locations	sf	$5.00	500	$2,500
			Task Sub-Total	**$50,500**
Reporting and Compliance Monitoring				
Compliance Monitoring	lump	$20,000.00	1	$20,000
Remedial action report	lump	$20,000.00	1	$20,000
			Task Sub-Total	**$40,000**
	Total Estimated Costs for Alternative 5			**$208,200**
Contingency	20%	$208,200.00	1	$41,640
Total Estimated Costs including Contingency - Alternative 5				**$249,840**

Notes:

[1]Unit costs derived from either recent similar project experience or estimates from local vendors. Estimated costs are considered to be within a margin of +/- 20 percent.

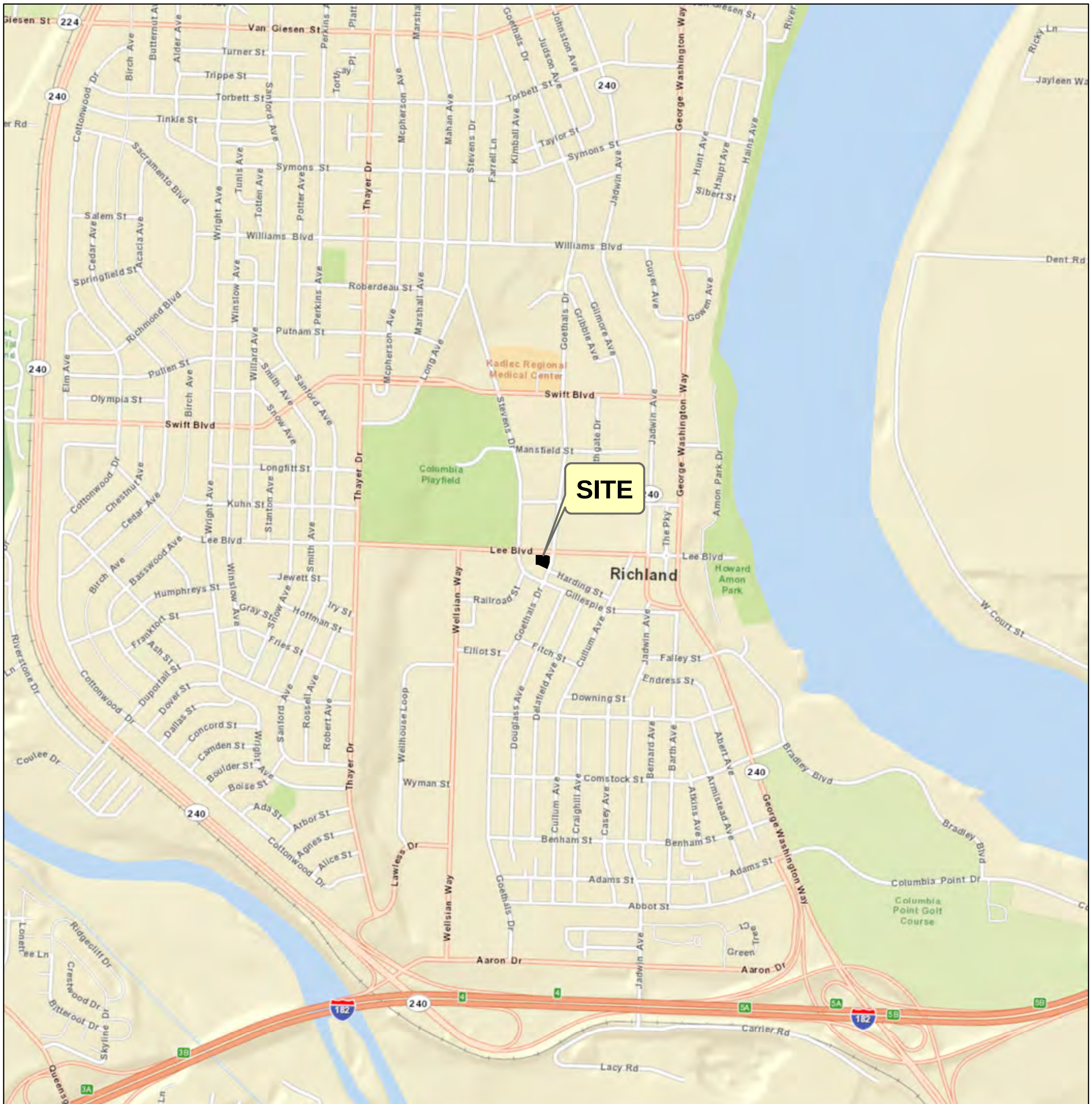
[2]Permitting for this alternative might include a SEPA review and underground injection control (UIC) registration.

