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NIROP FRIDLEY, MN
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SUMMARY OF FINDINGS FOR THE SUBSURFAACE INVESTIGATION CONDUCTED AT INTERSECTION OF BROADWAY AND 7TH AVENUE INSIDE THE U S DEFENSE ARMAMENT SYSTEM DIVISION NIROP FRIDLEY MN
1/30/1997
DAHL

DAHL
& Associates, Inc.

Environmental Consultants, Contractors & Engineers

January 30, 1997

Mr. Doug Hildre
Armament Systems Division
United Defense L.P., FMC/ BMY
4800 East River Road
Fridley, MN 55459

RE: Summary of Findings for the Subsurface Investigation Conducted at the Intersection of Broadway and 7th Avenue Inside the United Defense Facility, Armament Systems Division, 4800 East River Road, Minneapolis, Minnesota, DAHL Project #24975500.

Dear Mr. Hildre:

DAHL and Associates Inc., was retained by Mr. Jim Dzubay, of Matrix Technologies Inc., on January 8, 1997, to provide a project geologist for a subsurface soil investigation to be conducted within the United Defense facility. The geologist was retained to collect and characterize soil samples and submit certain predetermined samples for laboratory analysis.

Between January 13 and January 16, 1997, DAHL provided a geologist for the advancement of 9 Geoprobe borings at the United Defense Facility. United Defense identified boring locations prior to the arrival of the DAHL representative on-site. Soil samples were retrieved continuously from 9 soil borings from the base of the removed concrete flooring (0 feet) to 16 feet below that level in each boring. All soil samples were characterized according to visual, and olfactory observations, and classified according to the USCS classification system. Soil was also collected every two feet and analyzed for organic vapors according to the Minnesota Pollution Control Agency (MPCA) Fact Sheet #3.22 "Soil Sample Analysis and Collection Procedures." Boring logs documenting the data collected during soil boring advancement are included in Appendix C.

Soil samples submitted for laboratory analysis were collected from 0 feet to 2 feet and 10 feet to 12 feet, unless otherwise noted. The samples were submitted for analysis of Volatile Organic Compounds (VOC), Diesel Range Organics (DRO), Gasoline Range Organics (GRO), and 8 RCRA Metals. Laboratory analysis results are included in Appendix B. Geoprobe operating

procedures, decontamination protocol, and soil sample retrieval techniques are described in the enclosed appendix, "Standard Operating Procedures" (Appendix A).

Throughout this report boring locations will be described in reference to large vertical I beams within the facility which are spaced approximately 30 feet apart beginning near Broadway Avenue and extending to the west. The beam closest to Broadway Avenue will be referred to as Beam 1 and the numbers will increase toward the west (walkways are labeled as streets and avenues).

Geoprobe boring #1 (GP-1) was located 12.1 feet west and 4.1 feet north of Beam 1, approximately 5 feet below grade in the floor of a dug out area which contains an oil sump. The sump is at least five feet in depth and appeared to be inactive. Minneapolis Concrete Sawing and Drilling removed 5 inches of concrete from the floor of the dug-out. Matrix began soil sample retrieval 77 inches below grade. The only headspace reading detected in soils collected from GP-1 was that of 2 parts per million (ppm) in the sample collected from 10 feet to 12 feet. Laboratory analysis of soil collected from 0 feet to 2 feet indicated the presence of 5.1 ppm barium, 3.5 ppm chromium, 30 ppm DRO, 28 ppb naphthalene, 360 ppb toluene, 47 ppb 1, 2, 4 trimethylbenzene, and 78 ppb xylene. Laboratory analysis of soil collected from 10 feet to 12 feet indicated the presence of 13 ppm barium, 9.5 ppm chromium, 2.0 ppm lead, 370 ppm DRO, 54 ppb ethyl benzene, 41 ppb naphthalene, 1200 ppb toluene, 91 ppb trichloroethene, 91 ppb 1, 2, 4 trimethylbenzene, and 252 ppb xylene.

Geoprobe boring #2 was located 3.9 feet east and 5.5 feet north of Beam 2 in the floor of a 4 foot by 4 foot by five foot deep dug-out area. Minneapolis Concrete Sawing and Drilling removed approximately 5 inches of concrete from the floor of dug out. Matrix began soil sample retrieval 77 inches below grade. No headspace readings were detected in soils collected from GP-2. Laboratory analysis of the soil collected from 0 feet to 2 feet indicated the presence of 3.1 ppm barium, 2.9 ppm chromium, 15 ppm lead, 6800 ppm DRO, and 93 ppb trichloroethene. Laboratory analysis of soil collected from 10 feet to 12 feet indicated the presence of 8.4 ppm barium, 5.8 ppm chromium, 3.2 ppm lead, 2500 ppm DRO, 81 ppb 1, 4 dichlorobenzene, 110 ppb ethyl benzene, 140 ppb naphthalene, 3200 ppb toluene, 230 ppb 1, 2, 4 trimethylbenzene, 67 ppb 1, 3, 5 trimethylbenzene, and 540 ppb xylenes.

Geoprobe boring #3 was located 5.4 feet west and 6.4 feet north of Beam 2 . Minneapolis Concrete Sawing and Drilling removed approximately 50 inches of concrete from the floor of the facility. Matrix began soil sample retrieval 50 inches below grade. No headspace readings were detected in soils collected from GP-3. Laboratory analysis of the soil collected from 0 feet to 2 feet indicated the presence of 9.5 ppm barium, 5.9 ppm chromium, and 2.7 ppm lead. Laboratory analysis of soil collected from 10 feet to 12 feet indicated the presence of 1.3 ppm arsenic, 8.9 ppm barium, 5.0 ppm chromium, and 56 ppb trichloroethene.

Geoprobe boring #4 was located 12.4 feet west and 17.3 feet north of Beam 2 . Minneapolis Concrete Sawing and Drilling removed approximately 12 inches of concrete, encountered 24 inches of sand and then removed another 36 inches of concrete from the floor of the facility.

Matrix began soil sample retrieval 72 inches below grade. Headspace readings of 2 ppm were detected in soils collected from 10 to 16 feet below the bottom of the concrete floor. Laboratory analysis of the soil collected from 0 feet to 2 feet indicated the presence of 0.9 ppm arsenic, 5.4 ppm barium, 4.0 ppm chromium, 2.3 ppm lead, and 35 ppb 1, 1, 1 trichloroethane. Laboratory analysis of soil collected from 10 feet to 12 feet indicated the presence of 6.1 ppm barium, 3.9 ppm chromium, 1.7 ppm lead, and 36 ppb trichloroethene.

Geoprobe boring #5 was located 6.1 feet directly west of Beam 3 . Minneapolis Concrete Sawing and Drilling removed approximately 48 inches of concrete from the floor of the facility. Matrix began soil sample retrieval 48 inches below grade. Matrix encountered refusal at 4 feet below the bottom of the concrete floor and discontinued the boring. Headspace readings of 48 ppm and 300 ppm were detected in soils collected from 0 feet to 2 feet and 2 feet to 4 feet. These were the only 2 soil samples from this boring which were submitted for laboratory analysis. Laboratory analysis of the soil collected from 0 feet to 2 feet indicated the presence of 0.7 ppm silver, 0.9 ppm arsenic, 12 ppm barium, 8.8 ppm chromium, 1.8 ppm lead, and 1100 ppm DRO. Laboratory analysis of soil collected from 2 feet to 4 feet indicated the presence of 6.4 ppm barium, 2.8 ppm chromium, 2.4 ppm lead, 12 ppm GRO, 13,000 ppm DRO, 830 ppb trichloroethene, and 32 ppb xylenes.

Geoprobe boring #6 was located 1 foot east and 9.3 feet north of Beam 4. Minneapolis Concrete Sawing and Drilling removed approximately 73 inches of concrete from the floor of the facility. Matrix began soil sample retrieval 73 inches below grade. No headspace readings were detected in soils collected from GP-6. Laboratory analysis of the soil collected from 0 feet to 2 feet indicated the presence of 1.0 ppm arsenic, 7.4 ppm barium, 41 ppb toluene, and 56 ppb trichloroethene. Laboratory analysis of soil collected from 10 feet to 12 feet indicated the presence of 2.1 ppm arsenic, 12 ppm barium, 6.0 ppm chromium, 1.8 ppm lead, and 65 ppb trichloroethene.

