1. Keywords

2. Start Date: FY 98
End Date: FY 98

3. HQ Division:

4. Phase:

5. Program NO: 38

6. Survey Type: HYDROGEOLOGIC INVESTIGATION

7. INSTALLATION OR SOURCE OF INFORMATION (CITY & STATE OR COUNTY ARE ESSENTIAL)
ZZ - NOT APPLICABLE

8. Authors:

9. ARLOC/Activity: 11933 WRAMC
Location: WALTER REED AMC
State: DC

10. Project Control Number: 38-EH-8209-98

11. Title: HYDROGEOLOGIC INVESTIGATION, WRAMC, BUILDING 500 AREA OF FOREST GLEN ANNEX, 11-14 MAY 1998

12. DSA:

U.S. Army Center for Health Promotion and Preventive Medicine

HYDROGEOLOGIC INVESTIGATION NO. 38-EH-8209-98
WALTER REED ARMY MEDICAL CENTER
BUILDING 500 AREA OF THE FOREST GLEN ANNEX
SILVER SPRING, MARYLAND
11-14 MAY 1998

Readiness Thru Health

GW

DEPARTMENT OF THE ARMY
U.S. ARMY CENTER FOR HEALTH PROMOTION AND PREVENTIVE MEDICINE
5158 BLACKHAWK ROAD
ABERDEEN PROVING GROUND, MARYLAND 21010-5422

REPLY TO
ATTENTION OF

MCHB-TS-EGW (40)

07 JUL 1998

MEMORANDUM FOR Commander, Walter Reed Army Medical Center, ATTN: LTC Martha A. Sanders, Environmental Division, 6825 16th Street NW, Washington DC 20307

SUBJECT: Hydrogeologic Investigation No. 38-EH-8209-98, Walter Reed Army Medical Center, Building 500 Area of the Forest Glen Annex, Silver Spring, Maryland, 11-14 May 1998

Four copies of subject report with Executive Summary are enclosed.

FOR THE COMMANDER:

Encl

JOHN W. BAUER, P.G.
Program Manager
Ground Water and Solid Waste

CF (w/encl):
HQDA(DAIM-ED)
USACPW, ATTN: CECPW-ES
CDR, MEDCOM, ATTN: MCHO-CL-W
CDR, NORTH ATLANTIC RMC
CDR, USAEC, ATTN: SFIM-AEC-EQ
CDR, USACHPPM-N

DEPARTMENT OF THE ARMY
U.S. ARMY CENTER FOR HEALTH PROMOTION AND PREVENTIVE MEDICINE
5158 BLACKHAWK ROAD
ABERDEEN PROVING GROUND, MARYLAND 21010-5422

REPLY TO
ATTENTION OF

EXECUTIVE SUMMARY
HYDROGEOLOGIC INVESTIGATION NO. 38-EH-8209-98
WALTER REED ARMY MEDICAL CENTER
BUILDING 500 AREA OF THE FOREST GLEN ANNEX
SILVER SPRING, MARYLAND
11-14 MAY 1998

1. PURPOSE. To investigate petroleum hydrocarbon contamination of soil and ground water with in the Building 500 area of the Forest Glen Annex of Walter Reed Army Medical Center.

2. CONCLUSIONS.

a. No evidence was found to indicate that a point source of petroleum hydrocarbon contamination exists at the present time in the area of investigation. Slight to moderate petroleum hydrocarbon contamination was detected in a large volume of subsurface soils extending throughout the area of investigation. Diminished fuel odors and results of analyses conducted on samples collected at greater depths indicate that contamination of subsurface sediments is restricted to the soft, weathered saprolite layer.

b. It is probable that petroleum hydrocarbon contamination of ground water has resulted from fuel oil entrapped in the weathered saprolite. Fuel oils may have spread outward from the source by floating on the water table, which occurred at the time of release at the approximate depth at which soil contamination was detected in this investigation. Migration of fuel oil towards the recovery wells may currently be impeded by a high clay content in the saprolite layer and by the absence of ground water at this depth due to lowering of the water table by the pump-and-treat system.

3. RECOMMENDATIONS.

a. Relocate recovery wells from the present locations to monitoring wells that currently contain product.

b. Increased mobilization of fuel oils through the weathered saprolite may be accomplished by discharging pump-and-treat effluent directly onto ground surface of the affected area, allowing the water to flush through subsurface sediments, or by suspending pump-and-treat operations periodically to allow the water table to return to the elevation at which soil contamination occurs. Also use a lower pumping rate to create a shallower cone of depression around the recovery well.

Readiness thru Health

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DEPARTMENT OF THE ARMY
U.S. ARMY CENTER FOR HEALTH PROMOTION AND PREVENTIVE MEDICINE
5158 BLACKHAWK ROAD
ABERDEEN PROVING GROUND, MARYLAND 21010-5422

REPLY TO
ATTENTION OF

HYDROGEOLOGIC INVESTIGATION NO. 38-EH-8209-98
WALTER REED ARMY MEDICAL CENTER
BUILDING 500 AREA OF THE FOREST GLEN ANNEX
SILVER SPRING, MARYLAND
11 - 14 MAY 1998

1. REFERENCES. See Appendix A for a list of references.

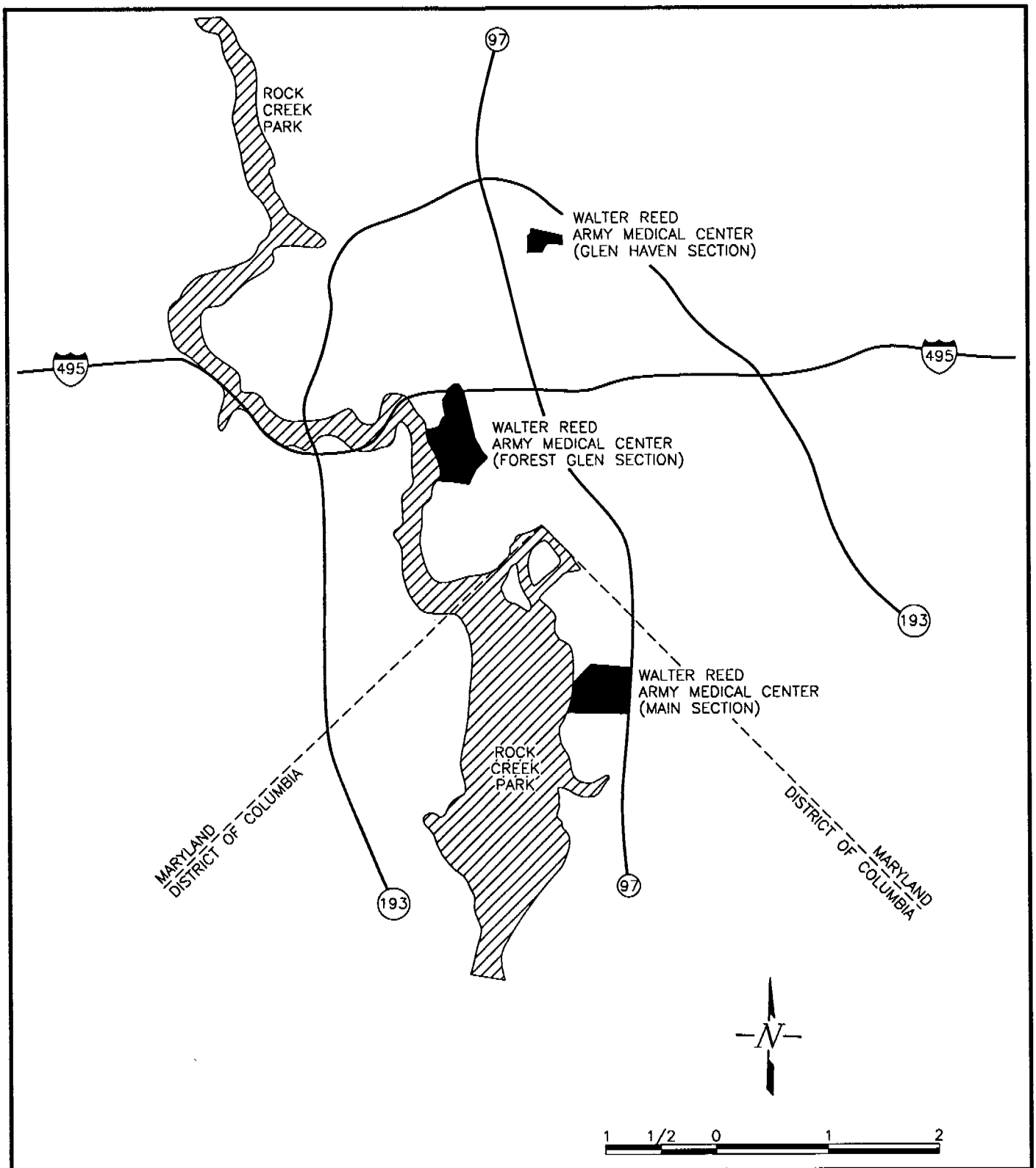
2. AUTHORITY. USACHPPM Form 250-R-E, MCHB-CG-PIO, 1 May 1995, Project Number 38-EH-8209-98.

