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PARSONS ENGINEERING SCIENCE, INC.

1700 Broadway, Suite 900 • Denver, Colorado 80290 • (303) 831-8100 • Fax: (303) 831-8208

April 26, 1996

Captain Ed Marchand
AFCEE/ERT
8001 Arnold Drive
Brooks AFB, Texas 78235-5357

Subject: Results of Soil Gas Sampling at the Building U-3 Petroleum, Oils, and
Lubricants (POL) Site, Camp Ripley, Minnesota

Dear Captain Marchand:

This letter report contains the results of an initial soil gas characterization performed by Parsons Engineering Science, Inc. (Parsons ES) at the subject site on 27 March 1996. The initial soil gas characterization was performed after a meeting held on 26 March 1996 at Camp Ripley to initiate Option 3 bioventing pilot testing under the AFCEE Extended Bioventing Project (Contract F41624-92-D-8036, Delivery Order 17). I attended this kickoff meeting, along with Mr. Jim Gonzales of AFCEE/ERT, Mr. Gene Fabian of the US Army Environmental Center (USAEC), Mr. Larry Rainey and Mr. John Ebert of the Minnesota Department of Military Affairs, and Ms. Sandra Miller-Moren and Mr. Brad Nordberg of the Minnesota Pollution Control Agency.

Background

The Building U-3 POL Site is a former truck service area where fuels were stored and dispensed. Tank removal, subsurface investigation activities, and corrective action design at the site were performed by Wenck Associates, Inc. (Wenck), of Maple Plain, Minnesota. The following background information has been summarized from a report entitled *Remedial Investigation/Corrective Action Design Report, Camp Ripley, Building U-3 POL* (Wenck, May 1994). One 10,000-gallon diesel fuel underground storage tank (UST), one 10,000-gallon gasoline UST, one 5,000-gallon gasoline UST, and a dispenser pump island that formerly existed at the site were removed in 1992. The 5,000-gallon UST and the product piping associated with the dispenser pump island are believed to be the primary sources of contamination at this site. Tank and dispenser pump island locations are illustrated in Figures 7 and 8 of the Wenck report, included in Attachment A to this letter.

Numerous soil borings, groundwater monitoring wells, and wells for soil vapor extraction (SVE) and air sparging pilot testing were installed to characterize the hydrogeologic conditions and to define the extent of petroleum hydrocarbon contamination at the site. Figures 7 and 8 in Attachment A illustrate the locations of these wells and soil borings, along with estimated extents of soil and groundwater

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contamination, respectively. A hydrogeologic cross-section (Figure 4 from the Wenck report) and soil and groundwater analytical results (Wenck Tables 2 and 3) are also included in Attachment A. Soil boring logs and well construction diagrams have been included as Attachment B.

Soils at the site consist primarily of medium-grained sands. Groundwater occurs at a depth of approximately 18 feet below ground surface, and flows to the east-southeast at a gradient of approximately 0.002 foot/foot. Petroleum-contaminated soil appears to be limited to a "smear zone" corresponding with the groundwater table. Water level information obtained from Camp Ripley on April 25, 1996 strongly suggests that the "smear zone" contamination has been entirely underwater for the past 2 1/4 years (Attachment C). Benzene and total petroleum hydrocarbons (TPH) as gasoline-range organics (GRO) have been detected in "smear zone" soils at concentrations as high as 4.5 milligrams per kilogram (mg/kg) and 1,000 mg/kg, respectively. Fuel-related contamination in shallower soils was negligible. Benzene concentrations in groundwater were as high as 570 micrograms per liter ($\mu\text{g/L}$) in an October 1993 sampling event, and the groundwater contaminant plume is approximately 500 feet long by 300 feet wide, as defined by the 10 $\mu\text{g/L}$ benzene isopleth.

Wenck performed SVE and air sparging pilot testing in March 1994 following the site investigation. The SVE pilot test was conducted for 1 day at flow rates ranging from 25 to 133 standard cubic feet per minute (scfm). Soil gas extracted during the pilot test was not significantly contaminated. Volatile hydrocarbons were detected at a maximum concentration of 116 parts per million, volume per volume (ppmv) during the pilot test. The air sparging pilot test was also conducted for 1 day at flow rates ranging from 6 to 101 scfm. Dissolved oxygen (DO) was not detected in fuel-contaminated groundwater prior to the air sparging pilot test, indicating the occurrence of aerobic fuel hydrocarbon biodegradation in the saturated zone.

Initial Soil Gas Characterization

In March 1996, soil gas samples were collected from all accessible wells in the soil contamination source area to characterize subsurface conditions and to determine if the site was a candidate for remediation using *in situ* bioventing. The wells were purged, and initial oxygen, carbon dioxide, and total volatile hydrocarbon (TVH) concentrations were measured using portable gas analyzers, as described in the document entitled *Test Plan and Technical Protocol for a Field Treatability Test for Bioventing* (Hinchee *et al.*, 1992). Soil gas oxygen and carbon dioxide levels were measured to determine if aerobic hydrocarbon biodegradation is occurring in vadose zone soils. If oxygen is depleted (below 5 percent) and carbon dioxide concentrations are elevated in soil gas drawn from fuel-contaminated soil, then aerobic hydrocarbon biodegradation likely is occurring and is limited by available oxygen. Bioventing can therefore be used to provide oxygen to fuel-contaminated soil and to stimulate the naturally occurring biodegradation of petroleum hydrocarbons. If TVH concentrations are elevated in soil gas [above approximately 5,000 parts per million, volume per volume (ppmv)], emissions of volatile hydrocarbons to the surface may be a concern

with an air-injection remedial option, and SVE may be a more appropriate low-cost option for remediation of vadose zone soils.

Table 1 (below) summarizes the initial soil gas chemistry at the site. Oxygen was present at elevated concentrations, ranging from 19.8 to 20.7 percent. Also, carbon dioxide was present at low concentrations, ranging from 0.3 to 1.5 percent. It appears that sufficient oxygen concentrations are already present to support aerobic biodegradation of the remaining fuel residuals in the vadose zone soils at the site. Initial TVH concentrations in soil gas ranged from 31 to 195 ppmv. These are near-background concentrations. It appears that any volatile fuel hydrocarbon contamination in the vadose zone has either naturally biodegraded or was substantially removed during the earlier SVE pilot testing performed by Wenck.

TABLE 1
INITIAL SOIL GAS CHEMISTRY
BUILDING U-3 POL SITE
27 MARCH 1996

Well	Time of Sample Collection	Oxygen (%)	Carbon Dioxide (%)	TVH (ppmv)
EV-1	1055	20.4	.95	140
MW-2	1011	19.8	1.5	195
MW-3	1117	20.7	0.3	38
MW-4	1200	20.6	0.3	31
MW-5	0948	20.3	0.7	115

Conclusions

The results of this soil gas sampling event indicate that there is very little volatile petroleum contamination remaining in vadose zone soil at this site, and that vadose zone remediation using either SVE or bioventing is unnecessary. Parsons ES recommends the reallocation of the Option 3 to a more appropriate site.

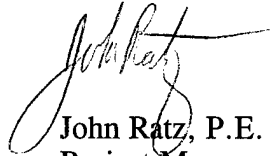
A plume of groundwater BTEX contamination exists at the site, but it does not appear to be mobile, based on long-term groundwater monitoring conducted by Camp Ripley. A risk-based approach using intrinsic remediation under Minnesota's risk-based corrective action guidelines may be the most appropriate option for achieving regulatory action levels for groundwater at this site.

Captain Ed Marchand
April 26, 1996
Page 4

If you have any questions about this sampling effort or need further information about risk-based corrective action or intrinsic remediation please call me or Doug Downey at (303) 831-8100.

Sincerely,

PARSONS ENGINEERING SCIENCE, INC.



