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# UNITED STATES ARMY ENVIRONMENTAL HYGIENE AGENCY

ABERDEEN PROVING GROUND, MD 21010-5422

PHASE 1
HAZARDOUS WASTE STUDY NO. 37-26-0725-87
EVALUATION OF FIRE TRAINING PITS
FORT RICHARDSON, ALASKA
8-26 SEPTEMBER 1986

# DEPARTMENT OF THE ARMY

U. S. ARMY ENVIRONMENTAL HYGIENE AGENCY
ABERDEEN PROVING GROUND, MARYLAND 21010-5422

REPLY TO
ATTENTION OF

HSHB-ME-SE

11 May 1987

SUBJECT: Phase 1, Hazardous Waste Study No. 37-26-0725-87, Evaluation of Fire Training Pits, Fort Richardson, Alaska, 8-26 September 1986

Commander
US Army Forces Command
ATTN: AFEN-FDE
Fort Gillem,
Forest Park, GA 30305-6000

EXECUTIVE SUMMARY

The purpose and the recommendations of the enclosed report follow:

a. Purpose. To evaluate the existence and extent of contamination released to the soil at four fire training pits (FTP's) at Fort Richardson (2), Fort Wainwright (1), and Fort Greely (1). Phase 2 of this project will resample FTP2 and FTP3 for volatile organic contaminants and evaluate waste oil segregation procedures to ensure that hazardous wastes are not commingled with waste oils.

b. Recommendations.

(1) To ensure regulatory compliance, the following recommendation is made: Do not mix the petroleum wastes that are burned at the FTP's with hazardous wastes such as halogenated solvents.

(2) To ensure good environmental engineering practice, the following recommendations are made: Label all of the drums at FTP1 and FTP3, and place them in an area where containment of spills is provided; remove all of the empty drums and debris from the area around the FTP's; clean up all of the fuel spills in the area of the FTP's; take soil samples to determine the appropriate closure methods for FTP1 and FTP3 upon closure; take additional surface samples for volatile organic analysis in FTP2 and FTP3; evaluate the waste oil segregation procedures on each installation; implement the construction of new FTP's at each installation; expedite the construction of the new burn pit at Fort Richardson and properly close FTP1; and conduct a geohydrological study to determine the quality of the ground water at FTP4.

FOR THE COMMANDER:

Encl

KARL J. DAUBEL
Colonel, MS
Director, Environmental Quality

CF:
HQDA(DAEN-ZCF-U/DAEN-ZCE) (w/encl)
HQDA(DASG-PSP) (wo/encl)
Cdr, FORSCOM (AFMD-PC) (4 cy) (w/encl)
Cdr, Ft Richardson (DEH) (2 cy) (w/encl)
Cdr, Ft Wainwright (DEH) (2 cy) (w/encl)
Cdr, Ft Greely (DEH) (2 cy) (w/encl)
Cdr, MEDDAC, Alaska (PVNTMED Svc) (2 cy) (w/encl)
Cdr, MAMC (PVNTMED Svc) (w/encl)
Cdr, USAEHA Fld Spt Actv, FAMC (w/encl)

Phase 1, Hazardous Waste Study No. 37-26-0725-87, Ft Richardson, AK, 8-26 Sep 86

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8-26 SEPTEMBER 1986

I. AUTHORITY. Letter, FORSCOM, AFMD-PC, 27 August 1985, subject: USAEHA Mission Services, FY 86.

II. REFERENCES. A list of references is included in Appendix A.

III. PURPOSE. To evaluate the existence and extent of contamination released to the soil at four fire training pits at Fort Richardson (2), Fort Wainwright (1), and Fort Greely (1).

IV. GENERAL.

A. Briefings.

1. An entrance briefing for Fort Richardson was conducted on 9 September 1986 with the following DEH personnel in attendance: Ms. Catherine Benediktsson, Chief, Environmental Branch, and Mr. Carl Gysler, Environmental Engineer. An exit briefing for Fort Richardson was conducted on 16 September 1986 with the following personnel in attendance: Ms. Benediktsson and Mr. Gysler.

2. An entrance briefing for Fort Wainwright was conducted on 17 September 1986 with the following DEH personnel in attendance: Mr. Brent Koenen, Environmental Engineer; Mr. Paul Stookey, Environmental Engineer; Mr. Junior Kerns, Biologist; and Mr. Ken Spires, Wildlife Biologist. An exit briefing for Fort Wainwright was conducted on 18 September 1986 with the following personnel in attendance: Mr. Koenen, Mr. Stookey, Mr. Kerns, and Mr. Spires.

3. An entrance briefing for Fort Greely was conducted on 19 September 1986 with Mr. Kent Monroe, Environmentalist, DEH. An exit briefing for Fort Greely was conducted telephonically with Mr. Monroe on 24 September 1986.

B. Abbreviations and Definitions. The abbreviations used in this report are defined in Appendix B.

C. Study Personnel. This project was conducted by 1LT Gregory S. Porter, Project Officer, USAEHA; with the assistance of Mr. Dennis Van Landingham, Drill Rig Operator, USAEDA; Mr. Kenneth Mitchell, Drilling Assistant, USAEDA; and Mr. Keith Mitchell, Drill Rig Operator, USAEDA.

D. Background.

1. The 6th Infantry Division (Light) is organized on a one-installation, three-post concept. The posts involved in this organization are Fort Richardson, Fort Wainwright, and Fort Greely. The locations of these installations are shown in Figure 1. Most of the staff offices are organized at Fort Richardson with branch offices located at Fort Wainwright and Fort Greely.

2. Fort Richardson is the headquarters of the 6th Infantry Division (Light) whose mission is to train arctic and mountain fighting forces. Fort Richardson is located northeast of Anchorage on approximately 62,500 acres of land. It is bounded by the Knik Arm of Cook Inlet to the north and the Chugach Mountains on the southeast. The population of Fort Richardson is approximately 11,800 people.

3. Fort Wainwright's mission is to train soldiers and test equipment in arctic conditions. Fort Wainwright consists of approximately 667,000 acres of land immediately east of Fairbanks. The Tanana River divides the installation into a northern portion, which includes the cantonment area, and a southern portion, which is used for training. The installation population is approximately 7,000 people.

4. Fort Greely's mission is to train soldiers and test equipment in arctic conditions, and provide support to the US Army Northern Warfare Training Center, US Army Cold Regions Test Center, and the US Army Meteorological Team. Fort Greely consists of approximately 661,000 acres of land approximately 98 miles southeast of Fairbanks, near the city of Delta Junction. Fort Greely has an installation population of approximately 1,850 people.

5. In October 1984, Fort Richardson was cited with several EPA and ADEC violations at FTP2, FTP3, and FTP4. These violations included improper storage of HW's, unlabeled HW containers, and waste spills. The ADEC required soil and liquid sampling from the pit and various drums. In May 1985, the surface soil in FTP2 was sampled and found to have a high concentration of cadmium, lead, and zinc, and the surface soil in FTP4 was sampled and contained high concentrations of toluene, xylene, 1,1,1-trichloroethane, and trichloroethylene.

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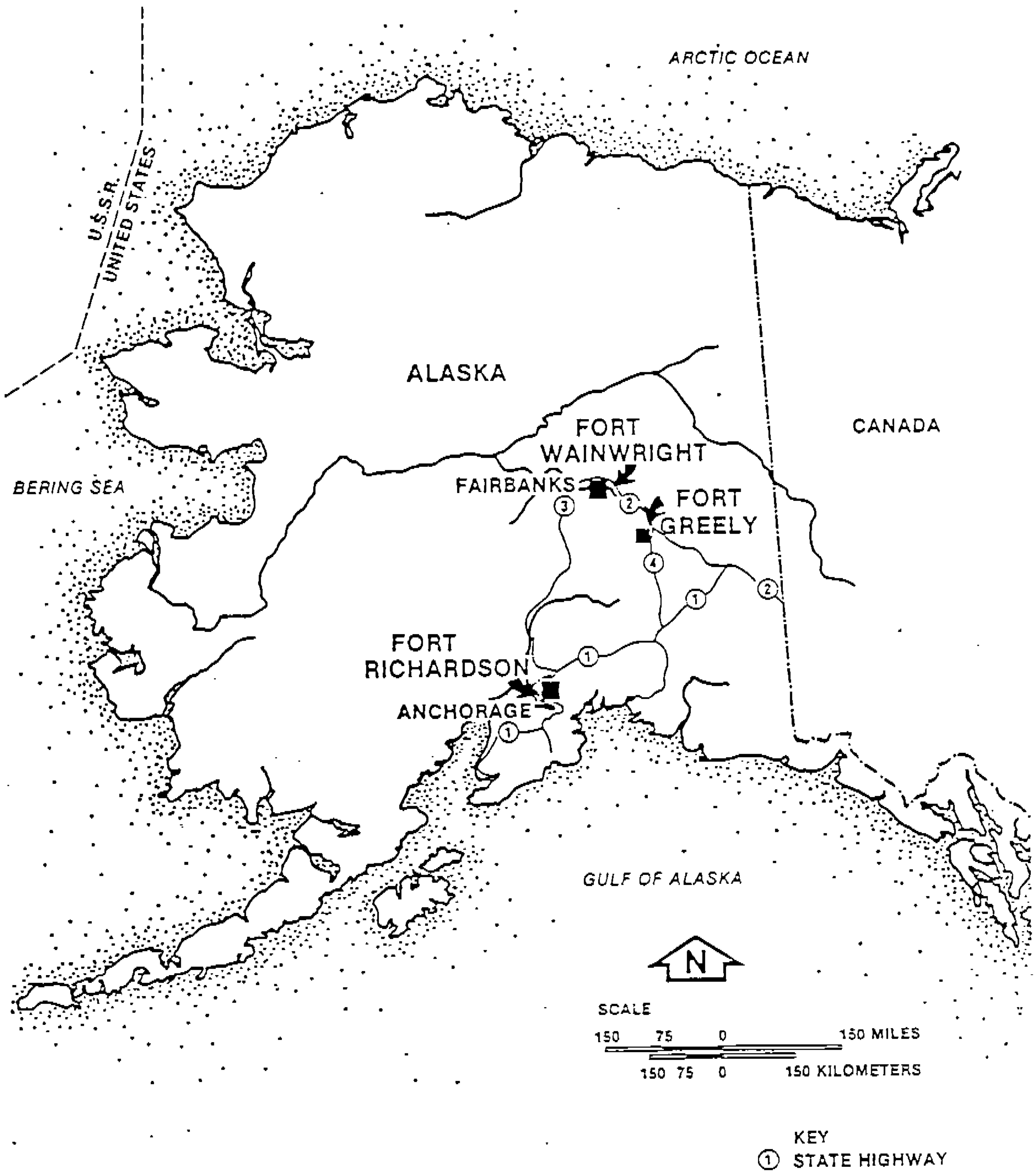


Figure 1. Installation Locations.

V. FINDINGS AND DISCUSSION.

A. General.

1. Used petroleum products from installation motor pools were burned by the Fort Richardson, Fort Wainwright, and Fort Greely Fire Departments for training under a variance from the ADEC. Hazardous wastes, such as used solvents and brake fluids, may have been mixed with the petroleum wastes in the past. Each installation should ensure that petroleum products that have been mixed with HW, such as halogenated solvents, are not burned at the FTP's. In general, the commingling of an HW with a non-HW yields the entire mixture as an HW. If segregation of HW and non-HW is not being accomplished, testing of the resulting mixture must be done to ensure that the mixture does not exhibit hazardous characteristics. Open burning of halogenated solvents is not permitted by RCRA.

2. Fire training was accomplished by saturating the soil in the pits with water and then discharging fuel into the shallow, unlined pits, and burning it. The fuel used in the pits consisted of oil, solvent, transmission fluid, brake fluid, hydraulic fluid, and water-contaminated diesel and JP4. These materials were stored at the sites in 55-gallon drums until they were later burned in training exercises. The fuel used for training at FTP3 is stored onsite in 55-gallon drums and in an aboveground storage tank. Approximately 1,500-2,300 gallons of these wastes were burned at each FTP yearly.

3. Improper storage of potentially HW's, unlabeled waste drums, and waste fuel spills were noted at FTP1 and FTP3 during the study. To prevent contaminant releases to the environment and improve installation waste management techniques, all drums should be labeled and placed in an area where containment of spills is provided, or tanks should be utilized for waste fuel or oil storage. Empty drums should be removed from the sites and reused or properly disposed of. All spills in the waste fuel storage areas should be cleaned up to avoid further contamination to the environment. Diesel- and JP4-contaminated soil from spills was placed in piles in the area of FTP1 to aerate and will be spread out to allow the JP4 to dissipate. Further treatment may be needed to complete the cleanup of this soil.

