ENGINEERING EVALUATION/ COST ANALYSIS

October 10, 2001

Acme Lumber Co.
1060 West Addison
State of Confusion

EXECUTIVE SUMMARY

This Engineering Evaluation /Cost Analysis (EE/CA) has been prepared to analyze non-time-critical removal action alternatives for the former Acme Lumber facility in State of Confusion. intends to clean up the site pursuant to State and Federal cleanup requirements and to develop the site for residential use.

Tetrachloroethene (PCE) is the primary contaminant of concern at the Site. Two dry wells appear to be the source of PCE contamination. PCE concentrations observed in fill from these two dry wells ranged from 10,665 micrograms per kilogram (:g/kg) to 267,900 :g/kg. Outside of the immediate vicinity of the dry wells, PCE was detected in soil samples ranging from non-detect to 218 :g/kg.

Based on comparison of the results of the Phase II Site Investigations with State cleanup requirements, it has been determined that there are no unacceptable risks from the Site in its current state but if no remediation is undertaken at the site and the planned residential development occurs, there could an unacceptable risk to future residents or other users of the property from exposure to volatile organic compounds potentially migrating from contaminated soils and groundwater. Therefore a non-time-critical removal action is appropriate to eliminate potential exposure to nearby human populations from hazardous substances and the imminent and substantial endangerment that would otherwise result from the likely future land use.

The scope of Removal Action involves addressing the contaminated soils in the vicinity of the two dry wells. The scope also includes an additional investigation to better delineate and characterize the degree of the impacted soils in the area of the dry wells in order to more effectively control response costs.

The goal of the removal action is to mitigate risks posed to possible future residents from exposure to volatile compounds and eliminate or minimize the potential for contaminant migration from soils at or near the surface as may occur under the redeveloped Site conditions. This will include remediation of all soils with concentrations of PCE in excess of the state cleanup standards for PCE in soils.

Three response alternatives that have the potential to achieve the removal action goals have been evaluated; soil vapor extraction; soil flushing; and excavation and off-site disposal/treatment.

Based on the evaluation of removal action alternatives, a comparative analysis was performed to rank each alternative. Based on the results of this comparative analysis, excavation and off-site disposal is the preferred technology. The evaluation and comparative analysis were performed based on existing data; addition data could alter the outcome.

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1.0 INTRODUCTION

This Engineering Evaluation/Cost Analysis (EE/CA) has been prepared to analyze non-time-critical removal action alternatives for the former _____ facility in State of ______.

In June 1998, the EPA conducted a Preliminary Assessment/Site Investigation (PA/SI) and determined that hazardous materials were present at the Site and a removal action was warranted. Between November 24, 1998 and January 19, 1999, all hazardous materials documented by EPA, including containerized materials and friable asbestos, were removed from the property as part of the EPA removal action.

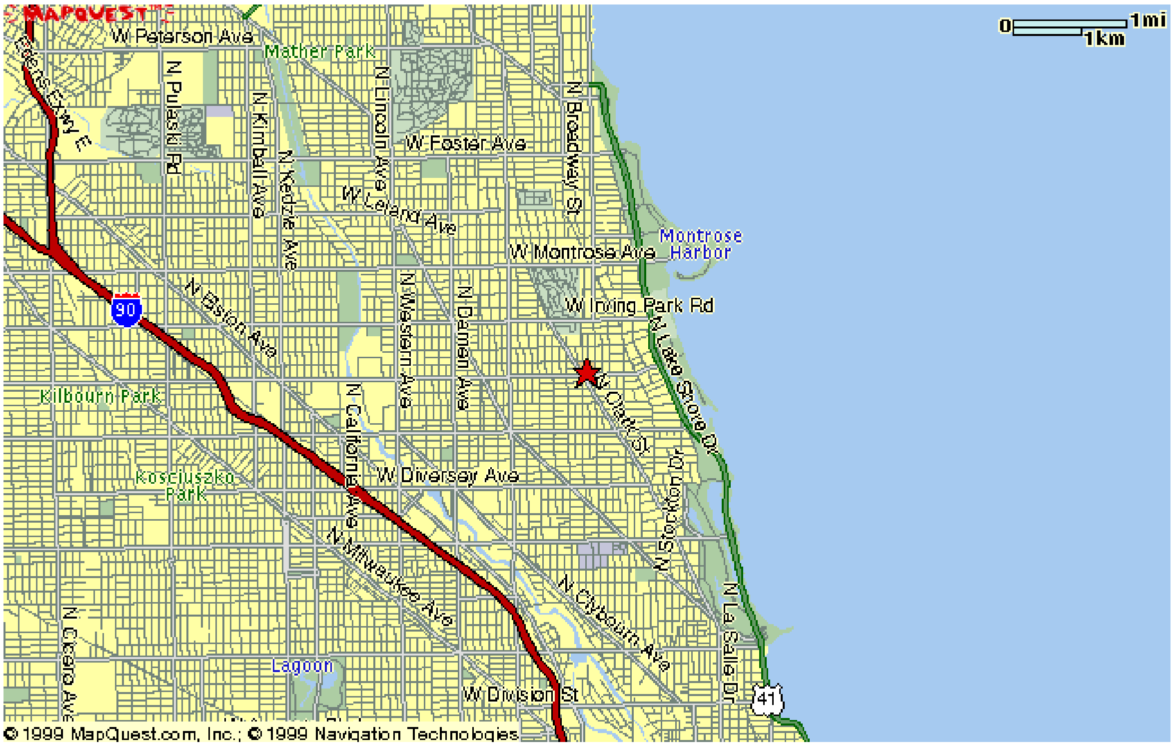
Curly, Larry & Moe completed a Site Assessment, Risk Assessment and a Remedial Alternatives Evaluation and Cost Estimates in October 1999 addressing environmental conditions at the Site and evaluating the implications of hazardous substances on redevelopment of the Site for residential use. This report is considered supplemental to the Remedial Alternatives Evaluation and Cost Estimates Report dated October 19, 1999.

