HARTCROWSER

Earth and Environmental Technologies

Butler Aviation P.O.L. Pipeline Site Assessments 19th Avenue and "C" Street 16th Avenue and "C" Street Anchorage, Alaska

Prepared for
Butler Aviation-Anchorage, Inc.

October 1989
A-8167

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BUTLER AVIATION POL PIPELINE
SITE ASSESSMENTS

INTRODUCTION

In late 1988 and early 1989, leaks occurred in the Butler Aviation pipeline at two sites adjacent to "C" Street, between 16th and 19th Avenues in Anchorage, Alaska. The first break occurred near Chester Creek, at the intersection of 19th Avenue and "C" Street; this is referred to as the 19th and "C" site (Figure 1). The second break occurred further north along "C" Street, between 16th and 19th Avenues; this is referred to as the 16th and "C" site (Figure 2).

During the pipeline repair process, soils which contained visible petroleum hydrocarbons were removed from each site to the extent practical. Approximately 130 cubic yards were removed from the 19th and "C" site, and approximately 20 cubic yards from the 16th and "C" site. Excavation was limited by nearby underground utilities, Chester Creek, and the proximity of "C" Street, a major thoroughfare.

In addition to soil removal, three free product recovery wells were installed: two 42-inch diameter wells at the 19th and "C" site, and one 20-inch diameter well at the 16th and "C" site. From May 2, 1989 through October 25, 1989, approximately 132 gallons of product was recovered from the two wells on the 19th and "C" site. From May 2, 1989 through October 20, 1989, approximately 104 gallons of product was removed from the 16th and "C" well.

This report presents the results of our soil quality evaluation of the two spill sites. The initial survey was conducted using soil gas techniques, including field soil gas analysis for benzene, toluene, ethylbenzene and xylene (BTEX) using gas chromatography (GC). Discreet soil sample collection with laboratory California Luft (CA LUFT) analysis for total petroleum hydrocarbons (TPH) was employed to verify field analytical results. Subsequent exploration was conducted using soil borings with discrete soil sampling, and laboratory CA LUFT TPH analysis.

The report is organized as follows:

- Summary of Findings
- Project Chronology
- Field Procedures
- Data Evaluation
- Recommendations

Figure 1 presents the soil gas probe locations, soil boring locations, soil gas results, and soil sample results for the 19th and "C" site. Figure 2 presents the same information for the 16th and "C" site.

Tables 1 and 2 present the soil gas sample results for the 19th and "C" and 16th and "C" sites, respectively, as analyzed in the field using gas chromatography.

A detailed description of soil gas sampling procedures is presented in Appendix A. Appendix B contains the drilling and sampling procedures employed to collect discrete soil samples, along with the soil boring logs. Detailed field GC analytical methodology and quality control (QC) information is presented in Appendix C, while complete laboratory results are contained in Appendix D.

This report has been prepared for the exclusive use of Butler Aviation. This work was performed in general accordance with our proposal dated August 9, 1989, using generally accepted professional practices at the time and location in which the work was performed. No other warranty, express or implied, is made.

SUMMARY OF FINDINGS

The following is a summary of our findings. The main body of the report should be consulted for supporting data and analysis.

19th and "C" Site

- A TPH level of 762 mg/kg was obtained from sample BH-5 S-1, using the CA LUFT method of analysis, and the petroleum product was identified as Jet-A fuel. This sample was collected from the soils contained behind the southwest wing wall of the Chester Creek Bridge south abutment.

- Three other soil samples collected from BH-3, BH-4, and BH-6 contained non-detectable TPH concentrations (less than 10 mg/kg). (Figure 1)

- Field soil gas BTEX values ranged from non-detectable (less than 0.2 ppmV) to 7.3 ppmV, with the highest value found in sample CC-E, collected near the Chester Creek Bridge south abutment. (Figure 1)

- Data indicate that elevated petroleum hydrocarbon concentrations remain in the soil contained behind the Chester Creek Bridge south abutment. These soils appear to be the source of the approximately 132 gallons of product that have been recovered from the two recovery wells on site since May 2, 1989.

  Excavation of the soils containing the elevated levels of petroleum hydrocarbons is not recommended, however, as remediation is being accomplished through the recovery wells. Petroleum hydrocarbons do not appear to be migrating horizontally, and excavation of the soils behind

the abutment would require the closing of "C" Street, a major thoroughfare.

16th and "C" Site

- All soil samples collected for CA LUFT analysis from BH-1, BH-2, BH-7, BH-9, and BH-10 contained non-detectable concentrations of TPH.

- Field soil gas BTEX values ranged from non-detectable to 8.3 ppmV. Detectable concentrations were found in CST-4, CST-5, CST-6 and CST-7, with trace amounts found in CST-8. These samples were collected within approximately 50 feet of the recovery well, both to the north and the south. (Figure 2)

- As the soil borings which were placed within approximately 70 to 110 feet of the recovery well yielded non-detectable TPH results, data indicate that the source of the petroleum product collecting in the recovery well is most likely located within an approximate 70 foot radius of the well.

- Over 100 gallons of free product have been collected from the recovery well since May 2, 1989. At the time of this report, the well is still removing product from the soil, and hydrocarbons do not appear to be migrating horizontally away from the spill site. Considering these factors, additional excavation is not recommended at this time.

PROJECT CHRONOLOGY

The initial soil gas sampling commenced the week of August 14, 1989. Municipal permits and underground utility locations were obtained August 14 and 15, and work began August 16, 1989.

Fourteen soil gas probes (CC-A through CC-M) were installed and sampled August 16, 1989 at the 19th and "C" site. Probe locations are indicated on Figure 1. Field GC analysis of the samples was accomplished the same day.

The following day, August 17, 1989, eight soil gas probes (CST-1 through CST-8) were installed and sampled at the 16th and "C" site. Probe locations are indicated in Figure 2. Field GC analysis of the samples was accomplished the same day.

Guided by the results of the soil gas survey, four soil borings (BH-1 through BH-4) were drilled August 18, 1989: BH-1 and BH-2 at the 16th and "C" site, and BH-3 and BH-4 at the 19th and "C" site (Figures 1 and 2). The boring logs are presented in Appendix B. The samples collected were submitted to Chemical and Geological Laboratories of Alaska on August 18, 1989 for TPH analysis using the CA LUFT method.

Additional exploration was scheduled to take place at the end of August. Utility locates were scheduled for August 28, 1989. On that day, however, heavy rains were falling (as they had the two days prior). The rains were forecasted to continue for a sustained period of time.

The heavy rains saturated the soil vadose zone and produced an elevated local water table, and prevented asphalt pavement repair. (At least one of the borings was to be placed in the paved intersection of 19th Avenue and "C" Street.) Considering

the existing conditions, it was decided to delay the project until conditions imrpoved.

The project was continued the first week of October. The appropriate permits were obtained October 4, 1989, and underground utilities located the same day.

As soil and groundwater conditions had changed considerably since the initial soil gas survey, it was decided that soil gas techniques would not be appropriate at this time. Therefore, five soil borings were drilled and sampled October 5, 1989. BH-5 and BH-6 were placed at the 19th and "C" site, and BH-7, BH-9, and BH-10 were placed at the "C" Street site. The boring logs are presented in Appendix B. At least one sample from each boring was submitted October 5, 1989 to Chemical and Geological Laboratories of Alaska, for TPH analysis using the CA LUFT method.