3. PURPOSE. To investigate petroleum hydrocarbon contamination of soil and ground water with in the Building 500 area of the Forest Glen Annex of Walter Reed Army Medical Center (WRAMC).

4. GENERAL.

a. Installation Location and History. Forest Glen Annex of WRAMC is located in Montgomery County, approximately 1/2 mile north of Washington, D.C., near the town of Silver Spring, Maryland (Figure 1). Building 500 is located in the southern portion of the facility, near the intersection of Brookville Road and Talbot Avenue (Figure 2). Forest Glen Annex was purchased for use as a convalescent center near the beginning of the United States' participation in World War II. The area was formerly part of the National Park Seminary for Girls. Existing buildings were renovated and the first patients were received in January 1943. The area currently serves as an auxiliary service, support, and research area for the Main section of WRAMC, which contains the hospital and major research and teaching facilities (references 1 and 2). Activities conducted at Forest Glen include motor vehicle maintenance, research laboratories, and a post exchange.

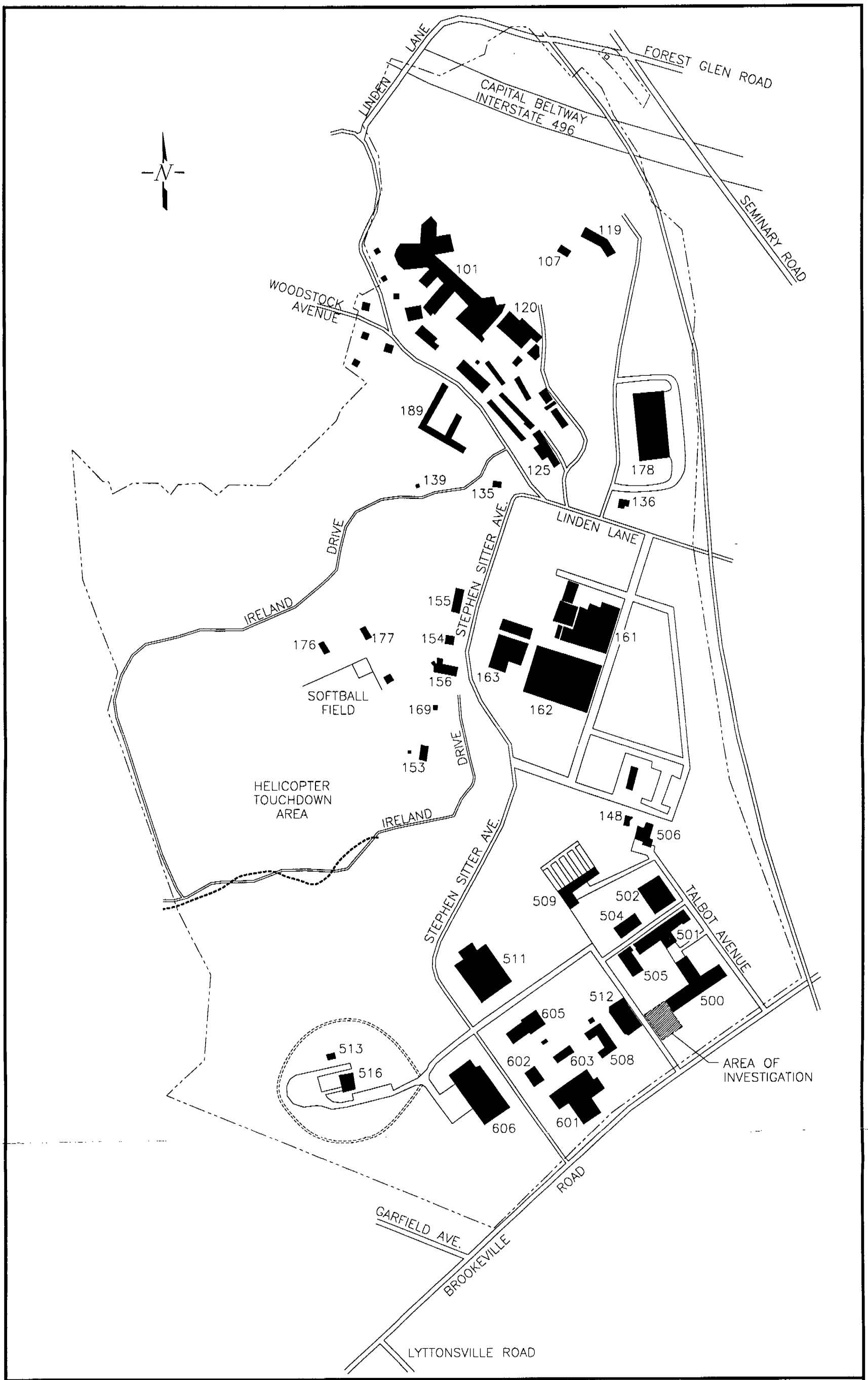
b. Project Personnel. This investigation was conducted by Ms. Kathleen Butoryak, Project Officer, Mr. Richard Kestner, Senior Engineering Technician, and Ms. Sandra Toscano, Environmental Protection Specialist.



UNITED STATES ARMY
CENTER FOR HEALTH PROMOTION
AND PREVENTIVE MEDICINE
ABERDEEN PROVING GROUND, MARYLAND

FIGURE 1.
LOCATION MAP OF
WALTER REED ARMY MEDICAL CENTER.

DRAWN BY	PROJ. #	FILE
GCL	38-EH-8209-98	DC/WALTER/FIG1



UNITED STATES ARMY
CENTER FOR HEALTH PROMOTION
AND PREVENTIVE MEDICINE
ABERDEEN PROVING GROUND, MARYLAND

FIGURE 2:
FOREST GLEN ANNEX.

