CORRECTIVE ACTION PLAN

Bentley Mall
Fairbanks, Alaska

January 2006

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1.0 INTRODUCTION

Alaska Resources and Environmental Services, LLC (ARES) in association with Environmental Resource Group, Inc. (ERG) was retained by Rawson, Blum and Company (Rawson & Blum) to prepare a Corrective Action Plan (CAP) for the Bentley Mall property located at 32 College Road in Fairbanks, Alaska (**Plate 1**, subject site). The CAP reviews environmental conditions at the subject site and evaluate three (3) remedial alternatives to mitigate the risk posed by subsurface soil and groundwater impact by halogenated volatile organic compounds.

In 2003, Alaska Resources and Environmental Services, LLC conducted an environmental investigation of the Bentley Mall property and identified tetrachloroethene (PCE) and trichloroethene (TCE) in subsurface soil and groundwater at concentrations exceeding regulatory action levels. Subsequent investigations outlined a plume of groundwater with PCE and TCE that extends from the Bentley Mall property to the west-southwest for more than one-thousand-and-five-hundred (1,500) feet below a mixed residential and commercial area. In December 2005, Rawson & Blum requested a CAP to address the environmental concern associated with the subject site.

2.0 BACKGROUND

The Bentley Mall property is owned by Rawson, Blum and Company (Rawson & Blum) of San Francisco, California. Rawson & Blum has retained the services of Alaska Resources and Environmental Services, LLC (ARES) of Fairbanks, Alaska as the lead environmental consulting firm, and Environmental Resource Group, Inc. (ERG) of Mill Valley, California. AIG Incorporated represents the prime insurance carrier for the property. The lead regulatory agency is the Alaska Department of Environmental Conservation (ADEC), Northern Region based in Fairbanks, Alaska.

2.1 Bentley Mall

The Bentley Mall includes the main mall building and several satellite buildings in the south portion of the property (**Plate 2**). In 2002, AMEC Earth & Environmental, Inc. (AMEC) conducted a Phase II Environmental Site Assessment of a property located southwest of the Bentley Mall and referred to as Tax Lot 221. Tax Lot 221 is occupied by the Fred Meyers Store and was formerly a salvage yard. Tetrachloroethene (PCE), trichloroethene (TCE), 1,2-dichloroethane (1,2-DCA) and benzene were reported above ADEC cleanup levels in soil and groundwater samples collected from Tax Lot 221.

Three (3) possible scenarios were proposed at the time to account for the contaminants identified at Tax Lot 221: a) an undocumented past release on Tax Lot 221; b) an undocumented release off-site and hydraulically up-gradient from Tax Lot 221; and c) a combination of these two (AMEC, 2002). Two (2) potential off-site sources of solvent-based compounds PCE and TCE were identified upgradient of Tax Lot 221: the East Satellite Building on the Bentley Mall property and the VIP Dry Cleaners and Laundromat (VIP Cleaners) at 510 Old Steese Highway. The East Satellite Building reportedly housed a dry cleaner approximately twenty (20) years ago, in the late 70’s and early 80’s. VIP Cleaners is currently operating a dry cleaning facility southeast of the East Satellite Building. Tax Lot 221 (Fred Meyers), Bentley Mall and VIP Cleaners are shown in **Attachment A**.

2.2 Discovery

In 2003, ARES completed a subsurface investigation of the subject site that included the collection of two (2) soil samples from borings, collection of grab groundwater samples from eight (8) temporary well points, and installation of three (3) groundwater monitoring wells for groundwater sampling and gradient evaluation. Soil and groundwater samples were submitted for laboratory analyses for volatile organic compounds (VOCs) via Environmental Protection Agency (EPA) Method 8260. The investigation results identified PCE and TCE in soil and groundwater samples, and the maximum concentrations were reported in the south portion of the subject site between the East Satellite Building and Wells Fargo Bank Building. ARES reported up to 2,910 micrograms per liter (µg/L) of PCE and 97.5 µg/L of TCE in groundwater samples, above the ADEC (May 26, 2004) cleanup level of 5.0 µg/L for both PCE and TCE. Analytical results of the two (2) soil samples taken at five (5) feet below ground surface (feet bgs) indicated 0.242 and 0.292 milligrams per kilogram (mg/kg) of PCE, above the ADEC (May 26, 2004) cleanup level of 0.03 mg/kg. The investigation results were presented in a report by ARES dated March 2003. Soil and groundwater analytical data are summarized in **Attachment A**.

In August 2003, a soil-gas survey utilizing EMFLUX® passive soil-gas collectors was completed and confirmed a source area of the halogenated VOCs spatially associated with the East Satellite Building. A utilities survey was conducted by ARES and indicated that the East Satellite Building is serviced by a wastewater line that extends west from the building along the north side of College Road and continues to the property boundary, approximately nine-hundred (900) feet to the west where it discharges into the municipal sanitary sewer. The wastewater line that services VIP Cleaners extends east from the VIP Cleaners Building and away from the Bentley Mall to discharge into the municipal sanitary sewer below Old Steese Highway. The wastewater lines are located in **Attachment A**.

The results of the August 2003 investigation were presented in a report by ARES dated November 2003. ARES concluded that historical dry cleaning operations at the East Satellite Building represented a likely source for the PCE and TCE in the subsurface media.

3.0 SUMMARY OF ENVIRONMENTAL CONDITIONS

The following summary is based on the investigations completed by ARES (November 2003; November 2004; February 2005; October 2005).

3.1 Soil and Soil-Gas Sampling Results

In June 2004, additional soil-gas samples via EMFLUX® passive soil-gas collectors were collected to further evaluate subsurface contamination at the subject site (Beacon, September 8, 2004). The June 2004 soil-gas data confirmed the August 2003 data and indicated that subsurface concentrations of PCE and TCE were distributed below and west of the East Satellite Building and in the vicinity of the underground wastewater line that extends along the north side of College Road. The study results suggested historical dry cleaning operations at the East Satellite Building as the most likely source of the halogenated VOCs. The wastewater line may have acted as a preferential pathway and/or secondary release source for the contaminants.

In November 2004, soil samples were collected from six (6) borings (BM1 to BM6) drilled in the south portion of the subject site. The soil samples were submitted for laboratory analyses for VOCs via EPA Method 8260B. PCE concentrations up to 0.590 mg/kg, above the ADEC (May 26, 2004) soil cleanup level of 0.03 mg/kg, were reported in soil samples from five (5) to fifteen (15) feet bgs between the East Satellite Building and McDonalds Restaurant Building. The boring locations and analytical data are presented in **Attachment B**. The soil sampling results were presented in a report by ARES dated November 2004.

3.2 Groundwater Sampling Results

A comprehensive groundwater investigation was conducted in December 2004 and January 2005 (ARES, February 2005). Groundwater samples were collected on-site and off-site from soil borings along transects oriented perpendicular to the plume axis. Sixty-six (66) samples were collected and analyzed for halogenated VOCs via a portable gas chromatograph (GC). Those groundwater samples with the highest PCE and TCE analytical results were submitted for laboratory analyses verification. A total of thirty-six (36) groundwater samples were laboratory analyzed for EPA Method 8260B VOCs.

The groundwater analytical results are presented in **Attachment C**. The highest concentrations of PCE and TCE were reported in those groundwater samples collected near the East Satellite Building. Laboratory analytical results indicated up to 4,600 µg/L PCE and 210 µg/L TCE in groundwater samples. The highest concentrations of PCE and TCE in groundwater samples collected off-site were 640 µg/L and 42 µg/L, respectfully. PCE and TCE in groundwater were concentrated at the top of the saturated zone in the nineteen (19) to twenty-five (25) feet depth interval. Vertical profiling in the source area indicated 30 µg/L PCE at sixty-five (65) feet bgs and no detectable TCE (ARES, February 2005).

3.3 Groundwater Contaminant Plume

The groundwater investigations completed to date indicate that groundwater flow direction in the area encompassing the subject site is west-southwest with a gradient of approximately 0.0009 horizontal feet/vertical feet. The groundwater surface or water table is approximately seventeen (17) feet bgs (ARES, March 2003; November 2003, February 2005; October 2005).

The groundwater investigations by ARES have outlined a plume of groundwater with PCE and TCE in solution. The head or source area of the plume occurs in the south portion of the Bentley Mall property near the East Satellite Building. The plume extends west-southwest of the subject site below College Road and Tax Lot 221 (Fred Moyers), and continues beyond Noyes Slough into the Charles Slater Homestead Subdivision. Although not fully characterized, the plume is at least 520 feet wide and extends for more than 1,500 feet downgradient from the subject site. **Attachment C** includes a plan view of the groundwater plume and site conceptual model in ARES (February 2005). The groundwater plume extends beneath the East Satellite, Wells Fargo Bank, McDonalds and West Satellite Buildings.

3.4 Indoor-Air Sampling Results

Indoor air samples were collected in March 2005 from those satellite buildings located in the core area of the groundwater plume and submitted for laboratory analyses for PCE and TCE via EPA Method TO-15 (ARES, October 2005). The purpose of the investigation was to evaluate the potential for soil-vapor intrusion into the buildings. The buildings sampled included the East Satellite, Wells Fargo Bank and McDonalds Buildings. The PCE and TCE concentrations in indoor air samples from the East Satellite Building and Wells Fargo Bank were reported to be above indoor air target levels. Maximum concentrations in indoor air samples were 290 micrograms per cubic meter ($\mu g/m^3$) of PCE and 6.8 $\mu g/m^3$ of TCE. The EPA target levels for indoor air are 8.1 $\mu g/m^3$ for PCE and 0.22 $\mu g/m^3$ for TCE.

To mitigate indoor air concerns, the heating and air conditioning systems for the East Satellite Building and Wells Fargo Bank were adjusted in March 2005 to maintain a positive pressure inside the buildings. In May 2005, another set of indoor air samples was collected and the analytical results indicated PCE and TCE concentrations had decreased to 15 $\mu g/m^3$ and 1.4 $\mu g/m^3$, respectfully (ARES, October 2005).

3.5 Surface Water Sampling Results

Noyes Slough is a 5.5-mile long waterway connected to the Chena River. A complex hydraulic interaction between the Chena River and Noyes Slough exists and both streams have an influence on the groundwater hydraulics and flow regime in the Fairbanks area. Two discharge peaks characterize the Chena River: spring snowmelt runoff and late summer precipitation. The Noyes Slough locally influences groundwater flow and stages of Noyes

Slough typically rise and fall in response to stage changes of the Chena River (ARES, March 2003; Burrows et al, 2000).

In July 2005, surface water samples were collected along a section of the Noyes Slough inferred to be in the path of the groundwater plume as outlined by ARES (February 2005). The water samples were analyzed for VOCs via EPA Method 8260B to assess the possible seepage or discharge of impacted groundwater into Noyes Slough. The analytical results identified PCE (6.9 µg/L) and TCE (6.8 µg/L) in surface water samples at concentrations slightly above the ADEC cleanup level for surface water (ARES, October 2005).

4.0 POTENITAL CHEMICAL EXPOSURES AND PATHWAYS

Based on the current land use of the area underlain by impacted subsurface soil and groundwater, potential human receptors to be considered in corrective actions include: 1) construction/landscape workers; 2) indoor adult workers including office and retail sales personnel; and 3) adults, children and other sensitive receptors in residential setting downgradient of the subject site.

Potential ecological receptors are identified off-site in Noyes Slough, the nearest surface water body located relatively downgradient of the subject site. A potential ecological exposure risk exists because the groundwater plume is suspected to intercept Noyes Slough. However, a full assessment of potential groundwater seepage and contributions from other sources to Noyes Slough has not been completed to date.

4.1 Potential Exposure Pathways

Potential human receptors may be exposed to halogenated VOCs in subsurface soil and groundwater via one or more of the following possible pathways:

- Inhalation of volatile chemicals from groundwater or soil;
- Dermal contact due to direct soil and/or groundwater contact;
- Inhalation of airborne suspended soil particulates; and
- Incidental soil ingestion.

The areas underlain by impacted soil and groundwater are primarily covered by pavement and building foundations. The water table in the area is relatively deep at approximately seventeen (17) feet bgs. With the exception of potential short-term exposures by construction and landscape workers, dermal contact due to direct soil and/or groundwater contact, inhalation of airborne suspended soil particulates and incidental soil ingestion are not considered complete exposure pathways at the subject site.

Ingestion of groundwater is not considered a complete exposure pathway because the subject site and vicinity are serviced by potable water from the municipal water system. No drinking water well receptors were identified in the well survey completed by ARES in 2005. The well survey encompassed the area underlain by the groundwater plume and identified two (2) wells located in the Charles Slater Homestead Subdivision, approximately 1,200 feet west to southwest of the subject site. The two (2) wells are reportedly used or designated for irrigation purposes (ARES, October 2005).

4.2 Soil and Groundwater Target Levels

ADEC (May 26, 2004) has published cleanup goals for soil and groundwater for organic and inorganic chemicals, including PCE and TCE. These cleanup goals are based on conservative human and environmental risk criteria, and are subject to change in the future as a result of new risk and toxicological information.

ADEC cleanup goals for soil are 0.03 mg/kg for PCE and 0.027 mg/kg for TCE. ADEC cleanup goals for groundwater and surface water are 5.0 µg/L for both PCE and TCE (ADEC, May 26, 2004).

Remedial action at the subject site is warranted at this time inasmuch as the concentrations of PCE and TCE in soil and groundwater samples exceed the applicable ADEC cleanup goals. Furthermore, an indoor air quality concern has been raised as a result of detectable concentrations of PCE in indoor air samples collected from buildings in the southern portion of subject site. The investigations by ARES have identified a potential on-site primary source of halogenated VOCs associated with past dry cleaning operations at the East Satellite Building. A potential secondary source has been suggested along the underground wastewater line that extends west from the East Satellite Building along the north side of College Road (ARES, October 2005).

The area targeted for remediation is outlined in the attached **Plate 2**.

5.0 CORRECTIVE ACTION PLAN

Three (3) remediation alternatives were identified to reduce contaminant concentrations in the subsurface soil and groundwater, and mitigate the environmental risks at the subject site:

- Remedial excavation and ozone sparging;
- Ozone sparging and soil vapor extraction; and
- HRC® injection and soil vapor extraction

5.1 Alternative I: Remedial Excavation and Ozone Sparging

Remedial excavation would remove the bulk of the on-site contaminant mass present in the subsurface soil in a relatively short period of time. Excavation would require the use of the parking area in the south portion of the subject site during the six (6) to eight (8) month duration of the project. The parking area would be fenced and dedicated for the handling and stockpiling of the excavated soil and as a staging area for the construction and remediation equipment and materials.

The option to have the excavated soil off-hauled to a permitted landfill facility is not considered at this time inasmuch as no landfill facility has been identified in near Fairbanks that would accept soil contaminated with halogenated organic compounds. Another option considered is to transport the excavated soil to an off-site facility for treatment such as by thermal desorption or vapor extraction or other technology. The option to stockpile and treat the soil on-site with a similar technology is discounted at this time because of the space limitations, and the difficulty in obtaining regulatory approval.