Geoprobe boring #7 was located 16.5 feet west and 13.4 feet north of Beam 5. Minneapolis Concrete Sawing and Drilling removed approximately 84 inches of concrete from the floor of the facility. Matrix began soil sample retrieval 84 inches below grade. Headspace readings of 3 ppm were detected in soil samples collected from 0 feet to 2 feet and 13 feet to 16 feet. Headspace readings of 2 ppm were detected in soil samples collected from 8 feet to 10 feet and 10 feet to 12 feet. Laboratory analysis of the soil collected from 0 feet to 2 feet indicated the presence of 0.9 ppm arsenic, 3.6 ppm barium, 3.1 ppm chromium, 2.3 ppm lead, 2400 ppm DRO, and 590 ppb trichloroethene. Laboratory analysis of soil collected from 10 feet to 12 feet indicated the presence of 1.0 ppm arsenic, 11 ppm barium, 15 ppm chromium, 39 ppb toluene, and 240 ppb trichlorethene.

Geoprobe boring #8 was located 5.1 feet west and 7.2 feet north of Beam 8. Minneapolis Concrete Sawing and Drilling removed approximately 32 inches of concrete from the floor of the facility. Matrix began soil sample retrieval 32 inches below grade. A headspace reading of 5 ppm was detected in soil collected from 0 feet to 2 feet in GP-8. Laboratory analysis of the soil collected from 0 feet to 2 feet indicated the presence of 1.1 ppm arsenic, 5.9 ppm barium, 4.0

ppm chromium, and 160 ppb trichloroethene. Laboratory analysis of soil collected from 10 feet to 12 feet indicated the presence of 7.4 ppm barium, 5.0 ppm chromium, 59 ppm DRO, 29 ppb naphthalene, and 110 ppb trichloroethene.

Geoprobe boring #9 was located outside of the structure, 73.7 feet from a southern corner of the United Defense facility at which a large vehicle access door is located. The boring was advanced 8 feet away from the building. Matrix drilled approximately 8 inches of frost prior to soil sample retrieval. No headspace readings were detected in soils collected from GP-9. Laboratory analysis of the soil collected from 0 feet to 2 feet indicated the presence of 5.3 ppm barium, 3.3 ppm chromium, 160 ppb 2-butanone, 98 ppb toluene, and 37 ppb xylenes. Laboratory analysis of soil collected from 10 feet to 12 feet indicated the presence of 6.4 ppm barium and 2.3 ppm chromium.

On-site headspace screening of the soil samples collected did not indicate the presence of organic vapors indicative of petroleum hydrocarbons. However, laboratory analysis of the some of the same soil indicated the presence of DRO, GRO, and certain VOC compounds, as well as some of the 8 RCRA metals. It is possible that the lack of soil headspace detection in soil containing petroleum related compounds is due to low volatility of those compounds. Heavy lubricating oils used in the operation of machinery might demonstrate such a characteristic.

Impact derived from petroleum related compounds appears to be most prevalent in borings GP-1, GP-2, GP-5, and GP-7. The highest concentrations of petroleum related analytes in borings GP-2, and GP-7 were detected at the 0 foot to 2 feet level. Petroleum related analytes detected in the laboratory samples collected from 10 feet to 12 feet in these borings exhibited lower concentrations. Borings GP-1 and GP-5 both exhibited higher concentrations of petroleum related analytes at deeper sampling intervals.

VOC analytes detected at the site which are not commonly associated with petroleum hydrocarbons are methylene chloride and trichlorethene. Both of these compounds are commonly used in manufacturing as degreasers. Methylene chloride was detected in boring GP-8 in soil collected from the 10 foot to 12 foot interval. Trichloroethene was detected at various concentrations in soil collected from all borings but GP-9.

Five of the eight RCRA metals analyzed were detected in soil collected from borings advanced at the site. Barium and cadmium were detected in all soils analyzed. The highest concentrations of these analytes were 12 ppm and 15 ppm in soil collected from GP-5 and GP-7, respectively. Detectable concentrations of silver, arsenic, and lead were also detected in several of the borings.

If you have any questions or need additional information regarding this matter, please contact me at 490-3795.

Sincerely yours,

DAHL & ASSOCIATES, INC.

Paul D. Meadows
Staff Scientist

Enclosure

pm/jr

cc: Mr. Jim Dzubay, Matrix Technologies Inc.

TABLE 1
SOIL SAMPLE ANALYTICAL RESULTS
United Defense (24975500)

		Metals (ppm)							VOCs (ppb)								
DATE	SAMPLE	Silver	Arsenic	Barium	Chromium	Lead	GRO (ppm)	DRO (ppm)	1, 4 DCB	Ethyl Benzene	Meth Chl	Naphthalene	Toluene	Trichloroethene	1,2,4 TMB	1,3,5, TMB	Xylenes
01/13/97	GP-1, 0' - 2'	<0.40	< 0.90	5.1	3.5	< 1.6	< 2.6	30	< 25	< 25	< 26	28	360	ND	37	< 26	78
01/13/97	GP-1, 10'-12'	<0.40	<0.90	13	9.5	2	7.7	370	< 26	< 26	< 26	41	1200	91	91	< 26	200
01/13/97	GP-2, 0'-2'	<0.40	< 0.90	3.1	2.9	15	< 2.6	6800	< 26	< 26	< 26	< 26	< 26	93	< 26	< 26	< 26
01/13/97	GP-2, 10'-12'	<0.40	< 0.90	8.4	5.8	3.2	18	2500	81	110	< 25	140	3200	< 25	230	67	420
01/13/97	GP-3, 0'-2'	<0.40	< 0.90	9.5	5.9	2.7	< 2.5	< 3.6	< 25	< 25	< 25	< 25	< 25	< 25	< 25	< 25	< 25
01/13/97	GP-3, 10'-12'	<0.40	1.3	8.9	5	< 1.6	< 2.5	< 3.5	< 25	< 25	< 25	< 25	< 25	56	< 25	, 25	, 25
01/15/97	GP-4, 0'-2'	<0.40	0.9	5.4	4	2.3	< 2.5	< 3.6	< 25	< 25	< 25	< 25	< 25	< 25	, 25	< 25	< 25
01/15/97	GP-4, 10'-12'	<0.40	< 0.90	6.1	3.9	1.7	< 2.5	< 3.6	< 25	< 25	< 25	< 25	< 25	36	< 25	< 25	< 25
01/15/97	GP-5, 0-2'	0.7	0.9	12	8.8	1.8	2.7	1100	< 27	< 27	< 27	< 27	< 27	< 27	< 27	< 27	< 27
01/15/97	GP-5, 2'-4'	<0.40	< 0.90	6.4	2.8	2.4	12	13000	< 27	< 27	< 27	< 27	< 27	830	< 27	< 27	32
01/15/97	GP-6, 0'-2'	<0.40	1	7.4	6.7	< 1.6	< 2.6	< 3.7	< 26	< 26	< 26	< 26	41	56	< 26	< 26	< 26
01/15/97	GP-6, 10'-12'	<0.40	2.1	12	6	1.8	< 2.5	< 3.3	< 25	< 25	< 25	< 25	< 25	65	< 25	< 25	< 25
01/16/97	GP-7, 0'-2'	<0.40	0.9	3.6	3.1	< 1.6	< 2.7	2400	< 27	< 27	< 27	< 27	< 27	590	< 27	< 27	< 27
01/16/97	GP-7, 10'-12'	<0.40	1	11	15	< 1.6	< 2.6	< 3.8	< 26	< 26	< 26	< 26	39	240	< 26	< 26	< 26
01/16/97	GP-8 0'-2'	<0.40	1.1	5.9	4	< 1.6	< 2.5	< 3.4	< 25	< 25	< 25	< 25	<130	160	< 25	< 25	< 25
01/16/97	GP-8, 10'-12'	< 0.50	< 1.0	7.4	5	< 1.8	< 2.9	59	< 29	<29	29	< 29	< 29	110	< 29	< 29	< 29
01/16/97	GP-9, 0'-2'	< 0.50	< 1.1	5.3	3.3	< 2.0	< 3.1	< 4.6	< 31	< 31	< 31	< 31	98	< 31	< 31	< 31	37
01/16/97	GP-9, 10'-12'	< 0.40	< 0.90	6.4	2.3	< 1.6	< 2.6	< 3.5	< 26	< 26	< 26	< 26	< 26	< 26	< 26	< 26	< 26