DRAWN BY	PROJ. #	FILE
GCL	38-EH-8209-98	DC/WALTER/FIG2

5. ENVIRONMENTAL SETTING. The following information briefly describes the physical and environmental setting of the area of investigation.

a. Physiography. Montgomery County is located on the eastern edge of the Piedmont physiographic province, which is characterized by varied topography that ranges from lowlands to peaks and ridges of moderate altitude and relief (reference 3). Rolling hills are predominant in the Forest Glen area; these landforms slope in a westerly direction towards the Rock Creek drainage system.

b. Climatology. Weather conditions in the area of investigation are variable, with influences from the Chesapeake Bay and Atlantic Ocean to the east, and the Appalachian Mountains to the west. Summers are characterized by maritime-tropical winds from the south and southwest, which bring warm, humid air to the region. High-pressure systems often stagnate over the area, creating the potential for air pollution episodes several times during the summer. Winter is characterized by cold, dry, continental-polar winds from the west and northwest. Mean monthly temperatures range from a low of 35°F in January to a high of 78°F in July. Average annual precipitation is 40 inches. Prevailing winds are from the south at an average speed of 10 miles per hour (references 3 and 4).

c. Geology. The lithology of the region consists of a thin mantle of soils overlying a layer of saprolite, which overlies a metamorphic rock unit. Soils in the Building 500 area are members in the Manor-Channery silt loam complex, which are shallow, micaceous soils that occur in upland areas. Saprolite is a general geologic term for a soft, earthy, clay-rich thoroughly decomposed rock, formed in place by chemical weathering of igneous, sedimentary, or metamorphic rocks. Saprolite is characterized by preservation of structures that were present in the unweathered rock. In the area of investigation, saprolite exhibits foliation characteristic of the metamorphic gneiss and schist that underlie this layer. Gneiss is a rock in which bands of granular minerals alternate with bands of micaceous minerals having a subparallel to parallel orientation. Schist is a strongly foliated metamorphic rock with well developed parallelism of more than 50 percent of the minerals present.

d. Hydrogeology. Although metamorphic bedrock in the area of investigation does not serve as an aquifer, a thick wedge of coastal sediments lies approximately 10 to 20 miles to the south and east, forming the Potomac aquifer. This aquifer underlies the North Atlantic Coastal Plain and consists of the Patuxet, Patapsco, and Magothy Aquifers in the Delaware and Maryland vicinity. A confining unit of clay and sandy clay overlies the aquifer in most of this region. The area of investigation is located within the recharge area of the Patuxet Aquifer (references 1, 2, and 3).

6. BACKGROUND AND PREVIOUS INVESTIGATIONS.

a. In May 1988, a thin film of oil was observed floating on ground water in an excavation located approximatley 25 feet west of the north corner of Builing 512 (the Post Motor Pool). At this time, there were 14 underground storage tanks (USTs) containing fuel oil in the immediate vicinity of Building 500 and Building 512 (references 5 and 6). WRAMC environmental staff notes dated September 1988 (author unknown) indicate tightness testing was conducted in June 1988 and that a 50,000 gallon UST located near Building 500 containing No. 2 fuel oil failed at this time. In June 1989, ten monitoring wells were installed by this Center [formerly the U.S. Army Environmental Health Agency (USAEHA)] in the area surrounding Building 500 and Building 512. A sheen of oil was noted on the water surface in monitoring wells MW 1, MW 5, MW 6, MW 7, and MW 8. Concentrations of petroleum hydrocarbons present in ground water samples obtained from these wells in June 1989 and in March 1990 are summarized in Table 1. Ground-water contamination was determined to be minimal at the time, tightness testing of all USTs was recommended (reference 6).

Table 1: Total petroleum hydrocarbons (TPH) detected in ground water (references 6 and 7).

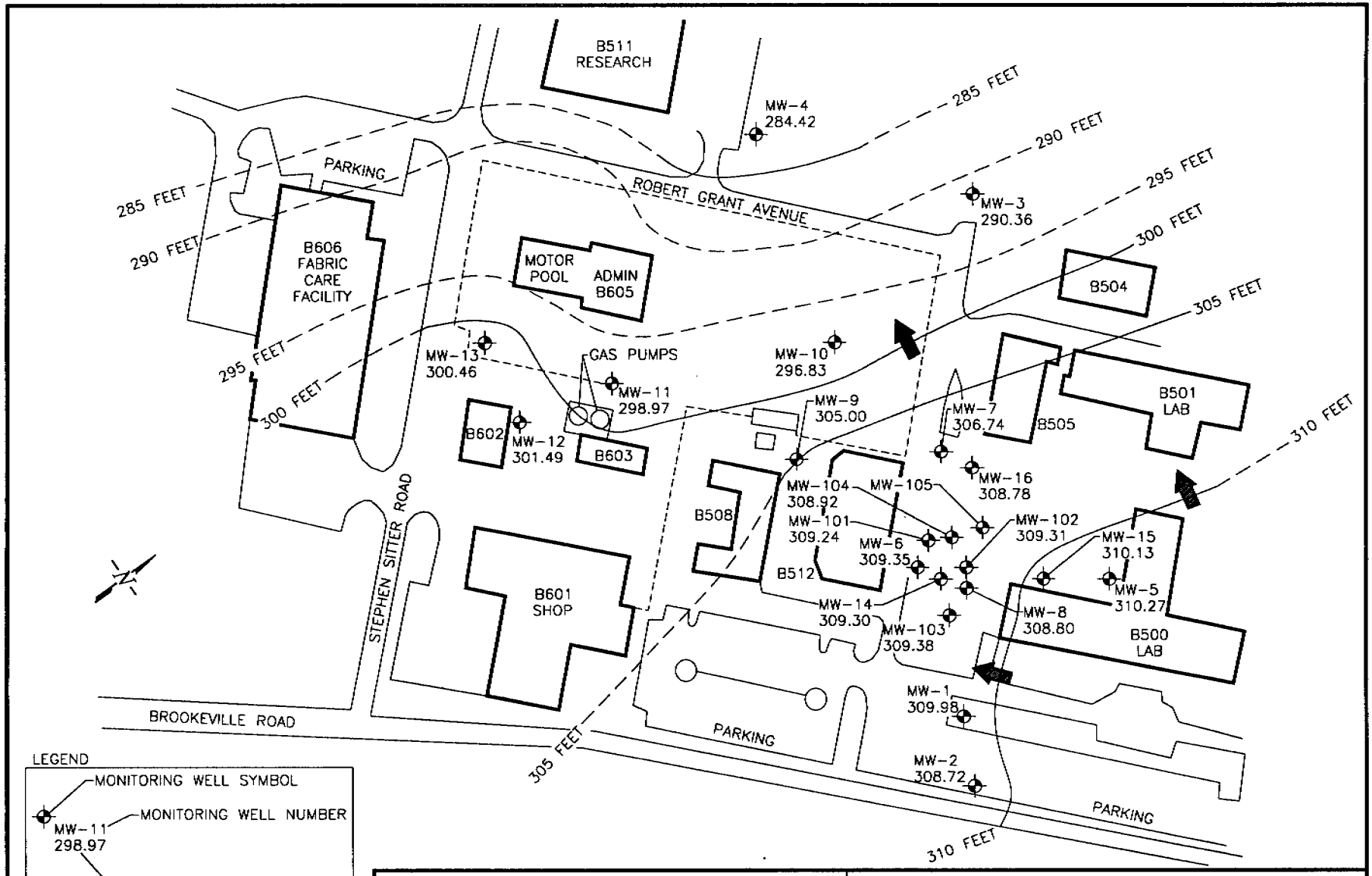
Monitoring Well Number	TPH (ppm) June 1989	TPH (ppm) March 1990
1	0.59	0.142
2	<0.1	<0.1
3	<0.1	<0.1
4	<0.1	<0.1
5	0.13	3.0
6	3.89	3.17
7	0.18	0.79
8	3.95	21.9
9	<0.1	<0.1
10	<0.1	<0.1