Ex-situ soil treatment candidates include thermal desorption and soil vapor extraction perhaps augmented by air sparging. The objective would be to treat the soil to ADEC cleanup standards. The excavated soil would be placed into lined cells and treated to remove the halogenated VOCs. The treatment technology selected would depend on pilot test results and ADEC approval. During full-scale treatment, the treated soil would be sampled, analyzed and characterized to ensure the treated soil meets ADEC cleanup goals for on-site reuse to backfill the excavations. Ex-situ soil treatment is contingent upon ADEC approval to adopt the remediation technology.

The installation of a limited groundwater extraction system in the excavation would advance the cleanup of the groundwater by removing groundwater-borne contaminants in a relatively short period of time. The excavation dewatering would proceed via extraction trenches or wells and continue until the groundwater met the groundwater cleanup goals, or until which time contaminant concentrations in the groundwater reached asymptotic levels and marginal reductions. The extracted groundwater would be pumped into water storage tank and treated on-site via granulated activated carbon (GAC) vessels located on the subject site. Water treated via GAC would be profiled and discharged into the municipal sanitary sewer system provided a discharge permit can be obtained from the local municipality. If discharge to the sanitary sewer is not feasible, then the treated water can be off-hauled as wastewater to a permitted off-site facility for final disposition.

An ozone sparging system would be installed at the subject site to treat in-situ the contaminants in groundwater not removed by dewatering. The ozone injection points would be distributed in a network encompassing the excavation and surrounding area. Sparging would enhance the volatilization of halogenated VOCs in the saturated zone and promote in-situ biodegradation of the contaminants.

Much of the on-site impacted area is accessible to excavation equipment, and the physical removal of the impacted soil coupled with dewatering of the excavation would effectively reduce the toxicity, volume and mobility of contaminants below the subject site. Remedial excavation would advance cleanup in a relatively short time frame compared to other remedial alternatives, but the costs would be high and disruption to Bentley Mall commercial operations would be significant. A post-excavation monitoring program is included in Alternative I to evaluate and monitor the off-site plume.

5.2 Alternative II: Ozone Sparging and Soil Vapor Extraction

Ozone sparging involves the injection of ozone through a contaminated aquifer. The injected air-ozone mixture traverses horizontally and vertically in channels through the soil column, creating an underground stripper that removes volatile contaminants by volatilization. The injected air helps to flush the contaminants into the unsaturated zone. Ozone in the injected air stream can enhance in-situ biodegradation of contaminants.

Soil vapor extraction (SVE) is implemented in conjunction with ozone sparging to remove the vapor-phase contaminants in the unsaturated zone including the volatiles generated from sparging of the saturated zone below. SVE is an in-situ unsaturated-zone soil remediation technology in which a vacuum is applied to the soil to reduce the controlled flow of air and remove volatile contaminants. The gas leaving the soil is treated above-ground by GAC vessels designed for treatment of vapor phase streams. Other vapor treatment technologies exist that may be more applicable depending on site-specific conditions. The treated vapor stream is generally discharged into the atmosphere under a permit from the local regulatory agency. Vertical extraction wells or points are typically installed in the unsaturated zone. Horizontal extraction pipes installed in trenches or horizontal borings are sometimes used instead depending on the contaminant zone geometry or other site-specific factors.

A pilot study would be performed initially to establish the feasibility of the method as well as to obtain information necessary to design and configure a full-scale ozone sparging/SVE system. Design information include sparge well and vapor extraction well construction details, sparge and extraction well radius of influence, gas flow rates, optimal applied vacuum, and contaminant mass removal rates. During full-scale treatment, SVE can be run intermittently (pulsed operation) once the extracted mass removal rate has reached an asymptotic level. The pulsed operation can increase the cost-effectiveness of the system by facilitating extraction of higher concentrations of contaminants. After the contaminants are removed, other remedial measures can be investigated if remedial action objectives have not been met.

A combination of ozone sparging and vapor extraction would remove the contaminants in the subsurface soil and groundwater without major disruption to commercial site operations. The ozone sparging and SVE system would consist of an array of sparge points or wells distributed in the impacted area. An ozone generating equipment would inject ozone into the saturated zone via the sparge wells screened across the lower portion of the saturated zone. Ozone sparging combines the use of conventional air sparging with the injection of chemical oxidants (ozone) to oxidize and break down VOCs in groundwater. Sparging would be effective at stripping the target compounds (PCE and TCE) and provide oxygen to enhance the biodegradation of these compounds in-situ.

The sparging system design couples specially designed sparge diffusers with optimized pulsed injection to achieve greater distribution of the injected air/ozone stream. Sparging wells are constructed using ozone resistant PVC casings. The well screen and filter pack must be carefully sealed to avoid air leaks. The sparge diffusers are outfitted with micro-channel diffusers, which create streams of micro-bubbles. The injection serves to disperse the injected bubbles laterally through established channelized flow paths with bursts of injected air/ozone at varying depths and time intervals. The pulsed injection tends to disperse the injected air/ozone laterally within the saturated zone. Because of the relatively permeable nature of the saturated zone, air channels would be established and maintained as long as the air pressure is maintained. Air sparging works most effectively with air flow rates in a range of 3 to 10 standard cubic feet per minute per sparge point.

A preliminary design of ozone sparging includes the installation of approximately thirteen (13) sparge wells with an estimated total airflow rate of approximately 80-100 cfm. The sparging wells would be located on-site, where the highest target compound concentrations were detected in groundwater. The SVE system would include two (2) clusters of vapor extraction points, one distributed near the East Satellite Building and the other near the Wells Fargo Bank Building to mitigate indoor air concerns.

Alternative II includes a long term monitoring program to evaluate the remediation and monitor the off-site plume.

5.3 Alternative III. HRC® Injection and Soil Vapor Extraction

The third alternative consists of a soil vapor extraction system like that proposed in Alternative II coupled with injection and below-ground treatment with Hydrogen Release Compound (HRC®). HRC® is a proprietary environmental safe, polyactate ester manufactured by Regenesis Bioremediation Products, Inc. of Pasadena, California. The proposal is to enhanced reductive dechlorination of PCE and TCE in groundwater by the injection of HRC® into the saturated zone via push-points or dedicated wells. The effectiveness of HRC® depends on groundwater geochemistry, the concentration of halogenated compounds, saturated zone permeability and redox state, and other factors. Periodic sampling and analyses of groundwater from groundwater monitoring wells within the plume is used to evaluate the effectiveness of the remediation. Analysis includes halogenated VOCs and natural attenuation parameters. The later include dissolved oxygen, oxidation-reduction potential, pH, conductivity, temperature, ferrous iron, nitrate and nitrite, sulfate, methane, ethane, ethane, manganese and phosphorous.

Based on design criteria and pilot testing, HRC® injection grids are developed over the area targeted for remediation. A delivery spacing of five (5) to twenty (20) feet on center, the spacing depends on groundwater velocity, sediment permeability and contaminant concentrations. The injection rate for each point typically ranges from four (4) to ten (10) pounds per foot (lb/ft), and its specification depends on the contaminant concentrations and competing electron acceptors.

The use of fewer injection points and higher doses might not provide sufficient distribution of HRC and lactic acid throughout the contaminant plume. For larger plumes and/or large ranges of contaminant concentrations, the HRC dose rate should be adjusted as appropriate (i.e., the plume can be divided into high-, medium-, and low-contaminant concentration areas, each with a specific HRC dose rate). The need for reapplication of HRC will depend on achievable biodegradation rates, remedial goals for the site, proximity of downgradient receptors, and other technical/regulatory issues.

Spacing is a function of soil type, groundwater velocity, and HRC® dose. The lower the hydraulic conductivity of the soil matrix, the closer the spacing. For sites with silts and clay, delivery point spacing should be five (5) to eight (8) feet-on-center, while a site with sands and gravels may have up to fifteen (15) feet-on-center spacing. For barrier designs, a series of staggered HRC injection point rows are typically constructed. The spacing of delivery points perpendicular to the groundwater flow should be no more than ten (10) feet-on-center.

Based on an evaluation of the site conditions and plume distribution, a treatment area of approximately 28,800 square feet was outlined that encompasses the 1,000 µg/L isopleth for PCE in the southern portion of the subject site. The estimated cost includes HRC® injection over a grid with ten (10) feet-on-center injection points; HRC® application rate of approximately 7 lbs/ft; HRC® product, shipping and taxes; pilot testing to validate the HRC®-based enhancement of reductive dechlorination; evaluation of baseline conditions; and design for full-scale treatment.

Alternative III includes a long term monitoring program to evaluate the remediation and monitor the off-site plume.

5.4 Cost Estimates

The preliminary cost estimates were developed to compare the remedial alternatives. The cost estimates are preliminary and first order estimates. Final cost estimates should be based on the final engineering design pending further review, pilot test results, contractor/supplier bids and other refinements.

The cost estimates are detailed in **Attachment D** and summarized in **Table 1**:

Capital Cost

The capital cost estimates developed for this evaluation include equipment, construction, design, permitting and construction management. A contingency factor has been included in the cost estimates to cover some or all of the unknown costs. Typically, preliminary cost estimates of this type are considered accurate to a range of minus 30 percent to plus 50 percent. The reasons for this large range are based on the variability of construction materials, variability in construction costs over time, the variability and undefined scope of work, the complexity of developing site-specific cost factors and sensitivity of construction costs to economic factors such as interest rates and materials costs.

Although some of the costs are not literally capital costs (i.e., construction management, engineering and permitting), they have been included to distinguish one-time initial costs versus long-term operation and maintenance costs. The capital costs for the three (3) alternatives are summarized on **Table 1**.

Operations and Maintenance Cost

The operation and maintenance (O&M) cost estimates developed for this evaluation include labor, equipment, supplies, laboratory fees and power. These estimates have been developed from cost estimating manuals and previous experience. O&M costs can vary greatly depending on the quality of the installation, inspection, specified equipment, preventive maintenance, assumed operation period, and site-specific conditions. The estimated O&M costs for the three (3) alternatives are summarized in **Table 1**.

Monitoring Cost

The monitoring cost estimates developed for this evaluation include labor, equipment, supplies, laboratory fees and reporting for implementing a groundwater monitoring and sampling program to evaluate the effectiveness of the remedial action and technologies selected. The main features of the monitoring program are as follows:

- Groundwater monitoring program of thirty (30) years with an initial quarterly frequency to be gradually reduced to semi-annual to annual to bi-annual at the end.

- Indoor air quality monitoring of buildings located in the core of the groundwater plume.

- Field measurement of water quality parameters, and laboratory analyses of groundwater samples for VOCs and natural attenuation parameters.

- Monitoring of groundwater plume distribution, migration and stability over time, and potential groundwater plume outflow to Noyes Slough.

- Development of a plume database to be used to negotiate risk-based groundwater cleanup goals for on-site and off-site areas.

The true monitoring costs depend on the number of monitoring points, the frequency of monitoring, the analytical testing and parameters to be monitored, the duration of the monitoring frequency, and the effectiveness of the remediation at achieving cleanup goals. The estimated monitoring costs are summarized in **Table 1**.

The monitoring data would be presented in reports to include descriptions of the methodologies used to collect the data; data tables and figures with sampling locations; interpretation of the monitoring results; and status of remedial actions.

Additional Investigation Cost

Further investigation to supplement the remediation and address information gaps include subsurface soil and groundwater sampling and analyses to further evaluate the extent and nature of the contamination, evaluation of other potential off-site sources of contaminants that may be contributing to the groundwater plume, and risk assessment to develop site-specific cleanup goals. Other investigation activities include three-year review of the corrective action plan, development of institutional controls such as a soil and groundwater management plan for the subject site, negotiations with regulatory agencies and community groups, and preparation of site closure arguments.

5.5 Recommended Corrective Action

The three (3) remedial alternatives (Excavation and Ozone Sparging; Ozone Sparging and SVE, and HRC Injection and SVE) are compared in **Table 1**. Based on a comparison of the short- and long-term effectiveness, implementability and cost, ozone sparging and soil vapor extraction (Alternative II) is the recommended remedial alternative. The total estimated cost is below the other two (2) alternatives. The implementation of Alternative II will have a limited impact to commercial operations at the subject site compared to Alternative I. Ozone sparging is anticipated to effectively volatilize and promote the in-situ degradation of halogenated VOCs in the saturated zone. In combination with ozone sparging, SVE is anticipated to be effective at removing VOCs in the unsaturated zone above and reduce the concentrations of halogenated VOCs in both soil and groundwater. SVE will also mitigate the indoor air quality issue associated with buildings underlain by impacted media.

6.0 CONCLUSIONS

The recommended corrective action plan is to perform ozone sparging and soil vapor extraction at the subject site. The objective of this remediation technology is to address indoor air quality concerns associated with buildings, reduce contaminants in the subsurface soil, and reduce contaminants in the groundwater below. The pilot testing, remedial system design and system start-up and assessment can be completed within approximately three (3) months, followed by full-scale implementation over a twelve (12) month period. A thirty (30) years groundwater monitoring program is included to evaluate remediation effectiveness and monitor the groundwater plume off-site.

