Voluntary Cleanup Program

Washington State Department of Ecology
Toxics Cleanup Program

DEPARTMENT OF ECOLOGY State of Washington

TERRESTRIAL ECOLOGICAL EVALUATION FORM

Under the Model Toxics Control Act (MTCA), a terrestrial ecological evaluation is necessary if hazardous substances are released into the soils at a Site. In the event of such a release, you must take one of the following three actions as part of your investigation and cleanup of the Site:

1. Document an exclusion from further evaluation using the criteria in WAC 173-340-7491.
2. Conduct a simplified evaluation as set forth in WAC 173-340-7492.
3. Conduct a site-specific evaluation as set forth in WAC 173-340-7493.

When requesting a written opinion under the Voluntary Cleanup Program (VCP), you must complete this form and submit it to the Department of Ecology (Ecology). The form documents the type and results of your evaluation.

Completion of this form is not sufficient to document your evaluation. You still need to document your analysis and the basis for your conclusion in your cleanup plan or report.

If you have questions about how to conduct a terrestrial ecological evaluation, please contact the Ecology site manager assigned to your Site. For additional guidance, please refer to www.ecy.wa.gov/programs/tcp/policies/terrestrial/TEEHome.htm.

Step 1: IDENTIFY HAZARDOUS WASTE SITE	
Please identify below the hazardous waste site for which you are documenting an evaluation.	
Facility/Site Name: Town Center Mini-Mart	
Facility/Site Address: 15410 Main Street NE, Duvall, WA	
Facility/Site No:	VCP Project No.: Not Yet Assigned

Step 2: IDENTIFY EVALUATOR		
Please identify below the person who conducted the evaluation and their contact information.		
Name: Amy Tice		Title: Project Geologist
Organization: Aspect Consulting, LLC		
Mailing address: 401 2nd Avenue South, Suite 201		
City: Seattle	State: WA	Zip code: 98104
Phone: 206-838-6585	Fax: 206-838-5853	E-mail: atice@aspectconsulting.com

Step 3: DOCUMENT EVALUATION TYPE AND RESULTS

A. Exclusion from further evaluation.

1. Does the Site qualify for an exclusion from further evaluation?

☑ Yes — *If you answered "**YES,**" then answer **Question 2.***

☐ No or Unknown — *If you answered "**NO**" or "**UKNOWN,**" then skip to **Step 3B** of this form.*

2. What is the basis for the exclusion? *Check all that apply. Then skip to **Step 4** of this form.*

Point of Compliance: WAC 173-340-7491(1)(a)

☐ All soil contamination is, or will be,* at least 15 feet below the surface.

☑ All soil contamination is, or will be,* at least 6 feet below the surface (or alternative depth if approved by Ecology), and institutional controls are used to manage remaining contamination.

Barriers to Exposure: WAC 173-340-7491(1)(b)

☑ All contaminated soil, is or will be,* covered by physical barriers (such as buildings or paved roads) that prevent exposure to plants and wildlife, and institutional controls are used to manage remaining contamination.

Undeveloped Land: WAC 173-340-7491(1)(c)

☐ There is less than 0.25 acres of contiguous# undeveloped± land on or within 500 feet of any area of the Site and any of the following chemicals is present: chlorinated dioxins or furans, PCB mixtures, DDT, DDE, DDD, aldrin, chlordane, dieldrin, endosulfan, endrin, heptachlor, heptachlor epoxide, benzene hexachloride, toxaphene, hexachlorobenzene, pentachlorophenol, or pentachlorobenzene.

☐ For sites not containing any of the chemicals mentioned above, there is less than 1.5 acres of contiguous# undeveloped± land on or within 500 feet of any area of the Site.

Background Concentrations: WAC 173-340-7491(1)(d)

☐ Concentrations of hazardous substances in soil do not exceed natural background levels as described in WAC 173-340-200 and 173-340-709.

* An exclusion based on future land use must have a completion date for future development that is acceptable to Ecology.

± "Undeveloped land" is land that is not covered by building, roads, paved areas, or other barriers that would prevent wildlife from feeding on plants, earthworms, insects, or other food in or on the soil.

\# "Contiguous" undeveloped land is an area of undeveloped land that is not divided into smaller areas of highways, extensive paving, or similar structures that are likely to reduce the potential use of the overall area by wildlife.