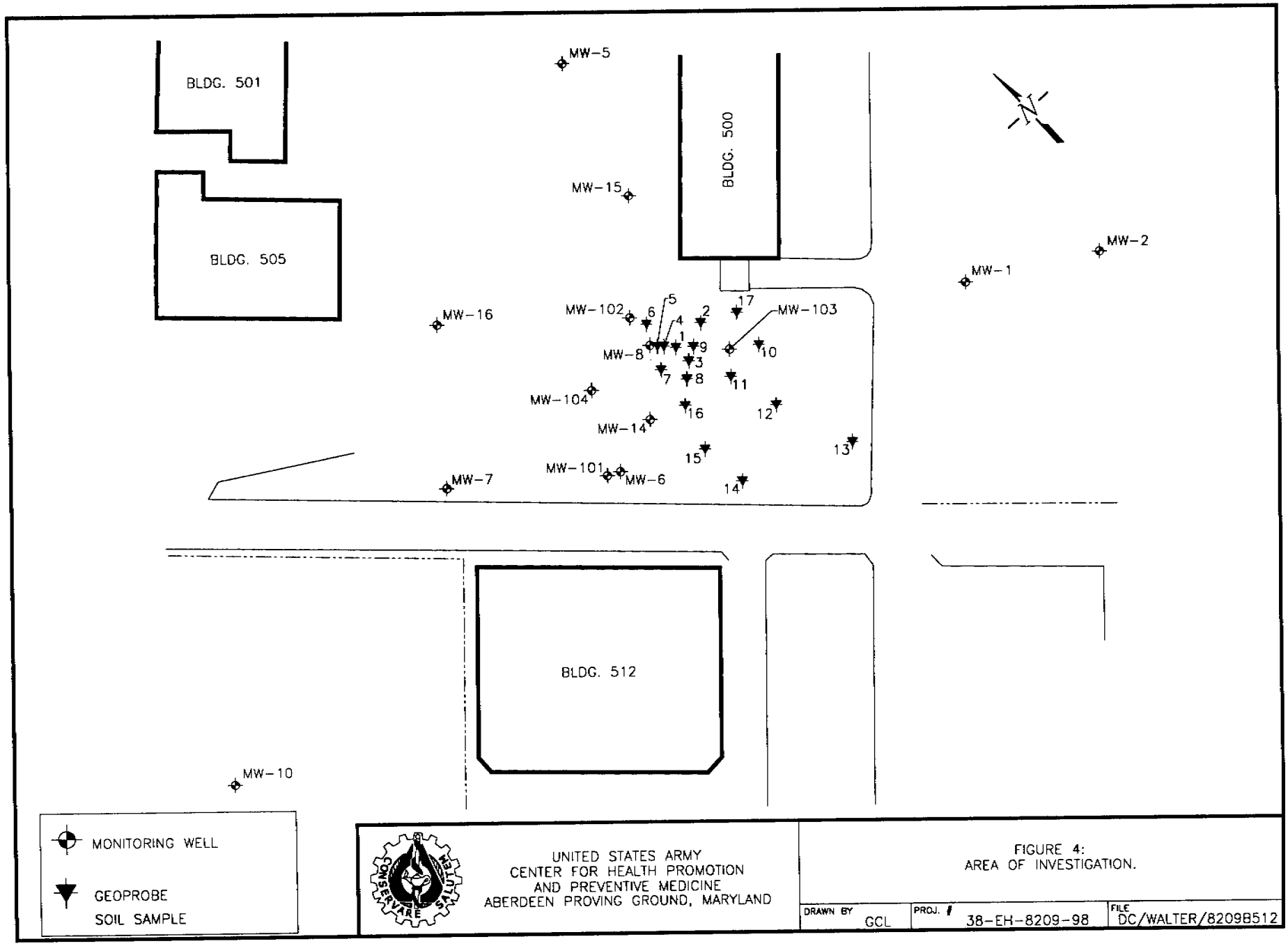
b. In December 1992, a 12,000 gallon UST located near Building 500 containing No. 2 fuel oil was removed. Free phase petroleum product was observed in the excavation, and 4 feet of product was measured in MW 6 and MW 8. A total of 5,000 gallons of free product were pumped from the excavation on 3 and 4 December 1992 (reference 8). Ten additional monitoring wells were installed by private contractors in December 1992 and February 1993. Locations of all 20 monitoring wells and direction of ground-water flow are illustrated in Figure 3. Two 50,000 gallon USTs located near Building 500 were removed in January 1993 (reference 2). Mr. Robert Day, regional inspector for the State of Maryland Department of the Environment, also reported during this time period that an UST in the Building 500 area had been improperly abandoned (reference 9). In May 1993, an extensive search was conducted for this tank. The southwest corner of Building 500 area was excavated and a metal detector was used to search the area to the west of the building. Neither effort produced evidence of a tank. Blueprints were located that indicate that the tank was removed under a contract dated July 1977 (reference 10).

c. A daily product bailing program was initiated in November 1993. A total of 5.69 gallons of free product were removed in November, 1.38 gallons were removed in December, and 1.14 gallons were removed in January 1994 from MW 6, MW 8, MW 15, MW 102, and MW 104 (reference 11). A pump-and-treat system was installed in March 1994, with MW 102, MW 104, and a new well (Well 105) serving as recovery wells. A total of 26 gallons of product were removed from March through September 1994, and 20 gallons were removed in March through June 1995 (references 12 and 13). Although further product recovery information could not be obtained, WRAMC environmental staff report that product recovery has decreased to less than a gallon per month (reference 14).

d. From 1989 to the present, MW 8 has contained high levels of petroleum hydrocarbons. The maximum quantities of product recorded in 1994, 1995, and 1996 were 0.92 feet, 2.04 feet, and 0.76 feet, respectively (references 15 and 16). Although the most recent system operations report indicates that no product recovery was achieved during the month of February, 1.19 feet of product was measured in MW 8 on 24 February 1998 (reference 17). In March 1998, MW 8 was run over by a truck. Other monitoring wells in the immediate vicinity (MWs 6, 14, 15, 101, and 103) have contained lesser quantities of product.

7. FINDINGS AND DISCUSSION. This investigation is based on a review of documents, interviews, a site visit, and environmental sampling. Boring logs are provided in Appendix B. Monitor Well 8 was replaced and soil samples were collected and analyzed in accordance with procedures described in Appendix C.


B511
RESEARCH
MW-4
284.42
285 FEET
290 FEET
295 FEET
300 FEET
305 FEET
310 FEET
PARKING
ROBERT GRANT AVENUE
MW-3
290.36
B606
FABRIC
CARE
FACILITY
MOTOR
POOL
ADMIN
B605
B504
MW-13
300.46
GAS PUMPS
MW-11
298.97
MW-10
296.83
MW-9
305.00
MW-7
306.74
B505
B501
LAB
B602
MW-12
301.49
B603
MW-16
308.78
MW-104
308.92
MW-105
MW-101
309.24
MW-102
309.31
B508
MW-6
309.35
MW-15
310.13
B512
MW-5
310.27
MW-14
309.30
MW-8
308.80
MW-103
309.38
B500
LAB
STEPHEN SITTER ROAD
B601
SHOP
MW-1
309.98
BROOKEVILLE ROAD
MW-2
308.72
N
LEGEND
MONITORING WELL SYMBOL
MW-11
298.97
MONITORING WELL NUMBER
MONITORING WELL ELEVATION
(FEBRUARY 1993)
GROUND WATER FLOW
UNITED STATES ARMY
CENTER FOR HEALTH PROMOTION
AND PREVENTIVE MEDICINE
ABERDEEN PROVING GROUND, MARYLAND
FIGURE 3:
MONITORING WELL LOCATIONS
AND DIRECTION OF GROUND WATER FLOW
(FROM REFERENCE 2).
DRAWN BY
GCL
PROJ. #
38-EH-8209-98
FILE
DC/WALTER/FIG3


