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Golder Associates Inc.
CONSULTING ENGINEERS

Industri-Plex
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SDMS # 230924

SDMS DocID 000230924

AQUIFER PUMPING TEST
INDUSTRI-PLEX SITE
WOBURN, MASSACHUSETTS

VOLUME 2 of 2

Prepared for:

Industri-Plex Site Remedial Trust
800 North Lindbergh Boulevard
St. Louis, Missouri

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December 1991

Project No.: 913-6744

GOLDER ASSOCIATES INC. • 20000 HORIZON WAY, SUITE 500, MT. LAUREL, NEW JERSEY 08054 • TELEPHONE (609) 273-1110 • FACSIMILE (609) 273-0778

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VOLUME 2

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APPENDIX A

Correspondence Modifying Pumping Test Work Plan

INDUSTRI-PLEX SITE

REMEDIAL TRUST

36 COMMERCE WAY
WOBURN, MA 01801

September 5, 1991

United States Environmental Protection Agency
HRS-CAN3, JFK Federal Building
90 Canal Street
Boston, MA 02203-2211

Attention: Mr. Joseph DeCola

RE: INDUSTRI-PLEX SITE, WOBURN, MASS.
AQUIFER PUMPING TEST

Gentlemen:

Following your approval of the Work Plan for the above test we have commenced drilling activities on site. As anticipated in the Work Plan, the proximity of overhead power lines has made it necessary to revise the location of extraction well E5 and the associated piezometers (see enclosed plan). The purpose of this letter is to advise you of these changes and to inform you of our interpretation of other elements of the Work Plan. As you appreciate, we have several field programs in progress on the site and we are proceeding on the basis described below in order to maintain the overall schedule. Please contact us promptly if further discussion of these matters is required.

1. Extraction well E5 and piezometers P1, P2, P4 and P8 have been offset approximately 40 feet in a northeasterly direction.

2. Piezometer P6 has been moved to the northeast approximately 100 feet maintaining its original orientation with respect to the extraction well. The revised location of this piezometer is also affected by the presence of sewer pipes east of the railroad lines. The hydrogeologic function of this piezometer is maintained by preserving its orientation relative to the extraction system and the new location is approximately 50 feet closer to the extraction well so that a larger response is expected during pumping.

3. Two alternate locations are being considered for piezometer cluster P3. The preferred location is within the MBTA right-of-way in between the MBTA tracks and two sewer lines. We understand that MBTA requires that drilling in their right-of-way must be performed

at a distance from the nearest track exceeding the height of the drilling rig. Preliminary measurements in the field indicate that there is sufficient horizontal clearance for drilling at this location. The alternate location is further to the northeast along the northern boundary of Boston Edison Right-of-way No. 9, east of the sewer lines. A final decision on location will be made in the field following further discussion with MBTA. Either of the proposed locations maintains the hydrogeologic function of this cluster to examine the aquifer and bedrock responses in an area where the aquifer is thin.

4. Piezometer P7 has been moved to the east north east approximately 120 feet to avoid power lines and physical access restraints. This location maintains the hydrogeologic function of this piezometer to examine the aquifer response in an area where the aquifer is thin.

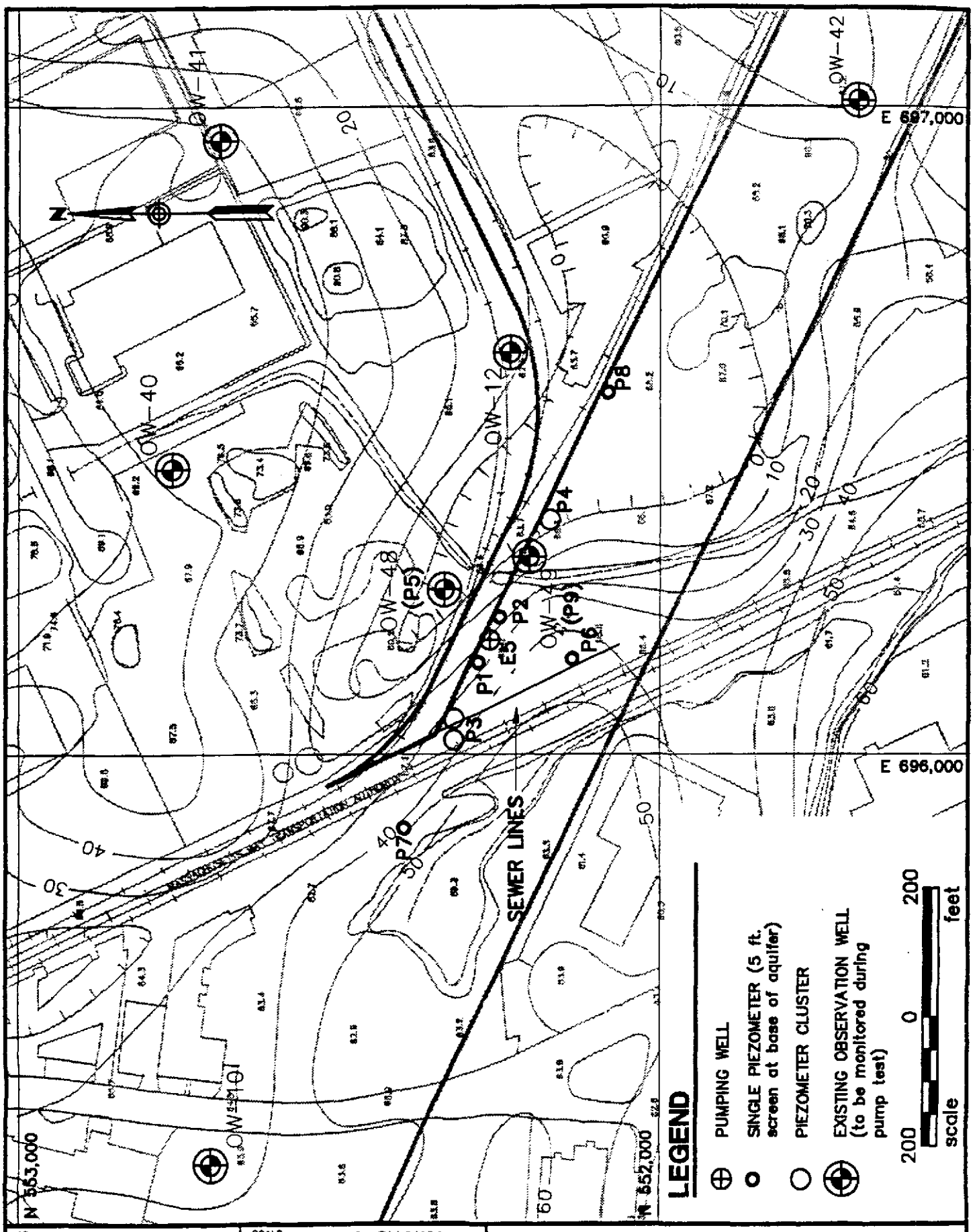
5. Additional observation wells were installed in the area of the pumping test as part of the recent Arsenic Pit-Chromium Lagoon hydrogeologic investigation. These wells were not shown on the plan included in the Aquifer Pumping Test Work Plan and in some cases the well locations approximately correspond to proposed piezometers. We therefore wish to use OW-48 to serve as Piezometer P5 and OW-49 to serve as Piezometer P9. Both wells have 10 foot screens which are located in the most permeable zone (based on visual assessment) close to the base of the Outwash Sand aquifer. The plan locations of these wells and their screen depths are such that they will fulfill the same hydrogeologic functions as the planned piezometers.

6. We plan to decontaminate the drilling rig and tools between piezometer holes by brushing off all loose soil. Soil will be collected with the cuttings at the drilling site, containerized and transported to the decon area. We consider this to be a technically acceptable procedure since the piezometers will not be used to measure water quality. The drilling rig and all tools will be decontaminated by steam cleaning at the decon pad prior to drilling the pilot hole and installing the extraction well at location E5.

Sincerely,

David L. Baumgartner
Project Manager

cc: P. S. Finn - Golder
T. D. Kling - ISRT
J. Naparstek - MDEP
A. Ostrofsky - NUS
W. L. Smull - G4WM
B. S. Yare - F2WJ



JOB No.: 903-6400	SCALE: AS SHOWN	PUMPING WELL AND PIEZOMETER LAYOUT	
DRAWN: MRM	DATE: 09/05/91		
CHECKED:	DWG. No.: 1MA01-664		
Golder Associates		INDUSTRI-PLEX SITE REMEDIAL TRUST	FIGURE 1

GOLDER ASSOCIATES INC.
20000 Horizon Way, Suite 500
Mt. Laurel, NJ 08054

Fax: 609-273-0778 Tel: 609-273-1110

FACSIMILE TRANSMISSION

DATE TRANSMITTED:	October 10, 1991	Project No.: 913-6744
TO:	JOE DECOLA,	USEPA
	JAY NAPARSTEK,	MDEP
	ARNIE OSTROFSKY,	NUS
	DAVE BAUMGARTNER	ISRT
	MIKE LIGHT,	ISRT
FROM:	P. STEPHEN FINN	
SUBJECT:	INDUSTRI-PLEX SITE, WOBURN, MA AQUIFER PUMPING TEST	

Total Number of Pages (Including Cover Page): 4
****

As requested, we set out below details of how we expect to conduct the Aquifer pumping test:

1. Pumping Rate

We will run the test at a constant discharge rate of 120 gpm. We expect to be able to run the test for 72 hours although the final duration may be limited by effluent chemistry and precipitation events as discussed further below. A 72 hour test at 120 gpm will produce 518,400 gals of effluent.

2. Effluent Treatment and Discharge

All groundwater extracted from the well will be treated by carbon adsorption prior to discharge. Treated effluent will be discharged at two locations, into the southern end of Halls Brook Holding Area (HBHA) as discussed in the Work Plan, and at the proposed wetland mitigation area on Site. The flow rate from the well and the discharge rate to HBHA will be recorded with separate flow meters. The discharge rate on site will then be calculable by difference. Pumping equipment will be available to discharge a maximum of 120 gpm on Site and 120 gpm to HBHA.

It is anticipated that water discharged on Site in the proposed mitigation area will percolate back into groundwater. We have estimated the available capacity of this area from the site topographic map and the current surface water level determined by reference to the known elevation of a monitoring well casing in the area. Based on a 1 foot increase in water level in the mitigation area, we

calculate that around 227,000 gals of water may be contained in this area. This calculation does not consider percolation or precipitation effects. Regular visual inspections will be made during discharge in this area to assess if the water is being adequately contained. In addition, 100,000 gals of tank storage is available for use on site, if necessary.

The discharge rate to HBHA will be regulated by effluent chemistry and will be maximized. Based on the above storage volumes, an average discharge rate to HBHA of 44 gpm is required throughout the test to achieve a 72 hour duration at 120 gpm total flow. Such a discharge rate is not inconsistent with the currently available data for **untreated** effluent discussed below, and treatment is expected to lead to higher permissible discharge rates.

3. Discharge Limits

Discharges to Halls Brook Holding Area will be regulated by effluent chemistry in the following manner. Effluent samples will be collected on an hourly basis from a port immediately downstream of the carbon unit. Treated effluent will be analyzed on site for Benzene, Toluene, Arsenic, Chromium, Ammonia (un-ionized and total), Copper, Iron and Zinc. The turnaround time for a complete suite of tests is expected to be on the order of 1 to 2 hours. The following ambient water quality criteria will be used:

Benzene	5.3	mg/l (=ppm)
Toluene	17	mg/l
Arsenic	0.36	mg/l
Chromium	1.7	mg/l
Un-ionized Ammonia	0.026	mg/l
Total Ammonia	30	mg/l
Copper	0.018	mg/l
Iron	1.0	mg/l
Zinc	0.12	mg/l

For each of the above chemicals a maximum discharge rate will be calculated using the following equation, derived from the formula presented in the Work Plan, and based on the recently measured flow rate in HBHA of 1460 gpm:

$$\text{Discharge rate} = \frac{1460 \times \text{Ambient criteria}}{(\text{Effluent level} - \text{Ambient Criteria})}$$

The actual discharge rate will be determined by whichever chemical gives the lowest permissible discharge rate.

The presently available chemical data (5 samples) is for **untreated** effluent taken from the well and storage tanks. The data ranges and corresponding permissible discharge rates are as follows:

	Effluent Level mg/l	Discharge Rate
Benzene	<0.001 - 0.003	Unlimited
Toluene	<0.001 - 0.016	Unlimited
Arsenic	<0.05 - 0.09	Unlimited
Chromium	<0.1	Unlimited
Un-ionized Ammonia	<0.05 - 0.98	40 - 1582 gpm
Total Ammonia	48 - 96	664 - 2433 gpm
Copper	<0.05 - 0.65	42 - 821 gpm
Iron	2.9 - 29	52 - 768 gpm
Zinc	0.15 - 42	4 - 5840 gpm

The discharge rate to HBHA will be reviewed for each set of effluent chemistry data. Discharge rates will not be increased or decreased until two sets of confirmatory data are available for the most critical chemical. In the event of a likely change in discharge rate, a second confirmatory test for the most critical chemical will be executed as quickly as the sampling and test method allows. For practical reasons, the discharge rate to HBHA will not normally be varied in smaller increments than 10 gpm.

The discharge rate on Site will be the balance of the total flow which cannot be discharged to HBHA. The tank storage will be used as a contingency reserve in the event that on Site capacity is reached.

Test termination will occur at 72 hours or at an earlier time if the storage capacity on Site and in tanks is full and the effluent chemistry does not allow discharge of the full flow to HBHA. In the event of premature test termination, three consecutive confirmatory results would be required before terminating the test.

4. Schedule

Our present schedule is to complete the discharge pumping and piping arrangements on Friday, October 11 and run the system for a short period (around 30 - 60 minutes) to check the discharge operation and obtain a further sample of treated groundwater towards the end of the pumping period. Effluent will be discharged on Site after treatment. Chemical analyses of the treated effluent will be run on Friday and, based on these results, we will propose an initial discharge rate to HBHA. We will fax the test results and our proposed initial discharge rate to HBHA to ISRT and the Agencies as soon as possible. The main constant rate discharge test will be run starting on Tuesday morning.

In order for us to proceed on this basis we will require written direction from the Agencies which should specifically address the on Site discharge.

Please call us promptly if this does not accurately reflect your requirements.

Regards

Steve Finn

cc. Bob Glazier, Golder
Randy White, Golder

****

PLEASE MARK TIME AFTER TRANSMISSION: Sent at 12.10 am/pm

By Bf
(Initials of Sender)

GOLDER ASSOCIATES INC.
20000 Horizon Way, Suite 500
Mt. Laurel, NJ 08054

Fax: 609-273-0778 Tel: 609-273-1110

FACSIMILE TRANSMISSION

DATE TRANSMITTED:	October 14, 1991	Project No.: 913-6744
TO:	JOE DECOLA,	USEPA
	JAY NAPARSTEK,	MDEP
	ARNIE OSTROFSKY,	NUS
	DAVE BAUMGARTNER	ISRT
	MIKE LIGHT,	ISRT
FROM:	P. STEPHEN FINN	
SUBJECT:	INDUSTRI-PLEX SITE, WOBURN, MA AQUIFER PUMPING TEST	

Total Number of Pages (Including Cover Page): 1
****

Further to our fax dated October 11, we set out below details of the chemistry of a treated effluent sample taken towards the end of a short trial pumping period on Friday October, 11:

Benzene	<0.001	mg/l (=ppm)
Toluene	<0.001	mg/l
Arsenic	<0.1	mg/l
Chromium	<0.5	mg/l
Un-ionized Ammonia	<0.1	mg/l
Total Ammonia	105	mg/l
Copper	<0.1	mg/l
Iron	3.6	mg/l
Zinc	4.5	mg/l

Based on these results, Zinc is the critical constituent and we propose an initial discharge rate to HBHA of 40 gpm. As noted previously, the balance of the flow (80 gpm) will be discharged on Site in the proposed wetland mitigation area.

In order for us to proceed with the planned test starting tomorrow (Tuesday) we will require written direction from the Agencies today. The Agencies confirmation to proceed should specifically address the on Site discharge.

Regards

Steve Finn

****

PLEASE MARK TIME AFTER TRANSMISSION: Sent at 4:00 am/pm

By LM
(Initials of Sender)

INDUSTRI-PLEX SITE

REMEDIAL TRUST

36 COMMERCE WAY
WOBURN, MA 01801

October 15, 1991

Joseph N. DeCola
Remedial Project Manager
Waste Management Division
U. S. EPA-I
J. F. K. Federal Bldg., HRS-CAN3
Boston, MA 02203-2211

Dear Joe:

This will confirm our telephone conversation this morning, October 15, 1991, at which time you authorized the IRST to begin the 72-hour Aquifer Pump Test as described in the Golder fax dated October 10, 1991 (sent October 11, 1991). This modification to the approved Work Plan called for diverting a portion of the treated effluent to the proposed mitigation area on-site for storage and percolation back into the groundwater. This change is due to the higher than expected constituent levels of the tested chemicals from the pumping well requiring a limiting of the flow rate into Halls Brook Holding Area.

In addition to the testing called out in the modified plan, untreated samples of the well effluent will be taken every 12 hours for analysis.

Sincerely,

D L Baumgartner

David L. Baumgartner
Project Manager

cc: P. S. Finn - GAI
T. D. Kling - ISRT
M. A. Leon - W&S
D. M. Light - G4WM
J. W. Moorman - CW&T
Jay Naparstek - MDEP
Arnie Ostrofsky - NUS
E. J. Propp - ICI
B. S. Yare - F2WJ

TEL. 617-932-0509
FAX 617-932-9560

APPENDIX B

Geologic Logs

PROJECT: ISRT/PUMP TEST
PROJECT LOCATION: MASS.
PROJECT NUMBER: 913-6744

RECORD OF BOREHOLE E-5 (PILOT)

BORING DATE: 09-11-91
BORING LOCATION: N: 552,280.7 E: 696,172.0

SHEET: 1 OF 2
DATUM: NGVD

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT ■ (20 40 60 80) / WATER CONTENT, PERCENT Wp O W Wl (20 40 60 80)	PIEZOMETER OR STANDPIPE INSTALLATION
0					64.00							
	4-1/4" HSA	0.0-7.0 ft. Loose to compact, moderate to yellowish brown, m-f SAND, little silt, trace gravel, traces of roots (SP-SM). <FILL>	SP-SM		0.00	S-1	DO	3,4,6,8	10	50		
						S-2	DO	14,12,12,9	24	45		
5						S-3	DO	12,10,10,9	20	40		
					57.00	S-4	DO	2,1,1,1	2	100		
		7.0-20.5 ft. Very soft to firm, black to dark brown, silty CLAY to silty ORGANIC CLAY, little to some f-sand, occassional to frequent roots and root mass, slight hydrogen sulfide odor (CL to OH). <POSSIBLE FILL OR PEAT> Water encountered at approx. 8.0 ft. below ground surface.	CL to OH		7.00	S-5	DO	12,11,9,15	20	13		
10						S-6	DO	1,4,1,1	5	45		
						S-7	DO	2,1,1,1	2	100		
						S-8	DO	1,1,1,1	2	45		
15						S-9	DO	1,1,1,3	2	100		
						S-10	DO	1,0,1,2	1	100		
20					43.50	S-11	DO	2,6,13,8	19	75		
		20.5-27.5 ft. Compact to very dense, medium gray, c-f SAND, some gravel, trace silt (SW) <POSSIBLE FILL OR OUTWASH SAND>	SW		20.50	S-12	DO	13,21,36,45	57	35		
25						S-13	DO	4,20,41,50	81	40		
						S-14	DO	21,20,13,10	23	40		
					36.50							
		27.5-31.5 ft. Compact to dense, medium gray to moderate brown c-f SAND, little silt, trace gravel (SP-SM) <OUTWASH SAND>	SP-SM		27.50	S-15	DO	6,26,21,20	49	30		
30						S-16	DO	3,10,10,11	20	30		
					32.50							
		31.5-52.6 ft. Loose to dense, moderate to yellowish brown, c-f SAND, little to some gravel, trace to little silt, *occassional medium gray fine sand lenses* (SP to SP-SM). <OUTWASH SAND>	SP to SP-SM		31.50	S-17	DO	12,17,20,23	37	75		
35						S-18	DO	8,23,20,20	43	75		
						S-19	DO	13,13,9,11	22	65		
						S-20	DO	5,5,4,7	9	25		
		CONTINUED ON NEXT PAGE										
40												

DRILL RIG: ATV MOBILE B-53
DRILLING CONTRACTOR: D.L. MAHER
DRILLER: J. GRAGLIA

Golder Associates

LOGGED: RJI/RMG
CHECKED: RMG/RJI
DATE: 09-30-91

PROJECT: ISRT/PUMP TEST

PROJECT LOCATION: MASS.

PROJECT NUMBER: 913-6744

RECORD OF BOREHOLE E-5 (PILOT)

BORING DATE: 09-11-91

BORING LOCATION: N: 552,280.7 E: 696,172.0

DATUM: NGVD

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT ■ (20 40 60 80) / WATER CONTENT, PERCENT Wp ⊢—○W—⊣ Wl (20 40 60 80)	PIEZOMETER OR STANDPIPE INSTALLATION
40	4-1/4" HSA	31.5-52.6 ft. Loose to dense, moderate to yellowish brown, c-f SAND, little to some gravel, trace to little silt, occassional medium gray fine sand lenses (SP to SP-SM) <OUTWASH SAND>	SP to SP-SM		24.00 / 40.00	S-21	DO	8,7,7,8	14	30		
						S-22	DO	8,6,5,5	11	25		
45						S-23	DO	4,4,4,4	8	20		
						S-24	DO	----	-	90		
						S-25	DO	6,4,5,8	9	100		
50						S-26	DO	4,8,10,15	18	85		
					11.40 / 52.60	S-27	DO	16,50,100	100	100		
		52.6-54.1 ft. Very dense, medium to olive gray, c-f SAND and GRAVEL, little to some silt (SM). <GLACIAL TILL> (Possible weathered bedrock at refusal)	SM		9.90 / 54.10	S-28	DO	92,100/.1'	>100	100		
55		BORING TERMINATED AT 54.1 FT. BELOW GROUND SURFACE.										
60												
65												
70												
75												
80												

DRILL RIG: ATV MOBILE B-53

DRILLING CONTRACTOR: D.L. MAHER

DRILLER: J. GRAGLIA

Golder Associates

LOGGED: RJI/RMG

CHECKED: RMG/RJI

DATE: 09-30-91

PROJECT: ISRT/PUMP TEST
PROJECT LOCATION: MASS.
PROJECT NUMBER: 913-6744

RECORD OF BOREHOLE P-1

BORING DATE: 09-13-91
BORING LOCATION: N: 552,297.0 E: 696,131.2

SHEET: 1 OF 2
DATUM: NGVD

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT ■ (20 40 60 80) / WATER CONTENT, PERCENT Wp ⊢—○W—⊣ Wl (20 40 60 80)	PIEZOMETER OR STANDPIPE INSTALLATION
					64.40							
0	4-1/4" HSA	0.0-14.0 ft. Very loose to loose, deep purplish red, c-f SAND, little silt (SP-SM). <FILL>	SP-SM		0.00	S-1	DO	2,3,2,3	5	75	■	
5						S-2	DO	1,0,1,1	1	100	■	
		Water encountered at approx. 9.0 ft. below ground surface.										
10						S-3	DO	1,1,1,1	2	100	■	
					50.40							
		14.0-17.5 ft. Very soft, dark brown to black SILT, some sand, possible hide residue, root mass (CL). <POSSIBLE FILL>	CL		14.00							
15						S-4	DO	1,1,1,1	2	100	■	
					46.90							
		17.5-22.0 ft. Soft, pale olive gray, clayey SILT, little f sand, occasional roots (CL). <POSSIBLE FILL>	CL		17.50							
20						S-5	DO	0,1,1,4	2	100	■	
					42.40							
		22.0-35.0 ft. Dense, pale yellowish brown to pale olive gray, c-f SAND and GRAVEL, little silt (SP-SM). <POSSIBLE FILL>	SP-SM		22.00							
25						S-6	DO	12,17,20,28	37	100	■	
						S-6B	DO	1,25,37,30	62	25	■	
30						S-7	DO	8,21,27,19	48	20	■	
						S-8	DO	1,3,23,25	26	30	■	
					29.40							
35		35.0-52.0 ft. Compact, medium brown to yellowish brown, c-f SAND, trace silt, trace to little gravel, occassional dark gray to reddish gray silt lens (0.2 ft. thick) (SP). <OUTWASH SAND>	SP		35.00	S-9	DO	8,5,14,10	19	45	■	
		CONTINUED ON NEXT PAGE			24.40							
40					40.00							

DRILL RIG: BRAT 22R
DRILLING CONTRACTOR: D.L. MAHER
DRILLER: J. QUINN

Golder Associates

LOGGED: DSL
CHECKED: RMG/RJI
DATE: 09-30-91

PROJECT: ISRT/PUMP TEST

PROJECT LOCATION: MASS.

PROJECT NUMBER: 913-6744

RECORD OF BOREHOLE P-1

BORING DATE: 09-13-91

BORING LOCATION: N: 552,297.0 E: 696,131.2

SHEET: 2 OF 2

DATUM: NGVD

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT ■ (20 40 60 80) / WATER CONTENT, PERCENT Wp ⊢—○W—⊣ Wl (20 40 60 80)	PIEZOMETER OR STANDPIPE INSTALLATION
					24.40							
40	4-1/4" HSA	35.0-52.0 ft. Compact, medium brown to yellowish brown, c-f SAND, trace silt, trace to little gravel, occassional dark gray to reddish gray silt lens (0.2 ft. thick) (SP). <OUTWASH SAND>	SP		40.00	S-10	DO	1,2,16,30	18	25	■	
45						S-11	DO	5,6,9,10	15	52	■	
50					12.40	S-12	DO	8,11,18,21	29	80	■	
		52.0-53.4 ft. Compact olive gray GRAVEL and SAND, trace silt (GW).	GW		52.00							
		<TILL>			11.00 53.40	S-13	DO	100/.3'	>100	60		■
55		Auger refusal at 53.4 ft. <BEDROCK>										
		BORING TERMINATED AT 53.4 FT. BELOW GROUND SURFACE.										
60												
65												
70												
75												
80												

DRILL RIG: BRAT 22R

DRILLING CONTRACTOR: D.L. MAHER

DRILLER: J. QUINN

Golder Associates

LOGGED: DSL

CHECKED: RMG/RJI

DATE: 09-30-91

PROJECT: ISRT/PUMP TEST

PROJECT LOCATION: MASS.

PROJECT NUMBER: 913-6744

RECORD OF BOREHOLE P-2S

BORING DATE: 09-18-91

BORING LOCATION: N: 552,256.2 E: 696,217.0

SHEET: 1 OF 1

DATUM: NGVD

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT ■ (20 40 60 80) / WATER CONTENT, PERCENT Wp ⊢—o W—⊣ Wl (20 40 60 80)	PIEZOMETER OR STANDPIPE INSTALLATION
					65.20							
0		FOR SOIL DESCRIPTION SEE LOG FOR P-2D.			0.00							
5												
10												
15												
20												
25												
30												
35												
40												

DRILL RIG: BRATT 22R

DRILLING CONTRACTOR: D.L. MAHER

DRILLER: J. MORAN

LOGGED: DSL

CHECKED: RMG/RJI

DATE: 10-28-91

Golder Associates

PROJECT: ISRT/PUMP TEST

PROJECT LOCATION: MASS.

PROJECT NUMBER: 913-6744

RECORD OF BOREHOLE P-2I

BORING DATE: 09-19-91

BORING LOCATION: N: 552,256.8 E: 696,211.9

SHEET: 1 OF 1

DATUM: NGVD

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT ■ (20 40 60 80) / WATER CONTENT, PERCENT Wp ⊢—○W—⊣ Wl (20 40 60 80)	PIEZOMETER OR STANDPIPE INSTALLATION
0					65.20 / 0.00							
		FOR SOIL DESCRIPTION SEE LOG FOR P-2D.										
5												
10												
15												
20												
25												
30												
35												
40												

DRILL RIG: BRATT 22R

DRILLING CONTRACTOR: D.L. MAHER

DRILLER: J. MORAN

LOGGED: DSL

CHECKED: RMG/RJI

DATE: 10-28-91

Golder Associates

PROJECT: ISRT/PUMP TEST

PROJECT LOCATION: MASS.

PROJECT NUMBER: 913-6744

RECORD OF BOREHOLE P-2D

BORING DATE: 09-16-91

BORING LOCATION: N: 552,258.2 E: 696,212.2

SHEET: 1 OF 2

DATUM: NGVD

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT ■ (20 40 60 80) / WATER CONTENT, PERCENT Wp ⊢—○W—⊣ Wl (20 40 60 80)	PIEZOMETER OR STANDPIPE INSTALLATION
					65.50							
0	4-1/4" HSA	0.0-8.0 ft. Loose to compact, pale to dark yellowish brown c-f SAND, some gravel from 0.0-2.0 ft., trace silt (SP). <FILL>	SP		0.00	S-1	DO	5,10,12,20	22	25		
						S-2	DO	6,6,7,8	13	70		
5						S-3	DO	8,8,7,8	15	50		
						S-4	DO	4,3,2,3	5	50		
					57.50							
		8.0-9.35 ft. Firm, brown to black SILT, little m-f sand (ML).	ML		8.00	S-5	DO	2,9,20,27	29	80		
		<POSSIBLE FILL>			56.15							
10		9.35-14.0 ft. Compact to very dense, olive gray c-f SAND and GRAVEL, trace to little silt (SP to SP-SM). <POSSIBLE FILL> Water encountered at approx. 10.5 ft. below ground surface.	SP to SP-SM		9.35	S-6	DO	23,41,40,30	81	95		
						S-7	DO	35,20,10,15	30	80		
					51.50							
15		14.0-52.0 ft. Loose to very dense, yellowish brown to gray c-f SAND, trace to little gravel, trace silt (SP). <OUTWASH SAND>	SP		14.00	S-8	DO	12,14,13,13	27	25		
						S-9	DO	5,7,9,10	16	25		
20						S-10	DO	30,18,17,11	35	50		
						S-11	DO	9,6,7,8	15	20		
						S-12	DO	6,10,9,8	19	20		
25						S-13	DO	18,15,22,14	37	100		
						S-14	DO	13,9,11,12	20	60		
		(29.4-30.0 ft.) m-f SAND and SILT (SM).				S-15	DO	9,8,15,17	23	95		
30						S-16	DO	8,5,8,14	13	55		
						S-17	DO	6,9,10,13	19	55		
35						S-18	DO	6,11,13,17	24	80		
						S-19	DO	2,5,8,9	13	70		
						S-20	DO	10,11,12,18	23	80		
		CONTINUED ON NEXT PAGE										
40												

DRILL RIG: BRAT 22R

DRILLING CONTRACTOR: D.L. MAHER

DRILLER: J. MORGAN

Golder Associates

LOGGED: DSL

CHECKED: RMG/RJI

DATE: 09-30-91

PROJECT: ISRT/PUMP TEST

PROJECT LOCATION: MASS.