The ______ [lead agency] has concluded that a non-time-critical removal action is appropriate at this Site because the hazardous substances at the Site have the potential to cause unacceptable exposure to future residents by volatile compounds migrating from soil or groundwater into occupied buildings. See, EE/CA approval memo

1.1 SITE CHARACTERIZATION

The former Acme Lumber facility is located at 1060 Addison Street. The Site occupies 38,084 square feet and topographically is relatively flat. Acme Lumber is bounded by Addison S treet on the west, a parking area and a residential parcel to the north, and residential properties along the east and south (see Figure 1-2**).** Buildings occupy approximately 75% of the Site area, 24% is paved parking area and approximately 1% is soil covered. A small portion of the paved parking area, in the southeast corner of the Site has been excavated and backfilled following removal of a 10,000 gallon underground storage tank (UST) in 1993. Stony Brook flows through a concrete culvert below the ground surface through the center of the Site from north to south under the facility as shown on Figure 1-2. The brook is completely enclosed. Stony Brook merges with Strawberry Brook (also encased in a subterranean culvert) approximately 500 to 700 feet to the south. A catch basin near the loading dock provides access to Stony Brook. The only vegetation at the Site is limited to the unpaved areas between the building and the property lines along the north and east. The Acme Lumber property is surrounded by a chain link or stockade fence.

figure 1-1



The results of the site assessment provided the following primary conclusions regarding the subsurface environmental contamination at the Site:

C Tetrachloroethene (PCE) is the primary contaminant of concern at the Site. Two dry wells appear to be the source of PCE contamination. PCE concentrations observed in fill from these two dry wells ranged from 10,665 micrograms per kilogram (:g/kg) to 267,900 :g/kg. Outside of the immediate vicinity of the dry wells, PCE was detected in soil samples ranging from non-detect to 218 :g/kg. PCE was detected at 480 micrograms per liter (:g/L) and 2.3 :g/L in groundwater samples collected from two temporary monitoring wells located adjacent to and immediately downgradient of the dry wells.

C Degradation products of PCE including trichloroethene (TCE), cis-1,2 dichloroethene (cis-DCE) and vinyl chloride were also observed in soil and/or groundwater samples collected at the Site in the immediate vicinity of the dry wells. TCE was observed in fill from one dry well at a concentration of 2,970 :g/kg. The concentration of TCE observed in soils at the Site ranged from 86 ug/kg to 406 :g/kg. Cis-DCE was also observed in one soil sample at a concentration of 162 :g/kg. In addition to PCE (480 :g/L), the groundwater samples collected adjacent to one dry well exhibited concentrations of TCE (67 :g/L), cis-DCE (230 :g/L) and vinyl chloride (4.2 :g/L).

- Based on the data collected to date, the low-level PCE contamination outside of the dry well area is limited to unsaturated soils, above the water table. This contamination is presumed to be the result of PCE vapor migration from the source area through unsaturated soils. The existing concrete floor slab and paved parking areas have reduced the ability for the PCE in soil gas to volatilize to the atmosphere.

- The dry wells and adjacent soils where the highest concentration of PCE was detected are either located within an existing building or in an area covered with pavement and/or concrete, thereby preventing precipitation from infiltrating through the contaminated soil and causing transport.

