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Remediation Equipment Operation Completion Report Bentley Mall Fairbanks, Alaska

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REMEDIATION EQUIPMENT OPERATION COMPLETION REPORT

Bentley Mall
Fairbanks, Alaska

January 2011

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1.0 INTRODUCTION

Environmental Resource Group, Inc. (ERG) and CEECON Testing, Inc. (CEECON) have prepared this REMEDIATION EQUIPMENT OPERATION COMPLETION REPORT for the REMEDIATION SYSTEM installed at the Bentley Mall located at 32 College Road in Fairbanks, Alaska 99701 (**FIGURE 1, SITE VICINITY MAP, BENTLEY, FAIRBANKS, ALASKA**). This report evaluates the remediation progress of the air-sparge and vapor-extraction components of the Containerized Remediation Equipment (CRE), documents the reduction in levels of chlorinated compounds in soil and groundwater beneath this site, as well as ambient air quality data in two buildings located above the area of concern, and recommends Remediation Equipment Shutdown and continued groundwater monitoring at this site. This report was prepared pursuant to a request by Alaska Department of Environmental Conservation (ADEC) for a status report on the site remediation activities.

2.0 BACKGROUND

2.1 Site Description

The Bentley Mall complex is situated on an approximate 12 acre site located north of College Road near the intersection of College Road and the Old Steese Highway The site as depicted in the U.S. Geological Survey (USGS) Fairbanks D-2 (SE) quadrangle is located in the southwest ¼ of Section 2, Township 1 South, Range 1 West, Fairbanks Meridian. The Mall property includes several satellite buildings in addition to the main mall located in the Bentley Mall complex. The remaining portions of the site are paved. Nearby surface water bodies include Noyes Slough (0.1 miles to the south and west), and the Chena River (0.5 miles to the south).

2.2 History

The *Bentley Mall Site Characterization Report* dated April 2006, presented findings of contamination characteristics on Bentley Mall property and properties located hydraulically down-gradient from the site. The site investigation included evaluation of impacts to soil, groundwater, surface water, and evaluation of impacts affecting potential receptors such as water wells and buildings.

A contaminant plume consisting primarily of chlorinated volatile organic compounds tetrachlorethene (PCE), and the associated degradation product trichloroethene (TCE), was found to originate on Bentley Mall property in the vicinity of the East Satellite building with a trend to the west in the generalized direction of the groundwater flow (**Plate 5 Groundwater Monitoring Well Location Map, Bentley Mall, Alaska**). The on-going environmental investigation and treatment of impacted soil and groundwater at this site is referred to as the East Satellite Building Area, and is located in the southern portion of the

subject site. The East Satellite Building case is under the oversight of the Alaska Department of Environmental Conservation (ADEC).

In January 2006, Alaska Resources & Environmental Services (ARES) submitted to ADEC a Corrective Action Plan (CAP: *"Corrective Action Plan, Bentley Mall, Fairbanks, Alaska"*) to begin remediation efforts at the East Satellite Building Area. This CAP documented the results of laboratory analysis of soil and groundwater samples, indoor air sampling, and soil-gas surveys completed in August 2003 and June 2004 in the south portion of the Bentley Mall. Three remedial alternatives were evaluated in the CAP and the most feasible and economic alternative selected was air-sparging and vapor extraction. ADEC issued a conditional approval of the CAP via a letter dated May 3, 2006, *"Approval of Site Characterization and Corrective Action Reports, Bentley Mall East Satellite Building, Fairbanks, Alaska."* A workplan for the CAP implementation was subsequently issued to ADEC in June 2006, *"Remedial Action Workplan, Bentley Mall, Fairbanks, Alaska."* Approval to proceed with the workplan was issued by ADEC in June 2006.

In accordance with the WORKPLAN submitted in June 2006, a Remediation System was installed in September 2006. The CRE consisted of a total of 16 air sparge wells, and nine vapor extraction wells along with associated underground piping and wiring. Operational characteristics of the remedial system were detailed in the *Air-Sparging and Vapor-Extraction System Installation and Start-Up Report* dated January 2007. A summary of other environmental investigations previously performed on this site is also included in the January 2007 Report.

3.0 CORRECTIVE ACTION

The treatment area for the air-sparging system and vapor-extraction system encompasses the East Satellite and Wells Fargo Bank Buildings in the southern portion of the parking lot for the Bentley Mall, an area of approximately 120,000 square feet (**FIGURE 2, BENTLEY MALL SVE SYSTEM LAYOUT 2010**). The treatment area is underlain by soil and groundwater impacted by PCE and TCE.

Air sparging involves the injection of air, and possibly a mixture of ozone, air, or other constituents capable of enhancing the degradation of chlorinated solvents dissolved in groundwater beneath the subject site. The mixture is injected via sparging wells into the contaminated water-bearing zone. The injected air mixture traverses horizontally and vertically via interstitial channels through the soil column. The three (3) main mechanisms for contaminant removal during sparging are believed to be: 1) in-situ stripping of dissolved volatile organic compounds, 2) volatilization of dissolved and adsorbed contaminants below the water table and in the overlying soil, and 3) aerobic and anaerobic biodegradation of contaminants enhanced by the injection of the mixture. When this action creates an underground 'air stripper' that removes volatile contaminants in the saturated zone as well as

in the overlying unsaturated zone, it makes the contaminants more readily available for extraction using the vapor-extraction portion of the remediation system.

Vapor extraction is used in conjunction with air sparging to mitigate soil vapor and treat the soils above the saturated zone. In vapor extraction, a vacuum is applied to the soil above the saturated zone along vertical extraction wells. The applied vacuum controls the subsurface flow of air and removes volatile contaminants. The extracted vapor is treated above-ground by an abatement unit prior to discharge to the atmosphere.

Between June and December 2006, 16 sparge wells, 9 vapor extraction wells, and 5 vapor monitoring wells were installed at this site. Containerized Remediation Equipment (CRE) was installed at this site for the purposes of Pilot Performance Testing. The CRE contained air-sparging and vapor-extraction equipment, and conveyance piping was installed to connect the recently installed wells to the CRE.

Pilot Performance Testing initial results and operational data for the CRE were described in the *Performance Evaluation Report* dated May 2008. A description of the remediation equipment installed on this site, including remediation system operation, was detailed in that report.

Remediation had progressed well on this project in that reductions were seen in chlorinated hydrocarbon concentrations in groundwater, in ambient air sampled in on-site buildings, and in vapor extracted from beneath the site. Subsequent to this report, an area of concern was identified near the College Road entryway where the addition of two vapor-extraction wells was proposed. A *Remediation Progress Report* dated April 2010 was prepared to evaluate the performance of the air-sparge and vapor-extraction components of the Containerized Remediation Equipment (CRE), and to document the reduction in levels of chlorinated compounds in soil and groundwater beneath this site, as well as improvements in ambient air quality in two buildings located above the area of concern.

The *Remediation Progress Report* also documented the installation of the two proposed additional vapor-extraction wells, the subsurface connection of these wells, and the connection of existing vapor-monitoring well VMF to the remediation system. The designation of VMF was changed to VE-12 after it was connected to the operating VES. Additionally, two minor sections of the VES plumbing were disconnected, to improve the integrity and reliability of VES plumbing. Also, improvements in groundwater quality in the eastern portion of the site diminished the usefulness of the two removed sections of the VES.