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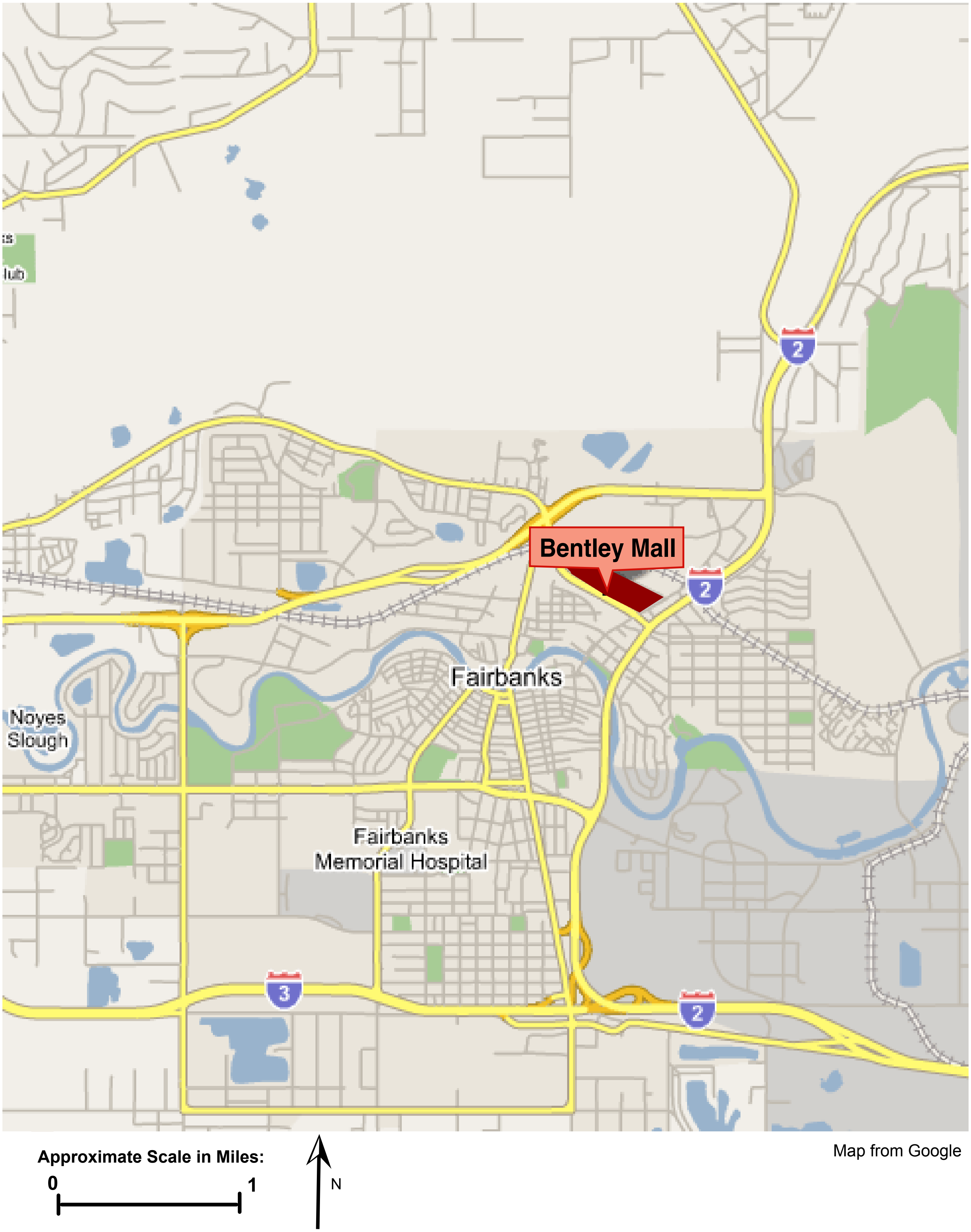
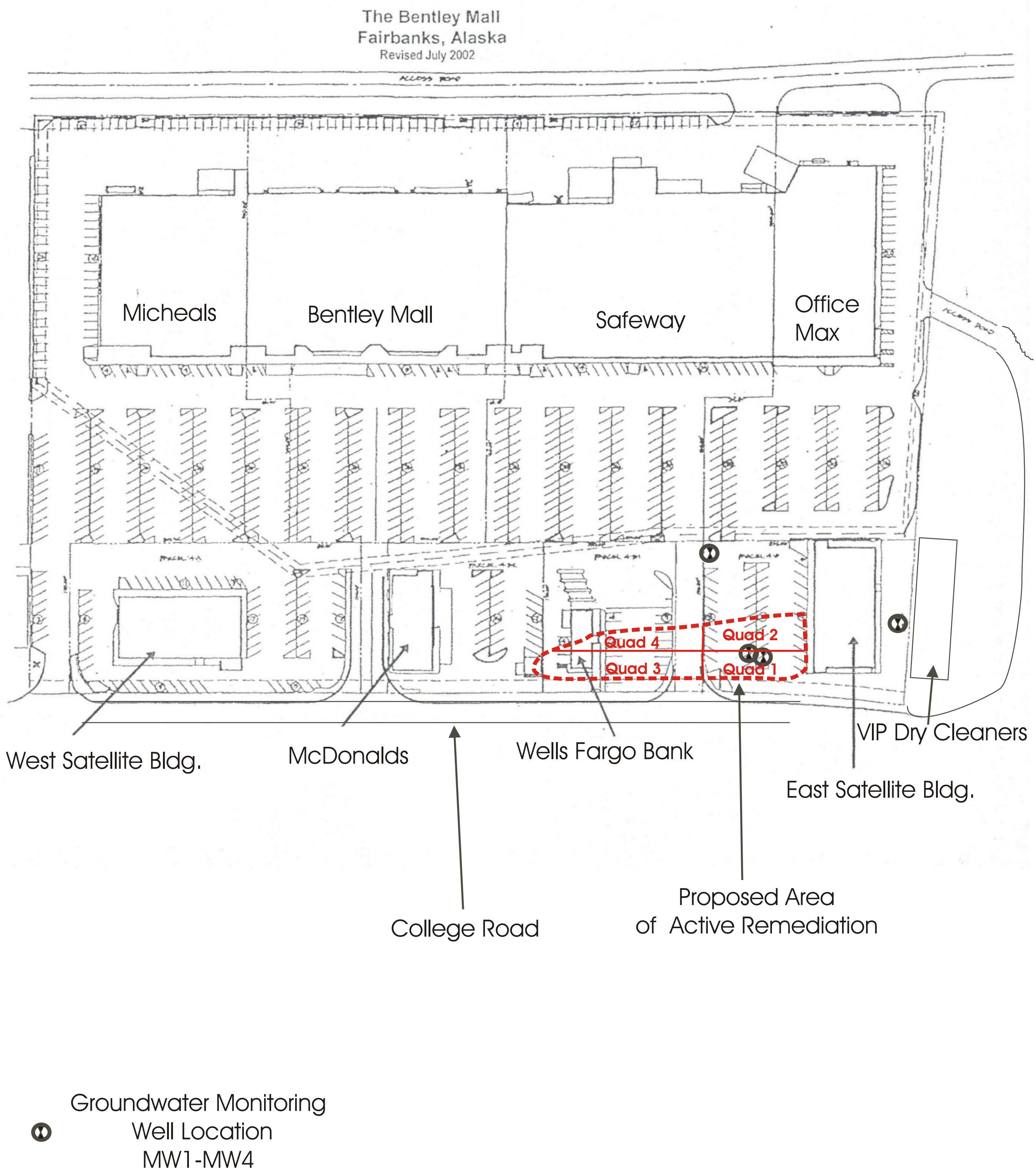


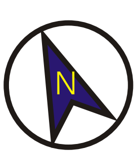
ERG
Environmental Resource Group

Bentley Mall Corrective Action Plan
Fairbanks, AK

January, 2006

Plate 1
Site Location





Scale in Feet

0 75 150

Bentley Mall
Proposed Area of Active Remediation

FIGURE 1
Bentley Mall Site Map
(November 2005)

Table 1: Screening of Corrective Action Alternatives, Bentley Mall, Fairbanks, Alaska

Alternative	Description	Feasibility	Costs					Comparison
			Capital	Operation-&-Maintenance	30-Year Monitoring	Additional Investigation	Total Estimate	
I	Excavation & Ozone Sparging	Feasible	$1,265,880	$60,690	$441,360	$80,000	$1,847,930	Effective at contaminant removal, shorter implementation, high capital cost and disruption to site operations
II	Ozone Sparging & Soil Vapor Extraction	Feasible	$397,166	$108,900	$441,360	$80,000	$1,027,426	Lower estimated cost, minimal impact on site operations, shorter-term implementation than HRC treatment
III	HRC Injection & Soil Vapor Extraction	Feasible	$430,143	$108,900	$549,360	$80,000	$1,168,403	Minimal impact on site operations, effectiveness potentially less than other alternatives, long-term implementation

ATTACHMENT A

Table A.1: Laboratory Analyses Results of Soil Samples, March 2003

Summary of Constituents Detected in Soil Samples		
Sample Location	**PCE (mg/kg)**	**ADEC Cleanup Level for PCE (mg/kg)**
E.S.-1	**0.242**	**0.03**
E.S.-2	**0.292**	**0.03**

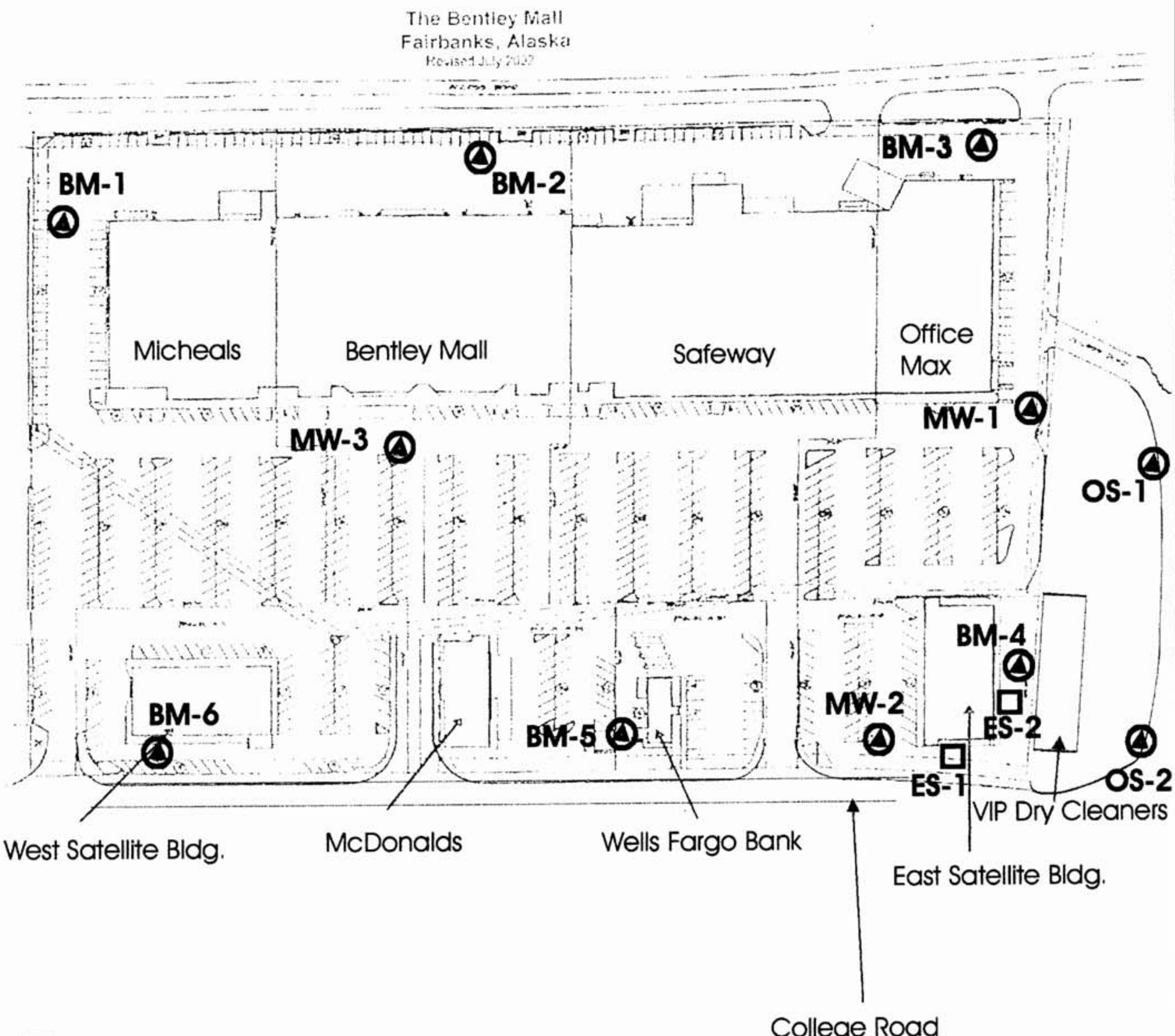
Table Notes:
Depth: Sample depth in feet below ground surface (feet bgs).
PCE: Tetrachloroethene
mg/kg: Milligrams per kilogram (parts per million equivalent)
ND: Not detected at or above the detection limit
[shaded box] Sample concentration exceeds the ADEC cleanup goal of 0.03 mg/kg
Laboratory analysis for volatile organic compounds (VOCs) by EPA Method SW8260B (GC/MS).
VOCs other than PCE were not detected at or above the reporting limit.

Table A.2: Laboratory Analyses Results of Groundwater Samples, March 2003

Sample Location	PCE (µg/L)	TCE (µg/L)
OS-1	ND	ND
OS-2	ND	ND
MW-1	ND	ND
MW-2	**2,910**	**13.8**
MW-3	ND	**6.1**
BM-1	ND	ND
BM-2	ND	ND
BM-3	ND	ND
BM-4	3.63	ND
BM-5	**1,540**	**97.5**
BM-6	**55.7**	**6.58**
Dup	**1,590**	**97.0**
ADEC Cleanup Level	**5.0**	**5.0**

Table Notes:
Dupl: Duplicate field blank sample to BM-5
PCE: Tetrachloroethene
TCE: Trichloroethene
µg/L: Micrograms per liter (parts per billion equivalent)
ND: Not detected at or above the detection limit
[shaded box] Sample concentration exceeds the ADEC cleanup goal of 5.0 µg/L
Laboratory analysis for volatile organic compounds (VOCs) was performed by EPA Method SW8260B (GC/MS). VOCs other than PCE and TCE were not detected at or above the reporting limit.

Source:
Alaska Resource and Environmental Services, LLC (March 2003): *"Phase II Environmental Site Assessment Report, Bentley Mall Complex, Fairbanks, Alaska."*



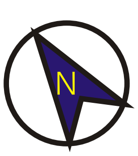
□ Soil Sample Location

Groundwater Well Location

Temporary Well Points
BM1 - BM6

Permanent Monitoring Well
MW1 - MW3

N	Scale in Feet 0 75 150	**Bentley Mall Phase II Environmental Site Assessment** March 2003	**FIGURE 2 Sample Locations** **Alaska Resources and Environmental Services, LLC**



KEY
Wastewater line

Note: Not to Scale

Bentley Mall
Phase II Addendum 1
Environmental Site
Assessment
November 2003

FIGURE 4
Wastewater Lines

Alaska Resources and
Environmental Services, LLC

ATTACHMENT B

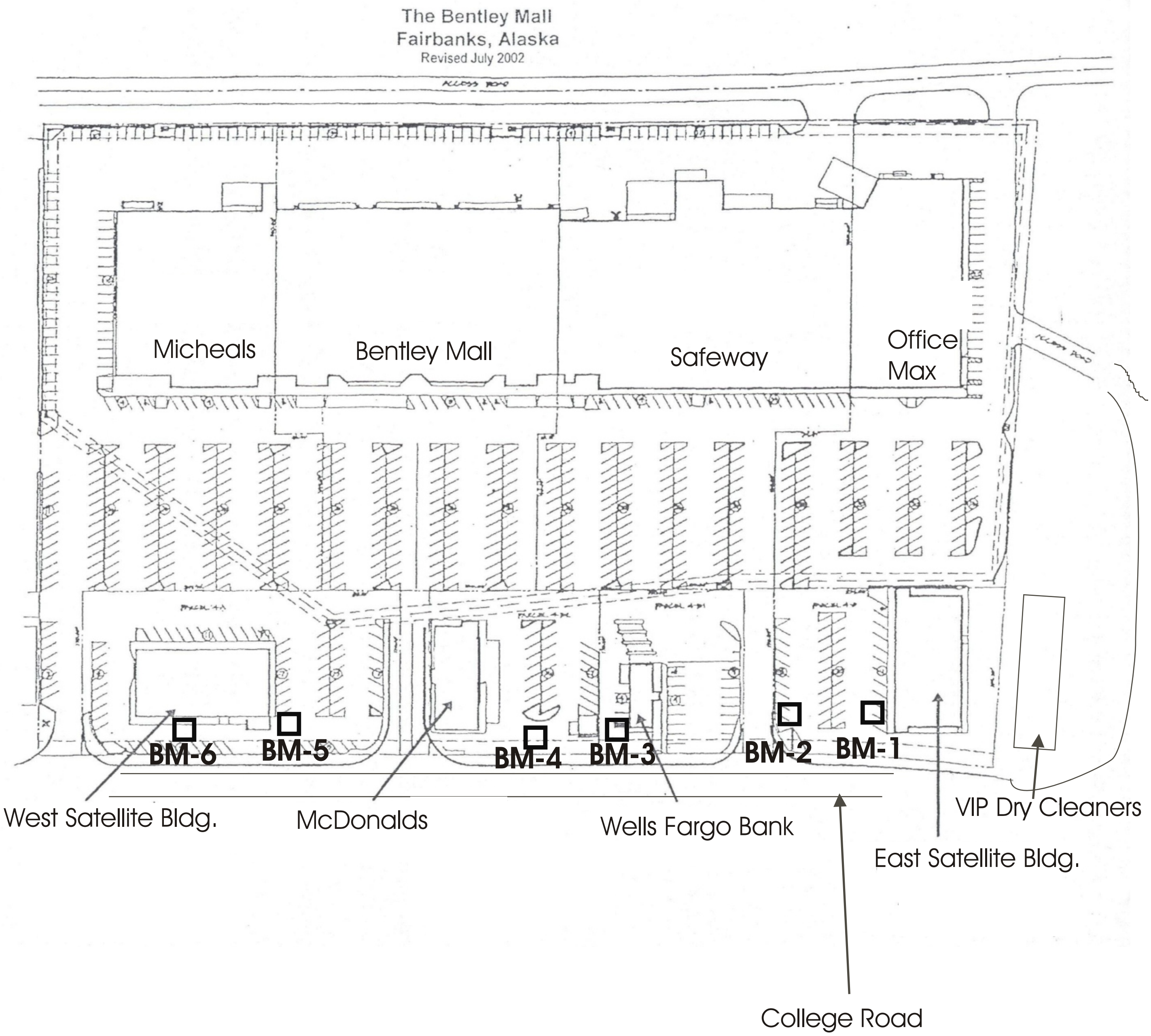
Table B-1
Laboratory Analytical Results of Soil Samples, November 2004, Bentley Mall, Fairbanks, Alaska