Explanation:

ppm - parts per million or mg/kg
ppb - parts per billion or ug/kg
GRO - Total Hydrocarbons as Gasoline/Gasoline Range Organics
DRO - Diesel Range Organics
1, 4 DCB - 1, 4 Dichlorobenzene
Meth Chl - Methylene Chloride
1,2,4 TMB - 1,2,4 Trimethylbenzene
1, 3, 5 TMB - 1, 3, 5 Trimethylbenzene

DAHL

Appendix A

Subsurface Assessment Results

SUBSURFACE ASSESSMENT RESULTS

UNITED DEFENSE L.P., FMC/BMY
ARMAMEMNT SYSTEMS DIVISION
FRIDLEY, MINNESOTA
MATRIX PROJECT NO. 97006

Prepared by: **MATRIX Technologies, Inc.**
8631 Jefferson Highway
Osseo, MN 55369
(612) 424-4803
fax: (612) 424-9452

January 20, 1997

SUBSURFACE ASSESSMENT RESULTS

UNITED DEFENSE L.P., FMC/BMY
ARMAMEMNT SYSTEMS DIVISION
FRIDLEY, MINNESOTA
MATRIX PROJECT NO. 97006

1.0 INTRODUCTION

MATRIX Technologies, Inc. (MATRIX), was authorized by Mr. Doug Hildre of United Defense L.P., FMC/BMY (United Defense), to perform a subsurface assessment at the United Defense site located at 4800 East River Road in Fridley, Minnesota. The goal of the assessment was to collect soil samples for off-site laboratory analysis of volatile organic compounds, petroleum hydrocarbons, and RCRA metals. Field work was completed on January 13 to 16, 1997. Sample logging, screening, and preparation was conducted by Mr. Paul Meadows of Dahl & Associates, Inc.

2.0 SCOPE OF WORK

The scope of services provided by MATRIX included the following:

- Arranged for all private utilities to be located in the investigation area through Hance Cable Testing.
- Contracted the concrete coring of eight (8) probe locations with Minneapolis Concrete Sawing and Coring.
- Advanced nine (9) probes to depths ranging from four (4) to sixteen (16) feet bgs to collect soil samples at requested depth profiles for logging, screening, and sample collection (Appendix A).
- Abandoned all probe locations with a neat cement grout mixture according to Minnesota Department of Health guidelines.

3.0 GENERAL COMMENTS

The analysis and opinions expressed in this report are based upon data obtained from the samples collected at the indicated locations and from other information discussed in this report. This report is prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted practices. No warranties, expressed or implied are intended or made.

This report was prepared by:

MATRIX Technologies, Inc.

James D. Dzubay, M.S. - Operations Manager/President

1/20/97
Date

Appendix C

Boring Logs

DAHL & ASSOCIATES, INC.

Geologic Report: SOIL BORING LOG

Project Name: MATRIX - FMC
Job Number: 24975500

HOLE ID: GP-1
Geologist: P.MEADOWS

DATE: 1/13/97
Driller/Co.: MATRIX

Depth (feet)	Sample #	Sample Type	Description of Material General	USCS	PID/FID (ppm)	Blow Counts	H2O
0	--	--	5" Concrete	--	--		
0-2	1	GP	Loose, dry, light gray, very fine to medium sand, well graded	SW	ND		
2-4	2	GP	Same soil, tan	SW	ND		
4-6	3	GP	Same soil	SW	ND		
5							
6-8	4	GP	Loose, dry, light brown, very fine sand to fine gravel	SW/ GW	ND		
8-10	5	GP	Loose, moist, poorly graded, fine sand, 10% medium to coarse sand	SP	ND		
10							
10-12	6	GP	Loose, dry, light brown, well graded, very fine to coarse sand, with 5% medium gravel	SW	2		
12-14	7	GP	Dry, loose, poorly graded, very fine sand, minor coarse sand	SP			
14-16	8	GP	Same soil, wet	SP	ND		
15							
			EOB @ 16'				
20			Borehole abandoned				
25							

DRILLING SUMMARY

Drill/Method:	GEO PROBE
Time Start:	12:15
Time Complete:	1:40
Total Time:	
Drilling Rate:	

PID/FID INFORMATION

Make:	FID
Model:	Century OVA 108
Unit ID:	#5
ppm Span Gas:	
Time of Calibration:	

ELEVATION DATA

Surveyed:
Surface Elevation:
WATER LEVEL: 21'

Water level indicated on log: *
Depth of oxidation on log: ox

DAHL & ASSOCIATES, INC.

Geologic Report: SOIL BORING LOG

Project Name: MATRIX - FMC
Job Number: 24975500

HOLE ID: GP-2
Geologist: P.MEADOWS

DATE: 1/13/97
Driller/Co.: MATRIX

Depth (feet)	Sample #	Sample Type	Description of Material General	USCS	PID/FID (ppm)	Blow Counts	H2O
0	--	--	5" Concrete	--	--		
0-2	1	GP	Dry, loose, tan, poorly graded, fine sand				
2-4	2	GP	Dry, loose, light brown, well graded very fine sand and gravel	GW	ND		
4-6	3	GP	Dry, loose, light brown, poorly graded, very fine sand	SP	ND		
5							
6-8	4	GP	Dry, loose, light brown, poorly graded, very fine to medium sand	SP	ND		
8-10	5	GP	Dry, loose, light brown poorly graded, very fine sand	SP	ND		
10							
10-12	6	GP	Dry, loose, brown, well graded, very fine to coarse sand	SW	ND		
12-14	7	GP	Moist, loose, brown, poorly graded, fine sand	SP	ND		
14-16	8	GP	Wet, loose, brown, poorly graded medium sand	SP	ND		
15							
			EOB @ 16'				
			Borehole abandoned				
20							
25							

DRILLING SUMMARY

Drill/Method:	GEO PROBE
Time Start:	14:00
Time Complete:	16:00
Total Time:	2 Hrs
Drilling Rate:	

PID/FID INFORMATION

Make:	FID
Model:	Century OVA 108
Unit ID:	5#
ppm Span Gas:	
Time of Calibration:	

ELEVATION DATA

Surveyed:
Surface Elevation:
WATER LEVEL: 20'

Water level indicated on log: *
Depth of oxidation on log: ox

DAHL & ASSOCIATES, INC.

Geologic Report: SOIL BORING LOG

Project Name: MATRIX - FMC
Job Number: 24975500

HOLE ID: GP-3
Geologist: P.MEADOWS

DATE: 1/13/97
Driller/Co.: MATRIX

Depth (feet)	Sample #	Sample Type	Description of Material General	USCS	PID/FID (ppm)	Blow Counts	H2O
0	--	--	50" Concrete	--	--		
0-2	1	GP	Dry, loose, tan, well graded, very fine sand with medium	GW	ND		
			gravel	GW	ND		
2-4	2	GP	Same soil				
4-6	3	GP	Dry, loose, tan, poorly graded, very fine sand	SP	ND		
5							
6-8	4	GP	Dry, loose, tan,poorly graded, very fine to medium sand,	SP	ND		
8-10	5	GP	Same soil	SP	ND		
10							
10-12	6	GP	Same soil	SP	ND		
12-14	7	GP	Loose, moist, poorly graded, very fine to medium sand,	SP	ND		
14-16	8	GP	Same soil, wet	SP	ND		
15							
			EOB @ 16'				
			Borehole abandoned				
20							
25							

DRILLING SUMMARY

Drill/Method:	GEO PROBE
Time Start:	15:15
Time Complete:	17:15
Total Time:	2 Hrs
Drilling Rate:	

PID/FID INFORMATION

Make:	FID
Model:	Century OVA 108
Unit ID:	5#
ppm Span Gas:	
Time of Calibration:	

ELEVATION DATA

Surveyed:
Surface Elevation:
WATER LEVEL: 20'

Water level indicated on log: *
Depth of oxidation on log: ox

DAHL & ASSOCIATES, INC.