FIELD PROCEDURES

Initial Survey

Soil Gas Survey. The soil gas probes for the initial survey were placed to conform to an approximate grid pattern, using a spacing of 50 feet where possible (Figures 1 and 2). With the assistance of a Butler Aviation representative, the water level in each recovery well was determined. Using a hand level and the water levels observed in the recovery wells, the approximate depth to the groundwater table was determined for each probe.

Soil gas probes were placed using a Mobile B-24 drill rig fitted with a Bosch electric jackhammer, advancing heavy-duty EW hollow steel rod with perforated tips. Samples were collected using the system presented in Figure A-1. Detailed sampling and equipment decontamination procedures are presented in Appendix A.

Samples were collected at a depth approximately one foot above the inferred water table. Sample depths ranged from 2.5 to 7.0 feet. Prior to sample collection, the probe was sealed at the surface with a bentonite grout, to prevent surface air from being drawn into the probe. The soil gas samples were analyzed in the field using a temperature-programmable Shimadzu GC-8A gas chromatograph equipped with a flame-ionization detector.

Soil Borings. Guided by the field-determined BTEX concentrations in the soil gas samples, two soil boring were drilled and sampled at each of the two spill sites. The borings were located to: 1) confirm soil gas results or 2) to gather information at a location not sampled by soil gas techniques.

A Mobile B-47 drill rig was used to advance 3 1/2-inch inside diameter (ID) hollow stem auger. Samples were collected at

pre-determined intervals using a 2 1/2-inch ID split-spoon sampler. Detailed drilling, sampling and decontamination procedures are presented in Appendix B.

BH-1 and BH-2 were drilled at the 16th and "C" site, and both were taken to a depth of 7.5 feet. No water was encountered in BH-1 at the time of drilling (ATD), but water was encountered at 7.0 feet ATD in BH-2. BH-3 and BH-4 were drilled at the 19th and "C" site, and taken to a depth of 8.0 and 5.5 feet, respectively. Water was encountered in BH-3 at 7.5 feet ATD, and water was encountered at 5.0 feet ATD in BH-4.

Subsequent Exploration

After analyzing the field and laboratory data collected during the initial phase of the project, it was determined that additional information would be necessary to verify the horizontal extent of the petroleum hydrocarbons in the soils at the two sites. The work was delayed for seven weeks due to heavy rains, during which time the water table changed considerably. Soil gas techniques do not work well under these conditions, and results would not have been comparable to those collected almost two months earlier. Therefore, an additional six borings were planned; two at the 19th and "C" site, and three at the 16th and "C" site.

At the 19th and "C" site, one boring (BH-5) was placed to collect a sample of the soils contained behind the "C" Street bridge south abutment, and was taken to a depth of 9.5 feet. Water was encountered in the boring at a depth of 9.0 feet. The second boring (BH-6) was placed on the east side of "C" Street, to determine if petroleum hydrocarbons had migrated laterally under the thoroughfare. This boring was taken to a depth of 8.0 feet, and no free water was encountered ATD.

Three additional borings were placed at the 16th and "C" site; one east of "C" Street (BH-7), and two west of "C" Street (BH-9 and BH-10), west of the initial soil gas probes. BH-7 was drilled with the Mobile B-47 as described above, and taken to a depth of 5.0 feet. No water was encountered ATD.

BH-9 and BH-10 were drilled using a hand auger; samples were collected with a 1 1/2-inch ID split spoon sampler, hand-driven. BH-9 was taken to a depth of 4.5 feet, and the water level, at the time of drilling, was at 2.75 feet. BH-10 was taken to a depth of 3.67 feet; no water was encountered ATD.

DATA EVALUATION

19th and "C" Site

The preliminary soil gas survey of this site yielded field GC soil gas total BTEX values ranging from non-detectable (less than 0.2 parts-per-million-by-volume, ppmV) to a maximum of 7.3 ppmV in sample CC-E (Figure 1). The confirmatory soil samples collected at this site from BH-3 and BH-4 yielded TPH values of less than 10 mg/kg, or below the detection limit.

As petroleum product was being retrieved from the two recovery wells on this site at the time of the initial exploration, additional borings were deemed necessary to explore the soils behind the Chester Creek Bridge south abutment. BH-5 was placed to allow for sampling of these soils. Sample S-1 from BH-5, collected at a depth of 8.5 feet, displayed a strong POL odor. Laboratory CA LUFT analysis yielded a TPH value of 762 mg/kg, and indicated that the product was most likely Jet-A fuel.

BH-6 was placed on the west side of "C" Street, to determine if petroleum hydrocarbons had migrated underneath the thoroughfare. Samples S-1 and S-2, collected at depths of 5.5 feet and 7.0 feet, respectively, displayed no POL odor. Subsequent CA LUFT analysis of S-2 from BH-6 yielded a TPH value of less than 10 mg/kg.

This information indicates that the product released from the spill does not appear to have migrated horizontally to a great extent. The only sample collected with detectable TPH concentrations was that from BH-5, located behind the bridge abutment; though the TPH concentration in that sample was relatively high, samples collected from BH-3 and BH-6, each

within approximately 70 feet of BH-5, yield non-detectable results.

The soils behind the Chester Creek bridge south abutment could not be removed during the pipeline repair and cleanup operation without conflicting with "C" Street traffic. Data indicate that this area may be the source of the free product found in the recovery well nearest Chester Creek.

16th and "C" Site

The preliminary soil gas survey yielded field GC soil gas total BTEX results ranging from non-detectable (less than 0.2 ppmV) to 8.3 ppmV, found in CST-4. Confirmatory soil sampling and CA LUFT analysis yielded non-detectable results (less than 10 mg/kg) in both BH-1 and BH-2, though a slight POL odor was detected in the sample collected at 7.0 feet in BH-2.

Additional soil sampling again yielded non-detectable TPH results, and no POL odor was detected in the soil samples during drilling and sampling of BH-7, BH-9, and BH-10.

Though over 100 gallons of product has been removed from the recovery well on this site, the data indicate that petroleum hydrocarbons have not migrated horizontally to an appreciable extent. The five soil borings placed at this site are between approximately 70 and 110 feet from the recovery well; it appears that product has not migrated those distances, and it is most likely concentrated in the soils adjacent to the recovery well and the unexcavated soils just north of the point of the pipeline break.

RECOMMENDATIONS

19th and "C" Site

Approximately 130 cubic yards of soil were removed from this site during the initial pipeline repair and remediation effort. Excavation was limited at that time by the close proximity of "C" Street and the Chester Creek Bridge. As those structures still remain, additional excavation of the soils located behind the bridge south abutment does not appear to be a realistic alternative.

The recovery wells on-site have functioned as designed, allowing for the retrieval of over 130 gallons of free product since May 2, 1989. As the product appears to be contained in the soils east of the recovery well behind the south bridge abutment, and does not appear to be migrating horizontally further to the east. Additional remediation does not seem warranted as long as the well is in place.

16th and "C" Site

No elevated TPH readings were encountered in any of the borings located to the north, south, east or west of the recovery well at the 16th and "C" site. As the borings were within 70 to 110 feet of the recovery well, it appears that the product is not migrating horizontally away from the spill site.

The data indicate that the product collecting in the recovery well is originating from the soils within an approximate 70 foot radius of the recovery well. The soils to the north of the pipeline break, which were not excavated during the initial repair and remediation effort may contain product which is being collected in the well.

Considering that the recovery well has allowed for the retrieval of over 100 gallons of free product, and that the petroleum hydrocarbons in the soil appear to be localized, additional remediation does not seem warranted at this time.