Sample ID	Sample Depth (feet bgs)	PCE (µg/kg)	ADEC Soil Cleanup Level for PCE (µg/kg)
BM1-5	5	**160**	30
BM1-10	10	**79**	30
BM1-15	15	**47**	30
BM2-5	5	**460**	30
BM2-10	10	**370**	30
BM2-15	15	**390**	30
BM3-5	5	**41**	30
BM3-10	10	**120**	30
BM3-15	15	**140**	30
BM4-5	5	**590**	30
BM4-10	10	**160**	30
BM4-15	15	**59**	30
BM5-5	5	**42**	30
BM5-10	10	**31**	30
BM5-15	15	ND	30
BM6-5	5	ND	30
BM6-10	10	9.7	30
BM6-15	15	8.5	30
DUP1		**170**	30
DUP2		ND	30

Table Notes:
Depth: Sample depth in feet below ground surface (feet bgs).
DUP1: Duplicate sample of BM3-15
DUP2 Duplicate sample of BM5-10
PCE: Tetrachloroethene
TCE: Trichloroethene
µg/kg: Micrograms per kilogram (parts per billion equivalent)
ND: Not detected at or above the detection limit
[shaded box] Sample concentration exceeds the ADEC cleanup goal of 30 µg/kg

Laboratory analysis for volatile organic compounds (VOCs) by EPA Method SW8260B (GC/MS). VOCs other than PCE and TCE were not detected above reporting limits.

Source:
Alaska Resource and Environmental Services, LLC (November 2004): *"Bentley Mall Soil Sample Results Summary, Tax Lot 217, Section 2, Township 1 South, Range 1 West Fairbanks Meridian, Fairbanks, Alaska."*



□ Soil Sample Location

N

Scale in Feet

0 75 150

Bentley Mall
Phase II
Environmental Site
Assessment

FIGURE 2
Soil Sample Locations
(November 2004)

ATTACHMENT C

Table C-1
Field and Laboratory Analytical Results of Groundwater Samples,
December 2004 - January 2005,
Bentley Mall, Fairbanks, Alaska

Sample ID	Field Analytical Results		Laboratory Analytical Results	
	PCE (µg/L)	TCE (µg/L)	PCE (µg/L)	TCE (µg/L)
FM-MW1			<MDL	<MDL
FM-MW2			<MDL	<MDL
FM1-17	<5	<5	<MDL	<MDL
FM1-29	<5	<5		
FM2-19	<5	<5	<MDL	<MDL
FM2-29	<5	<5		
BM1-19	**27.6**	<5	**23**	<MDL
BM1-29	<5	<5		
BM1-39	**5.3**	<5		
BM2-19	**2,478.9**	**21**	**4,600**	**22**
BM2-24	**1,605.2**	**12.5**		
BM2-29	**70.7**	<5		
BM2-34	**24.3**	<5		
BM2-39	**29.7**	<5		
BM2-54	**78.5**	<5		
BM2-65	**30.5**	<5		
BM3-19	**2,145.6**	**11.8**	**1,500**	**5.0**
BM3-29	<5	<5		
BM3-39	**9.7**	<5		
BM4-19	<5	<5	<MDL	<MDL
BM5-19	**560.2**	**113**	**980**	**210**
BM5-29	**66.5**	<5		
BM5-39	**319.8**	**21.2**		
BM5-49	**34.2**	<5		
BM5-65	**11.5**	<5		
BM6-19	<5	<5	**1.4**	**3.5**
BM7-19	**188.7**	**7**	**130**	**7.6**
BM7-34	**13.9**	<5		
BM7-49	**5.9**	<5		
BM8-19	**56.6**	<5	**20**	**2.6**
BM8-34	<5	<5		
BM9-19	**68.3**	<5	**30**	**2.2**
BM9-34	**8.4**	<5		
BM10-19	**8.6**	<5	**3.8**	**2.4**

Sample ID	**Field Analytical Results (GC)**		**Laboratory Results (GC/MS)**	
	PCE (µg/L)	**TCE (µg/L)**	**PCE (µg/L)**	**TCE (µg/L)**
KB1-19	<5	<5	<MDL	<MDL
KB2-20	**12.9**	<5		
KB2-30	**53**	<5	**47**	**5.1**
KB3-21	**213.6**	**9.7**	**280**	**26**
DUP2 (Duplicate to KB3-21			**290**	**23**
KB3-30	**299.5**	**43.4**	**160**	**20**
KB3-45	**95.7**	**10.4**		
RCM1-21	**25.3**	**6.9**		
RCM1-30	**71.9**	**5.7**	**40**	**8.2**
RCM2-21	**5.9**	<5	**2.8**	**2.5**
FM3-21	**1,084.5**	**63.4**	**640**	**42**
FM3-35	**942.4**	**65.3**		
FM3-50	**110.7**	<5		
FM4-21	**317.8**	<5	**230**	<MDL
FM4-35	**10.5**	<5		
FM4-50	**16**	<5		
FM5-24	<5	<5	<MDL	<MDL
FM6-24	<5	<5	<MDL	<MDL
RVM1-24	<5	<5	<MDL	<MDL
RVM2-24	**362**	**79.3**	**200**	**69**
RVM2-40	**96.4**	**5.1**		
EQ (Equipment Blank)			<MDL	<MDL
NS1-24	**94.1**	**7.6**		
NS1-35	**96.7**	**6.6**	**71**	**20**
DUP4 (Duplicate to NS1-35)			**67**	**21**
NS2-21	**162.7**	**17.9**	**93**	**32**
NS2-35	**132.4**	**7.9**		
IS1-25	<5	<5	<MDL	<MDL
IS2-25	**78.2**	**6**	**50**	**21**
MS-25	<5	<5	**0.79**	**0.19**
CS1-25	<5	<5	<MDL	<MDL
CS2-25	<5	<5	<MDL	<MDL

Table C-1 (Continuation)
Field and Laboratory Analytical Results of Groundwater Samples, December 2004 - January 2005, Bentley Mall, Fairbanks, Alaska

Table Notes:
Sample ID: The last two digits in the sample ID correspond to the sample depth in feet below ground surface (feet bgs).

PCE: Tetrachloroethene

TCE: Trichloroethene

µg/L: Micrograms per liter (parts per billion equivalent)

<MDL: Not detected at or above the mean detection limit

<5: Not detected at or above the detection limit

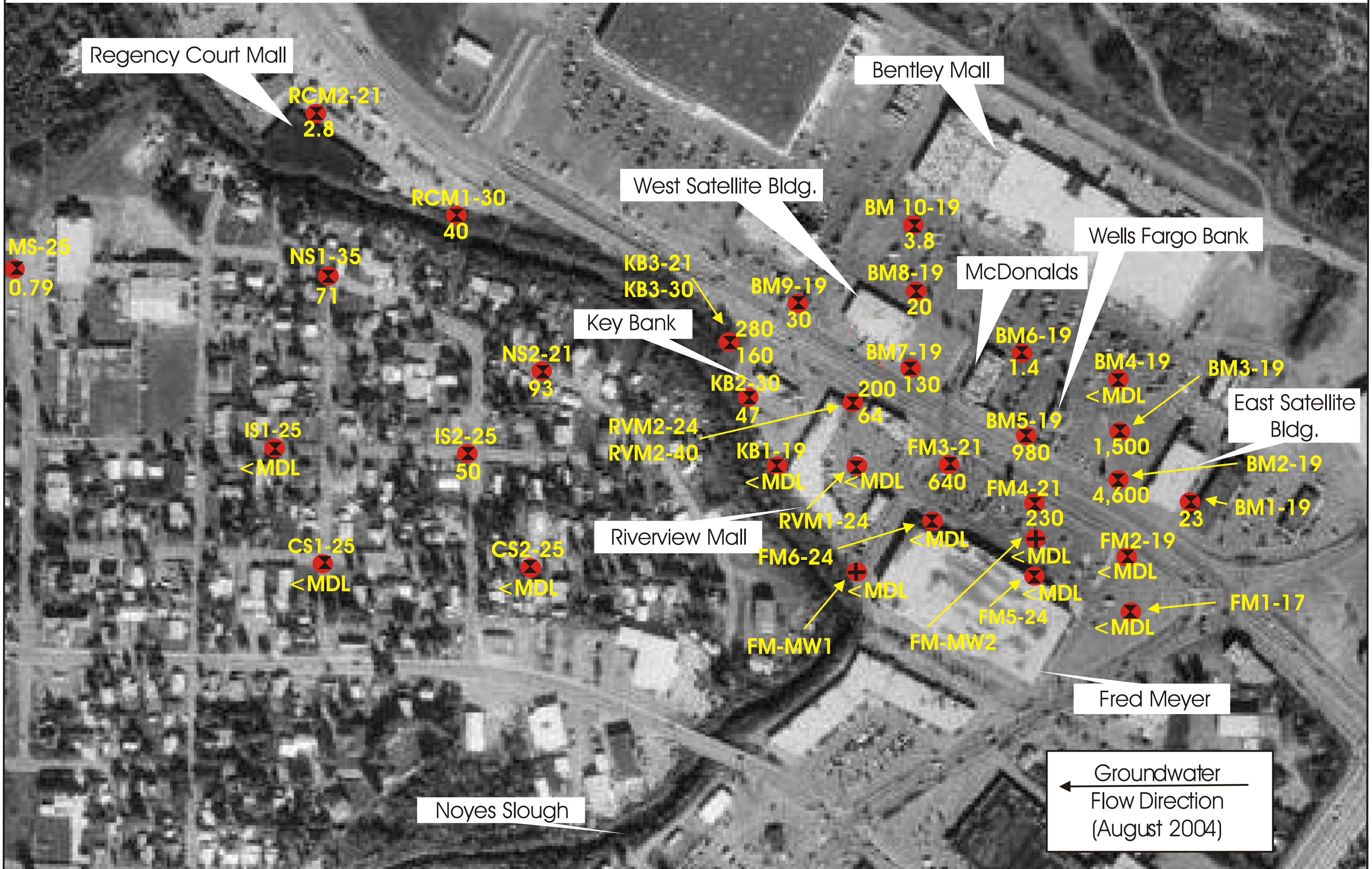
Field-based analysis for PCE and TCE was performed by purge-and-trap method 5030B using a portable SR1 8610C Portable Gas Chromatograph (GC) unit.

Laboratory-based analysis for volatile organic compounds (VOCs) was performed by EPA Method SW8260B (GC/MS).

[shaded box] Sample concentration exceeds the ADEC cleanup goal of 5.0 µg/L

Source:
Alaska Resource and Environmental Services, LLC (February 2005): *"Bentley Mall Groundwater Sample Results Summary, Tax Lot 217, Section 2, Township 1 South, Range 1 West Fairbanks Meridian, Fairbanks, Alaska."*

PCE Distribution - January 2005

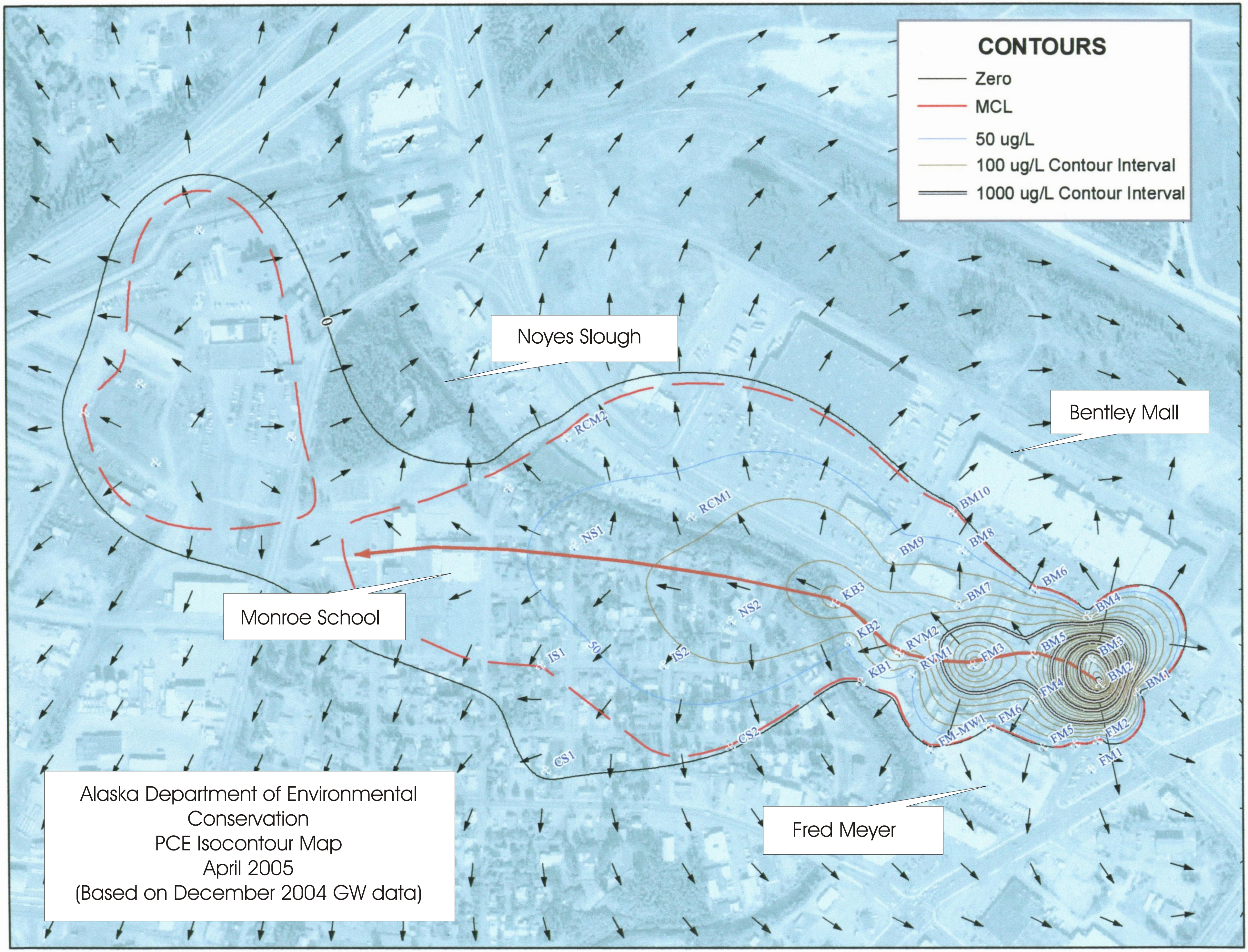


Grab Sample Location
(Numerical Value) — Results/PCE in Parts per Billion
<MDL — Less Than Mean Detection Limit
Permanent Monitoring Well