PROJECT NUMBER: 913-6744

RECORD OF BOREHOLE P-2D

BORING DATE: 09-16-91

BORING LOCATION: N: 552,258.2 E: 696,212.2

DATUM: NGVD

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT ■ (20 40 60 80) / WATER CONTENT, PERCENT Wp W Wl (20 40 60 80)	PIEZOMETER OR STANDPIPE INSTALLATION
					25.50							
40	4-1/4" HSA	14.0-52.0 ft. Loose to very dense, yellowish brown to gray c-f SAND, trace to little gravel, trace silt (SP). <OUTWASH SAND>	SP		40.00	S-21	DO	8,12,17,15	29	100		
						S-22	DO	9,9,8,8	17	95		
45						S-23	DO	4,5,5,5	10	70		
						S-24	DO	4,4,5,5	9	50		
						S-25	DO	5,35,43,15	78	50		
50						S-26	DO	1-15,17,23,35	40	75		
					13.50							
		52.0-56.0 ft. Dense to very dense yellowish brown to pale olive, c-f SAND and GRAVEL, trace silt (SP). <OUTWASH SAND>	SP		52.00	S-27	DO	10,39,66,54	>100	100		
55						S-28	DO	15,28,30,38	58	100		
					9.50							
		56.0-64.8 ft. Dense to very dense, yellowish brown to pale olive, c-f SAND, trace gravel, trace to little silt (SP to SP-SM). <OUTWASH SAND>	SP to SP-SM		56.00	S-29	DO	8,26,39,42	67	-		
						S-30	DO	8,25,24,33	49	80		
60						S-31	DO	10,27,28,30	55	100		
						S-32	DO	13,31,41,51	72	65		
					0.70							
65		64.8-66.0 ft. Very dense, olive gray clayey SILT, some m-f sand, trace gravel (ML/CL). <TILL>	ML/CL		64.80	S-33	DO	2,29,150/.4	>100	75		
					-0.50							
		Auger refusal at 66.0 ft. <BEDROCK>			66.00	S-34	DO	150/.2'	>100	0		
		BORING TERMINATED AT 66.0 FT. BELOW GROUND SURFACE.										
70												
75												
80												

DRILL RIG: BRAT 22R

DRILLING CONTRACTOR: D.L. MAHER

DRILLER: J. MORGAN

Golder Associates

LOGGED: DSL

CHECKED: RMG/RJI

DATE: 09-30-91

PROJECT: ISRT/PUMP TEST

PROJECT LOCATION: MASS.

PROJECT NUMBER: 913-6744

RECORD OF BOREHOLE P-3S

BORING DATE: 09-30-91

BORING LOCATION: N: 552,334.7 E: 696,039.3

SHEET: 1 OF 1

DATUM: NGVD

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT ■ (20 40 60 80) / WATER CONTENT, PERCENT Wp ⊢—○W—⊣ Wl (20 40 60 80)	PIEZOMETER OR STANDPIPE INSTALLATION
0		FOR SOIL DESCRIPTION SEE LOG FOR P-3D.			66.00 / 0.00							
5												
10												
15												
20												
25												
30												
35												
40												

DRILL RIG: ATV B-53

DRILLING CONTRACTOR: D.L. MAHER

DRILLER: J. GRAGLIA

Golder Associates

LOGGED: RMG

CHECKED: RMG/RJI

DATE: 10-28-91

PROJECT: ISRT/PUMP TEST
PROJECT LOCATION: MASS.
PROJECT NUMBER: 913-6744

RECORD OF BOREHOLE P-3D

BORING DATE: 09-18-91
BORING LOCATION: N: 552,339.0 E: 696,036.5

DATUM: NGVD

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT ■ (20 40 60 80) / WATER CONTENT, PERCENT Wp W Wl (20 40 60 80)	PIEZOMETER OR STANDPIPE INSTALLATION
					66.00							
0	4-1/4" ID HSA	0.0-8.4 ft. Loose to very loose, dark brown to dusky red, c-f SAND, trace to some silt, trace gravel, roots from 2.0-4.0 ft. (SP to SM). <FILL>	SP to SM		0.00							
						S-1	DO	4,4,3,4	7	95	■	
5												
		8.4-9.0 ft. Soft, black PEAT, some clayey silt (PT). <PEAT>	PT		57.60 / 57.00	S-2	DO	3,1,2,2	3	80	■	
10		9.0-13.6 ft. Dense, reddish-gray, c-f SAND and GRAVEL, trace to little silt (SP to SP-SM). <POSSIBLE FILL> Water encountered at 10.7 ft. below ground surface.	SP to SP-SM		9.00							
						S-3	DO	25,20,25,32	45	80	■	
		13.6-49.0 ft. Loose to very dense, gray to light olive brown to yellowish brown, c-f SAND, trace to and gravel, trace silt (SP). <OUTWASH SAND>	SP		52.40 / 13.60							
15												
						S-4	DO	17,20,44,28	64	50	■	
20												
						S-5	DO	7,9,7,12	16	85	■	
25												
						S-6	DO	7,4,5,10	9	60	■	
30												
						S-7	DO	20,25,22,15	47	60	■	
35												
						S-8	DO	8,14,12,11	26	50	■	
		CONTINUED ON NEXT PAGE.			26.00							
40					40.00							

DRILL RIG: ATV B-53
DRILLING CONTRACTOR: D.L. MAHER
DRILLER: J. GRAGLIA

Golder Associates

LOGGED: V. FOSTER
CHECKED: RMG/RJI
DATE: 10-10-91

PROJECT: ISRT/PUMP TEST

PROJECT LOCATION: MASS.

PROJECT NUMBER: 913-6744

RECORD OF BOREHOLE P-3D

BORING DATE: 09-18-91

BORING LOCATION: N: 552,339.0 E: 696,036.5

DATUM: NGVD

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT ■ (20 40 60 80) / WATER CONTENT, PERCENT Wp ⊢—○W—⊣ Wt (20 40 60 80)	PIEZOMETER OR STANDPIPE INSTALLATION
					26.00							
40	4-1/4" ID HSA	13.6-49.0 ft. Loose to very dense, gray to light olive brown to yellowish brown, c-f SAND, trace to and gravel, trace silt (SP). <OUTWASH SAND>	SP		40.00							
						S-9	DO	7,4,3,5	7	100	■	
45												
		Spoon refusal at 49.0 ft. <BEDROCK>			17.00	S-10	DO	9,70,130/.3	>100	38		■
					49.00							
50		NOTE: 4 inch casing driven to 53.0 ft. and 3 inch casing spun to 54.0 ft. until competent rock encountered. Casing cleared out with a roller bit. Begin coring at 54.3 ft. See RECORD OF DRILLHOLE P-3D for rock log.										
55												
60												
65												
70												
75												
80												

DRILL RIG: ATV B-53

DRILLING CONTRACTOR: D.L. MAHER

DRILLER: J. GRAGLIA

Golder Associates

LOGGED: V. FOSTER

CHECKED: RMG/RJI

DATE: 10-10-91

RECORD OF DRILLHOLE P-3D

PROJECT: ISRT/PUMP TEST
PROJECT NO: 913-6744
LOCATION: MASS.

BORING METHOD: NX CORE
DRILLING DATE: 09-27-91
DRILL RIG: B-57

DATUM: NGVD
COORDINATES N: 552,339.0
AZIMUTH: 000

REFERENCE ELEV: 66.0
E: 696,036.5
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slickensided, SM-Smooth, R-Rough, VR-V. Rough
CL-Clay, FE-Iron, UE-Uneven

DEPTH SCALE (FEET)	DESCRIPTION (ROCK TYPE)	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD	FRACTURES PER FOOT	DIP wrt CORE AXIS	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	HYDRAULIC CONDUCTIVITY cm/sec	NOTES WATER LEVELS INSTRUMENTATION
			16.00									
50	0.0-54.0 ft. For soil descriptions and drilling notes see boring log P-3D.		50.00									
			11.70									
	54.3-74.3 ft. Slightly to moderately weathered, moderately foliated at 25-30 degrees to the core axis, moderate to dark green, fine to medium grained, slightly altered (moderate in places) GABBRO.		54.30						CL,SM,PL			
55				1	96				J,R,PL CL,R,PL J,SM,PL,FE			
				2	100				J,R,UE,FE			
	55.5-58.6 ft. Highly fractured joint faces show iron staining. Intact core shows pitted apperance.								J,ST,FE			
				3	97				CL,R,PL			
60	59.0-59.4 ft. Core is strongly weathered and pitted with secondary mineralization in the form of epidote.								SH,S,SM,PL			
	60.6-61.6 ft. Core is broken, joint faces show iron staining.								J,SM,PL J,C,SM			
	62.9-65.0 ft. Possible flow structures Qtz veining is convoluted.			4	100				J,SM,PL J,SM,PL			
65									J,ST,R			
				5	100				J,ST,SM,P J,SM,PL J,SM,PL J,SM,PL			
	CONTINUED ON NEXT PAGE.		-4.00						J,SM,PL CL,ST,R			
70			70.00									

DEPTH SCALE: 1 inch = 5 feet
DRILLING CONTRACTOR: D. L. MAHER
DRILLER: J. GRAGLIA

LOGGED: DSL
CHECKED: RMG/RJI
DATE: 10-10-91

Golder Associates

RECORD OF DRILLHOLE P-3D

PROJECT: ISRT/PUMP TEST
PROJECT NO: 913-6744
LOCATION: MASS.

BORING METHOD: NX CORE
DRILLING DATE: 09-27-91
DRILL RIG: B-57

DATUM: NGVD
COORDINATES N: 552,339.0
AZIMUTH: 000

REFERENCE ELEV: 66.0
E: 696,036.5
INCLINATION: -90

ROCK TYPE: J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation; PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular; P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough; CL-Clay, FE-Iron, UE-Uneven

DEPTH SCALE (FEET)	DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD (80 60 40 20)	FRACTURES PER FOOT (2 4 6 8 10)	DIP wrt CORE AXIS (0 30 60 90)	TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	HYDRAULIC CONDUCTIVITY cm/sec	NOTES WATER LEVELS INSTRUMENTATION
			-4.00									
70	54.3-74.3 ft. Slightly to moderately weathered, moderately foliated at 25-30 degrees to the core axis, moderate to dark green, fine to medium grained, slightly altered (moderate in places) GABBRO.		70.00						J,C,SM			
				5	100				J,SM,PL J,C,R			
	70.6-74.3 ft. Dark green, unfoliated fine grained gabbro.								J,SM,PL J,SM,PL J,SM,PL			
				6	86				J,C,SM			
									J,R,UE			
			-8.30						J,SM,PL J,SM,PL,FE			
			74.30									
75												
80												
85												
90												

DEPTH SCALE: 1 inch = 5 feet
DRILLING CONTRACTOR: D. L. MAHER
DRILLER: J. GRAGLIA

LOGGED: DSL
CHECKED: RMG/RJI
DATE: 10-10-91

Golder Associates

PROJECT: ISRT/PUMP TEST

PROJECT LOCATION: MASS.

PROJECT NUMBER: 913-6744

RECORD OF BOREHOLE P-4S

BORING DATE: 09-27-91

BORING LOCATION: N: 552,174.0 E: 696,382.9

SHEET: 1 OF 1

DATUM: NGVD

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT ■ (20, 40, 60, 80) / WATER CONTENT, PERCENT Wp ⊢—○W—⊣ Wl (20, 40, 60, 80)	PIEZOMETER OR STANDPIPE INSTALLATION
0		FOR SOIL DESCRIPTION SEE LOGS FOR P-4I AND P-4D.			61.40 / 0.00							
5												
10												
15												
20												
25												
30												
35												
40												

DRILL RIG: BRATT 22R

DRILLING CONTRACTOR: D.L. MAHER

DRILLER: J. MORAN

Golder Associates

LOGGED: DSL

CHECKED: RMG/RJI

DATE: 10-28-91

PROJECT: ISRT/PUMP TEST

PROJECT LOCATION: MASS.

PROJECT NUMBER: 913-6744

RECORD OF BOREHOLE P-4I

BORING DATE: 09-15-91

BORING LOCATION: N: 552,183.8 E: 696,379.2

SHEET: 1 OF 2

DATUM: NGVD

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT ■ (20 40 60 80) / WATER CONTENT, PERCENT Wp W Wl (20 40 60 80)	PIEZOMETER OR STANDPIPE INSTALLATION
0	4-1/4" HSA	0.0-2.5 ft. Dense, very dark brown becoming brownish yellow, c-f SAND and GRAVEL, trace to little silt, root mass present from 0.0-0.3 (SP to SP-SM). <FILL>	SP to SP-SM		61.80 / 0.00	S-1	DO	3,16,15,15	31	65		
		2.5-7.5 ft. Compact, light brownish yellow c-f SAND, some gravel (SP). <POSSIBLE FILL>	SP		59.30 / 2.50							
5		Water encountered at approx. 7.3 ft. below ground surface.				S-2	DO	8,8,8,7	16	50		
		7.5-46.0 ft. Loose to dense, gray to dark gray, c-f SAND, trace to little gravel, trace to little silt, slightly odiferous from 10.0-12.0 ft. (SP to SP-SM). <OUTWASH SAND>			54.30 / 7.50							
10						S-3	DO	1,1,2,3	3	50		
15						S-4	DO	3,5,9,9	14	50		
20			SP to SP-SM			S-5	DO	3,5,7,8	12	70		
25						S-6	DO	4,8,14,7	22	70		
30						S-7	DO	7,7,7,9	14	65		
35						S-8	DO	6,9,14,20	23	100		
40		CONTINUED ON NEXT PAGE										

DRILL RIG: ATV MOBILE B53

DRILLING CONTRACTOR: D.L. MAHER

DRILLER: J. GRAGLIA

Golder Associates

LOGGED: DSL

CHECKED: RMG/RJI

DATE: 09-30-91

PROJECT: ISRT/PUMP TEST
PROJECT LOCATION: MASS.
PROJECT NUMBER: 913-6744

RECORD OF BOREHOLE P-4I

BORING DATE: 09-15-91
BORING LOCATION: N: 552,183.8 E: 696,379.2

SHEET: 2 OF 2
DATUM: NGVD

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT ■ (20 40 60 80) / WATER CONTENT, PERCENT Wp ⊢—○W—⊣ Wl (20 40 60 80)	PIEZOMETER OR STANDPIPE INSTALLATION
					21.80							
40	4-1/4" HSA	7.5-46.0 ft. Loose to dense, gray to dark gray, c-f SAND, trace to little gravel, trace to little silt, (SP to SP-SM). <OUTWASH SAND>	SP to SP-SM		40.00	S-9	DO	16,19,27,27	46	100		
45					15.80	S-10	DO	8,11,10,15	21	90		
		46.0-52.0 ft. Compact to dense, light olive gray m-f SAND, some silt (SM). <OUTWASH SAND>	SM		46.00							
50					9.80	S-11	DO	19,6,6,6	12	75		
		52.0-61.1 ft. Dense pale gray to gray, m-f SAND, some silt (SM). <OUTWASH SAND>	SM		52.00							
55						S-12	DO	8,26,24,34	50	100		
60					0.70	S-13	DO	10,18,20,100/.25	38	88		
		61.0-61.5 ft. Dense, pale olive gray f SAND and SILT (SM). <TILL> Auger refusal at 61.5 ft.	SM		0.30 / 61.50	S-14	DO	>100	100	-		
65		BORING TERMINATED AT 61.5 FT. BELOW GROUND SURFACE.										
70												
75												
80												

DRILL RIG: ATV MOBILE B53
DRILLING CONTRACTOR: D.L. MAHER
DRILLER: J. GRAGLIA

Golder Associates

LOGGED: DSL
CHECKED: RMG/RJI
DATE: 09-30-91

PROJECT: ISRT/PUMP TEST

PROJECT LOCATION: MASS.

PROJECT NUMBER: 913-6744

RECORD OF BOREHOLE P-4D

BORING DATE: 09-17-91

BORING LOCATION: N: 552,178.2 E: 696,380.7

SHEET: 1 OF 2

DATUM: NGVD

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT ■ (20 40 60 80) / WATER CONTENT, PERCENT Wp W Wl (20 40 60 80)	PIEZOMETER OR STANDPIPE INSTALLATION
					61.80							
0	6-5/8" ID HSA	0.0-20.0 ft. NO SAMPLING. See borehole log for P-4I.			0.00							
5												
10												
15												
					41.80							
20		20.0-25.3 ft. Compact, dark gray, c-f SAND, trace to little gravel, trace silt (SP). <OUTWASH SAND>	SP		20.00	S-1	SS	3,6,6,7	14	50	■	
						S-2	SS	7,6,3,5	11	10	■	
25					36.50	S-3	SS	9,6,8,12	14	75	■	
		25.3-30.0 ft. Compact, light yellowish brown, m-f SAND, little to some silt, trace gravel (SP to SP-SM). <OUTWASH SAND>	SP to SP-SM		25.30	S-4	SS	6,8,10,10	18	50	■	
						S-5	SS	8,12,13,10	25	50	■	
					31.80							
30		30.0-65.0 ft. NO SAMPLING. See borehole log for P-4I.			30.00							
35												
					21.80							
40					40.00							

DRILL RIG: ATV B53

DRILLING CONTRACTOR: D.L. MAHER

DRILLER: J. GRAGLIA

Golder Associates

LOGGED: V. FOSTER

CHECKED: RMG/RJI

DATE: 10-22-91

PROJECT: ISRT/PUMP TEST

PROJECT LOCATION: MASS.

PROJECT NUMBER: 913-6744

RECORD OF BOREHOLE P-4D

BORING DATE: 09-17-91

BORING LOCATION: N: 552,178.2 E: 696,380.7

SHEET: 2 OF 2

DATUM: NGVD

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT ■ (20 40 60 80) / WATER CONTENT, PERCENT Wp ⊢—○W—⊣ Wl (20 40 60 80)	PIEZOMETER OR STANDPIPE INSTALLATION
					21.80							
40		30.0-65.0 ft. NO SAMPLING. See borehole log for P-4I.			40.00							
45												
50												
55												
60												
		Auger refusal at 65.0 ft. <BEDROCK>			-3.20							
65		NOTE: Reemed hole to 68.0 ft. Material running into hole. Spun 4 inch casing to 68.5 ft. Began coring at 68.5 ft. See RECORD OF DRILLHOLE P-4D for rock log.			65.00							
70												
75												
80												

DRILL RIG: ATV B53

DRILLING CONTRACTOR: D.L. MAHER

DRILLER: J. GRAGLIA

Golder Associates

LOGGED: V. FOSTER

CHECKED: RMG/RJI

DATE: 10-22-91

RECORD OF DRILLHOLE P-4D

PROJECT: ISRT/PUMP TEST
PROJECT NO: 913-6744
LOCATION: MASS.

BORING METHOD: NX CORE
DRILLING DATE: 09-23-91
DRILL RIG: ATV B53

DATUM: NGVD
COORDINATES N: 552,178.2
AZIMUTH: 000

REFERENCE ELEV: 61.8
E: 696,380.7
INCLINATION: -90

J-Joint, F-Fault, S-Shear, B-Bedding, F-Foliation
PL-Planar, C-Curved, U-Undulating, ST-Stepped, I-Irregular
P-Polished, K-Slikensided, SM-Smooth, R-Rough, VR-V. Rough
FE-Iron, UE-Uneven

DEPTH SCALE (FEET)	ROCK TYPE DESCRIPTION	GRAPHIC LOG	ELEV / DEPTH (FT)	RUN NO.	CORE RECOVERY	RQD (80 60 40 20)	FRACTURES PER FOOT (2 4 6 8 10)	DISCONTINUITY DATA: DIP wrt CORE AXIS (0 30 60 90)	DISCONTINUITY DATA: TYPE AND SURFACE DESCRIPTION	GRAPHIC LOG	HYDRAULIC CONDUCTIVITY cm/sec	NOTES WATER LEVELS INSTRUMENTATION
50	0.0-68.5 ft. For soil descriptions and *drilling notes see borehole logs P-4I* and P-4D.		11.80 50.00									
55												
60												
65			-6.70									
70	68.5-88.5 ft. Fresh, moderately to strongly foliated @ 28-40 degrees to the core axis, dark green, fine to medium grained GABBRO. 72.1-73.5 ft. Series of sub-parallel faults @ 35-40 degrees to the core axis, offset 3-8mm; plunging at 90 degrees to the foliation.		68.50	1	93				J,R,PL CL,R,PL J,R,PL J,R,PL J,R,UE J,R,PL J,R,PL F,R,PL CL,SM,PL,P CL,SM,PL,P			
75	75.15-75.50 ft. Broken core.								CL,SM,PL,P CL,SM,PL CL,SM,PL,P			
80	68.5-88.5 ft. Fresh, moderately to strongly foliated @ 28-40 degrees to the core axis, dark green, fine to medium grained GABBRO. 80.0-81.4 and 85.4-87.1 ft. Very fine grained, unfoliated, non-indurated gabbro.		-18.20 80.00	2	100				CL,SM,PL J,UR,PL,FE J,R,UE			
85				3	100				J,R,PL			
90	BORING TERMINATED AT 88.5 FT. BELOW GROUND SURFACE		-26.70 88.50									

DEPTH SCALE: 1 inch = 5 feet
DRILLING CONTRACTOR: D. L. MAHER
DRILLER: J. GRAGLIA

LOGGED: DSL/RMG
CHECKED: RMG/RJI
DATE: 10-22-91

Golder Associates

PROJECT: ISRT/PUMP TEST

PROJECT LOCATION: MASS.

PROJECT NUMBER: 913-6744

RECORD OF BOREHOLE P-6

BORING DATE: 09-06-91

BORING LOCATION: N: 552,060.3 E: 696,216.7

SHEET: 1 OF 2

DATUM: NGVD

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT ■ (20 40 60 80) / WATER CONTENT, PERCENT Wp W Wl (20 40 60 80)	PIEZOMETER OR STANDPIPE INSTALLATION
					67.20 / 0.00							
0	4-1/4" HSA	0.0-15.0 ft. Very dense, medium brown, c-f SAND, little to some gravel, trace silt (SP). <FILL>										
						S-1	DO	10,46,21	67	67		
5												
			SP			S-2	DO	17,95,73	100	67		
10		Water encountered at approximately 9.3 ft. below ground surface.										
						S-3	DO	24,100/.3	100	0		
15		15.0-40.0 ft. Compact to very dense, pale brown to dark gray, c-f SAND, trace to little silt, trace gravel (SP to SP-SM). <OUTWASH SAND>			52.20 / 15.00							
						S-4	DO	24,23,20	43	33		
20												
						S-5	DO	36,26,27	55	53		
25												
			SP to SP-SM			S-6	DO	0,7,14	21	67		
30												
						S-7	DO	4,14,32	46	100		
35												
						S-8	DO	24,36,69	100	100		
40		CONTINUED ON NEXT PAGE			27.20 / 40.00							

DRILL RIG: B-53/BRATT 22R

DRILLING CONTRACTOR: D.L. MAHER

DRILLER: J. QUINN

Golder Associates

LOGGED: DSL

CHECKED: RMG/RJI

DATE: 09-30-91

PROJECT: ISRT/PUMP TEST

PROJECT LOCATION: MASS.

PROJECT NUMBER: 913-6744

RECORD OF BOREHOLE P-6

BORING DATE: 09-06-91

BORING LOCATION: N: 552,060.3 E: 696,216.7

DATUM: NGVD

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT ■ (20 40 60 80) / WATER CONTENT, PERCENT Wp ○W Wl (20 40 60 80)	PIEZOMETER OR STANDPIPE INSTALLATION
					27.20							
40	4-1/4" HSA	40.0-49.5 ft. Very dense, gray beige m-f SAND, trace silt (SP) <OUTWASH SAND>	SP		40.00							
						S-9	DO	30,38,65	>100	100	■	
45												
						S-10	DO	70,100/.4	>100	33	■	
					17.70							
50		49.5-68.1 ft. Very dense gray-beige, c-f SAND, trace silt, occassional lens of m-f to f SAND (SP) <OUTWASH SAND>	SP		49.50							
						S-11	DO	42,42,43,51	85	100	■	
55												
						S-12	DO	19,41,55	96	100	■	
60												
						S-13	DO	26,32,24,30	56	50	■	
65												
					-0.90	S-14	DO	5,35,44,116	79	100	■	
		68.1-70.5 ft. Very dense olive green-gray c-f SAND, some gravel, little silt (SP-SM). <GLACIAL TILL>	SP-SM		68.10							
70					-3.30							
		Auger refusal at 70.5 ft. <BEDROCK>			70.50							
		BORING TERMINATED AT 70.5 FT. BELOW GROUND SURFACE.										
75												
80												

DRILL RIG: B-53/BRATT 22R

DRILLING CONTRACTOR: D.L. MAHER

DRILLER: J. QUINN

Golder Associates

LOGGED: DSL

CHECKED: RMG/RJI

DATE: 09-30-91

PROJECT: ISRT/PUMP TEST

PROJECT LOCATION: MASS.

PROJECT NUMBER: 913-6744

RECORD OF BOREHOLE P-7

BORING DATE: 09-20-91

BORING LOCATION: N: 552,407.8 E: 695,881.9

SHEET: 1 OF 2

DATUM: NGVD

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT ■ (20 40 60 80) / WATER CONTENT, PERCENT Wp ⊢—○W—⊣ Wl (20 40 60 80)	PIEZOMETER OR STANDPIPE INSTALLATION
0	4-1/4" ID HSA	0.0-3.8 ft. Loose, moderate brown to dark purplish red, c-f SAND, trace to little silt, root mass (SP). <FILL>	SP		61.90 / 0.00							
						S-1	DO	7,5,3,2	8	100	■	
		3.8-4.0 ft. Soft black SILT, organic matter, possible hide residue (ML). <POSSIBLE FILL>	ML		58.10 / 4.00							
5		4.0-10.0 ft. Very dense, pale olive gray, c-f SAND and GRAVEL, trace silt (SP). <POSSIBLE FILL> Water encountered at 5.3 ft. below ground surface.	SP			S-2	DO	23,50,38,35	88	75	■	
10		10.0-48.0 ft. Compact, yellowish brown to olive gray, c-f SAND, trace to some gravel, trace to little silt (SP to SP-SM). <OUTWASH SAND>	SP to SP-SM		51.90 / 10.00							
						S-3	DO	4,9,10,8	19	80	■	
15												
						S-4	DO	3,5,11,17	16	75	■	
20												
						S-5	DO	7,11,11,13	22	40	■	
25												
						S-6	DO	3,5,7,7	12	80	■	
30												
						S-7	DO	5,5,8,12	13	70	■	
35												
						S-8	DO	7,12,14,21	26	75	■	
40		CONTINUED ON NEXT PAGE.			21.90 / 40.00							

DRILL RIG: BRAT 22R

DRILLING CONTRACTOR: D.L. MAHER

DRILLER: J. MORAN

Golder Associates

LOGGED: DSL

CHECKED: RMG/RJI

DATE: 10-10-91

PROJECT: ISRT/PUMP TEST
PROJECT LOCATION: MASS.
PROJECT NUMBER: 913-6744

RECORD OF BOREHOLE P-7

BORING DATE: 09-20-91
BORING LOCATION: N: 552,407.8 E: 695,881.9

SHEET: 2 OF 2
DATUM: NGVD

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT ■ (20 40 60 80) / WATER CONTENT, PERCENT Wp ○W Wl (20 40 60 80)	PIEZOMETER OR STANDPIPE INSTALLATION
					21.90							
40	4-1/4" ID HSA	10.0-48.0 ft. Compact, yellowish brown to olive gray, c-f SAND, trace to some gravel, trace to little silt (SP to SP-SM). <OUTWASH SAND>	SP to SP-SM		40.00							
						S-9	DO	2,4,1,82	5	75	■	
45												
					13.90	S-10	DO	3,40,150/.3	>100	69		■
		48.0-48.5 ft. Very dense, olive gray, c-f SAND and GRAVEL, some silt (SM). <TILL> Auger refusal at 48.5 ft. <BEDROCK>	SM		13.40 / 48.50							
50		BORING TERMINATED AT 48.5 FT. BELOW GROUND SURFACE										
55												
60												
65												
70												
75												
80												

DRILL RIG: BRAT 22R
DRILLING CONTRACTOR: D.L. MAHER
DRILLER: J. MORAN

Golder Associates

LOGGED: DSL
CHECKED: RMG/RJI
DATE: 10-10-91

PROJECT: ISRT/PUMP TEST
PROJECT LOCATION: MASS.
PROJECT NUMBER: 913-6744

RECORD OF BOREHOLE P-8

BORING DATE: 09-12-91
BORING LOCATION: N: 552,079.7 E: 696,574.2

SHEET: 1 OF 2
DATUM: NGVD

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT ■ (20 40 60 80) / WATER CONTENT, PERCENT Wp W Wl (20 40 60 80)	PIEZOMETER OR STANDPIPE INSTALLATION
0	4-1/4" HSA	0.0-7.25 ft. Very loose to compact, light to dark brown m-f SAND, trace to little silt (SP to SP-SM). <FILL>	SP to SP-SM		64.40 / 0.00	S-1	DO	5,7,9	16	60	■	
5												
		7.25-11.0 ft. Very soft, black, PEAT, trace wood, decayed leaves, and roots (PT). <PEAT> Water encountered at 10.2 ft. below ground surface.	PT		57.15 / 7.25	S-2	DO	1,1,1,1	2	25	■	
10					53.40 / 11.00							
		11.0-45.5 ft. Compact, dark gray to black, m-f SAND, trace to some silt, occassional cobble, few lenses of fine sand with some silt, frequent hide odor (SP to SM). <OUTWASH SAND>				S-3	DO	6,9,20,17	29	50	■	
15												
						S-4	DO	5,5,7,11	12	25	■	
20												
			SP to SP-SM			S-5	DO	5,7,9,8	16	55	■	
25												
						S-6	DO	5,6,12,10	18	65	■	
30												
						S-7	DO	5,5,6,6	11	60	■	
35												
						S-8	DO	3,5,4,4	9	55	■	
40		CONTINUED ON NEXT PAGE										

DRILL RIG: ATV MOBILE B-53
DRILLING CONTRACTOR: D.L. MAHER
DRILLER: J. GRAGLIA

LOGGED: RMG
CHECKED: RMG/RJI
DATE: 09-30-91

Golder Associates

PROJECT: ISRT/PUMP TEST

PROJECT LOCATION: MASS.