B. Simplified evaluation.

1. Does the Site qualify for a simplified evaluation?

☐ Yes — *If you answered **"YES,"** then answer **Question 2** below.*

☐ No or Unknown — *If you answered **"NO"** or **"UNKNOWN,"** then skip to **Step 3C** of this form.*

2. Did you conduct a simplified evaluation?

☐ Yes — *If you answered **"YES,"** then answer **Question 3** below.*

☐ No — *If you answered **"NO,"** then skip to **Step 3C** of this form.*

3. Was further evaluation necessary?

☐ Yes — *If you answered **"YES,"** then answer **Question 4** below.*

☐ No — *If you answered **"NO,"** then answer **Question 5** below.*

4. If further evaluation was necessary, what did you do?

☐ Used the concentrations listed in Table 749-2 as cleanup levels. *If so, then skip to **Step 4** of this form.*

☐ Conducted a site-specific evaluation. *If so, then skip to **Step 3C** of this form.*

5. If no further evaluation was necessary, what was the reason? *Check all that apply. Then skip to **Step 4** of this form.*

Exposure Analysis: WAC 173-340-7492(2)(a)

☐ Area of soil contamination at the Site is not more than 350 square feet.

☐ Current or planned land use makes wildlife exposure unlikely. Used Table 749-1.

Pathway Analysis: WAC 173-340-7492(2)(b)

☐ No potential exposure pathways from soil contamination to ecological receptors.

Contaminant Analysis: WAC 173-340-7492(2)(c)

☐ No contaminant listed in Table 749-2 is, or will be, present in the upper 15 feet at concentrations that exceed the values listed in Table 749-2.

☐ No contaminant listed in Table 749-2 is, or will be, present in the upper 6 feet (or alternative depth if approved by Ecology) at concentrations that exceed the values listed in Table 749-2, and institutional controls are used to manage remaining contamination.

☐ No contaminant listed in Table 749-2 is, or will be, present in the upper 15 feet at concentrations likely to be toxic or have the potential to bioaccumulate as determined using Ecology-approved bioassays.

☐ No contaminant listed in Table 749-2 is, or will be, present in the upper 6 feet (or alternative depth if approved by Ecology) at concentrations likely to be toxic or have the potential to bioaccumulate as determined using Ecology-approved bioassays, and institutional controls are used to manage remaining contamination.

C. Site-specific evaluation. A site-specific evaluation process consists of two parts: (1) formulating the problem, and (2) selecting the methods for addressing the identified problem. Both steps require consultation with and approval by Ecology. *See* WAC 173-340-7493(1)(c).

1. Was there a problem? *See* WAC 173-340-7493(2).

- ☐ Yes — *If you answered **"YES,"** then answer **Question 2** below.*
- ☐ No — *If you answered **"NO,"** then identify the reason here and then skip to **Question 5** below:*
  - ☐ No issues were identified during the problem formulation step.
  - ☐ While issues were identified, those issues were addressed by the cleanup actions for protecting human health.

2. What did you do to resolve the problem? *See* WAC 173-340-7493(3).

- ☐ Used the concentrations listed in Table 749-3 as cleanup levels. *If so, then skip to **Question 5** below.*
- ☐ Used one or more of the methods listed in WAC 173-340-7493(3) to evaluate and address the identified problem. *If so, then answer **Questions 3 and 4** below.*

3. If you conducted further site-specific evaluations, what methods did you use? *Check all that apply. See* WAC 173-340-7493(3).

- ☐ Literature surveys.
- ☐ Soil bioassays.
- ☐ Wildlife exposure model.
- ☐ Biomarkers.
- ☐ Site-specific field studies.
- ☐ Weight of evidence.
- ☐ Other methods approved by Ecology. If so, please specify:

4. What was the result of those evaluations?

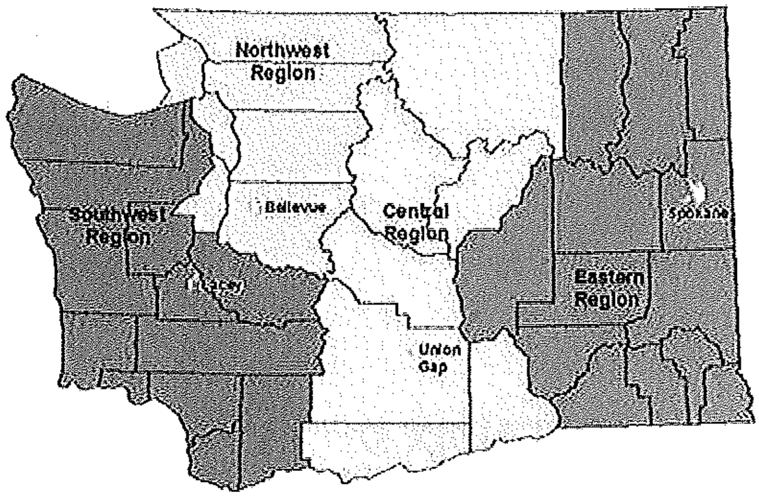
- ☐ Confirmed there was no problem.
- ☐ Confirmed there was a problem and established site-specific cleanup levels.