4.0 CHLORINATED COMPOUND LEVEL IN PASSIVE SOIL-GAS

In October 2010, ERG coordinated with Beacon Environmental Services (BEACON) to collect and analyze passive soil-gas (PSG) samples from the Bentley Mall and along Noyes Street to the west of the Bentley Mall. The results of this work were summarized in a report

by ERG (Passive Soil-Gas and Indoor Air Survey Report, January 2011), and compared to baseline readings from similar work performed prior to implementation of remediation work (ARES, April 2006).

The investigation results indicate an approximately 84% decrease in PCE and TCE when the PSG sampling results for October 2010 are compared to the baseline PGS sampling results for August 2003-June 2004. The PSG survey results provide evidence of source removal by remediation efforts with reduced PCE and TCE levels in subsurface soil in the southern portion of the Bentley Mall. PSG maps showing results for October 2010 (**Figure 4A and 4B**) and August 2003-June 2004 (**Figure 3A and 3B**) are attached for comparison.

5.0 CHLORINATED COMPOUND LEVEL IN AMBIENT AIR

Alaska Resources & Environmental Services (ARES) and ERG have performed indoor air monitoring associated with the historical release of chlorinated solvents into the groundwater at this site. The East Satellite Building and the Wells Fargo Bank were evaluated, both of which are located on Bentley Mall property. Samples were collected to monitor vapor intrusion levels and consisted of 24-hour time integrated samples. Sample results through December 2010 showed overall decreasing levels of both PCE and TCE compounds. In addition, all results of laboratory analysis of ambient air samples collected in December 2010 are below the ADEC/EPA threshold for indoor air in a commercial/industrial land use.

In October 2010, a ventilation system was installed in the crawl space below the floor slab of the Wells Fargo Bank building. Horizontal ducting was installed in the crawl space and attached to an electrical fan device in the mechanical room to ventilate the crawl space and discharge the exhaust out the wall to the exterior. Photographs and a summary of this work are attached in Appendix A. Improvements in indoor air ventilation of the East Satellite building have also contributed to air quality improvement in that building. A summary of indoor air sampling results through December of 2010 is shown below in **Table 1** and **Table 2**.

Table 1
Analytical Results of Indoor Air Samples,
East Satellite Building, Bentley Mall

Sample Location	Sample Date	PCE ($\mu g/m^3$)	TCE ($\mu g/m^3$)
ES-1	07/15/05	**15.0**	**1.4**
	06/13/06	**14**	ND <0.83
	02/20/07	**9.3**	ND <0.93
	01/30/08	3.2	0.054
	07/07/08	**13**	ND <0.39
	02/05/09	5.7	ND <0.078
	7/21/09	**26**	ND <0.040
	02/09/10	0.74	ND <0.030
	12/03/10	5.2	ND <0.21
ES-2	07/15/05	**11**	**0.65**
	06/13/06	**14.0**	ND <0.82
	02/20/07	**9.2**	ND <0.98
	01/30/08	3.2	0.051
	07/07/08	**13**	ND <0.37
	02/05/09	**3.5**	0.12
	07/21/09	**36**	ND <0.038
	02/09/10	6.3	0.045
	12/03/10	7.1	ND <0.21
ADEC/ EPA *Cleanup Levels		8.1	0.22

Table Notes:
$\mu g/m^3$ Micrograms/cubic meter
ND <0.21 Not detected at or above the laboratory reporting limit
N/A Not Applicable
* The ADEC/EPA cleanup goals are based on Environmental Protection Agency (EPA, November 2002), *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils.*

Table 2
Analytical Results of Indoor Air Samples,
Wells Fargo Bank Building, Bentley Mall

Sample Location	Sample Date	PCE (µg/m^3)	TCE (µg/m^3)
WFB-1	07/15/05	6.7	**0.92**
	06/13/06	**15**	0.15
	02/20/07	**12.0**	0.090
	01/30/08	4.5	0.054
	07/07/08	1.2	0.058
	02/05/09	6.8	0.13
	07/21/09	4.8	0.050
	02/09/10	6.2	0.041
	12/03/10	1.8	ND <0.21
Dup	12/03/10	1.7	ND <0.21
WFB-2	07/15/05	5.6	**0.87**
	06/13/06	**15**	0.15
	02/20/07	7.2	0.096
	01/30/08	5.0	0.035
	07/07/08	0.96	0.037
	02/05/09	4.8	0.12
	7/21/09	4.8	0.044
	02/09/10	2.7	ND <0.038
	12/03/10	1.9	ND <0.21
ADEC/ EPA *Cleanup Levels		8.1	0.22

Sample Location	Sample Date	PCE (µg/m^3)	TCE (µg/m^3)
WFB-3	07/15/05	6.4	0.091
	06/13/06	**15**	0.15
	03/20/07	**9.7**	0.10
	01/30/08	4.3	0.046
	07/07/08	1.3	0.041
	02/05/09	7.1	0.13
	7/21/09	4.9	ND <0.041
	02/09/10	**13**	0.044
	12/03/10	1.2	ND <0.21
ADEC/ EPA *Cleanup Levels		8.1	0.22

Table Notes:
µg/m^3 Micrograms/cubic meter
ND <0.21 Not detected at or above the laboratory reporting limit
N/A Not Applicable
* The ADEC/EPA cleanup goals are based on United States Environmental Protection Agency (EPA, November 2002), *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils.*

6.0 CHLORINATED COMPOUND LEVEL IN GROUNDWATER

ARES and ERG have performed groundwater monitoring associated with the historical release of chlorinated solvents into the groundwater at this site. The most recent groundwater monitoring results indicate an overall reduction in PCE results in groundwater samples when the 2010 results are compared to past results. Groundwater analytical results for on-site groundwater monitoring wells MW-2 and MW-4 near the East Satellite building, and within the anticipated zone of influence of the on-site remediation system, indicate overall decreases in PCE since groundwater monitoring began in 2005. As shown in **Table 3** below, the PCE results for 2010 samples from the source area well MW2 indicate a reduction of approximately 88% since 2005. The PCE results for 2010 were approximately 57% below PCE results for 2009.

Table 3
Average PCE Results for Well MW-2
(Not including duplicate samples)

Year	Average PCE (µg/L)	Percentage change from 2005	Percentage change from previous year
2005	2,900	--	--
2006	2,860	1%	1%
2007	2,507	14%	12%
2008	834	71%	67%
2009	793	73%	5%
2010	337	88%	57%