B. Sampling Procedures.

1. Track-mounted auger drill rigs turning 8-inch hollow stem auger were used to collect soil samples to determine the existence and extent of contamination at each site. A Mobile B47 drill rig was used at Fort Richardson, and a Mobile B50 drill rig was used at Fort Wainwright and Fort Greely. Three boreholes were drilled at each site. The first borehole was located topographically upgradient of the pit to obtain background chemical data for the soil, the second one was topographically downgradient of the pit, and the third one was drilled in the pit. This order of drilling was used to reduce the possibility of cross contamination by drilling into the

areas expected to be the cleanest before drilling into the potentially more contaminated areas. By comparing the results of the chemical analyses for the downgradient borehole with those of the pit and the upgradient, an indication of the horizontal contaminant migration can be obtained. The boreholes were logged in detail from the auger cuttings in the field by the project officer, using the Unified Soils Classification System. Samples were taken with a split-spoon sampler at the following intervals, where possible; surface, 5 feet, 10 feet, 20 feet, and 30 feet. The actual depth of the holes was determined by the depth to the top of the water table, or refusal. Drilling was limited to 6 feet at FTP1 because it was located on a closed landfill. The drill team encountered buried waste at this depth and discontinued drilling. Drilling into a landfill is an environmentally unsound practice, and can be a safety hazard to the drill team.

2. The boreholes were sealed with a minimum of 3 feet of bentonite clay in the bottom, grouted to within 3 feet of the surface, and filled to the surface with bentonite clay. This procedure was used to seal the borehole; thus, preventing it from acting as an avenue for contamination migration.

3. Samples were taken with a 3-inch diameter split-spoon driven by a 340-pound hammer. The split-spoon and all other sampling equipment that was used were washed, triple rinsed in tap water, and rinsed with acetone to avoid cross contamination between samples. A clean, unused plastic scoop was used to collect additional surface samples in each pit and topographically downgradient of each pit to further assess the extent of contamination in the area of each pit. The soil collected at the surface for the volatile organic analysis was taken from a depth of approximately 3 to 5 inches.

C. Quality Control Procedures.

1. To preserve the samples until analysis, the samples were containerized in prerinsed, clean glass bottles with Teflon® inserts in the lids, and stored on ice until they were transported to the laboratory.

2. Samples were taken from the fire training pits at Fort Richardson, Fort Wainwright, and Fort Greely, and were subjected to an organics scan by GC upon arrival at this Agency's laboratory. This scan was used to detect the presence of organics to aid in the determination of the extent of sampling to be done at each site. The organics detected in the scan were not specifically quantified or identified at this point in the analytical process.

®Teflon is a registered trademark of the E. I. DuPont de Nemours, and Co., Inc., Wilmington, Delaware.

3. The EPA recommended holding times for the volatile, acid extractable, and base/neutral extractable organics were exceeded. This may not have had a substantial effect on the acid extractable and base/neutral extractable organics results because these compounds are not highly volatile. Due to a mechanical malfunction of the Gas Chromatograph/Mass Spectograph in the laboratory, only one sample from each fire training pit was analyzed for volatile organics in an effort to identify the contaminants contained in them. All of the samples were analyzed for EP Toxic metals, explosives, acid extractable organics, base/neutral extractable organics, and pesticides. In-house quality control samples were analyzed by the laboratory, and no major discrepancies were detected. Appendix E contains a complete list of the constituents that were analyzed.

D. Fort Richardson, Fire Training Pit 1 (FTP1) and Fire Training Pit 2 (FTP2).

1. FTP1.

a. Geology.

(1) Fort Richardson is located primarily within the Cook Inlet-Susitna Lowland section of the Coastal Trough physiographic province of Alaska. This area is a flat to gently rolling, wooded area that contains numerous streams and ponds. The eastern-central and south-eastern portions of Fort Richardson lie in the Kenai-Chugach Mountains section of the Pacific Border Ranges physiographic province. This section consists of mountains separated by rounded valleys and eroded passes resulting from previous glaciation.

(2) Fort Richardson is underlain by metamorphic rocks of the Kenai Formation. The mountains and lowlands are mantled by Wisconsin deposits of till, outwash, silt, and Pleistocene or recent alluvial fan deposits. Five periods of glaciation occurred in the area of Fort Richardson; Mount Susitna glaciation to the northwest, Carabou Hills Glaciation to the east, and Eklutna glaciation, Knik glaciation, and Naptowne glaciation in the Anchorage area. Glacial deposits from the Naptowne glaciation overlie the Bootlegger Cove Clay and underlie the Naptowne advance outwash. These are the primary materials that outcrop on the installation. The Bootlegger Cove clay is a light gray silty clay which underlies sand and gravel in the banks along the lower portions of Ship Creek and extends under the Naptowne glaciation outwash and ground moraine east of Knik Arm. Erosional processes in the area have caused the undercutting of sea-bluffs, landslides, and downcutting by streams into consolidated and unconsolidated materials.

(3) In general, two major soil types occur on Fort Richardson; Rockland soil and loams. The Rockland soil, a rocky material, is predominant throughout the Chugach Mountains. These soils are primarily gravels. Rockland loam occurs on lower slopes, moraine hills, and glacial outwash plains. It is a well-drained shallow composition of silt-loam and peat overlying a gravelly or sandy loam. Peat occurs in depressions, and silty soils occupy small drainageways and depressions.

(4) The alluvium of the Anchorage Plain consists mainly of gravel and sand. It is primarily gravel in the eastern portion of the installation, grading into sand to the west. In the western end of the deposits, the soil grades into a well-sorted sand with small amounts of gravel. This is commonly overlain by 1 to 5 feet of silt or silty-clay.

b. Hydrology.

(1) The primary surface drainage features on Fort Richardson are Eagle River and Ship Creek and their associated tributaries. Both streams originate in the Chugach Mountains and flow across the installation in a western direction into the Knik Arm of Cook Inlet. Eagle River is fed by turbid glacial melt waters, and Ship Creek is sustained by snowmelt runoff. Both streams have peak flows in the summer and low flows in the winter. Fort Richardson receives domestic water from a water supply reservoir on Ship Creek in the Chugach Mountains.

(2) Fort Richardson is located in the south-central hydrologic subregion of Alaska. The ground-water supply in the area is recharged from surface water streams. Ship Creek recharges the ground-water system near the mountains, and Ship Creek is recharged by the ground water near Knik Arm. Regional ground water flow is to the west. The depth to water on most of Fort Richardson ranges from 20 to 40 feet below the land surface.

(3) The local water table aquifer in the area of FTP1 flows southwest in the Ship Creek drainage basin. This aquifer eventually empties into Knik Arm.

c. FTP1, Specific Findings.

(1) The site was a 50-foot diameter, unlined FTP located on a closed landfill as shown in Figure 2. This FTP has been in use since 1985.

(2) As indicated in the borelogs in Appendix C, the soils in the area of FTP1 are primarily a silty clay underlain by a rocky clayey sand. These soils were logged from the auger cuttings in the field. Split-spoon samples were taken at the surface and at 5-foot intervals for chemical analysis. The depth at which the split-spoon samples were taken is depicted in the borelogs. Drilling was limited to 6 feet at FTP1 because it was located on a closed sanitary landfill. The Drill Team encountered waste at this depth and discontinued drilling. Drilling into a landfill is an environmentally unsound practice, and can be a safety hazard to the drill team. Additional surface samples were collected with plastic scoops in an effort to detect horizontal contamination migration from the pit. The location of these boreholes and additional surface samples are shown in Figure 3. Table 1 identifies the samples taken in FTP1.

(3) While highly variable, the number of constituents and their concentrations tended to decrease as the depth of the borehole increased. The surface sample from the borehole in the pit (P1B301) contained 54 ppm

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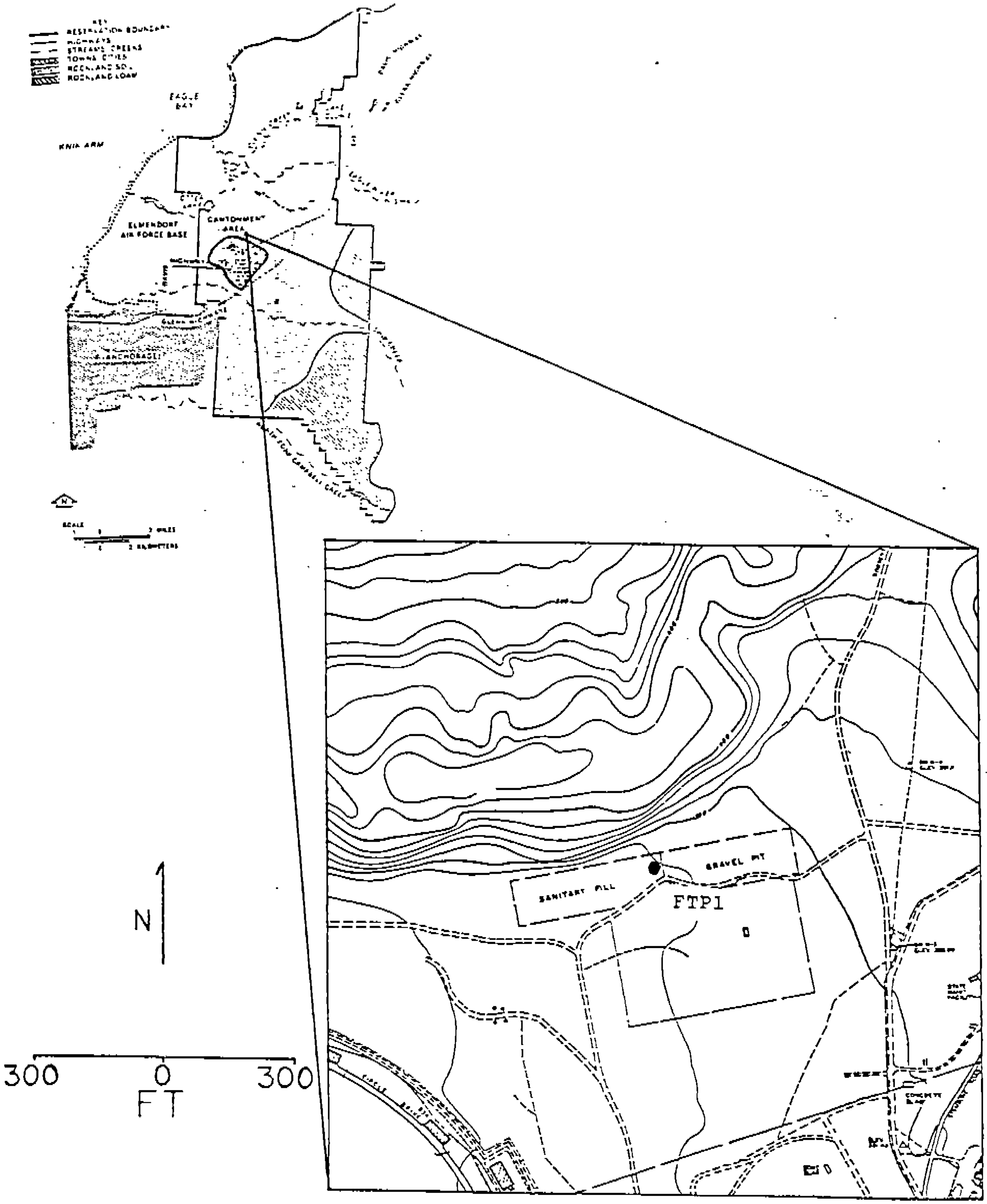


Figure 2. Location of FTP1, Fort Richardson.