Respectfully submitted,

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Staff Environmental Engineer

James D. Gill, P.E.
Alaska Manager

FIGURES

19th Avenue and "C" Street Site

Location of Gas Probes and Soil Borings, with Total BTEX and TPH Data

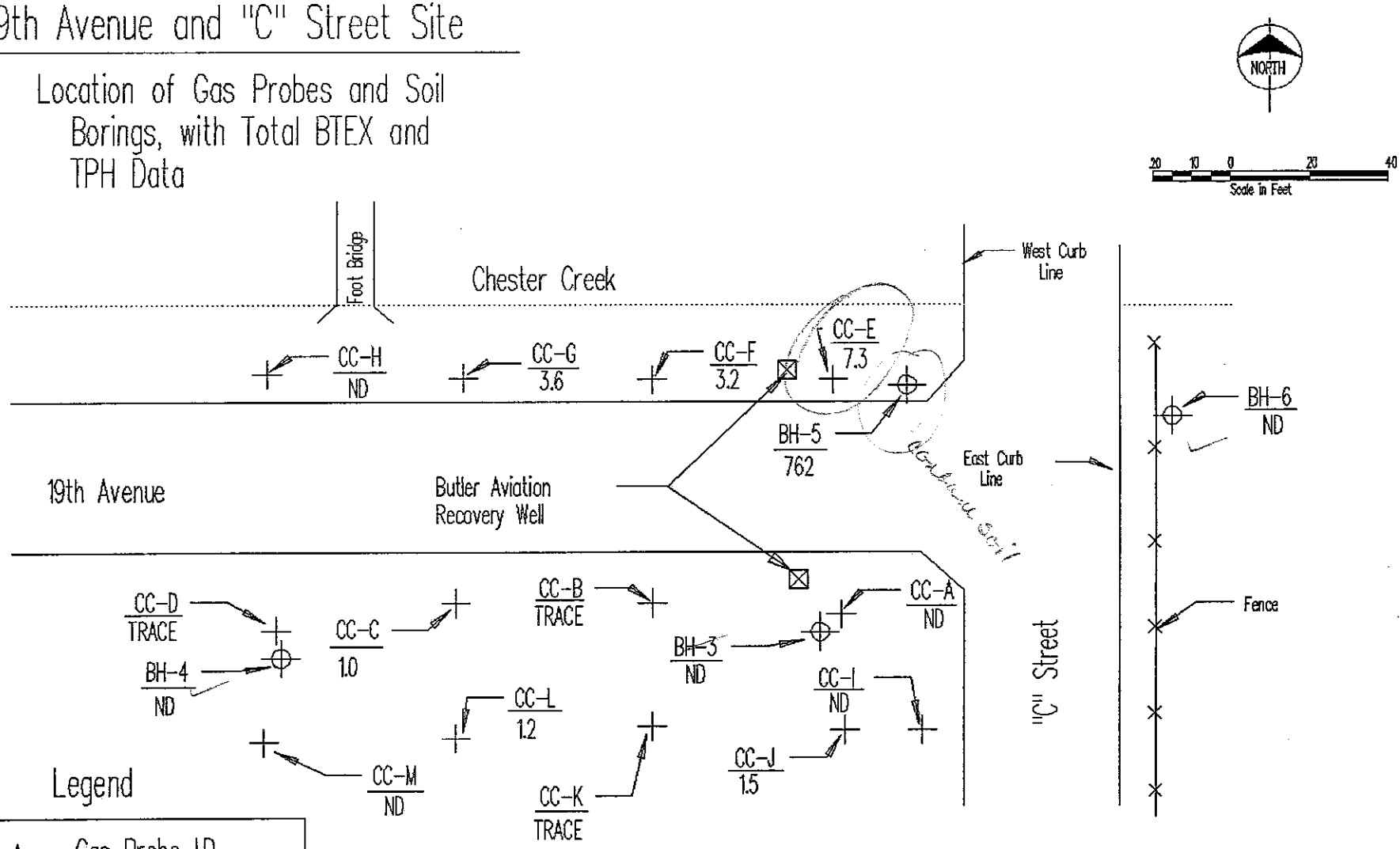

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Figure 1

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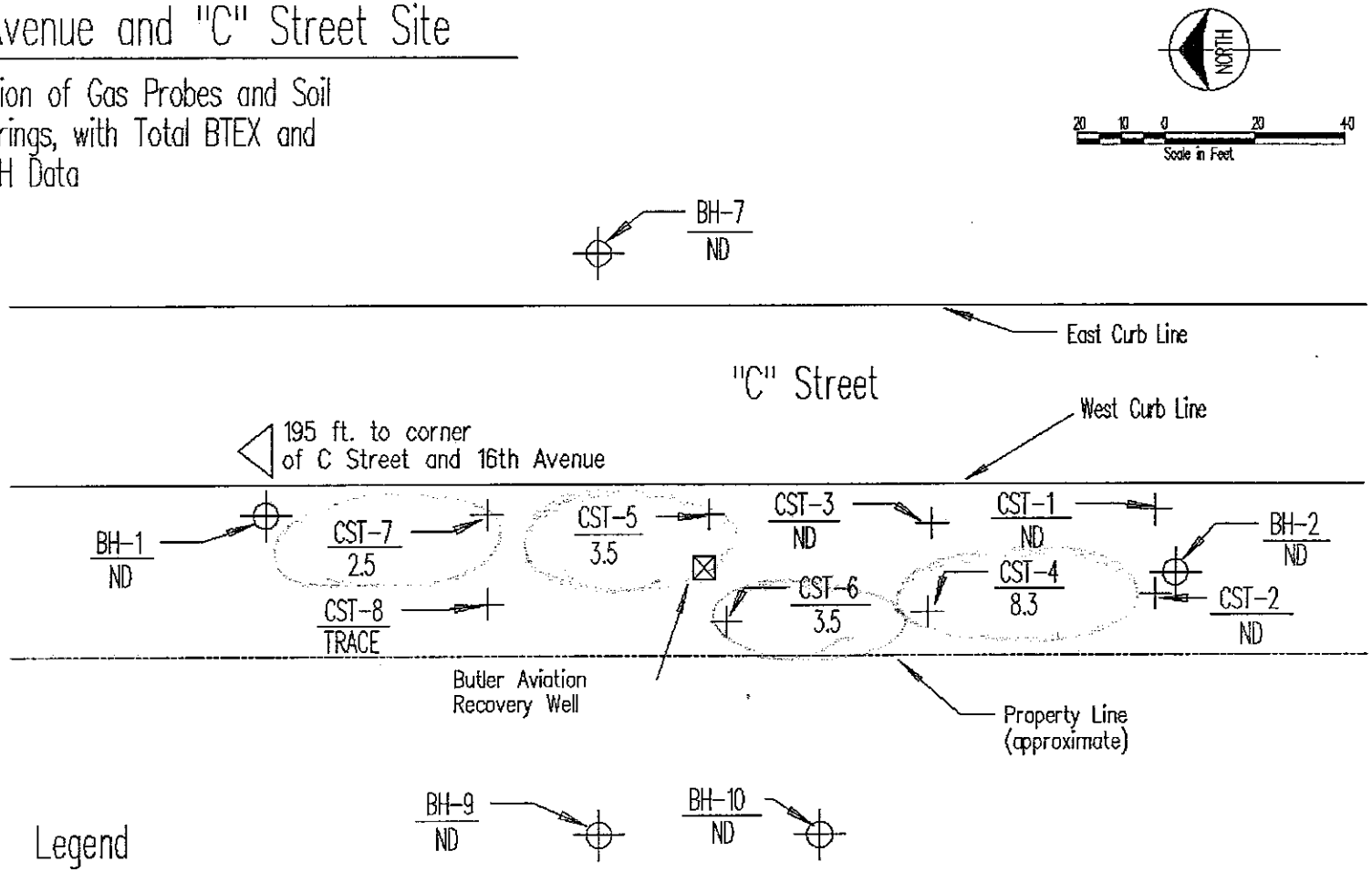
16th Avenue and "C" Street Site