Geologic Report: SOIL BORING LOG

Project Name: MATRIX - FMC
Job Number: 24975500
HOLE ID: GP-4
Geologist: P.MEADOWS
DATE: 1/15/97
Driller/Co.: MATRIX

Depth (feet)	Sample #	Sample Type	Description of Material General	USCS	PID/FID (ppm)	Blow Counts	H2O
0	--	--	12" Concrete, 24" Fill, 36" Concrete	--	--		
0-2	1	GP	Loose, dry, light brown, well graded, sand with minor medium to coarse gravel	SW	ND		
2-4	2	GP	Loose, dry, tan, poorly graded, very fine sand, minor medium sand with fine gravel	SP	ND		
4-6	3	GP	Same soil as 0-2' interval	SW	ND		
6-8	4	GP	Loose, dry, light brown, poorly graded, very fine to medium sand	SP	ND		
8-10	5	GP	Loose, dry, brown well graded, very fine sand to fine gravel	SW	ND		
10-12	6	GP	Loose, dry, light brown, poorly graded, fine sand	SP	2		
12-14	7	GP	Same soil, minor coarse sand	SP	2		
14-16	8	GP	Moist, loose, brown, poorly graded, very fine to medium sand	SP	2		
			EOB @ 16'				
			Borehole abandoned				

DRILLING SUMMARY

Drill/Method: GEO PROBE
Time Start: 8:30
Time Complete: 9:30
Total Time: 1 Hrs
Drilling Rate:

PID/FID INFORMATION

Make: FID
Model: Century OVA 108
Unit ID: #5
ppm Span Gas:
Time of Calibration:

ELEVATION DATA

Surveyed:
Surface Elevation:
WATER LEVEL:
Water level indicated on log: *
Depth of oxidation on log: ox

DAHL & ASSOCIATES, INC.

Geologic Report: SOIL BORING LOG

Project Name: MATRIX - FMC
Job Number: 24975500

HOLE ID: GP-5
Geologist: P.MEADOWS

DATE: 1/15/97
Driller/Co.: MATRIX

Depth (feet)	Sample #	Sample type	Description of Material General	USCS	PID/FID (ppm)	Blow Counts	H2O
0	--	--	62" Concrete	--	--		
0-2	1	GP	Very moist, loose, gray well graded very fine to coarse	SW	48		
2-4	2	GP	sand	SW	300		
			Same soil				
5			EOB @ 4'				
			Refusal @ 4'				
			Borehole Abandoned				
10							
15							
20							
25							

DRILLING SUMMARY

Drill/Method:	GEO PROBE
Time Start:	10:00
Time Complete:	10:30
Total Time:	30 Min
Drilling Rate:	

PID/FID INFORMATION

Make:	FID
Model:	Century OVA 108
Unit ID:	5#
ppm Span Gas:	
Time of Calibration:	

ELEVATION DATA

Surveyed:
Surface Elevation:

WATER LEVEL:

Water level indicated on log: *
Depth of oxidation on log: ox

DAHL & ASSOCIATES, INC.

Geologic Report: SOIL BORING LOG

Project Name: MATRIX - FMC
Job Number: 24975500
HOLE ID: GP-6
Geologist: P.MEADOWS
DATE: 1/15/97
Driller/Co.: MATRIX

Depth (feet)	Sample #	Sample Type	Description of Material General	USCS	PID/FID (ppm)	Blow Counts	H2O
0	--	--	73" Concrete	--	--		
0-2	1	GP	Moist, loose, gray, well graded very fine sand to gravel	SW/ GW	ND ND		
2-4	2	GP	Moist, loose, light gray, poorly graded fine sand	SP	ND		
4-6	3	GP	Moist, loose, light brown, well graded, fine to coarse sand	SW	ND		
6-8	4	GP	Same soil, 10 % coarse gravel	SW	ND		
8-10	5	GP	Same soil as 4-6' but with fine to medium gravel	SW	ND		
10-12	6	GP	Dry, loose, light brown, poorly graded, fine sand, with minor medium to coarse sand	SP	ND		
12-14	7	GP	Dry, loose, light gray, well graded, very fine to coarse sand	SW	ND		
14-16	8	GP	Moist, loose, brown, poorly graded, fine sand	SP	ND		
15			EOB @ 16'				
			Borehole abandoned				
20							
25							

DRILLING SUMMARY

Drill/Method: GEO PROBE
Time Start: 13:00
Time Complete: 14:45
Total Time: 1 Hrs 45 Min
Drilling Rate:

PID/FID INFORMATION

Make: FID
Model: Century OVA 108
Unit ID: #5
ppm Span Gas:
Time of Calibration:

ELEVATION DATA

Surveyed:
Surface Elevation:
WATER LEVEL:

Water level indicated on log: *
Depth of oxidation on log: ox

DAHL & ASSOCIATES, INC.

Geologic Report: SOIL BORING LOG

Project Name: MATRIX -FMC
Job Number: 24975500
HOLE ID: GP-7
Geologist: P.MEADOWS
DATE: 1/16/97
Driller/Co.: MATRIX

Depth (feet)	Sample #	Sample type	Description of Material General	USCS	PID/FID (ppm)	Blow Counts	H2O
0	--	--	84" Concrete	--	--		
0-2	1	GP	Moist,loose, light brown, well graded, very fine to coarse sand	SW	5		
2-4	2	GP	Dry, loose, light brown, poorly graded, fine to medium sand	SP	ND		
4-6	3	GP	Same soil	SP	ND		
6-8	4	GP	Same soil, trace fine gravel	SP	ND		
8-10	5	GP	Same soil	SP	2		
10-12	6	GP	Dry, loose, light brown, well graded, fine to coarse sand	SW	2		
13-16	7	GP	Same soil, wet @ 15'				
			EOB @ 16'				
			Borehole abandoned				

DRILLING SUMMARY

Drill/Method: GEO PROBE
Time Start: 14:00
Time Complete: 15:15
Total Time: 1 Hr 15 Min
Drilling Rate:

PID/FID INFORMATION

Make: FID
Model: Century OVA 108
Unit ID: 5#
ppm Span Gas:
Time of Calibration:

ELEVATION DATA

Surveyed:
Surface Elevation:
WATER LEVEL: 15'
Water level indicated on log: *
Depth of oxidation on log: ox

DAHL & ASSOCIATES, INC.

Geologic Report: SOIL BORING LOG

Project Name: MATRIX - FMC
Job Number: 24975500
HOLE ID: GP-8
Geologist: P.MEADOWS
DATE: 1/16/97
Driller/Co.: MATRIX

Depth (feet)	Sample #	Sample type	Description of Material General	USCS	PID/FID (ppm)	Blow Counts	H2O
0	--	--	32" Concrete	--	--		
0-2	1	GP	Moist, loose, tan, poorly graded, fine sand	SP	5		
2-4	2	GP	Same soil	SP	ND		
4-6	3	GP	No retrieval				
5							
6-8	4	GP	Dry, loose, light brown, well graded, very fine to coarse sand	SW	ND		
8-10	5	GP	Dry, loose, light brown, poorly graded, fine sand	SP	ND		
10							
10-12	6	GP	Dry, loose, light brown, very fine to medium sand, minor fine gravel	SP/SW	ND		
12-14	7	GP	Same soil	SP/SW	ND		
14-16	8	GP	Same soil	SP/SW	ND		
15							
			EOB @ 16'				
			Borehole abandoned				
20							
25							

DRILLING SUMMARY

Drill/Method:	GEO PROBE
Time Start:	15:00
Time Complete:	16:15
Total Time:	1 Hr 15 Min
Drilling Rate:	

PID/FID INFORMATION

Make:	FID
Model:	Century OVA 108
Unit ID:	#5
ppm Span Gas:	
Time of Calibration:	

ELEVATION DATA

Surveyed:
Surface Elevation:

WATER LEVEL:

Water level indicated on log: *
Depth of oxidation on log: ox

DAHL & ASSOCIATES, INC.