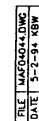
John Ratz, P.E.
Project Manager

cc: Mr. Gene Fabian, USAEC
Mr. Jim Gonzales, AFCCE/ERT
Mr. Larry Rainey, State of Minnesota Department of Military Affairs

Attachments: A - Tables and Figures
B - Soil Boring Logs and Well Construction Diagrams
C - Groundwater Elevations and Estimated "Smear Zone" Elevation

ATTACHMENT A

TABLES AND FIGURES
(WENCK, MAY 1994)



MINNESOTA ARMY NATIONAL GUARD
Camp Ripley – Building U-3 POL
Limits of Groundwater Contamination

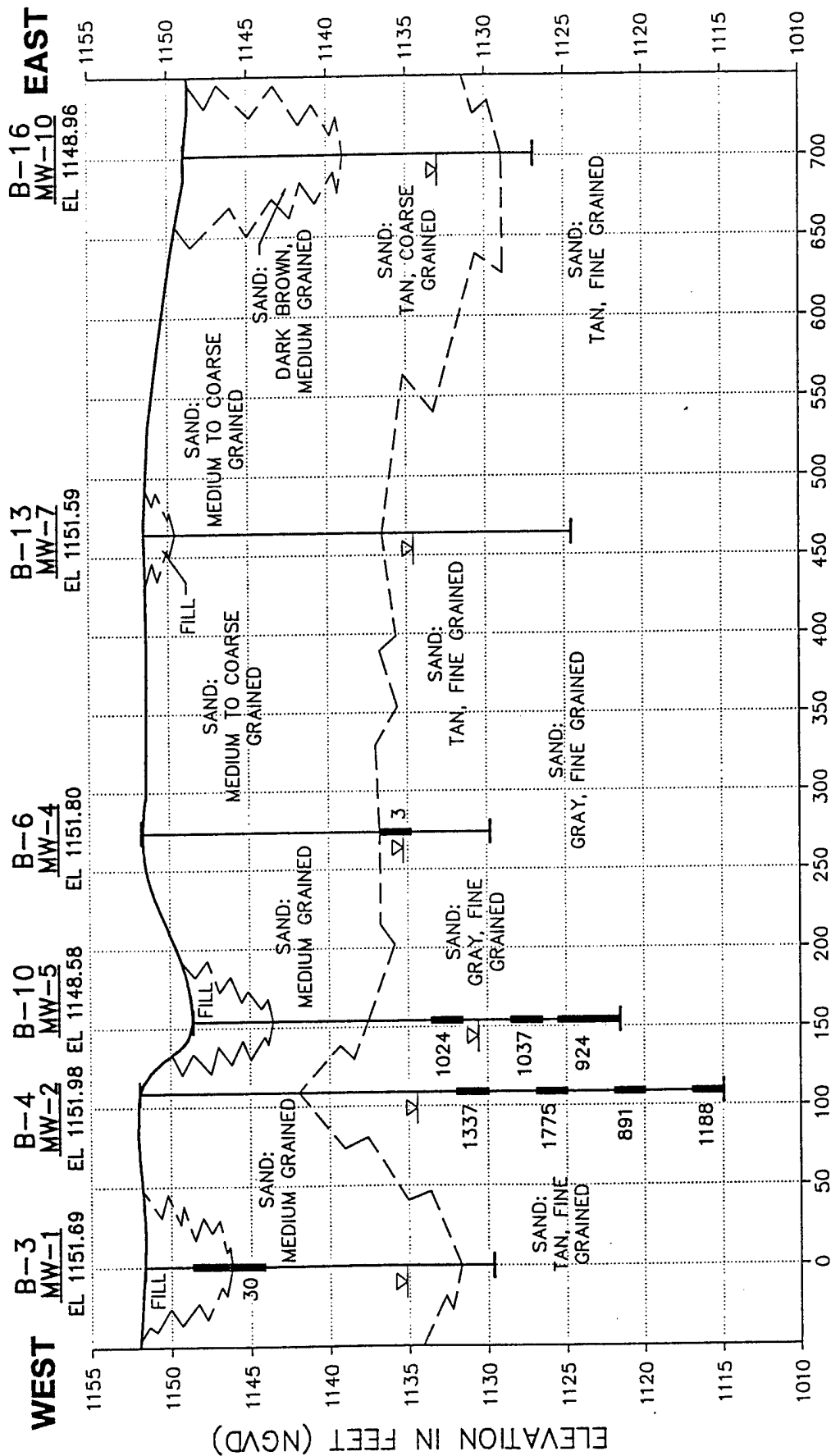


MAY 1994

Figure No. 8

A

A'



FILE MAX01044.DWG
 DATE 5-2-94 KBW

MINNESOTA ARMY NATIONAL GUARD
 Camp Ripley - Building U-3 POL
 Cross-Section A-A'

Wenck
 Wenck Associates, Inc. 1800 Pioneer Creek Cir.
 Environmental Engineers Maple Plain, MN 55359

MAY 1994

Figure 4

TABLE 2
Soil Sample Laboratory Analytical Results
Camp Ripley - Building U-3 POL

Soil Boring	Depth (ft)	Date	Methyl										Lead (mg/kg)
			TPH as GRO (mg/kg)	TPH as Gasoline (mg/kg)	TPH as #2 Fuel oil (mg/kg)	Methyl tert-butyl ether (ug/kg)	Benzene (ug/kg)	Toluene (ug/kg)	Ethyl benzene (ug/kg)	m,p Xylenes (ug/kg)	o-Xylene (ug/kg)	Total Xylene (ug/kg)	
Tank 1 East		11-6-92	NA	<0.60	<0.80	NA	NA	NA	NA	NA	NA	NA	NA
Tank 1 West		11-6-92	NA	<0.60	<0.80	NA	NA	NA	NA	NA	NA	NA	NA
Tank 2 East		11-6-92	NA	<0.60	<0.80	<7.5	<5.0	<5.0	<5.0	NA	NA	14	<7.5
Tank 2 West		11-6-92	NA	<0.60	<0.80	<7.5	<5.0	<5.0	<1.0	NA	NA	<10	NA
B-2	17-19	5-10-93	490 ¹	NA	NA	NA	4,500	55,000	16,000	NA	NA	88,000	NA
B-7	18-20	6-10-93	<4.0	NA	NA	<200	<100	<100	<100	<100	<100	NA	<3.4
B-8	15-17	6-10-93	<4.0	NA	NA	<200	<100	<100	<100	<100	<100	NA	<3.4
B-9	5-7	8-11-93	NA	NA	NA	<500	<100	<100	<100	<100	<100	NA	8.5
B-10	15-17	8-11-93	NA	NA	NA	<500	<100	6,000	13,000	51,000	14,000	NA	7.7
B-11	25-27	8-11-93	NA	NA	NA	<500	<100	<100	<100	<100	<100	NA	18

Note:

¹=Contains product which elutes outside the retention time provided by the DRO standard.

NA=Not Analyzed

TABLE 3
Groundwater Sample Laboratory Analytical Results
Camp Ripley - Building U-3 POL

Monitoring Well	Date	TPH as GRO		Benzene (ug/L)	Ethyl-benzene (ug/L)	Toluene (ug/L)	Total Xylenes (ug/L)	Methyl tert butyl ether (MTBE) (ug/L)	2-Methyl-butene ² (ug/L)	Ethyl ether (ug/L)	Chloroform (ug/L)	Tetrahydrofuran (ug/L)
		(mg/L)	(mg/L)									
RAL		--	--	10	700	1,000	10,000	--	700	1,000	60	100
B-9	11-Aug-93	NA	NA	<400	1300	6400	8100	<2,000	39,000	<2,000	<30	<2,000
MW-1	15-Jun-93	<0.1	<5	<5	<5	<5	<10	<1	<20	<20	<5	<20
	08-Oct-93	--	<0.1	1.6	<1.0	<1.0	<2.0	<5	--	--	--	--
MW-2	15-Jun-93	32 ¹	28	18	600	1,500	1390	<250	<20	<20	<5	<20
	08-Oct-93	--	6.5	110	62	530	940	--	--	--	--	--
MW-3	15-Jun-93	1.2 ¹	5	170	180	120	88	<250	<20	<20	<5	<20
	08-Oct-93	--	6	560	310	300	<140	--	--	--	--	--
MW-4	15-Jun-93	4.1 ¹	9.8	34	240	86	500	<250	<20	<20	<5	<20
	08-Oct-93	--	6.8	150	<50	170	<380	--	--	--	--	--
MW-5	17-Aug-93	--	0.4	520	420	1,500	2360	<200	20,000	2100	<38	<200
	08-Oct-93	--	32	570	310	1,700	2130	<8	--	<16	<8	<40
MW-6	17-Aug-93	--	0.7	12	5.0	2.1	3.4	<2	380	<20	<0.03	<2
	08-Oct-93	--	0.4	14	4.3	3.3	<2.2	9.5	--	--	--	--
MW-7	17-Aug-93	--	1.4	35	8.9	12	12.3	<2	1700	100	0.40	<2
	08-Oct-93	--	1.9	21	19	6.5	13.2	58	--	<4	<2	<2
MW-8	17-Aug-93	--	<0.1	<0.4	<0.4	0.36	<2	<2	<20	<2	13	<2
	08-Oct-93	--	<0.1	<1.0	<1.0	<1.0	<2.0	<5	--	--	--	--
MW-9	08-Oct-93	--	<0.1	<0.40	<1.0	<1.0	<2.0	<2	<2	<2	<0.03	<2
MW-10	08-Oct-93	--	0.2	0.9	0.4	0.36	<2	<2	<2	<20	<0.03	35

NOTE:
1: Contains product which elutes outside the retention window provided by the DRO standard (see Appendix C).
2: Compound mis-identified as Acetone