Location of Gas Probes and Soil Borings, with Total BTEX and TPH Data



Legend

CST-3 / ND — Gas Probe I.D. / BTEX, ppmV

BH-7 / ND — Soil Boring I.D. / TPH, mg/kg

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Figure 2

TABLES

TABLE 1: Soil Gas Data - BTEX as ppmV
19th and "C" Site - Butler Aviation POL Pipeline Site Assessments
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SAMPLE	BENZENE (ppmV)	TOLUENE (ppmV)	E-BENZENE (ppmV)	M & P-XYLENE (ppmV)	O-XYLENE (ppmV)	BTEX (ppmV)
CC-A	ND	ND	ND	ND	ND	ND
CC-B	ND	TRACE	ND	ND	ND	TRACE
CC-C	ND	1.0	ND	ND	ND	1.0
CC-C2	ND	TRACE	ND	ND	ND	TRACE
CC-D	ND	TRACE	ND	ND	ND	TRACE
CC-E	ND	6.2	TRACE	1.1	ND	7.3
CC-F	ND	3.2	ND	TRACE	ND	3.2
CC-G/REP	ND/ND	2.2/2.6	TRACE/ND	1.3/1.1	ND/ND	3.5/3.7
CC-H	ND	ND	ND	ND	ND	ND
CC-I	ND	ND	ND	ND	ND	ND
CC-J	ND	1.5	ND	TRACE	ND	1.5
CC-K	ND	TRACE	ND	ND	ND	TRACE
CC-L	ND	1.2	ND	TRACE	ND	1.2
CC-M	ND	ND	ND	ND	ND	ND

Limit of Quantitation - 1.0 parts-per-million by volume (ppmV)
ND - None Detected (Less than 0.2 ppmV) REP - Replicate Analysis
TRACE - Compound detected but at non-quantifiable level.

TABLE 2: Soil Gas Data - BTEX as ppmV
16th and "C" Site - Butler Aviation POL Pipeline Site Assessments
Butler Aviation A-8167

SAMPLE	BENZENE (ppmV)	TOLUENE (ppmV)	E-BENZENE (ppmV)	M & P-XYLENE (ppmV)	O-XYLENE (ppmV)	BTEX (ppmV)
CST-1	ND	ND	ND	ND	ND	ND
CST-2	ND	ND	ND	ND	ND	ND
CST-3	ND	ND	ND	ND	ND	ND
CST-4	ND	8.3	ND	TRACE	ND	8.3
CST-5	ND/ND	2.6/2.4	ND/ND	1.0/1.0	ND/ND	3.6/3.4
CST-6	ND	3.5	ND	TRACE	ND	3.5
CST-7	ND	2.5	ND	TRACE	ND	2.5
CST-8	ND	TRACE	ND	TRACE	ND	TRACE

Limit of Quantitation - 1.0 parts-per-million by volume (ppmV)
ND - None Detected (Less than 0.2 ppmV) REP - Replicate Analysis
TRACE - Compound detected but at non-quantifiable level.

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APPENDIX A
SOIL GAS PROBE INSTALLATION AND SAMPLING PROCEDURES

This appendix documents the field procedures Hart Crowser used to collect soil gas samples. Major topics include:

- Description of Probe
- Probe Installation
- Probe Sampling
- Decontamination Procedures

Description of Probe. Soil gas probes consist of hollow-steel heavy-duty EW drill rod fitted with a pointed, perforated tip. The EW drill rod is machined to allow for each joint to be sealed with a rubber gasket.

Probe Installation. From August 16 through August 18, 1989, probes were placed using a Mobile B-24 drill rig fitted with a Bosch "Brute" electric jackhammer. Heavy-duty EW rod soil gas probes were driven into the soil to depths within 1 foot of the inferred groundwater table.

Prior to sampling, the probes were sealed at the surface with bentonite grout (Volclay) to prevent entrance of surface air.

Probe Sampling. Using the vacuum sampling system illustrated in Figure A-1, 3 to 5 probe volumes of soil gas were purged from each probe. A peristaltic pump was then used to fill a 1-liter Tedlar brand sample bag with soil gas from the probe.

The sample was labeled with date and time of collection, probe identification, depth, and initials of the sample collector, and taken to the field GC laboratory for BTEX analysis.

Decontamination Procedures. Soil gas probes were cleaned between sample attempts using a scrub-brush-assisted wash in an Alconox soap solution and double fresh water rinses.

VACUUM SAMPLING SYSTEM

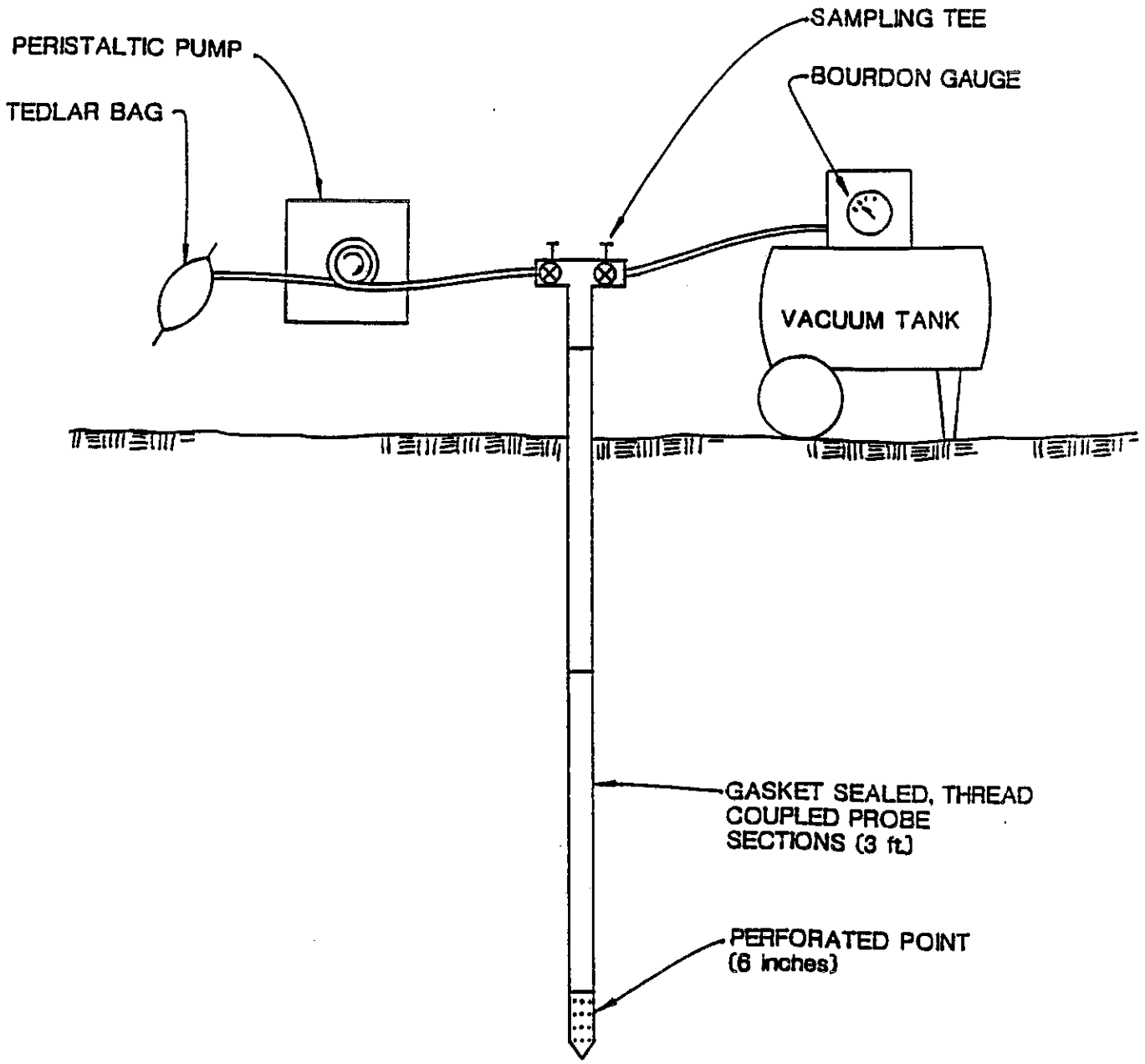

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Figure A-1

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APPENDIX B
FIELD DRILLING AND SAMPLING