PROJECT NUMBER: 913-6744

RECORD OF BOREHOLE P-8

BORING DATE: 09-12-91

BORING LOCATION: N: 552,079.7 E: 696,574.2

DATUM: NGVD

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT ■ (20 40 60 80) / WATER CONTENT, PERCENT Wp W Wl (20 40 60 80)	PIEZOMETER OR STANDPIPE INSTALLATION
40	4-1/4" HSA	11.0-45.5 ft. Compact, dark gray to black, m-f SAND, trace to some silt, occassional cobble, few lenses of fine sand with some silt, frequent hide odor (SP to SM). <OUTWASH SAND>	SP to SP-SM		24.40 / 40.00	S-9	DO	5,8,18,20	26	65	■	
45		45.5-50.0 ft. Compact, medium to light gray, f-SAND and SILT, strong hide odor (SM). <OUTWASH SAND>	SM		18.90 / 45.50	S-10	DO	7,14,14,13	28	50	■	
50		50.0-51.5 ft. Olive gray c-f SAND and GRAVEL, trace silt (SW). <TILL> Auger refusal at 51.5 ft. <BEDROCK>	SW		14.40 / 50.00 / 12.90 / 51.50							
55		BORING TERMINATED AT 51.5 FT. BELOW GROUND SURFACE.										
60												
65												
70												
75												
80												

DRILL RIG: ATV MOBILE B-53

DRILLING CONTRACTOR: D.L. MAHER

DRILLER: J. GRAGLIA

Golder Associates

LOGGED: RMG

CHECKED: RMG/RJI

DATE: 09-30-91

APPENDIX C

Extraction Well E-5 Design Calculations

Revised 9/19/91 APM

Golder Associates	SUBJECT Selection of Filter Pack Size and Well Screen Slot Size for ISRT Pumping Well E5		
	Job No. 913-6744	Made by APM	Date 9/16/91
	Ref.	Checked Ray Pearson 12/12/91	Sheet 1 of 10
		Reviewed RSW 12/13/91	

Purpose: Design a well screen and filter pack for the pumping well at the ISRT site. (Well E5)

Method: The filter pack design and well screen selection will be based on the methodology presented by Driscoll, 1986 (Groundwater and Wells, 2nd Edition, Johnson Division, St. Paul, MN) pgs 438 to 443 ✓

Given: Field Boring Log for boring E-5 (Pilot)*
Particle Size Distribution Curves (ASTM D-421+422)** for soil samples collected from E-5 including:

11.5' to 19.5' depth
19.5' to 31.5' depth ✓
31.5' to 41.5' depth
41.5' to 51.5' depth ✓

Assumptions:

The saturated thickness of the unconsolidated deposits can be grouped into 3 soil types as follows

8.0-20.5 CLAY to SILTY ORGANIC CLAY, little to some f. sand (CL to OL) ✓

20.5-31.5 C-F SAND, and GRAVEL little silt (SP-SM) ✓

31.5-52.6 C-F SAND, little to some gravel, trace to little silt (SP to SP-SM) ✓

These groupings are based on the field log soil descriptions and are supported by the results of the grain size analyses. The material from 8.0 to 20.5 feet is not considered suitable for screening. Therefore, a screen and sandpack will only be design for the lower two soil types, and the particle size curve for 11.5 to 19.5 feet is not used (Sheet 8) ✓

* See Sheets 9 & 10 for boring log

** See Sheets 3, 4, 6 & 8 for curves

Golder Associates	SUBJECT Screen slot size – well E5		
	Job No. 913-6744 Ref.	Made by APM Checked R Pearson 12/12/91 Reviewed RSW 12/13/91	Date 9/16/91 Sheet 2 of 10

Soil Type 1 31.5 to 52.6

Step 1

Multiply the 30% percent passing (70% retained) by a factor between 4 and 10, based on the following:

Use 4 to 6 if the formation is uniform and the 60% passing size is 0.010 inch (0.25mm) or less

Use 6 to 10 if the formation is highly non-uniform and includes silt or clay stringers

Based on the grain size curves for this soil (see attached pages 3 of 10 and 4 of 10) the following coefficients of uniformity (C_u) are calculated:

Sample 31.5 – 41.5 (S_1)

$$C_u = \frac{D_{60}}{D_{10}} = \frac{1.5}{0.18} = 8.3$$

(Holtz and Kovacks, 1981, Geotechnical Engineering, Prentice-Hall, Inc.)

Sample 41.5 – 51.5 (S_2)

$$C_u = \frac{D_{60}}{D_{10}} = \frac{1.6}{0.21} = 7.6$$

Calculate Coefficient of Curvature

Sample 31.5 – 41.5 (S_1)

$$C_c = \frac{D_{30}^2}{D_{10} \times D_{60}} = \frac{(0.59^2)}{0.18 \times 1.5} = 1.29$$

(Holtz and Kovacks, 1981)

Sample 41.5 – 51.2 (S_2)

$$C_c = \frac{D_{30}^2}{D_{10} \times D_{60}} = \frac{(0.50)^2}{0.21 \times 1.6} = 0.744$$

(Holtz and Kovacks, 1981)

Since these soils are fairly well graded (i.e $C_u > 4$, $C_c \sim 10$) a multiplyer factor of 7 is used:

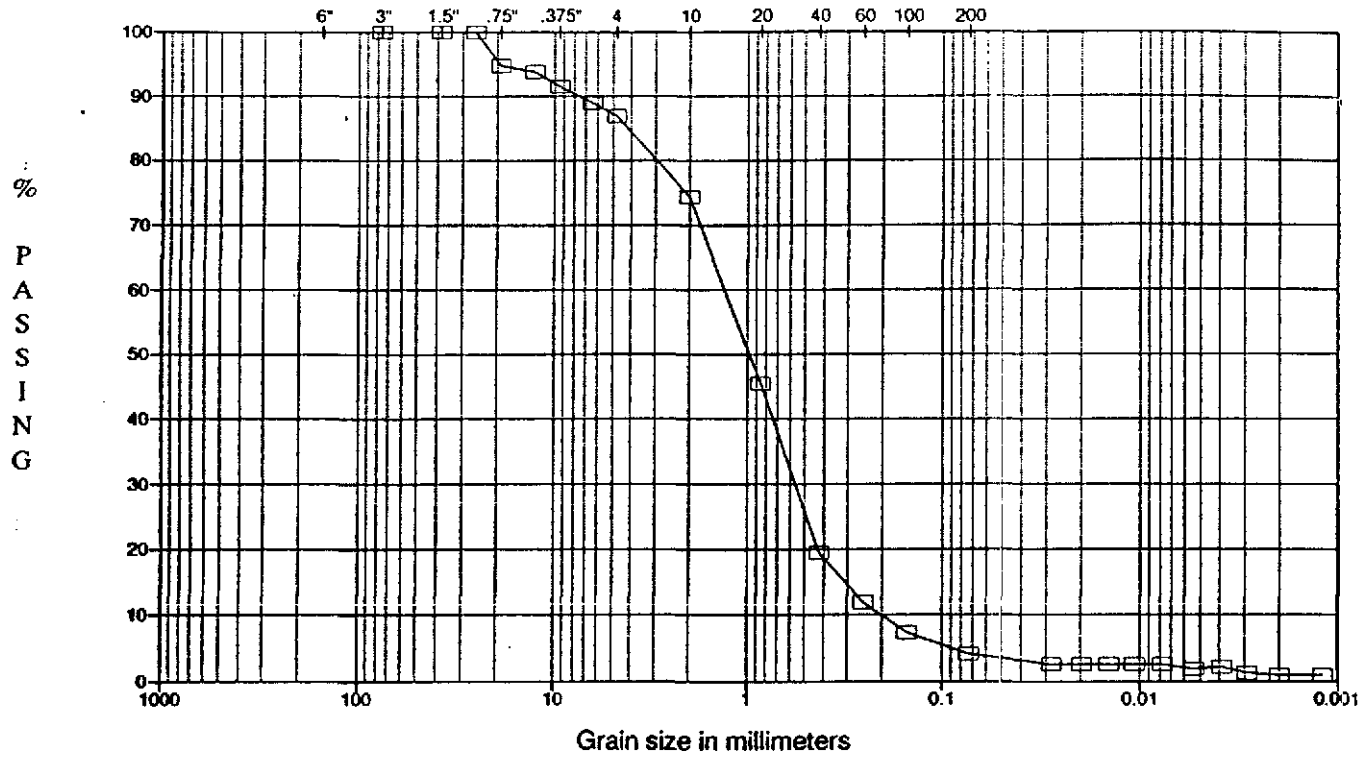
(S_1) D_{30} = ~~0.49~~ 0.59 RP × 7 = ~~3.43~~ 4.13 ×

(S_2) D_{30} = 0.50 × 7 = 3.50

Say 3.75 = D_{30} of filter pack

PARTICLE SIZE DISTRIBUTION ASTM D-421 AND 422

US STANDARD SIEVE OPENING SIZES



USCS

COBBLES	GRAVEL		SAND			FINES (Silt or Clay)
	Coarse	Fine	C	Med	Fine	

TECH: MLM
DATE: 9/19/91
CHECKED: RMJ
REVIEWED: RF

SAMPLE ID	W%	LL	PL	PI	GRAV	DESCRIPTION
E5 (31.5'-41.5')	17.6					Variegated c-f SAND, some f gravel trace fines
Sample Type:	BULK	Date Tested:	9/16/91			

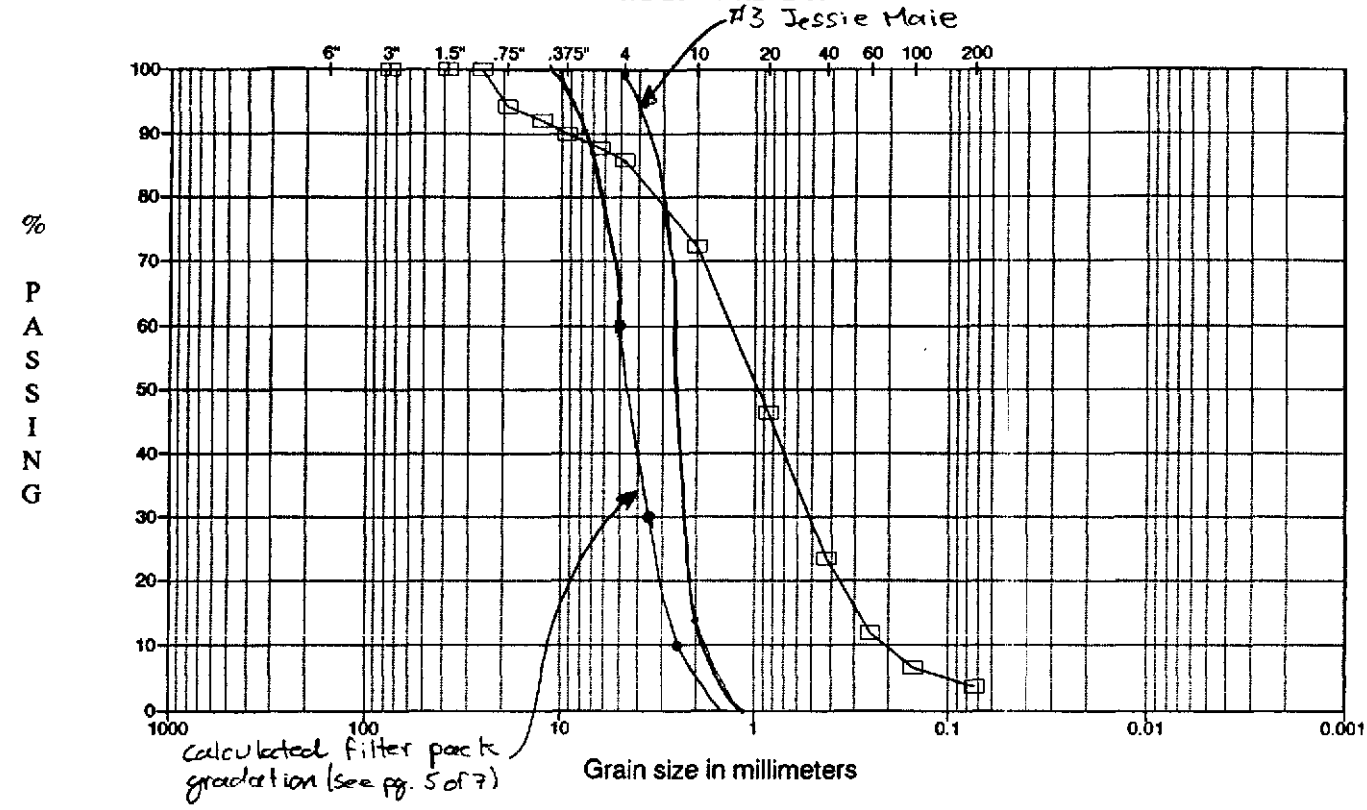
ISRT/ADDITIONAL PUMP TEST/MA
913-6744.393

GOLDER ASSOCIATES INC.
Consulting Engineers

Form LABNJ 2-3

PARTICLE SIZE DISTRIBUTION ASTM D-421 AND 422

US STANDARD SIEVE OPENING SIZES



USCS

	Coarse	Fine	C	Med	Fine	
COBBLES	GRAVEL		SAND			FINES (Silt or Clay)

TECH: MLM
DATE: 9/16/91
CHECKED: RMW
REVIEWED: RP

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
E-5	16.0					Variegated
41.5' -						c-f SAND, some f gravel
51.5'						trace fines

Sample Type: BULK Date Tested: 9/16/91

ISRT/ADDITIONAL PUMP TEST/MA
913-6744.393

GOLDER ASSOCIATES INC.
Consulting Engineers

Form LABNJ 1.2

Golder Associates	SUBJECT Screen Slot Size — well E5		
	Job No. 913-6744 Ref.	Made by AFM Checked Ray Pearson 12/12/91 Reviewed RSW 12/13/91	Date Sheet 5 of 10

Using a D_{30} of 3.50 mm for the filter pack, draw a uniformly graded curve ($C_u \approx 2.0$) See Pg 4 of 7

$$C_u = 2.0 = \frac{D_{60}}{D_{10}}$$

Say $D_{60} = 5.00$, $D_{10} = 2.50$ $\quad C_u = \frac{5.00}{2.50} = 2$ ✓

Therefore, the filter pack sand should have characteristics similar to the following:

$D_{10} = 2.50$ mm ✓
$D_{30} = 3.75$ mm ✓
$D_{60} = 5.00$ mm ✓

The screen slot size should retain 90 percent or more of the filter pack material. From page 4 of 10 RSW ~ 90% retaining corresponds to a grain size of approximately 2.50 mm or 0.100 in

---

Soil type 2 19.5 to 31.5

This soil is even more well graded than the previous soil as observed from the grain size curve; therefore a multiplyer of 8 will be used

$$D_{30} = 0.30 \times 8 = 2.40$$ ✓

$$C_u = 2.0 = \frac{D_{60}}{D_{10}} = \frac{3.25}{1.8} = 1.81$$ ✓

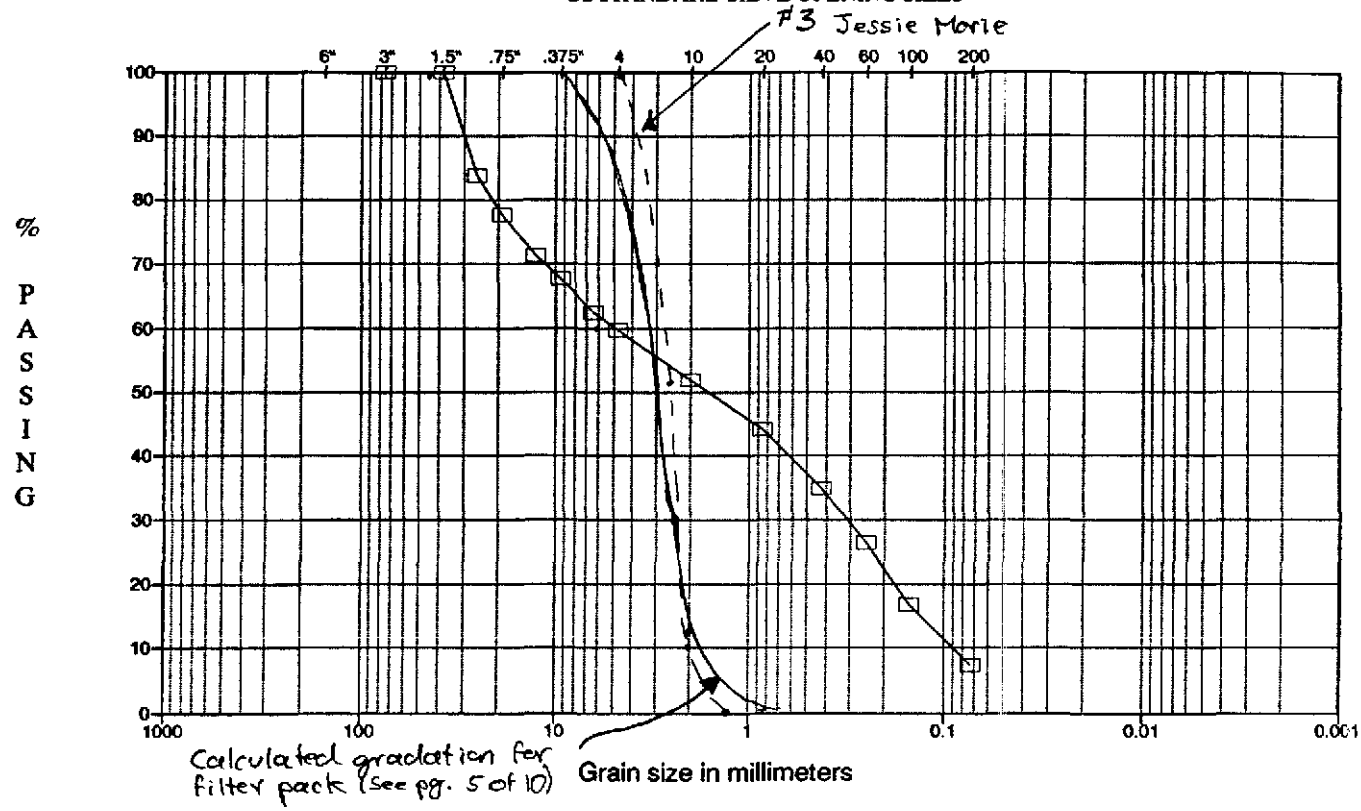
Therefore the filter pack sand with the following characteristics should be used

$D_{10} = 1.80$ mm ✓
$D_{30} = 2.40$ mm ✓
$D_{60} = 3.25$ mm ✓

The screen slot size should correspond to the 90% retaining value of the filter pack curve ≈ 1.80 mm or 0.070 in ✓

PARTICLE SIZE DISTRIBUTION ASTM D-421 AND 422

US STANDARD SIEVE OPENING SIZES



USCS

	Coarse	Fine	C	Med	Fine	
COBBLES	GRAVEL		SAND			FINES (Silt or Clay)

TECH: MLM
DATE: 9/16/91
CHECKED: RMW
REVIEWED: RP

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
E-5	23.9					Variegated
19.5' -						m-f SAND and c-f GRAVEL
31.5'						little fines
Sample Type:	BULK	Date Tested:	9/16/91			

ISRT/ADDITIONAL PUMP TEST/MA
913-6744.393

GOLDER ASSOCIATES INC.
Consulting Engineers

Form LABNJ 1-2

Golder Associates	SUBJECT Screen Slot size - Well E2		
	Job No. 913-6744	Made by APM	Date
	Ref.	Checked Ray Pearson 12/12/91	Sheet 7 of 10
		Reviewed RSW 12/13/91	

Method 2: Use a natural sandpack

As discussed by Driscoll (1986) the typical approach to using a natural sandpack is to select a well screen that will retain 40% of the formation and pass 60%. However a more conservate approach is recommended when the following apply

1) There is some doubt about the reliability of the samples
2) The aquifer is thin and overlain by loose fine grained material
3) Development time is at a premium
4) The formation is well sorted

Items 3 and 4 apply to this situation therefore a slot size that will retain 50% of the formation material will be used

Therefore for soil sample 1 (Sheets 3 of 10 and 4 of 10)

31.5 - 41.5 D_{50} = 1.1 mm = Slot size of 0.043 inches

41.5 - 51.5 D_{50} = 0.98 mm = Slot size of 0.039 inches

* A slot size of 0.040 would be appropriate

For Soil sample 2 (Sheet 6 of 10)

19.5 - 31.5 D_{50} = 1.75 = Slot size of 0.069 inches

* A slot size of 0.070 or 0.060 would be appropriate

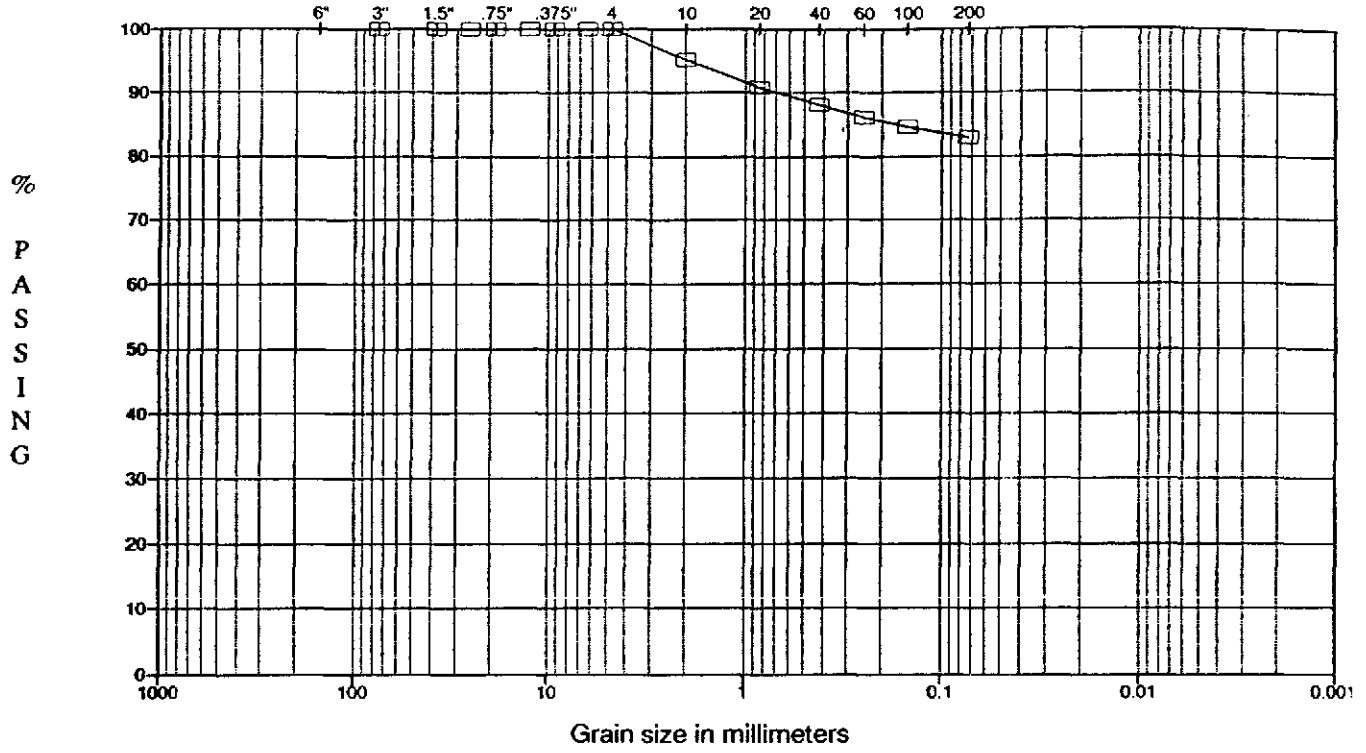
Final Decision:
The driller (D.L. Maher) recommended either a 0.10 in slot and #4 Morie sand or 0.080 inch slot and #3 Morie sand. Based on these calculations the 0.080 inch slot size and #3 morie sand were deemed to be most appropriate. APM

Agreed RPearson

PARTICLE SIZE DISTRIBUTION ASTM D-421 AND 422

Sheet 8 of 10

US STANDARD SIEVE OPENING SIZES



USCS

COBBLES	GRAVEL		SAND			FINES (Silt or Clay)
	Coarse	Fine	C	Med	Fine	

TECH: MLM
DATE: 9/16/91
CHECKED: RMN
REVIEWED: APW

SAMPLE ID	W%	LL	PL	PI	Other	DESCRIPTION
E-5	322.5					Variegated
11.5' -						FINES
19.5'						some f sand

Sample Type: BULK Date Tested: 9/16/91

ISRT/ADDITIONAL PUMP TEST/MA
913-6744.393

GOLDER ASSOCIATES INC.
Consulting Engineers

Form LABNJ 1-2

PROJECT: ISRT/PUMP TEST
PROJECT LOCATION: MASS.
PROJECT NUMBER: 913-6744

RECORD OF BOREHOLE E-5 (PILOT)

BORING DATE: 09-11-91
BORING LOCATION: N: 552,280.7 E: 696,172.0

SHEET: 1 OF 2
DATUM: NGVD

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLE NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT
0	4-1/4" HSA	0.0-7.0 ft. Loose to compact, moderate to yellowish brown, m-f SAND, little silt, trace gravel, traces of roots (SP-SM). <FILL>	SP-SM		94.00 / 0.00	S-1	DO	3,4,6,8	10	50
						S-2	DO	14,12,12,9	24	45
5						S-3	DO	12,10,10,9	20	40
		7.0-20.5 ft. Very soft to firm, black to dark brown, silty CLAY to silty ORGANIC CLAY, little to some f-sand, occassional to frequent roots and root mass, slight hydrogen sulfide odor (CL to OH). <POSSIBLE FILL OR PEAT> Water encountered at approx. 8.0 ft. below ground surface.	OH to CL		87.00 / 7.00	S-4	DO	2,1,1,1	2	100
						S-5	DO	12,11,9,15	20	13
10						S-6	DO	1,4,1,1	5	45
						S-7	DO	2,1,1,1	2	100
15						S-8	DO	1,1,1,1	2	45
						S-9	DO	1,1,1,3	2	100
						S-10	DO	1,0,1,2	1	100
20		20.5-27.5 ft. Compact to very dense, medium gray, c-f SAND, some gravel, trace silt (SW) <POSSIBLE FILL OR OUTWASH SAND>	SW		43.50 / 20.50	S-11	DO	2,6,13,8	19	75
						S-12	DO	13,21,36,45	57	35
25						S-13	DO	4,20,41,50	61	40
						S-14	DO	21,20,13,10	23	40
		27.5-31.5 ft. Compact to dense, medium gray to moderate brown c-f SAND, little silt, trace gravel (SP-SM) <OUTWASH SAND>	SP-SM		36.50 / 27.50	S-15	DO	6,28,21,20	49	30
30						S-16	DO	3,10,10,11	20	30
		31.5-52.6 ft. Loose to dense, moderate to yellowish brown, c-f SAND, little to some gravel, trace to little silt, occassional medium gray fine sand lenses (SP to SP-SM). <OUTWASH SAND>	SP to SP-SM		32.50 / 31.50	S-17	DO	12,17,20,23	37	75
35						S-18	DO	6,23,20,20	43	75
						S-19	DO	13,13,9,11	22	65
						S-20	DO	5,5,4,7	9	25
		CONTINUED ON NEXT PAGE								
40										

PENETRATION RESISTANCE BLOWS/FT ■ (20, 40, 60, 80)
WATER CONTENT, PERCENT Wp ⊢ W ⊣ Wl (20, 40, 60, 80)

PIEZOMETER OR STANDPIPE INSTALLATION

DRILL RIG: ATV MOBILE B-53
DRILLING CONTRACTOR: D.L. MAHER
DRILLER: J. GRAGLIA

Golder Associates

LOGGED: RJI/RMG
CHECKED: RMG/RJI
DATE: 09-30-91

PROJECT: ISRT/PUMP TEST
PROJECT LOCATION: MASS.
PROJECT NUMBER: 913-6744

RECORD OF BOREHOLE E-5 (PILOT)

BORING DATE: 09-11-91
BORING LOCATION: N: 552,280.7 E: 696,172.0

SHEET: 2 OF 2 Sht 10 of 10
DATUM: NGVD

DEPTH SCALE FEET	BORING METHOD	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV / DEPTH	SAMPLES: NUMBER	TYPE	BLOWS / 6 in	N	REC/ATT	PENETRATION RESISTANCE BLOWS/FT (20 40 60 80) / WATER CONTENT, PERCENT (Wp 20 40 60 Wl 80)	PIEZOMETER OR STANDPIPE INSTALLATION
40	4-1/4" HSA	31.5-52.6 ft. Loose to dense, moderate to yellowish brown, c-f SAND, little to some gravel, trace to little silt, occasional medium gray fine sand lenses (SP to SP-SM) <OUTWASH SAND>	SP to SP-SM		24.00 / 40.00	S-21	DO	8,7,7,8	14	30		
						S-22	DO	8,6,5,5	11	25		
45						S-23	DO	4,4,4,4	8	20		
						S-24	DO	----	-	80		
						S-25	DO	6,4,5,6	9	100		
50						S-26	DO	4,8,10,15	18	85		
					11.40 / 52.60	S-27	DO	16,50,100	100	100		
		52.6-54.1 ft. Very dense, medium to olive gray, c-f SAND and GRAVEL, little to some silt (SM). <GLACIAL TILL> (Possible weathered bedrock at refusal)	SM		9.90 / 54.10	S-28	DO	92,100/.1'	>100	100		
55		BORING TERMINATED AT 54.1 FT. BELOW GROUND SURFACE.										
60												
65												
70												
75												
80												