Geologic Report: SOIL BORING LOG

Project Name: MATRIX - FMC
Job Number: 24975500

HOLE ID: GP-9
Geologist: P.MEADOWS

DATE: 1/13/97
Driller/Co.: MATRIX

Depth (feet)	Sample #	Sample Type	Description of Material General	USCS	PID/FID (ppm)	Blow Counts	H2O
0-4	1	GP	0-2': Tan, poorly graded, medium sand, frost	SP	ND		
			2-4': Moist, soft, dark brown silt	ML	ND		
4-8	2	GP	4-6': Loose, dry, light gray, fine to medium sand	SP	ND		
			6-6.5': Tan, moist, soft clayey silt	ML			
			6.5-8': Loose, dry, light grey, fine to medium sand	SP	ND		
8-10	3	GP	Moist, loose, light grey, medium to coarse sand	SP	ND		
10-12	4	GP	Same soil	SP	ND		
12-14	5	GP	Moist, loose, light grey, very fine to medium sand	SP	ND		
14-16	6	GP	Same soil	SP	ND		
			EOB @ 16'				
			Borehole abandoned				

DRILLING SUMMARY

Drill/Method:	GEO PROBE
Time Start:	10:45
Time Complete:	12:00
Total Time:	1 Hr 15 Min
Drilling Rate:	

PID/FID INFORMATION

Make:	FID
Model:	Century OVA 108
Unit ID:	#5
ppm Span Gas:	
Time of Calibration:	

ELEVATION DATA

Surveyed:
Surface Elevation:

WATER LEVEL:

Water level indicated on log: *
Depth of oxidation on log: ox

APPENDIX A

STANDARD OPERATING PROCEDURES

MACRO-CORE® SOIL SAMPLER

STANDARD OPERATING PROCEDURE

TECHNICAL BULLETIN NO. 96.001

PREPARED: JANUARY 8, 1996; REVISED:

1.0 OBJECTIVE

The objective of this procedure is to collect a soil sample at depth and recover it for visual inspection and/or chemical analysis.

2.0 BACKGROUND

2.1 Definitions

- **Geoprobe®**: A vehicle-mounted hydraulically-powered soil probing machine that uses static force and percussion to advance small diameter sampling tools into the subsurface for collecting soil core, soil gas, or ground water samples.

- **Macro-Core® (MC) Soil Sampler:** A 48-inch long X 2.0-inch diameter (1219 mm X 51 mm) soil sampler capable of recovering a sample that measures up to 1302-ml in volume, as a 45-inch X 1.5-inch (1143 mm X 38 mm) core contained inside a removable liner. The Macro-Core® Sampler may be used for open-tube as well as closed-piston sampling.

- **Liner:** A 46-inch long X 1.75-inch (1168 mm X 44 mm) diameter removable/replaceable, thin-walled tube inserted inside the Macro-Core® Sampler tube for containing and storing soil samples. Liner materials include stainless steel, Teflon®, and clear plastic (PETG).

2.2 Discussion

In this procedure, the assembled Macro-Core Sampler is connected to the leading end of a Geoprobe brand probe rod and driven into the subsurface using a Geoprobe machine. Additional probe rods are connected in succession to advance the sampler to depth. The Macro-Core Sampler may be used as either an open-tube or closed-piston sampler.

The simplest and most common use of the Macro-Core Sampler is an open-tube sampler. In this method, coring starts at the ground surface with an open-ended sampler. From the ground surface, the Macro-Core Sampler is advanced 48 inches (1219 mm) and retrieved from the hole with the first soil core. In stable soils, the open-tube sampler is inserted back down the same hole to obtain the next core.

In unstable soils that tend to collapse into the core hole, the Macro-Core Sampler can be equipped with a closed-piston point assembly. This assembly locks into the cutting shoe and prevents soil from entering the sampler as it is advanced in the existing hole.

The Macro-Core Closed-Piston Sampler is not designed to be driven through undisturbed soil. Soil is first removed to the sampling depth with an open-tube sampler, or a pilot hole may be made with a Macro-Core Pre-Probe. A closed-piston tip is then installed and the sampler is inserted or driven back down the same hole. When the leading end of the sampler reaches the top of the next sampling interval, the piston tip is unlocked using extension rods inserted down the inside of the probe rods.

Once the piston tip is released, the sampler is simply driven another 48 inches (1219 mm). Soil entering the sampler pushes the piston assembly to the top of the sample liner where it is retrieved upon removal of the soil core and liner.

3.0 REQUIRED EQUIPMENT

The following equipment is required to recover soil core samples using the Geoprobe Macro-Core® Sampler and driving system (See Attached Figure).

3.1 Macro-Core Sampler Parts

MC Drive Head	1
MC Sampler Tube	1
MC Cutting Shoe	1
MC Piston Bolt	1
MC Piston Washer	1
MC Locking Ring Assembly	2
MC Piston Point Assembly	1
MC Piston Release Rod	1
MC Core Catcher(optional)	1
MC Spacer Ring	1

3.2 Geoprobe Tools

• Probe Rod (48", 36", 24", or 12")	Variable
• Drive Cap	1
• Pull Cap	1
• Extension Rod	Variable
• Extension Rod Coupler	Variable
• Extension Rod Handle	1

4.0 OPERATION

4.1 Decontamination

Before and after each use, thoroughly clean all parts of the soil sampling system according to project specific requirements. A clean, new liner is recommended for each use. Parts should also be inspected for wear or damage at this time.

4.2 Open-Tube Sampler Assembly

1a. **With MC Core Catcher.** Place the open end of a MC Core Catcher over the threaded end of a MC Cutting Shoe. Apply pressure to the core catcher until it snaps into the machined groove on the cutting shoe.

1b. **Without MC Core Catcher.** Push the base of a MC Spacer Ring onto the threaded end of a cutting shoe until it snaps into place. Either a core catcher or a spacer ring is required with all Macro-Core liners.

2. Thread the cutting shoe into one end of a MC Sampler Tube. Tighten until the cutting shoe is completely threaded into the sampler.

3. Insert the appropriate liner into the sampler tube.

4. Connect a MC Drive Head to the top of the sampler tube. Tighten the cutting shoe using a wrench.

4.3 Closed-Piston Sampler Assembly

1. Install an O-ring in the machined groove on the MC Piston Point.

2. Place MC Piston Washer on the MC Piston Bolt radius side away from the bolt head.

3. Assemble the MC Piston Assembly according to Geoprobe Instructions.

4. Slide the assembled point into a MC Cutting Shoe. The point assembly should be placed so that one half of the set screw protrudes from under the lower cutting edge of the cutting shoe.

5. Tighten the piston bolt using a wrench.

6a. **With MC Core Catcher.** Place the open end of an MC Core Catcher over the threaded end of a MC Cutting Shoe. Apply pressure to the core catcher until it snaps into the machined groove on the cutting shoe.

6b. **Without MC Core Catcher.** Push the base of a MC Spacer Ring onto the threaded end of a cutting shoe until it snaps into place. Either a core catcher or a spacer ring is required with all Macro-Core liners.

7. Thread the cutting shoe into one end of a MC Sampler Tube. Tighten until the cutting shoe is completely threaded into the sampler.

8. Insert the appropriate liner into the sampler tube.

9. Connect an MC Drive Head to the top of the sampler tube. Securely tightly, the cutting shoe with a wrench.

4.4 Pilot Hole

A pilot hole is appropriate when the surface to be penetrated contains gravel, asphalt, hard sands, or rubble. Pre-probing can prevent unnecessary wear on the sampling tools. A MC Pre-Probe may be used for this purpose. The pilot hole should be made only to a depth above the sampling interval.

4.5 Open-Tube Sampling

For open-tube sampling, the soil must be removed from above the desired core depth. This is accomplished by driving a Macro Core Sampler 48-inches (1219mm) the length of one sampler tube, into the soil from the ground surface. The first soil core is retrieved and the sampler is driven down the same hole to remove the next 48-inch (1219 mm) core. This cycle is repeated until the desired sampling depth is reached.

The cutting shoe is tapered to minimize the amount of soil scraped from the walls when inserting the sampler down an existing hole. When sampling non-cohesive soils, however, the hole may collapse as the sampler is retrieved. This collapsed soil enters the sampler as it is driven back down the hole for the next soil core, resulting in a non-representative sample. The user may elect to use the Closed-Piston Macro-Core Sampler under such conditions.

1. Use an assembled open-tube sampler as described in section 4.3. Attach a drive cap to the sampler head.

2. Drive the assembly into the subsurface until the drive head of the sample tube is just above the ground surface.

3. To sample continuous sampling intervals, push a sampler down the previously opened hole until the top of the next sampling interval is reached. Drive the probe string another 48-inches (1219 mm) to fill the sampler with soil. An open-tube

sampler may be used for consecutive sampling or, if soil slough is expected, a closed-piston sampler is available.

4.6 Closed-Piston Sampling

1. Use an assembled closed-piston sampler. Attach a drive cap to the sampler drive head.

2. Place the sampler point in the previously opened hole. Drive the sampler to the desired sampling interval.

3. Move the probe unit away from the probe rods to allow for room to work.

4. Remove the drive cap and insert a MC Piston Release Rod down the inside of the probe rods: use extension rods as needed.