This appendix documents the procedures Hart Crowser uses in determining the nature of the soils underlying the project site addressed by this report. The discussion includes information on the following subjects:

- Borings and Location
- Decontamination of Drilling & Sampling Equipment
- Sample Compositing and Handling

Borings and Location

Nine borings were drilled during the course of this project. The exploration logs within this appendix show our interpretation of the drilling ,sampling, and testing data. They indicate the depth where the soils change. Note that the change may be gradual. In the field, we classified the samples taken from the explorations according to the methods presented on Figure A-1, Key to Boring Logs. This figure also provides a legend explaining the symbols and abbreviations used in the logs.

Location of Borings. Figures 1 and 2 show the location of borings, located in the field by hand taping from existing features.

Auger Borings. The first set of borings were drilled August 18, 1989, with depths ranging from 5 to 8 feet. A Mobile b-47 drill rig subcontracted to Hart Crowser was used to advance four borings with 3 1/2-inch inside diameter (ID) hollow-stem auger.

Samples were collected at predetermined intervals using a 2 1/2-inch ID split-spoon sampler, driven with a 140-pound drop hammer free-falling a distance of 30 inches.

The second set of borings (BH-5, BH-6, BH-7, BH-9, and BH-10) were drilled October 5, 1989, with depths ranging from 5 to 9.5 feet. The same procedures described above were used, with the following exceptions:

- BH-5 was placed in a concrete sidewalk. A 10-inch concrete coring tool was used by a subcontractor to core through the sidewalk.

- BH-9 and BH-10 were drilled manually using a hand auger. Samples were collected using a 1.5-inch ID aplit-spoon sampler, driven by hand using a 40-pound drop hammer.

All borings were backfilled with the auger cuttings. As BH-5 perforated a concrete sidewalk, the backfill was compacted in 1-foot lifts, stopping approximately 6 inches from the surface. At that point, pre-mix concrete was placed in the borehole and brought level with the existing concrete slab.

The drilling was continuously observed by an engineer or geologist from Hart Crowser. Detailed field logs were prepared of each boring. The boring logs are presented on Figures A-2 through A-6 at the end of this appendix.

Decontamination of Drilling and Sampling Equipment

Prior to use on the site, all drilling equipment was thoroughly cleaned with a high pressure, hot water wash. Drilling equipment was similarly cleaned prior to reuse on this project. All

sampling tools were thoroughly cleaned between sampling attempts in an Alconox (a soluble, rinsable detergent) solution, followed by two rinses in clear tap water prior to each sampling attempt.

Sample Compositing and Handling

From each soil sample recovered, a representative sample was placed in a 500-ml glass jar with PTFE-lined lid.

All soil samples were submitted under chain-of-custody for analysis for total petroleum hydrocarbons using the California LUFT method. Detailed laboratory results are presented in Appendix D.

Key to Boring and Test Pit Logs

Sample Descriptions

Classification of soils in this report is based on visual field and laboratory observations which include density/consistency, moisture condition, grain size, and plasticity estimates and should not be construed to imply field nor laboratory testing unless presented herein. Visual-manual classification methods of ASTM D 2488 were used as an identification guide.

Soil descriptions consist of the following: Color, textural soil classification, USC, frost classification, density/consistency, moisture, and additional remarks.

Density/Consistency

Soil density/consistency in borings is estimated based on the Standard Penetration Resistance (SPT) or from tests on undisturbed samples. Soil density/consistency in test pits is estimated based on visual observation and is presented parenthetically on the test pit logs. Correlation between SPT and Shear Strength is to be considered approximate only, and not to be used for design.

SAND or GRAVEL Density	Standard Penetration Resistance in Blows/Foot
Very loose	0 - 4
Loose	4 - 10
Medium dense	10 - 30
Dense	30 - 50
Very dense	>50

SILT or CLAY Consistency	Standard Penetration Resistance in Blows/Foot	Approximate Shear Strength in TSF
Very Soft	0 - 2	> 0.125
Soft	2 - 4	0.125 - 0.25
Medium stiff	4 - 8	0.25 - 0.5
Stiff	8 - 15	0.5 - 1.0
Very stiff	15 - 30	1.0 - 2.0
Hard	> 30	> 2.0

Moisture

Dry	Little perceptible moisture
Damp	Some perceptible moisture probably below optimum
Moist	Probably near optimum moisture content
Wet	Much perceptible moisture, probably above optimum

Sampling

BORING SAMPLES

- ⊠ Split Spoon (SPT-1.4" I.D. SS -2.5" I.D.)
- ⊠ Shelby Tube
- ▤ Cuttings
- ▥ Core Run
- * No Sample Recovery
- P Tube pushed, Not Driven

TEST PIT SAMPLES

- ⊠ Grab (Jar)
- ⊠ Bag
- ⊠ Shelby Tube

Ground Water Observations

- Surface Seal
- Ground Water Level on Date (ATD At Time of Drilling)
- Observation Well Tip or Slotted Section
- Ground Water Seepage (Test Pits)

Test Symbols

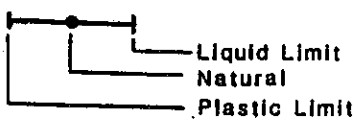
AL	Atterberg Limits
CBR	California Bearing Ratio
CN	Consolidation
DS	Direct Shear
FPD	Freezing Point Depression (°C)
GS	Grain Size Classification
K	Permeability
LOI	Loss on Ignition (% by weight)
MD	Moisture Density Curve
PP	Pocket Penetrometer (Approximate Compressive Strength in TSF)
QU	Unconfined Compression
TCD	Triaxial Consolidated Drained
TCU	Triaxial Consolidated Undrained
TUU	Triaxial Unconsolidated Undrained
TV	Torvane (Approximate Shear Strength in TSF)

THERMAL STATE

Frozen

Unfrozen

WATER CONTENT IN PERCENT



POL Petroleum oil Liquids (fuel products)