DRILL RIG: ATV MOBILE B-53
DRILLING CONTRACTOR: D.L. MAHER
DRILLER: J. GRAGLIA

Golder Associates

LOGGED: RJI/RMG
CHECKED: RMG/RJI
DATE: 09-30-91

APPENDIX D

Piezometer and Well Construction Logs

MONITORING WELL INSTALLATION LOG

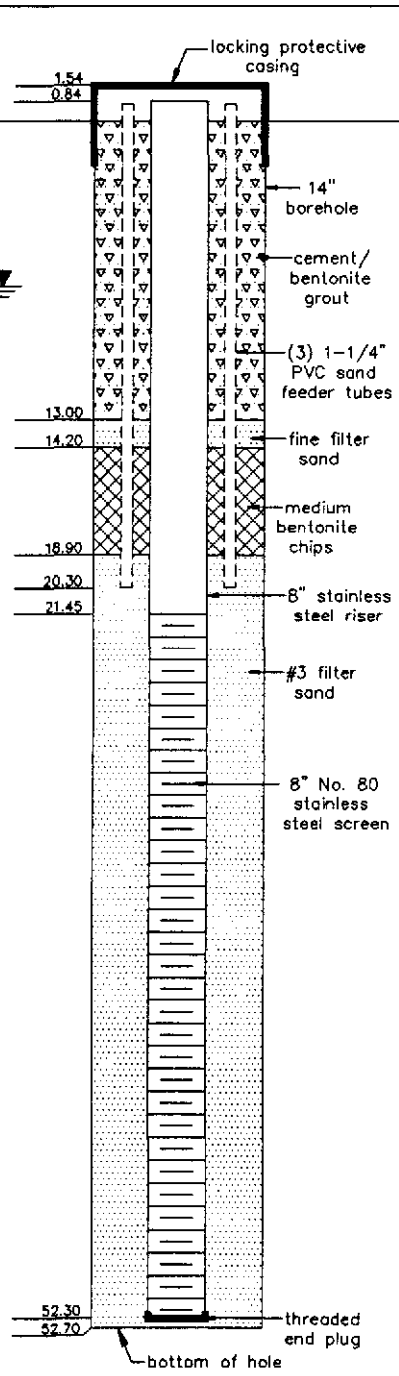
JOB NO.	913-6744	PROJECT	ISRT/ADDITIONAL PUMP TEST/MA	WELL NO.	E-5	SHEET	1 of 1
GA INSP.	GRF	DRILLING METHOD	AIR ROTARY (14 INCH)	GROUND ELEV.	64.0 ft.	WATER DEPTH	7.16 ft.
WEATHER	SUNNY	DRILLING COMPANY	D. L. MAHER	TOP PVC ELEV.	64.84 ft.	DATE/TIME	10-02-91/1100
TEMP.	65° F.	DRILL RIG	BARBER RIG	DRILLER	JOHN BOWEN	STARTED (TIME / DATE)	100/09-30-91
						COMPLETED (TIME / DATE)	1000/10-04-91
LOCATION / COORDINATES	N: 552,280.7 E: 696,172.0						

MATERIALS INVENTORY

WELL CASING	8 in. dia. 22.29 l.f.	WELL SCREEN	8 in. dia. 30.85 l.f.	BENTONITE SEAL	PURE GOLD MEDIUM CHIPS
CASING TYPE	STAINLESS STEEL	SCREEN TYPE	STAINLESS STEEL	INSTALLATION METHOD	GRAVITY
JOINT TYPE	WELDED	SLOT SIZE	No. 80 MACHINE SLOTTED	FILTER PACK QTY.	(27) 100 lb. BAGS
GROUT QUANTITY	68 GALLONS	CENTRALIZERS	NONE USED	FILTER PACK TYPE	#3 SILICA SAND
GROUT TYPE	95% PORTLAND CEMENT/5% BENTONITE	DRILLING MUD TYPE	N/A	INSTALLATION METHOD	GRAVITY

DEPTH	SOIL/ROCK DESCRIPTION
	GROUND SURFACE
0.00	0.0–7.0 ft. Loose to compact, moderate to yellowish brown, m–f SAND, little silt, trace gravel, traces of roots (SP–SM). <FILL>
10.00	7.0–20.5 ft. Very soft to firm, black to dark brown, silty CLAY, to silty ORGANIC CLAY, little to some f sand, occasional to frequent roots and root mass, slight hydrogen sulfide odor (CL to OH). <POSSIBLE FILL OR PEAT>
20.00	20.5–27.5 ft. Compact to very dense, medium gray, c–f SAND, some gravel, trace silt (SW). <POSSIBLE FILL> or <OUTWASH SAND>
30.00	27.5–31.5 ft. Compact to dense, medium gray to moderate brown c–f SAND, little silt, trace gravel (SP–SM). <OUTWASH SAND>
40.00	31.5–52.6 ft. Loose to dense, moderate to yellowish brown, c–f SAND, trace to little silt, occasional medium gray fine sand lenses (SP–SM). <OUTWASH SAND>
50.00	52.6–54.1 ft. Very dense, medium to olive gray, c–f SAND and GRAVEL, little to some silt (SM). <GLACIAL TILL> (Possible weathered bedrock at pilot hole refusal)

WELL SKETCH



INSTALLATION NOTES

E-5 (pilot) borehole backfilled/grouted. Second borehole drilled to construct well.

Three 1.25 inch PVC pipes were placed around stainless steel riser and filled with sand pack in the event that sand pack settles during development/pump test.

Measuring point is top of stainless steel casing at seam.

Water level at 8.0 ft. below ground surface during drilling of pilot hole.

Water encountered at approximately 8.0 ft. below ground surface.

WELL DEVELOPMENT NOTES

Pumped at 45 gpm and used surge blocks for 2 hours. Water clear, even with surging after 1.5 hours. Maximum drawdown in well was 0.5 feet.

Pumped at 137 to 157 gpm with surging for 1.75 hours. Water clear, even with surging. Maximum drawdown was 1.4 feet. No sediment in discharge, but was has a faint yellow color.

Pumped at 235 gpm for 1 hour. No sediment in discharge, even with surging. Water has a white foam in discharge, and faint yellow color. Maximum drawdown was 2.25 feet after 25 minutes. 90% recovery after 8 minutes.

MONITORING WELL INSTALLATION LOG

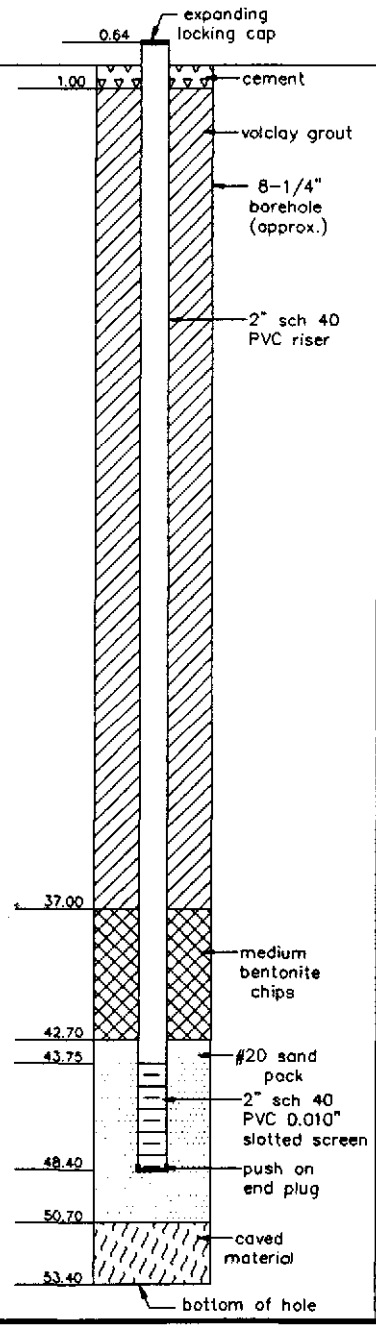
JOB NO. 913-6744 PROJECT ISRT/ADDITIONAL PUMP TEST/MA WELL NO. P-1 SHEET 1 of 1
GA INSP. RMG DRILLING METHOD 4-1/4" ID HOLLOW STEM AUGERS GROUND ELEV. 64.4 ft. WATER DEPTH 7.4 ft.
WEATHER DRIZZLE DRILLING COMPANY D. L. MAHER TOP PVC ELEV. 65.04 ft. DATE/TIME 10-03-91/0900
TEMP. 65° F. DRILL RIG BRAT 22R DRILLER JEFF QUINN STARTED 1400/09-14-91 (TIME / DATE) COMPLETED 0930/09-20-91 (TIME / DATE)
LOCATION / COORDINATES N: 552,297.0 E: 696,131.2

MATERIALS INVENTORY

WELL CASING 2 in. dia. 44.39 l.f. WELL SCREEN 2 in. dia. 4.65 l.f. BENTONITE SEAL PURE GOLD MEDIUM CHIPS
CASING TYPE SCH 40 PVC SCREEN TYPE SCH 40 PVC INSTALLATION METHOD GRAVITY
JOINT TYPE FLUSH THREADED SLOT SIZE 0.010" MACHINE SLOTTED FILTER PACK QTY. 150 lbs.
GROUT QUANTITY APPROX. 110 GALLONS CENTRALIZERS NONE USED FILTER PACK TYPE MYSTIC WHITE #20 SILICA SAND
GROUT TYPE VOLCLAY DRILLING MUD TYPE N/A INSTALLATION METHOD GRAVITY

DEPTH	SOIL/ROCK DESCRIPTION
	GROUND SURFACE
0.00	0.0-14.0 ft. Very loose to loose, deep purplish red, c-f SAND, little silt (SP-SM). <FILL>
10.00	14.0-17.5 ft. Very soft, dark brown to black SILT, some sand, possible hide residue, root mass (CL). <POSSIBLE FILL>
20.00	17.5-22.0 ft. Soft, pale olive gray, clayey SILT, little, fine sand, occasional roots (CL). <POSSIBLE FILL>
	22.0-35.0 ft. Dense, pale yellowish brown to pale olive gray, c-f SAND and GRAVEL, little silt (SP-SM). <POSSIBLE FILL>
30.00	
40.00	35.0-52.0 ft. Compact, medium brown to yellowish brown, c-f SAND, trace silt, trace to little gravel, occasional dark gray to reddish gray silt lens (0.2 ft. thick) (SP). <OUTWASH SAND>
50.00	52.0-53.4 ft. Compact, olive gray GRAVEL and SAND, trace silt (GW). <TILL> Auger refusal at 53.4 ft. <BEDROCK> BORING TERMINATED AT 53.4 FT. BELOW GROUND SURFACE

WELL SKETCH



INSTALLATION NOTES

GROUT VOLUME ESTIMATE

$V = \pi r^2 h (7.48)$ gallons
$= (3.14)(0.33)^2 (36.0)(7.48)$
$= 92$ gallons

Measuring point is notch in top of PVC.

Water encountered at approximately 9.0 ft. below ground surface.

WELL DEVELOPMENT NOTES

The well was developed on 09-26-91 with a centrifugal pump and surge block until the water was clear of sediment. 275 gallons of water were removed.

Golder Associates

MONITORING WELL INSTALLATION LOG

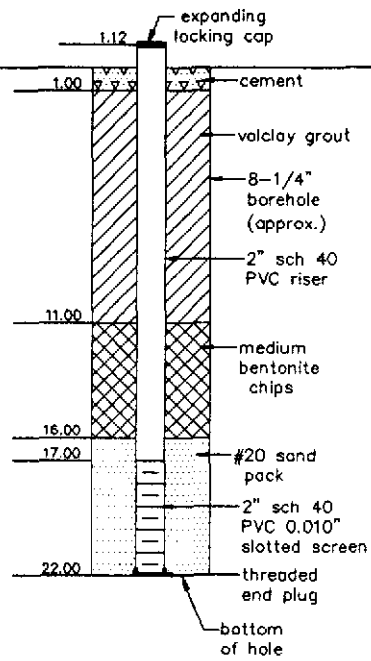
JOB NO. 913-6744 PROJECT ISRT/ADDITIONAL PUMP TEST/MA WELL NO. P-2S SHEET 1 of 1
GA INSP. D. LEY DRILLING METHOD 4-1/4" ID HOLLOW STEM AUGERS GROUND ELEV. 65.2 ft. WATER DEPTH 8.56 ft.
WEATHER PARTLY CLOUDY DRILLING COMPANY D. L. MAHER TOP PVC ELEV. 66.32 ft. DATE/TIME 10-03-91/0900
TEMP. 75° F. DRILL RIG BRAT 22R DRILLER J. MORAN STARTED 1430/09-18-91 (TIME / DATE) COMPLETED 1200/09-19-91 (TIME / DATE)
LOCATION / COORDINATES N: 552,256.2 E: 696,217.0

MATERIALS INVENTORY

WELL CASING 2 in. dia. 18.12 l.f. WELL SCREEN 2 in. dia. 5 l.f. BENTONITE SEAL PURE GOLD MEDIUM CHIPS
CASING TYPE SCH 40 PVC SCREEN TYPE SCH 40 PVC INSTALLATION METHOD GRAVITY
JOINT TYPE FLUSH THREADED SLOT SIZE 0.010" MACHINE SLOTTED FILTER PACK QTY. 150 lbs.
GROUT QUANTITY 26 GALLONS CENTRALIZERS NONE USED FILTER PACK TYPE MYSTIC WHITE #20 SILICA SAND
GROUT TYPE VOLCLAY DRILLING MUD TYPE N/A INSTALLATION METHOD GRAVITY

DEPTH	SOIL/ROCK DESCRIPTION
	GROUND SURFACE
0.00	FOR SOIL DESCRIPTIONS SEE BOREHOLE LOG FOR P-2D.
10.00	
20.00	BORING TERMINATED AT 22.0 FT. BELOW GROUND SURFACE.
30.00	
40.00	
50.00	

WELL SKETCH



INSTALLATION NOTES

GROUT VOLUME ESTIMATE

$V = \pi r^2 h (7.48)$ gallons
$= (3.14)(0.33)^2 (10.0)(7.48)$
$= 26$ gallons

Measuring point is notch in top of PVC.

WELL DEVELOPMENT NOTES

The well was developed on 09-26-91 with a centrifugal pump and surge block until the water was clear of sediment. Approximately 100 gallons of water were removed.

MONITORING WELL INSTALLATION LOG

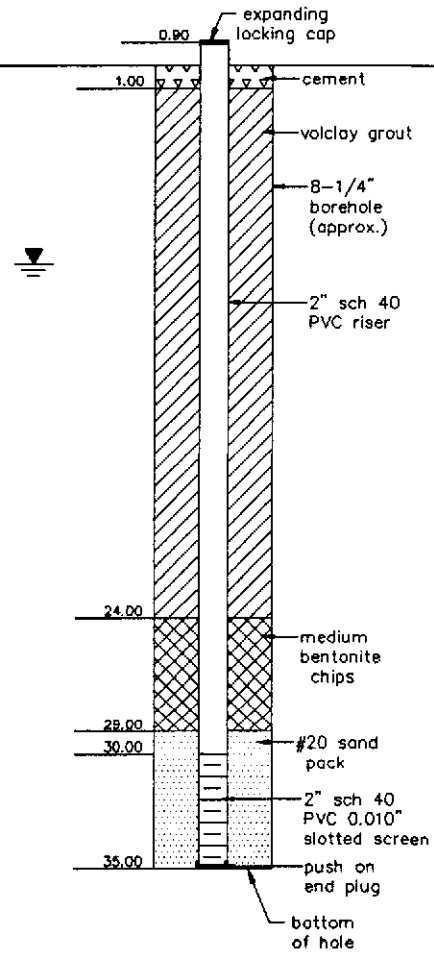
JOB NO.	913-6744	PROJECT	ISRT/ADDITIONAL PUMP TEST/MA	WELL NO.	P-2I	SHEET	1 of 1
GA INSP.	D. LEY	DRILLING METHOD	4-1/4" ID HOLLOW STEM AUGERS	GROUND ELEV.	65.2 ft.	WATER DEPTH	8.58 ft.
WEATHER	OVERCAST	DRILLING COMPANY	D. L. MAHER	TOP PVC ELEV.	66.14 ft.	DATE/TIME	10-03-91/0900
TEMP.	70° F.	DRILL RIG	BRAT 22R	DRILLER	J. MORAN	STARTED	1030/09-19-91 (TIME / DATE)
						COMPLETED	0830/09-20-91 (TIME / DATE)
LOCATION / COORDINATES	N: 552,252.8 E: 696,211.9						

MATERIALS INVENTORY

WELL CASING	2 in. dia. 30.90 l.f.	WELL SCREEN	2 in. dia. 5 l.f.	BENTONITE SEAL	PURE GOLD MEDIUM CHIPS
CASING TYPE	SCH 40 PVC	SCREEN TYPE	SCH 40 PVC	INSTALLATION METHOD	GRAVITY
JOINT TYPE	FLUSH THREADED	SLOT SIZE	0.010" MACHINE SLOTTED	FILTER PACK QTY.	100 lbs.
GROUT QUANTITY	54 GALLONS	CENTRALIZERS	NONE USED	FILTER PACK TYPE	MYSTIC WHITE #20 SILICA SAND
GROUT TYPE	VOLCLAY	DRILLING MUD TYPE	N/A	INSTALLATION METHOD	GRAVITY

DEPTH	SOIL/ROCK DESCRIPTION
	GROUND SURFACE
0.00	FOR SOIL DESCRIPTIONS SEE BOREHOLE LOG FOR P-2D.
10.00	
20.00	
30.00	
	BORING TERMINATED AT 35.0 FT. BELOW GROUND SURFACE.
40.00	
50.00	

WELL SKETCH



INSTALLATION NOTES

GROUT VOLUME ESTIMATE

$V = \pi r^2 h (7.48)$ gallons

$= (3.14)(0.33)^2 (23.0)(7.48)$

$= 59$ gallons

Measuring point is notch in top of PVC.

WELL DEVELOPMENT NOTES

The well was developed on 09-25-91 with a centrifugal pump and surge block until the water was clear of sediment. Approximately 175 gallons of water were removed @ approx. 5 gpm.

MONITORING WELL INSTALLATION LOG

JOB NO. 913-6744 PROJECT ISRT/ADDITIONAL PUMP TEST/MA WELL NO. P-20 SHEET 1 of 2
GA INSP. D. LEY DRILLING METHOD 4-1/4" ID HOLLOW STEM AUGERS GROUND ELEV. 65.5 ft. WATER DEPTH 8.86 ft.
WEATHER SUNNY DRILLING COMPANY D. L. MAHER TOP PVC ELEV. 66.45 ft. DATE/TIME 10-03-91/0900
TEMP. 90° F. DRILL RIG BRAT 22R DRILLER J. MORAN STARTED 1430/09-17-91 (TIME / DATE) COMPLETED 1600/09-18-91 (TIME / DATE)
LOCATION / COORDINATES N: 552,258.2 E: 696,212.2

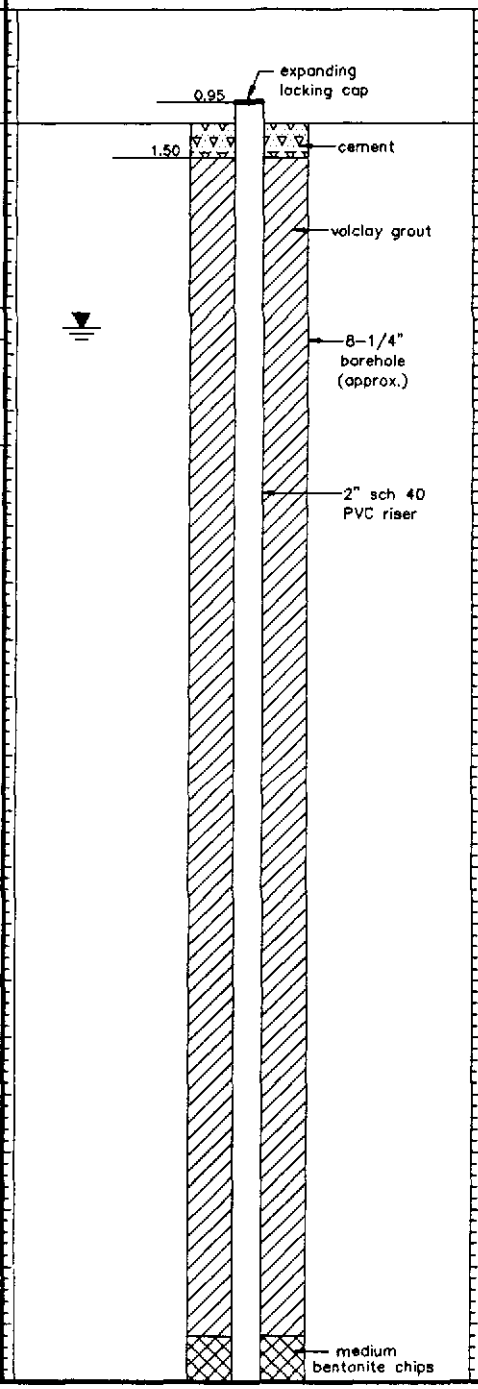
MATERIALS INVENTORY

WELL CASING 2 in. dia. 59.95 l.f. WELL SCREEN 2 in. dia. 5 l.f. BENTONITE SEAL PURE GOLD MEDIUM CHIPS
CASING TYPE SCH 40 PVC SCREEN TYPE SCH 40 PVC INSTALLATION METHOD GRAVITY
JOINT TYPE FLUSH THREADED SLOT SIZE 0.010" MACHINE SLOTTED FILTER PACK QTY. 150 lbs.
GROUT QUANTITY 144 GALLONS CENTRALIZERS NONE USED FILTER PACK TYPE MYSTIC WHITE #20 SILICA SAND
GROUT TYPE VOLCLAY DRILLING MUD TYPE N/A INSTALLATION METHOD GRAVITY

DEPTH	SOIL/ROCK DESCRIPTION
	GROUND SURFACE
0.00	0.0-8.0 ft. Loose to compact, pale to dark yellowish brown, c-f SAND, some gravel from 0.0-2.0 ft., trace silt (SP). <FILL>
	8.0-9.35 ft. Firm, brown to black SILT, little m-f sand (ML). <POSSIBLE FILL>
10.00	9.35-14.0 ft. Compact to very dense, olive gray, c-f SAND and GRAVEL, trace to little silt (SP to SP-SM). <POSSIBLE FILL>
20.00	14.0-52.0 ft. Loose to very dense, yellowish brown to gray, c-f SAND, trace to little gravel, trace silt (SP). <OUTWASH SAND>
30.00	29.4-30.0 ft. m-f SAND and SILT (SM).
40.00	
50.00	52.0-56.0 ft. Dense to very dense, yellowish brown to pale olive, c-f SAND and GRAVEL, trace silt (SP). <OUTWASH SAND>

CONTINUED ON NEXT PAGE

WELL SKETCH



INSTALLATION NOTES

GROUT VOLUME ESTIMATE

$V = \pi r^2 h (7.48)$ gallons
$= (3.14)(0.33)^2 (53.0)(7.48)$
$= 135$ gallons

Measuring point is notch in top of PVC.

Water encountered at approximately 10.5 ft. below ground surface during drilling.

WELL DEVELOPMENT NOTES

The well was developed on 09-26-91 with a centifugal pump and surge block until the water was clear of sediment. Unable to maintain pumping at 5-10 gpm. Approximately 50 gallons of water were removed.

MONITORING WELL INSTALLATION LOG

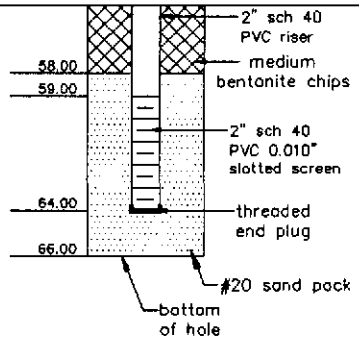
JOB NO.	913-6744	PROJECT	ISRT/ADDITIONAL PUMP TEST/MA	WELL NO.	P-20	SHEET	2 of 2
GA INSP.	D. LEY	DRILLING METHOD	4-1/4" ID HOLLOW STEM AUGERS	GROUND ELEV.	65.5 ft.	WATER DEPTH	8.86 ft.
WEATHER	SUNNY	DRILLING COMPANY	D. L. MAHER	TOP PVC ELEV.	66.45 ft.	DATE/TIME	10-03-91/0900
TEMP.	90° F.	DRILL RIG	BRAT 22R	DRILLER	J. MORAN	STARTED (TIME / DATE)	1430/09-17-91
						COMPLETED (TIME / DATE)	1600/09-18-91
LOCATION / COORDINATES	N: 552,258.2 E: 696,212.2						

MATERIALS INVENTORY

WELL CASING	2 in. dia. 59.95 l.f.	WELL SCREEN	2 in. dia. 5 l.f.	BENTONITE SEAL	PURE GOLD MEDIUM CHIPS
CASING TYPE	SCH 40 PVC	SCREEN TYPE	SCH 40 PVC	INSTALLATION METHOD	GRAVITY
JOINT TYPE	FLUSH THREADED	SLOT SIZE	0.010" MACHINE SLOTTED	FILTER PACK QTY.	150 lbs.
GROUT QUANTITY	144 GALLONS	CENTRALIZERS	NONE USED	FILTER PACK TYPE	MYSTIC WHITE #20 SILICA SAND
GROUT TYPE	VOLCLAY	DRILLING MUD TYPE	N/A	INSTALLATION METHOD	GRAVITY

DEPTH	SOIL/ROCK DESCRIPTION
	52.0–56.0 ft. Dense to very dense, yellowish brown to pale olive, c–f SAND and GRAVEL, trace silt (SP). <OUTWASH SAND>
60.00	56.0–64.8 ft. Dense to very dense, yellowish brown to pale olive, c–f SAND, trace gravel, trace to little silt (SP to SP–SM). <OUTWASH SAND>
	64.8–66.0 ft. Very dense, olive gray, clayey SILT, some m–f sand, trace gravel (ML/CL). <TILL>
70.00	Auger refusal at 66.0 ft. <BEDROCK>
	BORING TERMINATED AT 66.0 FT. BELOW GROUND SURFACE
80.00	
90.00	
100.00	
110.00	

WELL SKETCH



INSTALLATION NOTES

GROUT VOLUME ESTIMATE

$V = r^2 h (7.48)$ gallons

$= (3.14)(0.33)^2 (53.0)(7.48)$

$= 135$ gallons

Measuring point is notch in top of PVC.

Water encountered at approximately 10.5 ft. below ground surface during drilling.

WELL DEVELOPMENT NOTES

The well was developed on 09-25-91 with a centifugal pump and surge block until the water was clear of sediment. Unable to maintain pumping at 5–10 gpm. Approximately 50 gallons of water were removed.

MONITORING WELL INSTALLATION LOG

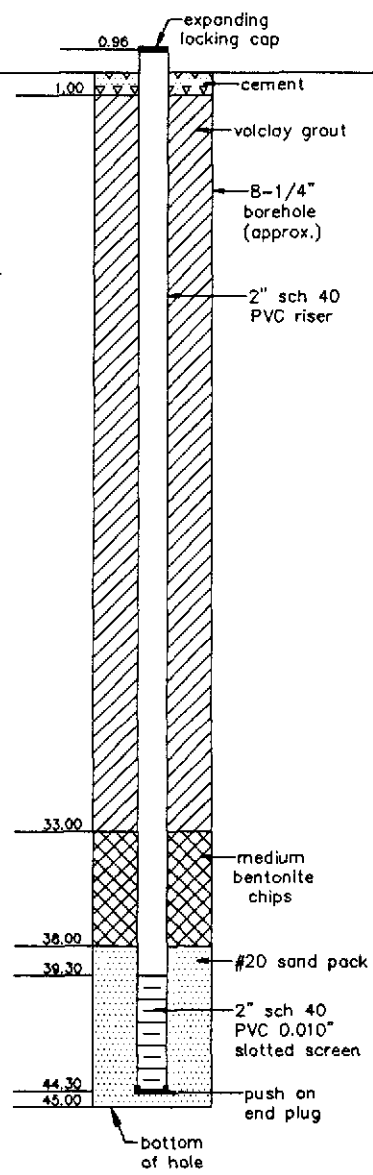
JOB NO. 913-6744 PROJECT ISRT/ADDITIONAL PUMP TEST/MA WELL NO. P-3S SHEET 1 of 1
GA INSP. RMG DRILLING METHOD 4-1/4" ID HOLLOW STEM AUGERS GROUND ELEV. 66.0 ft. WATER DEPTH 8.68 ft.
WEATHER PARTLY CLOUDY DRILLING COMPANY D. L. MAHER TOP PVC ELEV. 66.96 ft. DATE/TIME 10-03-91/0900
TEMP. 60° F. DRILL RIG ATV B-53 DRILLER J. GRAGLIA STARTED 1000/09-30-91 (TIME / DATE) COMPLETED 10-01-91 (TIME / DATE)
LOCATION / COORDINATES N: 552,334.7 E: 696,039.3

MATERIALS INVENTORY

WELL CASING 2 in. dia. 40.26 l.f. WELL SCREEN 2 in. dia. 5 l.f. BENTONITE SEAL PURE GOLD MEDIUM CHIPS
CASING TYPE SCH 40 PVC SCREEN TYPE SCH 40 PVC INSTALLATION METHOD GRAVITY
JOINT TYPE FLUSH THREADED SLOT SIZE 0.010" MACHINE SLOTTED FILTER PACK QTY. 200 lbs.
GROUT QUANTITY APPROX. 75 GALLONS CENTRALIZERS NONE USED FILTER PACK TYPE MYSTIC WHITE #20 SILICA SAND
GROUT TYPE VOLCLAY DRILLING MUD TYPE N/A INSTALLATION METHOD GRAVITY

DEPTH	SOIL/ROCK DESCRIPTION
	GROUND SURFACE
0.00	FOR SOIL DESCRIPTION, SEE LOG FOR P-3D.
10.00	
20.00	
30.00	
40.00	
50.00	

WELL SKETCH



INSTALLATION NOTES

GROUT VOLUME ESTIMATE

$V = \pi r^2 h (7.48)$ gallons
$= (3.14)(0.33)^2 (32.0)(7.48)$
$= 82$ gallons

Measuring point is notch in top of PVC.

WELL DEVELOPMENT NOTES

The well was developed on 10-01-91 using a centrifugal pump and surge block until the water clear of sediment. Approximately 75 gallons of water were removed @ about 5 gpm.