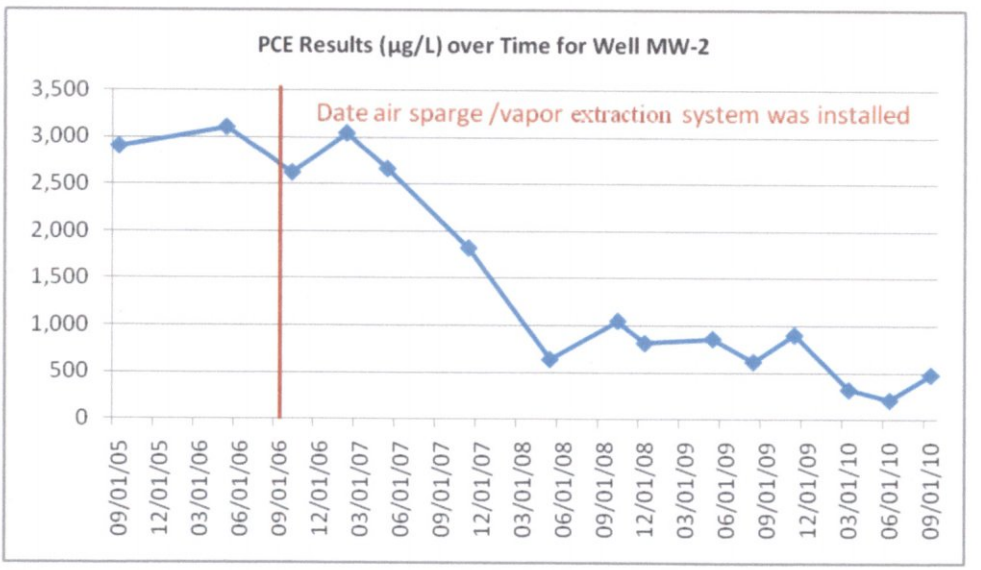
Table 4 below shows the historical PCE results for well MW-2.

Table 4
Historical PCE Results for Well MW-2
(Not including duplicate samples)

Well	Sample Date	PCE (µg/L)
MW-2	09/22/05	2,900
	05/15/06	3,100
	10/16/06	2,620
	02/08/07	3,040
	05/23/07	2,660
	11/05/07	1,820
	05/19/08	638
	10/06/08	1,050
	12/18/08	814
	05/12/09	860
	08/25/09	616
	11/30/09	902
	03/15/10	320
	06/02/10	210
	09/29/10	480

The **Graph 1** below depicts the trend for PCE results for well MW-2 since the start-up of the sparge/vapor extraction system.

Graph 1
Groundwater Analytical Results over Time for Well MW-2



7.0 SUMMARY and RECOMMENDATIONS

The Remediation System installed in September 2006 was designed to remove the source of chlorinated solvents in soil in the East Satellite Building area, to decrease the level of chlorinated compounds dissolved in groundwater beneath the site, and to improve the air quality in two buildings located above the area of concern. The Remediation System has operated since initial start-up, expanded in 2009-2010, and optimized during site visits after periodic review of environmental data in groundwater and ambient air. Operation of the Remediation system has shown:

- An overall 84% reduction in PCE and TCE concentration in ambient soil gas collected in the area that could be anticipated to be affected by remediation equipment operation.

- In conjunction with the modification of existing ventilation system in the East Satellite Building and the installation crawl-space ventilation system beneath the Wells Fargo Bank, a reduction of PCE and TCE levels in ambient vapor to below the ADEC/EPA threshold for indoor air in a commercial/industrial land use.

- An overall 88% reduction in PCE and TCE dissolved in groundwater in source area well MW2. Groundwater quality improvements were largely made during the first few years of remediation system operation, and diminishing returns have been seen with continued system operation.

- Representatives from the previous owners and current owners of this property have committed to re-lining the existing sewer system running along the southern edge of the Bentley Mall along the edge of College Road and from College Road towards the Bentley Mall, in the immediate vicinity of chlorinated hydrocarbon impact.

In an April 2007 RECORD OF DECISION letter from Mr. Douglas Bauer, ADEC Environmental Engineer Associate, ADEC agreed that:

> *Bentley Mall shall operate the ADEC approved air-sparging and soil vapor extraction system until established cleanup levels are attained or ADEC approves modification or termination of the system. ADEC shall consider modification or termination of the remediation system based on a technical analysis of the operation efficiency of the system. The analysis shall include a review of monthly field screen vapor samples, system performance monitoring, collection of quarterly vapor samples at vapor extraction wellheads and influent ports, collection of seasonal (winter/summer) indoor air samples, results of periodic and final rebound tests, and collection of periodic soil and ground water samples.*

In the event that Bentley Mall and ADEC determine that the approved remediation system will not attain the soil and vapor intrusion cleanup standards after the remediation system has been optimized and operated for a reasonable time, Bentley Mall shall submit within 60 days of the determination, an alternate cleanup plan in accordance 18 AAC 75.

This report has summarized the progress made by remediation equipment in operation at this site since 2006. Substantial improvements have been seen in passive soil-gas surveys and groundwater quality in the vicinity of the area that could be anticipated to be affected by remediation equipment operation. PCE and TCE levels in ambient vapor are now below the ADEC/EPA threshold for indoor air in a commercial/industrial land use in both the Wells Fargo Building and East Satellite Building. We anticipate that the recent modifications to the existing ventilation system and the installation of the crawl-space ventilation system beneath the Wells Fargo Bank will maintain this indoor air quality. Diminishing returns in groundwater in the area anticipated to be affected by the remediation equipment operation has been seen over the past two years. In accordance with the ADEC RECORD OF DECISION letter, CEECON now recommends that operation of the Remediation Equipment be terminated. Continued monitoring of groundwater in wells on site and in the vicinity of this site will be addressed in separate correspondence from ERG.