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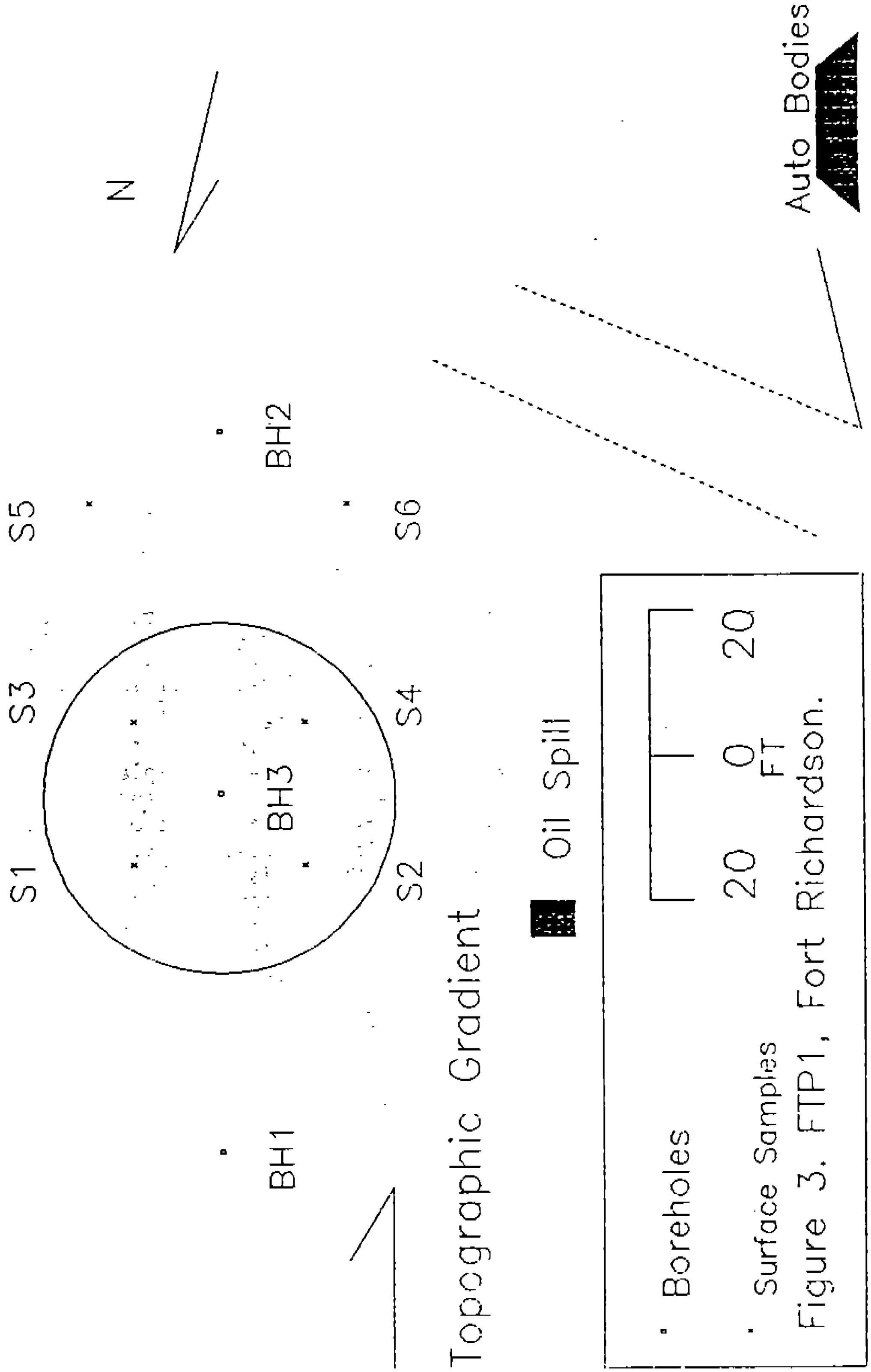

Figure 3. FTP1, Fort Richardson.

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TABLE 1. SAMPLE IDENTIFICATION, FTP1

| Sample Number | Location | Depth |
|---|---|---|
| P1B101 | BH1, Upgradient | Surface |
| P1B102 | BH1, Upgradient | 5 Feet |
| P1B201 | BH2, Downgradient | Surface |
| P1B202 | BH2, Downgradient | 5 Feet |
| P1B301 | BH3, In Pit | Surface |
| P1B302 | BH3, In Pit | 5 Feet |
| P1S1 | In Pit | Surface |
| P1S2 | In Pit | Surface |
| P1S3 | In Pit | Surface |
| P1S4 | In Pit | Surface |
| P1S5 | Downgradient | Surface |
| P1S6 | Downgradient | Surface |

of 2-methylnaphthalene. This was also found in three other surface samples in the pit ranging from 270 ppm in sample P1S2 to 47 ppm in P1S3. Although this compound displays only slightly toxic characteristics, high concentrations could adversely affect human health or the environment if it migrates into the ground water. However, 2-methylnaphthalene was not detected in the sample taken 5 feet below the surface which may indicate that little or no vertical migration of this constituent has occurred. Sample P1S2 had 58 ppm of bis (2-ethylhexyl) phthalate detected in it. The absence of this compound in the subsoils in the area indicates little migration towards the ground water; therefore, this quantity should not present a substantial hazard to human health or the environment. While bis (2-ethylhexyl) phthalate is a suspected carcinogen, it is also a common laboratory contaminant; thus, it may not have originated from the soil. Even though the holding time for the volatile organic analysis for sample P1S2 was exceeded, 207 ppm of toluene and 107 ppm of ethylbenzene were detected. These are volatile organics and may have actually existed in the soil at higher concentrations. The NPDWR RMCL of toluene is 2.0 ppm and the proposed RMCL for ethylbenzene is 0.68 ppm; therefore, if a large amount of these contaminants migrate into the ground water, a potential hazard to human health or the environment would exist. Because FTP1 is still in use and the potential for burning unauthorized wastes exist, additional soil samples should be taken to determine the extent and depth of contamination in the pit upon closure. These samples could also be used to determine the appropriate remedial action requirements for the pit (i.e., depth of soil removal and soil treatment or disposal techniques, a clay capping system for the pit, or no action required). A complete list of the constituents found in the samples is provided in Appendix D, and a list of analytical parameters is included in Appendix E.

(4) Fort Richardson had submitted a work request for a new burn pit. This request called for an 8-inch thick concrete floor with berms for containment of unburned waste oils and fuels. This design also included replacement of the current "flood" type fuel supply system with a fuel feed system which has a storage tank for the fuel. This would provide better management of the fuel than that provided by the drum storage system that is currently in use. The proposed system would reduce the potential for environmental contamination from fire training operations.

(5) Due to the high concentrations of 2-methylnaphthalene, toluene, and ethylbenzene found in FTP1, the expedient construction of the new burn pit should be implemented for fire training and FTP1 should be closed. Appropriate remedial actions should be initiated to ensure proper closure procedures are used at FTP1.

2. FTP2.

a. Geology. For details of the general geology of Fort Richardson, refer to section VB1a of this report.

b. Hydrology. For details of the general hydrology of Fort Richardson, refer to section VB1b of this report. The local water table aquifer in the area of FTP2 flows west in the Ship Creek drainage basin. This area appears to be within the principle confined aquifer recharge zone; therefore, potential for contamination of the phreatic aquifer and confined aquifer systems exists.

c. FTP2, Specific Findings.

(1) The FTP was a 50-foot diameter, unlined pit located near a gravel borrow area as shown in Figure 4. This FTP was in operation prior to 1985.

(2) Debris was found in and around FTP2. This debris consisted of empty drums, partially burned wood, oil cans, car bodies and parts, paint cans, varnish cans, cables, and pallets. Waste oil spills were observed near the pit also. These spills should be cleaned-up to avoid further contamination to the environment. The pit also had standing water in it at the time of the study.

(3) The borelogs in Appendix C illustrate that the soils in the area of FTP2 are primarily stratified layers of silty sands or clayey sands, and gravels. These soils were logged from the auger cuttings in the field. Split-spoon samples were taken at the surface and at 5-foot intervals for chemical analysis. The depth at which the split-spoon samples were taken are depicted in the borelogs. Additional surface samples were collected with plastic scoops in an effort to detect horizontal contaminant migration from the pit. The location of these boreholes and additional surface samples are shown in Figure 5. Table 2 identifies the samples taken in FTP2.

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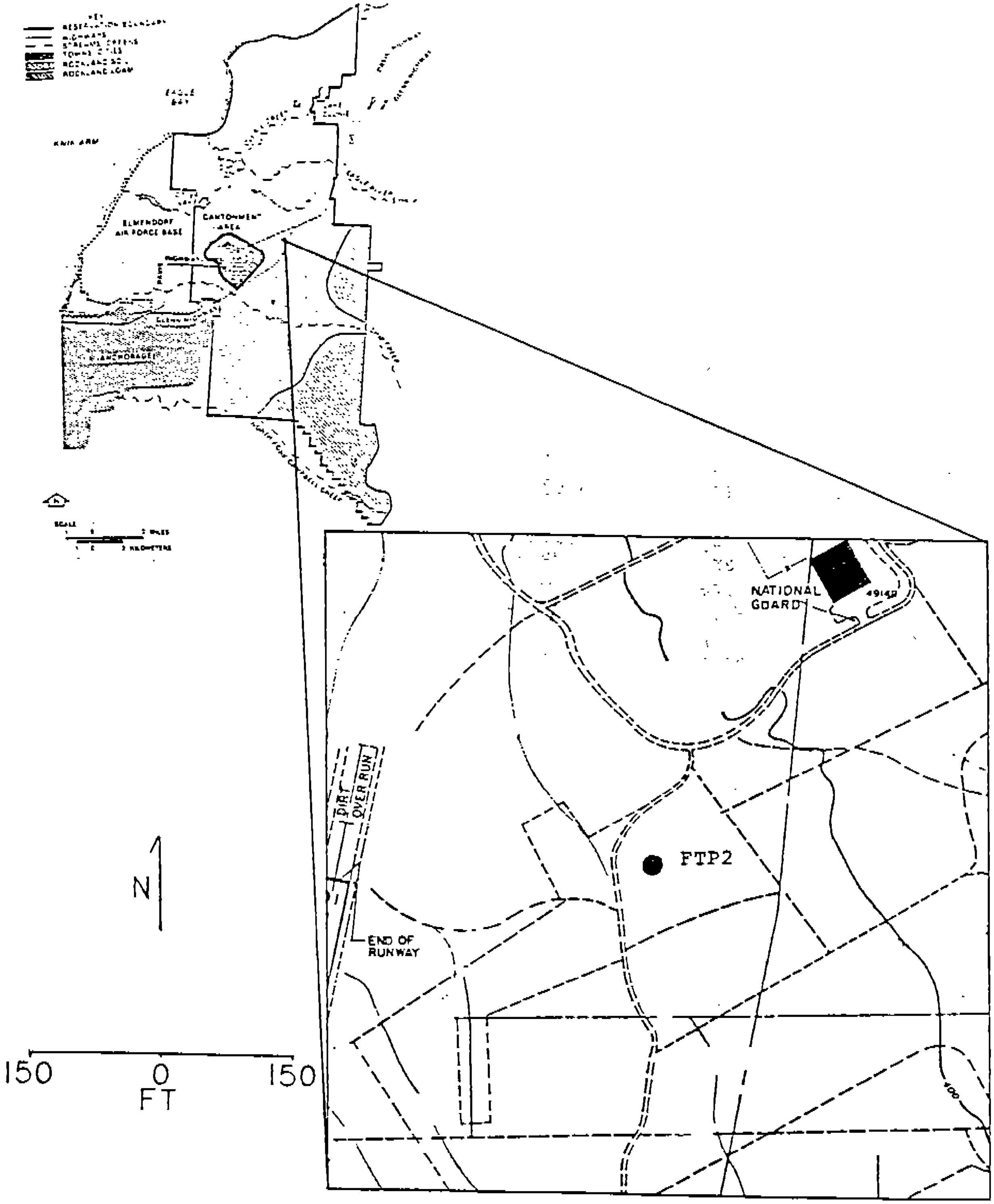


Figure 4. Location of FTP2, Fort Richardson.

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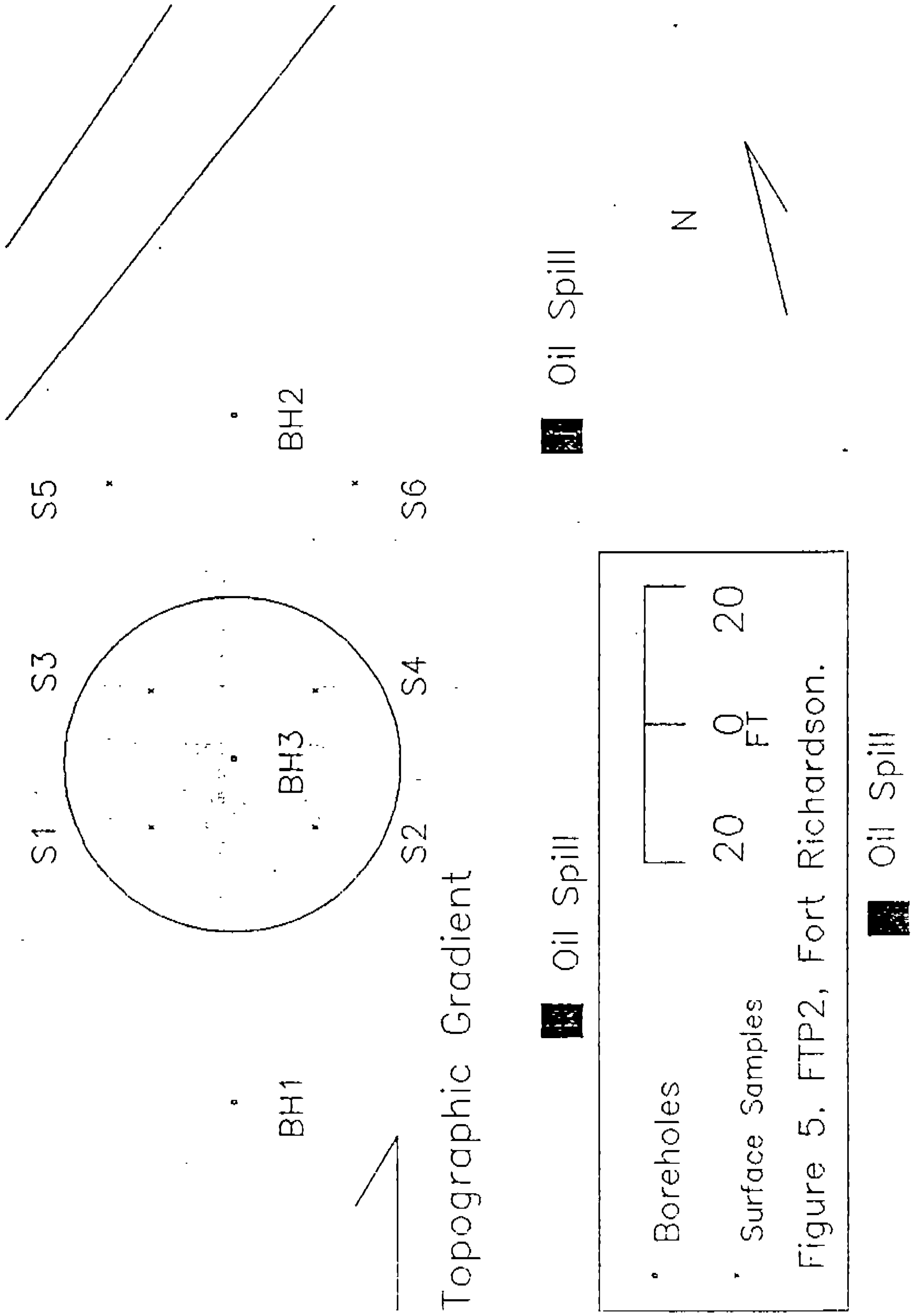


Figure 5. FTP2, Fort Richardson.