- The Site, is underlain by a thick clay deposit. The soils above this clay unit in the area of proposed removal are fill consisting of a heterogeneous mixture of silt, sand, gravel, bricks, concrete, slag, ash, and wood.

Based on comparison of the results of the Phase II Site Investigations with State and Federal cleanup requirements, it has been determined that there are no unacceptable risks from the Site in its current state, but if no remediation is undertaken at the site and the planned residential development occurs, there could an unacceptable risk to future residents from long-term exposure via inhalation of volatile organic compounds potentially migrating from contaminated soils and groundwater. Furthermore, there could be short-term risks to workers during removal actions which can and should be addressed as part of the health and safety plan for the selected response action.

No other compounds or exposure routes appear likely to result in an unacceptable risk. While some contamination is present in groundwater, groundwater cleanup is unnecessary because drinking water in the vicinity of the site is provided from the city’s public water supply, the aquifer beneath the site is designated non-potable, and the levels of contamination present do not exceed State cleanup standards for this class of aquifer.

As discussed in the EE/CA approval memo, Given that the plan is to redevelop the site for residential use, there is potential exposure to nearby human populations from hazardous substances such that a removal action is appropriate to eliminate the imminent and substantial endangerment that would otherwise result from the likely future land use.

1.2 REMOVAL ACTION SCOPE, GOALS AND OBJECTIVES

The Removal Action Scope involves addressing the contaminated soils in the vicinity of the two dry wells, believed to be the predominant source of identified Site contamination. The scope of the removal action also includes confirmation sampling to confirm that the removal goals and objectives have been achieved and that no contamination remains on site above acceptable levels.

The goal of the removal action is to mitigate risks posed to possible future residents from exposure to volatile compounds and eliminate or minimize the potential for contaminant migration from soils at or near the surface as a result of infiltrating precipitation as may occur under the redeveloped Site conditions. Since the planned future land use is residential, the goal is to achieve cleanup standards designed for unrestricted residential use. The State of Confusion has cleanup standards for PCE in soils designed to protect human health and the environment from ingestion and/or transfer to groundwater or the air. The PCE standard for unrestricted use is 400 mg/kg, which will be used as the cleanup action level goal for evaluating removal options at this site.

The specific objective of this removal action is to eliminate or reduce to acceptable levels the contamination in the soil. Performing the removal action without putting site workers, the public or the environment at risk is also an objective of the proposed removal action.

1.3 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)

Removal actions conducted pursuant to the Brownfields Cleanup Revolving Loan Fund must comply with federal and state requirements that are applicable or relevant and appropriate (ARARs) to the actions taken, as defined in 40 CFR 300.400(g), provided that compliance with such actions is practicable considereing the “exigencies of the situation”. Practicability is evaluated taking into account appropriate factors, including the urgency of the situation and the scope of the removal action.

A state requirement may be an ARAR if it is 1) promulgated (of general applicability and legally enforceable), 2) an environmental or facility siting law or regulation, 3) substantive (not procedural or administrative), 4) more stringent than a comparable federal requirement, 5) identified by the state in a timely manner, and 6) consistently applied.

In keeping with the stated goal of eliminating or reducing the contamination in soils to acceptable levels for residential use of the site, action-, chemical- and location-specific ARARs pertinent to such a removal action have been identified and considered in selecting the preferred alternative.

<u>1) Action-Specific ARARs</u>

Off-site Disposal of Hazardous Waste -
Resource Conservation and Recovery Act, as amended (RCRA), 42 U.S.C. §§ 6901 et seq., and its implementing regulations codified in 40 CFR Chapter 260 through 265, 268, and 270 , including the following specific requirements identified at this time: 40 CFR §§ 263.20 and 263.21, relating to off-site transport of hazardous waste (handling and manifesting requirements), and 40 CFR Part 268, relating to off-site and on-site land disposal restrictions for hazardous wastes. These regulations establish requirements for those who generate, store, treat and dispose

of hazardous waste , and would be applicable or relevant and appropriate if off-site disposal is selected.

Confusion State Hazardous Waste Management Act (HWMA), and its implementing Dangerous Waste Regulations codified at Chapter 173-303 of the CAC. Since the state of Confusion has been authorized by EPA to implement the HWMA regulations in lieu of the federal RCRA regulations, the applicable RCRA regulations for this removal action shall be those EPA-authorized state regulations which are the counterparts to the federal RCRA regulations which were listed above. If no state regulatory counterpart exists under Chapter 173-303 CAC, then, in most cases, the federal RCRA regulations listed above shall apply.