7.0 REFERENCES

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FIGURES

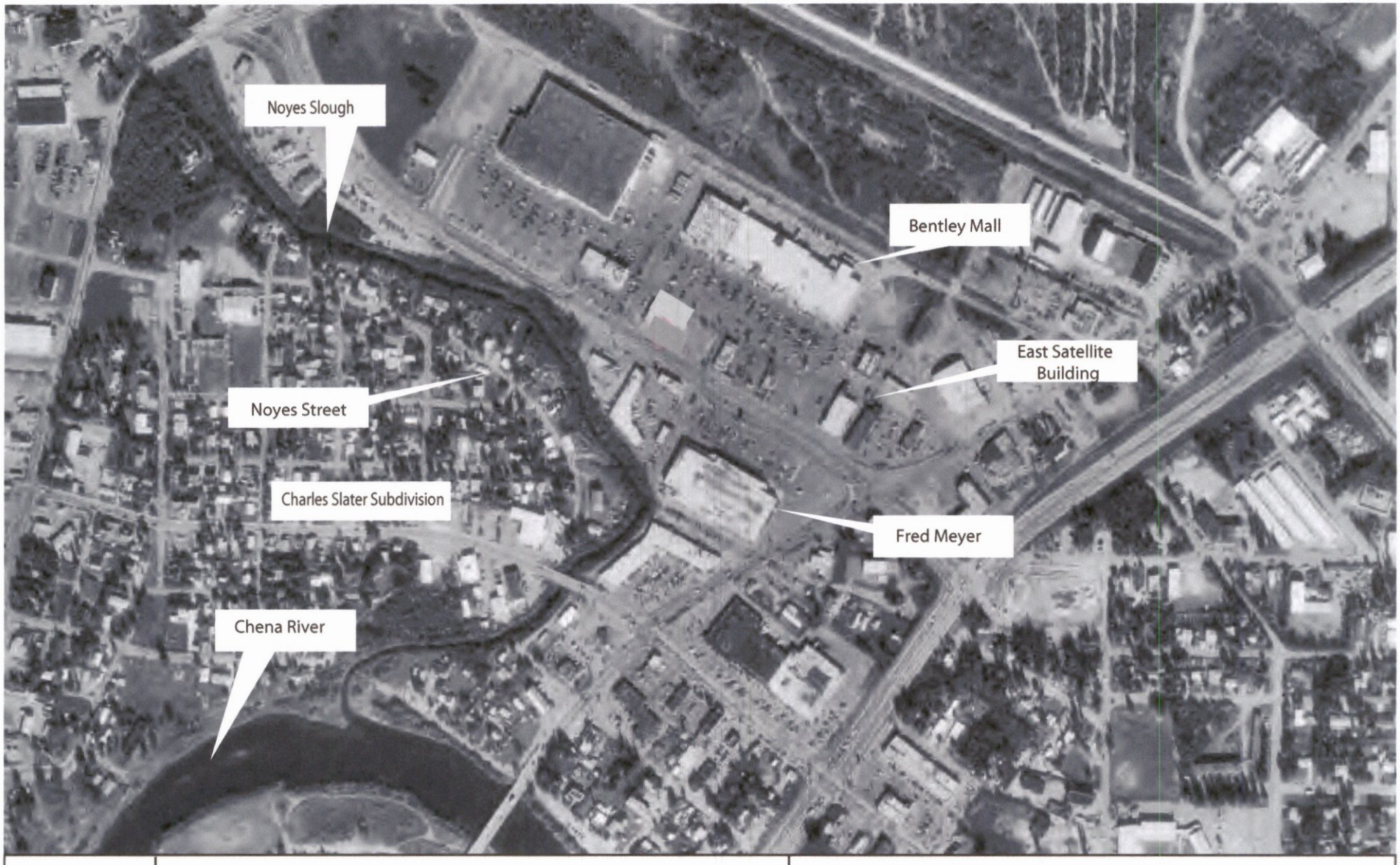

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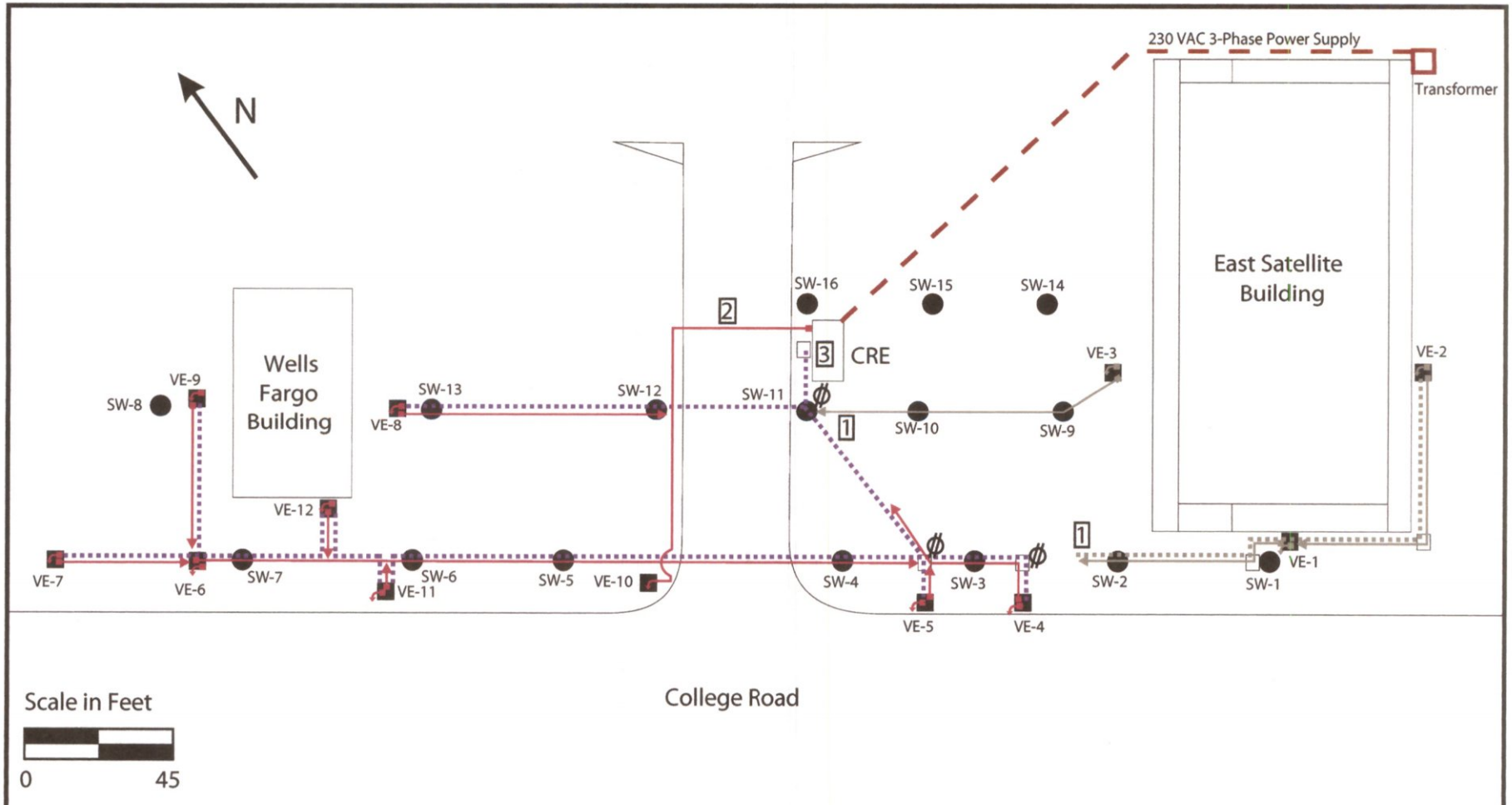
Figure 1
Site Vicinity Map
Bentley Mall, Fairbanks, Alaska