5. Attach an Extension Rod Handle to the top of the extension rod and slowly rotate clockwise. The release rod will drop into the groove in the piston point. Rotate the handle clockwise approximately four revolutions. The drive point assembly is now released.

6. Remove the release rod and extension rods.

7. Add a probe rod, if needed, attach a drive cap, reposition the probe unit. Drive the sampler another 48 inches (1219 mm) to fill the liner with soil.

4.7 Sampler Retrieval

1. Attach a pull cap to the top probe rod. Close the hammer latch over the pull cap and pull the tool string up one rod length by actuating the probe controls.

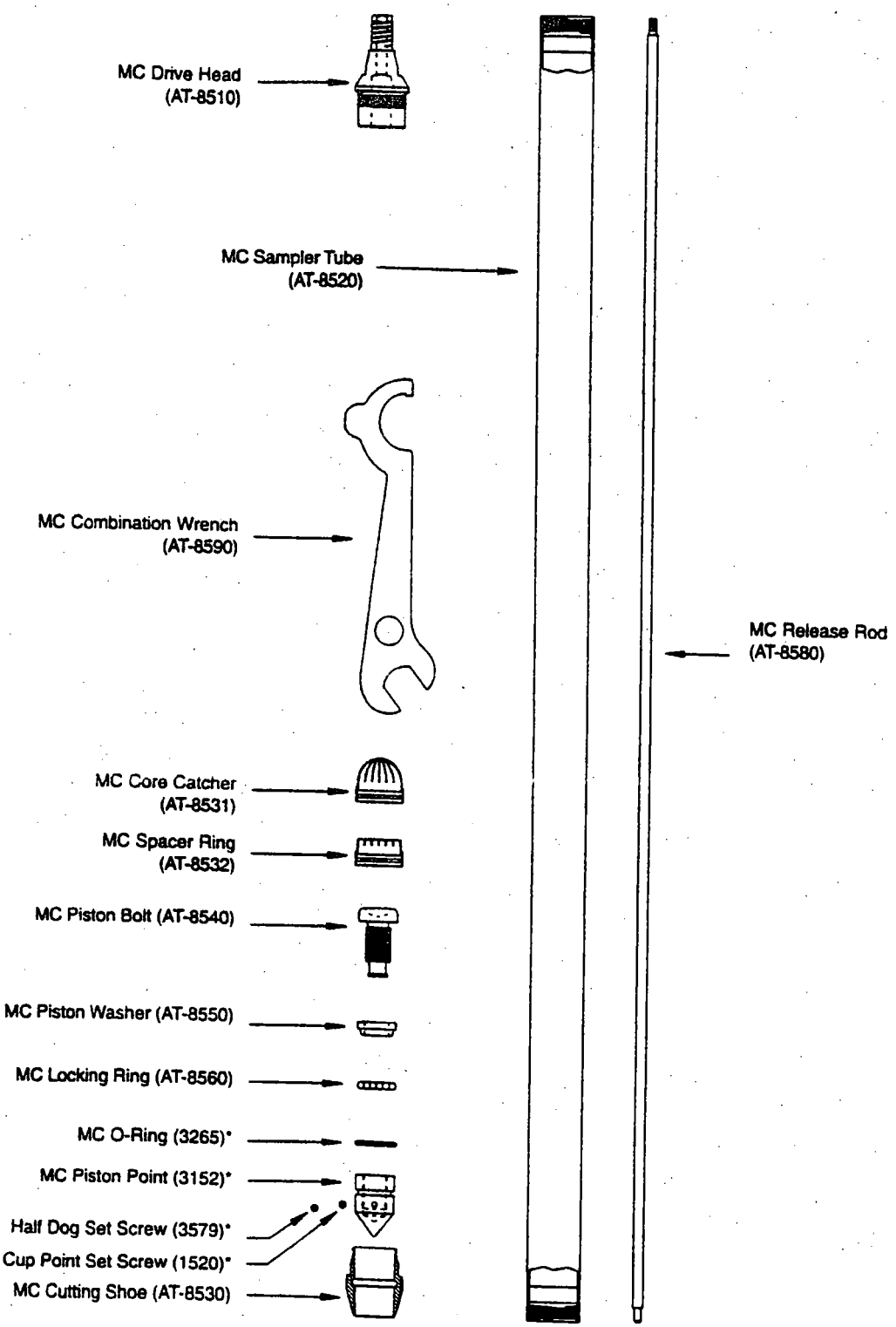
2. Remove the rod and repeat Step 1 until the sampler drive head is just above the ground.

3. Put the drive cap on the sampler drive head. Pull the sampler out of the ground by using the probe unit.

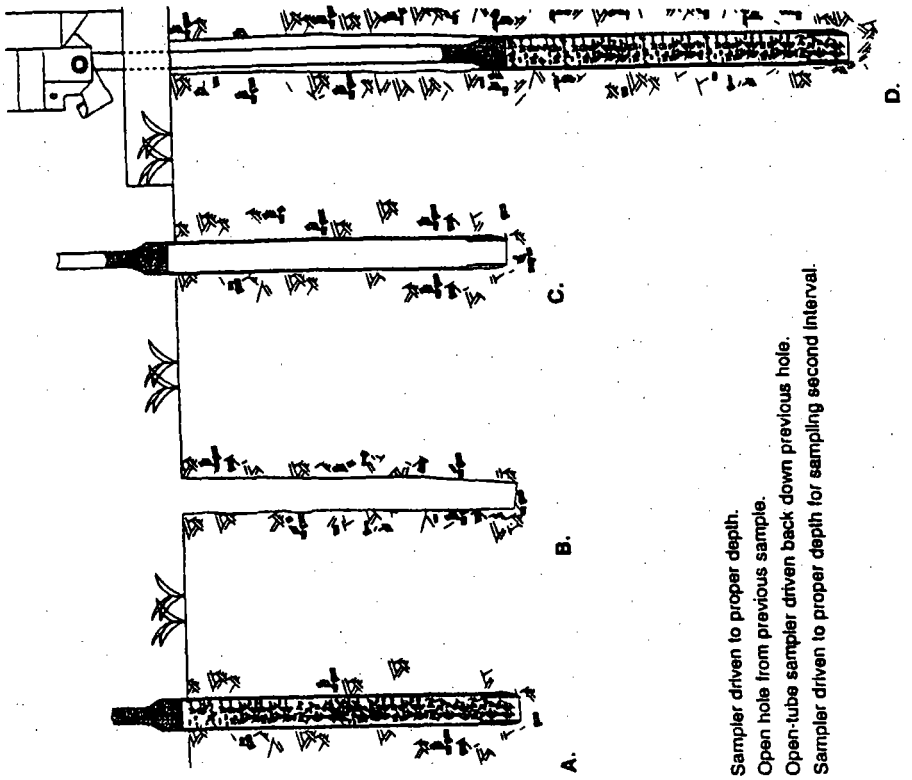
4.8 Soil Core Recovery

The soil sample is easily removed from the Macro-Core Sampler by unscrewing the cutting shoe and pulling out the liner. A few sharp taps on the cutting shoe will often sufficiently loosen the threads to allow removal by hand. If needed, a wrench may used to unscrew the cutting shoe. With the cutting shoe removed simply pull the liner and soil core from the sampler tube.

If the closed-piston sampler is used, the piston assembly is now retrieved from the end of the liner. Secure the soil sample by placing a vinyl end cap on each end of the liner. Undisturbed soil samples can be obtained from Teflon® and PETG liners by splitting the liner. Clamp one end of the liner and make a longitudinal cut, exposing the soil core.