Air Pollution Controls - Control of Dust, Particulates and Volatile Emissions
Federal Clean Air Act (CAA), 42 USC 7409, 7601; National Ambient Air Quality standards (NAAQS), 40 CFR part 50; Establishes programs to control airborne particulate and toxic emissions, control volatile emissions sources, and requires permits for new sources of air toxic emissions, including MTCA sites. If demolition and/or excavation is selected, these requirements may be applicable and removal action construction activities may need to be conducted under specific emissions controls, and ambient conditions may have to be monitored, as appropriate.

Confusion Clean Air Act (RCC 70.94); Confusion State Air General Regulations for Air Pollution Sources CAC 173-400, and Ambient Air Quality Standards for Particulate Matter, CAC 173-470, and Controls for Volatile Emissions Sources, CAC 173-490; These establish programs to control airborne particulate and toxic emissions, control volatile emissions sources, and require permits for new sources of air toxic emissions, including MTCA sites. If soil vapor extraction or excavation is selected, these requirements may be applicable and removal action construction activities may need to be conducted under specific emissions controls, and ambient conditions may have to be monitored, as appropriate.

<u>2) Chemical-specific ARARs</u>

Model Toxics Control Act - State (RCW70.105D, CAC 173-340)
The State of Confusion Model Toxics Control Act (MTCA) includes cleanup standards (discussed above) which may be applicable chemical-specific ARARS for cleanup of PCE in soils. The soil cleanup levels are designed to be protective for short-term direct contact exposure, volatilization and migration to groundwater.

<u>3) Location-Specific ARARs</u>

Wetlands Protection and Floodplains - federal- 40 CFR part 6
The potential actions contemplated will not affect any floodplains or wetlands. If additional actions become necessary, Acme Lumber will evaluate whether there are any impacts to floodplains or wetlands.

Endangered Species Act of 1973 as Amended (16 USC 1531 et seq., 50 CFR 200, 402)

The bald eagle, marbelled murret, peregrine falcon, and Puget Sound chinook salmon are listed species which inhabit the general vicinity of the site. However, the actions being considered on site and related off-site disposal action were determined to not affect endangered or threatened species known to live in the vicinity of the site.

Cultural Resources - National Historic Preservation Act (16 USC 470 and implementing regulations at 36 CFR part 60.4)

Under the National Historic Preservation Act federal agencies and lead agencies under CERCLA must take into account possible effects of their actions on properties on or eligible for inclusion on the National Register of Historic Places. Since the site is not listed on the NHRP, and all the buildings on the site are ugly modular buildings on concrete slabs built in 1966 after an earthquake destroyed all the neat old historic buildings, it has been determined that the site is not eligible for inclusion on the NHRP.

<u>NOTE:</u> In the interest of brevity, the analysis of alternatives later in this document does not go into further detail on ARARs, however there is further discussion of key ARARs for the <u>preferred</u> alternative after it is identified.

1.4 CERCLA REMOVAL LIMITS

Statutory limits are set forth in the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) on Federally funded removal actions. These limits require that the removal action be completed in one year from initiation and the cost not exceed two million dollars, unless an exemption is obtained. The proposed removal action in not anticipated to need an exemption from these statutory limits.

The removal action schedule is dictated by the schedule for the planned demolition of the Site building and floor slab to allow access to perform the additional investigation. The length of time to complete the removal action will be dependent on the mass of soil delineated for removal, weather conditions and other Site specific factors. The statutory one year limit to complete the removal action is anticipated to be sufficient

2.0 IDENTIFICATION AND ANALYSIS OF REMOVAL ACTION ALTERNATIVES

Several removal action alternatives were pre-selected on the following basis: the alternative can successfully remove the site specific contaminants, chlorinated organic compounds; the alternative is effective on soil contamination in the unsaturated zone and at relatively high concentrations, and; the alternative can achieve the goals in a reasonable time frame to allow re-development of the site.

2.1 SOIL VAPOR EXTRACTION

<u>Description</u>

Soil Vapor Extraction (SVE) employs mechanical systems to extract soil gas containing volatile organic contaminants from the subsurface vadose zone. Vertical or horizontal extraction wells are connected to a vacuum source, typically a blower, and the extracted soil gas is directed to a treatment unit/process. The vacuum applied through these extraction wells creates a pressure and concentration gradient that enhances the removal of gas phase contaminants from the subsurface. The amount of vacuum necessary, blower capacity and number of extraction wells are dependent site specific factors such as the nature and extent of contamination and hydrogeologic conditions. The radius of influence of an extraction well depends on the air permeability of the soils. The air permeability of the soils is a function of grain size, moisture content and the degree of homogeneity. High organic carbon content is soil matrices can limit SVE efficiency by affecting the ability of the contaminant to desorb into the gaseous phase.