XX1-19
Sample ID
Sample Interval Depth (feet bgs)

Alaska Resources & Environmental Services

January 2005


CONTOURS
Zero
MCL
50 ug/L
100 ug/L Contour Interval
1000 ug/L Contour Interval
Noyes Slough
Bentley Mall
Monroe School
Fred Meyer
0
50
RCM2
RCM1
NS1
NS2
IS1
IS2
CS1
CS2
KB3
KB2
KB1
RVM2
RVM1
BM10
BM9
BM8
BM7
BM6
BM5
BM4
BM3
BM2
BM1
FM3
FM4
FM5
FM6
FM2
FM1
FM-MW1
Alaska Department of Environmental
Conservation
PCE Isocontour Map
April 2005
(Based on December 2004 GW data)

ATTACHMENT D

Table D-1A: Capital Costs, Alternative I - Remedial Excavation and Ozone Sparging, Bentley Mall, Fairbanks, Alaska

DESCRIPTION	UNIT	QUANTITY	UNIT COST	COST	TOTAL
CAPITAL COST					
Site Preparation					
Utilities relocation	LS	1	$10,000	$10,000	
Permits	LS	1	$5,000	$5,000	
Traffic and storm drainage controls	LS	1	$5,000	$5,000	
Fencing and security/staging area preparation	LS	1	$10,000	$10,000	
Subtotal:					**$30,000**
Soil Excavation, Handling and Off-Haul for Treatment					
Contractor mobilization & staging	LS	1	$1,000	$1,000	
Pavement demolition (15,000 sf)	SF	15,000	$2	$30,000	
Debris hauling & disposal, 375 tons (5,000 cf @150 lb/cf)	TON	375	$10	$3,750	
Shoring (7,500 sf)	SF	7,500	$40	$300,000	
Soil excavation, load & off-haul (11,500 tons)	TON	11,500	$8	$92,000	
Water storage tank, 20,000 gallons	MON	8	$800	$6,400	
Water treatment system	LS	1	$5,000	$5,000	
Operation & treatment of system	MON	8	$1,000	$8,000	
Subtotal:					**$446,150**
Backfill and Site Restoration					
Contractor mobilization & staging	LS	1	$1,000	$1,000	
Treated soil load & off-haul, 11,500 tons	TON	11,500	$3	$34,500	
Backfill excavation with treated soil compacted in lifts	TON	11,500	$8	$92,000	
Additional imported clean backfill, assume 10% of 11,500 tons	TON	1,150	$12	$13,800	
Shoring removal	SF	1	$5,000	$5,000	
Pavement restoration	SF	15,000	$3	$45,000	
Demobilization and cleanup	LS	1	$5,000	$5,000	
Subtotal:					**$196,300**
Off-Site Treatment of Excavated Soil (SVE)					
Equipment delivery/mobilization	LS	1	$1,000	$1,000	
Permits	LS	1	$3,000	$3,000	
Site preparation, staging	LS	1	$5,000	$5,000	
Air sparger and connections	EA	0	$30,000	$0	
System blower w. controls	LS	1	$8,000	$8,000	
System GAC vessels w. fittings	EA	2	$3,500	$7,000	
Electrical installations	LS	1	$1,000	$1,000	
Treatment system compound housing	LS	1	$2,500	$2,500	
Installation and start-up testing	EA	1	$5,000	$5,000	
Piping/tubing, fittings and manifold	LF	1,000	$12	$12,000	
Operation and Maintenance	MON	8	$2,000	$16,000	
Subtotal:					**$60,500**
Ozone Sparging System					
Equipment delivery/mobilization	LS	1	$1,000	$1,000	
Permits	LS	1	$3,000	$3,000	
Pilot testing	LS	1	$5,000	$5,000	
Sparge well installation, 13 wells to 30 ft depth	EA	13	$1,200	$15,600	
Ozone system w. controls	LS	1	$38,000	$38,000	
Electrical installations	LS	1	$5,000	$5,000	
Ozone system compound housing	LS	1	$5,000	$5,000	
Installation and start-up testing	EA	1	$10,000	$10,000	
Piping/tubing, fittings and manifold (1,500 lf estimated)	LF	1,500	$12	$18,000	
Subtotal:					**$100,600**
Laboratory Analyses - Excavation Confirmation Samples					
VOCs (EPA Method 8260B)	Sample	50	$200	$10,000	
Contingency analysis	LS	1	$1,000	$1,000	
Subtotal:					**$11,000**
Laboratory Analyses - Groundwater Samples					
VOCs (EPA Method 8260B)	Sample	5	$200	$1,000	
Contingency analysis	LS	1	$1,000	$1,000	
Subtotal:					**$2,000**

Table D-1A: Capital Costs, Alternative I - Remedial Excavation and Ozone Sparging, Bentley Mall, Fairbanks, Alaska

DESCRIPTION	UNIT	QUANTITY	UNIT COST	COST	TOTAL
CAPITAL COST					
Laboratory Analyses - Pre-Treatment Soil Samples					
VOCs (EPA Method 8260)	Samples	3	$200	$600	
TVHs (EPA Method 8260)	Samples	3	$100	$300	
TPHs (EPA Method 8015)	Samples	3	$100	$300	
SVOCs (EPA 8270C)	Samples	3	$250	$750	
CAM 17 Metals	Samples	3	$200	$600	
Subtotal:					**$2,550**
Laboratory Analyses - Post-Treatment Soil Samples					
VOCs (EPA Method 8260)	Samples	75	$200	$15,000	
TVHs (EPA Method 8260)	Samples	75	$100	$7,500	
TPHs (EPA Method 8015)	Samples	20	$100	$2,000	
SVOCs (EPA 8270C)	Samples	10	$300	$3,000	
CAM 17 Metals	Samples	10	$200	$2,000	
Geotechnical physical properties	LS	10	$300	$3,000	
Subtotal:					**$32,500**
Remediation Report					
Review data, QA/QC, staff engineer/geologist	HR	30	$100	$3,000	
Review data, QA/QC, senior engineer/geologist	HR	30	$100	$3,000	
Risk assessment	LS	1	$10,000	$10,000	
Report preparation, staff engineer/geologist	HR	40	$65	$2,600	
Report preparation, senior engineer/geologist	HR	40	$100	$4,000	
Subtotal:					**$22,600**
SUBTOTAL					**$904,200**
Engineering/Design/Procurement (10% of subtotal)	%	0.10	$904,200	$90,420	
Excavation/Remediation Oversight/Management (10% of subtotal)	%	0.10	$904,200	$90,420	
Contingency (20% of subtotal)	%	0.20	$904,200	$180,840	
				$361,680	**$361,680**
TOTAL CAPITAL COST					**$1,265,880**

Notes:

(1) Remedial excavation of approximately 15,000 square feet (300 ft x 50 ft) as represented by Quads #1, #2, #3 and #4

(2) Assume remedial excavation to 10 to 15 feet depth to remove vadose zone (above groundwater) soil contamination

(3) Excavation will likely require shoring installation

(4) Excavation will require re-routing of underground utilities

(5) Excavation may be performed in phases and will affect on-going site operations

(6) Assume excavation over an 8 month period

(7) Assume excavated soil will be stockpiled into cells and treated on-site by soil vapor extraction for reuse as backfill
Assume soil vapor extraction will be effective at treatment to acceptable levels

(8) An air sparging system will be installed and used for stockpile treatment and later for in-situ groundwater treatment

(9) The soil density used in the calculations was 115 pounds per cubic foot

10) The concrete density used in the calculations was 150 pounds per cubic foot

11) Assume laboratory analyses of confirmation soil and groundwater samples includes VOCs via EPA 8260B
Soil and groundwater samples: EPA Method 8260B @$200 per sample

12) Assume excavations will be backfilled with treated soil plus 10% imported clean fill, compacted in layers.

Table D-1B: Operation and Maintenance Cost, Alternative I - Remedial Excavation and Ozone Sparging, Bentley Mall, Fairbanks, Alaska

DESCRIPTION	UNIT	QUANTITY	UNIT COST	ANNUAL	TOTAL
YEARS 1 AND 2 - OPERATION AND MAINTENANCE COST					
O&M labor	Months	12	$520	$6,240	
GAC maintenance costs	LBS	50	$1.50	$75	
Profile carbon, assumes 2 times includes analytical	EA	2	$200	$400	
Materials and equipment repair/replacement	LS	1	$500	$500	
Influent/midfluent/effluent analytical testing, estimated	LS	1	$500	$500	
Effluent discharge permit fee	LS	1	$400	$400	
Quarterly report	EA	4	$500	$2,000	
Subtotal:				**$10,115**	
ESTIMATED COST (YEARS 1 AND 2)					**$20,230**
YEARS 3 TO 6 - OPERATION AND MAINTENANCE COST					
O&M labor	Months	12	$520	$6,240	
GAC maintenance costs	LB	50	$1.50	$75	
Profile carbon, assumes 2 times includes analytical	EA	2	$200	$400	
Materials and equipment repair/replacement	LS	1	$500	$500	
Influent/midfluent/effluent analytical testing, estimated	LS	1	$500	$500	
Effluent discharge permit fee	LS	1	$400	$400	
Quarterly report	EA	4	$500	$2,000	
Subtotal:				**$10,115**	
ESTIMATED COST (YEARS 3 TO 6)					**$40,460**
YEARS 7 TO 10 - OPERATION AND MAINTENANCE COST					
O&M labor	Months	0	$900	$0	
GAC maintenance costs	LB	0	$1.50	$0	
Profile carbon, assumes 2 times includes analytical	EA	0	$200	$0	
Materials & equipment repair/replacement	LS	0	$500	$0	
Influent/midfluent/effluent analytical testing, estimated	LS	0	$500	$0	
Effluent discharge permit fee	LS	0	$400	$0	
Quarterly letter report	EA	0	$500	$0	
Subtotal:				**$0**	
ESTIMATED COST (YEARS 7 TO 10)					**$0**
TOTAL ESTIMATED OPERATION AND MAINTENANCE COST					**$60,690**

**Table D-2A: Capital Cost, Alternative II -
Ozone Sparging and Vapor Extraction System,
Bentley Mall, Fairbanks, Alaska**

DESCRIPTION	UNIT	QUANTITY	UNIT COST	COST	TOTAL
CAPITAL COST					
Ozone Sparging System					
Equipment delivery/mobilization	LS	1	$1,000	$1,000	
Permits	LS	1	$3,000	$3,000	
Pilot testing	LS	1	$5,000	$5,000	
Sparge well installation, 13 wells to 30 ft depth	EA	13	$1,200	$15,600	
Ozone system w. controls	LS	1	$38,000	$38,000	
Electrical installations	LS	1	$5,000	$5,000	
Ozone system compound housing	LS	1	$5,000	$5,000	
Installation and start-up testing	EA	1	$10,000	$10,000	
Saw-cut remove pavement (1,000 lf x 2 ft)	SF	2,000	$2.50	$5,000	
Trenching & stockpiling (6,000 cf x 115 lb/cf = 345 tons)	TON	345	$9	$3,105	
Piping/tubing, fittings and manifold	LF	1,500	$12	$18,000	
Backfill and compact trench (345 tons estimate)	TON	345	$12	$4,140	
Pave trench (2,000 sf)	SF	2,000	$3	$6,000	
Soil load, off-haul and dispose (345 tons estimate)	TON	345	$80	$27,600	
Debris load, off-haul and dispose (1,000 cf x 150 lb/cf = 75 tons)	TON	75	$10	$750	
Subtotal:					**$147,195**
Soil Vapor Extraction System					
Equipment delivery/mobilization	LS	1	$1,000	$1,000	
Permits	LS	1	$3,000	$3,000	
Pilot testing	LS	1	$5,000	$5,000	
Vapor extraction well installation, 12 wells to 10 ft depth	EA	12	$1,000	$12,000	
System blower w. controls	LS	2	$8,000	$16,000	
System GAC vessels w. fittings	EA	4	$3,500	$14,000	
Electrical installations	LS	2	$1,000	$2,000	
Treatment system compound housing	LS	2	$2,500	$5,000	
Installation and start-up testing	EA	2	$5,000	$10,000	
Saw-cut remove pavement (1,000 lf x 2 ft)	SF	2,000	$2.50	$5,000	
Trenching & stockpiling (6,000 cf x 115 lb/cf = 350 tons)	TON	345	$9	$3,105	
Piping/tubing, fittings and manifold	LF	1,000	$12	$12,000	
Backfill and compact trench (345 tons estimate)	TON	345	$12	$4,140	
Pave trench (2,000 sf)	SF	2,000	$3	$6,000	
Soil load, off-haul and dispose (345 tons estimate)	TON	345	$80	$27,600	
Debris load, off-haul and dispose (1,000 cf x 150 lb/cf = 75 tons)	TON	75	$10	$750	
Subtotal:					**$126,595**
System Start-Up Report					
System O&M manual: staff geologist/engineer	HR	20	$65	$1,300	
System O&M manual: senior geologist/engineer	HR	20	$100	$2,000	
Drafting, tables, coordination: staff geologist/engineer	HR	20	$65	$1,300	
Drafting, tables, coordination: senior geologist/engineer	HR	20	$100	$2,000	
Report preparation: staff geologist/engineer	HR	20	$65	$1,300	
Report preparation: senior geologist/engineer	HR	20	$100	$2,000	
Subtotal:					**$9,900**
SUBTOTAL					**$283,690**
Engineering / Design /Procurement (10% of subtotal)	%	0.10	$283,690	$28,369	
Treatment system oversight/ management (10% of subtotal)	%	0.10	$283,690	$28,369	
Contingency (20% of subtotal)	%	0.20	$283,690	$56,738	**$113,476**
TOTAL CAPITAL COST					**$397,166**

Notes:

(1) The treatment area includes Quad #1 to #4, approximately 30,000 sq-ft (300 ft x 75 ft)

(2) Based on a system of 13 sparge wells each constructed to 30 feet depth with a 30-ft radius of influence assuming a groundwater zone of sand and gravel.