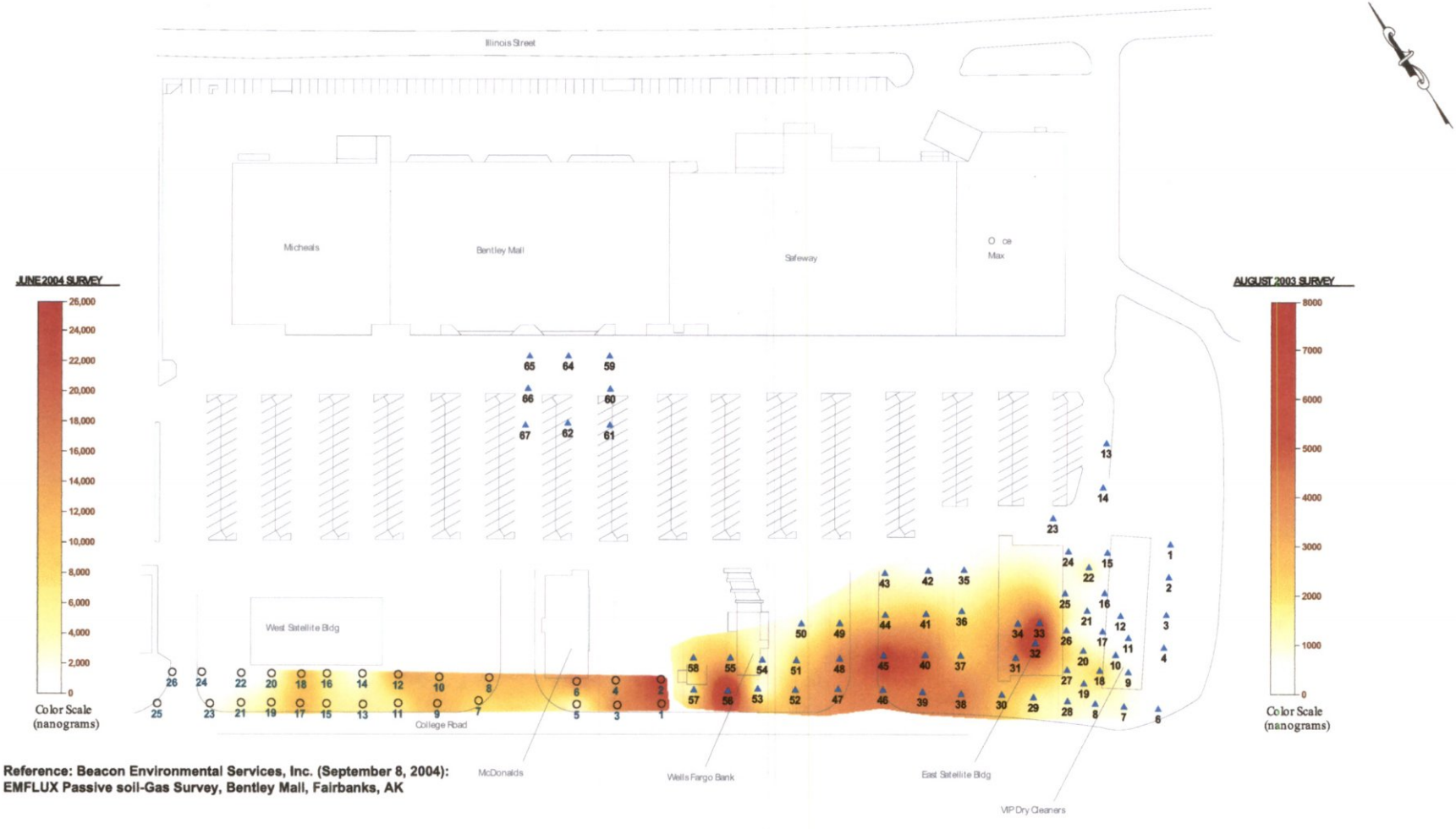
Notes:

1. During work activities in September 2009 some non-required electrical and heat trace lines were disconnected and left non-powered in place. These locations are marked as listed in the legend.
2. This heat trace run is on electrical circuit number four. All other heat trace is on circuits 5 and 6.
3. A short heat trace run above ground behind CRE connex for the sparge lines to run from the connex into the ground. (Circuit # 5).

Figure 2. Bentley Mall SVE System Layout 2010

Legend

- Branch Circuit Wiring
- Non-powered Branch Circuit Wiring
- Branch Circuit Wiring Junction
- Heat Trace Start
- Heat Trace End
- Heat Trace Well Run
- Non-powered Heat Trace



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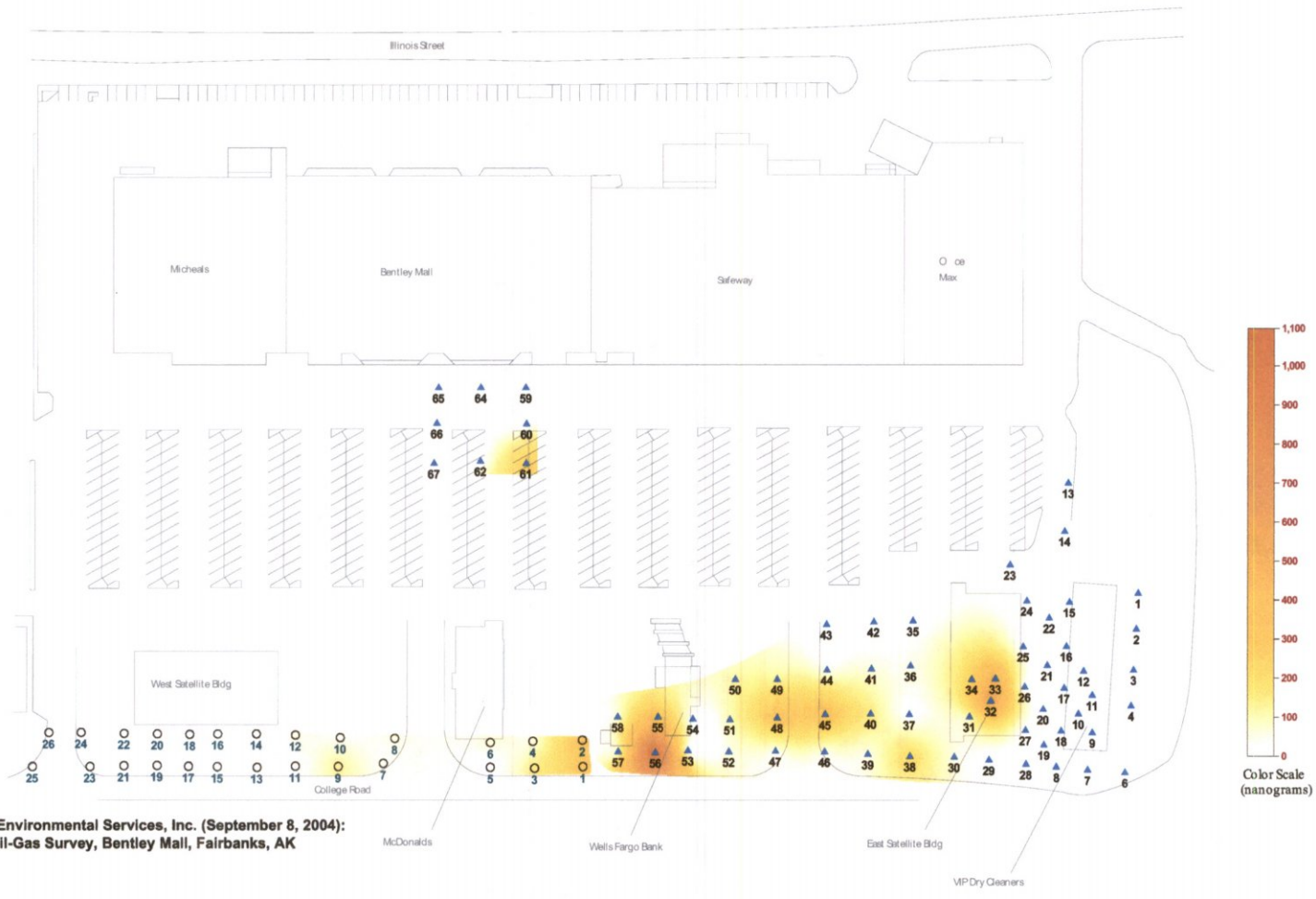
○ **Passive Soil-Gas Sample Location**
24 **(ERG, June 2004)**

▲ **Passive Soil-Gas Sample Location**
44 **(ERG, August 2003)**

Approximate Scale in Feet
0 100 200

FIGURE 3A:
Past Passive Soil-Gas Survey Results for Tetrachloroethene (PCE), August 2003 - June 2004 Surveys
Bentley Mall, Fairbanks, Alaska