Methods of removing or destroying the contaminants in the extracted soil gas include carbon adsorption and thermal and catalytic oxidation. A secondary benefit of SVE is promotion or enhancement of in situ biodegradation resulting from the continuous flow of air through the soil.

Effectiveness

SVE is an effective technology for removing volatile contaminants in permeable, homogeneous soils with low moisture and organic carbon content. With consistent and effective treatment or destruction of the extracted contaminants, implementation of the technology poses minimal risk to the community, site workers or the environment.

The heterogeneity of the subsurface soils at this Site (mixed fill, pipe trenches, and construction debris) may severely limit the effectiveness of SVE due to the preferential pathways for short-circuiting of air flow. Some of the fill materials encountered (ash, slag, wood) may restrict the ability of the contaminants to desorb into the gaseous phase thus limiting the ability of SVE to extract the contaminants and potentially reducing the long term effectiveness and permanence of the technology.

The volatile contaminant concentrations in the soils in and around the dry wells are in the tens to hundreds of thousands of parts per billion, therefore an SVE system will likely take a substantial length of time to achieve clean-up goals.

This alternative could be designed to achieve the State cleanup standards which are applicable for PCE cleanups.

Implementability

Pilot testing is generally required to determine the feasibility of SVE and to determine design parameters such as air flow rate, contaminant concentrations and number and spacing of extraction wells.

SVE could be readily implemented at this Site following the demolition of the building and slab. A geosynthetic liner placed over the target area could limit short-circuiting from the atmosphere and improve the degree of treatment to the near-surface soils. The SVE system could be constructed with readily available equipment and materials and would not require personnel with special skills to operate. With the exception of extracted gas treatment, the SVE system would require minimal operator attention.

Treatment of the extracted soil gas by carbon adsorption is generally effective for PCE, however, daughter products such as vinyl chloride that may be present in the soils adsorb poorly to carbon. This can result in frequent carbon media replacement and/or break-through of contaminants that may be released into the atmosphere. Thermal oxidation of difficult to burn halogenated compounds can result in hazardous byproducts such as dioxins and/or incomplete destruction. Oxidation equipment fitted with precious or base metal catalyst may be effective at destroying the contaminants in the extracted soil gas, however, chlorinated hydrocarbons may poison the catalyst reducing treatment efficiency. Oxidation of halogenated compounds may require a scrubber on exhaust gas to remove acid gas emissions.

The relatively high concentrations and types of contaminants will increase the cost of vapor treatment and potentially increase the time required to reach target goals substantially beyond one year.

The construction of a building for the extraction system hardware and the treatment unit/process would be needed. A temporary power service is necessary and depending on the type of treatment, an auxiliary fuel source may be needed.

Other than low noise levels SVE would have minimal impact on adjoining properties. The SVE system, could be constructed entirely on the Site property utilizing existing access eliminating the need for easements or right-of-ways.

Cost

Table 1 - Cost Estimate for Soil Vapor Extraction	
Recovery Wells	$ 25,000
Recovery Equipment	$ 15,000
Treatment Equipment	$ 50,000
Treatment Building and Utilities	$ 50,000
Construction Costs - Site Work	$ 25,000
Design and Start-up @ 20%	$ 33,000
18 Months **[previously said that 12-month limit would not be aproblem.]** of Operation and Maintenance @ $2,500/month	$ 45,000
Decommission and Residual Management	$10,000
TOTAL	$253,000

2.2 SOIL FLUSHING

Description

In-situ soil washing or flushing for chlorinated compounds is a process which typically uses an aqueous solvent solution to extract contaminants from soil. A solvent mixture is passed through the soils using injection or infiltration and contaminants are dissolved in the solvent which is extracted from the subsurface. An underlying low permeable soil strata is desirable to vertically contain the flushing solution and contaminants. The extracted fluids must be treated and where possible the flushing agent separated and collected for re-use. The potential exists for dissolved contamination to migrate past the recovery system. Air emissions from the collected groundwater and flushing solutions of volatile organic compounds may require treatment.

The success of the technology requires that the flushing solution can be applied such that it contacts all soil particles, making sites with low permeability or with heterogeneous soils less suited for this remedial alternative. Hydrogeologic conditions must be well understood and conducive to allowing capture of the flushing solution and contaminants.

Effectiveness

Soil washing can be an effective remedial technology in permeable, homogeneous soils at sites with underlying low permeable soils and where migration of dissolved contaminants can be controlled. With consistent and effective treatment or destruction of the extracted contaminants, implementation of the technology poses minimal risk to the community, site workers or the environment.