5. Have you already obtained Ecology's approval of both your problem formulation and problem resolution steps?

- ☐ Yes — If so, please identify the Ecology staff who approved those steps:
- ☐ No

Step 4: SUBMITTAL

Please mail your completed form to the Ecology site manager assigned to your Site. If a site manager has not yet been assigned, please mail your completed form to the Ecology regional office for the County in which your Site is located.



Northwest Region:	Central Region:
Attn: VCP Coordinator 3190 160th Ave. SE Bellevue, WA 98008-5452	Attn: VCP Coordinator 1250 West Alder St. Union Gap, WA 98903-0009
Southwest Region: Attn: VCP Coordinator P.O. Box 47775 Olympia, WA 98504-7775	**Eastern Region:** Attn: VCP Coordinator N. 4601 Monroe Spokane WA 99205-1295

If you need this publication in an alternate format, please call the Toxics Cleanup Program at 360-407-7170. Persons with hearing loss can call 711 for Washington Relay Service. Persons with a speech disability can call 877-833-6341.

APPENDIX D

MTCA Method B Cleanup Level Calculation for TPH

A1 Soil Cleanup Levels: Worksheet for Soil Data Entry: Refer to WAC 173-340-720, 740,745, 747, 750

1. Enter Site Information

Date: 05/27/15
Site Name: Town Center Mini-Mart
Sample Name: MW-6-7.5

Notes for Data Entry | Set Default Hydrogeology
Clear All Soil Concentration Data Entry Cells
Restore All Soil Concentration Data cleared previously

2. Enter Soil Concentration Measured

Chemical of Concern or Equivalent Carbon Group	Measured Soil Conc dry basis mg/kg	Composition Ratio %
Petroleum EC Fraction		
AL_EC >5-6	62	4.91%
AL_EC >6-8	430	34.08%
AL_EC >8-10	130	10.30%
AL_EC >10-12	12.5	0.99%
AL_EC >12-16	15	1.19%
AL_EC >16-21	2.5	0.20%
AL_EC >21-34	2.5	0.20%
AR_EC >8-10	260	20.61%
AR_EC >10-12	220	17.44%
AR_EC >12-16	26	2.06%
AR_EC >16-21	2.5	0.20%
AR_EC >21-34	2.5	0.20%
Benzene	0.076	0.01%
Toluene	0.14	0.01%
Ethylbenzene	21	1.66%
Total Xylenes	36	2.85%
Naphthalene	5.9	0.47%
1-Methyl Naphthalene	0	0.00%
2-Methyl Naphthalene	0	0.00%
n-Hexane	33	2.62%
MTBE	0	0.00%
Ethylene Dibromide (EDB)	0	0.00%
1,2 Dichloroethane (EDC)	0	0.00%
Benzo(a)anthracene	0	0.00%
Benzo(b)fluoranthene	0	0.00%
Benzo(k)fluoranthene	0	0.00%
Benzo(a)pyrene	0	0.00%
Chrysene	0	0.00%
Dibenz(a,h)anthracene	0	0.00%
Indeno(1,2,3-cd)pyrene	0	0.00%
Sum	1261.616	100.00%

REMARK:
Enter site-specific information here........

3. Enter Site-Specific Hydrogeological Data

Total soil porosity:	0.43	Unitless
Volumetric water content:	0.3	Unitless
Volumetric air content:	0.13	Unitless
Soil bulk density measured:	1.5	kg/L
Fraction Organic Carbon:	0.001	Unitless
Dilution Factor:	20	Unitless

4. Target TPH Ground Water Concentation (if adjusted)

If you adjusted the target TPH ground water concentration, enter adjusted value here:	800	ug/L

A2 Soil Cleanup Levels: Calculation and Summary of Results. Refer to WAC 173-340-720, 740, 745, 747, 750

Site Information

Date: 5/27/2015
Site Name: Town Center Mini-Mart
Sample Name: MW-6-7.5
Measured Soil TPH Concentration, mg/kg: **1,261.616**