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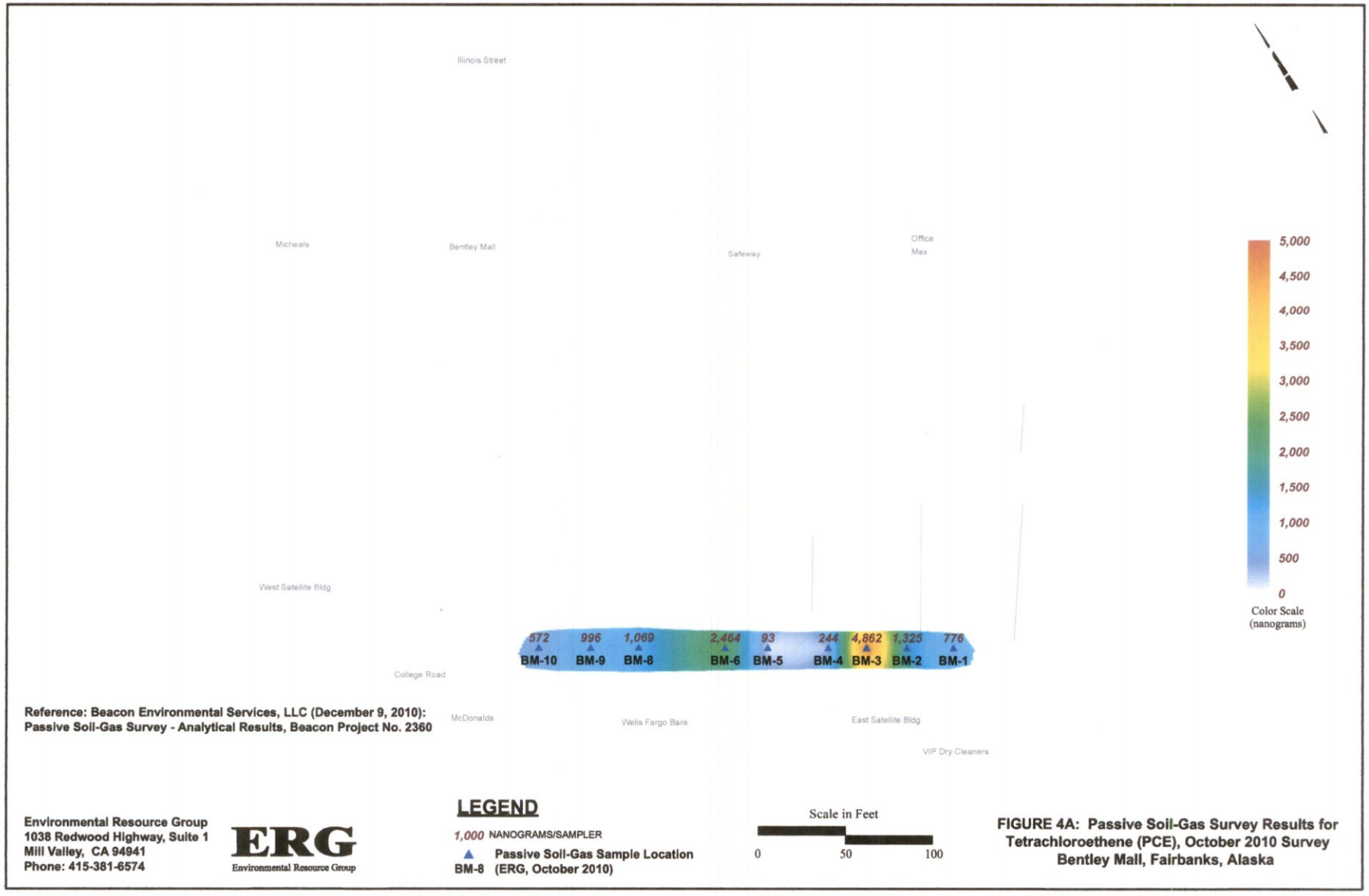
○ **Passive Soil-Gas Sample Location**
24 (ERG, June 2004)

▲ **Passive Soil-Gas Sample Location**
44 (ERG, August 2003)

Approximate Scale in Feet
0 100 200

FIGURE 3B:
Past Passive Soil-Gas Survey Results for Trichloroethene (TCE), August 2003 - June 2004 Surveys
Bentley Mall, Fairbanks, Alaska



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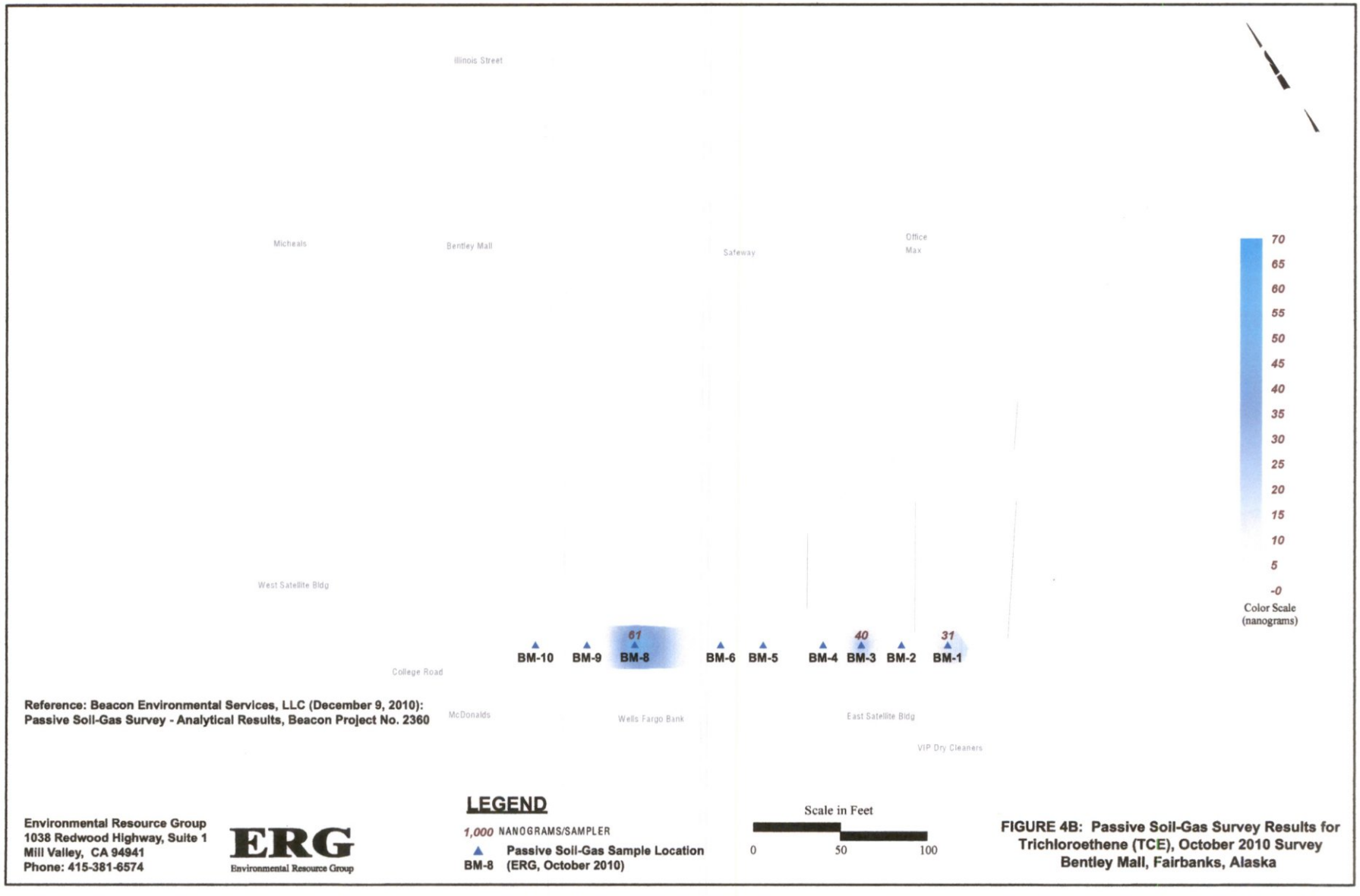
LEGEND