The heterogeneity of the subsurface soils at the Site (mixed fill, pipe trenches, and construction debris) may severely limit the effectiveness of soil washing due to the preferential pathways for the flushing solution. Some of the fill materials encountered (ash, slag, wood) may restrict the ability of the contaminants to desorb into the flushing solution thus potentially reducing the long term effectiveness and permanence of the technology.

The site groundwater flow appears to be towards Stony Brook, implying that either the culvert is highly permeable and groundwater is able to infiltrate the culvert, or the former stream channel, in which the culvert is located, remains a preferential pathway for groundwater discharge. The apparent groundwater flow regime may make controlling migration of the dissolved contamination difficult.

It is not clear whether this alternative could be designed to achieve the applicable State cleanup standards.

Implementability

Laboratory and field treatability tests are generally required to determine the feasibility of soil flushing technology and to determine the most suitable flushing solution and means of application.

Soil flushing could be readily implemented at this Site following the demolition of the building and slab. The delivery and extraction systems could be constructed with readily available equipment and materials. Special treatment and chemical separation equipment may

need to be custom fabricated. The technology requires personnel with special skills and experience to operate.

Managing the recovered fluids will require separation and the groundwater extracted will need treatment. Groundwater treatment by carbon adsorption is generally effective for PCE, however, daughter product such as vinyl chloride that may be present adsorb poorly to carbon. This is also true for potential contaminants that may volatilize from the extracted groundwater/flushing solution.

The construction of a building for the flushing solution application, extraction, separation and treatment systems would be needed. A temporary power service is necessary and depending on the type of treatment, an auxiliary fuel source may be needed.

It may be difficult to control migration of contaminants, a scenario potentially impacting adjoining properties. The extraction/recovery system may need to extend downgradient onto the neighboring property creating the need for an easement or right-of-way.

Cost

Table 2 Cost Estimate for Soil Washing/Flushing	
Injection and Recovery Wells	$ 50,000
Recovery Equipment	$ 25,000
Soil Washing Solution Delivery System	$ 25,000
Separation & Treatment Equipment	$ 100,000
Treatment Building and Utilities	$ 50,000
Construction Costs - Site Work	$ 25,000
Design and Start-up @ 20%	$ 35,000
12 Months **[With construction, wouldn't this alternative run into the statutory 12-month limit?]** of Operation and Maintenance @ $3,500/month	$ 42,000
Decommission and Residual Management	$15,000
TOTAL	$367,000

2.3 EXCAVATION AND OFFSITE DISPOSAL OR TREATMENT

Description

This technology employs excavation to remove the contaminated soils. Excavation would be performed in a controlled manner to mitigate short-term environmental and health issues dealing with air quality, dust, and contaminant migration via surface water runoff. Excavation is most suited for removal of soils in the vadose zone, however, dewatering can be employed to lower the groundwater to access saturated soils. Shallow contaminated soils are best suited for excavation.

Ideally the excavated soil is loaded directly onto trucks to minimize handling. Logistical issues may result in the need to temporarily stockpile the excavated soils for later transport.

Treatment or disposal options are typically dependent on the type and concentrations of the soil contaminants. The contaminants are either extracted via thermal desorption, destroyed by incineration or contained in a controlled disposal facilty.

<u>Effectiveness</u>

Excavation and off site disposal/treatment is a very effective technology for eliminating contaminant mass, especially for relatively small volumes of shallow soils located in the vadose zone. It can provide rapid and permanent cleanup of contaminant source areas.

On the negative side, high VOC levels during excavation could lead to short term exposure to workers or to residents living adjacent to the site, and personal protection devices for workers and perimeter monitoring should be further evaluated if this alternative is chosen.

The type of subsurface soils generally do not limit the effectiveness of excavation, however, concrete rubble and other debris in the soils may require size reduction.

Treatment/disposal facilities exist that can effectively destroy, extract or immobilize the contaminants.

This alternative could be designed to achieve the State cleanup standards which are applicable for PCE cleanups.

<u>Implementability</u>

Excavation could be readily implemented at this Site following the demolition of the building and slab. The necessary equipment and labor for soil excavation and offsite treatment/disposal are readily available.

Migration of contaminants via dust and/or runoff can be mitigated using standard construction practices and site controls. Personal protective equipment can eliminate or reduce the potential risk of worker exposure to the contaminants. Air emissions can be reduced by controlling the excavation to limit the amount of soil exposed at any given time. Tarpaulins over exposed soils during non-working hours, on temporary stockpiles, and over loaded trucks will help limit air emissions. There is adequate space on the property and the existing access is suitable for excavation and offsite disposal. Should it be necessary there is enough space on the property to temporarily stockpile excavated soil.