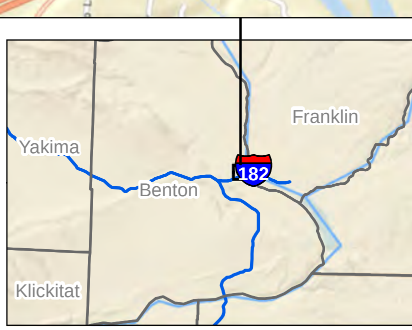
[3]Assumes infiltration gallery trench spoils will be disposed at Roosevelt Regional Landfill located near Roosevelt, Washington.

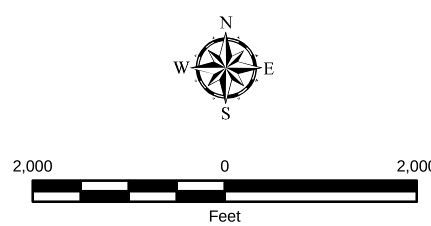
[4]Actual sampling frequency will depend on when groundwater cleanup levels are achieved.

ea = each unit; sf = square feet; lbs = pounds; lump = lump sum estimate

FIGURES







Notes:
1. The locations of all features shown are approximate.
2. This drawing is for information purposes. It is intended to assist in showing features discussed in an attached document. GeoEngineers, Inc. cannot guarantee the accuracy and content of electronic files. The master file is stored by GeoEngineers, Inc. and will serve as the official record of this communication.
Data Sources: ESRI Data & Maps, Street Maps 2008.
Basemap streets base from ESRI Data Online.
Projection: NAD 1983, UTM Zone 11 North.

Vicinity Map

Former L&L Exxon
1315 Lee Boulevard
Richland, Washington

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Figure 1

Office: PORT Path: P:\0\0504081_SPOK_GIS\00\GIS\050408100_F1_VM.mxd Map Revised: 5/01/2012 CRC

△ Approximate Location of Remediation System

⊡ Approximate Location of Transformer

UST Number and Approximate Location

Approximate Location of Historic Excavation Area

Historical Fuel Dispenser and Approximate Location

N
W E
S

0 40
Feet

Notes:
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Historic Site Features

Former L&L Exxon
1315 Lee Boulevard
Richland, Washington

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Figure 2

Office: PORT Path: P:\0\0504081\SPOK_GIS\00\GIS\050408101_F2_HSF.mxd Map Revised: 1/27/2014 CRC

TP-1
Test Pit Identification and Approximate Location

MW-1
Monitoring Well Number and Approximate Location

B-1
Soil Boring Identification and Approximate Location

N W E S

0 40 Feet

Notes:
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Data Sources: ESRI Data & Maps, Street Maps 2008.
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Approximate Soil Boring, Test Pit, and Monitoring Well Locations

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Richland, Washington

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Figure 3

Office:PORT Path: P:\0\0504081_SPOK_GIS\00\GIS\050408101_SoilTestPitLocs_MW.mxd Map Revised: 27 January 2014 ccabrera

TP-1 Test Pit Identification and Approximate Location

MW-1 Monitoring Well Number and Approximate Location

B-1 Soil Boring Identification and Approximate Location

Soil Sample Locations with Contaminate Concentrations > MTCA Method A Cleanup Level

N W E S

0 40 Feet

Notes:
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Data Sources: ESRI Data & Maps, Street Maps 2008.
Basemap streets base from ESRI Data Online.
Projection: NAD 1983, UTM Zone 11 North.

Soil Chemical Analytical Results

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Richland, Washington

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Figure 4

Office:PORT Path: P:\0\0504081_SPOK_GIS\00\GIS\050408101_SoilChemResults_F4.mxd Map Revised: 27 January 2014 ccabrera

TP-1 Test Pit Identification and Approximate Location

MW-1 Monitoring Well Number and Approximate Location

B-1 Soil Boring Identification and Approximate Location

Monitoring Wells with Chlorinated Solvent (PCE and/or TCE) Concentrations > MTCA Method A Cleanup Levels

Monitoring Wells with GRPH, DRPH and BTEXN Concentrations > MTCA Method A Cleanup Levels

N W E S

0 40 Feet

Notes:
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3. bgs = below ground surface

Data Sources: ESRI Data & Maps, Street Maps 2008.
Basemap streets base from ESRI Data Online.
Projection: NAD 1983, UTM Zone 11 North.

Groundwater Chemical Analytical Results

Former L&L Exxon
1315 Lee Boulevard
Richland, Washington

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Figure 5

Office:PORT Path: P:\0\0504081_SPOK_GIS\00\GIS\050408101_GWChemResults_F5.mxd Map Revised: 27 January 2014 ccabrera

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