TABLE 3

Groundwater Sample Laboratory Analytical Results
Camp Ripley - Building U-3 POL

Monitoring Well	Date	Tetrachloro-ethene (ug/L)	Styrene (ug/L)	Isopropyl-benzene (ug/L)	n-Propyl benzene (ug/L)	1,3,5-Tri methyl benzene (ug/L)	1,2,4-Tri methyl benzene (ug/L)	sec-Butyl benzene (ug/L)	4-Isopropyl toluene (ug/L)	n-Butyl benzene (ug/L)	Naphthalene (ug/L)	Lead (ug/L)
RAI		7	10	300	--	--	--	--	--	--	30	20
B-9	11-Aug-93	<40	<40	<500	<2,000	<2,000	2,500	<50	<500	590	1000	32
MW-1	15-Jun-93	<1	<5	<5	<5	<5	<5	<5	<5	<5	<5	<2.5
	08-Oct-93	--	--	--	--	--	--	--	--	--	--	--
MW-2	15-Jun-93	<5	<5	65	76	100	35	8.8	45	<5	380	3.3
	08-Oct-93	--	--	--	--	--	--	--	--	--	--	--
MW-3	15-Jun-93	<5	<5	20	19	36	21	<5	8.4	<5	64	<2.5
	08-Oct-93	--	--	--	--	--	--	--	--	--	--	--
MW-4	15-Jun-93	<5	<5	50	50	100	260	7.5	40	<5	150	<2.5
	08-Oct-93	--	--	--	--	--	--	--	--	--	--	--
MW-5	17-Aug-93	<4	<40	78	<200	<200	670	<5	<50	95	180	37
	08-Oct-93	<8	<8	54	55	600	590	<8	75	<8	170	12
MW-6	17-Aug-93	<0.4	0.43	2	<2	<2	<0.4	<0.05	0.54	2.5	4.8	23
	08-Oct-93	--	--	--	--	--	--	--	--	--	--	2.8
MW-7	17-Aug-93	<0.04	1.5	5.2	<2	<2	1	<0.05	2.5	4.3	6.5	<5
	08-Oct-93	<0.4	2.6	9.3	<2	10	<2	<2	2.6	<2	11	--
MW-8	17-Aug-93	<0.04	<0.04	<0.05	<0.2	<0.2	<0.4	<0.5	<0.05	<0.5	0.36	<5
	08-Oct-93	--	--	--	--	--	--	--	--	--	--	--
MW-9	08-Oct-93	0.42	<0.04	<0.05	<0.2	<0.2	<0.04	<0.05	<0.05	<0.05	<0.03	13
MW-10	08-Oct-93	<0.04	<0.4	<0.5	<0.2	<0.2	<0.4	<0.5	<0.5	<0.5	3.4	<2.5

NOTE:

- 1: Contains product which elutes outside the retention window provided by the DRO standard (see Appendix C).
2: Compound mis-identified as Acetone

ATTACHMENT B

SOIL BORING LOGS AND WELL CONSTRUCTION DIAGRAMS

WENCK ASSOCIATES, INCORPORATED

LOG OF SOIL BORING B-1

PROJECT NAME: MNARNG, CAMP RIPLEY, BLDG.U-3 POL
PROJECT LOCATION: LITTLE FALLS, MN

WAI PROJ. NO: 0198-02-137

CHECKED BY: GHN

SUBSURFACE PROFILE

SOIL SAMPLE DATA

ELEV. (FT)	USCS GROUP		DEPTH (FT)	SAMPLE TYPE	BLOW COUNT	HEADSPACE RESULTS (ppm)
	FILL	SAND: TAN-DK.BROWN,MED.-COARSE GRAINED, DAMP	0.0	SS		4.8
			2.0	SS		129
			4.0			
	SM	SAND: TAN-DK.BROWN,FINE-MEDIUM GRAINED, WELL SORTED.	6.0	SS		11
			8.0	SS		0
			10.0	SS		0
			12.0			
			14.0	SS		0
			16.0	SS		0
	SM	SAND: GRAY,FINE,POORLY SORTED	18.0	SS		763
			20.0	SS		710
		EOB @ 21.5'	22.0			
			24.0			
			26.0			
			28.0			
			30.0			
			32.0			
			34.0			
			36.0			

TOTAL DEPTH: 21.5 FT
DRILLING DATE: 5-10-93
INSPECTOR: GEOFF NASH
CONTRACTOR: TWIN CITY TESTING, INC.
DRILLER: DALE DUSCHER
DRILLING METHOD: HOLLOW STEM AUGER

WATER LEVEL OBSERVATION:
WATER FIRST OBSERVED AT 18 FEET

SOIL SAMPLING METHOD: SPLIT SPOON (SS)

FILE ANCRB103.DWG
DATE 10-20-93 DLM

WENCK ASSOCIATES, INCORPORATED

LOG OF SOIL BORING B-2

PROJECT NAME: MNARNG, CAMP RIPLEY, BLDG.U-3 POL
PROJECT LOCATION: LITTLE FALLS, MN

WAI PROJ. NO: 0198-02-137
CHECKED BY: GHN

SUBSURFACE PROFILE				SOIL SAMPLE DATA		
ELEV. (FT)	USCS GROUP		DEPTH (FT)	SAMPLE TYPE	BLOW COUNT	HEADSPACE RESULTS (ppm)
	FILL	SAND: MEDIUM BROWN, MEDIUM GRAINED, POORLY SORTED	0.0	SS		45
			2.0	SS		97
			4.0	SS		75
			6.0	SS		7
	SP	SAND: TAN-LT. BROWN, MEDIUM GRAINED, POORLY SORTED.	8.0	SS		-
			10.0	SS-PLUGGED/NO SAMPLE		-
			12.0	SS		2
			14.0	SS		0
	SP	SAND: TAN, FINE GRAINED, SILTY, POORLY SORTED.	16.0	SS		787
	SP	SAND: GRAY, FINE GRAINED, SILTY, POORLY SORTED.	18.0	SS		
		EOB @ 19'	20.0			
			22.0			
			24.0			
			26.0			
			28.0			
			30.0			
			32.0			
			34.0			
			36.0			

TOTAL DEPTH: 19 FT
DRILLING DATE: 5-10-93
INSPECTOR: GEOFF NASH
CONTRACTOR: TWIN CITY TESTING, INC.
DRILLER: DALE DUSCHER
DRILLING METHOD: HOLLOW STEM AUGER

WATER LEVEL OBSERVATION:
WATER FIRST OBSERVED AT 17 FEET

SOIL SAMPLING METHOD: SPLIT SPOON (SS)

FILE ANCR8203.DWG
DATE 10-20-93 DLM

WENCK ASSOCIATES, INCORPORATED

LOG OF SOIL BORING B-3 (MW-1)

PROJECT NAME: MNARNG, CAMP RIPLEY, BLDG.U-3 POL
PROJECT LOCATION: LITTLE FALLS, MN

WAI PROJ. NO: 0198-02-137
CHECKED BY: GHN

SUBSURFACE PROFILE				SOIL SAMPLE DATA		
ELEV. (FT)	USCS GROUP		DEPTH (FT)	SAMPLE TYPE	BLOW COUNT	HEADSPACE RESULTS (ppm)
	FILL	SAND: DK.BROWN, FINE-MED. GRAINED.	0.0	SS-PLUGGED/NO SAMPLE		-
			2.0			
			4.0			
	SP	SAND: TAN, MEDIUM GRAINED, SUBANGULAR, POORLY SORTED.	6.0	SS		0
			8.0			
			10.0	SS		0
			12.0			
			14.0			
			16.0	SS		0
			18.0			
			20.0			
	SW	SAND: TAN, FINE-MEDIUM GRAINED, ANGULAR, WELL SORTED.		SS		0
		EOB @ 21.4'	22.0			
			24.0			
			26.0			
			28.0			
			30.0			
			32.0			
			34.0			
			36.0			

TOTAL DEPTH: 21.4 FT
DRILLING DATE: 6-09-93
INSPECTOR: GEOFF NASH
CONTRACTOR: TRAUT HYDROTECH.
DRILLER:
DRILLING METHOD: HOLLOW STEM AUGER

WATER LEVEL OBSERVATION:
WATER FIRST OBSERVED AT 16.5 FEET

SOIL SAMPLING METHOD: SPLIT SPOON (SS)

FILE ANCRB303.DWG
DATE 04-14-94 DLM

WENCK ASSOCIATES, INCORPORATED

LOG OF SOIL BORING B-4 (MW-2)

PROJECT NAME: MNARNG, CAMP RIPLEY, BLDG.U-3 POL

WAI PROJ. NO: 0198-02-137

PROJECT LOCATION: LITTLE FALLS, MN

CHECKED BY: GHN

SUBSURFACE PROFILE			SOIL SAMPLE DATA			
ELEV. (FT)	USCS GROUP		DEPTH (FT)	SAMPLE TYPE	BLOW COUNT	HEADSPACE RESULTS (ppm)
	SP	SAND: TAN-MED BROWN, MEDIUM GRAINED, SUBANGULAR-SUBROUND, POORLY SORTED.	0.0	NO SAMPLE(NEW FILL)		
			2.0			
			4.0			
			6.0	SS		0
			8.0			
			10.0			
	SP	SAND: BUFF-TAN, FINE GRAINED. SUBANGULAR, POORLY SORTED.	12.0	SS		0
			14.0			
			16.0	SS-PLUGGED/NO SAMPLE		-
			18.0			
			20.0			
			22.0	SS		1377
	SP	SAND: GRAY, FINE GRAINED, ANGULAR-SUBANGULAR, POORLY SORTED.	24.0			
			26.0	SS		1775
			28.0			
			30.0	SS		891
			32.0			
			34.0			
			36.0	SS		1188
				EOB @ 37'.		