TABLE 2. SAMPLE IDENTIFICATION, FTP2

| Sample Number | Location | Depth |
|---|---|---|
| P2B101 | BH1, Upgradient | Surface |
| P2B102 | BH1, Upgradient | 5 Feet |
| P2B103 | BH1, Upgradient | 10 Feet |
| P2B104 | BH1, Upgradient | 15 Feet |
| P2B201 | BH2, Downgradient | Surface |
| P2B202 | BH2, Downgradient | 5 Feet |
| P2B203 | BH2, Downgradient | 10 Feet |
| P2B204 | BH2, Downgradient | 15 Feet |
| P2B205 | BH2, Downgradient | 20 Feet |
| P2B301 | BH3, In Pit | Surface |
| P2B302 | BH3, In Pit | 5 Feet |
| P2B303 | BH3, In Pit | 10 Feet |
| P2B304 | BH3, In Pit | 15 Feet |
| P2B305 | BH3, In Pit | 20 Feet |
| P2S1 | In Pit | Surface |
| P2S2 | In Pit | Surface |
| P2S3 | In Pit | Surface |
| P2S4 | In Pit | Surface |
| P2S5 | Downgradient | Surface |
| P2S6 | Downgradient | Surface |

(4) Surface sample P2S2 contained 0.511 ppm of leachable lead. This minute amount of lead should not have a substantial effect on human health or the environment. No other constituents were quantified as being present in FTP2; however, the holding time for the volatile organic samples was exceeded. Therefore, additional surface samples (3- to 5-inches below the surface) should be taken and analyzed for volatile organic parameters to ensure the protection of human health and the environment from potential contamination emanating from FTP2. A complete list of the constituents found in the samples including trace elements is in Appendix D, and a list of analytical parameters is in Appendix E.

E. <u>Fort Wainwright, FTP3</u>.

1. Geology.

a. Fort Wainwright is underlain primarily by Precambrian Birch Creek schist. The area has not been glaciated, but glaciers approached the area and glacial materials were deposited in the Fort Wainwright area by the heavily loaded Tanana River. Most of the area is covered by a mantle of silty micaceous loess derived from outwash plains of the Tanana River. This ranges from 35- to 90-feet deep in valleys to just inches on ridge tops. Some hills of Devonian and Mesozoic rock protrude from the alluvium.

b. The western section of Fort Wainwright, including the cantonment area, is located in the Tanana-Kuskokwin Lowlands of central Alaska, south of the city of Fairbanks. Most of the area consists of flat lowlands with flat to gently rolling surfaces.

c. The soils on Fort Wainwright are made up of silt loams, silty-sandy loams, and gravelly-silt loams. The upland area north of the Tanana River is covered by silt loams over bedrock. The Tanana and Chena River flood plains are occupied by poorly drained silty-sandy loams, and the soils near the northwestern boundary of the installation are stratified loams and a sandy-silty material. The area south of the Tanana River is primarily a silty loam. The north-facing slopes of the hills around Blair Lake and the southwestern edge of Fort Wainwright are occupied by gravelly-silty loam.

2. Hydrology.

a. The primary surface drainage features on Fort Wainwright are the Tanana River and Wood River. Peak flows occur during the summer and low flows are in the winter.

b. Isolated areas of dense permafrost which occur intermittently on Fort Wainwright act as confining beds. Recharge to the aquifers occurs in areas where the permafrost is absent or less dense. The ground water occurring above the permafrost is of poor quality, while the water below the permafrost is of good quality and is the primary source of drinking water on Fort Wainwright.

c. The ground-water supply is greatest along the flood plains of the major rivers and alluvial fan areas. Recharge to the phreatic aquifer occurs primarily from the alluvium along the Tanana and Chena Rivers, and from surface and underground flow from the mountains and upland areas.

d. The local water table aquifer in the area of FTP3 flows to the north. This water ultimately empties into the Chena River.

3. FTP3, Specific Findings.

a. The Fire Department conducts training for its firemen on a periodic basis at an open burn FTP. It is located south of the installation airfield, across Montgomery Road from Building 2104 as shown in Figure 6.

b. As indicated in the borelogs in Appendix C, the soils in the area of FTP3 are generally a fining upward sequence of clays, silts, and sands. These soils were logged by the auger cuttings in the field. Split-spoon samples were taken at the surface, and at 5-foot intervals for chemical analysis. The depth at which the split-spoon samples were taken is depicted in the borelogs. Additional surface samples were collected with plastic scoops in an effort to detect horizontal contaminant migration from the pit. Samples P3S7 and P3S8 were surface samples taken where fuel spills were observed. The location of these boreholes and additional surface samples are shown in Figure 7. Table 3 identifies the samples taken in FTP3.

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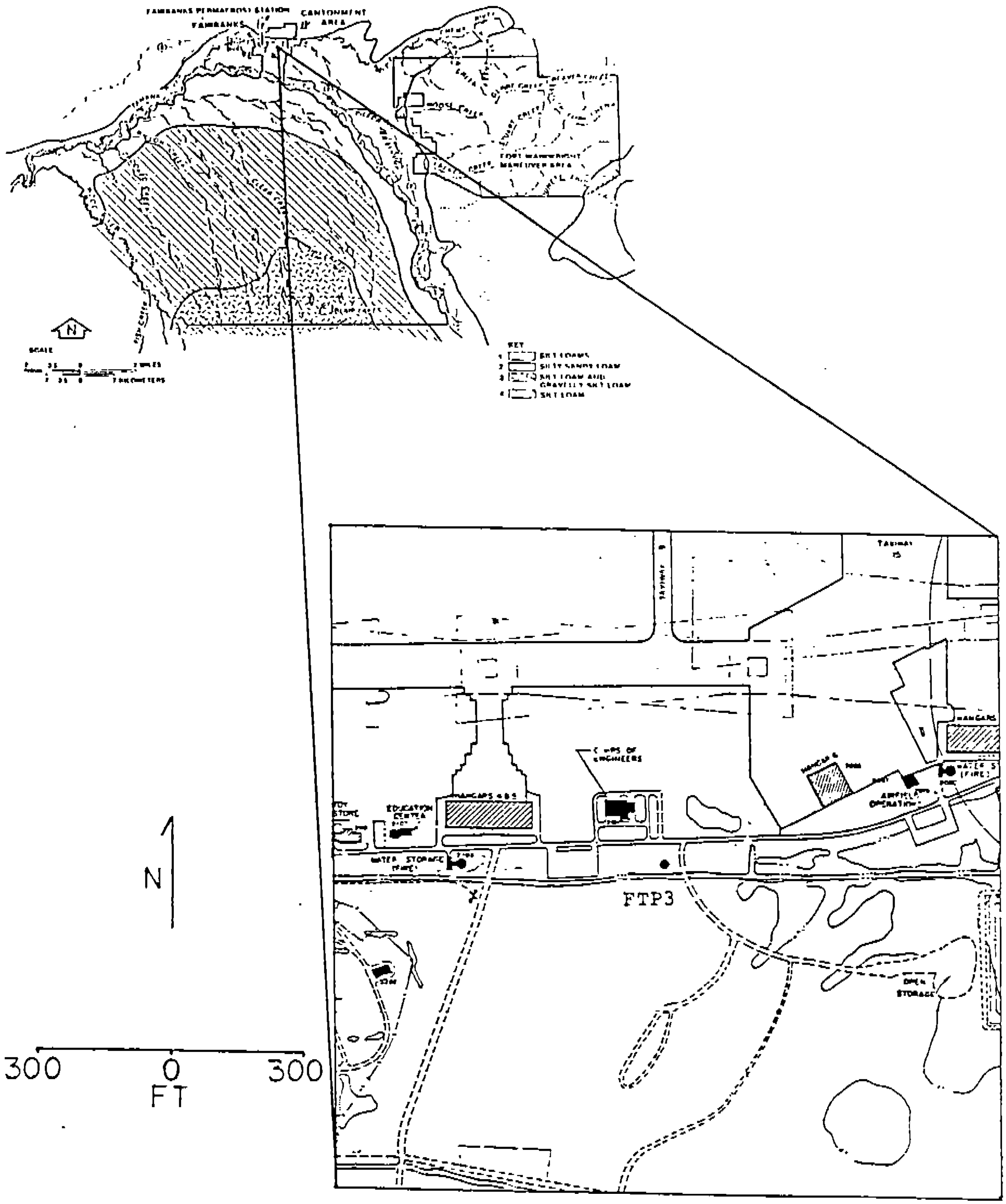


Figure 6. Location of FTP3, Fort Wainwright.

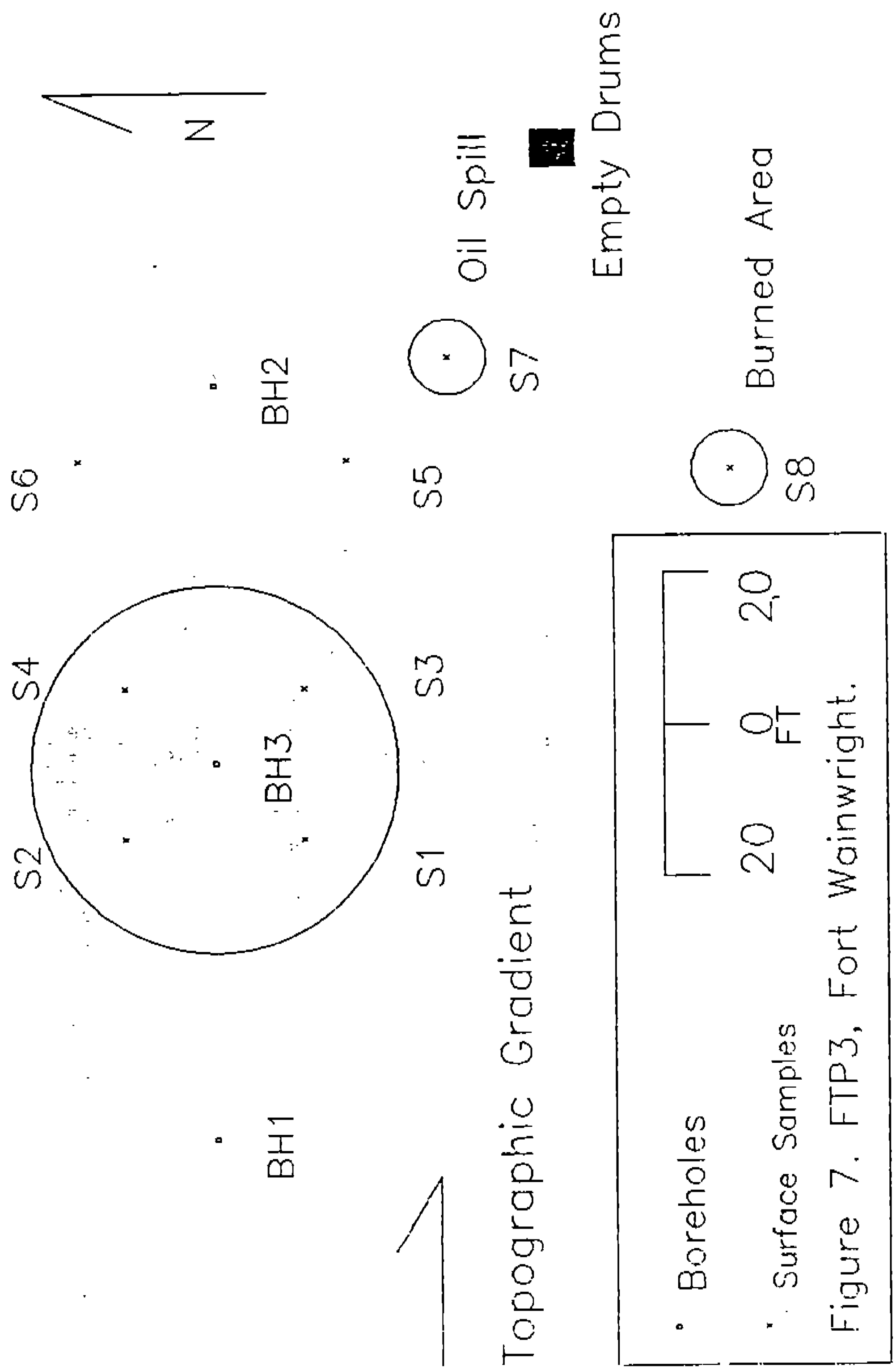


Figure 7. FTP3, Fort Wainwright.