1,000 NANOGRAMS/SAMPLER

▲ **Passive Soil-Gas Sample Location**
BM-8 (ERG, October 2010)

Scale in Feet
0 50 100

FIGURE 4A: Passive Soil-Gas Survey Results for Tetrachloroethene (PCE), October 2010 Survey Bentley Mall, Fairbanks, Alaska



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Environmental Resource Group

LEGEND

1,000 NANOGRAMS/SAMPLER

▲ **BM-8** **Passive Soil-Gas Sample Location (ERG, October 2010)**

Scale in Feet

0 50 100

FIGURE 4B: Passive Soil-Gas Survey Results for Trichloroethene (TCE), October 2010 Survey Bentley Mall, Fairbanks, Alaska

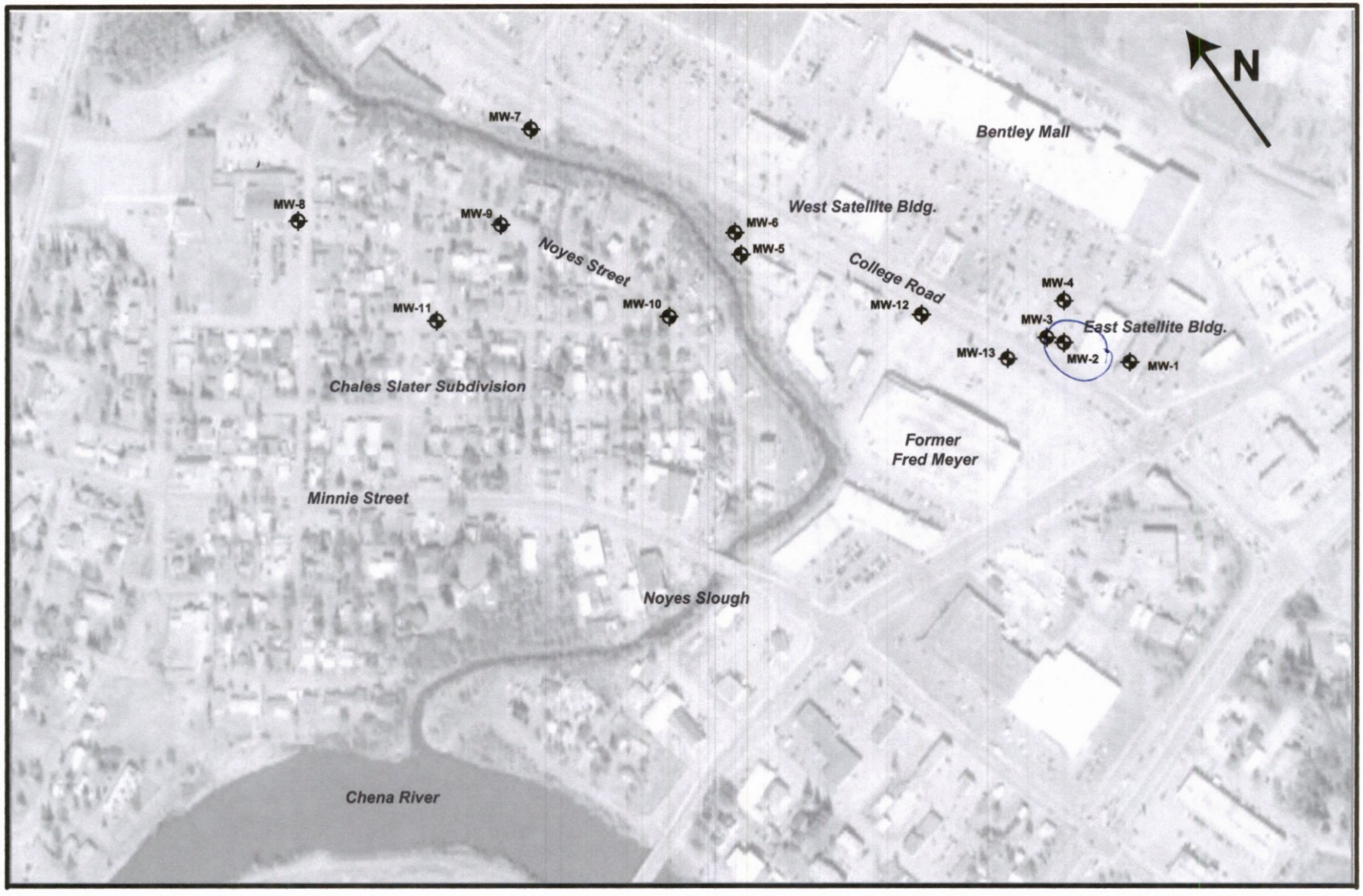

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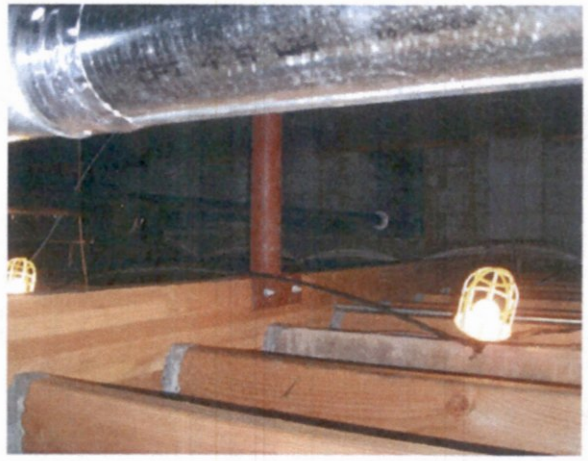
Figure 5: Groundwater Monitoring Wells Location Map, Bentley Mall, Fairbanks, Alaska

Scale in feet
0 400

Date:	Project:	Notes:
February 2011	Bentley Mall	MW-1 Groundwater monitoring well (ARES, Sept-Oct 2005)