MONITORING WELL INSTALLATION LOG

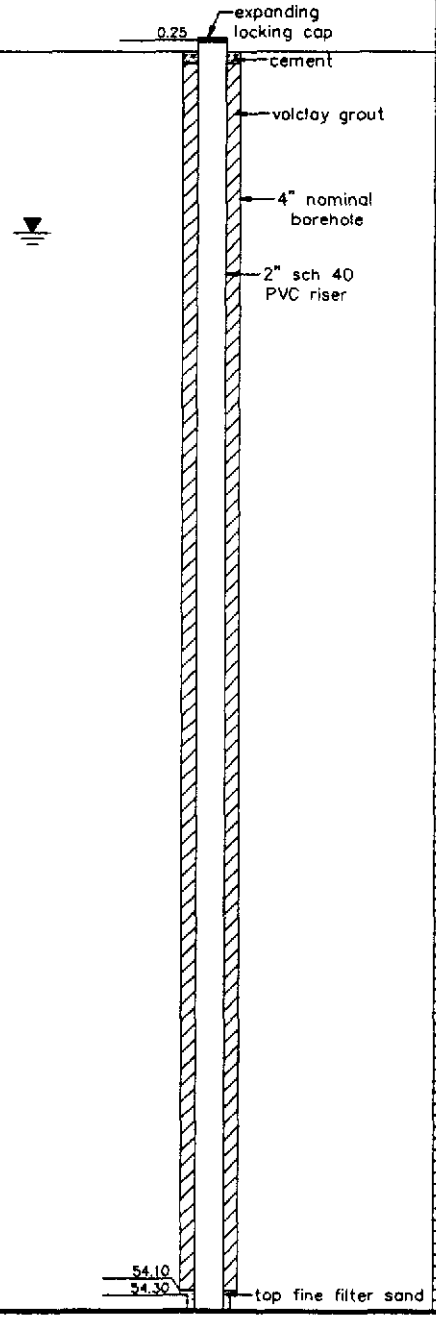
JOB NO. 913-6744 PROJECT ISRT/ADDITIONAL PUMP TEST/MA WELL NO. P-3D SHEET 1 of 2
GA INSP. GRF DRILLING METHOD DRIVEN 4" CASING, SPUN 3" CASING, ROLLER BIT GROUND ELEV. 66.0 ft. WATER DEPTH 8.85 ft.
WEATHER FINE, WINDY DRILLING COMPANY D. L. MAHER TOP PVC ELEV. 66.25 ft. DATE/TIME 10-03-91/0900
TEMP. 65° F. DRILL RIG ATV B-53 DRILLER J. GRAGLIA STARTED 09-28-91 (TIME / DATE) COMPLETED 0900/10-01-91 (TIME / DATE)
LOCATION / COORDINATES N: 552,339.0 E: 696,036.5

MATERIALS INVENTORY

WELL CASING 2 in. dia. 59.8 l.f. WELL SCREEN 2 in. dia. 10.2 l.f. BENTONITE SEAL PURE GOLD MEDIUM CHIPS
CASING TYPE SCH 40 PVC SCREEN TYPE SCH 40 PVC INSTALLATION METHOD GRAVITY
JOINT TYPE FLUSH THREADED SLOT SIZE 0.010" MACHINE SLOTTED FILTER PACK QTY. 50 lbs.
GROUT QUANTITY APPROX. 75 GALLONS CENTRALIZERS NONE USED FILTER PACK TYPE MYSTIC WHITE #20 SILICA SAND
GROUT TYPE VOLCLAY DRILLING MUD TYPE N/A INSTALLATION METHOD 3/4" PVC TREMMIE PIPE

DEPTH	SOIL/ROCK DESCRIPTION
	GROUND SURFACE
0.00	0.0–8.4 ft. Loose to very loose, dark brown to dusky red, c–f SAND, trace to some silt, trace gravel, roots (SP to SM). <FILL>
	8.4–9.0 ft. Soft, black PEAT, some clayey silt, root mass, (PT). <PEAT>
10.00	9.0–13.6 ft. Dense, reddish gray, c–f SAND and GRAVEL, trace to little silt (SP to SP–SM). <POSSIBLE FILL>
	13.6–49.0 ft. Loose to very dense, gray to light olive brown to yellowish brown, c–f SAND, trace to and gravel, trace silt, lenses with little silt (SP). <OUTWASH SAND>
20.00	
30.00	
40.00	
	Spoon refusal at 49.0 ft. <BEDROCK>
	54.3–74.3 ft. Slightly to moderately weathered, moderately foliated at 25–30 degrees to the core axis, moderate to dark green, fine to medium grained, slightly altered (moderate in places) GABBRO.
50.00	CONTINUED ON NEXT PAGE

WELL SKETCH



INSTALLATION NOTES

GROUT VOLUME ESTIMATE

$V = \pi r^2 h (7.48)$ gallons
$= (3.14)(0.167)^2 (53.1)(7.48)$
$= 35$ gallons

Measuring point is notch in top of PVC.

Drove 4" casing to 53 ft. poor seal but refusal. Spun 3" casing to 54 ft. poor seal but refusal. NX core barrel jammed for the first 4 feet. Bedrock highly weathered and fractured (see drillhole log). Lost circulation during coring. Corehole reamed with roller bit.

Water encountered at 10.7 ft. below ground surface during drilling.

WELL DEVELOPMENT NOTES

The well was developed on 10-01-91 using a centrifugal pump and surge block until the water was clear of sediment. Approx. 100 gallons of water were removed @ about 5 gpm.

MONITORING WELL INSTALLATION LOG

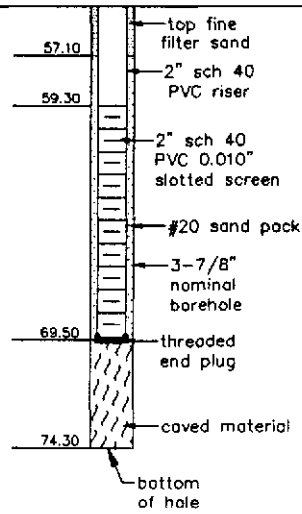
JOB NO.	913-6744	PROJECT	ISRT/ADDITIONAL PUMP TEST/MA	WELL NO.	P-30	SHEET	2 of 2
GA INSP.	GRF	DRILLING METHOD	DRIVEN 4" CASING, SPUN 3" CASING, ROLLER BIT	GROUND ELEV.	66.0 ft.	WATER DEPTH	8.85 ft.
WEATHER	FINE, WINDY	DRILLING COMPANY	D. L. MAHER	TOP PVC ELEV.	66.25 ft.	DATE/TIME	10-03-91/0900
TEMP.	65° F.	DRILL RIG	ATV B-53	DRILLER	J. GRAGLIA	STARTED (TIME / DATE)	09-28-91
						COMPLETED (TIME / DATE)	0900/10-01-91
LOCATION / COORDINATES	N: 552,339.0 E: 696,036.5						

MATERIALS INVENTORY

WELL CASING	2 in. dia. 59.8 l.f.	WELL SCREEN	2 in. dia. 10.2 l.f.	BENTONITE SEAL	PURE GOLD MEDIUM CHIPS
CASING TYPE	SCH 40 PVC	SCREEN TYPE	SCH 40 PVC	INSTALLATION METHOD	GRAVITY
JOINT TYPE	FLUSH THREADED	SLOT SIZE	0.010" MACHINE SLOTTED	FILTER PACK QTY.	50 lbs.
GROUT QUANTITY	APPROX. 75 GALLONS	CENTRALIZERS	NONE USED	FILTER PACK TYPE	MYSTIC WHITE #20 SILICA SAND
GROUT TYPE	VOLCLAY	DRILLING MUD TYPE	N/A	INSTALLATION METHOD	3/4" PVC TREMMIE PIPE

DEPTH	SOIL/ROCK DESCRIPTION
60.00	54.3–74.3 ft. Slightly to moderately weathered, moderately foliated at 25–30 degrees to the core axis, moderate to dark green, fine to medium grained, slightly altered (moderate in places) GABBRO. See record of drillhole for fracture data.
70.00	BORING TERMINATED AT 74.3 FT. BELOW GROUND SURFACE
80.00	
90.00	
100.00	
110.00	

WELL SKETCH



INSTALLATION NOTES

GROUT VOLUME ESTIMATE

$V = \pi r^2 h (7.48)$ gallons

$= (3.14)(0.167)^2 (53.1)(7.48)$

≈ 35 gallons

Measuring point is notch in top of PVC.

Drove 4" casing to 53 ft. poor seal but refusal. Spun 3" casing to 54 ft. poor seal but refusal. NX core barrel jammed for the first 4 feet. Bedrock highly weathered and fractured (see drillhole log). Lost circulation during coring. Corehole reamed with roller bit.

Water encountered at 10.7 ft. below ground surface during drilling.

WELL DEVELOPMENT NOTES

The well was developed on 10-01-91 using a centrifugal pump and surge block until the water was clear of sediment. Approx. 100 gallons of water were removed @ about 5 gpm.

MONITORING WELL INSTALLATION LOG

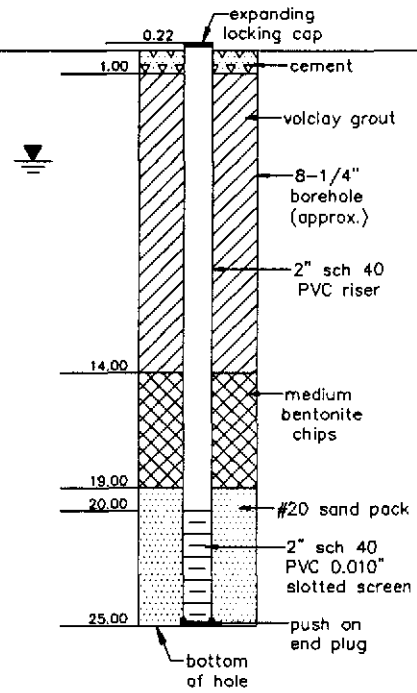
JOB NO. 913-6744 PROJECT ISRT/ADDITIONAL PUMP TEST/MA WELL NO. P-4S SHEET 1 of 1
GA INSP. D. LEY DRILLING METHOD 4-1/4" ID HOLLOW STEM AUGERS GROUND ELEV. 61.4 ft. WATER DEPTH 4.84 ft.
WEATHER SUNNY DRILLING COMPANY D. L. MAHER TOP PVC ELEV. 61.62 ft. DATE/TIME 10-03-91/0900
TEMP. 60° F. DRILL RIG BRAT 22R DRILLER J. MORAN STARTED 1415/09-27-91 (TIME / DATE) COMPLETED 1600/09-27-91 (TIME / DATE)
LOCATION / COORDINATES N: 552,174.0 E: 696,382.9

MATERIALS INVENTORY

WELL CASING 2 in. dia. 20.22 l.f. WELL SCREEN 2 in. dia. 5 l.f. BENTONITE SEAL PURE GOLD MEDIUM CHIPS
CASING TYPE SCH 40 PVC SCREEN TYPE SCH 40 PVC INSTALLATION METHOD GRAVITY
JOINT TYPE FLUSH THREADED SLOT SIZE 0.010" MACHINE SLOTTED FILTER PACK QTY. 100 lbs.
GROUT QUANTITY 40 GALLONS CENTRALIZERS NONE USED FILTER PACK TYPE MYSTIC WHITE #20 SILICA SAND
GROUT TYPE VOLCLAY DRILLING MUD TYPE N/A INSTALLATION METHOD GRAVITY

DEPTH	SOIL/ROCK DESCRIPTION
	GROUND SURFACE
0.00	FOR SOIL DESCRIPTION, SEE LOGS FOR P-4I AND P-4D.
10.00	
20.00	
30.00	
40.00	
50.00	

WELL SKETCH



INSTALLATION NOTES

GROUT VOLUME ESTIMATE

$V = \pi r^2 h (7.48)$ gallons
$= (3.14)(0.33)^2 (13.0)(7.48)$
$= 34$ gallons

Measuring point is notch in top of PVC.

WELL DEVELOPMENT NOTES

The well was developed on 10-01-91 using a centrifugal pump and surge block until the water was clear of sediment. Approximately 100 gallons of water were removed @ about 10 to 5 gpm.

MONITORING WELL INSTALLATION LOG

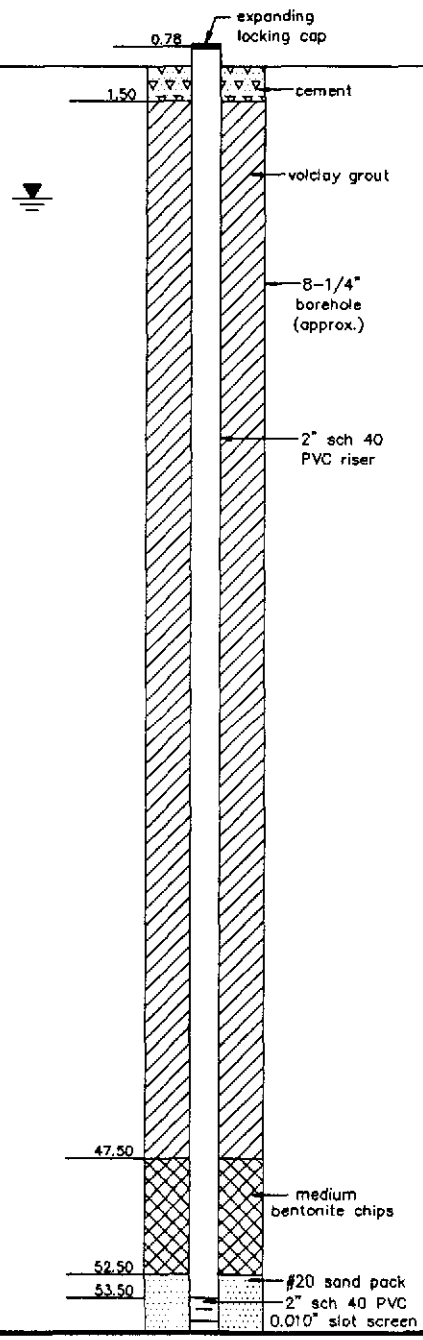
JOB NO. 913-6744 PROJECT ISRT/ADDITIONAL PUMP TEST/MA WELL NO. P-41 SHEET 1 of 2
GA INSP. V. FOSTER DRILLING METHOD 4-1/4" ID HOLLOW STEM AUGERS GROUND ELEV. 61.8 ft. WATER DEPTH 5.71 ft.
WEATHER OVERCAST DRILLING COMPANY D. L. MAHER TOP PVC ELEV. 62.58 ft. DATE/TIME 10-03-91/0900
TEMP. 70° F. DRILL RIG ATV MOBILE B53 DRILLER J. GRAGLIA STARTED 0800/09-16-91 (TIME / DATE) COMPLETED 1200/09-16-91 (TIME / DATE)
LOCATION / COORDINATES N: 552,183.8 E: 696,379.2

MATERIALS INVENTORY

WELL CASING 2 in. dia. 54.28 l.f. WELL SCREEN 2 in. dia. 5 l.f. BENTONITE SEAL PURE GOLD MEDIUM CHIPS
CASING TYPE SCH 40 PVC SCREEN TYPE SCH 40 PVC INSTALLATION METHOD GRAVITY
JOINT TYPE FLUSH THREADED SLOT SIZE 0.010" MACHINE SLOTTED FILTER PACK QTY. 200 lbs.
GROUT QUANTITY APPROX. 110 GALLONS CENTRALIZERS NONE USED FILTER PACK TYPE MYSTIC WHITE #20 SILICA SAND
GROUT TYPE VOLCLAY DRILLING MUD TYPE N/A INSTALLATION METHOD GRAVITY

DEPTH	SOIL/ROCK DESCRIPTION
	GROUND SURFACE
0.00	0.0-2.5 ft. Dense, very dark brown, becoming brownish yellow, c-f SAND and GRAVEL, trace to little silt, root mass present from 0.0-0.3 ft. (SP to SP-SM). <FILL>
	2.5-7.5 ft. Compact, light brownish yellow, c-f SAND, some gravel (SP). <POSSIBLE FILL>
10.00	7.5-46.0 ft. Loose to dense, gray to dark gray, c-f SAND, trace to little gravel, trace to little silt, odiferious from 10.0-12.0 ft. (SP to SP-SM). <OUTWASH SAND>
20.00	
30.00	
40.00	
	46.0-52.0 ft. Compact to dense, light olive gray, m-f SAND, some silt (SM). <OUTWASH SAND>
50.00	52.0-61.1 ft. Dense, pale gray to gray, m-f SAND, some silt (SM). <OUTWASH SAND>
	CONTINUED ON NEXT PAGE

WELL SKETCH



INSTALLATION NOTES

GROUT VOLUME ESTIMATE

$V = \pi r^2 h (7.48)$ gallons
$= (3.14)(0.33)^2 (46.5)(7.48)$
$= 1.21$ gallons

Measuring point is notch in top of PVC.

Water encountered at about 7.3 ft. below ground surface during drilling.

WELL DEVELOPMENT NOTES

The well was developed on 10-01-91 using a centifugal pump and surging block until the water was clear of sediment. About 150 gallons of water were removed @ about 5 gpm.

MONITORING WELL INSTALLATION LOG

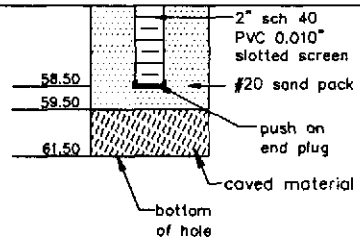
JOB NO. 913-6744 PROJECT ISRT/ADDITIONAL PUMP TEST/MA WELL NO. P-41 SHEET 2 of 2
GA INSP. V. FOSTER DRILLING METHOD 4-1/4" ID HOLLOW STEM AUGERS GROUND ELEV. 61.8 ft. WATER DEPTH 5.71 ft.
WEATHER OVERCAST DRILLING COMPANY D. L. MAHER TOP PVC ELEV. 62.58 ft. DATE/TIME 10-03-91/0900
TEMP. 70° F. DRILL RIG ATV MOBILE B53 DRILLER J. GRAGLIA STARTED 0800/09-16-91 (TIME / DATE) COMPLETED 1200/09-16-91 (TIME / DATE)
LOCATION / COORDINATES N: 552,183.8 E: 696,379.2

MATERIALS INVENTORY

WELL CASING 2 in. dia. 54.28 l.f. WELL SCREEN 2 in. dia. 5 l.f. BENTONITE SEAL PURE GOLD MEDIUM CHIPS
CASING TYPE SCH 40 PVC SCREEN TYPE SCH 40 PVC INSTALLATION METHOD GRAVITY
JOINT TYPE FLUSH THREADED SLOT SIZE 0.010" MACHINE SLOTTED FILTER PACK QTY. 200 lbs.
GROUT QUANTITY APPROX. 110 GALLONS CENTRALIZERS NONE USED FILTER PACK TYPE MYSTIC WHITE #20 SILICA SAND
GROUT TYPE VOLCLAY DRILLING MUD TYPE N/A INSTALLATION METHOD GRAVITY

DEPTH	SOIL/ROCK DESCRIPTION
	52.0–61.1 ft. Dense, pale gray to gray, m–f SAND, some silt (SM).
60.00	<OUTWASH SAND>
	61.1–61.5 ft. Dense, pale olive gray, f SAND and SILT (SM). <TILL> Auger refusal at 61.5 ft.
	BORING TERMINATED AT 61.5 FT. BELOW GROUND SURFACE
70.00	
80.00	
90.00	
100.00	
110.00	

WELL SKETCH



INSTALLATION NOTES

GROUT VOLUME ESTIMATE

$V = \pi r^2 h (7.48)$ gallons
$= (3.14)(0.33)^2 (46.5)(7.48)$
$= 121$ gallons

Measuring point is notch in top of PVC.

Water encountered at about 7.3 ft. below ground surface during drilling.

WELL DEVELOPMENT NOTES

The well was developed on 10-01-91 using a centifugal pump and surging block until the water was clear of sediment. About 150 gallons of water were removed @ about 5 gpm.

MONITORING WELL INSTALLATION LOG

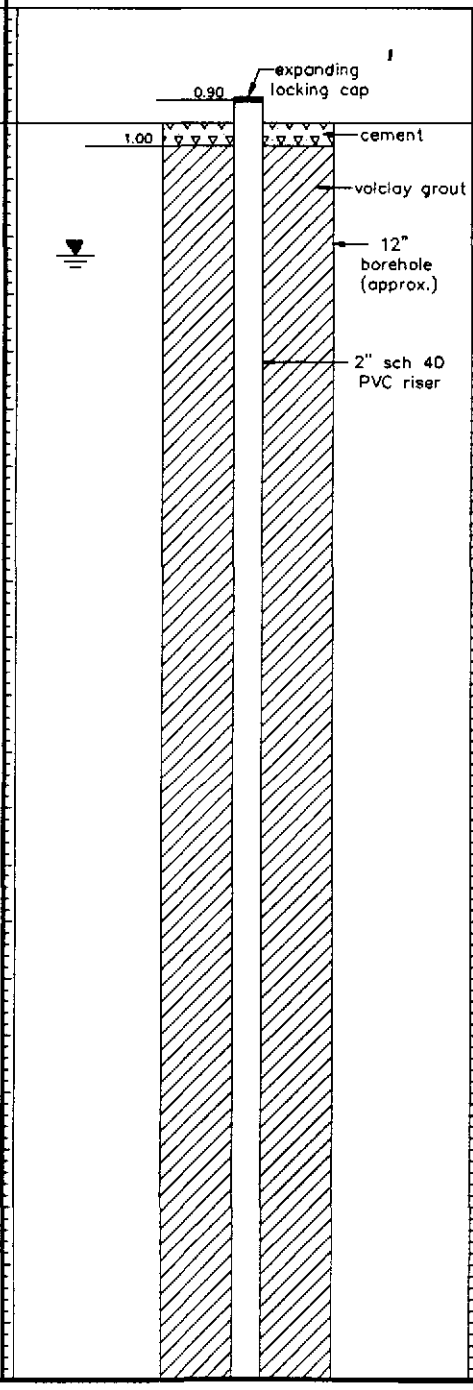
JOB NO.	913-6744	PROJECT	ISRT/ADDITIONAL PUMP TEST/MA	WELL NO.	P-4D	SHEET	1 of 2
GA INSP.	D. LEY	DRILLING METHOD	8-1/4" ID HSA/NQ HOLE REAMED TO 4"	GROUND ELEV.	61.8 ft.	WATER DEPTH	5.82 ft.
WEATHER	SUNNY	DRILLING COMPANY	D. L. MAHER	TOP PVC ELEV.	62.70 ft.	DATE/TIME	10-04-91/1030
TEMP.	60° F.	DRILL RIG	ATV B-53/BRAT 22R	DRILLER	J. GRAGLIA/J. MORAN	STARTED	1400/09-24-91 (TIME / DATE)
						COMPLETED	0900/10-01-91 (TIME / DATE)
LOCATION / COORDINATES	N: 552,178.2 E: 696,380.7						

MATERIALS INVENTORY

WELL CASING	2 in. dia. 74.90 l.f.	WELL SCREEN	2 in. dia. 10 l.f.	BENTONITE SEAL	VOLCLAY
CASING TYPE	SCH 40 PVC	SCREEN TYPE	SCH 40 PVC	INSTALLATION METHOD	TREMIE METHOD
JOINT TYPE	FLUSH THREADED	SLOT SIZE	0.010" MACHINE SLOTTED	FILTER PACK QTY.	100 lbs.
GROUT QUANTITY	APPROX. 165 GALLONS	CENTRALIZERS	NONE USED	FILTER PACK TYPE	MYSTIC WHITE #20 SILICA SAND
GROUT TYPE	VOLCLAY	DRILLING MUD TYPE	N/A	INSTALLATION METHOD	TREMIE METHOD

DEPTH	SOIL/ROCK DESCRIPTION
	GROUND SURFACE
0.00	0.0-68.5 ft. SEE LOG FOR P-4D FOR SOIL DESCRIPTIONS.
10.00	
20.00	
30.00	
40.00	
50.00	
	CONTINUED ON NEXT PAGE

WELL SKETCH



INSTALLATION NOTES

GROUT VOLUME ESTIMATE

$V = \pi[(r_1^2 h_1^2) + (r_2^2 h_2^2)](7.48)$

r_1 (0.0-65.0) = 0.5

h_1 = 65.0 ft.

r_2 (65.0-72.0) = 0.17

h_2 = 7.0 ft.

$V = (3.14)[(0.5)^2(65.0) + (0.17)^2 \times (7.0)](7.48) = 387$ GALLONS

Measuring point is notch in top of PVC riser.

WELL DEVELOPMENT NOTES

The well was developed on 10-01-91 using a centrifugal pump and surge block, but the well would go dry immediately. About 20 gallons of water were removed on 10-01-91 and 10-02-91 using a foot valve pump.

MONITORING WELL INSTALLATION LOG

JOB NO. 913-6744 PROJECT ISRT/ADDITIONAL PUMP TEST/MA WELL NO. P-40 SHEET 2 of 2

GA INSP. D. LEY DRILLING METHOD 8-1/4" ID HSA/NQ HOLE REAMED TO 4" GROUND ELEV. 61.8 ft. WATER DEPTH 5.82 ft.

WEATHER SUNNY DRILLING COMPANY D. L. MAHER TOP PVC ELEV. 62.70 ft. DATE/TIME 10-04-91/1030

TEMP. 60° F. DRILL RIG ATV B-53/BRAT 22R DRILLER J. GRAGLIA/J. MORAN STARTED 1400/09-24-91 (TIME / DATE) COMPLETED 0900/10-01-91 (TIME / DATE)

LOCATION / COORDINATES N: 552,178.2 E: 696,380.7

MATERIALS INVENTORY

WELL CASING 2 in. dia. 74.90 l.f. WELL SCREEN 2 in. dia. 10 l.f. BENTONITE SEAL VOLCLAY

CASING TYPE SCH 40 PVC SCREEN TYPE SCH 40 PVC INSTALLATION METHOD TREMIE METHOD

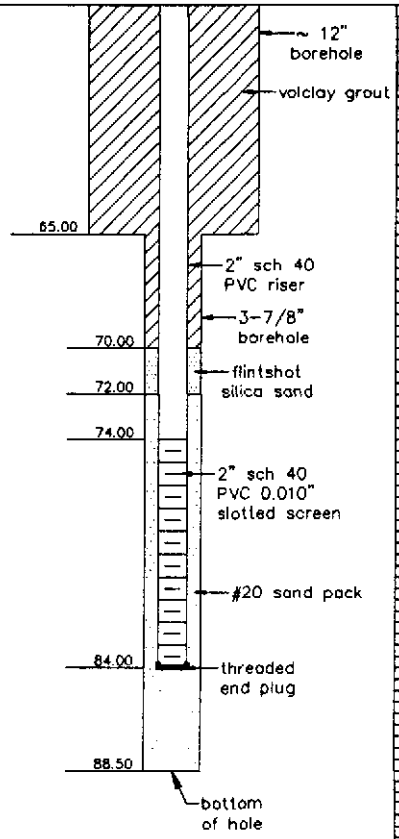
JOINT TYPE FLUSH THREADED SLOT SIZE 0.010" MACHINE SLOTTED FILTER PACK QTY. 100 lbs.

GROUT QUANTITY APPROX. 165 GALLONS CENTRALIZERS NONE USED FILTER PACK TYPE MYSTIC WHITE #20 SILICA SAND

GROUT TYPE VOLCLAY DRILLING MUD TYPE N/A INSTALLATION METHOD TREMIE METHOD

DEPTH	SOIL/ROCK DESCRIPTION
60.00	0.0-68.5 ft. SEE LOG FOR P-4D FOR SOIL DESCRIPTIONS.
70.00	68.5-88.5 ft. Fresh, moderately to strongly foliated @ 28-40 degrees to the core axis, dark green, fine to medium grained GABBRO.
80.00	72.1-73.5 ft. Series of sub-parallel faults @ 35-40 degrees to the core axis, offset 3-8mm; plunging at 90 degrees to the foliation. 75.15-75.50 ft. Broken core. 80.0-81.4 and 85.4-87.1 ft. Very fine grained, unfoliated, non-indurated gabbro.
90.00	BORING TERMINATED AT 88.5 FT. BELOW GROUND SURFACE
100.00	
110.00	

WELL SKETCH



INSTALLATION NOTES

GROUT VOLUME ESTIMATE

$V = \pi[(r_1^2 h_1) + (r_2^2 h_2)](7.48)$

r_1 (0.0-65.0) = 0.5

h_1 = 65.0 ft.

r_2 (65.0-72.0) = 0.17

h_2 = 7.0 ft.

$V = (3.14)[(0.5)^2(65.0) + (0.17)^2 \times (7.0)](7.48)$ = 387 GALLONS

Measuring point is notch in top of PVC riser.

WELL DEVELOPMENT NOTES

The well was developed on 10-01-91 using a centrifugal pump and surge block, but the well would go dry immediately. About 20 gallons of water were removed on 10-01-91 and 10-02-91 using a foot valve pump.