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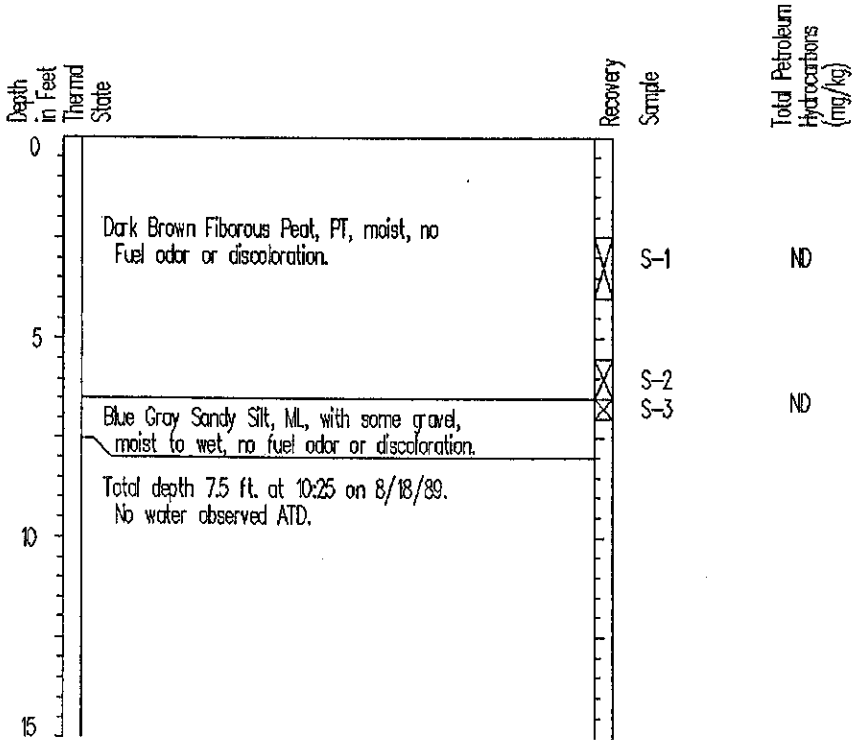
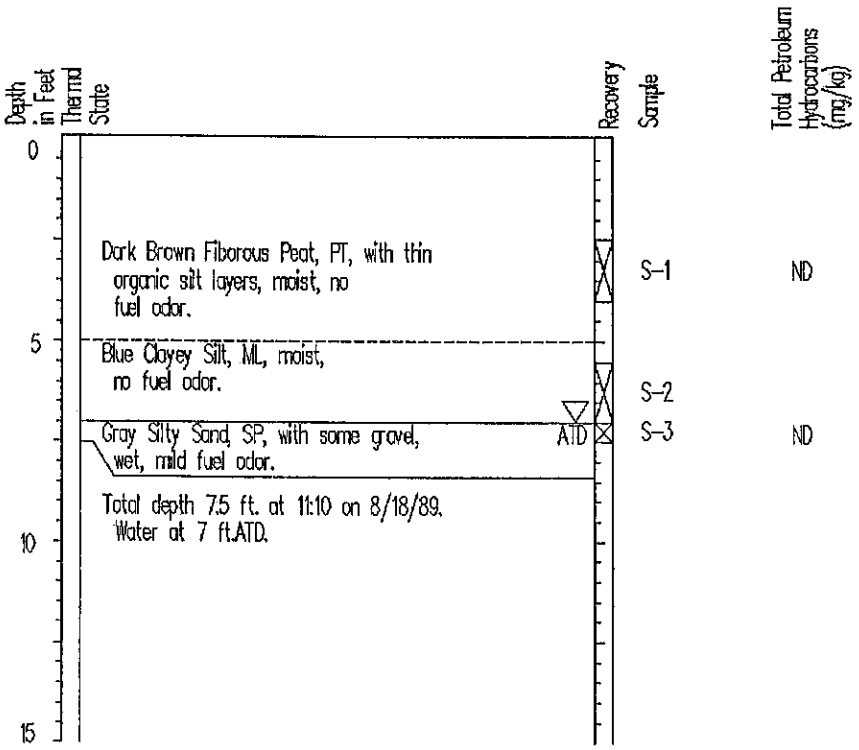
Figure B-1

ACE 6041914

Boring Log BH-1



Boring Log BH-2



NOTES:

1. Soil descriptions are interpretative and actual changes may be gradual.
2. Water level is for date indicated and may vary with time of year. (ATD – At Time of Drilling)
3. Refer to Figure B-1 for explanation.

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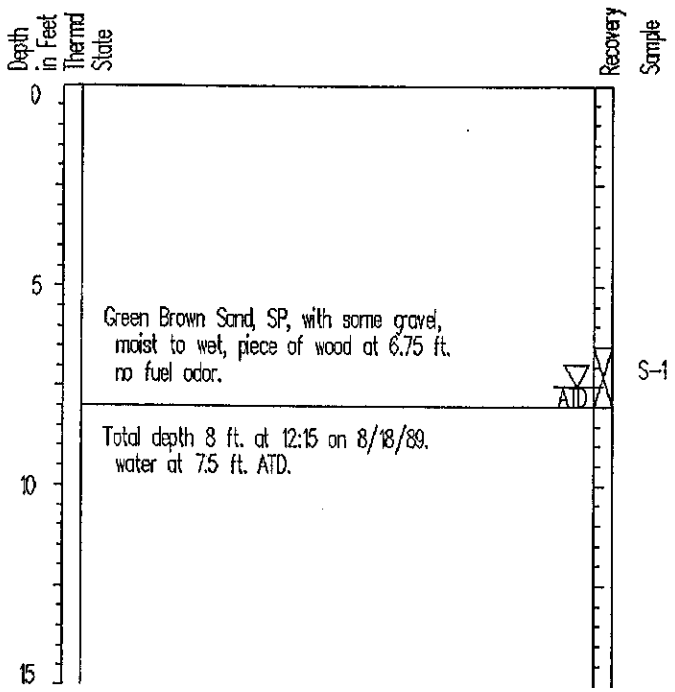
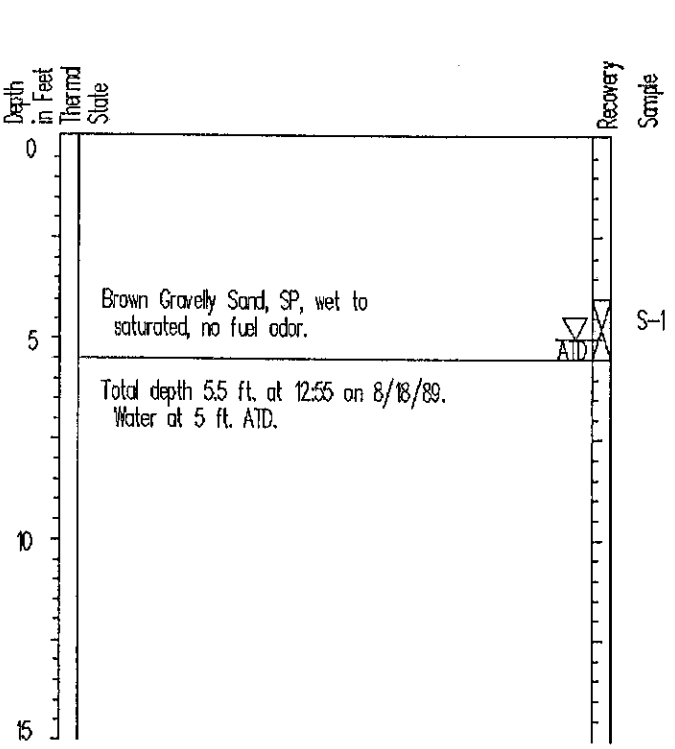
Figure B-2

ACE 6041915

Boring Log BH-3



Boring Log BH-4



NOTES:

1. Soil descriptions are interpretative and actual changes may be gradual.
2. Water level is for date indicated and may vary with time of year. (ATD - At Time of Drilling)
3. Refer to Figure B-1 for explanation.