TOTAL DEPTH: 37 FT
 DRILLING DATE: 6-09-93
 INSPECTOR: GEOFF NASH
 CONTRACTOR: TRAUT HYDROTECH.
 DRILLER:
 DRILLING METHOD: HOLLOW STEM AUGER

WATER LEVEL OBSERVATION:
 WATER FIRST OBSERVED AT 17.5 FEET

SOIL SAMPLING METHOD: SPLIT SPOON (SS)

FILE: ANCRB403.DWG
 DATE: 5-2-94 KBW

WENCK ASSOCIATES, INCORPORATED

LOG OF SOIL BORING B-5 (MW-3)

PROJECT NAME: MNARNG, CAMP RIPLEY, BLDG.U-3 POL

WAI PROJ. NO: 0198-02-137

PROJECT LOCATION: LITTLE FALLS, MN

CHECKED BY: GHN

SUBSURFACE PROFILE				SOIL SAMPLE DATA		
ELEV. (FT)	USCS GROUP		DEPTH (FT)	SAMPLE TYPE	BLOW COUNT	HEADSPACE RESULTS (ppm)
			0.0			
				NO SAMPLE		-
			2.0			
			4.0			
	SP	SAND: TAN, MEDIUM GRAINED, ANGULAR-SUBANGULAR POORLY SORTED.	6.0	SS		0
			8.0			
			10.0	SS-PLUGGED/NO SAMPLE		0
			12.0			
			14.0			
	SP	SAND: GRAY, FINE GRAINED, SILTY, POORLY SORTED.	16.0	SS		0
			18.0			
			20.0	SS		30
		EOB @ 22'.	22.0			
			24.0			
			26.0			
			28.0			
			30.0			
			32.0			
			34.0			
			36.0			

TOTAL DEPTH: 22 FT
 DRILLING DATE: 6-10-93
 INSPECTOR: GEOFF NASH
 CONTRACTOR: TRAUT HYDROTECH.
 DRILLER:

WATER LEVEL OBSERVATION:
 WATER FIRST OBSERVED AT 17.7 FEET

DRILLING METHOD: HOLLOW STEM AUGER

SOIL SAMPLING METHOD: SPLIT SPOON (SS)

WENCK ASSOCIATES, INCORPORATED

LOG OF SOIL BORING B-6 (MW-4)

PROJECT NAME: MNARNG, CAMP RIPLEY, BLDG.U-3 POL
PROJECT LOCATION: LITTLE FALLS, MN

WAI PROJ. NO: 0198-02-137

CHECKED BY: GHN

SUBSURFACE PROFILE				SOIL SAMPLE DATA		
ELEV. (FT)	USCS GROUP		DEPTH (FT)	SAMPLE TYPE	BLOW COUNT	HEADSPACE RESULTS (ppm)
	SP	SAND: MED.BROWN,MEDIUM GRAINED, SUBANGULAR-SUBROUND POORLY SORTED.	0.0	NO SAMPLE-STARTED BORING W/ POSTHOLE DIGGER		-
	SP	SAND: GRAY,FINE GRAINED, SILTY, POORLY SORTED.	16.0	SS		3
		EOB @ 22'.	22.0			

SAND: MED.BROWN,MEDIUM GRAINED,
SUBANGULAR-SUBROUND
POORLY SORTED.

SAND: GRAY,FINE GRAINED,
SILTY,
POORLY SORTED.

EOB @ 22'.

TOTAL DEPTH: 22 FT
DRILLING DATE: 6-10-93
INSPECTOR: GEOFF NASH
CONTRACTOR: TRAUT HYDROTECH.
DRILLER:
DRILLING METHOD: HOLLOW STEM AUGER

WATER LEVEL OBSERVATION:
WATER FIRST OBSERVED AT 16.5 FEET

SOIL SAMPLING METHOD: SPLIT SPOON (SS)

FILE ANCRB603.DWG
DATE 10-20-93 DLM

WENCK ASSOCIATES, INCORPORATED

LOG OF SOIL BORING B-9

PROJECT NAME: MNARNG, CAMP RIPLEY, BLDG.U-3 POL
PROJECT LOCATION: LITTLE FALLS, MN

WAI PROJ. NO: 0198-02-137
CHECKED BY: GHN

SUBSURFACE PROFILE				SOIL SAMPLE DATA		
ELEV. (FT)	USCS GROUP		DEPTH (FT)	SAMPLE TYPE	BLOW COUNT	HEADSPACE RESULTS (ppm)
	FILL	SAND: TAN-BROWN, ANGULAR-SUBANGULAR, SOME PEBBLES WELL SORTED.	0.0			
				SS		2
	SP	SAND: TAN, FINE GRAINED, POORLY SORTED.	6.0	SS		0
				SS		4
				SS		2
					SS	
		EOB @ 22'.	22.0			

TOTAL DEPTH: 22 FT
DRILLING DATE: 8-11-93
INSPECTOR: GEOFF NASH
CONTRACTOR: TRAUT HYDROTECH.
DRILLER:
DRILLING METHOD: HOLLOW STEM AUGER

WATER LEVEL OBSERVATION:
WATER FIRST OBSERVED AT 18 FEET

SOIL SAMPLING METHOD: SPLIT SPOON (SS)

WENCK ASSOCIATES, INCORPORATED

LOG OF SOIL BORING B-10 (MW-5)

PROJECT NAME: MNARNG, CAMP RIPLEY, BLDG.U-3 POL
PROJECT LOCATION: LITTLE FALLS, MN

WAI PROJ. NO: 0198-02-137

CHECKED BY: GHN

SUBSURFACE PROFILE				SOIL SAMPLE DATA		
ELEV. (FT)	USCS GROUP		DEPTH (FT)	SAMPLE TYPE	BLOW COUNT	HEADSPACE RESULTS (ppm)
	FILL	SAND: MEDIUM BROWN, MEDIUM GRAINED, GRANITE, ASPHALT	0.0	NO SAMPLE(OBSTRUCTION)		
			2.0			
			4.0	SS		0
	SW	SAND: MEDIUM BROWN, MEDIUM-COARSE GRAINED, SUBANGULAR, SOME PEBBLES 0.5-1CM WELL SORTED.	6.0	SS		0
			8.0			
			10.0	SS		0
	SP	SAND: TAN, FINE GRAINED, ANGULAR, POORLY SORTED.	12.0			
			14.0			
	SP	SAND: GRAY, FINE GRAINED, ANGULAR, OIL SHEEN, POORLY SORTED.	16.0	SS		1024
			18.0			
			20.0	SS		1037
			22.0			
			24.0			
			26.0	SS		924
		EOB @ 27'	28.0			
			30.0			
			32.0			
			34.0			
			36.0			

TOTAL DEPTH: 27 FT
 DRILLING DATE: 8-11-93
 INSPECTOR: GEOFF NASH
 CONTRACTOR: TRAUT HYDROTECH.
 DRILLER: PAT BARR
 DRILLING METHOD: HOLLOW STEM AUGER

WATER LEVEL OBSERVATION:
 WATER FIRST OBSERVED AT 18 FEET

SOIL SAMPLING METHOD: SPLIT SPOON (SS)

FILE ANRB1003.DWG
 DATE 10-20-93 DLM

WENCK ASSOCIATES, INCORPORATED

LOG OF SOIL BORING B-14 (MW-8)

PROJECT NAME: MNARNG, CAMP RIPLEY, BLDG.U-3 POL

WAI PROJ. NO: 0198-02-137

PROJECT LOCATION: LITTLE FALLS, MN

CHECKED BY: GHN

SUBSURFACE PROFILE			SOIL SAMPLE DATA		
ELEV. (FT)	USCS GROUP	DEPTH (FT)	SAMPLE TYPE	BLOW COUNT	HEADSPACE RESULTS (ppm)
		0.0			
		2.0			
		4.0			
		6.0			
		8.0			
		10.0			
		12.0			
		14.0			
		16.0			
		18.0			
		20.0			
		22.0			
		24.0			
	SP	26.0	NOT SAMPLED— DRILLER OFF ON DEPTH		
		28.0			
		30.0	GRAB		0
		32.0			
		34.0			
		36.0			

TOTAL DEPTH: 72 FT
DRILLING DATE: 8-13-93
INSPECTOR: GEOFF NASH
CONTRACTOR: TRAUT HYDROTECH.
DRILLER:
DRILLING METHOD: MUD ROTARY

SOIL SAMPLING METHOD: GRAB

WATER LEVEL OBSERVATION:
WATER FIRST OBSERVED AT FEET

WENCK ASSOCIATES, INCORPORATED

LOG OF SOIL BORING B-14 (MW-8)CONT.