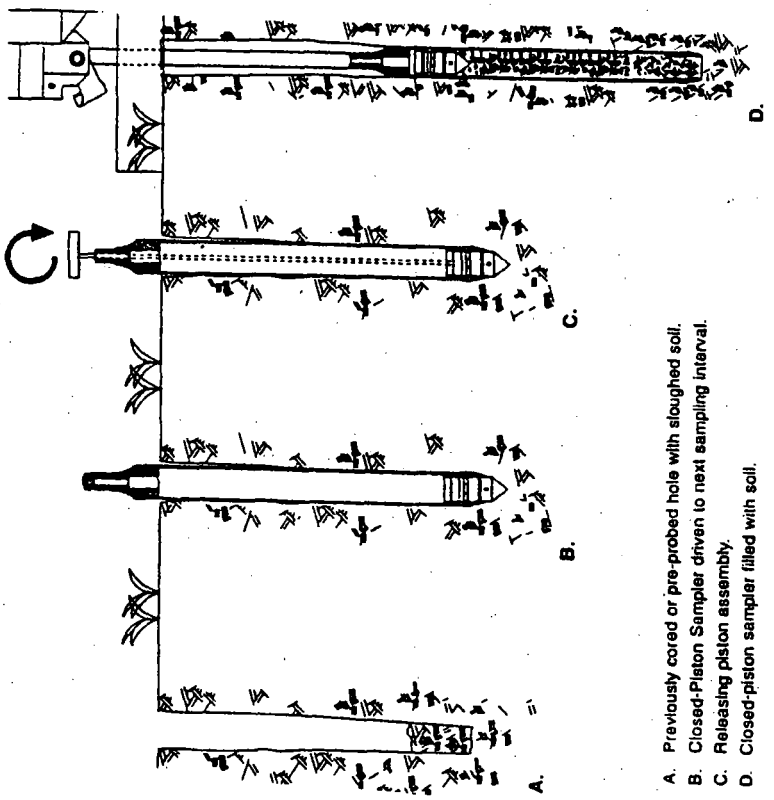


Macro Core Soil Sampler Parts



A. Sampler driven to proper depth.
B. Open hole from previous sample.
C. Open-tube sampler driven back down previous hole.
D. Sampler driven to proper depth for sampling second interval.

Phases of Macro-Core Open Tube Sampling



A. Previously cored or pre-probed hole with sloughed soil.
B. Closed-Piston Sampler driven to next sampling interval.
C. Releasing piston assembly.
D. Closed-piston sampler filled with soil.

Phases of Macro-Core Closed Piston Soil Sampling

LARGE BORE SOIL SAMPLER

STANDARD OPERATING PROCEDURE

TECHNICAL BULLETIN NO. 93.002

PREPARED: APRIL 01, 1993; REVISED: SEPTEMBER 15, 1994

1.0 OBJECTIVE

The objective of this procedure is to collect a discrete soil sample at depth and recover it for visual inspection and/or chemical analysis.

2.0 BACKGROUND

2.1 Definitions

- **Geoprobe®**: A vehicle-mounted hydraulically-powered soil probing machine that utilizes static force and percussion to advance small diameter sampling tools into the subsurface for collecting soil core, soil gas, or ground water samples.

- **Large Bore Soil Sampler:** A 24-inch long X 1-3/8-inch diameter piston-type soil sampler capable of recovering a discrete sample that measures up to 320-ml in volume, in the form of a 22-inch X 1-1/16-inch core contained inside a removable liner.

- **Liner:** A 24-inch long X 1-1/8-inch diameter removable/replaceable, thin-walled tube inserted inside the Large Bore Sampler body for the purpose of containing and storing soil samples. Liner materials include brass, stainless steel, Teflon®, and clear plastic.

2.2 Discussion

In this procedure, the assembled Large Bore Soil Sampler is connected to the leading end of a Geoprobe brand probe rod and driven into the subsurface using a Geoprobe machine. Additional probe rods are connected in succession to advance the sampler to depth. The sampler remains sealed by a piston tip as it is being driven. The piston is held in place by a reverse-threaded stop-pin at the trailing end of the sampler. When the sampler tip has reached the top of the desired sampling interval, a series of extension rods, sufficient to reach depth, are coupled together and lowered down the inside diameter of the probe rods. The extension rods are then rotated clock-wise. The male threads on the leading end of the extension rods engage the female threads on the top end of the stop-pin, and the pin is removed. After the extension rods and stop-pin have been removed, the tool string is advanced an additional 24-inches. The piston is displaced inside the sampler body

by the soil as the sample is cut. To recover the sample, the sampler is recovered from the hole and the liner containing the soil sample is removed.

3.0 REQUIRED EQUIPMENT

The following equipment is required to recover soil core samples using the Geoprobe Large Bore Soil Sampler and driving system (See Attached Figure).

3.1 Large Bore Soil Sampler Parts

STD Piston Stop-pin, O-ring	1
LB Cutting Shoe	1
LB Drive Head	1
LB Sample Tube	1
LB Piston Tip	1
LB Piston Rod	1
LB Clear Plastic Liner	Variable

3.2 Geoprobe Tools

• Probe Rod (48", 36", 24", or 12")	Variable
• Drive Cap	1
• Pull Cap	1
• Extension Rod	Variable
• Extension Rod Coupler	Variable
• Extension Rod Handle	1

4.0 OPERATION

4.1 Decontamination

Before and after each use, thoroughly clean all parts of the soil sampling system according to project specific requirements. A clean, new liner is recommended for each use. Parts should also be inspected for wear or damage at this time.

4.2 Assembly

a. Install a new O-ring into the O-ring groove on the stop-pin.

b. Seat the pre-flared end of the LB Liner over the interior end of the cutting shoe.

c. Insert the liner into either end of the sample tube and screw the cutting shoe and liner into place.

d. Screw the piston rod into the piston tip. Insert the piston tip and rod into the sample tube from the end opposite the cutting shoe. Push and rotate the rod until the tip is seated completely into the cutting shoe.

e. Screw the drive head onto the top end of the sample tube, aligning the piston rod through the center bore.

f. Screw the reverse threaded stop-pin into the top of the drive head and turn it counter-clockwise with a 3/8-inch wrench until tight.

4.3 Pilot Hole

A pilot hole is appropriate when the surface to be penetrated contains gravel, asphalt, hard sands, or rubble. Pre-probing can prevent unnecessary wear on the sampling tools. A large bore pre-probe may be used for this purpose. The pilot hole should be made only to a depth above the sampling interval.

4.4 Driving

a. Attach an 1-foot probe rod to the assembled sampler and an drive cap to the probe rod. Position the assembly for driving into the subsurface.

b. Drive the assembly into the subsurface until the drive head of the sample tube is just above the ground surface.

c. Remove the drive cap and the 1-foot probe rod. Secure the drive head with a 1-inch or adjustable wrench and re-tighten the stop-pin with a 3/8-inch wrench.

d. Attach an 3-foot probe rod in succession until the leading end of the sampler reaches the top of the desired sampling interval.

4.5 Preparing to Sample

a. When sampling depth has been reached, position the Geoprobe machine away from the top of the probe rod to allow room to work.

b. Insert an extension rod down the inside diameter of the probe rods. Attach another extension rod to the coupler and lower the jointed rods down the hole.

c. When the leading extension rod has reached the stop-pin, turn the handle clock-wise until the stop-pin detaches from the threads on the drive head.

d. Remove the extension rods and uncouple the sections.

e. The stop-pin should be attached to the bottom of the last extension rod upon

removal. Once the stop-pin has been removed, the sampler is ready to be re-driven to collect a sample.

4.6 Sample Collection

a. Reposition the Geoprobe machine over the probe rods, adding an additional probe rod to the tool string if necessary. Make a mark on the probe rod 24-inches above the ground surface.

b. Attach a drive cap to the probe rod and drive the tool string and sampler another 24-inches. Do not overdrive the sampler.

4.7 Retrieval

a. Remove the drive cap on the top probe rod and attach a pull cap. Lower the probe shell and close the hammer latch over the pull cap.

b. With the Geoprobe foot firmly on the ground, pull the tool string out of the hole. Stop when the top of the sampler is about 12-inches above the ground surface.

c. Because the piston tip and rod have been displaced inside the sample tube, the piston rod now extends into the 2-foot probe rod section. In loose soils, the 2-foot probe rod and sampler may be recovered as one piece by using the foot control to lift the sampler the remaining distance out of the hole.