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TABLE 3. SAMPLE IDENTIFICATION, FTP3

| Sample Number | Location | Depth |
|---|---|---|
| P3B101 | BH1, Upgradient | Surface |
| P3B102 | BH1, Upgradient | 5 Feet |
| P3B103 | BH1, Upgradient | 10 Feet |
| P3B201 | BH2, Downgradient | Surface |
| P3B202 | BH2, Downgradient | 5 Feet |
| P3B203 | BH2, Downgradient | 10 Feet |
| P3B301 | BH3, In Pit | Surface |
| P3B302 | BH3, In Pit | 5 Feet |
| P3B303 | BH3, In Pit | 10 Feet |
| P3S1 | In Pit | Surface |
| P3S2 | In Pit | Surface |
| P3S3 | In Pit | Surface |
| P3S4 | In Pit | Surface |
| P3S5 | Downgradient | Surface |
| P3S6 | Downgradient | Surface |
| P3S7 | Oil Spill, Upgradient | Surface |
| P3S8 | Oil Spill, Upgradient | Surface |

c. Four surface samples from FTP3 contained bis (2-ethylhexyl) phthalate ranging from 17 ppm in sample P3S3 to 1 ppm in P3S7. The absence of this compound in the subsoils in the area indicates little migration towards the ground water; therefore, this quantity should not present a substantial hazard to human health or the environment. While bis (2-ethylhexyl) phthalate is a suspected carcinogen, it is also a common laboratory contaminant; thus, it may not have actually originated in the soil. No other constituents were quantified as being present in FTP3; however, the holding times for the volatile organic samples were exceeded. Surface samples (3- to 5-inches below the surface) should be taken and analyzed for volatile organic parameters to ensure the protection of human health and the environment from potential contamination emanating from FTP3. Upon closure, soil samples should be taken to determine the depth and extent of contamination in the pit because FTP3 is still in use and the potential for burning unauthorized wastes exist. Data from these samples should be used to determine the proper closure procedures for FTP3. A complete list of the constituents found in the samples is in Appendix D, and a list of analyzed parameters is in Appendix E.

d. Fort Wainwright was designing a new FTP at the time of the study. This pit would include up to four 75- to 100-foot diameter pits using mobile spray trees for the fuel. These pits would be constructed out of 2.0 mm polyethylene liners and concrete, bermed pads. This design would reduce the potential of contaminant releases to the environment due to fire training operations.

Phase 1, Hazardous Waste Study No. 37-26-0725-87, Ft Richardson, AK, 8-26 Sep 86

F. <u>Fort Greely, FTP4</u>.

1. Geology.

a. Fort Greely is located in two physiographic provinces; the Tanana-Kuskokwin lowlands, and the Alaska Range province. The Tanana-Kuskokwin lowlands are characterized by bottomland forests and wetlands and a flat to gently rolling topography. The Alaska Range province is characterized by flat-topped ridges separated by rolling lowlands.

b. The northern portion of Fort Greely is underlain by Quaternary deposits resulting from Pleistocene glaciation. The foothills of the Alaska Range, in the southern portion of Fort Greely, are composed of granodiorite rock of Mesozoic Age and Precambrian Birch Creek Schist.

c. Fort Greely consists of flood plain gravelly alluvium, glacio-fluvial deposits, glacial alluvium deposits, and upland rocky soils. The flood plain gravelly alluvium consists of well stratified layers and lenses of unconsolidated silt, loam, sand, and gravel which range in depth from 1 to 15 feet. This formation is well drained and contains local channel deposits of sand or silt. The glacio-fluvial deposits are stratified layers and lenses of unconsolidated, silty or sandy gravels. These soils are well drained. The glacial alluvium deposits are unstratified, unconsolidated, sandy till. This includes sandy to gravelly lenses, kames, and channel fillings. These soils are well drained on slopes but poorly drained in swales, bogs, and areas where they are perennially frozen. The upland rocky soils occur in mountainous areas and are gravelly, moderately to well drained soils.

2. Hydrology.

a. Fort Greely is in the Tanana subregion of the Yukon River system. It is drained by streams which originate in the Alaska Range and flow north into the Tanana River. The peak flow in these streams is in the summer and the low flow is in the winter.

b. The areas with the highest ground-water extraction potential are flood plain alluvial zones and the alluvial fans on the northern edge of the Alaska Range. The aquifer system is recharged primarily by surface water streams. An unconfined aquifer is Fort Greely's major source of drinking water.

c. The local water table aquifer in the area of FTP4 flows to the west and is recharged by Jarvis Creek. Potential contamination from the pit would be carried in the aquifer beneath the northern section of the cantonment area, and empty into the Delta River. There is; however, potential for contamination to Fort Greely's drinking water supply depending on the amount of disruption to the normal aquifer flow patterns caused by the drawdown from the potable water wells at the southern end of the cantonment area.

3. FTP4, Specific Findings.

a. The FTP is located south of the installation airfield as shown in Figure 8. The FTP was closed in May 1985. The Fort Greely Roads and Grounds reportedly reclaimed the site by removing approximately 4 to 5 feet of soil, replacing it with clean soil, and covering it with a gravelly soil. When split-spoon samples were taken from the surface, evidence of the pit's surface soil (discolorization of the soil and a strong fuel odor) was evident approximately 1 foot under the cover material. This contaminated soil was not removed before the cover soil was implaced which indicates that the FTP may not have been adequately reclaimed.

b. The borelogs in Appendix C illustrate that the soils in the area of FTP4 are primarily silty sands and gravelly silty sands. These soils were logged from the auger cuttings in the field. Split-spoon samples were taken at the surface and at 5-foot intervals for chemical analysis. The depth at which the split-spoon samples were taken is depicted in the borelogs. The location of these boreholes is shown in Figure 9. Table 4 identifies the samples taken from FTP4.

c. While highly variable, the number of constituents and their concentrations tended to decrease as the depth of the borehole increased. Contamination was detected in the surface sample of the upgradient borehole (P4B101). The perimeter of FTP4 could not be observed because it had been covered with approximately 1 to 2 feet of soil, and this borehole may have been located within the boundary of the pit. Surface sample P4B301 (in the pit) was also contaminated. Samples P4B101 and P4B301 contained fluoranthene (40 ppm and 30 ppm), pyrene (70 ppm and 30 ppm), benzo (a) anthracene (60 ppm and 30 ppm), chrysene (both 40 ppm), benzo (b) fluoranthene (20 ppm and 100 ppm), benzo (k) fluoranthene (50 ppm and 10 ppm), benzo (a) pyrene (50 ppm and 40 ppm), ideno (1,2,3-cd) pyrene (40 ppm and 20 ppm), and benzo (ghi) perylene (40 ppm and 240 ppm). Sample P4B301 also contained 30 ppm of dibenzo (a,h) anthracene. Napthalene was detected in samples P4B302 at 5 feet (50 ppm), and P4B303 at 10 feet (40 ppm) in the pit. All of the above constituents are suspected carcinogens or equivocal tumorigenic agents, and are listed as Priority Pollutants. If a large amount of these contaminants migrate into the ground water, a potential hazard to human health could exist. A geohydrologic study should be conducted at FTP4 to assess the extent of contaminant migration in the ground water. A complete list of the constituents found in the samples is in Appendix D, and a list of analyzed parameters is in Appendix E.

d. Fort Greely was working on plans for a new FTP at the time of the study. This pit will consist of a concrete pad with containment berms. This design would reduce the potential of contaminant releases to the environment due to fire training operations.

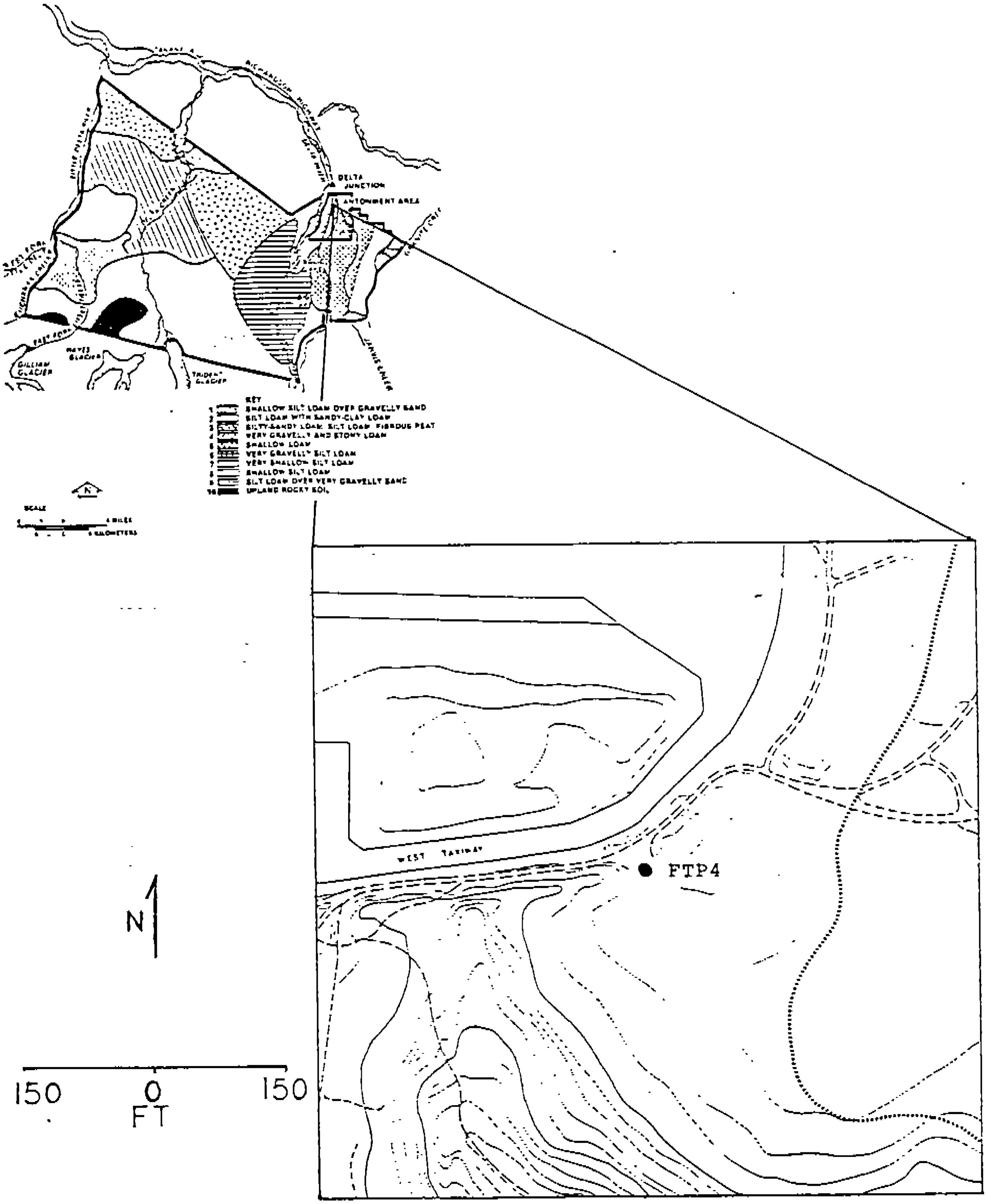


Figure 8. Location of FTP4, Fort Greely.