1. Summary of Calculation Results

Exposure Pathway	Method/Goal	Protective Soil TPH Conc, mg/kg	With Measured Soil Conc		Does Measured Soil Conc Pass or Fail?
			RISK @	HI @	
Protection of Soil Direct Contact: Human Health	Method B	4,335	4.18E-09	2.91E-01	Pass
	Method C	80,987	5.60E-10	1.56E-02	Pass
Protection of Method B Ground Water Quality (Leaching)	Potable GW: Human Health Protection	29	6.33E-06	2.55E+00	Fail
	Target TPH GW Conc. @ 800 ug/L	51	NA	NA	Fail

Warning! Check to determine if a simplified or site-specific Terrestrial Ecological Evaluation may be required (Refer to WAC 173-340-7490 through ~7494).

Warning! Check Residual Saturation (WAC340-747(10)).

2. Results for Protection of Soil Direct Contact Pathway: Human Health

	Method B: Unrestricted Land Use	Method C: Industrial Land Use
Protective Soil Concentration, TPH mg/kg	**4,334.73**	**80,986.53**
Most Stringent Criterion	HI =1	HI =1

Soil Criteria	Protective Soil Concentration @Method B				Protective Soil Concentration @Method C			
	Most Stringent?	TPH Conc, mg/kg	RISK @	HI @	Most Stringent?	TPH Conc, mg/kg	RISK @	HI @
HI =1	YES	4.33E+03	1.44E-08	1.00E+00	YES	8.10E+04	3.60E-08	1.00E+00
Total Risk=1E-5	*NO*	3.01E+06	1.00E-05	6.95E+02	*NO*	2.25E+07	1.00E-05	2.78E+02
Risk of Benzene= 1E-6	*NO*	3.01E+05	1.00E-06	6.95E+01	NA			
Risk of cPAHs mixture= 1E-6	NA	NA	NA	NA				
EDB	NA	NA	NA	NA				
EDC	NA	NA	NA	NA				

3. Results for Protection of Ground Water Quality (Leaching Pathway)

3.1. Protection of Potable Ground Water Quality (Method B): Human Health Protection

Most Stringent Criterion	**HI=1**
Protective Ground Water Concentration, ug/L	**505.15**
Protective Soil Concentration, mg/kg	**29.30**

Ground Water Criteria	Protective Potable Ground Water Concentration @Method B				Protective Soil Conc, mg/kg
	Most Stringent?	TPH Conc, ug/L	RISK @	HI @	
HI=1	YES	5.05E+02	3.94E-07	1.00E+00	2.93E+01
Total Risk = 1E-5	*NO*	1.48E+03	9.43E-06	2.65E+00	100% NAPL
Total Risk = 1E-6	*NO*	1.02E+03	1.00E-06	1.95E+00	7.68E+01
Risk of cPAHs mixture= 1E-5	NA	NA	NA	NA	NA
Benzene MCL = 5 ug/L	*NO*	1.45E+03	6.29E-06	2.55E+00	1.24E+03
MTBE = 20 ug/L	NA	NA	NA	NA	NA

Note: 100% NAPL is 67000 mg/kg TPH.

3.2 Protection of Ground Water Quality for TPH Ground Water Concentration previously adjusted and entered

Ground Water Criteria	Protective Ground Water Concentration			Protective Soil Conc, mg/kg
	TPH Conc, ug/L	Risk @	HI @	
Target TPH GW Conc = 800 ug/L	8.00E+02	6.74E-07	1.56E+00	**5.06E+01**

APPENDIX E

Review of Potential Remedial Technologies

E.1 Institutional Controls

Institutional controls are measures that allow contaminated materials to remain onsite by controlling access or exposure to those materials through administrative means. An example of an institutional control is placing an environmental covenant on the property deed to limit or prohibit activities that may interfere with the integrity of a cleanup action or result in exposure to hazardous substances.

Advantages

- Can be easy to implement without disrupting operations.
- Relatively low cost.

Limitations

- Does not address the destruction or remediation of COCs.
- Not sufficient to prevent migration of COCs, if that is a risk.
- May result in restrictions on the property use.

Summary Evaluation

Because of its low cost and ease of implementation, institutional controls can be a valuable component of a remediation strategy at the Site; however, it will not achieve RAOs as a stand-alone alternative and would need to be combined with other technologies to address remediation of COCs.