The majority of the contaminated soils are thought be located in the vadose zone. The culvert that contains Stony Brook is immediately adjacent to one of the former dry wells on the property. Extra care will be needed in excavating near this buried culvert. For example, partial backfilling to support the culvert as the excavation progresses may be required.

Cost

Table 3 Cost Estimate for Excavation and Off-site Disposal/Treatment	
Design/Planning	$15,000
Mobilization and Staging	$7,500
Excavation	$15,000
Temporary Stockpile of Soils	$6,000
Characterization Sampling	$9,000
Load, Transport and Dispose Soils	$150,000
Backfill and Compact Excavation	$7,500
TOTAL	$210,000

2.4 COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES

Based on the foregoing evaluation of removal action alternatives a comparative analysis was performed. This comparative analysis qualitatively ranked each alternative using the criteria shown in Table 4. Each evaluation criterion was given a score for each alternative of 1, 2, or 3, with 1 being poor, 2 being average, and 3 being good. The individual scores were summed for each alternative to give a total score. The larger the score the better the ranking. The evaluation of remedial alternatives and this comparative analysis were performed based on existing data. Additional data may have the potential to alter the outcome.

TABLE 4 Comparative Analysis of Alternatives			
	SVE	SOIL WASHING	EXCAVATION
Effectiveness			
Protectiveness			
Protective of public health and community	3	2	3
Protective of workers during implementation	3	3	3
Protective of the environment	3	2	3
Complies with ARARs	3	1**[3 or 1?]**	3

TABLE 4 **Comparative Analysis of Alternatives**			
	SVE	SOIL WASHING	EXCAVATION
Ability to Achieve Removal Objectives			
Level of treatment/containment expected	2	2	3
No residual effect concerns	2	2	3
Will maintain control until long-term solution implemented	NA	NA	NA
Implementability			
Technical Feasibility			
Construction and operational considerations	3	2	3
Demonstrated performance/useful life	2	2	3
Adaptable to environmental conditions	3	3	3
Contributes to remedial performance	NA	NA	NA
Can be implemented in 1 year	1	2	3
Availability			
Equipment	3	2	3
Personnel and services	3	2	3
Outside laboratory testing capacity	NA	NA	NA
Off-site treatment and disposal capacity	NA	NA	NA **[Why is this NA?]**
Post removal site control	NA	NA	NA
Administrative Feasibility			
Permits required	NA	NA	NA
Easements or right-of-ways required	3	2	3
Impact on adjoining property	3	2	3
Ability to impose institutional controls	NA	NA	NA
Likelihood of exceeding statutory 12-month limit **[It looks like SVE and soil washing would both exceed the 12-month limit.]**	NA	NA	NA
Cost			
Capital cost	2	1	3
Post removal site cost	NA	NA	NA

TABLE 4
Comparative Analysis of Alternatives

	SVE	SOIL WASHING	EXCAVATION
Present worth cost	NA	NA	NA
TOTAL SCORE	39	**32[this isn't right if complies with ARARs is 1 instead of 3.]**	44 **[Isn't this 45?]**

3.0 RECOMMENDED REMOVAL ACTION ALTERNATIVE

Based on the results of the comparative analysis, excavation and off-site disposal is the preferred removal action remedial technology. The reasons that excavation and off-site disposal is the most feasible option include: relatively high contaminant concentrations; apparent limited volume of source soils; contaminated soils appear to be predominantly shallow and located above the water table; and, the soils will be readily accessible once building demolition is completed. Excavation and off-site disposal is a long established and effective remedial alternative for contaminated soils under these circumstances. Among the advantages of this alternative are:

< it can provide rapid and permanent clean-up of source areas
< the required equipment for excavation, loading and transport is readily available
< the volume, mobility and toxicity are reduced by contaminant mass removal
< it is effective in all soil types, including fill and miscellaneous debris
< it does not require extensive design, pilot or bench scale testing, or long term operation and maintenance
< it can readily achieve the State cleanup standards for PCE in soils.

In addition to the generic benefits listed above, there are Site specific conditions that make excavation and off-site disposal advantageous, as follows:

< once the building and concrete slab are removed, the soils will be readily accessible and adequate space will be available for staging, soil stockpiling and loading trucks
< with the exception of the culverted brook, which appears to be on the periphery of the source area, there are no known subsurface conflicts
< the extent of the contaminated soils in the source zone appear to be limited in vertical extent by underlying low permeability soils
< the large majority of the source zone soils appear to be located above the groundwater table
< based on the apparent low permeable soils in the saturated zone, anticipated groundwater flow into the excavation will likely be at a low rate and easily managed
< The schedule requirements for this remedial alternative fit well with the overall site redevelopment timetable.