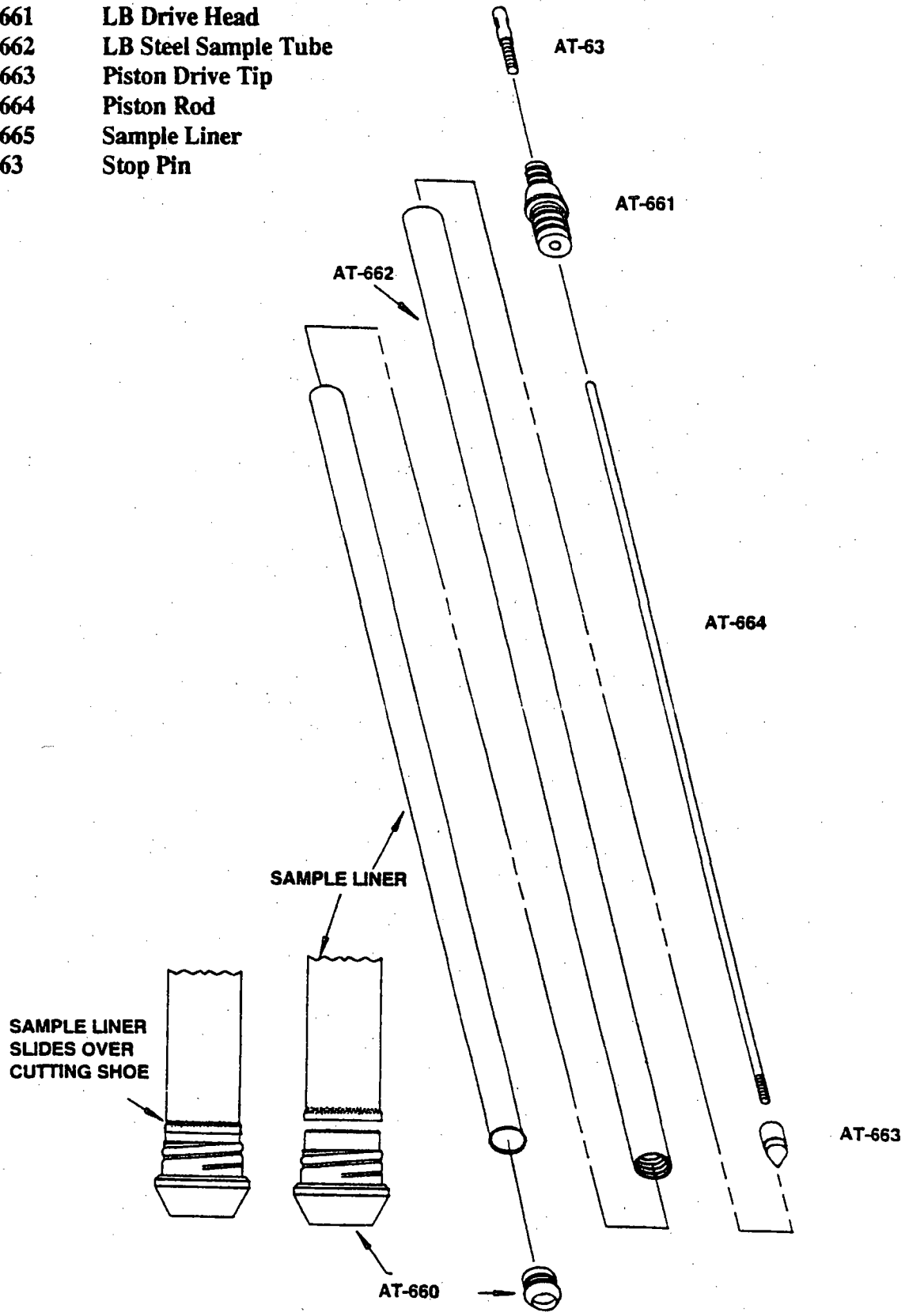
d. If excessive resistance is encountered while attempting to lift the sampler and probe rod out of the hole using the foot control, unscrew the drive head from the sampler and remove it with the probe rod, the piston rod, and the piston tip. Replace the drive head onto the sampler and attach a pull cap to it. Lower the probe shell and close the hammer latch over the pull cap and pull the sampler the remaining distance out of the hole with the probe machine foot firmly on the ground.

4.8 Sample Recovery

a. Detach the 2-foot probe rod if it has not been done previously.

b. Unscrew the cutting shoe, and pull the cutting shoe out with the liner attached. If the liner doesn't slide out readily with the cutting shoe, take off the drive head and push down on the side wall of the liner. The liner and sample should slide out easily.

AT-660	Cutting Shoe
AT-661	LB Drive Head
AT-662	LB Steel Sample Tube
AT-663	Piston Drive Tip
AT-664	Piston Rod
AT-665	Sample Liner
AT-63	Stop Pin



Large Bore Sampler Parts

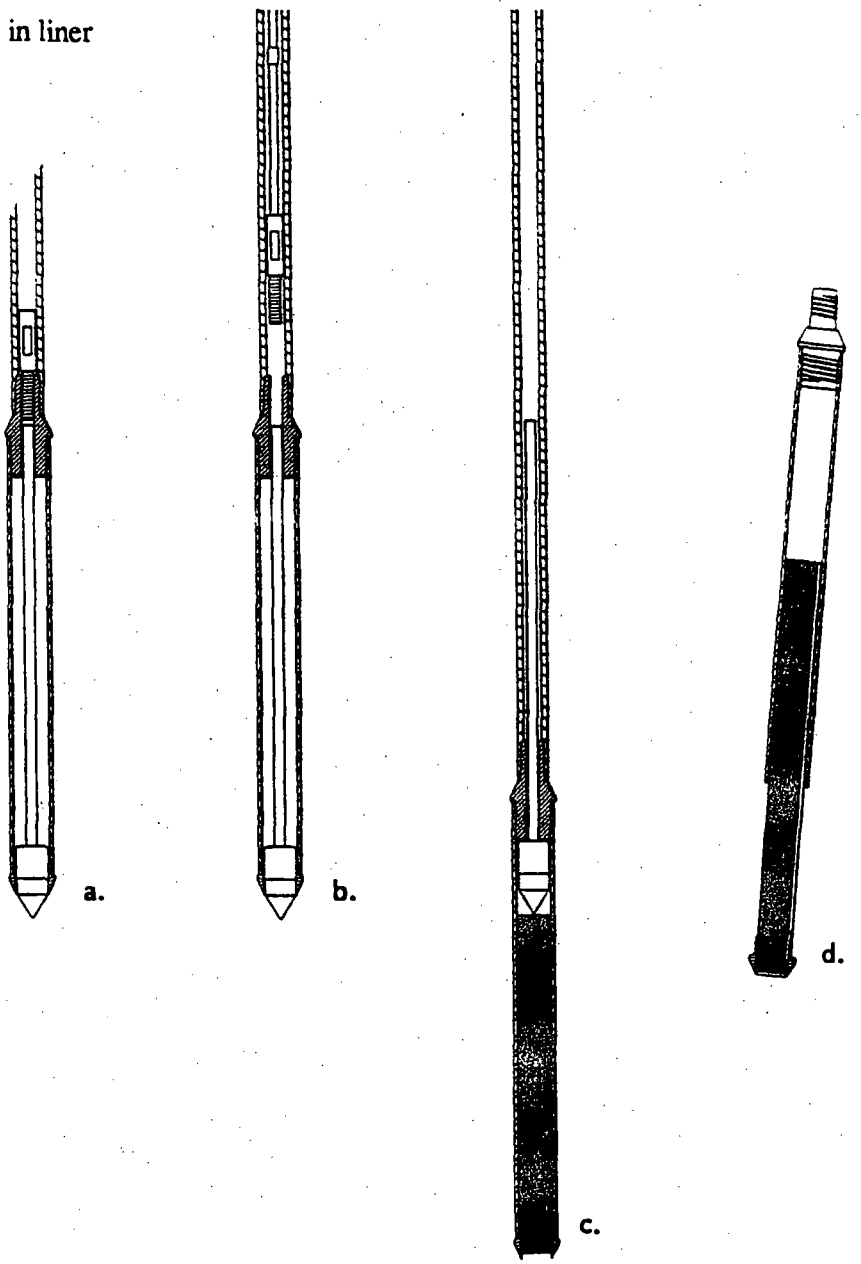
Unlike split-spoon samplers, the large bore sampler remains completely sealed while it is pushed or driven to the desired sampling depth. A piston stop-pin at the top end of the sampler is removed by means of extension rods inserted down the inside diameter of the probe rods after the sampler has been driven to depth. This enables the piston to retract into the sample tube as it is driven to recover a sample.

A. Driving the sealed sampler

B. Removing the stop-pin

C. Collecting a sample

D. Recovering sample in liner



Driving and Sampling with the Large Bore Soil Sampler