MONITORING WELL INSTALLATION LOG

JOB NO. 913-6744 PROJECT ISRT/ADDITIONAL PUMP TEST/MA WELL NO. P-6 SHEET 1 of 2
GA INSP. D. LEY DRILLING METHOD 4-1/4" ID HOLLOW STEM AUGERS GROUND ELEV. 67.2 ft. WATER DEPTH 10.59 ft.
WEATHER SUNNY DRILLING COMPANY D. L. MAHER TOP PVC ELEV. 67.71 ft. DATE/TIME 10-03-91/0900
TEMP. 70° F. DRILL RIG ATV MOBILE B53/BRAT 22R DRILLER J. QUINN/J. MORAN STARTED 1600/09-12-91 (TIME / DATE) COMPLETED 1050/09-13-91 (TIME / DATE)
LOCATION / COORDINATES N: 552,060.3 E: 696,216.7

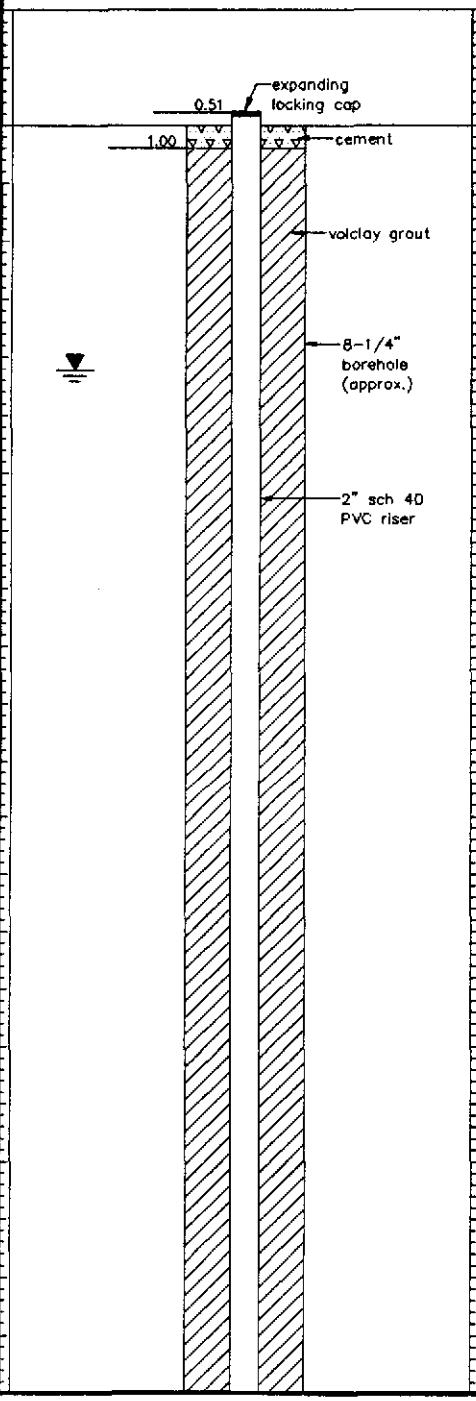
MATERIALS INVENTORY

WELL CASING 2 in. dia. 62.51 l.f. WELL SCREEN 2 in. dia. 5 l.f. BENTONITE SEAL PURE GOLD MEDIUM CHIPS
CASING TYPE SCH 40 PVC SCREEN TYPE SCH 40 PVC INSTALLATION METHOD GRAVITY
JOINT TYPE FLUSH THREADED SLOT SIZE 0.010" MACHINE SLOTTED FILTER PACK QTY. 150 lbs.
GROUT QUANTITY 157 GALLONS CENTRALIZERS NONE USED FILTER PACK TYPE MYSTIC WHITE #2D SILICA SAND
GROUT TYPE VOLCLAY DRILLING MUD TYPE N/A INSTALLATION METHOD GRAVITY

DEPTH	SOIL/ROCK DESCRIPTION
	GROUND SURFACE
0.00	0.0–15.0 ft. Very dense, medium brown, c–f SAND little to some gravel, trace silt (SP). <FILL>
10.00	
	15.0–40.0 ft. Compact to very dense, pale brown to dark gray, c–f SAND, trace to little silt, trace gravel (SP to SP–SM). <OUTWASH SAND>
20.00	
30.00	
40.00	40.0–49.5 ft. Very dense, gray beige, m–f SAND, trace silt (SP). <OUTWASH SAND>
50.00	49.5–68.1 ft. Very dense, gray beige, c–f SAND, trace silt, occassional lens of m–f to f sand (SP). <OUTWASH SAND>

CONTINUED ON NEXT PAGE

WELL SKETCH



INSTALLATION NOTES

GROUT VOLUME ESTIMATE

$V = \pi r^2 h (7.48)$ gallons
$= (3.14)(0.33)^2 (55.0)(7.48)$
$= 141$ gallons

Measuring point is notch in top of PVC.

Water encountered at approximately 9.3 ft. below ground surface during drilling.

WELL DEVELOPMENT NOTES

The well was developed on 09–26–91 with a centrifugal pump and surge block until the water was clear of sediment. Approx. 100 gallons of water were removed @ < 5 gpm.

MONITORING WELL INSTALLATION LOG

JOB NO. 913-6744 PROJECT ISRT/ADDITIONAL PUMP TEST/MA WELL NO. P-6 SHEET 2 of 2

GA INSP. D. LEY DRILLING METHOD 4-1/4" ID HOLLOW STEM AUGERS GROUND ELEV. 67.2 ft. WATER DEPTH 10.59 ft.

WEATHER SUNNY DRILLING COMPANY D. L. MAHER TOP PVC ELEV. 67.71 ft. DATE/TIME 10-03-91/0900

TEMP. 70° F. DRILL RIG ATV MOBILE B53/BRATT 22R DRILLER J. QUINN/J. MORAN STARTED 1600/09-12-91 (TIME / DATE) COMPLETED 1050/09-13-91 (TIME / DATE)

LOCATION / COORDINATES N: 552,060.3 E: 696,216.7

MATERIALS INVENTORY

WELL CASING 2 in. dia. 62.51 l.f. WELL SCREEN 2 in. dia. 5 l.f. BENTONITE SEAL PURE GOLD MEDIUM CHIPS

CASING TYPE SCH 40 PVC SCREEN TYPE SCH 40 PVC INSTALLATION METHOD GRAVITY

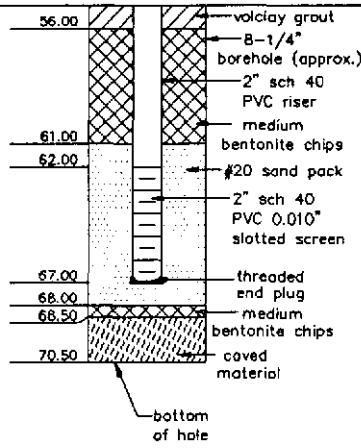
JOINT TYPE FLUSH THREADED SLOT SIZE 0.010" MACHINE SLOTTED FILTER PACK QTY. 150 lbs.

GROUT QUANTITY 157 GALLONS CENTRALIZERS NONE USED FILTER PACK TYPE MYSTIC WHITE #20 SILICA SAND

GROUT TYPE VOLCLAY DRILLING MUD TYPE N/A INSTALLATION METHOD GRAVITY

DEPTH	SOIL/ROCK DESCRIPTION
	49.5-68.1 ft. Very dense, gray beige, c-f SAND, trace silt, occassional lens of m-f to f sand (SP).
60.00	<OUTWASH SAND>
	68.1-70.5 ft. Very dense, olive green-gray, c-f SAND, some gravel, little silt (SP-SM).
	<GLACIAL TILL>
	Auger refusal at 70.5 ft.
70.00	<BEDROCK>
	BORING TERMINATED AT 70.5 FT. BELOW GROUND SURFACE.
80.00	
90.00	
100.00	
110.00	

WELL SKETCH



INSTALLATION NOTES

GROUT VOLUME ESTIMATE

$V = \pi r^2 h (7.48)$ gallons

$= (3.14)(0.33)^2 (55.0)(7.48)$

$= 141$ gallons

Measuring point is notch in top of PVC.

Water encountered at approximately 9.3 ft. below ground surface during drilling.

WELL DEVELOPMENT NOTES

The well was developed on 09-26-91 with a centrifugal pump and surge block until the water was clear of sediment. Approx. 100 gallons of water were removed @ < 5 gpm.

MONITORING WELL INSTALLATION LOG

JOB NO. 913-6744 PROJECT ISRT/ADDITIONAL PUMP TEST/MA WELL NO. P-7 SHEET 1 of 1

GA INSP. D. LEY DRILLING METHOD 4-1/4" ID HOLLOW STEM AUGERS GROUND ELEV. 61.9 ft. WATER DEPTH 6.02 ft.

WEATHER RAINING DRILLING COMPANY D. L. MAHER TOP PVC ELEV. 62.65 ft. DATE/TIME 10-03-91/0900

TEMP. 60° F. DRILL RIG BRAT 22R DRILLER J. MORAN STARTED 1300/09-23-91 (TIME / DATE) COMPLETED 1500/09-23-91 (TIME / DATE)

LOCATION / COORDINATES N: 552,407.8 E: 695,881.9

MATERIALS INVENTORY

WELL CASING 2 in. dia. 41.75 l.f. WELL SCREEN 2 in. dia. 5 l.f. BENTONITE SEAL PURE GOLD MEDIUM CHIPS

CASING TYPE SCH 40 PVC SCREEN TYPE SCH 40 PVC INSTALLATION METHOD GRAVITY

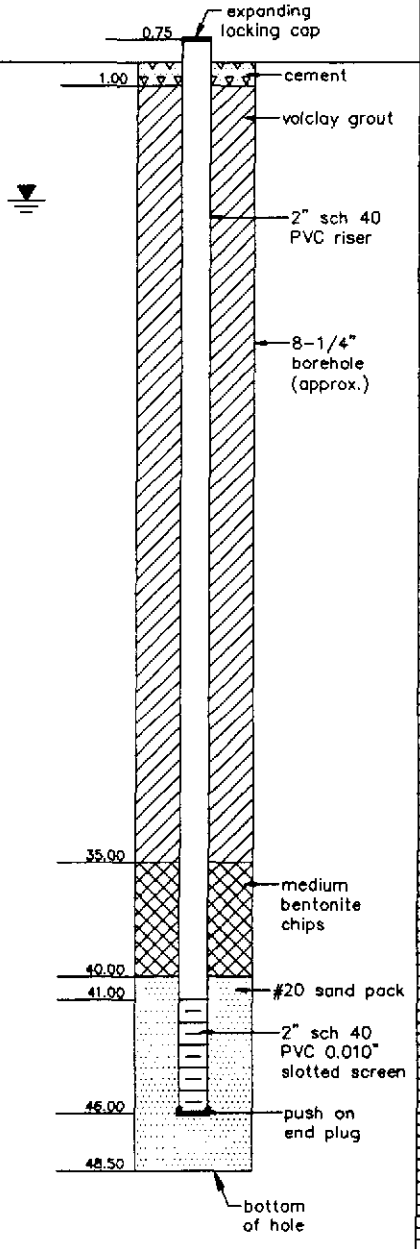
JOINT TYPE FLUSH THREADED SLOT SIZE 0.010" MACHINE SLOTTED FILTER PACK QTY. 150 lbs.

GROUT QUANTITY 79 GALLONS CENTRALIZERS NONE USED FILTER PACK TYPE MYSTIC WHITE #20 SILICA SAND

GROUT TYPE VOLCLAY DRILLING MUD TYPE N/A INSTALLATION METHOD GRAVITY

DEPTH	SOIL/ROCK DESCRIPTION
	GROUND SURFACE
0.00	0.0–3.8 ft. Loose, moderate brown to dark purplish red, c–f SAND, trace to little silt, root moss (SP). <FILL>
	3.8–4.0 ft. Soft, black SILT, organic matter, possible hide residue (ML). <POSSIBLE FILL>
10.00	4.0–10.0 ft. Very dense, pale olive gray, c–f SAND and GRAVEL, trace silt (SP). <POSSIBLE FILL>
	10.0–48.0 ft. Compact, yellowish brown, to olive gray c–f SAND, trace to some gravel, trace to little silt. <OUTWASH SAND>
20.00	
30.00	
40.00	
	48.0–48.5 ft. Very dense, olive gray, c–f SAND and GRAVEL, some silt (SM). <TILL> Auger refusal at 48.5 ft. <BEDROCK>
50.00	BORING TERMINATED AT 48.5 FT. BELOW GROUND SURFACE

WELL SKETCH



INSTALLATION NOTES

GROUT VOLUME ESTIMATE

$V = \pi r^2 h (7.48)$ gallons

$= (3.14)(0.33)^2 (34.0)(7.48)$

$= 88$ gallons

Measuring point is notch in top of PVC.

Water encountered at 5.3 ft. below ground surface during drilling.

WELL DEVELOPMENT NOTES

The well was developed on 09-26-91 using a centrifugal pump and surge block until the water was clear of sediment. 275 gallons of water were removed @ approximately 5 gpm.

MONITORING WELL INSTALLATION LOG

JOB NO. 913-6744 PROJECT ISRT/ADDITIONAL PUMP TEST/MA WELL NO. P-8 SHEET 1 of 1

GA INSP. RMG DRILLING METHOD 4-1/4" ID HOLLOW STEM AUGERS GROUND ELEV. 64.4 ft. WATER DEPTH 9.08 ft.

WEATHER SUNNY DRILLING COMPANY D. L. MAHER TOP PVC ELEV. 64.49 ft. DATE/TIME 10-03-91/0900

TEMP. 70° F. DRILL RIG ATV MOBILE B53 DRILLER J. GRAGLIA STARTED 1230/09-13-91 (TIME / DATE) COMPLETED 0800/09-15-91 (TIME / DATE)

LOCATION / COORDINATES N: 552,079.7 E: 696,574.2

MATERIALS INVENTORY

WELL CASING 2 in. dia. 39.89 l.f. WELL SCREEN 2 in. dia. 5 l.f. BENTONITE SEAL PURE GOLD MEDIUM CHIPS

CASING TYPE SCH 40 PVC SCREEN TYPE SCH 40 PVC INSTALLATION METHOD GRAVITY

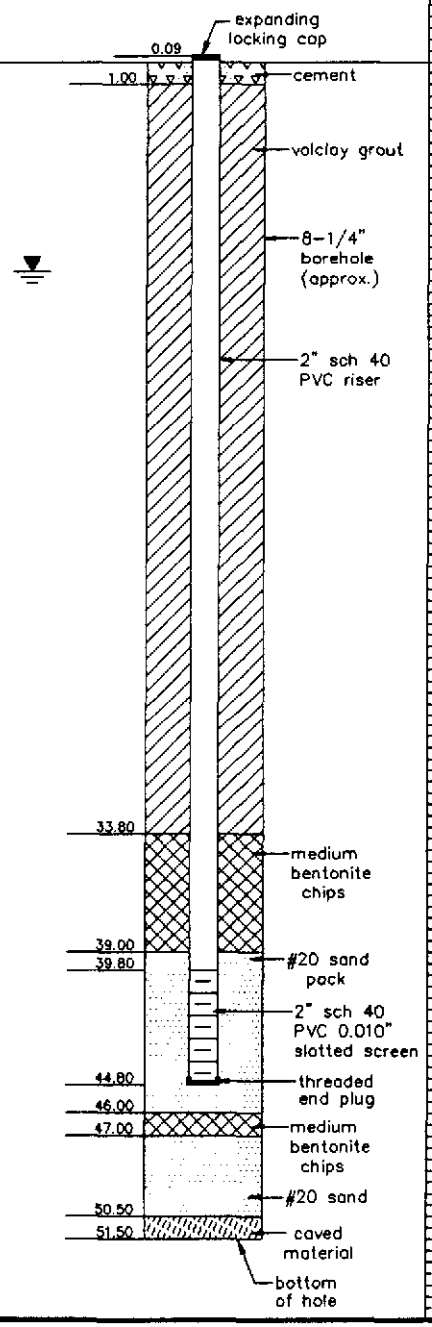
JOINT TYPE FLUSH THREADED SLOT SIZE 0.010" MACHINE SLOTTED FILTER PACK QTY. 200 lbs.

GROUT QUANTITY 100 GALLONS CENTRALIZERS NONE USED FILTER PACK TYPE MYSTIC WHITE #20 SILICA SAND

GROUT TYPE VOLCLAY DRILLING MUD TYPE N/A INSTALLATION METHOD GRAVITY

DEPTH	SOIL/ROCK DESCRIPTION
	GROUND SURFACE
0.00	0.0-7.25 ft. Very loose to compact, light to dark brown, m-f SAND, trace to little silt (SP to SP-SM). <FILL>
	7.25-11.0 ft. Very soft, black PEAT, trace wood, decayed leaves, and roots (PT). <PEAT>
10.00	11.0-45.5 ft. Compact, dark gray to black, m-f SAND, trace to some silt, occassional cobble, few lenses of fine sand with some silt, frequent hide odor (SP to SM). <OUTWASH SAND>
20.00	
30.00	
40.00	45.5-50.0 ft. Compact, medium to light gray, f SAND and SILT, strong hide odor (SM). <OUTWASH SAND>
	50.0-51.5 ft. Olive gray, c-f SAND and GRAVEL, trace silt (SW). <TILL>
50.00	Auger refusal at 51.5 ft. <BEDROCK>
	BORING TERMINATED AT 51.5 FT. BELOW GROUND SURFACE.

WELL SKETCH



INSTALLATION NOTES

GROUT VOLUME ESTIMATE

$V = \pi r^2 h (7.48)$ gallons

$= (3.14)(0.33)^2 (32.8)(7.48)$

$= 84$ gallons

Measuring point is notch in top of PVC.

Water encountered at approximately 10.2 ft. below ground surface during drilling.

WELL DEVELOPMENT NOTES

The well was developed on 09-26-91 with a centrifugal pump and suge block until the water was clear of sediment. About 100 gallons of water were removed.

APPENDIX E

Effluent Analyses and Discharge Record

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES - GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME H-1 eff	DATE	TIME	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01	10/15/91	13:30	BENZENE	<1	ug/L-PPB
IP/394/OE5/ /2/ /02			TOLUENE	<1	ug/L-PPB
IP/394/OE5/ /2/ /03			ARSENIC	<.05	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM	~~.062~~ <.05	mg/L-PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	~~130~~ .062	mg/L-PPM
			AMMONIA NH3 & NH4+	130	mg/L-PPM
IP/394/OE5/ /2/ /06			COPPER	<.05	mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC	<.05	mg/L-PPM
IP/394/OE5/ /2/ /08			IRON	9.0	mg/L-PPM

OPERATOR #1 MPD

OPERATOR #2 JMB

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES – GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME 14-2	DATE	TIME	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01	10/15/91	14:30	BENZENE	<1	ug/L-PPB
IP/394/OE5/ /2/ /02			TOLUENE	<1	ug/L-PPB
IP/394/OE5/ /2/ /03			ARSENIC	.05	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM	<.05	mg/L-PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	.17	mg/L-PPM
			AMMONIA NH3 & NH4+	160	mg/L-PPM
IP/394/OE5/ /2/ /06			COPPER	<.05	mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC	1.0	mg/L-PPM
IP/394/OE5/ /2/ /08			IRON	4.5	mg/L-PPM

OPERATOR #1 _____

OPERATOR #2 JMB

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES - GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME H-3 EFF	DATE	TIME	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01	10/15/91	15:30	BENZENE	<1	ug/L-PPB
IP/394/OE5/ /2/ /02			TOLUENE	<1	ug/L-PPB
IP/394/OE5/ /2/ /03			ARSENIC	.063	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM	<.05	mg/L-PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	.083	mg/L-PPM
			AMMONIA NH3 & NH4+	130	mg/L-PPM
IP/394/OE5/ /2/ /06			COPPER	<.05	mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC	.39	mg/L-PPM
IP/394/OE5/ /2/ /08			IRON	3.25	mg/L-PPM

OPERATOR #1 MPD

OPERATOR #2 JMB

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES – GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME H-4	DATE	TIME	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01	10/15/91	1630	BENZENE	<1	ug/L-PPB
IP/394/OE5/ /2/ /02			TOLUENE	<1	ug/L-PPB
IP/394/OE5/ /2/ /03			ARSENIC	.068	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM	<.05	mg/L-PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	.15	mg/L-PPM
			AMMONIA NH3 & NH4+	1.40	mg/L-PPM
IP/394/OE5/ /2/ /06			COPPER	<.05	mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC	.24	mg/L-PPM
IP/394/OE5/ /2/ /08			IRON	3.25	mg/L-PPM

OPERATOR #1 MPD

OPERATOR #2 JMB

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES – GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME H-5 Inf	DATE	TIME	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01	10/15/91	17:45	BENZENE	~~3~~ 2.9	ug/L-PPB
IP/394/OE5/ /2/ /02			TOLUENE	<1	ug/L-PPB
IP/394/OE5/ /2/ /03			ARSENIC	.17	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM	.21	mg/L-PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	.45	mg/L-PPM
			AMMONIA NH3 & NH4+	170	mg/L-PPM
IP/394/OE5/ /2/ /06			COPPER	<.05	mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC	7.4	mg/L-PPM
IP/394/OE5/ /2/ /08			IRON	9.75	mg/L-PPM

OPERATOR #1 _____

OPERATOR #2 JMB

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES - GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME H-5 EFF	DATE	TIME	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01	10/15/91	1745	BENZENE	<1	ug/L-PPB
IP/394/OE5/ /2/ /02			TOLUENE	<1	ug/L-PPB
IP/394/OE5/ /2/ /03			ARSENIC	.065	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM	<.05	mg/L-PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	<.05	mg/L-PPM
			AMMONIA NH3 & NH4+	130	mg/L-PPM
IP/394/OE5/ /2/ /06			COPPER	<.05	mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC	.32	mg/L-PPM
IP/394/OE5/ /2/ /08			IRON	3.5	mg/L-PPM

OPERATOR #1 MPD

OPERATOR #2 JMB

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES – GOLDER ASSOCIATES
GZA JOB NO. 12695

120 gpm

SAMPLE NAME H-6 EP	DATE	TIME	TARGET CMPD.	RESULT	UNITS	
IP/394/OE5/ /2/ /01	10-15-91	1845	BENZENE	<1	ug/L-PPB	✓
IP/394/OE5/ /2/ /02			TOLUENE	<1	ug/L-PPB	✓
IP/394/OE5/ /2/ /03			ARSENIC	0.066	mg/L-PPM	
IP/394/OE5/ /2/ /04			CHROMIUM	<.05	mg/L-PPM	✓
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	~~0.398~~ .40	mg/L-PPM	X
			AMMONIA NH3 & NH4+	~~139~~ 140	mg/L-PPM	✓
IP/394/OE5/ /2/ /06			COPPER	<.05	mg/L-PPM	✓
IP/394/OE5/ /2/ /07			ZINC	.22	mg/L-PPM	✓
IP/394/OE5/ /2/ /08			IRON	4.0	mg/L-PPM	✓

OPERATOR #1 MPD

OPERATOR #2 JMB

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES – GOLDER ASSOCIATES
GZA JOB NO. 12695

120gph

SAMPLE NAME H-7 EFF	DATE	TIME	TARGET CMPD.	RESULT	UNITS	
IP/394/OE5/ /2/ /01	10/15/91	19:45	BENZENE	<1.0	ug/L-PPB	✓
IP/394/OE5/ /2/ /02			TOLUENE	<1.0	ug/L-PPB	✓
IP/394/OE5/ /2/ /03			ARSENIC	0.05	mg/L-PPM	
IP/394/OE5/ /2/ /04			CHROMIUM	<0.05	mg/L-PPM	
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	.10	mg/L-PPM	✓
			AMMONIA NH3 & NH4+	.140	mg/L-PPM	✓
IP/394/OE5/ /2/ /06			COPPER	<0.05	mg/L-PPM	✓
IP/394/OE5/ /2/ /07			ZINC	~~1.19~~ 1.70	mg/L-PPM	X
IP/394/OE5/ /2/ /08			IRON	3.5	mg/L-PPM	✓

OPERATOR #1 LDF

OPERATOR #2 BZ

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES – GOLDER ASSOCIATES
GZA JOB NO. 12695

for 120 gpm

SAMPLE NAME H-8 Eff	DATE	TIME	TARGET CMPD.	RESULT	UNITS	
IP/394/OE5/ /2/ /01	10/15/91	21:20	BENZENE	<1.0	ug/L-PPB	✓
IP/394/OE5/ /2/ /02			TOLUENE	<1.0	ug/L-PPB	✓
IP/394/OE5/ /2/ /03			ARSENIC	0.05	mg/L-PPM	
IP/394/OE5/ /2/ /04			CHROMIUM	<0.05	mg/L-PPM	✓
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	0.11	mg/L-PPM	✓
			AMMONIA NH3 & NH4+	140	mg/L-PPM	✓
IP/394/OE5/ /2/ /06			COPPER	<0.05	mg/L-PPM	✓
IP/394/OE5/ /2/ /07			ZINC	0.51	mg/L-PPM	✓
IP/394/OE5/ /2/ /08			IRON	11.0	mg/L-PPM	✓

OPERATOR #1 WDP

OPERATOR #2 BT

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES – GOLDER ASSOCIATES
GZA JOB NO. 12695

for 1209pm

SAMPLE NAME H-9 Eff	DATE	TIME	TARGET CMPD.	RESULT	UNITS	
IP/394/OE5/ /2/ /01	10/15/91	21:45	BENZENE	<1.0	ug/L-PPB	✓
IP/394/OE5/ /2/ /02			TOLUENE	<1.0	ug/L-PPB	✓
IP/394/OE5/ /2/ /03			ARSENIC	0.06	mg/L-PPM	
IP/394/OE5/ /2/ /04			CHROMIUM	< 0.05	mg/L-PPM	✓
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	0.11	mg/L-PPM	✓
			AMMONIA NH3 & NH4+	ND	mg/L-PPM	✓
IP/394/OE5/ /2/ /06			COPPER	<0.05	mg/L-PPM	✓
IP/394/OE5/ /2/ /07			ZINC	5.00	mg/L-PPM	X
IP/394/OE5/ /2/ /08			IRON	2.0	mg/L-PPM	✓

OPERATOR #1 LDF

OPERATOR #2 BF

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES - GOLDER ASSOCIATES
GZA JOB NO. 12695

120 ppm

SAMPLE NAME H-10 Eff	DATE	TIME	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01	10/15/91	22:45	BENZENE	<1.0	ug/L-PPB
IP/394/OE5/ /2/ /02			TOLUENE	<1.0	ug/L-PPB
IP/394/OE5/ /2/ /03			ARSENIC	0.064	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM	<0.05	mg/L-PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	0.09	mg/L-PPM
			AMMONIA NH3 & NH4+	190	mg/L-PPM
IP/394/OE5/ /2/ /06			COPPER	<0.05	mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC	0.80	mg/L-PPM
IP/394/OE5/ /2/ /08			IRON	7.80	mg/L-PPM

OPERATOR #1 LDF

OPERATOR #2 BT

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES – GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME H-11 Eff	DATE	TIME	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01	10/15/91	23:30	BENZENE	<1.0	ug/L-PPB
IP/394/OE5/ /2/ /02			TOLUENE	<1.0	ug/L-PPB
IP/394/OE5/ /2/ /03			ARSENIC	0.061	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM	<0.05	mg/L-PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	0.10	mg/L-PPM
			AMMONIA NH3 & NH4+	140	mg/L-PPM
IP/394/OE5/ /2/ /06			COPPER	<0.05	mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC	1.40	mg/L-PPM
IP/394/OE5/ /2/ /08			IRON	2.7	mg/L-PPM

OPERATOR #1 LDF

OPERATOR #2 BZ

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES – GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME H-12 EFF	DATE	TIME	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01	10/16/91	0:55	BENZENE	<1.0	ug/L-PPB
IP/394/OE5/ /2/ /02			TOLUENE	<1.0	ug/L-PPB
IP/394/OE5/ /2/ /03			ARSENIC	0.059	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM	<0.05	mg/L-PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	0.10	mg/L-PPM
			AMMONIA NH3 & NH4+	1.0	mg/L-PPM
IP/394/OE5/ /2/ /06			COPPER	<0.05	mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC	1.8	mg/L-PPM
IP/394/OE5/ /2/ /08			IRON	3.1	mg/L-PPM

OPERATOR #1 LDF

OPERATOR #2 BJ

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES – GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME H-13 EFF	DATE	TIME	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01	10/16/91	02:00	BENZENE	<1.0	ug/L–PPB
IP/394/OE5/ /2/ /02			TOLUENE	<1.0	ug/L–PPB
IP/394/OE5/ /2/ /03			ARSENIC	0.062	mg/L–PPM
IP/394/OE5/ /2/ /04			CHROMIUM	<0.05	mg/L–PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	0.08	mg/L–PPM
			AMMONIA NH3 & NH4+	130	mg/L–PPM
IP/394/OE5/ /2/ /06			COPPER	<0.05	mg/L–PPM
IP/394/OE5/ /2/ /07			ZINC	1.8	mg/L–PPM
IP/394/OE5/ /2/ /08			IRON	2.8	mg/L–PPM

OPERATOR #1 LDF

OPERATOR #2 BJ

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES – GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME H-14 EH	DATE	TIME	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01	10/16/91	02:45	BENZENE	<1.0	ug/L-PPB
IP/394/OE5/ /2/ /02			TOLUENE	<1.0	ug/L-PPB
IP/394/OE5/ /2/ /03			ARSENIC	0.056	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM	< 0.05	mg/L-PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	0.12	mg/L-PPM
			AMMONIA NH3 & NH4+	110	mg/L-PPM
IP/394/OE5/ /2/ /06			COPPER	0.11	mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC	6.1	mg/L-PPM
IP/394/OE5/ /2/ /08			IRON	2.3	mg/L-PPM

OPERATOR #1 LDF

OPERATOR #2 BT

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES - GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME H-15 Eff	DATE	TIME	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01	10/16/91	03:50	BENZENE	<1.0	ug/L-PPB
IP/394/OE5/ /2/ /02			TOLUENE	<1.0	ug/L-PPB
IP/394/OE5/ /2/ /03			ARSENIC	0.052	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM	< 0.05	mg/L-PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	0.10	mg/L-PPM
			AMMONIA NH3 & NH4+	110	mg/L-PPM
IP/394/OE5/ /2/ /06			COPPER	<0.05	mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC	6.3	mg/L-PPM
IP/394/OE5/ /2/ /08			IRON	2.4	mg/L-PPM

OPERATOR #1 LDF

OPERATOR #2 BT

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES - GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME H-16 Ext	DATE	TIME	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01	10/16/91	04:40	BENZENE	<1.0	ug/L-PPB
IP/394/OE5/ /2/ /02			TOLUENE	<1.0	ug/L-PPB
IP/394/OE5/ /2/ /03			ARSENIC	0.064	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM	<0.05	mg/L-PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	0.16	mg/L-PPM
			AMMONIA NH3 & NH4+	110	mg/L-PPM
IP/394/OE5/ /2/ /06			COPPER	0.17	mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC	6.8	mg/L-PPM
IP/394/OE5/ /2/ /08			IRON	0.9	mg/L-PPM

OPERATOR #1 LDF

OPERATOR #2 BT

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES – GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME A-17 Eff	DATE	TIME	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01	10/16/91	05:50	BENZENE	< 1.0	ug/L-PPB
IP/394/OE5/ /2/ /02			TOLUENE	< 1.0	ug/L-PPB
IP/394/OE5/ /2/ /03			ARSENIC	0.006	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM	< 0.05	mg/L-PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	0.08	mg/L-PPM
			AMMONIA NH3 & NH4+	110	mg/L-PPM
IP/394/OE5/ /2/ /06			COPPER	< 0.05	mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC	5.9	mg/L-PPM
IP/394/OE5/ /2/ /08			IRON	0.9	mg/L-PPM

OPERATOR #1 LDF

OPERATOR #2 BT

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES – GOLDER ASSOCIATES
GZA JOB NO. 12695

120 gpm

SAMPLE NAME H-18 Inf	DATE	TIME	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01	10/16/91	06:45	BENZENE	< 1.0	ug/L-PPB ✓
IP/394/OE5/ /2/ /02			TOLUENE	< 1.0	ug/L-PPB ✓
IP/394/OE5/ /2/ /03			ARSENIC	*	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM	< .05	mg/L-PPM ✓
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	0.09	mg/L-PPM ✓
			AMMONIA NH3 & NH4+	29.0	mg/L-PPM ✓
IP/394/OE5/ /2/ /06			COPPER	3.5 CMD	mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC	JMG ~~1.9~~ 3.3	mg/L-PPM
IP/394/OE5/ /2/ /08			IRON	72.8	mg/L-PPM

* to be run Fri 10/18/91

OPERATOR #1 LDF

OPERATOR #2 CMD

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES - GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME H-18 E3 inf	DATE	TIME	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01	10/16/91	6:15	BENZENE		ug/L-PPB
IP/394/OE5/ /2/ /02			TOLUENE		ug/L-PPB
IP/394/OE5/ /2/ /03			ARSENIC	.18	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM		mg/L-PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY		mg/L-PPM
			AMMONIA NH3 & NH4+		mg/L-PPM
IP/394/OE5/ /2/ /06			COPPER		mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC		mg/L-PPM
IP/394/OE5/ /2/ /08			IRON		mg/L-PPM

OPERATOR #1 JMB

OPERATOR #2 CMO

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES – GOLDER ASSOCIATES
GZA JOB NO. 12695

120 gpm

SAMPLE NAME H-18 Eff	DATE	TIME	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01	10/16/91	06:45	BENZENE	<1.0	ug/L-PPB
IP/394/OE5/ /2/ /02			TOLUENE	<1.0	ug/L-PPB
IP/394/OE5/ /2/ /03			ARSENIC	.065	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM	<.05	mg/L-PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	0.08	mg/L-PPM
			AMMONIA NH3 & NH4+	110	mg/L-PPM
IP/394/OE5/ /2/ /06			COPPER	< 0.05	mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC	JMB ~~[illegible]~~ 1.8	mg/L-PPM
IP/394/OE5/ /2/ /08			IRON	.9	mg/L-PPM

OPERATOR #1 LDF

OPERATOR #2 BT

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES – GOLDER ASSOCIATES
GZA JOB NO. 12695

120 91 m

SAMPLE NAME H-19	DATE	TIME	TARGET CMPD.	RESULT	UNITS	
IP/394/OE5/ /2/ /01	10/16/91	7:30	BENZENE	<1	ug/L-PPB	✓
IP/394/OE5/ /2/ /02			TOLUENE	<1	ug/L-PPB	✓
IP/394/OE5/ /2/ /03			ARSENIC	.064	mg/L-PPM	✓
IP/394/OE5/ /2/ /04			CHROMIUM	<0.05	mg/L-PPM	✓
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	.24	mg/L-PPM	✓
			AMMONIA NH3 & NH4+	1.30	mg/L-PPM	✓
IP/394/OE5/ /2/ /06			COPPER	<.05	mg/L-PPM	✓
IP/394/OE5/ /2/ /07			ZINC	1.5	mg/L-PPM	✓
IP/394/OE5/ /2/ /08			IRON	1.1	mg/L-PPM	✓

OPERATOR #1 JMB

OPERATOR #2 CMO

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES – GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME H-20	DATE	TIME	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01	10/16/91	8:25	BENZENE	<1	ug/L-PPB
IP/394/OE5/ /2/ /02			TOLUENE	<1	ug/L-PPB
IP/394/OE5/ /2/ /03			ARSENIC	.063	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM	<0.05	mg/L-PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	.15	mg/L-PPM
			AMMONIA NH3 & NH4+	~~147~~ 150	mg/L-PPM
IP/394/OE5/ /2/ /06			COPPER	<.05	mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC	~~[illegible]~~ 1.3	mg/L-PPM
IP/394/OE5/ /2/ /08			IRON	3.9	mg/L-PPM

OPERATOR #1 JMB

OPERATOR #2 CMO.