APPENDIX A



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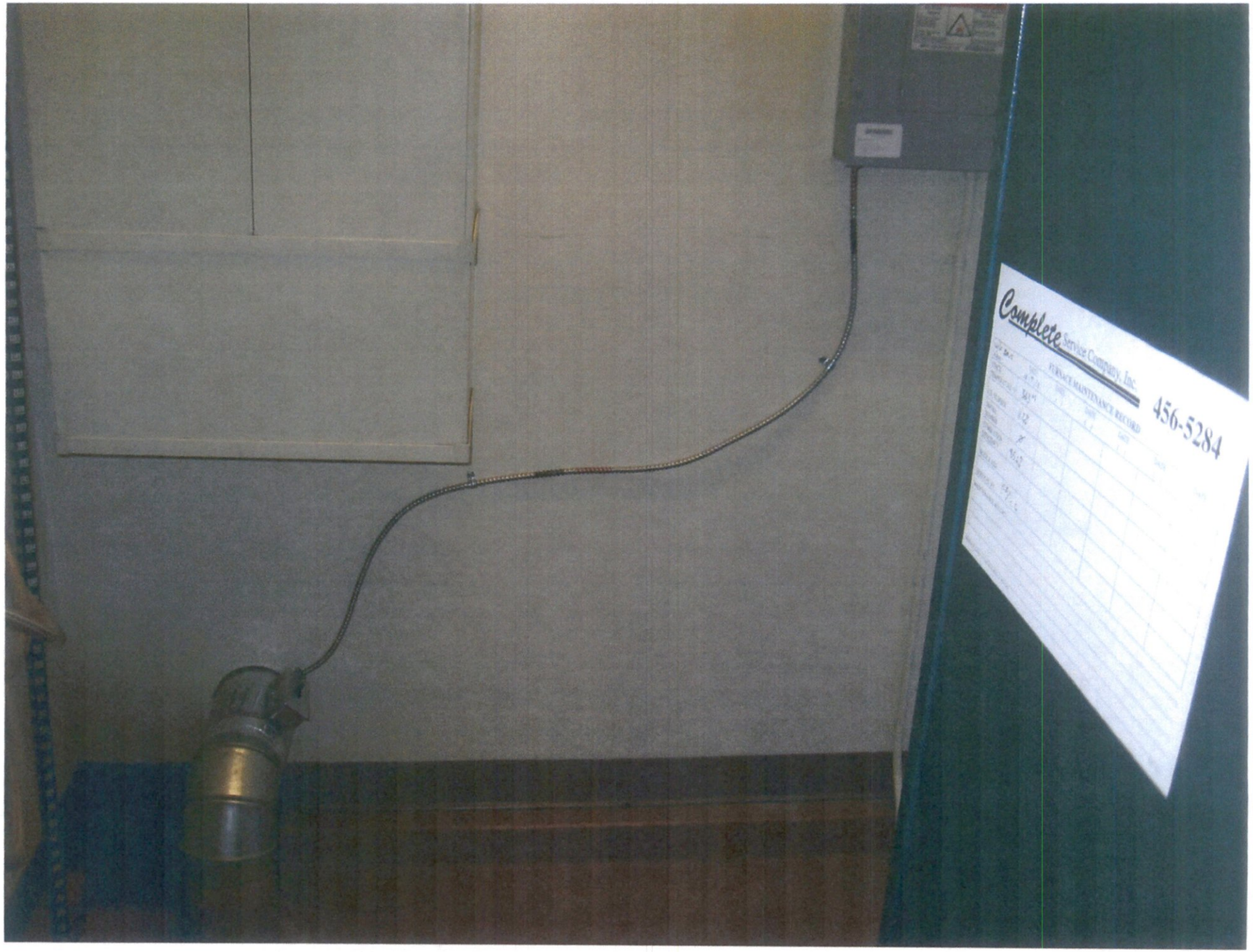
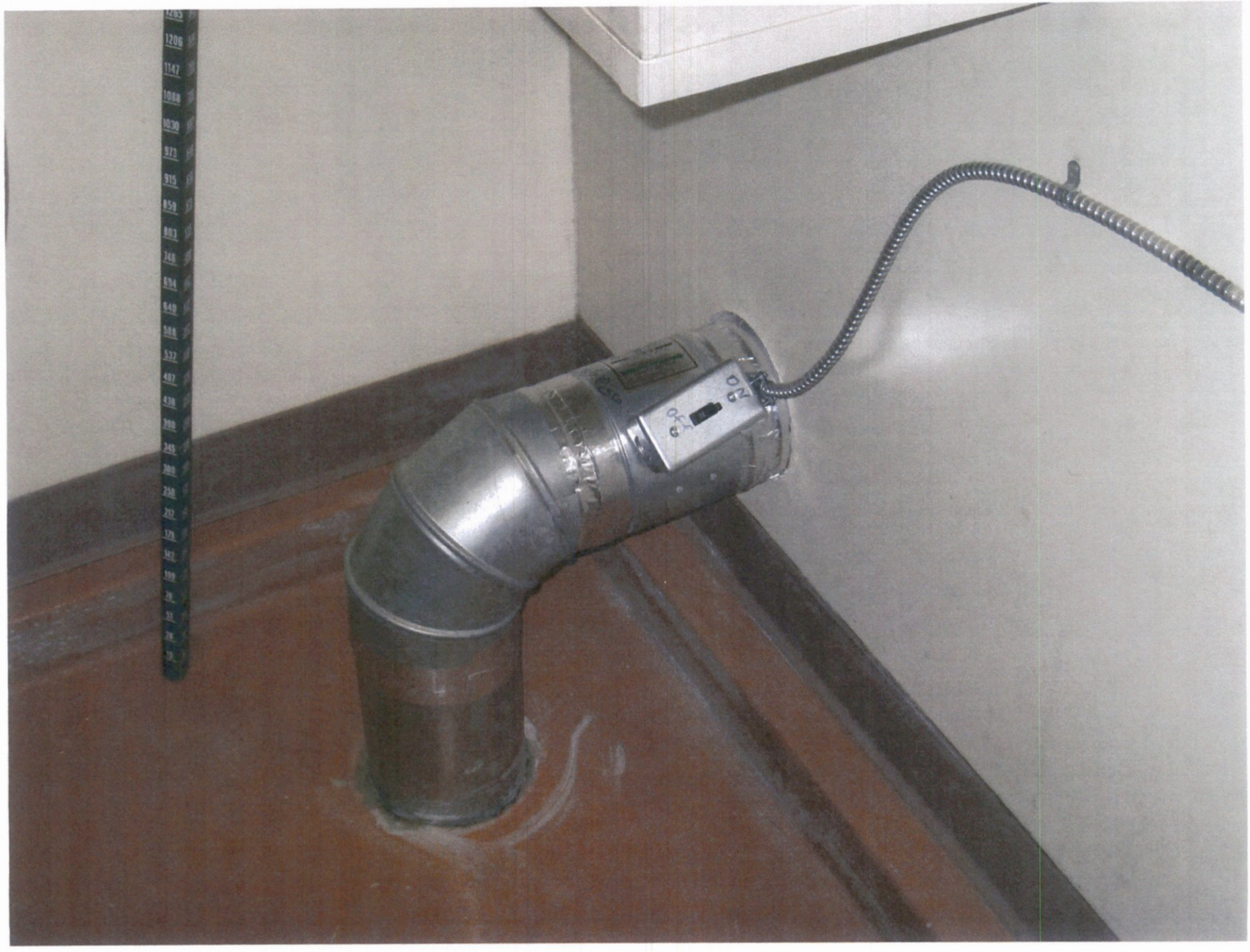

Complete Service Company, Inc.
FURNACE MAINTENANCE RECORD
456-5284

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