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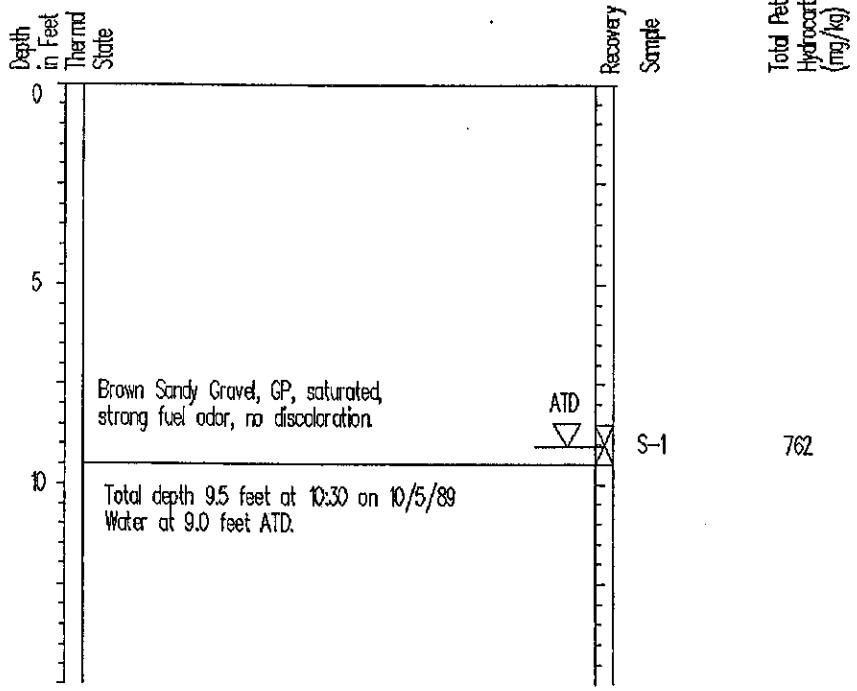
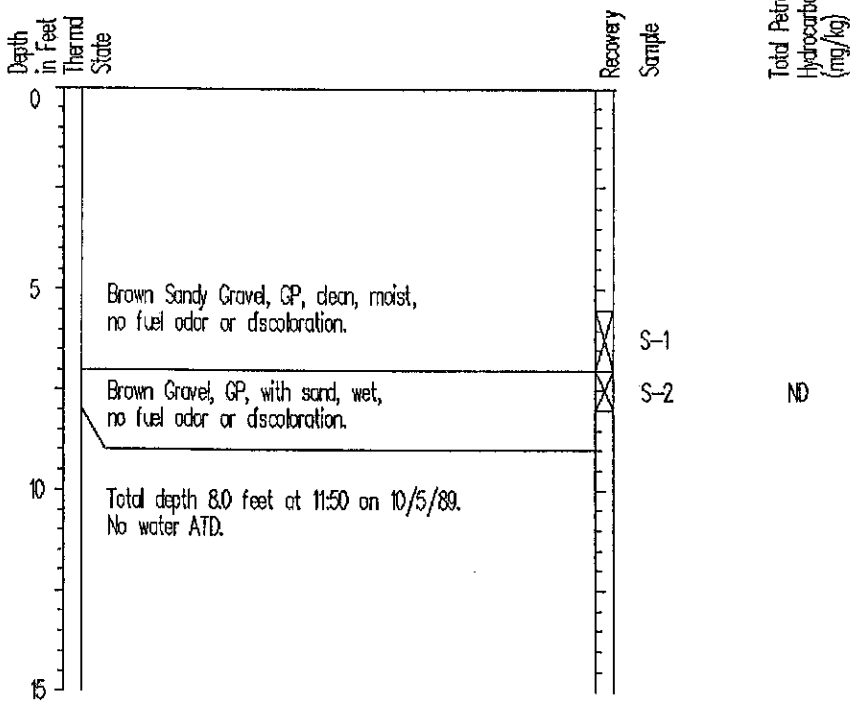
Boring Log BH-5



Boring Log S-6



NOTES:

1. Soil descriptions are interpretive and actual changes may be gradual.
2. Water level is for date indicated and may vary with time of year. (ATD - At Time of Drilling)
3. Refer to Figure B-1 for explanation.

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Figure B-4

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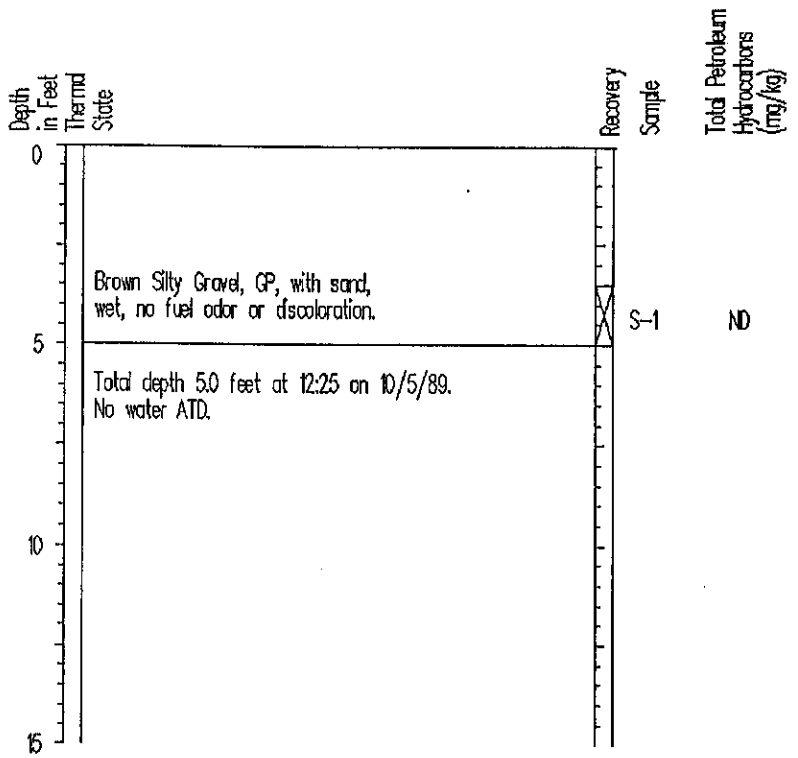
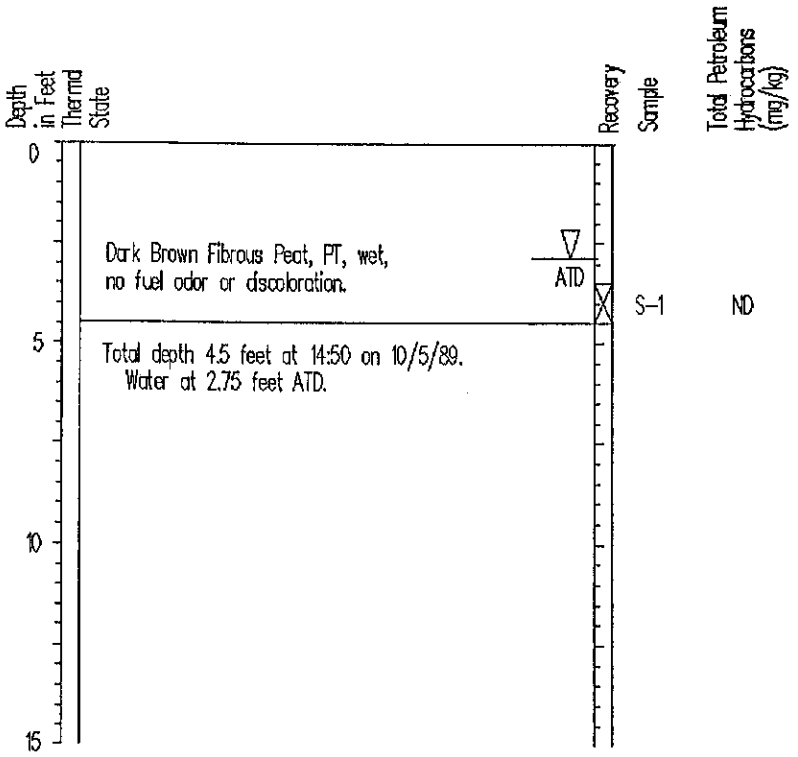
Boring Log BH-7



Boring Log BH-9



NOTES:

1. Soil descriptions are interpretive and actual changes may be gradual.
2. Water level is for date indicated and may vary with time of year. (ATD – At Time of Drilling)
3. Refer to Figure B-1 for explanation.