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES - GOLDER ASSOCIATES
GZA JOB NO. 12695

120 gpm

SAMPLE NAME H-21 EFF	DATE	TIME	TARGET CMPD.	RESULT	UNITS	
IP/394/OE5/ /2/ /01	10/16/91	9:30	BENZENE	<1	ug/L-PPB	✓
IP/394/OE5/ /2/ /02			TOLUENE	<1	ug/L-PPB	✓
IP/394/OE5/ /2/ /03			ARSENIC	.091	mg/L-PPM	✓
IP/394/OE5/ /2/ /04			CHROMIUM	<0.05	mg/L-PPM	✓
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	.61	mg/L-PPM	X
			AMMONIA NH3 & NH4+	160	mg/L-PPM	✓
IP/394/OE5/ /2/ /06			COPPER	<.05	mg/L-PPM	✓
IP/394/OE5/ /2/ /07			ZINC	1.60	mg/L-PPM	✓≈
IP/394/OE5/ /2/ /08			IRON	1.3	mg/L-PPM	✓

OPERATOR #1 JMB

OPERATOR #2 CMO.

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES - GOLDER ASSOCIATES
GZA JOB NO. 12695

120 gpm

SAMPLE NAME H-22 EFF	DATE	TIME	TARGET CMPD.	RESULT	UNITS	
IP/394/OE5/ /2/ /01	10/16/91	10:40	BENZENE	<1	ug/L-PPB	✓
IP/394/OE5/ /2/ /02			TOLUENE	<1	ug/L-PPB	✓
IP/394/OE5/ /2/ /03			ARSENIC	.10	mg/L-PPM	✓
IP/394/OE5/ /2/ /04			CHROMIUM	<.05	mg/L-PPM	✓
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	.31	mg/L-PPM	✓
			AMMONIA NH3 & NH4+	130	mg/L-PPM	✓
IP/394/OE5/ /2/ /06			COPPER	.066	mg/L-PPM	✓
IP/394/OE5/ /2/ /07			ZINC	.45	mg/L-PPM	✓
IP/394/OE5/ /2/ /08			IRON	4.8	mg/L-PPM	✓

OPERATOR #1 JMB

OPERATOR #2 CMD

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES – GOLDER ASSOCIATES
GZA JOB NO. 12695

120 gpm

SAMPLE NAME H-23 EFF	DATE	TIME	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01	10/16/91	11:30	BENZENE	<1	ug/L-PPB
IP/394/OE5/ /2/ /02			TOLUENE	<1	ug/L-PPB
IP/394/OE5/ /2/ /03			ARSENIC	.076	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM	<.05	mg/L-PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	.073	mg/L-PPM
			AMMONIA NH3 & NH4+	140	mg/L-PPM
IP/394/OE5/ /2/ /06			COPPER	<.05	mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC	1.6 ~~1.5~~ CMD	mg/L-PPM
IP/394/OE5/ /2/ /08			IRON	1.7	mg/L-PPM

1.60 as per GZA

OPERATOR #1 JMB

OPERATOR #2 CMD

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES - GOLDER ASSOCIATES
GZA JOB NO. 12695

120 ppm

SAMPLE NAME H-24 EFF	DATE	TIME	TARGET CMPD.	RESULT	UNITS	
IP/394/OE5/ /2/ /01	10/16/91	12:30	BENZENE	<1	ug/L-PPB	✓
IP/394/OE5/ /2/ /02			TOLUENE	<1	ug/L-PPB	✓
IP/394/OE5/ /2/ /03			ARSENIC	.075	mg/L-PPM	✓
IP/394/OE5/ /2/ /04			CHROMIUM	<.05	mg/L-PPM	✓
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	.52	mg/L-PPM	X
			AMMONIA NH3 & NH4+	170	mg/L-PPM	✓
IP/394/OE5/ /2/ /06			COPPER	<.05	mg/L-PPM	✓
IP/394/OE5/ /2/ /07			ZINC	1.6	mg/L-PPM	118 ppm
IP/394/OE5/ /2/ /08			IRON	1.4	mg/L-PPM	✓

OPERATOR #1 JMB

OPERATOR #2 CMO

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES - GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME H-25 EFF	DATE	TIME	TARGET CMPD.	RESULT	UNITS	
IP/394/OE5/ /2/ /01	10/16/91	13:35	BENZENE	<1	ug/L-PPB	✓
IP/394/OE5/ /2/ /02			TOLUENE	<1	ug/L-PPB	✓
IP/394/OE5/ /2/ /03			ARSENIC	.076	mg/L-PPM	✓
IP/394/OE5/ /2/ /04			CHROMIUM	<.05	mg/L-PPM	✓
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	.34	mg/L-PPM	✓
			AMMONIA NH3 & NH4+	160	mg/L-PPM	✓
IP/394/OE5/ /2/ /06			COPPER	<0.05	mg/L-PPM	✓
IP/394/OE5/ /2/ /07			ZINC	1.2	mg/L-PPM	✓
IP/394/OE5/ /2/ /08			IRON	2.8	mg/L-PPM	✓

OPERATOR #1 JMB

OPERATOR #2 CMO

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES – GOLDER ASSOCIATES
GZA JOB NO. 12695

120 ppm

SAMPLE NAME H-216 EFF	DATE	TIME	TARGET CMPD.	RESULT	UNITS	
IP/394/OE5/ /2/ /01	10/16/91	14:30	BENZENE	<1	ug/L-PPB	✓
IP/394/OE5/ /2/ /02			TOLUENE	<1	ug/L-PPB	✓
IP/394/OE5/ /2/ /03			ARSENIC	.074	mg/L-PPM	✓
IP/394/OE5/ /2/ /04			CHROMIUM	<.05	mg/L-PPM	✓
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	.33	mg/L-PPM	✓
			AMMONIA NH3 & NH4+	16.0	mg/L-PPM	✓
IP/394/OE5/ /2/ /06			COPPER	<.05	mg/L-PPM	✓
IP/394/OE5/ /2/ /07			ZINC	5.6	mg/L-PPM	118.5 ppm
IP/394/OE5/ /2/ /08			IRON	2.7	mg/L-PPM	✓

1.6 as per GZA

OPERATOR #1 JMB

OPERATOR #2 CMO.

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES – GOLDER ASSOCIATES
GZA JOB NO. 12695

120gpm

SAMPLE NAME H-27 EFF	DATE	TIME	TARGET CMPD.	RESULT	UNITS	
IP/394/OE5/ /2/ /01	10/16/91	15:35	BENZENE	<1	ug/L–PPB	✓
IP/394/OE5/ /2/ /02			TOLUENE	<1	ug/L–PPB	✓
IP/394/OE5/ /2/ /03			ARSENIC	.071	mg/L–PPM	✓
IP/394/OE5/ /2/ /04			CHROMIUM	<.05	mg/L–PPM	✓
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	.57	mg/L–PPM	X
			AMMONIA NH3 & NH4+	200	mg/L–PPM	✓
IP/394/OE5/ /2/ /06			COPPER	<.05	mg/L–PPM	✓
IP/394/OE5/ /2/ /07			ZINC	.78	mg/L–PPM	✓
IP/394/OE5/ /2/ /08			IRON	6.0	mg/L–PPM	✓

OPERATOR #1 JMB

OPERATOR #2 CMO.

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES - GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME H-28 EFF	DATE	TIME	TARGET CMPD.	RESULT	UNITS	120 ppm
IP/394/OE5/ /2/ /01	10/16/91	16:30	BENZENE	<1	ug/L-PPB	✓
IP/394/OE5/ /2/ /02			TOLUENE	<1	ug/L-PPB	✓
IP/394/OE5/ /2/ /03			ARSENIC	.070	mg/L-PPM	✓
IP/394/OE5/ /2/ /04			CHROMIUM	<.05	mg/L-PPM	✓
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	.61	mg/L-PPM	X 65 ppm
			AMMONIA NH3 & NH4+	160	mg/L-PPM	✓
IP/394/OE5/ /2/ /06			COPPER	<.05	mg/L-PPM	✓
IP/394/OE5/ /2/ /07			ZINC	13.	mg/L-PPM	X
IP/394/OE5/ /2/ /08			IRON	5.1	mg/L-PPM	✓

OPERATOR #1 JMB

OPERATOR #2 CMO

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES - GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME H-29 EFF	DATE	TIME	TARGET CMPD.	RESULT	UNITS	120 ppm
IP/394/OE5/ /2/ /01	10/16/91	17:20	BENZENE	<1	ug/L-PPB	✓
IP/394/OE5/ /2/ /02			TOLUENE	<1	ug/L-PPB	✓
IP/394/OE5/ /2/ /03			ARSENIC	.080	mg/L-PPM	✓
IP/394/OE5/ /2/ /04			CHROMIUM	<0.05	mg/L-PPM	✓
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	.58	mg/L-PPM	X
			AMMONIA NH3 & NH4+	160	mg/L-PPM	✓
IP/394/OE5/ /2/ /06			COPPER	<.05	mg/L-PPM	✓
IP/394/OE5/ /2/ /07			ZINC	5.6	mg/L-PPM	X 30 ppm
IP/394/OE5/ /2/ /08			IRON	1.2	mg/L-PPM	✓

OPERATOR #1 JMB

OPERATOR #2 CMO.

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES – GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME H-30 IN	DATE	TIME	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01	10/16/91	18:27	BENZENE	2.1	ug/L-PPB
IP/394/OE5/ /2/ /02			TOLUENE	<1	ug/L-PPB
IP/394/OE5/ /2/ /03			ARSENIC	*	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM	.09	mg/L-PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	1.2	mg/L-PPM
			AMMONIA NH3 & NH4+	150	mg/L-PPM
IP/394/OE5/ /2/ /06			COPPER	<.05	mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC	5.6	mg/L-PPM
IP/394/OE5/ /2/ /08			IRON	4.4	mg/L-PPM

* to be run fri. 10/18/91

OPERATOR #1 JMB

OPERATOR #2 BJ

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES - GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME H-30 INF	DATE 10/14/91	TIME 18:27	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01			BENZENE		ug/L-PPB
IP/394/OE5/ /2/ /02			TOLUENE		ug/L-PPB
IP/394/OE5/ /2/ /03			ARSENIC	< .05	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM		mg/L-PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY		mg/L-PPM
			AMMONIA NH3 & NH4+		mg/L-PPM
IP/394/OE5/ /2/ /06			COPPER		mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC		mg/L-PPM
IP/394/OE5/ /2/ /08			IRON		mg/L-PPM

OPERATOR #1 JMB

OPERATOR #2 CMO

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES - GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME H-30 Eff	DATE	TIME	TARGET CMPD.	RESULT	UNITS	120 ppm
IP/394/OE5/ /2/ /01	10/16/91	18:42	BENZENE	<1	ug/L-PPB	✓
IP/394/OE5/ /2/ /02			TOLUENE	<1	ug/L-PPB	✓
IP/394/OE5/ /2/ /03			ARSENIC	0.088	mg/L-PPM	
IP/394/OE5/ /2/ /04			CHROMIUM	< 0.05	mg/L-PPM	✓
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	.63	mg/L-PPM	X ≈ 64 ppm
			AMMONIA NH3 & NH4+	120	mg/L-PPM	✓
IP/394/OE5/ /2/ /06			COPPER	<.05	mg/L-PPM	✓
IP/394/OE5/ /2/ /07			ZINC	5.7	mg/L-PPM	30 ppm
IP/394/OE5/ /2/ /08			IRON	1.2	mg/L-PPM	✓

OPERATOR #1 JMB

OPERATOR #2 BF

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES – GOLDER ASSOCIATES
GZA JOB NO. 12695

120 ppm

SAMPLE NAME H-31 Eff	DATE	TIME	TARGET CMPD.	RESULT	UNITS	
IP/394/OE5/ /2/ /01	10/14/91	19:30	BENZENE	< 1.0	ug/L-PPB	
IP/394/OE5/ /2/ /02			TOLUENE	< 1.0	ug/L-PPB	
IP/394/OE5/ /2/ /03			ARSENIC	0.084	mg/L-PPM	
IP/394/OE5/ /2/ /04			CHROMIUM	< .05	mg/L-PPM	✓
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	0.13	mg/L-PPM	✓
			AMMONIA NH3 & NH4+	150	mg/L-PPM	✓
IP/394/OE5/ /2/ /06			COPPER	<0.05	mg/L-PPM	✓
IP/394/OE5/ /2/ /07			ZINC	5.9	mg/L-PPM	X
IP/394/OE5/ /2/ /08			IRON	1.3	mg/L-PPM	✓

OPERATOR #1 LDF

OPERATOR #2 BT

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES - GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME H-32 EFF	DATE	TIME	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01	10/16/91	20:35	BENZENE	<1.0	ug/L-PPB
IP/394/OE5/ /2/ /02			TOLUENE	<1.0	ug/L-PPB
IP/394/OE5/ /2/ /03			ARSENIC	0.078	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM	<0.05	mg/L-PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	0.17	mg/L-PPM
			AMMONIA NH3 & NH4+	200.0	mg/L-PPM
IP/394/OE5/ /2/ /06			COPPER	<0.05	mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC	5.3	mg/L-PPM
IP/394/OE5/ /2/ /08			IRON	7.9	mg/L-PPM

OPERATOR #1 LDF

OPERATOR #2 BJ

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES – GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME H-33 EA	DATE	TIME	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01	10/16/91	21:45	BENZENE	< 1.0	ug/L-PPB
IP/394/OE5/ /2/ /02			TOLUENE	< 1.0	ug/L-PPB
IP/394/OE5/ /2/ /03			ARSENIC	0.087	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM	< .05	mg/L-PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	0.21	mg/L-PPM
			AMMONIA NH3 & NH4+	190	mg/L-PPM
IP/394/OE5/ /2/ /06			COPPER	<0.05	mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC	9.0	mg/L-PPM
IP/394/OE5/ /2/ /08			IRON	1.2	mg/L-PPM

OPERATOR #1 LDF

OPERATOR #2 BT

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES - GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME H-34 EFH	DATE	TIME	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01	10/16/91	22:35	BENZENE	<1.0	ug/L-PPB
IP/394/OE5/ /2/ /02			TOLUENE	<1.0	ug/L-PPB
IP/394/OE5/ /2/ /03			ARSENIC	0.075	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM	<0.05	mg/L-PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	0.22	mg/L-PPM
			AMMONIA NH3 & NH4+	190	mg/L-PPM
IP/394/OE5/ /2/ /06			COPPER	<0.05	mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC	6.1	mg/L-PPM
IP/394/OE5/ /2/ /08			IRON	1.2	mg/L-PPM

OPERATOR #1 LDF

OPERATOR #2 BZ

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES - GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME H-35 EFF.	DATE	TIME	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01	10/16/91	23:40	BENZENE	<1.0	ug/L-PPB
IP/394/OE5/ /2/ /02			TOLUENE	<1.0	ug/L-PPB
IP/394/OE5/ /2/ /03			ARSENIC	0.091	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM	<0.05	mg/L-PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	0.23	mg/L-PPM
			AMMONIA NH3 & NH4+	210	mg/L-PPM
IP/394/OE5/ /2/ /06			COPPER	<0.05	mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC	5.4	mg/L-PPM
IP/394/OE5/ /2/ /08			IRON	1.6	mg/L-PPM

OPERATOR #1 LDF

OPERATOR #2 BZ

GZA GEOENVIRONMENTAL, INC.
ENGINEERS AND SCIENTISTS

Page No.

Project 1P/394/OES Series File No.

Location Date By

Subject Checked By

Based on Revised By

Sample name H-36 EFF

date 10/17/91

time 00:45

Results

Benzene	<1.0
Toluene	<1.0
As	0.085
Cr^{6+}	<0.05
NH_3	0.33
$NH_3 + NH_4^+$	200.0
Cu	<0.05
Zn	5.7
Fe	1.4

OPERATOR # 1 LDP

OPERATOR # 2 BJ

GZA GEOENVIRONMENTAL, INC.
ENGINEERS AND SCIENTISTS

Page No.

Project 1P/394/OES Series | File No.

Location | Date | By

Subject | Checked | By

Based on | Revised | By

Sample name H-37 eff

date 10/17/91

time 01:33

Results

Benzene	<1.0
Toluene	<1.0
As	0.085
Cr^{6+}	<.05
NH_3	0.22
$NH_3 + NH_4^+$	200.0
Cu	<0.05
Zn	5.9
Fe	1.3

Oper. #1 ADF

Oper. #2 BT

GZA GeoEnvironmental, Inc.
Engineers and Scientists

Page No.

Project	IP/394/DES Series		File No.
Location		Date	By
Subject		Checked	By
Based on		Revised	By

Sample name	H-38
date	10/17/91
Time	LDF 02:45
Results	
Benzene	LDF <1.0
Toluene	<1.0
As	0.079
Cr^{6+}	<.05
NH_3	0.87
$NH_3 + NH_4^+$	200.0
Cu	<0.05
Zn	6.5
Fe	1.4
oper. #1	LDF
oper. #2	B7

GZA GEOENVIRONMENTAL, INC.
ENGINEERS AND SCIENTISTS

Page No.

Project	TP/394/OES Series		File No.
Location		Date	By
Subject		Checked	By
Based on		Revised	By

Sample name H-39

date 10/17/91

time 03:40

Results

Benzene	<1.0
Toluene	<1.0
As	0.074
Cr^{6+}	<.05
NH_3	0.60
$NH_3 + NH_4^+$	200.0
Cu	<0.05
Zn	7.2
Fe	1.6
Oper #1	LDF
Oper #2	87

GZA GEOENVIRONMENTAL, INC.
ENGINEERS AND SCIENTISTS

Page No.

Project: IP/394/OES Series

File No.

Location | Date | By

Subject | Checked | By

Based on | Revised | By

Sample name	H-40
date	10/17/91
time	04:40
results	
Benzene	<1.0
Toluene	<1.0
As	0.07
Cr^{6+}	<.05
NH_3	0.32
$NH_3 + NH_4$	190
Cu	<0.05
Zn	5.9
Fe	1.7
oper #1	LDF
oper #2	B7

GZA GeoEnvironmental, Inc.
Engineers and Scientists

Page No.

Project	IP/394/OES Senior	File No.	
Location	Date	By	
Subject	Checked	By	
Based on	Revised	By	

sample name H-41 influent
date 10/17/91
time 05:50
Results 120 gpm

Benzene	<1.0	✓
Toluene	<1.0	✓
~~As~~		+ will be run 10/18/91
Cr^{6+}	<0.05	✓
NH_3	0.14	✓
NH_3 + NH_4^+	45	✓
Cu	3.6	✓
Zn	16.	X
Fe	71. ~~7.1~~ CMO	

oper #1 LDF
oper #2 CMO.

GZA GEOENVIRONMENTAL, INC.
ENGINEERS AND SCIENTISTS

Page No.

Project	IP/394 / DES Sewer		File No.
Location		Date	By
Subject		Checked	By
Based on		Revised	By

Sample name H-41 EFF

date 10/17/91

time 05:50

Results

Benzene	<1.0
Toluene	<1.0
As	0.074
Cr^{6+}	<.05
NH_3	0.23
$NH_3 + NH_4$	190
Cu	<0.05
Zn	1.4 ✓
Fe	2.3
Oper #1	LDF
Oper #2	CMO

GZA GeoEnvironmental, Inc.
Engineers and Scientists

Page No.

Project	IP/394/OES Series		File No.
Location		Date	By
Subject		Checked	By
Based on		Revised	By

Sample name H-42

date 10/17/91

time 07:00 (6:30)

Results

Benzene	<1.0	1209pm ✓
Toluene	<1.0	✓
As	.079	✓
Cr^{6+}	<0.05	✓
NH_3	0.29	✓
$NH_3 + NH_4^+$	190	✓
Cu	<0.05	✓
Zn	1.2	✓
Fe	2.3	✓

oper #1 LDF

oper #2 CMO.

GZA GEOENVIRONMENTAL, INC.
ENGINEERS AND SCIENTISTS

Page No.

Project			File No.
Location		Date	By
Subject		Checked	By
Based on		Revised	By

Sample name H-43

Date 10/17/91

Time 7:30

Results

		120ppm	
Benzene	<1	✓	
Toluene	<1	✓	
As	.075	✓	
Cr^{6+}	< .05	✓	
NH_3	.371	X	~110ppm
NH_3 & NH_4^+	200	✓	
Cu^{++}	<.05	✓	
Zn	1.4	✓	
Fe.	2.3	✓	

Oper 1 JMB

Oper 2 CMO

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES - GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME H-[illegible] INF	DATE	TIME	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01	10/17/91	5:30	BENZENE		ug/L-PPB
IP/394/OE5/ /2/ /02			TOLUENE		ug/L-PPB
IP/394/OE5/ /2/ /03			ARSENIC	<.05	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM		mg/L-PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY		mg/L-PPM
			AMMONIA NH3 & NH4+		mg/L-PPM
IP/394/OE5/ /2/ /06			COPPER		mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC		mg/L-PPM
IP/394/OE5/ /2/ /08			IRON		mg/L-PPM

OPERATOR #1 JMB

OPERATOR #2 KW

GZA GEOENVIRONMENTAL, INC.
ENGINEERS AND SCIENTISTS

Page No.

Project		File No.
Location	Date	By
Subject	Checked	By
Based on	Revised	By

Sample name H-44 Eff
Date 10/17/91
Time 8:35

Results

		12091	
Benzene	<1	✓	
Toluene	<1	✓	
As	.075	✓	
Cr 6+	<.05	✓	
NH_3	.56	X	70 ppm
NH_3 & NH_4+	190	✓	
Cu++	.054	✓	
Zn	1.2	✓	
Fe	3.4	✓	

Oper 1 JMB
Oper 2 CMO

GZA GeoEnvironmental, Inc.
Engineers and Scientists

Page No.

Project		File No.
Location	Date	By
Subject	Checked	By
Based on	Revised	By

Sample name H-45
Date 10/17/91
Time 9:30

Results

Benzene	<1
Toluene	<1
As	.074
Cr^{6+}	<.05
NH_3	.55
NH_3 & NH_4^+	210
Cu^{++}	<.05
Zn	.20
Fe	4.4

operator 1 JMB

operator 2 CMO

GZA GEOENVIRONMENTAL, INC.
ENGINEERS AND SCIENTISTS

Page No.

Project			File No.
Location		Date	By
Subject		Checked	By
Based on		Revised	By

Sample name H-46 EFF
Date 10/17/91
Time 10:30

Results

		20 ppm
Benzene	<1	✓
Toluene	<1	✓
As	.094	✓
Cr^{6+}	<.05	✓
NH_3	.44	X - 91.69 ppm to H.B.
NH_3 & NH_4^+	140	✓
Cu^{++}	.058	✓
Zn	1.4	✓
Fe	2.7	✓

Operator 1 ____

Operator 2 CMO

GZA GEOENVIRONMENTAL, INC.
ENGINEERS AND SCIENTISTS

Page No.

Project		File No.
Location	Date	By
Subject	Checked	By
Based on	Revised	By

Sample name H-47 Eff
Date 10/17/91
Time 11:30

Results.

			120 ppm
Benzene	<1	✓	
Toluene	<1	✓	
As	.082	✓	
Cr^{6+}	<.05	✓	
NH_3	.45	X	89.52 ppm
NH_3 & NH_4^+	170	✓	
Cu^{++}	.082	✓	
Zn	1.1	✓	
Fe	2.6	✓	

oper 1 JMB
oper 2 CMO.

GZA GEOENVIRONMENTAL, INC.
ENGINEERS AND SCIENTISTS

Page No.

Project			File No.
Location		Date	By
Subject		Checked	By
Based on		Revised	By

Sample- H-48 EFF

Date- 10/17/91
Time- 12:30

results		120 ppm
Benzene	<1	✓
Toluene	<1	✓
As	.075	✓
Cr^{6+}	<.05	✓
NH_3	.65	X - 60.8 ppm
NH_3 & NH_4^+	160	✓
Cu^{++}	.053	✓
Zn	1.4	✓
Fe	2.5	✓

oper 1 JMB
oper 2 CMO

GZA GEOENVIRONMENTAL, INC.
ENGINEERS AND SCIENTISTS

Page No.

Project		File No.
Location	Date	By
Subject	Checked	By
Based on	Revised	By

Sample H-49 EFF
Date 10/17/91
Time 13:25

Results		1209pm
Benzene	<1	✓
Toluene	<1	✓
As	.077	✓
Cr^{6+}	<.05	✓
NH_3	JMB <.05	✓
NH_3 & NH_4^+	~~<.05~~ .79 JMB	✓
Cu^{++}	<.05	✓
Zn	1.1	✓
Fe	2.5	✓

Operator 1 JMB

Operator 2 CMO

GZA GeoEnvironmental, Inc.
Engineers and Scientists

Page No.

Project		File No.
Location	Date	By
Subject	Checked	By
Based on	Revised	By

Sample H-50 OFF
Date 10/17/91
Time: 14:35

Results

		120ppm
Benzene	<1	✓
Toluene	<1	✓
As	.064	✓
Cr^{6+}	<.05	✓
NH_3	<.05	✓
NH_3 & NH_4^+	80	✓
Cu^{++}	<.05	✓
Zn	1.4	✓
Fe	2.4	✓

Operator 1 JMB

Operator 2 CMO.

GZA GEOENVIRONMENTAL, INC.
ENGINEERS AND SCIENTISTS

Page No.

Project		File No.
Location	Date	By
Subject	Checked	By
Based on	Revised	By

Sample - H-51 Eff.
Date 10/17/91
Time 15:30

Results

		120 g/m
Benzene	<1	✓
Toluene	<1	✓
As	.082	✓
Cr^{6+}	<.05	✓
NH_3	<.05	✓
NH_3 & NH_4^+	82.	✓
Cu^{++}	.058	✓
Zn	1.3	✓
Fe	2.5	✓

Operator 1 JMB

Operator 2 CMD

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES – GOLDER ASSOCIATES
GZA JOB NO. 12695

128pm

SAMPLE NAME H-52 EPC	DATE 10/17/91	TIME 16.30	TARGET CMPD.	RESULT	UNITS	
IP/394/OE5/ /2/ /01			BENZENE	<1	ug/L-PPB	✓
IP/394/OE5/ /2/ /02			TOLUENE	<1	ug/L-PPB	✓
IP/394/OE5/ /2/ /03			ARSENIC	.079	mg/L-PPM	✓
IP/394/OE5/ /2/ /04			CHROMIUM	<.05	mg/L-PPM	✓
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	<.05	mg/L-PPM	✓
			AMMONIA NH3 & NH4+	44	mg/L-PPM	✓
IP/394/OE5/ /2/ /06			COPPER	<.05	mg/L-PPM	✓
IP/394/OE5/ /2/ /07			ZINC	.92	mg/L-PPM	✓
IP/394/OE5/ /2/ /08			IRON	5.1	mg/L-PPM	✓

OPERATOR #1 JMB

OPERATOR #2 CMO.