PROJECT NAME: MNARNG, CAMP RIPLEY, BLDG.U-3 POL
PROJECT LOCATION: LITTLE FALLS, MN

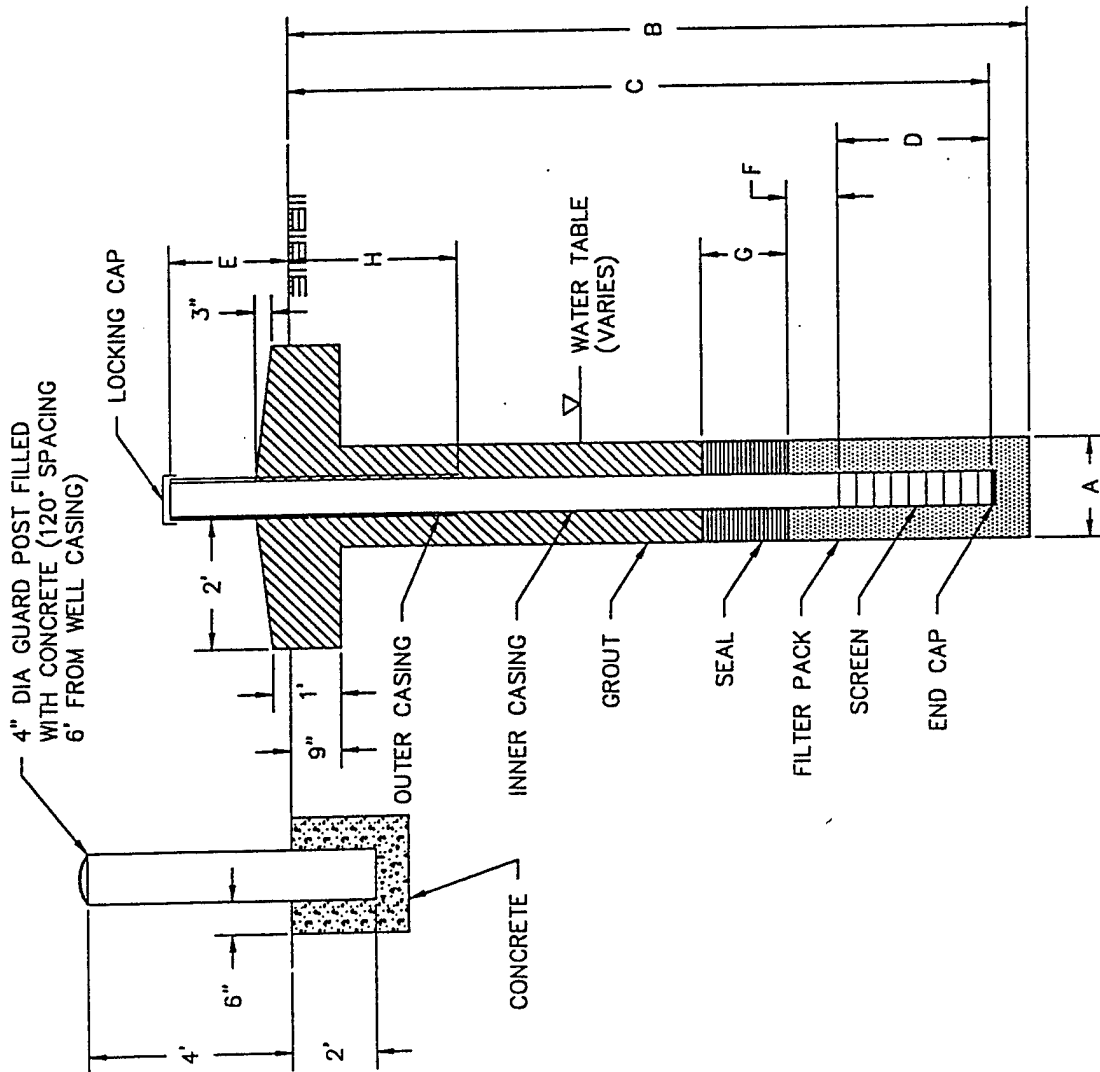
WAI PROJ. NO: 0198-02-137

CHECKED BY: GHN

SUBSURFACE PROFILE				SOIL SAMPLE DATA		
ELEV. (FT)	USCS GROUP		DEPTH (FT)	SAMPLE TYPE	BLOW COUNT	HEADSPACE RESULTS (ppm)
	SP	SAME AS ABOVE	-36.0			
			-38.0			
	SW	SAND: TAN-GRAY, FINE-COARSE GRAINED, SUBANGULAR, WELL SORTED.	-40.0	GRAB		0
			-42.0			
			-44.0			
			-46.0			
			-48.0			
	SW	SAND: TAN-GREEN, MEDIUM-COARSE GRAINED, SUBANGULAR, WELL SORTED	-50.0	GRAB		0
			-52.0			
			-54.0			
			-56.0			
			-58.0			
			-60.0	GRAB		0
			-62.0			
			-64.0			
			-66.0			
	CL	SAND: BROWN, SLIGHTLY SILTY, PLASTIC, FRAGMENTS	-68.0	GRAB		-
	CL	SAND: GRAY, SILTY, PLASTIC, FRAGMENTS	-70.0	GRAB		-
	BR	BEDROCK: BLACK SCHIST, OBLONG FRAGMENTS	-72.0	GRAB		-
				EOB @ 72'		

TOTAL DEPTH: 72 FT
DRILLING DATE: 8-13-93
INSPECTOR: GEOFF NASH
CONTRACTOR: TRAUT HYDROTECH.
DRILLER:
DRILLING METHOD: MUD ROTARY
SOIL SAMPLING METHOD: GRAB

WATER LEVEL OBSERVATION:
WATER FIRST OBSERVED AT FEET



BOREHOLE INFORMATION

A	BOREHOLE DIAMETER	37 FEET
B	BOREHOLE DEPTH	23.5 FEET
C	WELL DEPTH	

SCREEN INFORMATION

D	SCREEN LENGTH	10 FEET
-	SCREEN DIAMETER	2 INCHES
-	SLOT SIZE	0.10 INCHES
-	MATERIAL	PVC
-	SCREENED INTERVAL	13.5 TO 23.5 FEET