(3) Based on a system of 12 vapor extraction wells each constructed to 10 feet depth and assuming sandy vadose zone

(4) Cluster sparge wells at source area near East Satellite Building

(5) Cluster vapor extraction wells around East Satellite Building and Wells Fargo Bank Building, vapor treatment system at each building

(6) The soil density used in the calculations was 115 pounds per cubic foot

Table D-2A: Capital Cost, Alternative II -
Ozone Sparging and Vapor Extraction System,
Bentley Mall, Fairbanks, Alaska

DESCRIPTION	UNIT	QUANTITY	UNIT COST	COST	TOTAL

(7) The concrete/pavement density used in the calculations was 150 pounds per cubic foot

Table D-2B: Operation and Maintenance Cost, Alternative II - Ozone Sparging and Vaport Extraction System, Bentley Mall, Fairbanks, Alaska

DESCRIPTION	UNIT	QUANTITY	UNIT COST	ANNUAL	TOTAL
YEARS 1 AND 2 - OPERATION AND MAINTENANCE COST					
O&M labor	Months	12	$1,000	$12,000	
GAC maintenance	LBS	100	$1.50	$150	
Profile carbon, assumes 2 times includes analytical	EA	2	$400	$800	
Materials and equipment repair/replacement	LS	1	$1,000	$1,000	
Influent/midfluent/effluent analytical testing, estimated	LS	1	$1,000	$1,000	
Effluent discharge permit fee	LS	1	$400	$400	
Quarterly report	EA	4	$700	$2,800	
Subtotal:				**$18,150**	
ESTIMATED COST (YEARS 1 AND 2)					**$36,300**
YEARS 3 TO 6 - OPERATION AND MAINTENANCE COST					
O&M labor	Months	12	$1,000	$12,000	
GAC maintenance	LB	100	$1.50	$150	
Profile carbon, assumes 2 times includes analytical	EA	2	$400	$800	
Materials and equipment repair/replacement	LS	1	$1,000	$1,000	
Influent/midfluent/effluent analytical testing, estimated	LS	1	$1,000	$1,000	
Effluent discharge permit fee	LS	1	$400	$400	
Quarterly report	EA	4	$700	$2,800	
Subtotal:				**$18,150**	
ESTIMATED COST (YEARS 3 TO 6)					**$72,600**
YEARS 7 TO 10 - OPERATION AND MAINTENANCE COST					
O&M labor	Months	0	$1,000	$0	
GAC maintenance	LB	0	$1.50	$0	
Profile carbon, assumes 2 times includes analytical	EA	0	$400	$0	
Materials & equipment repair/replacement	LS	0	$1,000	$0	
Influent/midfluent/effluent analytical testing, estimated	LS	0	$1,000	$0	
Effluent discharge permit fee	LS	0	$400	$0	
Quarterly letter report	EA	0	$700	$0	
Subtotal:				**$0**	
ESTIMATED COST (YEARS 7 TO 10)					**$0**
TOTAL ESTIMATED OPERATION AND MAINTENANCE COST					**$108,900**

Table D-3A: Capital Cost, Alternative III - HRC Injection and Soil Vapor Extraction, Bentley Mall, Fairbanks, Alaska

DESCRIPTION	UNIT	QUANTITY	UNIT COST	SUBTOTAL	TOTAL
CAPITAL COST					
HRC Application					
Contractor mobilization	LS	1	$1,000	$1,000	
Baseline and batch pilot testing	LS	1	$5,000	$5,000	
Remdiation agent application design and coordination	LS	1	$5,000	$5,000	
Remedial agent material costs	LS	1	$75,000	$75,000	
HRC application via slurry injections probes	EA	288	$300	$86,400	
Subtotal:					**$172,400**
Soil Vapor Extraction System					
Equipment delivery/mobilization	LS	1	$1,000	$1,000	
Permits	LS	1	$3,000	$3,000	
Pilot testing	LS	1	$5,000	$5,000	
Vapor extraction well installation, 12 wells to 10 ft depth	EA	12	$1,000	$12,000	
System blower w. controls	LS	2	$8,000.00	$16,000	
System GAC vessels w. fittings	EA	4	$3,500	$14,000	
Electrical installations	LS	2	$1,000	$2,000	
Treatment system compound housing	LS	2	$2,500	$5,000	
Installation and start-up testing	EA	2	$5,000	$10,000	
Saw-cut remove pavement (1,000 lf x 2 ft)	SF	2,000	$3	$5,000	
Trenching & stockpiling (6,000 cf x 115 lb/cf = 345 tons)	TON	345	$9	$3,105	
Piping/tubing, fittings and manifold	LF	1,000	$12	$12,000	
Backfill and compact trench (345 tons estimate)	TON	345	$12	$4,140	
Pave trench (2,000 sf)	SF	2,000	$3	$6,000	
Soil load, off-haul and dispose (345 tons estimate)	TON	345	$80	$27,600	
Debris load, off-haul and dispose (1,000 cf x 150 lb/cf = 75 tons)	TON	75	$10	$750	
Subtotal:					**$126,595**
Remediation and System Start-up Report					
Review data, QA/QC data, staff engineer/geologist	HR	10	$65	$650	
Review data, QA/QC data, senior engineer/geologist	HR	10	$100	$1,000	
Report preparation, staff engineer/geologist	HR	40	$65	$2,600	
Report preparation, senior engineer/geologist	HR	40	$100	$4,000	
Subtotal:					**$8,250**
SUBTOTAL					**$307,245**
Engineering / Design /Procurement (10% of subtotal)	%	0.10	$307,245	$30,725	
Project Oversight/Management (10% of subtotal)	%	0.10	$307,245	$30,725	
Contingency & change orders (20% of subtotal)	%	0.20	$307,245	$61,449	**$122,898**
TOTAL CAPITAL COST					**$430,143**

Notes:

(1) Treatment area is approximately 28,800 square feet (360 ft x 80 ft) inclusive of Quads #1, #2, #3 and #4

(2) Assume groundwater zone comprised of sand to gravelly sand

(3) HRC application over a grid with injection points spaced at 10-foot centers and 20 rows over the treatment area

(4) HRC Injection points via drill rig to 30 feet depth

Table D-3B: Operation and Maintenance Cost, Alternative III - HRC Injection and Soil Vapor Extraction, Bentley Mall, Fairbanks, Alaska

DESCRIPTION	UNIT	QUANTITY	UNIT COST	ANNUAL	TOTAL
YEARS 1 AND 2 - OPERATION AND MAINTENANCE COST					
O&M labor	Months	12	$1,000	$12,000	
GAC maintenance costs	LBS	100	$1.50	$150	
Profile carbon, assumes 2 times includes analytical	EA	2	$400	$800	
Materials and equipment repair/replacement	LS	1	$1,000	$1,000	
Influent/midfluent/effluent analytical testing, estimated	LS	1	$1,000	$1,000	
Effluent discharge permit fee	LS	1	$400	$400	
Quarterly report	EA	4	$700	$2,800	
Subtotal:				**$18,150**	
ESTIMATED COST (YEARS 1 AND 2)					**$36,300**
YEARS 3 TO 6 - OPERATION AND MAINTENANCE COST					
O&M labor	Months	12	$1,000	$12,000	
GAC maintenance costs	LBS	100	$1.50	$150	
Profile carbon, assumes 2 times includes analytical	EA	2	$400	$800	
Materials and equipment repair/replacement	LS	1	$1,000	$1,000	
Influent/midfluent/effluent analytical testing, estimated	LS	1	$1,000	$1,000	
Effluent discharge permit fee	LS	1	$400	$400	
Quarterly report	EA	4	$700	$2,800	
Subtotal:				**$18,150**	
ESTIMATED COST (YEARS 3 TO 6)					**$72,600**
YEARS 7 TO 10 - OPERATION AND MAINTENANCE COST					
O&M labor	Months	0	$1,000	$0	
GAC maintenance costs	LB	0	$1.50	$0	
Profile carbon, assumes 2 times includes analytical	EA	0	$400	$0	
Materials & equipment repair/replacement	LS	0	$1,000	$0	
Influent/midfluent/effluent analytical testing, estimated	LS	0	$1,000	$0	
Effluent discharge permit fee	LS	0	$400	$0	
Quarterly letter report	EA	0	$700	$0	
Subtotal:				**$0**	
ESTIMATED COST (YEARS 7 TO 10)					**$0**
TOTAL ESTIMATED OPERATION AND MAINTENANCE COST					**$108,900**

Table D-1C: Groundwater Monitoring Cost, Alternative I,
Bentley Mall, Fairbanks, Alaska

DESCRIPTION	UNIT	# UNITS	UNIT COST	EVENT	ANNUAL	TOTAL
YEARS 1 TO 4 - QUARTERLY GROUNDWATER MONITORING						
Field Activities						
Pre-field activities	HR	2	$65	$130		
Depth-to-water & subjective evaluations	HR	2	$65	$130		
Groundwater sampling	HR	20	$65	$1,300		
Equipment and materials	LS	1	$200	$200		
Coordinate purge water disposal	HR	2	$65	$130		
Water disposal	LS	1	$800	$800		
Subtotal:				**$2,690**		
Laboratory Analyses						
VOCs (EPA Method 8260B)	EA	15	$200	$3,000		
Natural attenuation parameters	EA	15	$250	$3,750		
HRC-based reaction parameters	EA	0	$200	$0		
Subtotal:				**$6,750**		
Report Preparation						
Perform data validation	HR	2	$100	$200		
Document expenses	EA	1	$100	$100		
Prepare report drawings and tables	HR	8	$65	$520		
Prepare report	HR	10	$100	$1,000		
Subtotal:				**$1,820**		
GROUNDWATER MONITORING COST				**$11,260**	**$45,040**	**$180,160**
Semi-Annual Indoor Air Sampling						
Indoor air sampling & monitoring	LS	1	$1,000	$1,000		
Laboratory analyses for VOCs (TO-15)	EA	6	$250	$1,500		
Reporting	LS	2	$1,000	$2,000		
Subtotal:				**$4,500**		
INDOOR AIR MONITORING COST				**$4,500**	**$9,000**	**$36,000**
TOTAL ESTIMATED COST (YEARS 1 TO 4)						**$216,160**
YEARS 5, 6 AND 7 - SEMI-ANNUAL GROUNDWATER MONITORING						
Field Activities						
Pre-field activities	HR	2	$65	$130		
Depth-to-water & subjective evaluations	HR	2	$65	$130		
Groundwater sampling	HR	20	$65	$1,300		
Equipment and materials	LS	1	$200	$200		
Coordinate purge water disposal	HR	2	$65	$130		
Water disposal	LS	1	$800	$800		
Subtotal:				**$2,690**		
Laboratory Analyses						
VOCs (EPA Method 8260B)	EA	15	$200	$3,000		
Natural attenuation parameters	EA	15	$250	$3,750		
HRC-based reaction parameters	EA	0	$200	$0		
Subtotal:				**$6,750**		
Report Preparation						
Perform data validation	HR	2	$100	$200		
Document expenses	EA	1	$100	$100		
Prepare report drawings and tables	HR	8	$65	$520		
Prepare report	HR	10	$100	$1,000		
Subtotal:				**$1,820**		
GROUNDWATER MONITORING COST				**$11,260**	**$22,520**	**$67,560**
Semi-Annual Indoor Air Sampling						
Indoor air sampling & monitoring	LS	0	$1,000	$0		
Laboratory analyses for VOCs (TO-15)	EA	0	$250	$0		
Reporting	LS	0	$1,000	$0		
Subtotal:				**$0**		
INDOOR AIR MONITORING COST				**$0**	**$0**	**$0**
TOTAL ESTIMATED COST (YEARS 5, 6 AND 7)						**$67,560**

Table D-1C: Groundwater Monitoring Cost, Alternative I,
Bentley Mall, Fairbanks, Alaska

DESCRIPTION	UNIT	# UNITS	UNIT COST	EVENT	ANNUAL	TOTAL
YEARS 8 TO 12 - ANNUAL GROUNDWATER MONITORING						]
Field Activities						
Pre-field activities	HR	2	$65	$130		
Depth-to-water & subjective evaluations	HR	2	$65	$130		
Groundwater sampling	HR	20	$65	$1,300		
Equipment and materials	LS	1	$200	$200		
Coordinate purge water disposal	HR	2	$65	$130		
Water disposal	LS	1	$800	$800		
Subtotal:				**$2,690**		
Laboratory Analyses						
VOCs (EPA Method 8260B)	EA	15	$200	$3,000		
Natural attenuation parameters	EA	15	$250	$3,750		
HRC-based reaction parameters	EA	0	$200	$0		
Subtotal:				**$6,750**		
Report Preparation						
Perform data validation	HR	2	$100	$200		
Document expenses	EA	1	$100	$100		
Prepare report drawings and tables	HR	8	$65	$520		
Prepare report	HR	10	$100	$1,000		
Subtotal:				**$1,820**		
GROUNDWATER MONITORING COST				**$11,260**	**$11,260**	**$56,300**
Semi-Annual Indoor Air Sampling						
Indoor air sampling & monitoring	LS	0	$1,000	$0		
Laboratory analyses for VOCs (TO-15)	EA	0	$250	$0		
Reporting	LS	0	$1,000	$0		
Subtotal:				**$0**		
INDOOR AIR MONITORING COST				**$0**	**$0**	**$0**
TOTAL ESTIMATED COST (YEARS 8 TO 12)						**$56,300**
YEARS 13 TO 30 - BI-ANNUAL GROUNDWATER MONITORING						
Field Activities						
Pre-field activities	HR	2	$65	$130		
Depth-to-water & subjective evaluations	HR	2	$65	$130		
Groundwater sampling	HR	20	$65	$1,300		
Equipment and materials	LS	1	$200	$200		
Coordinate purge water disposal	HR	2	$65	$130		
Water disposal	LS	1	$800	$800		
Subtotal:				**$2,690**		
Laboratory Analyses						
VOCs (EPA Method 8260B)	EA	15	$200	$3,000		
Natural attenuation parameters	EA	15	$250	$3,750		
HRC-based reaction parameters	EA	0	$200	$0		
Subtotal:				**$6,750**		
Report Preparation						
Perform data validation	HR	2	$100	$200		
Document expenses	EA	1	$100	$100		
Prepare report drawings and tables	HR	8	$65	$520		
Prepare report	HR	10	$100	$1,000		
Subtotal:				**$1,820**		
GROUNDWATER MONITORING COST				**$11,260**	**$5,630**	**$101,340**
Semi-Annual Indoor Air Sampling						
Indoor air sampling & monitoring	LS	0	$1,000	$0		
Laboratory analyses for VOCs (TO-15)	EA	0	$250	$0		
Reporting	LS	0	$1,000	$0		
Subtotal:				**$0**		
INDOOR AIR MONITORING COST				**$0**	**$0**	**$0**
TOTAL ESTIMATED COST (YEARS 13 TO 30)						**$101,340**
TOTAL MONITORING COST (30 YEARS)						**$441,360**

Table D-1C: Groundwater Monitoring Cost, Alternative I,
Bentley Mall, Fairbanks, Alaska

DESCRIPTION	UNIT	# UNITS	UNIT COST	EVENT	ANNUAL	TOTAL

TABLE NOTES:

(1) Assumes 15 groundwater samples per event including groundwater monitoring well (on-site and off-site) samples and quality assurance/quality control (QA/QC: trip blank, trip blank, duplicate) samples

(2) Assumes indoor-air sampling for a total of 6 air samples including QA/QC samples

(3) Assumes a 30-year program of groundwater monitoring including indoor-air monitoring during the first 4-years:
Years 1 to 4: Quarterly groundwater monitoring and semi-annual indoor-air sampling
Years 5 to 7: Semi-annual groundwater monitoring with no indoor-air sampling
Years 8 to 12: Annual groundwater monitoring with no indoor air-sampling
Years 13 to 30: Bi-annual groundwater monitoring with no indoor air-sampling

4) Assume laboratory analyses of air and groundwater samples for volatile organic compounds (VOCs):
Groundwater samples: EPA Method 8260B @$200 per sample
Air samples: EPA T015 @$250 per sample

5) Assume field parameters to be measured during groundwater sampling:
Temperature, pH, dissolved oxygen and conductivity

5) Assume laboratory analyses of groundwater samples for natural attenuation parameters:
Nitrate/nitrite, manganese, ferrous iron, sulfate, carbon dioxide, alkalinity, redox potential, chloride and total dissolved solids: @$250 per sample

6) Assume laboratory analyses of groundwater samples for HRC-based enhancement of reductive dechlorination monitoring parameters:
Total organic carbon, metabolic acids (lactic, pyruvic, acetic, proponic, and butyric) for HRC-based electron donor parameters and carbon dioxide, methane, ethane and ethene for end-product dissolved gases: @$200 per sample

7) Assumes contingency and change orders percentage of 2% (0.02) per event

**Table D-1C: Groundwater Monitoring Cost, Alternative I,
Bentley Mall, Fairbanks, Alaska**

DESCRIPTION	UNIT	# UNITS	UNIT COST	EVENT	ANNUAL $	TOTAL $
YEARS 1 TO 4 - QUARTERLY GROUNDWATER MONITORING						
Field Activities	LS	1	$2,690	$2,690		
Laboratory Analyses	LS	1	$6,750	$6,750		
Report Preparation	LS	1	$1,820	$1,820		
GROUNDWATER MONITORING COST				$11,260	**$45,040**	**$180,160**
INDOOR AIR MONITORING COST	LS	1	$4,500	$4,500	**$9,000**	**$36,000**
TOTAL ESTIMATED COST (YEARS 1 TO 4)						**$216,160**
YEARS 5, 6 AND 7 - SEMI-ANNUAL GROUNDWATER MONITORING						
Field Activities	LS	1	$2,690	$2,690		
Laboratory Analyses	LS	1	$6,750	$6,750		
Report Preparation	LS	1	$1,820	$1,820		
GROUNDWATER MONITORING COST				$11,260	**$22,520**	**$67,560**
INDOOR AIR MONITORING COST	LS	1	$0	$0	**$0**	**$0**
TOTAL ESTIMATED COST (YEARS 5, 6 AND 7)						**$67,560**
YEARS 8 TO 12 - ANNUAL GROUNDWATER MONITORING						
Field Activities	LS	1	$2,690	$2,690		
Laboratory Analyses	LS	1	$6,750	$6,750		
Report Preparation	LS	1	$1,820	$1,820		
GROUNDWATER MONITORING COST				$11,260	**$11,260**	**$56,300**
INDOOR AIR MONITORING COST	LS	1	$0	$0	**$0**	**$0**
TOTAL ESTIMATED COST (YEARS 8 TO 12)						**$56,300**
YEARS 13 TO 30 - BI-ANNUAL GROUNDWATER MONITORING						
Field Activities	LS	1	$2,690	$2,690		
Laboratory Analyses	LS	1	$6,750	$6,750		
Report Preparation	LS	1	$1,820	$1,820		
GROUNDWATER MONITORING COST				$11,260	**$5,630**	**$101,340**
INDOOR AIR MONITORING COST	LS	1	$0	$0	**$0**	**$0**
TOTAL ESTIMATED COST (YEARS 13 TO 30)						**$101,340**
TOTAL MONITORING COST (30 YEARS)						**$441,360**

TABLE NOTES:

(1) Assumes 15 groundwater samples per event including groundwater monitoring well (on-site and off-site) samples and quality assurance/quality control (QA/QC: trip blank, trip blank, duplicate) samples

(2) Assumes indoor-air sampling for a total of 6 air samples including QA/QC samples

(3) Assumes a 30-year program of groundwater monitoring including indoor-air monitoring during the first 4-years:
Years 1 to 4: Quarterly groundwater monitoring and semi-annual indoor-air sampling
Years 5 to 7: Semi-annual groundwater monitoring with no indoor-air sampling
Years 8 to 12: Annual groundwater monitoring with no indoor air-sampling
Years 13 to 30: Bi-annual groundwater monitoring with no indoor air-sampling

4) Assume laboratory analyses of air and groundwater samples for volatile organic compounds (VOCs):
Groundwater samples: EPA Method 8260B @$200 per sample
Air samples: EPA T015 @$250 per sample

5) Assume field parameters to be measured during groundwater sampling:
Temperature, pH, dissolved oxygen and conductivity

5) Assume laboratory analyses of groundwater samples for natural attenuation parameters:
Nitrate/nitrite, manganese, ferrous iron, sulfate, carbon dioxide, alkalinity, redox potential, chloride and total dissolved solids: @$250 per sample

6) Assume laboratory analyses of groundwater samples for HRC-based enhancement of reductive dechlorination monitoring parameters:
Total organic carbon, metabolic acids (lactic, pyruvic, acetic, proponic, and butyric) for HRC-based electron donor parameters and carbon dioxide, methane, ethane and ethene for end-product dissolved gases: @$200 per sample

7) Assumes contingency and change orders percentage of 2% (0.02) per event

Table D-2C: Groundwater Monitoring Cost, Alternative II, Bentley Mall, Fairbanks, Alaska

DESCRIPTION	UNIT	# UNITS	UNIT COST	EVENT	ANNUAL	TOTAL
YEARS 1 TO 4 - QUARTERLY GROUNDWATER MONITORING						
Field Activities						
Pre-field activities	HR	2	$65	$130		
Depth-to-water & subjective evaluations	HR	2	$65	$130		
Groundwater sampling	HR	20	$65	$1,300		
Equipment and materials	LS	1	$200	$200		
Coordinate purge water disposal	HR	2	$65	$130		
Water disposal	LS	1	$800	$800		
Subtotal:				**$2,690**		
Laboratory Analyses						
VOCs (EPA Method 8260B)	EA	15	$200	$3,000		
Natural attenuation parameters	EA	15	$250	$3,750		
HRC-based reaction parameters	EA	0	$200	$0		
Subtotal:				**$6,750**		
Report Preparation						
Perform data validation	HR	2	$100	$200		
Document expenses	EA	1	$100	$100		
Prepare report drawings and tables	HR	8	$65	$520		
Prepare report	HR	10	$100	$1,000		
Subtotal:				**$1,820**		
GROUNDWATER MONITORING COST				**$11,260**	**$45,040**	**$180,160**
Semi-Annual Indoor Air Sampling						
Indoor air sampling & monitoring	LS	1	$1,000	$1,000		
Laboratory analyses for VOCs (TO-15)	EA	6	$250	$1,500		
Reporting	LS	2	$1,000	$2,000		
Subtotal:				**$4,500**		
INDOOR AIR MONITORING COST				**$4,500**	**$9,000**	**$36,000**
TOTAL ESTIMATED COST (YEARS 1 TO 4)						**$216,160**
YEARS 5, 6 AND 7 - SEMI-ANNUAL GROUNDWATER MONITORING						
Field Activities						
Pre-field activities	HR	2	$65	$130		
Depth-to-water & subjective evaluations	HR	2	$65	$130		
Groundwater sampling	HR	20	$65	$1,300		
Equipment and materials	LS	1	$200	$200		
Coordinate purge water disposal	HR	2	$65	$130		
Water disposal	LS	1	$800	$800		
Subtotal:				**$2,690**		
Laboratory Analyses						
VOCs (EPA Method 8260B)	EA	15	$200	$3,000		
Natural attenuation parameters	EA	15	$250	$3,750		
HRC-based reaction parameters	EA	0	$200	$0		
Subtotal:				**$6,750**		
Report Preparation						
Perform data validation	HR	2	$100	$200		
Document expenses	EA	1	$100	$100		
Prepare report drawings and tables	HR	8	$65	$520		
Prepare report	HR	10	$100	$1,000		
Subtotal:				**$1,820**		
GROUNDWATER MONITORING COST				**$11,260**	**$22,520**	**$67,560**
Semi-Annual Indoor Air Sampling						
Indoor air sampling & monitoring	LS	0	$1,000	$0		
Laboratory analyses for VOCs (TO-15)	EA	0	$250	$0		
Reporting	LS	0	$1,000	$0		
Subtotal:				**$0**		
INDOOR AIR MONITORING COST				**$0**	**$0**	**$0**
TOTAL ESTIMATED COST (YEARS 5, 6 AND 7)						**$67,560**

Table D-2C: Groundwater Monitoring Cost, Alternative II, Bentley Mall, Fairbanks, Alaska

DESCRIPTION	UNIT	# UNITS	UNIT COST	EVENT	ANNUAL	TOTAL
YEARS 8 TO 12 - ANNUAL GROUNDWATER MONITORING						]
Field Activities						
Pre-field activities	HR	2	$65	$130		
Depth-to-water & subjective evaluations	HR	2	$65	$130		
Groundwater sampling	HR	20	$65	$1,300		
Equipment and materials	LS	1	$200	$200		
Coordinate purge water disposal	HR	2	$65	$130		
Water disposal	LS	1	$800	$800		
Subtotal:				**$2,690**		
Laboratory Analyses						
VOCs (EPA Method 8260B)	EA	15	$200	$3,000		
Natural attenuation parameters	EA	15	$250	$3,750		
HRC-based reaction parameters	EA	0	$200	$0		
Subtotal:				**$6,750**		
Report Preparation						
Perform data validation	HR	2	$100	$200		
Document expenses	EA	1	$100	$100		
Prepare report drawings and tables	HR	8	$65	$520		
Prepare report	HR	10	$100	$1,000		
Subtotal:				**$1,820**		
GROUNDWATER MONITORING COST				**$11,260**	**$11,260**	**$56,300**
Semi-Annual Indoor Air Sampling						
Indoor air sampling & monitoring	LS	0	$1,000	$0		
Laboratory analyses for VOCs (TO-15)	EA	0	$250	$0		
Reporting	LS	0	$1,000	$0		
Subtotal:				**$0**		
INDOOR AIR MONITORING COST				**$0**	**$0**	**$0**
TOTAL ESTIMATED COST (YEARS 8 TO 12)						**$56,300**
YEARS 13 TO 30 - BI-ANNUAL GROUNDWATER MONITORING						
Field Activities						
Pre-field activities	HR	2	$65	$130		
Depth-to-water & subjective evaluations	HR	2	$65	$130		
Groundwater sampling	HR	20	$65	$1,300		
Equipment and materials	LS	1	$200	$200		
Coordinate purge water disposal	HR	2	$65	$130		
Water disposal	LS	1	$800	$800		
Subtotal:				**$2,690**		
Laboratory Analyses						
VOCs (EPA Method 8260B)	EA	15	$200	$3,000		
Natural attenuation parameters	EA	15	$250	$3,750		
HRC-based reaction parameters	EA	0	$200	$0		
Subtotal:				**$6,750**		
Report Preparation						
Perform data validation	HR	2	$100	$200		
Document expenses	EA	1	$100	$100		
Prepare report drawings and tables	HR	8	$65	$520		
Prepare report	HR	10	$100	$1,000		
Subtotal:				**$1,820**		
GROUNDWATER MONITORING COST				**$11,260**	**$5,630**	**$101,340**
Semi-Annual Indoor Air Sampling						
Indoor air sampling & monitoring	LS	0	$1,000	$0		
Laboratory analyses for VOCs (TO-15)	EA	0	$250	$0		
Reporting	LS	0	$1,000	$0		
Subtotal:				**$0**		
INDOOR AIR MONITORING COST				**$0**	**$0**	**$0**
TOTAL ESTIMATED COST (YEARS 13 TO 30)						**$101,340**
TOTAL MONITORING COST (30 YEARS)						**$441,360**

Table D-2C: Groundwater Monitoring Cost, Alternative II, Bentley Mall, Fairbanks, Alaska

DESCRIPTION	UNIT	# UNITS	UNIT COST	EVENT	ANNUAL	TOTAL

TABLE NOTES:

(1) Assumes 15 groundwater samples per event including groundwater monitoring well (on-site and off-site) samples and quality assurance/quality control (QA/QC: trip blank, trip blank, duplicate) samples

(2) Assumes indoor-air sampling for a total of 6 air samples including QA/QC samples

(3) Assumes a 30-year program of groundwater monitoring including indoor-air monitoring during the first 4-years:
Years 1 to 4: Quarterly groundwater monitoring and semi-annual indoor-air sampling
Years 5 to 7: Semi-annual groundwater monitoring with no indoor-air sampling
Years 8 to 12: Annual groundwater monitoring with no indoor air-sampling
Years 13 to 30: Bi-annual groundwater monitoring with no indoor air-sampling

4) Assume laboratory analyses of air and groundwater samples for volatile organic compounds (VOCs):
Groundwater samples: EPA Method 8260B @$200 per sample
Air samples: EPA T015 @$250 per sample

5) Assume field parameters to be measured during groundwater sampling:
Temperature, pH, dissolved oxygen and conductivity

5) Assume laboratory analyses of groundwater samples for natural attenuation parameters:
Nitrate/nitrite, manganese, ferrous iron, sulfate, carbon dioxide, alkalinity, redox potential, chloride and total dissolved solids: @$250 per sample

6) Assume laboratory analyses of groundwater samples for HRC-based enhancement of reductive dechlorination monitoring parameters:
Total organic carbon, metabolic acids (lactic, pyruvic, acetic, proponic, and butyric) for HRC-based electron donor parameters and carbon dioxide, methane, ethane and ethene for end-product dissolved gases: @$200 per sample

7) Assumes contingency and change orders percentage of 2% (0.02) per event

Table D-2C: Groundwater Monitoring Cost, Alternative II,
Bentley Mall, Fairbanks, Alaska