BLDG. 501
BLDG. 505
BLDG. 500
BLDG. 512
MW-1
MW-2
MW-5
MW-6
MW-7
MW-8
MW-10
MW-14
MW-15
MW-16
MW-101
MW-102
MW-103
MW-104
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
N
MONITORING WELL
GEOPROBE
SOIL SAMPLE
UNITED STATES ARMY
CENTER FOR HEALTH PROMOTION
AND PREVENTIVE MEDICINE
ABERDEEN PROVING GROUND, MARYLAND
FIGURE 4:
AREA OF INVESTIGATION.
DRAWN BY GCL
PROJ. # 38-EH-8209-98
FILE DC/WALTER/82098512

a. Investigative Methodology. A Geoprobe® was used to construct 17 boreholes in the immediate vicinity of MW 8 near Building 500 (Figure 4). Continuous core samples were obtained from a depth of approximately 6 feet to refusal. Soils were inspected for odor or visual evidence of petroleum hydrocarbons. Evidence of TPH contamination was noted in boring logs maintained for each borehole (Appendix B). Borehole logs were reviewed as field work progressed in an attempt to identify a pattern or trend in occurrence of TPH contamination. Twelve soil samples were collected at selected locations and analyzed for TPH using a field test kit to determine if samples were above or below the State regulatory level of 100 ppm.

b. Site Geology and Hydrology. A layer of fill soil overlies a layer of saprolite in the area of investigation. Depth at which saprolite was first encountered varied from 6 to 10 feet. The saprolite unit decreases in degree of weathering with depth; refusal occurred from 12 to 19 feet below ground surface. Following construction of MW 8 in June 1989, ground water occurred at 9.85 feet below ground surface (reference 6). In February 1998, operation of the pump-and-treat remediation system had lowered the water table to approximately 20 feet below ground surface (reference 17). Exact depth to ground water is unknown due to the presence of 1.19 feet of product in this well.

c. Distribution of Petroleum Hydrocarbons in Subsurface Sediments. Faint TPH odors were most often detected at a depth of 6 to 10 feet. These odors tended to increase with depth until a decrease in the degree of weathering of the saprolite unit was noted, which corresponded with increased difficulty of drilling. TPH odors tended to decrease with increasing hardness of the rock formation and were generally very faint or not present at the depth at which refusal occurred. A light coating of oil was observed on pea gravel recovered from Borehole 7. Abrupt refusal and recovery of concrete chips in the cutting shoe at this borehole indicate that a concrete pad associated with a former UST is located here. No further visual evidence of TPH contamination was observed in the area of investigation. No evidence of a discrete, highly contaminated area was identified in this investigation.

® Geoprobe is a registered trademark of DEJR Engineering Inc., Salina, Kansas. Use of trademarked names does not imply endorsement by the U.S. Army but is intended only to assist in identification of a specific product.

d. Sample Analytical Results. Results of TPH analyses are presented in Table 2. Most soil samples containing greater than 100 ppm TPH occurred between 10 and 13 feet below ground surface. Most samples collected from depths at which decreased weathering of the saprolite unit was apparent contained less than 100 ppm TPH.

Table 2: Geoprobe Sampling Results

Borehole Number	Depth to Refusal (feet)	Depth Below Ground Surface (feet)	Analytical Results
10	13	10	above 100 ppm
		13	below 100 ppm
11	16	10	above 100 ppm
		16	above 100 ppm
12	19	13	above 100 ppm
		16	below 100 ppm
13	12	12	below 100 ppm
14	13	10	above 100 ppm
		13	below 100 ppm
15	16	16	below 100 ppm
16	16	13	above 100 ppm
17	15.5	15.5	below 100 ppm

8. CONCLUSIONS.

a. No evidence was found to indicate that a point source of petroleum hydrocarbon contamination exists at the present time in the area of investigation. Slight to moderate TPH contamination was detected in a large volume of subsurface soils extending throughout the area of investigation. Diminished fuel odors and results of analyses conducted on samples collected at greater depths indicate that contamination of subsurface sediments is restricted to the soft, weathered saprolite layer.

b. It is probable that TPH contamination of ground water has resulted from fuel oil entrapped in the weathered saprolite. Fuel oils may have spread outward from the source by floating on the water table, which occurred at the time of release at the approximate depth at

which soil contamination was detected in this investigation. Migration of fuel oil towards the recovery wells may currently be impeded by a high clay content in the saprolite layer and by the absence of ground water at this depth due to lowering of the water table by the pump-and-treat system.

9. RECOMMENDATIONS.

a. Relocate recovery wells from the present locations to monitor wells that currently contain product.

b. Increased mobilization of fuel oils through the weathered saprolite may be accomplished by discharging pump-and-treat effluent directly onto ground surface of the affected area and allowing the water to flush through subsurface sediments, or by suspending pump-and-treat operations periodically to allow the water table to return to the elevation at which soil contamination occurs. Also use a lower pumping rate to create a shallower cone of depression around the recovery well.

Kathleen Butoryak

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REVIEWED:

Wayne A Fox

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Team Leader
Compliance and Pollution Prevention

APPROVED:

John W. Bauer

JOHN W. BAUER, P.G.
Program Manager
Ground Water and Solid Waste

APPENDIX A

REFERENCES

1. Report No. 342, Installation Assessment of Headquarters, Walter Reed Army Medical Center, Washington, DC, and Noncontiguous Sections Forest Glen, Silver Spring, Maryland, and Glen Haven, Wheaton, Maryland, prepared by Environmental Science and Engineering, Inc., for U.S. Army Toxic and Hazardous Materials Agency, June 1984.

2. Memorandum, USAEHA, HSHB-ME-SG, 24 May 1993, Subject: Ground-Water Quality Consultation No. 38-26-K1HT-93, Forest Glen Section, Walter Reed Army Medical Center, Washington, DC, 8-10 February 1993.

3. Ground-Water Atlas of the United States, Segment 11, Delaware, Maryland, New Jersey, North Carolina, Pennsylvania, Virginia, and West Virginia, Henry Trapp, Jr., and Marilee A. Horn, USGS Hydrologic Investigations Atlas 730-L, 1997.

4. Climatic Atlas of the United States, US Department of Commerce, Environmental Science Administration, Environmental Data Service, June 1968.

5. Memorandum, USAEHA, HSHB-ME-SG, Subject: Ground-Water Quality Consultation No. 38-26-0328-88, POL Contaminated Ground-water, Forest Glen Section, Walter Reed Army Medical Center (WRAMC), 14 June 1998.

6. Memorandum, USAEHA, HSHB-ME-SG, 30 November 1989, Subject: Ground-Water Quality Consultation No. 38-26-0354-90, Forest Glen Section, Walter Reed Army Medical Center, Washington, DC, 19-30 June 1989.

7. Memorandum, USAEHA, HSHB-ME-SG, 24 April 1990, Subject: Chemical Analyses Results from Water Samples Collected from the Ground-Water Monitoring Wells Near Buildings 500 and 512 at the Forest Glen Section, Walter Reed Army Medical Center, (WRAMC) on 13 March 1990.

8. Tank Removal Form and Site Complaint Form, Enclosures in Memorandum for Record, from John G. Miller, Chief, Planning and Environmental Division, HSHL-EH, Subject: Oil Spill - Building 500 - Day Tank, 7 December 1992.

9. Correspondence from Mr. Herbert M. Meade, Compliance/Remediation Division, Oil Control Program, State of Maryland Department of the Environment, to Major General Ronald R. Blanck, RE: Notice of Violation NV-93-056, Walter Reed Army Medical Center, Forest Glen Annex Building 500 and 512, 22 December 1992.

10. Memorandum for Directorate of Engineering and Housing, Planning and Environmental Division, ATTN: Jean McGinn, from Wendell Leonard, Chief, Plans and Services, HSHL-EH, Subject: Underground Storage Tanks, 4 May 1993.

11. Correspondence from Mr. Kevin W. Howard, Senior Project Manager, ATEC Environmental Consultants, to Ms. Marguerite Morrison, Contract Administrator, WRAMC, RE: Free Product Recover Results, WRAMC, Forest Glen Section, 4 February 1994.

12. Correspondence from Mr. Sean P. Daniel, Project Manager, ATEC Associates, to Dr. Winston Williams, WRAMC, RE: Sixth Monthly Report and Ground water Contour Map, Groundwater Remediation System, WRAMC, Forest Glen Section, 5 October 1994.