INNER CASING INFORMATION

-	CASING DIAMETER	2 INCHES
-	CASING MATERIAL	PVC
E	STICK UP HEIGHT	2 FEET

FILTER PACK INFORMATION

F	DIST. ABOVE SCREEN	2 FEET
-	FILTER PACK MATERIAL	# 30 RED FLINT SAND

SEAL INFORMATION

G	SEAL THICKNESS	2 FEET
-	SEAL MATERIAL	BENTONITE CHIPS

OUTER CASING INFORMATION

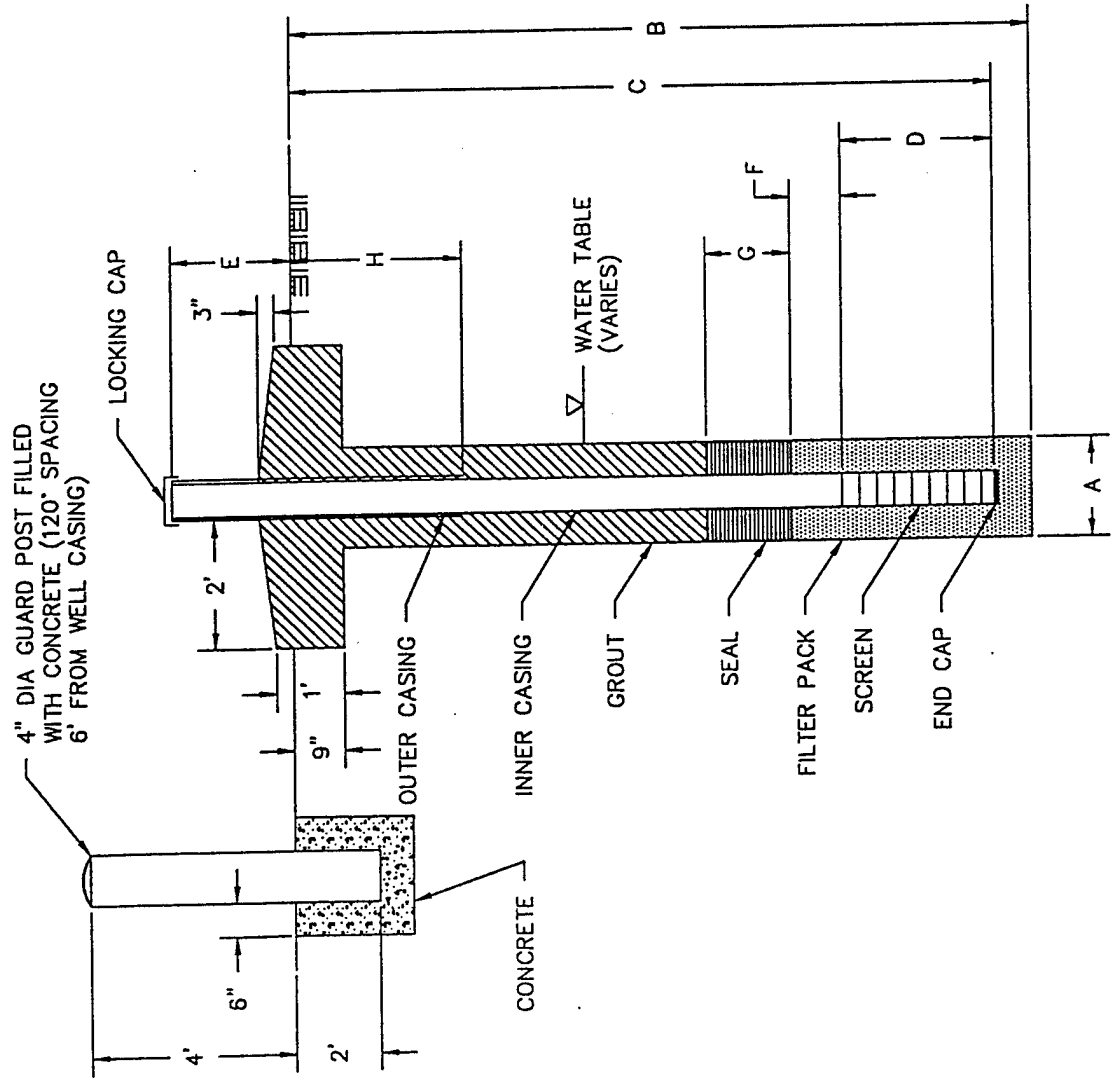
H	CASING DEPTH	4 FEET
-	CASING DIAMETER	6 INCHES
-	CASING MATERIAL	STEEL

OTHER INFORMATION

-	GROUT MATERIAL	NEAT CEMENT
-	SURFACE SEAL	PORTLAND CONCRETE
-	DRILLING METHOD	-HSA
-	DRILLER	-TRAUT
-	INNER CASING ELEV.	-1151.97 FEET
-	DEPTH TO WATER	-17.5 FEET
-	DATE DRILLED	-6-09-93
-	-	-
-	PROJECT NAME	-MNARNG
-	PROJECT LOCATION	-CAMP RIPLEY: BLDG. U-3

MONITORING WELL MW-2 SCHEMATIC

NOT TO SCALE



BOREHOLE INFORMATION

A BOREHOLE DIAMETER	22 FEET
B BOREHOLE DEPTH	22 FEET
C WELL DEPTH	22 FEET

SCREEN INFORMATION

D SCREEN LENGTH	10 FEET
SCREEN DIAMETER	2 INCHES
SLOT SIZE	0.10 INCHES
MATERIAL	PVC
SCREENED INTERVAL	12 TO 22 FEET

INNER CASING INFORMATION

CASING DIAMETER	2 INCHES
CASING MATERIAL	PVC
STICK UP HEIGHT	2 FEET

FILTER PACK INFORMATION

F DIST. ABOVE SCREEN	2 FEET
FILTER PACK MATERIAL	# 30 RED FLINT SAND

SEAL INFORMATION

G SEAL THICKNESS	2 FEET
SEAL MATERIAL	BENTONITE CHIPS

OUTER CASING INFORMATION

H CASING DEPTH	4 FEET
CASING DIAMETER	6 INCHES
CASING MATERIAL	STEEL

OTHER INFORMATION

GROUT MATERIAL	NEAT CEMENT
SURFACE SEAL	PORTLAND CONCRETE
DRILLING METHOD	HSA
DRILLER	TRAUT
INNER CASING ELEV.	-1151.93 FEET
DEPTH TO WATER	-16.5 FEET
DATE DRILLED	-6-10-93
PROJECT NAME	MNARNG
PROJECT LOCATION	CAMP RIPLEY: BLDG. U-3

MONITORING WELL MW-4 SCHEMATIC

NOT TO SCALE

BOREHOLE INFORMATION

A	BOREHOLE DIAMETER	INCHES
B	BOREHOLE DEPTH	27 FEET
C	WELL DEPTH	23 FEET

SCREEN INFORMATION

D	SCREEN LENGTH	10 FEET
E	SCREEN DIAMETER	2 INCH
F	SLOT SIZE	0.010 INCH
G	MATERIAL	PVC
H	SCREENED INTERVAL	13 TO 23 FEET

INNER CASING INFORMATION

I	CASING DIAMETER	2 INCH
J	CASING MATERIAL	PVC

FILTER PACK INFORMATION

K	DIST. ABOVE SCREEN	2 FEET
L	FILTER PACK MATERIAL	# 30 RED FLINT SAND

SEAL INFORMATION

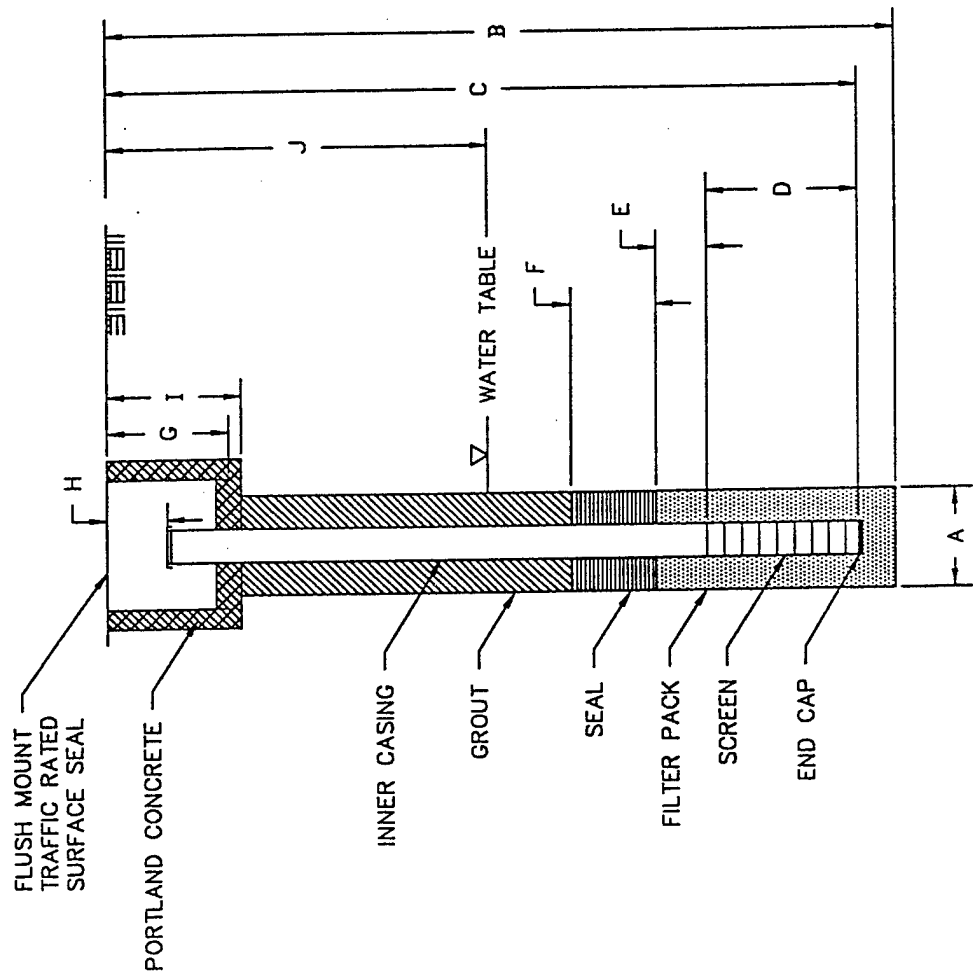
M	SEAL THICKNESS	2 FEET
N	SEAL MATERIAL	BENTONITE CHIPS

SURFACE SEAL INFORMATION

O	SEAL DEPTH	12 INCHES
P	SEAL DIAMETER	8 INCHES
Q	CASING MATERIAL	STEEL
R	INNER CASING DEPTH	INCHES
S	SURFACE EXCAVATION	18 INCHES