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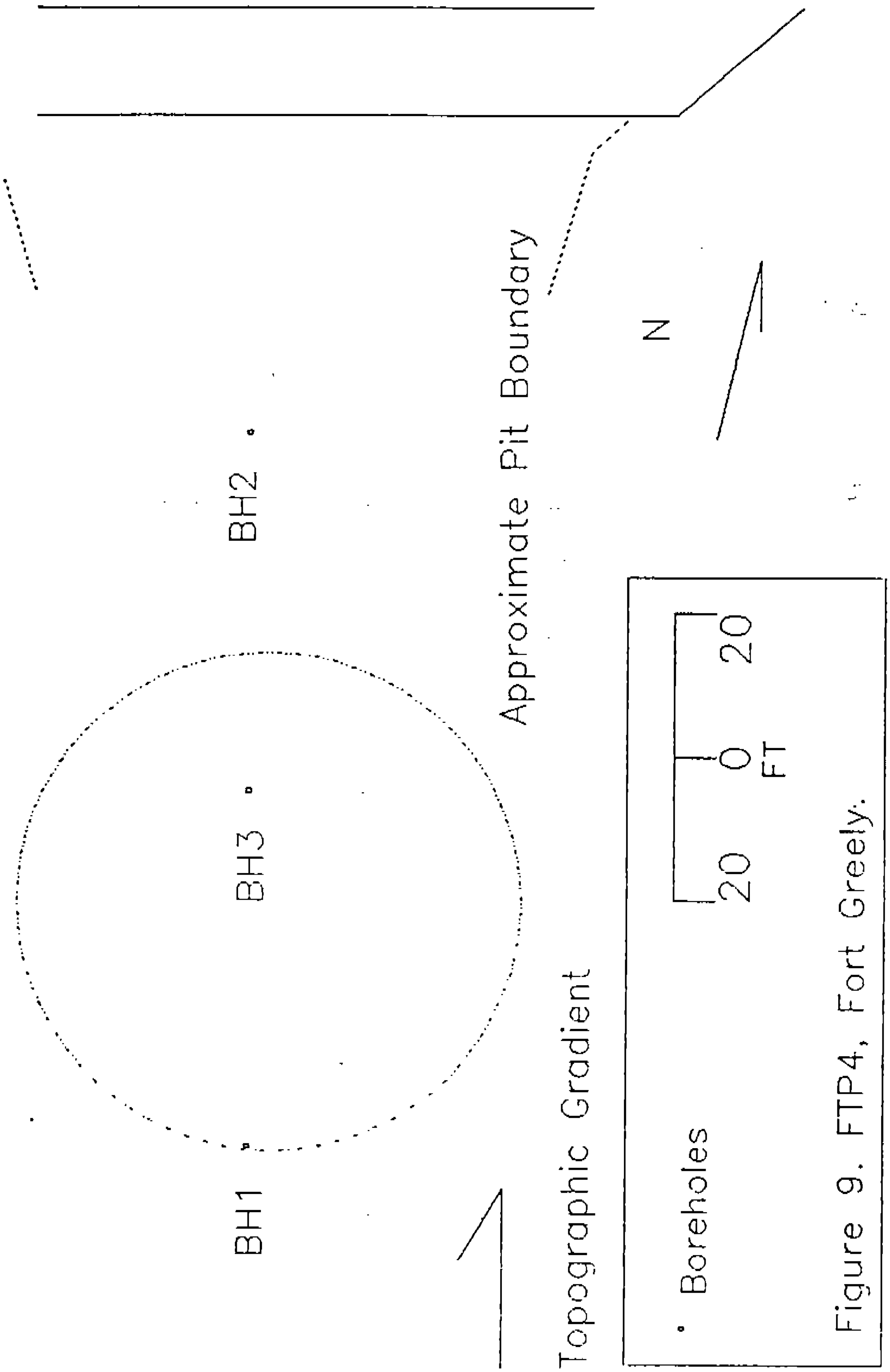


Figure 9. FTP4, Fort Greely.

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TABLE 4. SAMPLE IDENTIFICATION, FTP4

| Sample Number | Location | Depth |
|---|---|---|
| P4B101 | BH1, Upgradient | Pit Surface (1 foot) |
| P4B102 | BH1, Upgradient | 5 Feet |
| P4B103 | BH1, Upgradient | 10 Feet |
| P4B104 | BH1, Upgradient | 15 Feet |
| P4B105 | BH1, Upgradient | 20 Feet |
| P4B106 | BH1, Upgradient | 30 Feet |
| P4B201 | BH2, Downgradient | Pit Surface (1 foot) |
| P4B202 | BH2, Downgradient | 5 Feet |
| P4B203 | BH2, Downgradient | 10 Feet |
| P4B204 | BH2, Downgradient | 15 Feet |
| P4B301 | BH3, In Pit | Pit Surface (1 foot) |
| P4B302 | BH3, In Pit | 5 Feet |
| P4B303 | BH3, In Pit | 10 Feet |
| P4B304 | BH3, In Pit | 15 Feet |
| P4B305 | BH3, In Pit | 20 Feet |
| P4B306 | BH3, In Pit | 30 Feet |

G. Phase 2 Study. Due to the finding of this study, a second phase study will be conducted by this Agency. The Phase 2 study scheduled for 4th Qtr FY 87, will include surface sampling for volatile organics at FTP2 and FTP3, and evaluations of installation waste oil segregation procedures.

VI. CONCLUSIONS.

A. Data from the volatile, acid extractable, and base/neutral extractable organics samples are suspect.

B. Several waste management deficiencies were occurring at FTP1 and FTP3 during the study.

C. A potential environmental hazard exists due to fire training operations at FTP1.

D. Debris and oil spills in the area of FTP2 had not been cleaned up.

E. Waste fuel storage areas were not bermed to contain spills.

F. The FTP's at Fort Richardson, Fort Wainwright, and Fort Greely were not lined and bermed for containment of the fuel used during training exercises.

G. The FTP4 was not properly reclaimed when it was closed in May 1985.

H. There is potential for contamination to Fort Greely's drinking water supply from FTP4.

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I. In the past, petroleum products were mixed with HW's such as halogenated solvents and burned in the FTP's.

J. Improper waste oil segregation procedures have occurred at each installation.

VII. RECOMMENDATIONS.

A. To ensure regulatory compliance, the following recommendation is made: Do not mix the petroleum wastes that are burned at the FTP's with HW's such as halogenated solvents (40 CFR 262.10).

B. To ensure good environmental engineering practice, the following recommendations are made:

1. Label all of the drums at FTP1 and FTP3 and place them in an area where containment of spills is provided.

2. Remove all of the empty drums and debris from the area around the FTP's.

3. Clean up all of the fuel spills in the area of the FTP's.

4. Take soil samples, upon closure of FTP1 and FTP3, to determine the extent and depth of contamination in the pit and the appropriate remedial actions to be implemented.

5. Take surface samples for volatile organic compounds analysis in FTP2 and FTP3.

6. Evaluate waste oil segregation procedures to ensure that HW's are not commingled with waste oils.

7. Implement the construction of new FTP's at each installation upon review of the plans by the Environmental Office.

8. Expedite the construction of the new burn pit at Fort Richardson and properly close FTP1.

9. Conduct a geohydrologic study to determine the ground-water quality at FTP4.

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APPENDIX A

REFERENCES

1. Title 40, Code of Federal Regulations (CFR), 1986 rev, Part 141, National Primary Drinking Water Regulations.

2. Title 40, CFR, 1986 rev, Part 143, National Secondary Drinking Water Regulations.

3. Title 40, CFR, 1986 rev, Part 261, Identification and Listing of Hazardous Waste.

4. Title 40, CFR, 1986 rev, Part 262, Standards Applicable to Generators of Hazardous Waste.

5. Proposed Rule, National Primary Drinking Water Regulations; Volatile Synthetic Organic Chemicals, 50 Federal Register 46902, 13 November 1985.

6. Proposed Rule, National Primary Drinking Water Regulations; Synthetic Organic Chemicals, Inorganic Chemicals and Microorganisms, 50 Federal Register 46981, 13 November 1985.

7. Draft Installation Assessment of the Headquarters, 172d Infantry Brigade (Alaska), Fort Richardson, AK, Report No. 328, Parts A, B, and C, USATHAMA, 19 October 1982.

8. Samplers and Sampling Procedures for Hazardous Waste Streams, EPA 600/2-80-018, January 1980.

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18. Letter, US Army Medical Laboratory, Fort Baker, California, HSCML-EH, undated, subject: Solid Waste Survey, Fort Greely, AK, 23-24 August 1973.

19. Letter, USAEHA, HSE-ES/WP, 14 April 1981, subject: Army Pollution Abatement Program Study No. F-1616-S, Hazardous Waste Special Study, Fort Wainwright, Alaska, 22-23 July 1980 (USAEHA Control No. 81-26-8222-81).

20. Letter, USAEHA, HSE-ES/WP, 4 May 1981, subject: Army Pollution Abatement Program Study No. F-1627-S, Hazardous Waste Special Study, Fort Greely, Alaska, 23-24 July 1980 (USAEHA Control No. 81-26-8223-81).

21. Letter, USAEHA, HSE-ES/WP, 12 May 1981, subject: Army Pollution Abatement Program Study No. F-1628-S, Hazardous Waste Special Study, Fort Richardson, Alaska, 21 July - 1 August 1980 (USAEHA Control No. 82-26-8224-81).

22. Letter, USAEHA, HSHB-ES-G/WP, 16 February 1984, subject: Solid Waste Consultation No. 38-26-0354-84, Evaluation of Solid Waste Disposal Practices, Forts Richardson and Wainwright, Alaska, 24-28 October 1983.

23. Letter, USAEHA, HSHB-ES-G/WP, 5 March 1984, subject: Solid Waste Consultation No. 38-26-0355-84, Evaluation of Solid Waste Disposal Practices, Fort Greely, Alaska, 24-28 October 1983.

24. Letter, USAEHA, HSHB-ME-SE, 25 July 1986, subject: Protocol, Fire Training Pit Sampling, Hazardous Waste Special Study No. 37-58-0725, Fort Richardson, AK 99505-5500.

## APPENDIX B

## ABBREVIATIONS AND DEFINITIONS

| | |
|---|---|
| ADEC | Alaska Department of Environmental Conservation |
| As | Arsenic |
| AQAO | Analytical Quality Assurance Office |
| Ba | Barium |
| BDL | Below Detectable Limits |
| BH | Borehole |
| BOH | Bottom of Hole |
| Carcinogens | Cancer or tumor causing agents |
| Cd | Cadmium |
| CFR | Code of Federal Regulations |
| CL | Symbol in the Unified Soil Classification System representing inorganic clays of low to medium plasticity, gravelly clays, sandy clays, lean clays |
| container | Any portable device in which a material is stored, transported, treated, disposed of, or otherwise handled |
| Cr | Chromium |
| DA | Department of the Army |
| DEH | Director, Engineering and Housing |
| disposal | The discharge, deposit, injection, dumping, spilling, leaking, or placing of any solid waste or hazardous waste into or onto any water or land so that such waste or any constituent thereof may enter into the environment or be emitted into the air or discharged into any waters, including ground waters |
| DOD | Department of Defense |

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| | |
|---|---|
| EPA | US Environmental Protection Agency |
| EP Toxicity | A characteristic of a waste that is capable of causing death or severe temporary or permanent damage of an organism by the concentration of a contaminant (listed in Table I of 40 CFR 261.24) from the extract of a sample waste |
| Equivocal Tumorigenic Agents | Agents which may cause the development of tumors |
| FORSCOM | US Army Forces Command |
| FTP | Fire training pit |
| GC | Gas chromatography |
| ground water | Water under earth's surface that is free to move under the influence of gravity |
| ground-water table | Upper surface of a body of ground water |
| Hg | Mercury |
| HM | Hazardous material - substance or material which has been determined by the Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce, and which has been so designated |
| HW | Hazardous waste - a solid waste, or combination of solid wastes, which because of it's quantity, concentration, or physical, chemical, or infectious characteristics may cause, or significantly contribute to, any increase in mortality or an increase in serious irreversible or incapacitating reversible illness, or pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed |
| IAW | In accordance with |
| JP4 | Jet propelled fuel |
| kame | Low steep-sided conical or dome shaped hills often occurring on the outwash plain |

| | |
|---|---|
| km | Kilometer |
| m | Meter |
| ML | Symbol in the Unified Soil Classification System representing inorganic silts and fine sands, rock flower, silty or clayey fine sands, or clayey silts with slight plasticity |
| mg/kg | Milligrams per kilogram |
| NIPDWR | National Interim Primary Drinking Water Regulation |
| NPDML | North Pacific Division Materials Laboratory, Corps of Engineers |
| Pb | Lead |
| phreatic aquifer | Unconfined ground-water aquifer or water table aquifer |
| poorly graded | A soil that consists predominantly of one size of soil particle, or it has a wide range of sizes with some intermediate sizes obviously missing |
| ppm | Parts per million |
| RCRA | Resource Conservation and Recovery Act |
| RMCL | Recommended Maximum Contaminant Level |
| Se | Selenium |
| SM | Symbol in the Unified Soil Classification System representing silty sands or sand-silt mixtures |
| SP | Symbol in the Unified Soil Classification System representing poorly graded sands or gravelly sands, little or no fines |
| SW | Symbol in the Unified Soil Classification System representing well-graded sands, gravelly sands, little or no fines |
| swale | A shallow depression in an undulating ground moraine due to uneven glacial deposition |
| TEP | Toxic Extraction Procedure. Synonymous with EP Toxicity |

| | |
|---|---|
| treatment | Any method, technique, or process designed to change the chemical, physical, or biological character or composition of any hazardous waste so as to recover energy or material resource from the waste, or to render such waste nonhazardous, or less hazardous or safer to transport |
| Unified Soil Classification System | Method of identification and grouping of soils for engineering purposes |
| uniform graded soil | A soil where the grains are nearly all the same size |
| USAEDA | US Army Engineer District, Alaska |
| USAEHA | US Army Environmental Hygiene Agency |
| USGS | US Geological Survey |
| μg/g | Micrograms per gram |
| μg/L | Micrograms per liter |