13. Correspondence from Mr. James I. Gibb, Project Manager, ATEC Associates, to Dr. Winston Williams, WRAMC, RE: Second Quarterly Report, Groundwater Remediation System, WRAMC, Forest Glen Section, 21 July 1995.

14. Personal Communication with Dr. Winston A. Williams, Environmental Engineer, Environmental Division, WRAMC, May 1998.

15. Correspondence from Mr. Tokes A. Adesida, Project Geologist, APEX Environmental, Inc., to Dr. Winston Williams, WRAMC, RE: Monthly Progress Report, Groundwater Remediation System Operations and Maintenance, WRAMC, Forest Glen Section, 16 February 1996.

16. Correspondence from Mr. Tokes A. Adesida, Project Geologist, APEX Environmental, Inc., to Dr. Winston Williams, WRAMC, RE: Quarterly Progress Report, Groundwater Remediation System Operations and Maintenance, WRAMC, Forest Glen Section, 25 September 1996.

17. Correspondence from Mr. Sean P. Daniel, Project Manager, Environmental Science and Technology Corporation (ENSAT) to Dr. Winston Williams, WRAMC, RE: Monthly Operations and Maintenance Report, Groundwater Pump and Treat System, Building 500/ Forest Glen Complex, WRAMC, 20 April 1998.

APPENDIX B

DRILLING LOGS

U.S. ARMY CENTER FOR HEALTH PROMOTION AND PREVENTIVE MEDICINE
GROUND WATER & SOLID WASTE PROGRAM
GEOPROBE DRILLING LOG

BORE HOLE 1 DATE 5/11/98
INSTALLATION Walter Reed Army Medical Center, Forest Glen Annex
PROJECT NUMBER 38-26-8209-98 GEOLOGIST Kathleen Butoryak
DRILLERS/TECHNICIANS Richard Kestner Sandra Toscano

DEPTH (feet)	COMMENTS
0	No soil structure observed, sediments presumed to be fill. Brownish grey very fine to very coarse sand with some silt and a trace of fine gravel.
5	
10	Grey/tan saprolite - weathered schist and gneiss, predominantly silt with some clay, sand, and gravel. Faint TPH odor at 11', increasing with depth to strong at 12', very strong 12' through 18'.
15	
	Refusal at 19'.
20	

U.S. ARMY CENTER FOR HEALTH PROMOTION AND PREVENTIVE MEDICINE
GROUND WATER & SOLID WASTE PROGRAM
GEOPROBE DRILLING LOG

BORE HOLE 2 DATE 5/11/98
INSTALLATION Walter Reed Army Medical Center, Forest Glen Annex
PROJECT NUMBER 38-26-8209-98 GEOLOGIST Kathleen Butoryak
DRILLERS/TECHNICIANS Richard Kestner Sandra Toscano

DEPTH (feet)	COMMENTS
0	No soil structure observed, sediments presumed to be fill. Brownish grey very fine to very coarse sand with some silt and a trace of fine gravel.
	No odors detected throughout sequence.
5	
10	Refusal at 11'
15	
20	

U.S. ARMY CENTER FOR HEALTH PROMOTION AND PREVENTIVE MEDICINE
GROUND WATER & SOLID WASTE PROGRAM
GEOPROBE DRILLING LOG

BORE HOLE 3 DATE 5/11/98
INSTALLATION Walter Reed Army Medical Center, Forest Glen Annex
PROJECT NUMBER 38-26-8209-98 GEOLOGIST Kathleen Butoryak
DRILLERS/TECHNICIANS Richard Kestner Sandra Toscano

DEPTH (feet)	COMMENTS
0	No soil structure observed, sediments presumed to be fill. Brownish grey very fine to very coarse sand with some silt and a trace of fine gravel.
5	Faint TPH odor detected from 6' to 8'.
	1" thick layer of pea gravel located at approximately 7'.
10	Grey/tan saprolite - weathered schist and gneiss, predominantly silt with some clay, sand, and gravel. Faint TPH odor at 10', increasing with depth to strong at 12'.
	Refusal at 12'.
15	
20	

U.S. ARMY CENTER FOR HEALTH PROMOTION AND PREVENTIVE MEDICINE
GROUND WATER & SOLID WASTE PROGRAM
GEOPROBE DRILLING LOG

BORE HOLE 4 DATE 5/11/98
INSTALLATION Walter Reed Army Medical Center, Forest Glen Annex
PROJECT NUMBER 38-26-8209-98 GEOLOGIST Kathleen Butoryak
DRILLERS/TECHNICIANS Richard Kestner Sandra Toscano

DEPTH (feet)	COMMENTS
0	No soil structure observed, sediments presumed to be fill. Brownish grey very fine to very coarse sand with some silt and a trace of fine gravel.
	No TPH odor detected 0' to 3'.
	Very faint TPH odor detected from 3' to 7'.
5	
	Grey/tan saprolite - weathered schist and gneiss, predominantly silt with some clay, sand, and gravel. Faint TPH odor at 8', increasing with depth to strong at 11'.
10	
	Strong THP odor throughout interval 11' to 15'.
	Refusal at 15'.
15	
20	

U.S. ARMY CENTER FOR HEALTH PROMOTION AND PREVENTIVE MEDICINE
GROUND WATER & SOLID WASTE PROGRAM
GEOPROBE DRILLING LOG

BORE HOLE 5 DATE 5/11/98
INSTALLATION Walter Reed Army Medical Center, Forest Glen Annex
PROJECT NUMBER 38-26-8209-98 GEOLOGIST Kathleen Butoryak
DRILLERS/TECHNICIANS Richard Kestner Sandra Toscano

DEPTH (feet)	COMMENTS
0	No soil structure observed, sediments presumed to be fill. Brownish grey very fine to very coarse sand with some silt and a trace of fine gravel.
5	Very faint TPH odor detected from 6' to 10'.
10	Grey/tan saprolite - weathered schist and gneiss, predominantly silt with some clay, sand, and gravel. Faint TPH odor at 10', increasing with depth to strong at 15'.
15	TPH odor decreasing and density of Saprolite increasing with depth from 15'-19'; increased difficulty in drilling.
	Refusal at 19'.
20	

U.S. ARMY CENTER FOR HEALTH PROMOTION AND PREVENTIVE MEDICINE
GROUND WATER & SOLID WASTE PROGRAM
GEOPROBE DRILLING LOG

BORE HOLE 6 DATE 5/12/98
INSTALLATION Walter Reed Army Medical Center, Forest Glen Annex
PROJECT NUMBER 38-26-8209-98 GEOLOGIST Kathleen Butoryak
DRILLERS/TECHNICIANS Richard Kestner Sandra Toscano

DEPTH (feet)	COMMENTS
0	No soil structure observed, sediments presumed to be fill. Brownish grey very fine to very coarse sand with some silt and a trace of fine gravel. No THP odor detected 0' to 10'.
5	
10	Faint TPH odor at 10', increasing with depth to strong at 14'.
	Grey/tan saprolite - weathered schist and gneiss, predominantly silt with some clay, sand, and gravel. TPH odor strong throughout interval 14' to 18'.
15	
	Refusal at 18'.
20	

U.S. ARMY CENTER FOR HEALTH PROMOTION AND PREVENTIVE MEDICINE
GROUND WATER & SOLID WASTE PROGRAM
GEOPROBE DRILLING LOG

BORE HOLE 7 DATE 5/12/98
INSTALLATION Walter Reed Army Medical Center, Forest Glen Annex
PROJECT NUMBER 38-26-8209-98 GEOLOGIST Kathleen Butoryak
DRILLERS/TECHNICIANS Richard Kestner Sandra Toscano

DEPTH (feet)	COMMENTS
0	No soil structure observed, sediments presumed to be fill. Brownish grey very fine to very coarse sand with some silt and a trace of fine gravel.
5	Moderatly strong TPH odor detected at 6', increasing to very strong at 10'.
10	Pea gravel 9.5' to 10'.
	Approximatley 1' of pea gravel recovered in sample tube. Strong TPH odor at top of sequence, light coating of oil on gravel at bottom of sample.
	Refusal at 14.5' (abrupt). Concrete chips recovered in bit.
15	
20	