OTHER INFORMATION

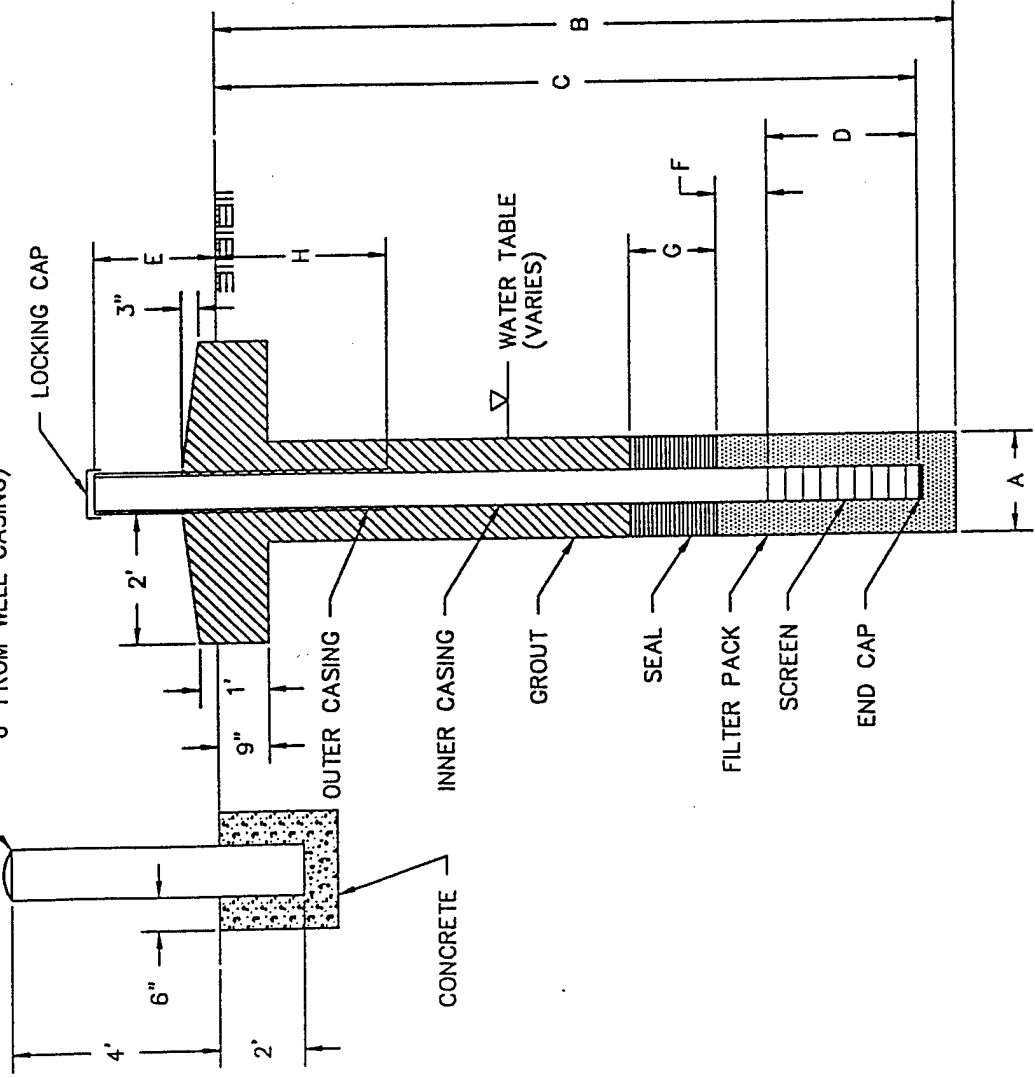
T	GROUT MATERIAL	NEAT CEMENT
U	SURFACE SEAL	PORTLAND CONCRETE
V	DRILLING METHOD	HOLLOW STEM AUGER
W	DRILLER	PAT BARR/TRAUT
X	INNER CASING ELEVATION	1148.58
Y	DEPTH TO WATER	APPROXIMATELY 14 FEET
Z	DATE DRILLED	8-11-93
AA	PROJECT NAME	MNARNG
AB	PROJECT LOCATION	CAMP RIPLEY BLDG.U-3



MONITORING WELL MW-5 SCHEMATIC

NOT TO SCALE

4" DIA GUARD POST FILLED
WITH CONCRETE (120" SPACING
6' FROM WELL CASING)



BOREHOLE INFORMATION

A BOREHOLE DIAMETER	
B BOREHOLE DEPTH	72 FEET
C WELL DEPTH	52 FEET

SCREEN INFORMATION

D SCREEN LENGTH	5 FEET
- SCREEN DIAMETER	2 INCHES
- SLOT SIZE	0.10 INCHES
- MATERIAL	STAINLESS STEEL
- SCREENED INTERVAL	47 TO 52 FEET

INNER CASING INFORMATION

- CASING DIAMETER	2 INCHES
- CASING MATERIAL	STEEL
E STICK UP HEIGHT	2 FEET

FILTER PACK INFORMATION

F DIST. ABOVE SCREEN	10 FEET
- FILTER PACK MATERIAL	# 30 RED FLINT SAND

SEAL INFORMATION

G SEAL THICKNESS	2 FEET
- SEAL MATERIAL	BENTONITE CHIPS
- LOWER SEAL	BENTONITE SEAL: 64' - 66'

OUTER CASING INFORMATION

H CASING DEPTH	4 FEET
- CASING DIAMETER	4 INCHES
- CASING MATERIAL	STEEL

OTHER INFORMATION

- GROUT MATERIAL	NEAT CEMENT
- SURFACE SEAL	- PORTLAND CONCRETE
- DRILLING METHOD	- HSA
- DRILLER	- TRAUT
- INNER CASING ELEV.	- 1151.39 FEET
- DEPTH TO WATER	- 17 FEET
- DATE DRILLED	- 8-13-93
-	-
- PROJECT NAME	- MNARNG
- PROJECT LOCATION	- CAMP RIPLEY: BLDG. U-3

MONITORING WELL MW-8 SCHEMATIC

NOT TO SCALE

BOREHOLE INFORMATION

A	BOREHOLE DIAMETER	6.25 INCHES
B	BOREHOLE DEPTH	21 FEET
C	WELL DEPTH	19 FEET

SCREEN INFORMATION

D	SCREEN LENGTH	15 FEET
-	SCREEN DIAMETER	4 INCH
-	SLOT SIZE	0.010 INCH
-	MATERIAL	PVC
-	SCREENED INTERVAL	4 TO 19 FEET

INNER CASING INFORMATION

-	CASING DIAMETER	4 INCH
-	CASING MATERIAL	PVC

FILTER PACK INFORMATION

E	DIST. ABOVE SCREEN	2 FEET
-	FILTER PACK MATERIAL	# 30 RED FLINT SAND

SEAL INFORMATION

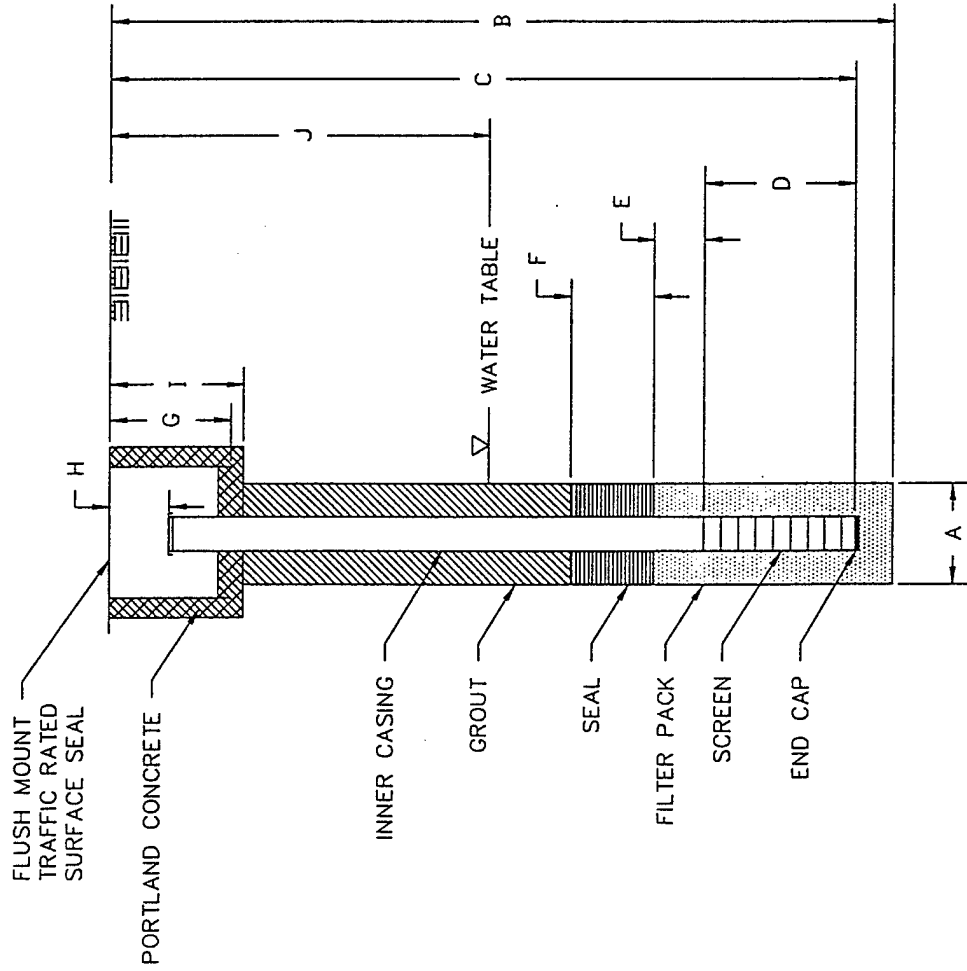
F	SEAL THICKNESS	1 FOOT
-	SEAL MATERIAL	BENTONITE CHIPS

SURFACE SEAL INFORMATION

G	SEAL DEPTH	12 INCHES
-	SEAL DIAMETER	24 INCHES
-	CASING MATERIAL	STEEL
H	INNER CASING DEPTH	6 INCHES
I	SURFACE EXCAVATION	18 INCHES