E.2 Engineering Controls

Engineering controls are measures that allow contaminated materials to remain on site by controlling access or exposure to those materials through physical means. Engineering controls can be passive or active. Examples of passive engineering controls include permeable or impermeable caps or vapor barriers over impacted media to prevent contact or exposure to soil, groundwater, and/or vapor. An example of an active engineering control is an impermeable cap such as an asphalt parking lot that prevents direct contact with impacted media.

Advantages

- Can be easy to implement without disrupting operations.
- Relatively low cost.

Limitations

- Does not address the destruction or remediation of COCs.
- Not sufficient to prevent migration of COCs, if that is a risk.
- May result in restrictions on the property use.

Summary Evaluation

Because of its low cost and ease of implementation, engineering controls can be a valuable component of a remediation strategy at the Site; however, it will not achieve RAOs as a stand-alone alternative and would need to be combined with other technologies to address remediation of COCs.

E.3 Monitored Natural Attenuation

COCs in site soil and groundwater will be slowly removed *in situ* by natural processes, such as biodegradation by native bacteria. This technology involves periodic monitoring of soil, groundwater, and/or air to evaluate remediation progress and ensure continued protectiveness.

Advantages

- COCs are permanently destroyed.
- Easy to implement without disrupting operations.
- Relatively low cost.

Limitations

- Remediation time with this technology may be a decade or more.
- Not sufficient to prevent migration of COCs, if that is a risk.

Summary Evaluation

Because of its low short term cost and ease of implementation, monitored natural attenuation can be a valuable component of a remediation strategy at the Site; however, it is unlikely to achieve RAOs as a stand-alone alternative and would need to be combined with other technologies to ensure protectiveness during the relatively long restoration timeframe.

E.4 Soil Vapor Extraction

COCs in soil above the water table can be removed by applying a vacuum to wells and treating constituents removed in the extracted soil gas. Equipment required with this technology includes wells, piping, a vacuum blower, moisture knockout pot, and treatment equipment (e.g., activated carbon vessels or a catalytic oxidizer). General operational requirements include electricity for the vacuum blower and catalytic oxidizer, disposal of generated wastes (condensate water and spent carbon), equipment maintenance, and air monitoring.

Advantages

- COCs are permanently destroyed.
- Relatively non-disruptive technology (will require temporary disturbance to install wells and piping).
- Area of treatment can extend underneath otherwise inaccessible utility areas.

Limitations

- Removal of COCs from low-permeability soils can be limited by the rate of diffusion through these soils.
- Not effective in groundwater or soil below the water table.

Summary Evaluation

SVE is not considered an effective technology for low permeability soils, such as those found at the Site. Further, the relatively shallow contamination is beneath a higher permeability landscaped area, which would likely lead to short circuiting of surface air through preferential pathways into the system. Year-to-year operating costs are moderate but can accrue significantly if remediation progresses slowly. Therefore, SVE is unlikely to achieve RAOs and this technology is not considered to be a viable option for the Site.

E.5 Air Sparging

COCs can be physically removed from Site soil and groundwater by aggressively injecting air in wells screened below the water table. Volatile contaminants evaporate into the injected air, which is typically collected and treated by a soil vapor extraction system. Equipment required with this technology includes wells, piping, and an air compressor. Operation requirements include electricity for the air compressor, equipment maintenance, and air monitoring.

Advantages

- COCs are permanently removed and destroyed (if collected/treated with soil vapor extraction).
- Relatively non-disruptive technology (will require temporary disturbances to install wells and piping).
- Area of treatment can extend underneath otherwise inaccessible facility areas.

Limitations

- Preferential pathways for subsurface air movement may still result in incomplete treatment in some areas.

Summary Evaluation

Air sparging is not considered an effective technology for low permeability soils, such as those found at the Site. Year-to-year operating costs are moderate but can accrue significantly if remediation progresses slowly. Therefore, this technology is not considered to be a viable option for the Site.

E.6 Dual-Phase Extraction

This approach uses soil vapor extraction in conjunction with groundwater pumping to depress the water table, which exposes shallow saturated soils to treatment by soil vapor extraction, and provides hydraulic containment and removal of COCs in Site groundwater. Because the removal of groundwater COCs by groundwater pumping is generally not cost-effective, this technology is often applied in conjunction with air sparging to provide additional groundwater treatment. In addition to equipment required by soil vapor extraction, this technology requires either submersible pumps or a high-vacuum blower to remove water, and additional treatment equipment. Water disposal would require obtaining a sewer discharge authorization and possibly treatment prior to discharge.