U.S. ARMY CENTER FOR HEALTH PROMOTION AND PREVENTIVE MEDICINE
GROUND WATER & SOLID WASTE PROGRAM
GEOPROBE DRILLING LOG

BORE HOLE 8 DATE 5/12/98
INSTALLATION Walter Reed Army Medical Center, Forest Glen Annex
PROJECT NUMBER 38-26-8209-98 GEOLOGIST Kathleen Butoryak
DRILLERS/TECHNICIANS Richard Kestner Sandra Toscano

DEPTH (feet)	COMMENTS
0	No soil structure observed, sediments presumed to be fill. Brownish grey very fine to very coarse sand with some silt and a trace of fine gravel.
5	
	Pea gravel at 9' - 9.5'.
10	Grey/tan saprolite - weathered schist and gneiss, predominantly silt with some clay, sand, and gravel. Strong TPH odor throughout sequence from 9.5' to 15'.
15	Refusal at 15'.
20	

U.S. ARMY CENTER FOR HEALTH PROMOTION AND PREVENTIVE MEDICINE
GROUND WATER & SOLID WASTE PROGRAM
GEOPROBE DRILLING LOG

BORE HOLE 9 DATE 5/12/98
INSTALLATION Walter Reed Army Medical Center, Forest Glen Annex
PROJECT NUMBER 38-26-8209-98 GEOLOGIST Kathleen Butoryak
DRILLERS/TECHNICIANS Richard Kestner Sandra Toscano

DEPTH (feet)	COMMENTS
0	No soil structure observed, sediments presumed to be fill. Brownish grey very fine to very coarse sand with some silt and a trace of fine gravel. No TPH odor detected.
5	
10	Grey/tan saprolite - weathered schist and gneiss, predominantly silt with some clay, sand, and gravel. Faint TPH odor at 10', increasing with depth to strong odor at 14'.
	Refusal at 14'.
15	
20	

U.S. ARMY CENTER FOR HEALTH PROMOTION AND PREVENTIVE MEDICINE
GROUND WATER & SOLID WASTE PROGRAM
GEOPROBE DRILLING LOG

BORE HOLE 10 DATE 5/12/98
INSTALLATION Walter Reed Army Medical Center, Forest Glen Annex
PROJECT NUMBER 38-26-8209-98 GEOLOGIST Kathleen Butoryak
DRILLERS/TECHNICIANS Richard Kestner Sandra Toscano

DEPTH (feet)	COMMENTS
0	
5	Saprolite - weathered schist and gneiss, color changing from orange/grey to grey/tan with depth. Degree of weathering decreasing with depth. Faint TPH odor detected throughout interval from 6' to 13'.
10	*Soil sample collected at 10' - Above 100ppm TPH.*
	Soil sample collected at 13' - Below 100ppm TPH. Refusal at 13'.
15	
20	

U.S. ARMY CENTER FOR HEALTH PROMOTION AND PREVENTIVE MEDICINE
GROUND WATER & SOLID WASTE PROGRAM
GEOPROBE DRILLING LOG

BORE HOLE 11 DATE 5/12/98
INSTALLATION Walter Reed Army Medical Center, Forest Glen Annex
PROJECT NUMBER 38-26-8209-98 GEOLOGIST Kathleen Butoryak
DRILLERS/TECHNICIANS Richard Kestner Sandra Toscano

DEPTH (feet)	COMMENTS
0	
5	
	Saprolite - weathered schist and gneiss, color changing from orange/grey to grey/tan with depth. Degree of weathering decreasing with depth from 6' to 9'. Faint TPH odor detected throughout interval from 6' to 10'.
10	Strong TPH odor detected throughout interval from 10' to 13'. *Soil sample collected at 10' - Above 100 ppm TPH.*
	TPH odor decreasing throughout interval from 13' to 16'.
15	*Soil sample collected at 16' - Above 100 ppm TPH.* Refusal at 16'.
20	

U.S. ARMY CENTER FOR HEALTH PROMOTION AND PREVENTIVE MEDICINE
GROUND WATER & SOLID WASTE PROGRAM
GEOPROBE DRILLING LOG

BORE HOLE 12 DATE 5/13/98
INSTALLATION Walter Reed Army Medical Center, Forest Glen Annex
PROJECT NUMBER 38-26-8209-98 GEOLOGIST Kathleen Butoryak
DRILLERS/TECHNICIANS Richard Kestner Sandra Toscano

DEPTH (feet)	COMMENTS
0	
5	Saprolite - weathered schist and gneiss, color changing from orange/grey to grey/tan with depth. Degree of weathering decreasing with depth from 6' to 9'. No TPH odor detected throughout interval from 6' to 10'.
10	TPH odor increasing with depth from faint to moderately strong throughout interval from 10' to 13'.
	TPH odor decreasing with depth from throughout interval from 13' to 16'. *Soil sample collected at 13' - Above 100 ppm TPH.*
15	TPH odor decreasing and density of saprolite increasing with depth throughout interval from 16' to 19'; increased difficulty in drilling. *Soil sample collected at 16' - Below 100 ppm TPH.*
	Refusal at 19'
20	

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GROUND WATER & SOLID WASTE PROGRAM
GEOPROBE DRILLING LOG

BORE HOLE 13 DATE 5/13/98
INSTALLATION Walter Reed Army Medical Center, Forest Glen Annex
PROJECT NUMBER 38-26-8209-98 GEOLOGIST Kathleen Butoryak
DRILLERS/TECHNICIANS Richard Kestner Sandra Toscano

DEPTH (feet)	COMMENTS
0	
5	Grey/tan saprolite - weathered schist and gneiss, predominantly silt with some clay, sand, and gravel. No TPH odor detected throughout interval from 6' to 10'.
10	Faint TPH odor detected throughout interval from 10' to 12'.
	Soil sample collected at 12' - Below 100 ppm TPH. Refusal at 12'.
15	
20	

U.S. ARMY CENTER FOR HEALTH PROMOTION AND PREVENTIVE MEDICINE
GROUND WATER & SOLID WASTE PROGRAM
GEOPROBE DRILLING LOG

BORE HOLE 14 DATE 5/13/98
INSTALLATION Walter Reed Army Medical Center, Forest Glen Annex
PROJECT NUMBER 38-26-8209-98 GEOLOGIST Kathleen Butoryak
DRILLERS/TECHNICIANS Richard Kestner Sandra Toscano

DEPTH (feet)	COMMENTS
0	No soil structure observed, sediments presumed to be fill. Brownish grey very fine to very coarse sand with some silt and a trace of fine gravel.
5	No TPH odor detected throughout sequence from 6' to 9'.
10	Grey/tan saprolite - weathered schist and gneiss, predominantly silt with some clay, sand, and gravel. TPH odor detected at 10', decreasing with depth to faint at 13'. *Soil sample collected at 10' -Above 100 ppm TPH.*
15	*Soil sample collected at 13' - Below 100 ppm TPH.* Refusal at 13'.
20	

U.S. ARMY CENTER FOR HEALTH PROMOTION AND PREVENTIVE MEDICINE
GROUND WATER & SOLID WASTE PROGRAM
GEOPROBE DRILLING LOG

BORE HOLE 15 DATE 5/13/98
INSTALLATION Walter Reed Army Medical Center, Forest Glen Annex
PROJECT NUMBER 38-26-8209-98 GEOLOGIST Kathleen Butoryak
DRILLERS/TECHNICIANS Richard Kestner Sandra Toscano