OTHER INFORMATION

-	GROUT MATERIAL	NEAT CEMENT
-	SURFACE SEAL	PORTLAND CONCRETE
-	DRILLING METHOD	HOLLOW STEM AUGER
-	DRILLER	TRAUT HYDROTECH
-	INNER CASING ELEVATION	N/A
J	DEPTH TO WATER	APPROXIMATELY 16 FEET
-	DATE DRILLED	3-3-94
-	-	-
-	-	-
-	PROJECT NAME	MNARNG
-	PROJECT LOCATION	CAMP RIPLEY BLDG.U-3



EXTRACTION VENT EV-1 SCHEMATIC

NOT TO SCALE

BOREHOLE INFORMATION

A	BOREHOLE DIAMETER	4.25 INCHES
B	BOREHOLE DEPTH	22 FEET
C	WELL DEPTH	22 FEET

SCREEN INFORMATION

D	SCREEN LENGTH	12 FEET
	SCREEN DIAMETER	2 INCH
	SLOT SIZE	0.010 INCH
	MATERIAL	PVC
	SCREENED INTERVAL	10 TO 22 FEET

INNER CASING INFORMATION

	CASING DIAMETER	2 INCH
	CASING MATERIAL	PVC

FILTER PACK INFORMATION

E	DIST. ABOVE SCREEN	2 FEET
	FILTER PACK MATERIAL	# 30 RED FLINT SAND

SEAL INFORMATION

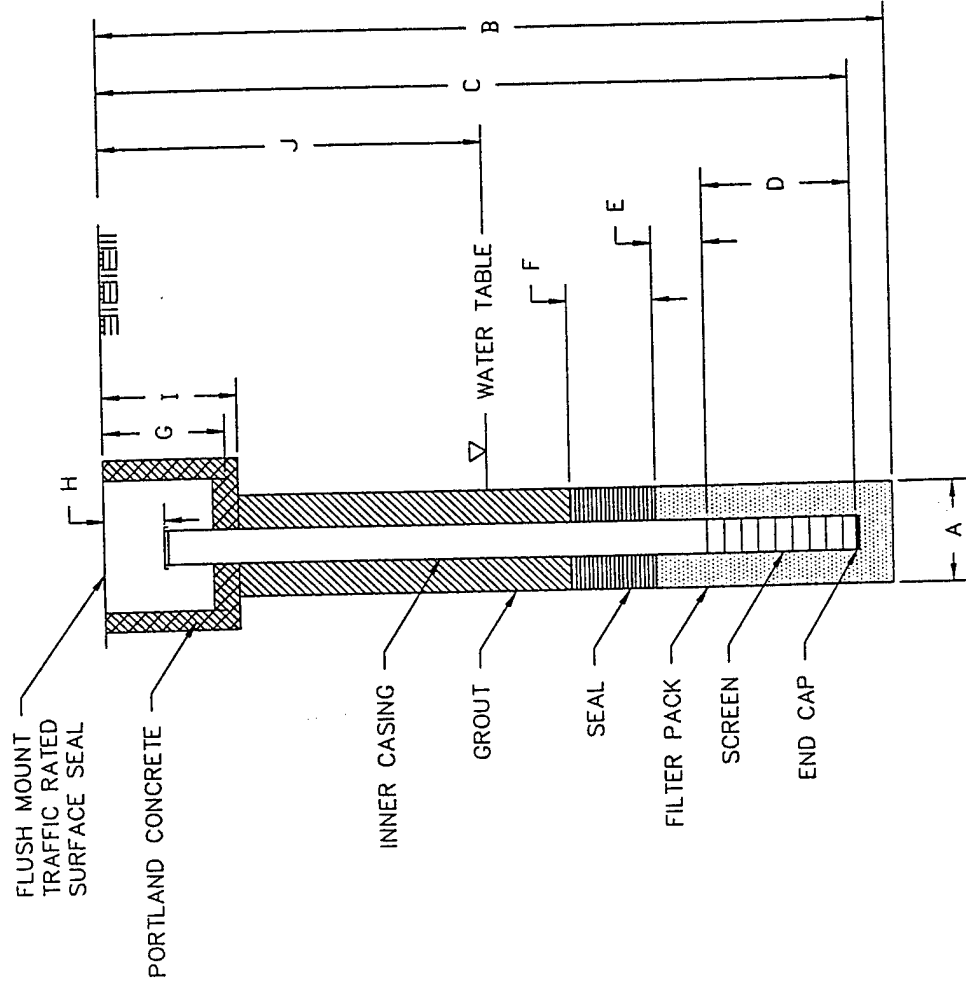
F	SEAL THICKNESS	2 FEET
	SEAL MATERIAL	BENTONITE CHIPS

SURFACE SEAL INFORMATION

G	SEAL DEPTH	12 INCHES
	SEAL DIAMETER	24 INCHES
	CASING MATERIAL	STEEL
H	INNER CASING DEPTH	6 INCHES
I	SURFACE EXCAVATION	18 INCHES

OTHER INFORMATION

	GROUT MATERIAL	NEAT CEMENT
	SURFACE SEAL	PORTLAND CONCRETE
	DRILLING METHOD	HOLLOW STEM AUGER
	DRILLER	TRAUT HYDROTECH
	INNER CASING ELEVATION	N/A
J	DEPTH TO WATER	APPROXIMATELY 17 FEET
	DATE DRILLED	3-3-94
		-
		-
	PROJECT NAME	MNARNG
	PROJECT LOCATION	CAMP RIPLEY BLDG.U-3



MONITORING VENT MV-1 SCHEMATIC

NOT TO SCALE

ATTACHMENT C

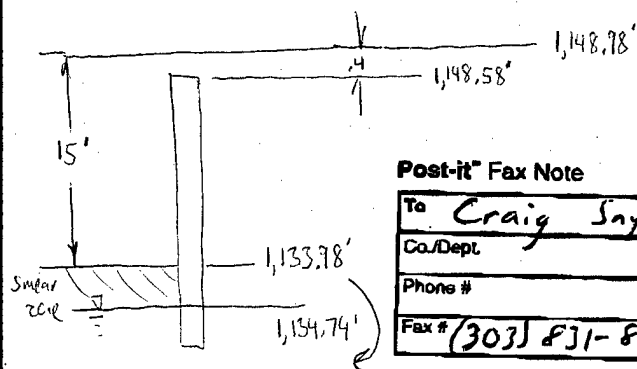
**GROUNDWATER ELEVATIONS AND
ESTIMATED "SMEAR ZONE" ELEVATION**

Bldg U-3 Camp Ripley

GROUND WATER ELEVATION

WELL #	23 NOV 93	27 OCT 94	26 JAN 95	20 APR 95	19 JUL 95	1 MAR 96
MW #1	1134.00	1135.80	1134.92	1135.17	1136.40	1135.03
→ MW #3	1133.63	1135.28	1134.40	1134.70	1135.89	1134.57
→ MW #4	1133.44	1135.34	1134.49	1134.75	1135.97	1134.63
→ MW #5	1133.67	1135.46	1134.54	1134.76	1135.99	1134.74
MW #6	1132.91	1135.12	1134.32	1134.62	1135.81	1133.52
MW #2	1133.92				1136.16	
MW #7	1133.09				1135.85	
MW #8	1133.50				1135.94	
MW #9	1132.27				1135.09	
MW #10	1132.53				1135.17	

MW-5:



Post-it Fax Note 7671		Date 25 Apr 96	# of pages 1
To Craig Snyder		From Larry Raring	
Co/Dept		Co. AN MRC	
Phone #		Phone #	
Fax # (303) 831-8208		Fax # 320-632-7473	

Notes by John Ratz on 4-26-96:

Well	Groundwater Elevation on 1 March 1996 (ft)	Inner Casing Elevation (ft)	Distance from top of Inner Casing to Ground (ft)	Distance from ground to top of "Smear Zone"	Smear Zone Above GW Table
MW-3 (stickup)	1,134.57	1,151.54	2.5	NA, clean hole	-
MW-4 (stickup)	1,134.63	1,151.93	2	NA, clean hole	-
MW-5 (stickup)	1,134.74	1,148.58	-.4 feet (approximate)	15'	0

* Smear zone at MW-5 begins at approximately 1,134.0 feet above msl (top of smear zone). Therefore, the smear zone has been entirely underwater since 23 Nov 93, when only about a 4" thickness was above groundwater (and even this section was likely saturated given capillary action). No contamination exists in the vadose zone, so bioventing/SVE is inappropriate.