DESCRIPTION	UNIT	# UNITS	UNIT COST	EVENT	ANNUAL $	TOTAL $
YEARS 1 TO 4 - QUARTERLY GROUNDWATER MONITORING						
Field Activities	LS	1	$2,690	$2,690		
Laboratory Analyses	LS	1	$6,750	$6,750		
Report Preparation	LS	1	$1,820	$1,820		
GROUNDWATER MONITORING COST				$11,260	**$45,040**	**$180,160**
INDOOR AIR MONITORING COST	LS	1	$4,500	$4,500	**$9,000**	**$36,000**
TOTAL ESTIMATED COST (YEARS 1 TO 4)						**$216,160**
YEARS 5, 6 AND 7 - SEMI-ANNUAL GROUNDWATER MONITORING						
Field Activities	LS	1	$2,690	$2,690		
Laboratory Analyses	LS	1	$6,750	$6,750		
Report Preparation	LS	1	$1,820	$1,820		
GROUNDWATER MONITORING COST				$11,260	**$22,520**	**$67,560**
INDOOR AIR MONITORING COST	LS	1	$0	$0	**$0**	**$0**
TOTAL ESTIMATED COST (YEARS 5, 6 AND 7)						**$67,560**
YEARS 8 TO 12 - ANNUAL GROUNDWATER MONITORING						
Field Activities	LS	1	$2,690	$2,690		
Laboratory Analyses	LS	1	$6,750	$6,750		
Report Preparation	LS	1	$1,820	$1,820		
GROUNDWATER MONITORING COST				$11,260	**$11,260**	**$56,300**
INDOOR AIR MONITORING COST	LS	1	$0	$0	**$0**	**$0**
TOTAL ESTIMATED COST (YEARS 8 TO 12)						**$56,300**
YEARS 13 TO 30 - BI-ANNUAL GROUNDWATER MONITORING						
Field Activities	LS	1	$2,690	$2,690		
Laboratory Analyses	LS	1	$6,750	$6,750		
Report Preparation	LS	1	$1,820	$1,820		
GROUNDWATER MONITORING COST				$11,260	**$5,630**	**$101,340**
INDOOR AIR MONITORING COST	LS	1	$0	$0	**$0**	**$0**
TOTAL ESTIMATED COST (YEARS 13 TO 30)						**$101,340**
TOTAL MONITORING COST (30 YEARS)						**$441,360**

TABLE NOTES:

(1) Assumes 15 groundwater samples per event including groundwater monitoring well (on-site and off-site) samples and quality assurance/quality control (QA/QC: trip blank, trip blank, duplicate) samples

(2) Assumes indoor-air sampling for a total of 6 air samples including QA/QC samples

(3) Assumes a 30-year program of groundwater monitoring including indoor-air monitoring during the first 4-years:
Years 1 to 4: Quarterly groundwater monitoring and semi-annual indoor-air sampling
Years 5 to 7: Semi-annual groundwater monitoring with no indoor-air sampling
Years 8 to 12: Annual groundwater monitoring with no indoor air-sampling
Years 13 to 30: Bi-annual groundwater monitoring with no indoor air-sampling

4) Assume laboratory analyses of air and groundwater samples for volatile organic compounds (VOCs):
Groundwater samples: EPA Method 8260B @$200 per sample
Air samples: EPA T015 @$250 per sample

5) Assume field parameters to be measured during groundwater sampling:
Temperature, pH, dissolved oxygen and conductivity

5) Assume laboratory analyses of groundwater samples for natural attenuation parameters:
Nitrate/nitrite, manganese, ferrous iron, sulfate, carbon dioxide, alkalinity, redox potential, chloride and total dissolved solids: @$250 per sample

6) Assume laboratory analyses of groundwater samples for HRC-based enhancement of reductive dechlorination monitoring parameters:
Total organic carbon, metabolic acids (lactic, pyruvic, acetic, proponic, and butyric) for HRC-based electron donor parameters and carbon dioxide, methane, ethane and ethene for end-product dissolved gases: @$200 per sample

7) Assumes contingency and change orders percentage of 2% (0.02) per event

Table D-3C: Groundwater Monitoring Cost, Alternative III,
Bentley Mall, Fairbanks, Alaska

DESCRIPTION	UNIT	# UNITS	UNIT COST	EVENT	ANNUAL	TOTAL
YEARS 1 TO 4 - QUARTERLY GROUNDWATER MONITORING						
Field Activities						
Pre-field activities	HR	2	$65	$130		
Depth-to-water & subjective evaluations	HR	2	$65	$130		
Groundwater sampling	HR	20	$65	$1,300		
Equipment and materials	LS	1	$200	$200		
Coordinate purge water disposal	HR	2	$65	$130		
Water disposal	LS	1	$800	$800		
Subtotal:				**$2,690**		
Laboratory Analyses						
VOCs (EPA Method 8260B)	EA	15	$200	$3,000		
Natural attenuation parameters	EA	15	$250	$3,750		
HRC-based reaction parameters	EA	15	$200	$3,000		
Subtotal:				**$9,750**		
Report Preparation						
Perform data validation	HR	2	$100	$200		
Document expenses	EA	1	$100	$100		
Prepare report drawings and tables	HR	8	$65	$520		
Prepare report	HR	10	$100	$1,000		
Subtotal:				**$1,820**		
GROUNDWATER MONITORING COST				**$14,260**	**$57,040**	**$228,160**
Semi-Annual Indoor Air Sampling						
Indoor air sampling & monitoring	LS	1	$1,000	$1,000		
Laboratory analyses for VOCs (TO-15)	EA	6	$250	$1,500		
Reporting	LS	2	$1,000	$2,000		
Subtotal:				**$4,500**		
INDOOR AIR MONITORING COST				**$4,500**	**$9,000**	**$36,000**
TOTAL ESTIMATED COST (YEARS 1 TO 4)						**$264,160**
YEARS 5, 6 AND 7 - SEMI-ANNUAL GROUNDWATER MONITORING						
Field Activities						
Pre-field activities	HR	2	$65	$130		
Depth-to-water & subjective evaluations	HR	2	$65	$130		
Groundwater sampling	HR	20	$65	$1,300		
Equipment and materials	LS	1	$200	$200		
Coordinate purge water disposal	HR	2	$65	$130		
Water disposal	LS	1	$800	$800		
Subtotal:				**$2,690**		
Laboratory Analyses						
VOCs (EPA Method 8260B)	EA	15	$200	$3,000		
Natural attenuation parameters	EA	15	$250	$3,750		
HRC-based reaction parameters	EA	15	$200	$3,000		
Subtotal:				**$9,750**		
Report Preparation						
Perform data validation	HR	2	$100	$200		
Document expenses	EA	1	$100	$100		
Prepare report drawings and tables	HR	8	$65	$520		
Prepare report	HR	10	$100	$1,000		
Subtotal:				**$1,820**		
GROUNDWATER MONITORING COST				**$14,260**	**$28,520**	**$85,560**
Semi-Annual Indoor Air Sampling						
Indoor air sampling & monitoring	LS	0	$1,000	$0		
Laboratory analyses for VOCs (TO-15)	EA	0	$250	$0		
Reporting	LS	0	$1,000	$0		
Subtotal:				**$0**		
INDOOR AIR MONITORING COST				**$0**	**$0**	**$0**
TOTAL ESTIMATED COST (YEARS 5, 6 AND 7)						**$85,560**

Table D-3C: Groundwater Monitoring Cost, Alternative III,
Bentley Mall, Fairbanks, Alaska

DESCRIPTION	UNIT	# UNITS	UNIT COST	EVENT	ANNUAL	TOTAL
YEARS 8 TO 12 - ANNUAL GROUNDWATER MONITORING						
Field Activities						
Pre-field activities	HR	2	$65	$130		
Depth-to-water & subjective evaluations	HR	2	$65	$130		
Groundwater sampling	HR	20	$65	$1,300		
Equipment and materials	LS	1	$200	$200		
Coordinate purge water disposal	HR	2	$65	$130		
Water disposal	LS	1	$800	$800		
Subtotal:				**$2,690**		
Laboratory Analyses						
VOCs (EPA Method 8260B)	EA	15	$200	$3,000		
Natural attenuation parameters	EA	15	$250	$3,750		
HRC-based reaction parameters	EA	15	$200	$3,000		
Subtotal:				**$9,750**		
Report Preparation						
Perform data validation	HR	2	$100	$200		
Document expenses	EA	1	$100	$100		
Prepare report drawings and tables	HR	8	$65	$520		
Prepare report	HR	10	$100	$1,000		
Subtotal:				**$1,820**		
GROUNDWATER MONITORING COST				**$14,260**	**$14,260**	**$71,300**
Semi-Annual Indoor Air Sampling						
Indoor air sampling & monitoring	LS	0	$1,000	$0		
Laboratory analyses for VOCs (TO-15)	EA	0	$250	$0		
Reporting	LS	0	$1,000	$0		
Subtotal:				**$0**		
INDOOR AIR MONITORING COST				**$0**	**$0**	**$0**
TOTAL ESTIMATED COST (YEARS 8 TO 12)						**$71,300**
YEARS 13 TO 30 - BI-ANNUAL GROUNDWATER MONITORING						
Field Activities						
Pre-field activities	HR	2	$65	$130		
Depth-to-water & subjective evaluations	HR	2	$65	$130		
Groundwater sampling	HR	20	$65	$1,300		
Equipment and materials	LS	1	$200	$200		
Coordinate purge water disposal	HR	2	$65	$130		
Water disposal	LS	1	$800	$800		
Subtotal:				**$2,690**		
Laboratory Analyses						
VOCs (EPA Method 8260B)	EA	15	$200	$3,000		
Natural attenuation parameters	EA	15	$250	$3,750		
HRC-based reaction parameters	EA	15	$200	$3,000		
Subtotal:				**$9,750**		
Report Preparation						
Perform data validation	HR	2	$100	$200		
Document expenses	EA	1	$100	$100		
Prepare report drawings and tables	HR	8	$65	$520		
Prepare report	HR	10	$100	$1,000		
Subtotal:				**$1,820**		
GROUNDWATER MONITORING COST				**$14,260**	**$7,130**	**$128,340**
Semi-Annual Indoor Air Sampling						
Indoor air sampling & monitoring	LS	0	$1,000	$0		
Laboratory analyses for VOCs (TO-15)	EA	0	$250	$0		
Reporting	LS	0	$1,000	$0		
Subtotal:				**$0**		
INDOOR AIR MONITORING COST				**$0**	**$0**	**$0**
TOTAL ESTIMATED COST (YEARS 13 TO 30)						**$128,340**
TOTAL MONITORING COST (30 YEARS)						**$549,360**

Table D-3C: Groundwater Monitoring Cost, Alternative III,
Bentley Mall, Fairbanks, Alaska

DESCRIPTION	UNIT	# UNITS	UNIT COST	EVENT	ANNUAL	TOTAL

TABLE NOTES:

(1) Assumes 15 groundwater samples per event including groundwater monitoring well (on-site and off-site) samples and quality assurance/quality control (QA/QC: trip blank, trip blank, duplicate) samples

(2) Assumes indoor-air sampling for a total of 6 air samples including QA/QC samples

(3) Assumes a 30-year program of groundwater monitoring including indoor-air monitoring during the first 4-years:
Years 1 to 4: Quarterly groundwater monitoring and semi-annual indoor-air sampling
Years 5 to 7: Semi-annual groundwater monitoring with no indoor-air sampling
Years 8 to 12: Annual groundwater monitoring with no indoor air-sampling
Years 13 to 30: Bi-annual groundwater monitoring with no indoor air-sampling

4) Assume laboratory analyses of air and groundwater samples for volatile organic compounds (VOCs):
Groundwater samples: EPA Method 8260B @$200 per sample
Air samples: EPA T015 @$250 per sample

5) Assume field parameters to be measured during groundwater sampling:
Temperature, pH, dissolved oxygen and conductivity

5) Assume laboratory analyses of groundwater samples for natural attenuation parameters:
Nitrate/nitrite, manganese, ferrous iron, sulfate, carbon dioxide, alkalinity, redox potential, chloride and total dissolved solids: @$250 per sample

6) Assume laboratory analyses of groundwater samples for HRC-based enhancement of reductive dechlorination monitoring parameters:
Total organic carbon, metabolic acids (lactic, pyruvic, acetic, proponic, and butyric) for HRC-based electron donor parameters and carbon dioxide, methane, ethane and ethene for end-product dissolved gases: @$200 per sample

7) Assumes contingency and change orders percentage of 2% (0.02) per event

Table D-3C: Groundwater Monitoring Cost, Alternative III,
Bentley Mall, Fairbanks, Alaska

DESCRIPTION	UNIT	# UNITS	UNIT COST	EVENT	ANNUAL $	TOTAL $
YEARS 1 TO 4 - QUARTERLY GROUNDWATER MONITORING						
Field Activities	LS	1	$2,690	$2,690		
Laboratory Analyses	LS	1	$9,750	$9,750		
Report Preparation	LS	1	$1,820	$1,820		
GROUNDWATER MONITORING COST				$14,260	**$57,040**	**$228,160**
INDOOR AIR MONITORING COST	LS	1	$4,500	$4,500	**$9,000**	**$36,000**
TOTAL ESTIMATED COST (YEARS 1 TO 4)						**$264,160**
YEARS 5, 6 AND 7 - SEMI-ANNUAL GROUNDWATER MONITORING						
Field Activities	LS	1	$2,690	$2,690		
Laboratory Analyses	LS	1	$9,750	$9,750		
Report Preparation	LS	1	$1,820	$1,820		
GROUNDWATER MONITORING COST				$14,260	**$28,520**	**$85,560**
INDOOR AIR MONITORING COST	LS	1	$0	$0	**$0**	**$0**
TOTAL ESTIMATED COST (YEARS 5, 6 AND 7)						**$85,560**
YEARS 8 TO 12 - ANNUAL GROUNDWATER MONITORING						
Field Activities	LS	1	$2,690	$2,690		
Laboratory Analyses	LS	1	$9,750	$9,750		
Report Preparation	LS	1	$1,820	$1,820		
GROUNDWATER MONITORING COST				$14,260	**$14,260**	**$71,300**
INDOOR AIR MONITORING COST	LS	1	$0	$0	**$0**	**$0**
TOTAL ESTIMATED COST (YEARS 8 TO 12)						**$71,300**
YEARS 13 TO 30 - BI-ANNUAL GROUNDWATER MONITORING						
Field Activities	LS	1	$2,690	$2,690		
Laboratory Analyses	LS	1	$9,750	$9,750		
Report Preparation	LS	1	$1,820	$1,820		
GROUNDWATER MONITORING COST				$14,260	**$7,130**	**$128,340**
INDOOR AIR MONITORING COST	LS	1	$0	$0	**$0**	**$0**
TOTAL ESTIMATED COST (YEARS 13 TO 30)						**$128,340**
TOTAL MONITORING COST (30 YEARS)						**$549,360**

TABLE NOTES:

(1) Assumes 15 groundwater samples per event including groundwater monitoring well (on-site and off-site) samples and quality assurance/quality control (QA/QC: trip blank, trip blank, duplicate) samples

(2) Assumes indoor-air sampling for a total of 6 air samples including QA/QC samples

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Years 13 to 30: Bi-annual groundwater monitoring with no indoor air-sampling

4) Assume laboratory analyses of air and groundwater samples for volatile organic compounds (VOCs):
Groundwater samples: EPA Method 8260B @$200 per sample
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5) Assume field parameters to be measured during groundwater sampling:
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5) Assume laboratory analyses of groundwater samples for natural attenuation parameters:
Nitrate/nitrite, manganese, ferrous iron, sulfate, carbon dioxide, alkalinity, redox potential, chloride and total dissolved solids: @$250 per sample

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Total organic carbon, metabolic acids (lactic, pyruvic, acetic, proponic, and butyric) for HRC-based electron donor parameters and carbon dioxide, methane, ethane and ethene for end-product dissolved gases: @$200 per sample

7) Assumes contingency and change orders percentage of 2% (0.02) per event