DEPTH (feet)	COMMENTS
0	No soil structure observed, sediments presumed to be fill. Brownish grey silt with some very fine to medium sand. with some and a trace of fine gravel.
5	Faint TPH odor incresing with depth from 6' to 10'.
10	Several 1/2" to 1" quartzite pebbles at bottom of 6' to 10' sequence.
	Grey/tan saprolite - weathered schist and gneiss, predominantly silt with some clay, sand, and gravel. Faint TPH odor at 10', increasing with depth to strong at 12'.
	TPH odor decreasing from strong at 13' to none detected at 16'.
15	*Soil sample collected at 16' - Below 100 ppm TPH.* Refusal at 16'.
20	

U.S. ARMY CENTER FOR HEALTH PROMOTION AND PREVENTIVE MEDICINE
GROUND WATER & SOLID WASTE PROGRAM
GEOPROBE DRILLING LOG

BORE HOLE 16 DATE 5/13/98
INSTALLATION Walter Reed Army Medical Center, Forest Glen Annex
PROJECT NUMBER 38-26-8209-98 GEOLOGIST Kathleen Butoryak
DRILLERS/TECHNICIANS Richard Kestner Sandra Toscano

DEPTH (feet)	COMMENTS
0	No soil structure observed, sediments presumed to be fill. Brownish grey very fine to very coarse sand with some silt and a trace of fine gravel.
5	Faint TPH odor increasing to moderately strong from from 6' to 10'.
10	Grey/tan saprolite - weathered schist and gneiss, predominantly silt with some clay, sand, and gravel. Moderatly stong TPH odor at 10' increasing with depth to very strong at 13'.
	TPH odor decreasing with depth from very strong at 13' to faint at 16'. *Soil sample collected at 13' - Above 100 ppm TPH.*
15	Refusal at 16'.
20	

APPENDIX C

SOIL SAMPLING METHODS AND MONITORING WELL CONSTRUCTION

1. SOIL SAMPLING METHODS

a. Geoprobe Sampling. A Geoprobe was used to collect soil samples in the Building 500 area. Boreholes were constructed using a percussion hammer and a 2-inch probe. Plastic-lined core samplers were used to retrieve samples as the borehole was advanced. Samples were placed in containers supplied by USACHPPM laboratories. A new pair of latex gloves was used for collection of each sample. Boreholes were closed by filling the holes with bentonite pellets or concrete and using distilled water to hydrate the bentonite and concrete.

b. Description of Soils. All boreholes were logged. Soil samples were examined and described by the project geologist as drilling progressed.

c. Analysis of Soils for Petroleum Hydrocarbon Contaminants. Soil samples were analyzed using a Petro Soil SamplePro Rapid Detection Kit developed by Strategic Diagnostics, Inc. Petroleum hydrocarbons were extracted from 10 grams of soil. The extract was filtered, diluted with an enzyme solution, and added to a test tube containing antibodies. In this process, petroleum hydrocarbon molecules bind to the antibodies and adhere to the test tube. Addition of a substrate solution causes a colorimetric reaction to occur. A photometer was then used to determine if greater than 100 ppm of TPH were present in the sample.

2. MONITORING WELL CONSTRUCTION

a. Drilling Equipment and Methods. The borehole was constructed using a 9-inch outside diameter hollow-stem auger. The boring was advanced to a depth of 25 feet below ground surface. No drilling fluids were used in borehole construction.

b. Well Installation Materials and Methods. The well was constructed using two 5-foot sections of 4-inch, inside-diameter, polyvinyl chloride (PVC) well casing and three 5-foot sections of preslotted well screen (0.010-inch slot size with flush-threaded joints) (see Figure). The top of the well screen was placed 8 feet below ground surface. The annulus surrounding the well screen was sand-packed with clean, dry, medium to coarse sand to a depth of 6 feet below ground surface. A bentonite seal was placed above the sand pack to a depth of 1 foot below ground surface. Concrete was used to fill the remaining annulus to the surface. Two feet of well casing that protruded above the ground surface was removed and a flush mount steel casing was installed around the PVC casing. A locking cap was installed in the PVC casing.

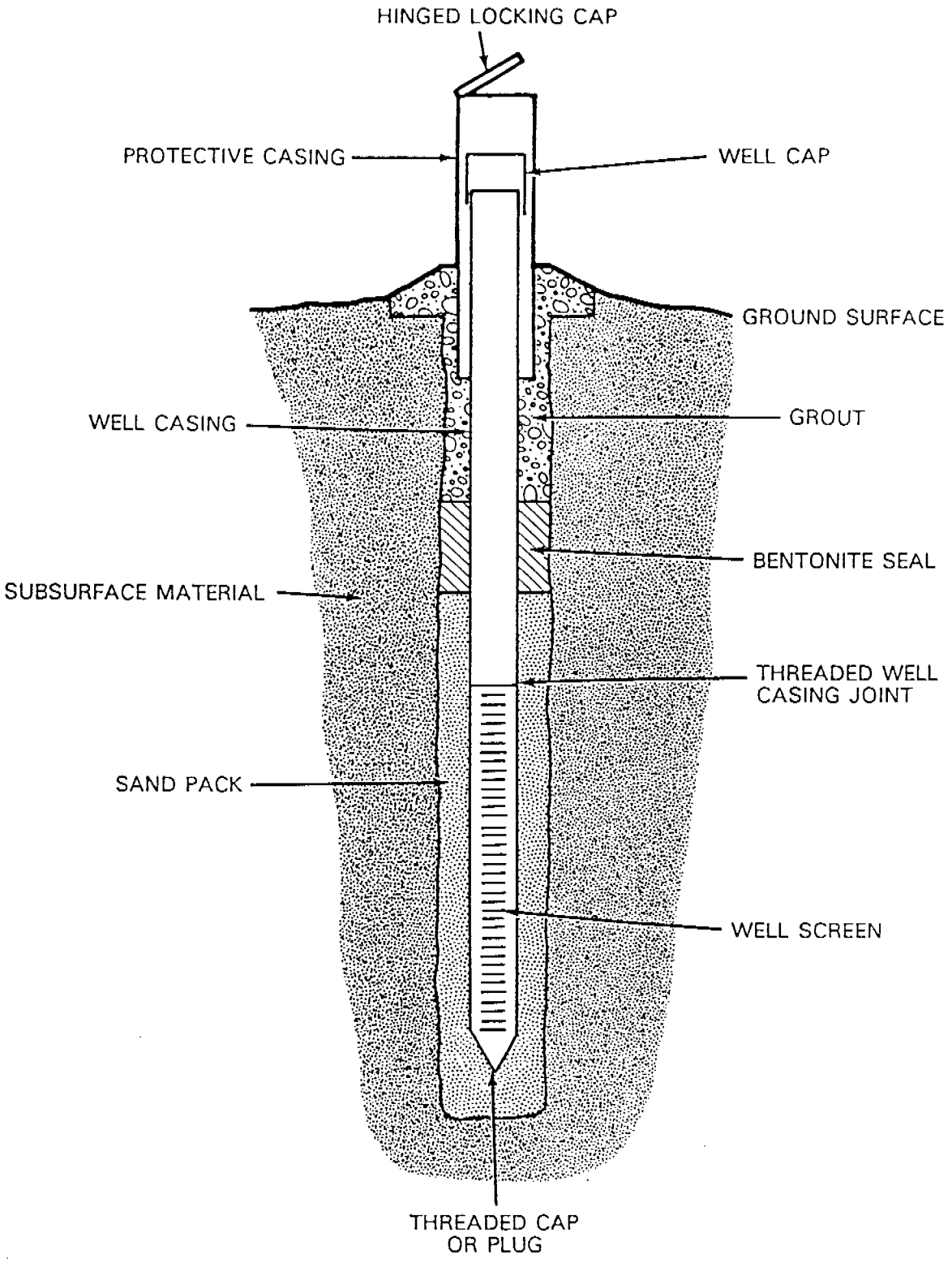

Figure **Generalized Monitoring Well Construction.**