# APPENDIX C

## BORE LOGS

# US ARMY ENVIRONMENTAL HYGIENE AGENCY

## DRILLING LOG

PROJECT Ft Richardson

DATE 10 Sep 86

LOCATION Active Fire Training Pit (P1)

DRILLERS USAEHA

DRILL RIG Mobile B47

BORE HOLE BH1

| DEPTH | SAMPLE TYPE / BLOWS PER 6 IN | DESCRIPTION | REMARKS |
|---|---|---|---|
| 0 | * | Brown silty clay | P1B101 |
| | | Brownish-gray rocky clayey sand | |
| 5 | * | | P1B102 |
| | | | BOH=6 Ft - Penetrated landfill Wood and metal chunks in soil |
| 10 | | | |
| | | | * split-spoon sample |

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 Aug 74 which will be used.

# US ARMY ENVIRONMENTAL HYGIENE AGENCY

## DRILLING LOG

PROJECT Ft Richardson DATE 10 Sep 86

LOCATION Active Fire Training Pit (P1) DRILLERS USAEDA

DRILL RIG Mobile B47 BORE HOLE BH2

| DEPTH | SAMPLE TYPE / BLOWS PER 6 IN | DESCRIPTION | REMARKS |
|---|---|---|---|
| 0 | * | Brown silty clay | P1B201 |
| | | Brown rocky clayey sand | |
| 5 | * | | P1B202 |
| | | | BOH=6 Ft - Penetrated landfill Wood and metal chunks in soil |
| 10 | | | |
| | | | * split-spoon sample |

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 Aug 74, which will be used.

# US ARMY ENVIRONMENTAL HYGIENE AGENCY

## DRILLING LOG

PROJECT Ft Richardson

DATE 10 Sep 86

LOCATION Active Fire Training Pit (P1)

DRILLERS USAEDA

DRILL RIG Mobile B47

BORE HOLE BH3

| DEPTH | SAMPLE TYPE / BLOWS PER 6 IN | DESCRIPTION | REMARKS |
|---|---|---|---|
| 0 | * | Blackish-brown silty clay | P1B301 |
| | | Gray rocky clayey sand | |
| 5 | * | | P1B302<br>BOH=5 Ft -<br>Penetrated landfill<br>Wood and metal<br>chunks in soil |
| 10 | | | |
| | | | * split-spoon sample |

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 Aug 74, which will be used.

# US ARMY ENVIRONMENTAL HYGIENE AGENCY

## DRILLING LOG

PROJECT Ft Richardson DATE 10 Sep 86

LOCATION Old Fire Training Pit (P2) DRILLERS USAEHA

DRILL RIG Mobile B47 BORE HOLE BH1

| DEPTH | SAMPLE TYPE / BLOWS PER 6 IN | DESCRIPTION | REMARKS |
|---|---|---|---|
| 0 | * | Grayish-brown rocky silty sand | P2B101 |
| | * | Gray rocky gravel | P2B102 |
| | | Grayish-brown silty sandy gravel | |
| | | Grayish-brown silty gravel | |
| 10 | * | Grayish-brown gravelly clayey sand | P2B103<br>13-15 Ft: Fuel odor |
| | * | Grayish-brown gravel | P2B104 |
| 20 | | | BOH=20 Ft - Refusal |
| 30 | | | * split-spoon sample |

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 [illegible] 74, which will be used.

# US ARMY ENVIRONMENTAL HYGIENE AGENCY

## DRILLING LOG

PROJECT Ft Richardson DATE 12 Sep 86

LOCATION Old Fire Training Pit (P2) DRILLERS USAEDA

DRILL RIG Mobile B47 BORE HOLE BH2

| DEPTH | SAMPLE TYPE / BLOWS PER 6 IN | DESCRIPTION | REMARKS |
|---|---|---|---|
| 0 | * | Brown silty sand | P2B201 |
| | * | Brown rocky silty sand | P2B202 |
| 10 | * | Brown silty sandy gravel | P2B203 |
| | * | Brown clayey sandy gravel | P2B204 |
| | | Gray-brown gravelly clayey sand | |
| 20 | * | Gray-brown rocky clayey sand | P2B205 |
| | | Grayish-brown rocky gravel | |
| | | Grayish-brown silty gravel | BOH=26 Ft - Refusal |
| 30 | | | * split-spoon sample |

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 ... 74, which will be used.

# US ARMY ENVIRONMENTAL HYGIENE AGENCY

## DRILLING LOG

PROJECT Ft Richardson DATE 12 Sep 86

LOCATION Old Fire Training Pit (P2) DRILLERS USAEHA

DRILL RIG Mobile B47 BORE HOLE BH3

| DEPTH | SAMPLE TYPE / BLOWS PER 6 IN | DESCRIPTION | REMARKS |
|---|---|---|---|
| 0 | * | Grayish-brown rocky clayey sand | P2B301<br>Water in pit |
| | | Gray-brown clayey sandy gravel | |
| | | Gray-brown gravelly silty sand | |
| | * | Brown gravelly clayey sand | P2B302 |
| | | Grayish-brown rocky clayey sand | |
| 10 | * | | P2B303 |
| | | Grayish-brown gravelly clayey sand | |
| | * | | P2B304 |
| | | Gray rocky clayey sand | |
| 20 | * | | P2B305<br>BOH=21 Ft - Refusal |
| 30 | | | * split-spoon sample |

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 A--- 74, which will be used.

# US ARMY ENVIRONMENTAL HYGIENE AGENCY

## DRILLING LOG

PROJECT Ft Wainwright DATE 18 Sep 86

LOCATION Active Fire Training Pit (P3) DRILLERS USAEDA

DRILL RIG Mobile B50 BORE HOLE BH1

| DEPTH | SAMPLE TYPE / BLOWS PER 6 IN | DESCRIPTION | REMARKS |
|---|---|---|---|
| 0 | * | Brown organic silty clay | P3B101 |
| 5 | * | Tanish-brown silt | P3B102 |
| | | Mixed brown and white fine sand | wet |
| 10 | * | | P3B103<br>BOH=10 Ft - water table |
| 15 | | | * split-spoon sample |

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 ^··- 74, which will be used.

# US ARMY ENVIRONMENTAL HYGIENE AGENCY

## DRILLING LOG

PROJECT Ft Wainwright DATE 18 Sep 86

LOCATION Active Fire Training Pit (P3) DRILLERS USAEHA

DRILL RIG Mobile B50 BORE HOLE BH2

| DEPTH | SAMPLE TYPE / BLOWS PER 6 IN | DESCRIPTION | REMARKS |
|---|---|---|---|
| 0 | * | Dark grayish-brown organic silt | P3B201 |
| | | Brown silt | |
| 5 | * | | P3B202 |
| | | Mixed black and white fine sand | |
| | | Brown silt | |
| | | Mixed black and white fine sand | wet |
| 10 | * | | P3B203<br>BOH=10 Ft - water table |
| 15 | | | * split-spoon sample |

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 Aug 74, which will be used.

# US ARMY ENVIRONMENTAL HYGIENE AGENCY

## DRILLING LOG

PROJECT Ft Wainwright DATE 18 Sep 86

LOCATION Active Fire Training PIT (P3) DRILLERS USAEHA

DRILL RIG Mobile B50 BORE HOLE BH3

| DEPTH | SAMPLE TYPE / BLOWS PER 6 IN | DESCRIPTION | REMARKS |
|---|---|---|---|
| 0 | * | Blackish-brown silt | P3B301 |
| 5 | * | Grayish-brown silt | P3B302 |
| | | Brown gravelly sand | wet |
| 10 | * | | P3B303<br>BOH=10 Ft - water table |
| 15 | | | * split-spoon sample |

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 ^ · 74, which will be used.

# US ARMY ENVIRONMENTAL HYGIENE AGENCY

## DRILLING LOG

PROJECT Fort Greely
DATE 20 Sep 86
LOCATION Closed Fire Training Pit (p4)
DRILLERS USAEDA
DRILL RIG Mobile B50
BORE HOLE BH1

| DEPTH | SAMPLE TYPE / BLOWS PER 6 IN | DESCRIPTION | REMARKS |
|---|---|---|---|
| 0 | * | Brown gravelly silty sand | P4B101 Fill material |
| | * | Brown silty sand | P4B102 |
| 10 | * | Brown gravelly silty sand | P4B103 |
| | * | Brown rocky silty sand | P4B104 |
| 20 | * | | P4B105 |
| | | Brown gravelly silty sand | |
| 30 | * | Grayish-brown rocky silty sand | * split-spoon sample BOH=30 Ft P4B106 |

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 Aug 74, which will be used.

# US ARMY ENVIRONMENTAL HYGIENE AGENCY

## DRILLING LOG

PROJECT Ft Greely DATE 20 Sep 86

LOCATION Closed Fire Training Pit (P4) DRILLERS USAEDA

DRILL RIG Mobile B50 BORE HOLE BH2

| DEPTH | SAMPLE TYPE / BLOWS PER 6 IN | DESCRIPTION | REMARKS |
|---|---|---|---|
| 0 | * | Brown gravelly silty sand | P4B201 Fill Material |
| | | Brown fine silty sand | |
| | * | | P4B202 |
| 10 | * | Brown rocky silty sand | P4B203 |
| | * | | P4B204 BOH=14 Ft - Refusal |
| 20 | | | |
| | | | * split-spoon sample |

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 ^··- ⁷4, which will be used.

# US ARMY ENVIRONMENTAL HYGIENE AGENCY

## DRILLING LOG

PROJECT Ft Greely — DATE 20 Sep 86

LOCATION Closed Fire Training — DRILLERS USAEDA

DRILL RIG Mobile B50 — BORE HOLE BH3

| DEPTH | SAMPLE TYPE / BLOWS PER 6 IN | DESCRIPTION | REMARKS |
|---|---|---|---|
| 0 | * | Dark brown gravelly silty sand | Fill Material P4B301 |
| | * | Dark brown silty sand | Fuel odor P4B302 |
| 10 | * | Dark brown gravelly silty sand | Fuel odor P4B303 |
| | | Dark brown rocky silty sand | Fuel odor |
| | * | Dark grayish-brown gravelly silty sand | Fuel odor P4B304 |
| 20 | * | Dark Grayish-brown rocky silty sand | Fuel odor P4B305 |
| 30 | * | Dark grayish-brown gravelly sand | Fuel odor<br>* split-spoon sample<br>BOH=30 Ft<br>P4B306 |

HSE-ES Form 78, 1 Jun 80

Replaces USAEHA Form 95, 12 ‸ - 74, which will be used.

# APPENDIX D

# CHEMICAL ANALYSIS

OUA 0000378

TABLE D-1. ANALYTICAL RESULTS FOR PURGABLE (VOLATILE) ORGANICS, METHOD NO. 624 - CONCENTRATIONS IN ug/gm

| PARAMETER | DETECTION LIMITS | SITES |
|---|---|---|
| | | P1S2 |
| Toluene | 35 | 207 |
| Ethylbenzene | 35 | 107 |

NOTE:
DUE TO EQUIPMENT MALFUNTIONS, THE DETECTION LIMITS FOR SAMPLES P1S2, P2S2, P3S2, AND P48304 WAS 35 UG/GM.
THE RESULTS REFLECT ONLY SAMPLES IN WHICH CONTAMINANTS WERE DETECTED. A COMPLETE LIST OF ANALYTICAL PARAMETERS AND THEIR DETECTION LIMITS IS PROVIDED IN APPENDIX E.