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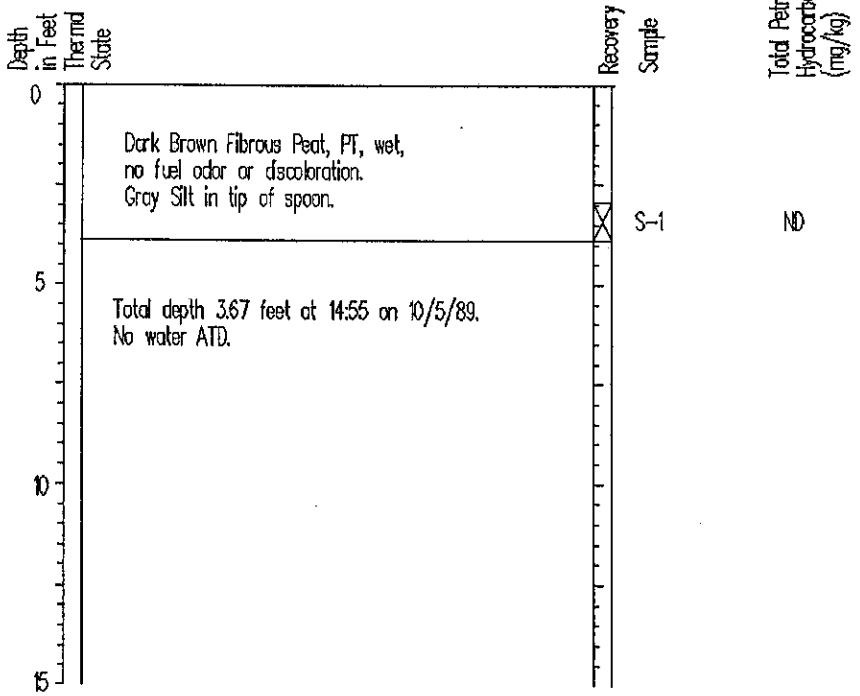
Boring Log BH-10



NOTES:

1. Soil descriptions are interpretive and actual changes may be gradual.
2. Water level is for date indicated and may vary with time of year. (ATD - At Time of Drilling)
3. Refer to Figure B-1 for explanation.

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Figure B-6

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APPENDIX C
FIELD ANALYTICAL PROCEDURES

This appendix documents the analytical procedures Hart Crowser uses to field screen soil gas samples for benzene, toluene, ethylbenzene, and xylenes (BTEX). Major topics addressed include:

- Procedures for Soil Gas Analysis
- Calibration Procedures and Frequency
- QA/QC Procedures

Procedures for Soil Gas Analysis

Sample Preparation. The soil gas samples were collected in 1-liter Tedlar bags with teflon-lined septa. Prior to soil gas analysis, the samples were held at ambient temperature in an insulated container.

Soil Gas Analysis. A 5-ml sample was withdrawn from the tedlar bag using a gas-tight syringe, and injected into the sample port of the gas chromatograph.

Analysis was performed on a Shimadzu GC-8A temperature-programmable gas chromatograph (GC) equipped with a flame ionization detector and a computerized integrator. A DB-624 0.53 mm x 30 m megabore capillary column was used to separate the compounds of interest. The oven temperature was programmed to optimize sample turnaround while maintaining the desired detection limits and peak resolution.

Quantification of Results. Peak area is measured by the integrator and compared to calibration curves prepared by the operator. The instrument was calibrated to benzene, using benzene in nitrogen standards supplied by Scott Specialty Gases.

Table 1 contains the results as parts-per-million by volume (ppmV). Compound identification was by retention time, as determined by analysis of a BTEX standard.

Calibration Procedures and Frequency

The gas chromatograph was calibrated for benzene.

Standard Preparation. Certified benzene in nitorgen gas standards were prepared by Scott Specialty Gases at 1, 100, and 1,000 ppmV.

Prior to Analysis. The calibration was checked at 1, 100, and 1,000 ppmV daily, prior to the beginning of analysis. If the calibration check differed by more than ±20% from the expected result, at any of the three concentrations, the GC was recalibrated at the suspect concentration.

Ongoing Calibration Checks. After no more than 10 analyses, or at the end of analysis, one of the calibration standards was reanalyzed. The standard chosen was of a concentration in the range of the previously analyzed samples.

If the calibration check differed by more than ±20% from the expected result, the G.C. was recalibrated and the samples analyzed (back to the most recent acceptable calibration check) and reanalyzed using the new calibration. Table C-1 presents the results of the calibration checks.

QA/QC Procedures

Replicate Analysis. A minimum of one in ten samples were analyzed in replicate to demonstrate analytical precision. The control limit for precision (P) was 20% of the sample mean, which was calculated as follows:

$$P = (R_1 - R_2/X) \times 100$$

where

R1 = sample value
R2 = replicate value
X = sample mean = $(R_1 + R_2)/2$

Precision values are presented in Table C-2.

TABLE C-1: Calibration Data - Benzene in Nitrogen Standards
Butler Aviation POL Pipeline Site Assessments
Butler Aviation A-8167

DATE	CONCENTRATION EXPECTED (ppmV)	CONCENTRATION OBSERVED (ppmV)	DELTA (%)
08/16/89	1.01	1.00	-1
08/16/89	1.01	0.949	-6
08/16/89	106	89.3	-15
08/16/89	1030	993	-4
08/16/89	1.01	0.909	-10
08/16/89	1.01	0.829	-18
08/17/89	106	88.8	-16
08/17/89	1030	978	-4.2
08/17/89	Recalibrated at 1.01 ppmV		
08/17/89	1.01	0.91	-9.9

Benzene in nitrogen standards prepared by Scott Specialty Gases Inc.

TABLE C-2: Precision Data
Butler Aviation POL Pipeline Site Assessments
Butler Aviation A-8167

SAMPLE	BENZENE (ppmV)	PRECISION (%)	TOLUENE (ppmV)	PRECISION (%)	E-BENZENE (ppmV)	PRECISION (%)	P & M-XYLENE (ppmV)	PRECISION (%)	O-XYLENE (ppmV)	PRECISION (%)	BTEX (ppmV)	PRECISION (%)
CC-A/REP	ND/ND	-	ND/ND	-	ND/ND	-	ND/ND	-	ND/ND	-	ND/ND	-
CC-G/REP	ND/ND	-	2.16/2.56	17	ND/ND	-	1.26/1.05	18	ND/ND	-	3.42/3.61	11
CST-5/REP	ND/ND	-	2.56/2.43	5.2	ND/ND	-	1.04/1.01	2.9	ND/ND	-	3.60/3.44	4.5

Limit of Quantitation - 1.0 ppmV ND - None Detected (Less than 0.2 ppmV) TRACE - Compound detected but at non-quantifiable level.