Advantages

- COCs are permanently removed and destroyed.
- Provides hydraulic control of chemical migration as well as on-site treatment.
- Area of influence from pumping would extend underneath inaccessible areas of the facility.

Limitations

- Low permeability soils limit the groundwater yield.
- Will require significant above-ground space for required equipment.
- Relatively high cost for water disposal.

Summary Evaluation

Groundwater removal and soil vapor extraction are not considered effective technologies in low permeability soils. Hydraulic control does not appear to be necessary given the age of the release and the delineated groundwater impacts at the Site to date. Given the technical challenges and cost associated with this technology, it is not considered to be a viable option for the Site.

E.7 Enhanced Aerobic Biodegradation

Enhanced aerobic bioremediation is the practice of adding oxygen (an electron acceptor) to groundwater and/or soil to increase the number and vitality of indigenous microorganisms already naturally performing biodegradation of COCs at the site. Application is typically accomplished via injection of a liquid or slurry compound to provide oxygen to the subsurface. This process is performed in several discrete injection events and does not require continuously-operating equipment on-site.

Advantages

- COCs are permanently destroyed *in situ*.
- Easy to implement without significantly disrupting operations.
- Can enhance remediation in otherwise inaccessible areas by altering groundwater conditions over a localized area.

Limitations

- Although faster than natural attenuation, the benefits may be difficult to measure as compared to natural attenuation alone. Remediation time with this technology may be a decade or more.
- Shallow injections and preferential pathways may pose a challenge for effective injection of amendments.
- Generally, not effective in soil above the water table.

Summary Evaluation

Enhanced aerobic biodegradation is not typically cost-effective for source removal, but is applicable at the Site as a polishing technology. Although faster than unassisted natural attenuation, this is still a somewhat slow process that can take several years to reach closure and may require multiple injection events. Low permeability soils, such as those found at the Site, prevent adequate distribution throughout the subsurface. Additionally, high concentrations of soil impacts will continue to act as a source to groundwater; therefore, this is not considered a viable technology at the Site.

E.8 *In Situ* Chemical Oxidation

For chemical oxidization, a strong oxidizing chemical (e.g., ozone, Fenton's reagent, activated persulfate, permanganate) is injected into groundwater or mixed into soil to react and mineralize (i.e., convert to carbon dioxide and water) organic contaminants. Ozone is typically applied in gas form as part of air sparging; Fenton's reagent and activated persulfate are typically injected as liquid solutions into groundwater.

Advantages

- COCs are permanently destroyed *in situ.*
- Does not require installation of permanent wells, piping, or equipment which may help minimize disruption to business operations.
- Potential area of influence could extend underneath inaccessible areas of the Site.

Limitations

- Shallow injections and preferential pathways may pose a challenge for effective injection of amendments.
- Generally, not effective in soil above the water table.

Summary Evaluation

The success of this technology is highly dependent on the chemical oxidant physically coming into contact and reacting with COCs in soil and groundwater and may be limited by the potential for "day-lighting" and preferential flow of the injected amendment as a result of the relatively shallow treatment zone and utility corridors. Due to the low permeability soils found at the Site, and the proximity of impacts next to a utility corridor with relatively higher-permeability soils, *in-situ* chemical oxidation is not considered a viable technology for addressing residual source area contamination at this Site.

E.9 Soil Excavation

This technology involves removing contaminated soils and transporting the soil to a permitted disposal facility (e.g., landfill or soil recycler). Soil can be removed by a variety of techniques; shallow soil is typically removed with an excavator, while deeper soil may be removed using overlapping augers or a shored excavation.

Advantages

- For soil that can be accessed, this is the most certain method of removing COCs from the site.
- For shallow impacted soils, excavation coupled with off-site disposal is typically the most cost-effective active remedial measure.

Limitations

- Excavation costs increase significantly with depth and proximity to load bearing structures and buildings, particularly when shoring and/or dewatering is required.
- Impacted soil beneath buildings and roadways requires the demolition of those structures and surfaces to access soil.
- Excavation is disruptive, particularly when the removal is not consistent with site development plans.

Summary Evaluation

Impacted soil at the site is relatively shallow and appears to be bounded within the property line, in the parking area and landscaped area away from buildings and other structures that prevent access. Subsurface utilities that pass through the excavation area would need to be protected or temporarily re-routed. Parking would be disrupted during excavation activities, but access to the pump islands and store would remain. Due to the accessibility of impacted soil and relatively shallow depth, this technology is a viable option for the Site.