TABLE D-2. ANALYTICAL RESULTS FOR ACID EXTRACTABLE ORGANICS - CONCENTRATIONS IN ug/gm.

| PARAMETER | DETECTION LIMITS | SITES |
|---|---|---|
| | | P3S5 |
| pentachlorophenol | 2.5 | TRC |

NOTE:
THE RESULTS REFLECT ONLY SAMPLES IN WHICH CONTAMINANTS WERE DETECTED. A COMPLETE LIST OF ANALYTICAL PARAMETERS AND THEIR DETECTION LIMITS IS PROVIDED IN APPENDIX E.

TABLE D-3. ANALYTICAL RESULTS FOR PESTICIDES, HERBICIDES and PCB'S - CONCENTRATIONS IN ppm (ug/gm)

| PARAMETER | DETECTION LIMITS | SAMPLES |
|---|---|---|

ALL PARAMETERS WERE BELOW DETECTABLE LIMITS FOR ALL SAMPLES

NOTE:
A COMPLETE LIST OF ANALYTICAL PARAMETERS AND THEIR DETECTION LIMITS IS PROVIDED IN APPENDIX E.

TABLE D-4. ANALYTICAL RESULTS FOR BASE/NEUTRAL ORGANICS CONCENTRATIONS IN ug/gm.

| PARAMETER | DETECTION LIMITS | SITES P1S1 | P1S2 | P1S3 | P1S4 | P1B301 | P2S1 | P2S2 | P2S3 | P2S4 | P2B104 | P2B301 | P2B302 | P3S1 | P3S2 | P3S3 | P3S5 | P3S7 | P4B101 | P4B301 | P4B302 | P4B303 | P4B304 | P4B305 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| naphthalene | 1 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | TRC | BDL | TRC | TRC | 50 | 40 | TRC | TRC |
| acenaphthylene | 1 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | TRC | BDL | BDL | BDL | BDL | BDL |
| dimethyl phthalate | 1 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | TRC | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| acenaphthene | 1 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | TRC | TRC | BDL | BDL | BDL | BDL |
| 2,4-dinitrotoluene | 1 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | TRC | BDL | BDL | BDL | BDL |
| fluorene | 1 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | TRC | BDL | BDL | BDL | BDL | TRC | TRC | TRC | BDL | BDL |
| diethyl phthalate | 1 | TRC | TRC | TRC | TRC | TRC | TRC | TRC | TRC | TRC | TRC | TRC | TRC | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| phenanthrene | 1 | BDL | TRC | BDL | TRC | TRC | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | TRC | TRC | TRC | BDL | BDL | BDL |
| anthracene | 1 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | TRC | TRC | BDL | BDL | BDL | BDL |
| di-n-butyl phthalate | 1 | TRC | BDL | BDL | BDL | TRC | TRC | TRC | BDL | BDL | BDL | TRC | BDL | BDL | TRC | BDL | TRC | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| fluoranthene | 1 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 40 | 30 | TRC | BDL | BDL | BDL |
| pyrene | 1 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 70 | 30 | TRC | BDL | BDL | BDL |
| benzo (a) anthracene | 1 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 60 | 30 | TRC | BDL | BDL | BDL |
| chrysene | 1 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 40 | 40 | TRC | BDL | BDL | BDL |
| bis (2-ethylhexyl) phthalate | 1 | BDL | 58 | BDL | TRC | BDL | BDL | BDL | TRC | TRC | BDL | TRC | BDL | 10 | 15 | 17 | TRC | 1 | TRC | BDL | BDL | BDL | BDL | BDL |
| di-n-octyl phthalate | 1 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | TRC | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |
| benzo (b) fluoranthene | 1 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 20 | 100 | BDL | BDL | BDL | BDL |
| benzo (K) fluoranthene | 1 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 50 | 10 | BDL | BDL | BDL | BDL |
| benzo (a) pyrene | 1 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 50 | 40 | BDL | BDL | BDL | BDL |
| indeno (1,2,3-cd) pyrene | 2.5 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 40 | 20 | BDL | BDL | BDL | BDL |
| dibenzo (a,h) anthracene | 2.5 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | TRC | 30 | BDL | BDL | BDL | BDL |
| benzo (ghi) perylene | 2.5 | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | 40 | 240 | BDL | BDL | BDL | BDL |
| 2-methylnaphthalene | 1 | BDL | 270 | 47 | 54 | 54 | BDL | BDL | BDL | BDL | BDL | BDL | TRC | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL | BDL |

NOTE:
THE RESULTS REFLECT ONLY SAMPLES IN WHICH CONTAMINANTSWERE DETECTED. A COMPLETE LIST OF ANALYTICAL PARAMETERS AND THEIR DETECTION LIMITS IS PROVIDED IN APPENDIX E.

TABLE D-5. ANALYTICAL RESULTS FOR METALS - CONCENTRATIONS IN ug/L

| PARAMETER | DETECTION LIMITS | SITES P2S2 |
|---|---|---|
| Pb | 0.500 | 0.511 |

NOTE:
THE RESULTS REFLECT ONLY SAMPLES IN WHICH CONTAMINANTS WERE DETECTED. A COMPLETE LIST OF ANALYTICAL PARAMETERS AND THEIR DETECTION LIMITS IS PROVIDED IN APPENDIX E.

TABLE D-6. ANALYTICAL RESULTS FOR EXPLOSIVES - CONCENTRATIONS IN ug/g (ppm)

| PARAMETER | DETECTION LIMITS | SITES |
|---|---|---|

ALL PARAMETERS WERE BELOW DETECTABLE LIMITS FOR ALL SAMPLES

NOTE:
A COMPLETE LIST OF ANALYTICAL PARAMETERS AND THEIR DETECTION LIMITS IS PROVIDED IN APPENDIX E.

# APPENDIX E

## ANALYTICAL PARAMETERS, METHODS AND DETECTION LIMITS

TABLE E-1. PURGABLE (VOLATILE) ORGANICS, METHOD NO. 8240* - IN μg/gm

| | Detection Limits |
|---|---|
| 2-Chloroethylvinyl ether | 0.5 |
| Chloromethane | 0.5 |
| Bromomethane | 0.5 |
| Vinyl Chloride | 0.5 |
| Chloroethane | 0.5 |
| Methylene chloride | 0.5 |
| 1,1-Dichloroethene | 0.5 |
| 1,1-Dichloroethane | 0.5 |
| trans-1,2-Dichloroethene | 0.5 |
| Chloroform | 0.5 |
| 1,2-Dichloroethane | 0.5 |
| 1,1,1-Trichloroethane | 0.5 |
| Carbon tetrachloride | 0.5 |
| Bromodichloromethane | 0.5 |
| 1,2-Dichloropropane | 0.5 |
| trans-1,3-Dichloropropene | 0.5 |
| Trichloroethylene | 0.5 |
| Benzene | 0.5 |
| cis-1,3-Dichloropropene | 0.5 |
| 1,1,2-Trichloroethane | 0.5 |
| Dibromochloromethane | 0.5 |
| Bromoform | 0.5 |
| Tetrachloroethene | 0.5 |
| 1,1,2,2-Tetrachloroethane | 0.5 |
| Toluene | 0.5 |
| Chlorobenzene | 0.5 |
| Ethylbenzene | 0.5 |
| Trichlorofluoromethane | 0.5 |
| 1,2-Dichlorobenzene | 0.5 |
| 1,3-Dichlorobenzene | 0.5 |
| 1,4-Dichlorobenzene | 0.5 |

NOTE: Because the holding times of the following samples were exceeded, they were not analyzed:

| FTP1 | FTP2 | FTP3 | FTP4 |
|---|---|---|---|
| P1B101 | P2B101 | P3B101 | P4B101 |
| P1B102 | P2B102 | P3B301 | P4B105 |
| P1B201 | P2B103 | P3B302 | P4B106 |
| P1B202 | P2B104 | P3B303 | P4B202 |
| P1B301 | P2B202 | P3S1 | P4B301 |
| P1B302 | P2B203 | P3S3 | P4B302 |
| P1S1 | P2B205 | P3S7 | P4B303 |
| P1S3 | P2B301 | P3S8 | P4B305 |
| P1S4 | P2B302 | | |
| P1S5 | P2B304 | | |
| P1S6 | P2S1 | | |
| | P2S4 | | |

P1S2, P2S2, P3S2, and P4B304 had detection limits of 35 ppm.

* USEPA SW-846 (Appendix A, reference 9).

TABLE E-2. ACID EXTRACTABLE ORGANICS, METHOD NO. 8270 - IN µg/gm

| | Detection Limits |
|---|---|
| 2-chlorophenol | 2.5 |
| phenol | 2.5 |
| 2-nitrophenol | 2.5 |
| 2,4-dimethylphenol | 2.5 |
| 2,4-dichlorophenol | 2.5 |
| 4,6-dinitro-o-cresol | 25 |
| 2,4,6-trichlorophenol | 2.5 |
| 2,4-dinitrophenol | 25 |
| 4-nitrophenol | 2.5 |
| P-chloro-M-cresol | 2.5 |
| pentachlorophenol | 2.5 |

TABLE E-3. EP TOXIC METALS, METHOD NO. 1310 - IN mg/L

| | Detection Limits |
|---|---|
| Ag | 0.5 |
| As | 0.5 |
| Ba | 10 |
| Cd | 0.1 |
| Cr | 0.5 |
| Pb | 0.5 |
| Se | 0.1 |
| Hg | 0.02 |

TABLE E-4. EXPLOSIVES USAEHA PROCEDURE* - IN µg/gm

| | Detection Limits |
|---|---|
| HMX | 1 |
| RDX | 1 |
| TETRYL | 5 |
| TNT | 1 |
| 2,6-DNT | 1 |
| 2,4-DNT | 1 |

* Appendix A, reference 14.

TABLE E-5. BASE NEUTRAL ORGANICS, METHOD NO. 8270 - IN μg/gm

| | Detection Limits |
|---|---|
| N-nitrosodimethylamine | 1 |
| bis (2-chloroethyl) ether | 1 |
| 1,3-dichlorobenzene | 1 |
| 1,4-dichlorobenzene | 1 |
| 1,2-dichlorobenzene | 1 |
| bis (2-chloroisopropyl) ether | 1 |
| hexachloroethane | 1 |
| N-nitrosodi-n-propylamine | 1 |
| nitrobenzene | 1 |
| isophorone | 1 |
| bis (2-chloroethoxy) methane | 1 |
| 1,2,4-trichlorobenzene | 1 |
| naphthalene | 1 |
| hexachlorobutadiene | 1 |
| hexachlorocyclopentadiene | 1 |
| 2-chloronaphthalene | 1 |
| acenaphthylene | 1 |
| dimethyl phthalate | 1 |
| 2,6-dinitrotoluene | 1 |
| acenaphthene | 1 |
| 2,4-dinitrotoluene | 1 |
| fluorene | 1 |
| 4-chlorophenyl phenyl ether | 1 |
| diethyl phthalate | 1 |
| 1,2-diphenylhydrazine | 1 |
| N-nitrosodiphenylamine | 1 |
| 4-bromophenyl phenyl ether | 1 |
| hexachlorobenzene | 1 |
| phenanthrene | 1 |
| anthracene | 1 |
| di-n-butyl phthalate | 1 |
| fluoranthene | 1 |
| pyrene | 1 |
| benzidine | 1 |
| butyl benzyl phthalate | 1 |
| benzo (a) anthracene | 1 |
| chrysene | 1 |
| 3,3-dichlorobenzidine | 1 |
| bis (2-ethylhexyl) phthalate | 1 |
| di-n-octyl phthalate | 1 |
| benzo (b ) fluoranthene | 1 |
| benzo (K) fluoranthene | 1 |
| benzo (a) pyrene | 1 |
| indeno (1,2,3-cd) pyrene | 2.5 |
| dibenzo (a,h) anthracene | 2.5 |
| benzo (ghi) perylene | 2.5 |
| 2-methylnaphthalene | 1 |

TABLE E-6. PESTICIDES, and PCB'S, METHOD NO. 8270 - IN μg/gm

| | Detection Limits |
|---|---|
| ALPHA-BHC | 1 |
| BETA-BHC | 1 |
| GAMMA-BHC | 1 |
| DELTA-BHC | 1 |
| 4,4-DDD | 1 |
| 4,4-DDE | 1 |
| 4,4-DDT | 1 |
| aldrin | 1 |
| alpha-endosulfan | 1 |
| beta-endosuflan | 1 |
| endosulfan sulphate | 1 |
| chlorodane | 1 |
| dieldrin | 1 |
| endrin | 1 |
| endrin aldehyde | 1 |
| heptachlor | 1 |
| heptachlor epoxide | 1 |
| toxaphene | 50 |
| PCB (Aroclor® 1242) | 5 |
| PCB (Aroclor 1248) | 5 |
| PCB (Aroclor 1254) | 5 |
| PCB (Aroclor 1260) | 5 |
| PCB (Aroclor 1221) | 5 |
| PCB (Aroclor 1232) | 5 |
| PCB (Aroclor 1016) | 5 |

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