It should be noted, however, that high VOC levels during excavation could lead to short term exposure to workers or to residents living adjacent to the site, so if this alternative is selected, personal protection devices should be required for workers during excavation and perimeter monitoring should be conducted for VOCs as well as dust emissions during excavation.

Table A-1 - ARARs for the Recommended Alternative

ARARs	Status	Major Requirements	Recommended Alternative Action
Resource Conservation and Recovery Act, as amended (RCRA), 42 U.S.C. §§ 6901 et seq., 40 CFR §§ 263.20 and 263.21, and 40 CFR Part 268	relevant and appropriate **[***Please see comment below about this RCRA discussion.]**	define federal hazardous waste and requirements for those who generate, store, treat and dispose of it	RCRA Subtitle C is not applicable because soil and debris have been determined not to be a RCRA waste Some RCRA requirements could, however, be relevant and appropriate including siting and operations requirements for solid and hazardous waste disposal facilities (which will be met by disposing of site materials at appropriately permitted facilities) and land disposal restrictions (any site materials to be land disposed will be appropriately treated, as necessary, prior to land disposal)
Confusion State Hazardous Waste Management Act (HWMA), and its implementing Dangerous Waste (DW) Regulations codified at Chapter 173-303 of the CAC..	relevant and appropriate	Since the state of Confusion has been authorized by EPA to implement the HWMA regulations in lieu of the federal RCRA regulations, the applicable RCRA regulations for this removal action shall be those EPA-authorized state regulations which are the counterparts to the federal RCRA regulations which were listed above. If no state regulatory counterpart exists under Chapter 173-303 CAC, then the federal RCRA regulations listed above shall apply	The dangerous waste regulations are not applicable because soil and debris have been determined not to be dangerous waste. Some DW requirements could, however, be relevant and appropriate including siting and operations requirements for solid and hazardous waste disposal facilities (which will be met by disposing of site materials at appropriately permitted facilities) and land disposal restrictions (any site materials to be land disposed will be appropriately treated, as necessary, prior to land disposal)

Confusion Clean Air Act (RCC 70.94); Confusion State Air General Regulations for Air Pollution Sources CAC 173-400, and Ambient Air Quality Standards for Particulate Matter, CAC 173-470, and Controls for Volatile Emissions Sources, CAC 173-490;	applicable	These establish programs to control airborne particulate and toxic emissions, control volatile emissions sources, and require permits for new sources of air toxic emissions, including MTCA sites.	During demolition and excavation, construction activities will need to be conducted under specific emissions controls, and ambient conditions will have to be monitored, as appropriate.
Federal Clean Air Act (CAA), 42 USC 7409, 7601; National Ambient Air Quality standards (NAAQS), 40 CFR part 50;	applicable	Establishes programs to control airborne particulate and toxic emissions, control volatile emissions sources, and require permits for new sources of air toxic emissions, including MTCA sites.	During demolition and excavation construction activities will need to be conducted under specific emissions controls, and ambient conditions will have to be monitored, as appropriate.
Confusion State Cleanup Standards (RCW70.105D, CAC 173-340)	applicable	allows use of promulgated cleanup levels or establishes methods for developing site-specific risk based cleanup standards; establishes rules for determining point of compliance	The recommended alternative includes a cleanup goal which meets the State standard and actions which are designed to achieve the standard.

[*re: RCRA ARAR discussion – there are several problematic issues involved in this item that we need to discuss:**
1) Stating that RCRA is not applicable – (a) I am not sure of the basis for this statement or whether it is accurate for the circumstances described in the sample. Are you trying to say that there was no listed or characteristic hazardous waste on-site or are you trying to say even though there might be listed or characteristic hazardous waste on-site, the activities being conducted on site will not trigger Subtitle C requirements? If the former, were the wastes contaminating the soil hazardous wastes?

2) Off-site disposal is not analyzed as an ARAR – need to comply with 40 CFR 300.440. Also, whether or not the waste sent off-site must be treated and/or sent to a subtitle C facility depends on the basis for the statement that RCRA is not applicable.

3) Since RCRA can be a complicated ARAR, and many Pilots may treat this as guidance on how to deal with RCRA as an ARAR, we should discuss whether this is the best type of example for RCRA and/or whether there is another way to identify the issues associated with RCRA as an ARAR.