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES - GOLDER ASSOCIATES
GZA JOB NO. 12695

120 ppm

SAMPLE NAME H-53 EFF	DATE	TIME	TARGET CMPD.	RESULT	UNITS	
IP/394/OE5/ /2/ /01	10/17/91	17:30	BENZENE	<1	ug/L-PPB	✓
IP/394/OE5/ /2/ /02			TOLUENE	<1	ug/L-PPB	✓
IP/394/OE5/ /2/ /03			ARSENIC	.080	mg/L-PPM	✓
IP/394/OE5/ /2/ /04			CHROMIUM	<.05	mg/L-PPM	✓
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	<.05	mg/L-PPM	✓
			AMMONIA NH3 & NH4+	52	mg/L-PPM	✓
IP/394/OE5/ /2/ /06			COPPER	<.05	mg/L-PPM	✓
IP/394/OE5/ /2/ /07			ZINC	07 ~~7.0~~ .58	mg/L-PPM	✓
IP/394/OE5/ /2/ /08			IRON	4.1	mg/L-PPM	✓

OPERATOR #1 JMB

OPERATOR #2 BZ

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES - GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME H-5H INF	DATE	TIME	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01	10/17/91	JMB ~~[illegible]~~ 18:20	BENZENE	2.3 B7	ug/L-PPB
IP/394/OE5/ /2/ /02			TOLUENE	< 1 B7	ug/L-PPB
IP/394/OE5/ /2/ /03			ARSENIC	*	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM	< .05	mg/L-PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	.079	mg/L-PPM
			AMMONIA NH3 & NH4+	48	mg/L-PPM
IP/394/OE5/ /2/ /06			COPPER	<.05	mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC	6.4	mg/L-PPM
IP/394/OE5/ /2/ /08			IRON	8.2	mg/L-PPM

* to be run fri. 10/18/91

OPERATOR #1 JMB

OPERATOR #2 B7

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES - GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME H-54 INF	DATE 10/17/91	TIME 6:20	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01			BENZENE		ug/L-PPB
IP/394/OE5/ /2/ /02			TOLUENE		ug/L-PPB
IP/394/OE5/ /2/ /03			ARSENIC	<.05	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM		mg/L-PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY		mg/L-PPM
			AMMONIA NH3 & NH4+		mg/L-PPM
IP/394/OE5/ /2/ /06			COPPER		mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC		mg/L-PPM
IP/394/OE5/ /2/ /08			IRON		mg/L-PPM

OPERATOR #1 JMB

OPERATOR #2 KW

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES - GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME H-54 EFF	DATE	TIME	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01	10/17/91	18:35	BENZENE	<1	ug/L-PPB
IP/394/OE5/ /2/ /02			TOLUENE	<1	ug/L-PPB
IP/394/OE5/ /2/ /03			ARSENIC	.085	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM	<.05	mg/L-PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	<.05	mg/L-PPM
			AMMONIA NH3 & NH4+	50	mg/L-PPM
IP/394/OE5/ /2/ /06			COPPER	<.05 ~~.060~~	mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC	1.24	mg/L-PPM
IP/394/OE5/ /2/ /08			IRON	3.1	mg/L-PPM

OPERATOR #1 JMB

OPERATOR #2 BZ

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES – GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME H-55 EFF	DATE	TIME	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01	10/17/91	19:45	BENZENE	<1.0	ug/L-PPB
IP/394/OE5/ /2/ /02			TOLUENE	<1.0	ug/L-PPB
IP/394/OE5/ /2/ /03			ARSENIC	0.085	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM	<.05	mg/L-PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	LDF <0.05	mg/L-PPM
			AMMONIA NH3 & NH4+	48	mg/L-PPM
IP/394/OE5/ /2/ /06			COPPER	<0.05	mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC	1.8	mg/L-PPM
IP/394/OE5/ /2/ /08			IRON	2.5	mg/L-PPM

OPERATOR #1 LDF

OPERATOR #2 BF

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES - GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME H-56 EFF	DATE	TIME	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01	10/17/91	20:45	BENZENE	<1.0	ug/L-PPB
IP/394/OE5/ /2/ /02			TOLUENE	<1.0	ug/L-PPB
IP/394/OE5/ /2/ /03			ARSENIC	0.068	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM	<0.05	mg/L-PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	0.06	mg/L-PPM
			AMMONIA NH3 & NH4+	54	mg/L-PPM
IP/394/OE5/ /2/ /06			COPPER	<0.05	mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC	1.4 ~~1.35~~ BT	mg/L-PPM
IP/394/OE5/ /2/ /08			IRON	3.4	mg/L-PPM

OPERATOR #1 LDP

OPERATOR #2 BT

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES - GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME H-57 44	DATE	TIME	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01	10/17/91	21:35	BENZENE	<1.0	ug/L-PPB
IP/394/OE5/ /2/ /02			TOLUENE	<1.0	ug/L-PPB
IP/394/OE5/ /2/ /03			ARSENIC	0.068	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM	<.05	mg/L-PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	<0.05	mg/L-PPM
			AMMONIA NH3 & NH4+	.50	mg/L-PPM
IP/394/OE5/ /2/ /06			COPPER	<0.05	mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC	1.4	mg/L-PPM
IP/394/OE5/ /2/ /08			IRON	3.7	mg/L-PPM

OPERATOR #1 LDF

OPERATOR #2 BT

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES - GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME H-58	DATE	TIME	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01	10/7/91	23:00	BENZENE	<1.0	ug/L-PPB
IP/394/OE5/ /2/ /02			TOLUENE	<1.0	ug/L-PPB
IP/394/OE5/ /2/ /03			ARSENIC	0.068	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM	< .05	mg/L-PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	<0.05	mg/L-PPM
			AMMONIA NH3 & NH4+	49	mg/L-PPM
IP/394/OE5/ /2/ /06			COPPER	<0.05	mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC	1.6	mg/L-PPM
IP/394/OE5/ /2/ /08			IRON	3.3	mg/L-PPM

OPERATOR #1 LDF

OPERATOR #2 BF

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES – GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME H-54 eff	DATE	TIME	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01	10/17/91	23:30	BENZENE	<1.0	ug/L-PPB
IP/394/OE5/ /2/ /02			TOLUENE	<1.0	ug/L-PPB
IP/394/OE5/ /2/ /03			ARSENIC	0.069	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM	<0.05	mg/L-PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	0.12	mg/L-PPM
			AMMONIA NH3 & NH4+	53	mg/L-PPM
IP/394/OE5/ /2/ /06			COPPER	<0.05	mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC	1.3	mg/L-PPM
IP/394/OE5/ /2/ /08			IRON	3.5	mg/L-PPM

OPERATOR #1 HDF

OPERATOR #2 BZ

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES - GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME H-60 off	DATE	TIME	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01	10/18/91	00:35	BENZENE	<1.0	ug/L-PPB
IP/394/OE5/ /2/ /02			TOLUENE	<1.0	ug/L-PPB
IP/394/OE5/ /2/ /03			ARSENIC	0.065	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM	<.05	mg/L-PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	<0.05	mg/L-PPM
			AMMONIA NH3 & NH4+	40	mg/L-PPM
IP/394/OE5/ /2/ /06			COPPER	<0.05	mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC	1.4	mg/L-PPM
IP/394/OE5/ /2/ /08			IRON	3.7	mg/L-PPM

OPERATOR #1 LDF

OPERATOR #2 BF

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES - GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME H-G1 EFF	DATE	TIME	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01	10/18/91	01:39 [redacted] BJ	BENZENE	<1.0	ug/L-PPB
IP/394/OE5/ /2/ /02			TOLUENE	<1.0	ug/L-PPB
IP/394/OE5/ /2/ /03			ARSENIC	0.072	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM	<.05	mg/L-PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	0.05	mg/L-PPM
			AMMONIA NH3 & NH4+	53	mg/L-PPM
IP/394/OE5/ /2/ /06			COPPER	<0.05	mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC	1.1	mg/L-PPM
IP/394/OE5/ /2/ /08			IRON	2.9	mg/L-PPM

OPERATOR #1 LDF

OPERATOR #2 BJ

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES - GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME H-L2 off	DATE	TIME	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01	10/18/91	03:05	BENZENE	<1.0	ug/L-PPB
IP/394/OE5/ /2/ /02			TOLUENE	<1.0	ug/L-PPB
IP/394/OE5/ /2/ /03			ARSENIC	0.077	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM	<0.05	mg/L-PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	<0.05	mg/L-PPM
			AMMONIA NH3 & NH4+	50	mg/L-PPM
IP/394/OE5/ /2/ /06			COPPER	<0.05	mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC	1.4	mg/L-PPM
IP/394/OE5/ /2/ /08			IRON	3.8	mg/L-PPM

OPERATOR #1 LDF

OPERATOR #2 BZ

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES – GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME H-63 off	DATE	TIME	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01	10/18/91	03:45	BENZENE	<1.0	ug/L-PPB
IP/394/OE5/ /2/ /02			TOLUENE	<1.0	ug/L-PPB
IP/394/OE5/ /2/ /03			ARSENIC	0.077	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM	<.05	mg/L-PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	<0.05	mg/L-PPM
			AMMONIA NH3 & NH4+	53	mg/L-PPM
IP/394/OE5/ /2/ /06			COPPER	<0.05	mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC	~~1.46~~ 1.5 OF	mg/L-PPM
IP/394/OE5/ /2/ /08			IRON	3.7	mg/L-PPM

OPERATOR #1 WF

OPERATOR #2 BZ

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES - GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME H-64	DATE	TIME	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01	10/18/91	04:35	BENZENE	<1.0	ug/L-PPB
IP/394/OE5/ /2/ /02			TOLUENE	<1.0	ug/L-PPB
IP/394/OE5/ /2/ /03			ARSENIC	0.046	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM	<0.05	mg/L-PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	<0.05	mg/L-PPM
			AMMONIA NH3 & NH4+	54	mg/L-PPM
IP/394/OE5/ /2/ /06			COPPER	<0.05	mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC	1.3	mg/L-PPM
IP/394/OE5/ /2/ /08			IRON	7.3	mg/L-PPM

OPERATOR #1 LDF

OPERATOR #2 BF

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES - GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME H-65 Eff	DATE	TIME	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01	10/18/91	05:40	BENZENE	<1.0	ug/L-PPB
IP/394/OE5/ /2/ /02			TOLUENE	<1.0	ug/L-PPB
IP/394/OE5/ /2/ /03			ARSENIC	0.071	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM	<0.05	mg/L-PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	<0.05	mg/L-PPM
			AMMONIA NH3 & NH4+	54	mg/L-PPM
IP/394/OE5/ /2/ /06			COPPER	<0.05	mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC	1.0 BF	mg/L-PPM
IP/394/OE5/ /2/ /08			IRON	3.8	mg/L-PPM

OPERATOR #1 LDF

OPERATOR #2 BF

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES – GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME H-66 eff	DATE	TIME	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01	10/18/91	06:35	BENZENE	<1.0	ug/L-PPB
IP/394/OE5/ /2/ /02			TOLUENE	<1.0	ug/L-PPB
IP/394/OE5/ /2/ /03			ARSENIC	<.05	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM	<.05.	mg/L-PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	<0.05	mg/L-PPM
			AMMONIA NH3 & NH4+	49	mg/L-PPM
IP/394/OE5/ /2/ /06			COPPER	<0.05	mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC	.47	mg/L-PPM
IP/394/OE5/ /2/ /08			IRON	5.2	mg/L-PPM

OPERATOR #1 LDF

OPERATOR #2 CMO

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES - GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME H-67 INF	DATE 10/18/91	TIME 7:25	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01			BENZENE	1.2	ug/L-PPB
IP/394/OE5/ /2/ /02			TOLUENE	<1	ug/L-PPB
IP/394/OE5/ /2/ /03			ARSENIC	*	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM	<.05	mg/L-PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	.15	mg/L-PPM
			AMMONIA NH3 & NH4+	50	mg/L-PPM
IP/394/OE5/ /2/ /06			COPPER	<.05	mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC	6.7	mg/L-PPM
IP/394/OE5/ /2/ /08			IRON	10.4	mg/L-PPM

* to be run fri 10/18/91

OPERATOR #1 JMB

OPERATOR #2 CMO

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES - GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME H-67 INF	DATE 10/16/91	TIME 7:25	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01			BENZENE		ug/L-PPB
IP/394/OE5/ /2/ /02			TOLUENE		ug/L-PPB
IP/394/OE5/ /2/ /03			ARSENIC	<0.05	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM		mg/L-PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY		mg/L-PPM
			AMMONIA NH3 & NH4+		mg/L-PPM
IP/394/OE5/ /2/ /06			COPPER		mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC		mg/L-PPM
IP/394/OE5/ /2/ /08			IRON		mg/L-PPM

OPERATOR #1 JMB

OPERATOR #2 KW

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES - GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME H-67 EFF	DATE 10/18/91	TIME 07:40	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01			BENZENE	<1	ug/L-PPB
IP/394/OE5/ /2/ /02			TOLUENE	<1	ug/L-PPB
IP/394/OE5/ /2/ /03			ARSENIC	.054	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM	<.05	mg/L-PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	<.05	mg/L-PPM
			AMMONIA NH3 & NH4+	50.	mg/L-PPM
IP/394/OE5/ /2/ /06			COPPER	<.05	mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC	.36	mg/L-PPM
IP/394/OE5/ /2/ /08			IRON	10.5	mg/L-PPM

OPERATOR #1 JMB

OPERATOR #2 CMO

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES – GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME H-168 Eff	DATE 10/8/91	TIME 8:35	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01			BENZENE	<1	ug/L-PPB
IP/394/OE5/ /2/ /02			TOLUENE	<1	ug/L-PPB
IP/394/OE5/ /2/ /03			ARSENIC	.056	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM	<.05	mg/L-PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	<.05	mg/L-PPM
			AMMONIA NH3 & NH4+	50	mg/L-PPM
IP/394/OE5/ /2/ /06			COPPER	<.05	mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC	.90	mg/L-PPM
IP/394/OE5/ /2/ /08			IRON	6.0	mg/L-PPM

OPERATOR #1 JMB

OPERATOR #2 CMO.

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES – GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME H-69 eff	DATE 10/19/91	TIME 9:35	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01			BENZENE	<1	ug/L-PPB
IP/394/OE5/ /2/ /02			TOLUENE	<1	ug/L-PPB
IP/394/OE5/ /2/ /03			ARSENIC	.063	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM	<.05	mg/L-PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	<.05	mg/L-PPM
			AMMONIA NH3 & NH4+	49	mg/L-PPM
IP/394/OE5/ /2/ /06			COPPER	.068	mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC	.66	mg/L-PPM
IP/394/OE5/ /2/ /08			IRON	7.8	mg/L-PPM

OPERATOR #1 JMB

OPERATOR #2 CMO.

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES – GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME H-70 EFF	DATE 10/18/91	TIME	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01	10/18/91	10:50	BENZENE	<1	ug/L-PPB
IP/394/OE5/ /2/ /02			TOLUENE	<1	ug/L-PPB
IP/394/OE5/ /2/ /03			ARSENIC	<.05	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM	.07	mg/L-PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	<.05	mg/L-PPM
			AMMONIA NH3 & NH4+	39	mg/L-PPM
IP/394/OE5/ /2/ /06			COPPER	<.05	mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC	1.2	mg/L-PPM
IP/394/OE5/ /2/ /08			IRON	14.	mg/L-PPM

OPERATOR #1 JMB

OPERATOR #2 CMO.

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES - GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME H-71 EFF	DATE	TIME	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01	10/18/91	11:30	BENZENE	<1	ug/L-PPB
IP/394/OE5/ /2/ /02			TOLUENE	<1	ug/L-PPB
IP/394/OE5/ /2/ /03			ARSENIC	.053	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM	<.05	mg/L-PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	<.05	mg/L-PPM
			AMMONIA NH3 & NH4+	44	mg/L-PPM
IP/394/OE5/ /2/ /06			COPPER	<.05	mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC	1.2	mg/L-PPM
IP/394/OE5/ /2/ /08			IRON	7.8	mg/L-PPM

OPERATOR #1 JMB

OPERATOR #2 CMO.

GZA GEOENVIRONMENTAL, INC.
LABORATORY SERVICES - GOLDER ASSOCIATES
GZA JOB NO. 12695

SAMPLE NAME H-72 EFF	DATE 10/16/91	TIME 12:15	TARGET CMPD.	RESULT	UNITS
IP/394/OE5/ /2/ /01			BENZENE	<1	ug/L-PPB
IP/394/OE5/ /2/ /02			TOLUENE	<1	ug/L-PPB
IP/394/OE5/ /2/ /03			ARSENIC	.051	mg/L-PPM
IP/394/OE5/ /2/ /04			CHROMIUM	<.05	mg/L-PPM
IP/394/OE5/ /2/ /05			AMMONIA NH3 ONLY	<.05	mg/L-PPM
			AMMONIA NH3 & NH4+	41	mg/L-PPM
IP/394/OE5/ /2/ /06			COPPER	<.05	mg/L-PPM
IP/394/OE5/ /2/ /07			ZINC	1.5	mg/L-PPM
IP/394/OE5/ /2/ /08			IRON	13.	mg/L-PPM

OPERATOR #1 JMB

OPERATOR #2 CMO

Discharge Record

	TASK	Approximate Volume to Halls Brook (gallons)	Approximate Volume to Wetland Mitigation Area (gallons)
1.	Development and Step Test Water (10/8/91 through 10/9/91)	40,000	
2.	System Operation/Calibration Test		30,400
3.	Pumping Test		
•	10/15/91 - 1230 through 1730 40 gpm to HBHA, 80 gpm to PMWA	12,000	24,000
•	10/15/91 - 1730 through 10/16/91 - 0400 120 gpm to HBHA	75,600	0
•	10/16/91 - 0400 through 0915 20 gpm to HBHA, 100 gpm to PMWA	6,300	31,500
•	10/16/91 - 0915 through 1700 120 gpm to HBHA	55,800	0
•	10/16/91 - 1700 through 1730 65 gpm to HBHA, 55 gpm to PMWA	1,800	1,650
•	10/16/91 - 1730 thorugh 10/17/91 - 0730 30 gpm to HBHA, 90 gpmto PMWA	25,200	75,600
•	10/17/91 - 0730 through 1000 120 gpm to HBHA	18,000	0
•	10/17/91 - 1000 through 1200 70 gpm to HBHA, 50 gpm to PMWA	8,400	6,000
•	10/17/91 - 1200 through 1500 90 gpm to HBHA, 30 gpm to PMWA	16,200	5,400
•	10/17/91 - 1500 through end of test 10/18/91 - 1300 120 gpm to HBHA	158,400	0
	TOTAL	417,700	174,550

APPENDIX F

Electronic and Manual Water Level Data

APPENDIX F

ELECTRONIC AND MANUAL WATER LEVEL DATA

Appendix F contains manual and digital water level measurement data transmitted via both machine readable disk and hard copy. Appendix F has been provided in written hard copy to the following parties: ISRT, USEPA, MDEP, and Golder. Owing to the possibility of potential errors on or unrecognized changes to the machine readable disk version of this information, only the accompanying written hard copy of this information should be considered the formal submittal by Golder Associates Inc. It is the responsibility of the recipient to assure that the information on the machine readable disk is consistent with the written hard copy submittal.

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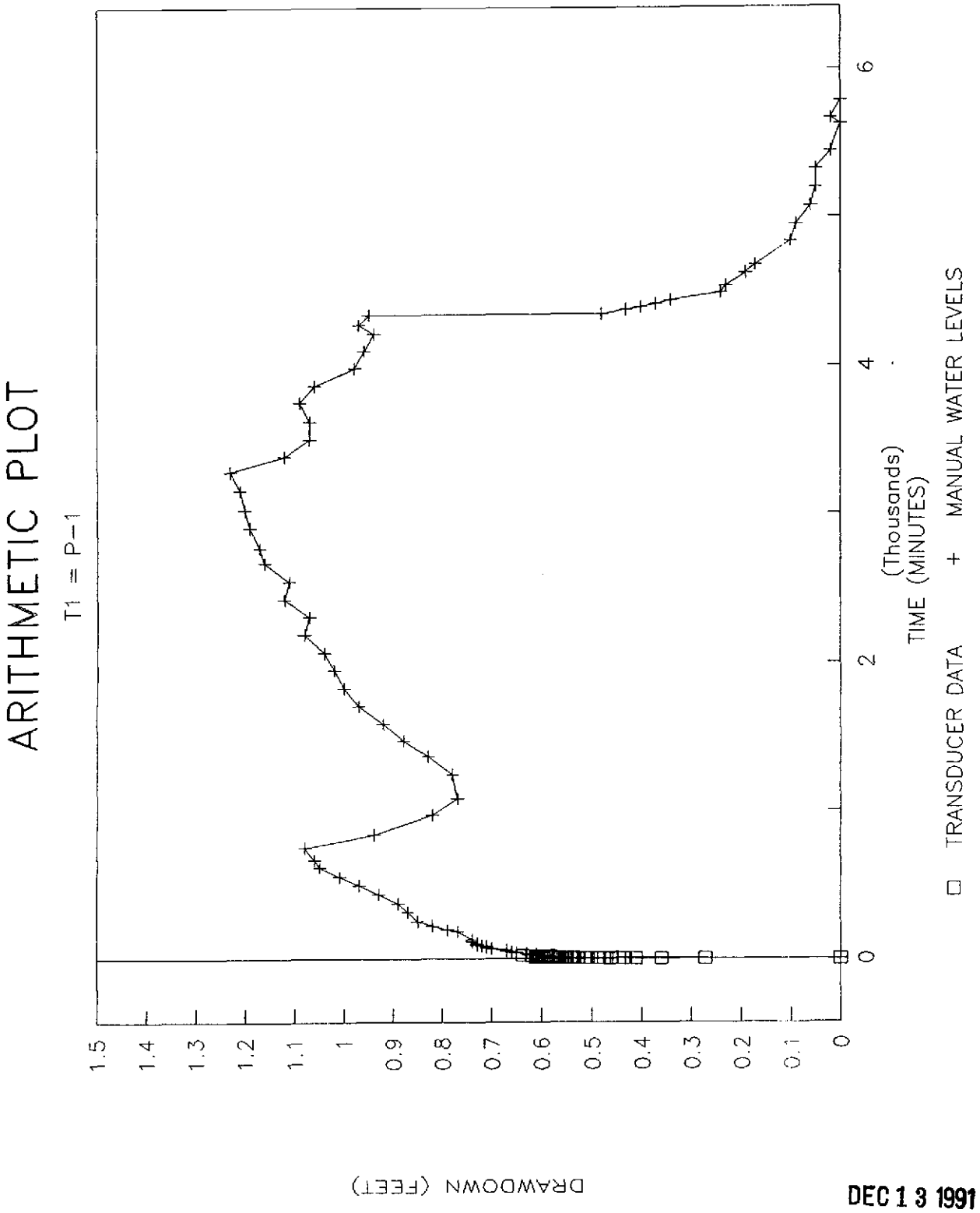
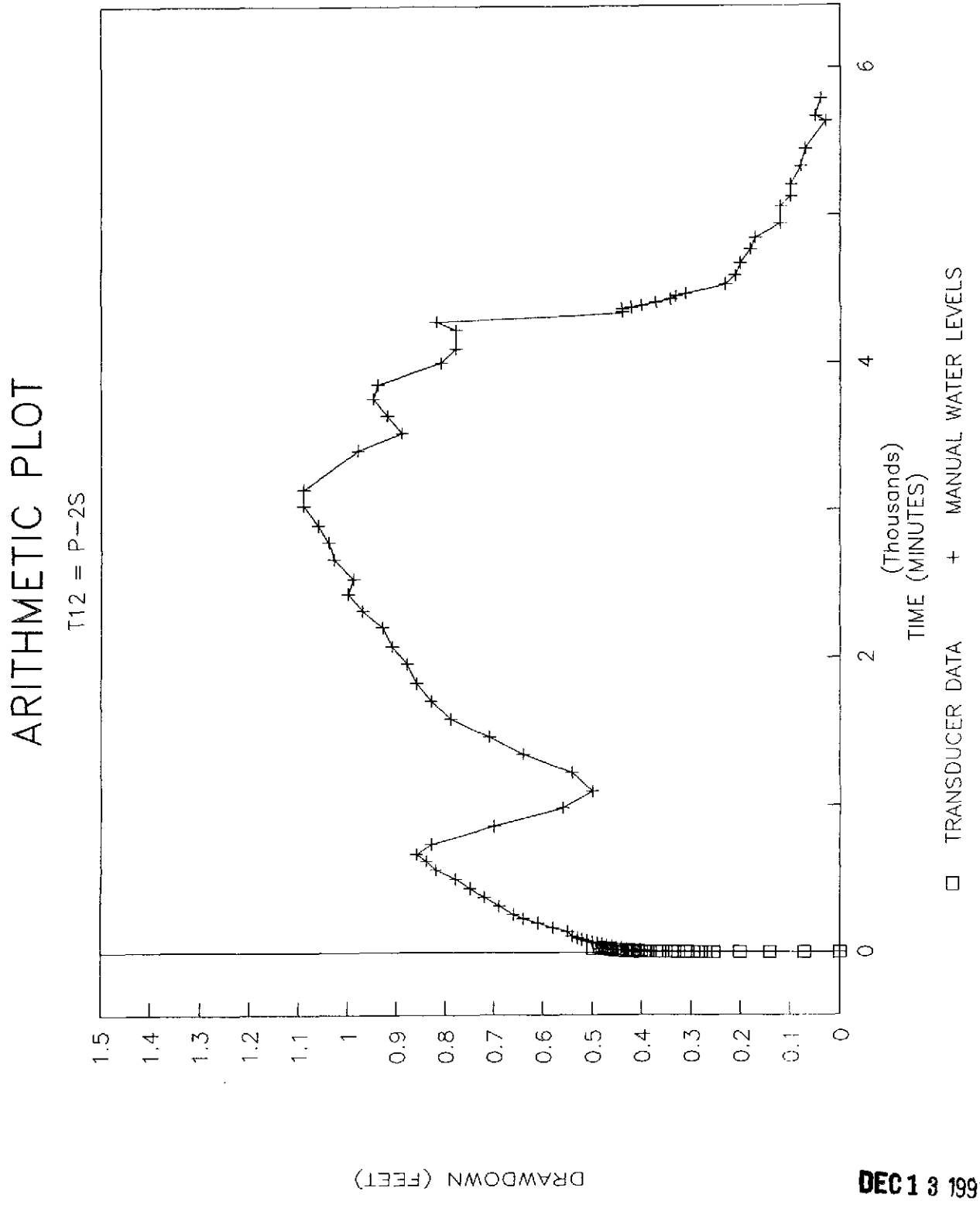
APPENDIX G

Arithmetic Plots of Time Versus Drawdown



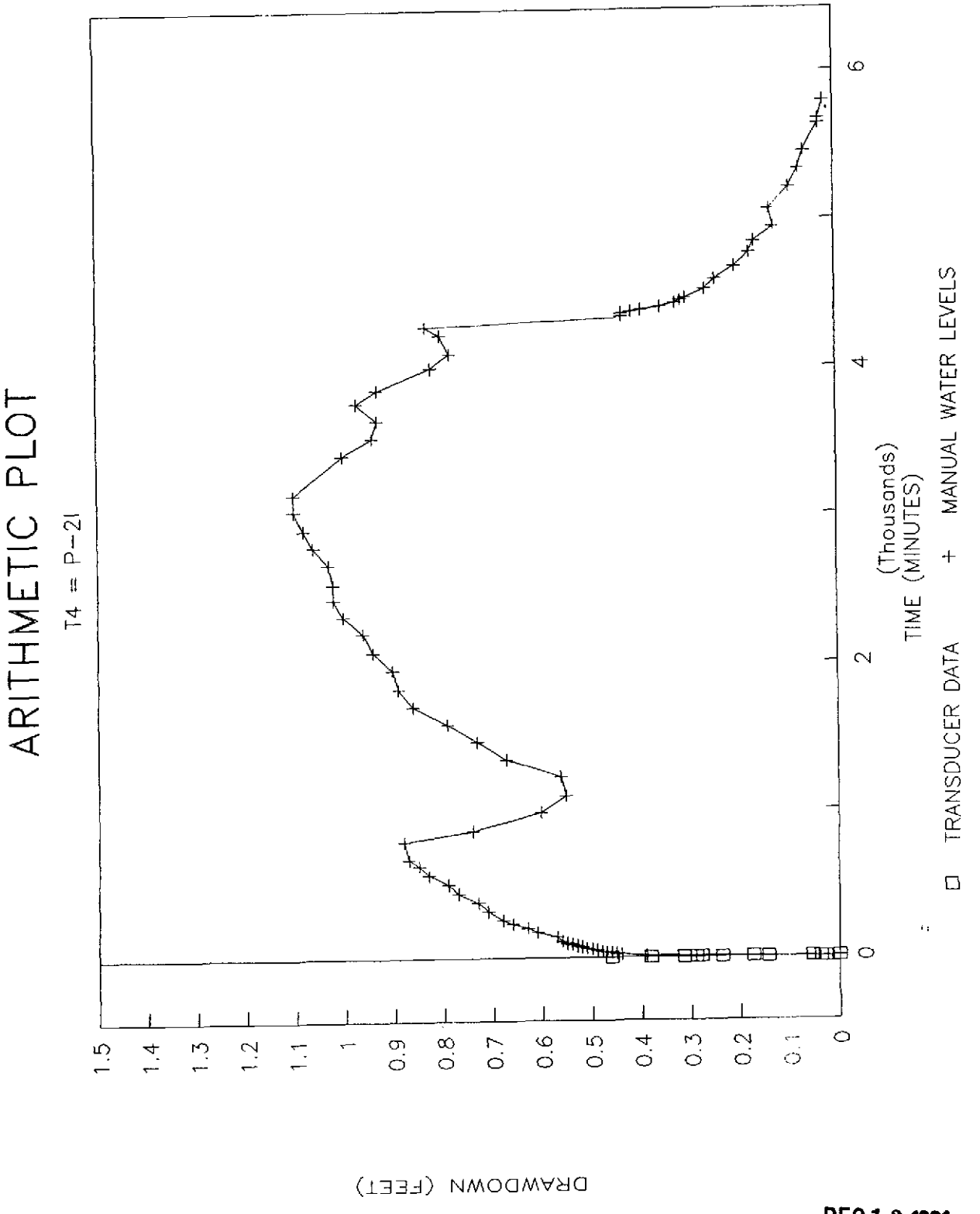
DEC 1 3 1991

JOB No.: 913-6744	SCALE: AS SHOWN	**ARITHMETIC PLOT MONITORING POINT P-1**		
DRAWN: FG	DATE: 11/08/91			
CHECKED: RSW	FILE No.: MA03-001			
Golder Associates		INDUSTRI-PLEX SITE REMEDIAL TRUST	FIGURE **G-1**	



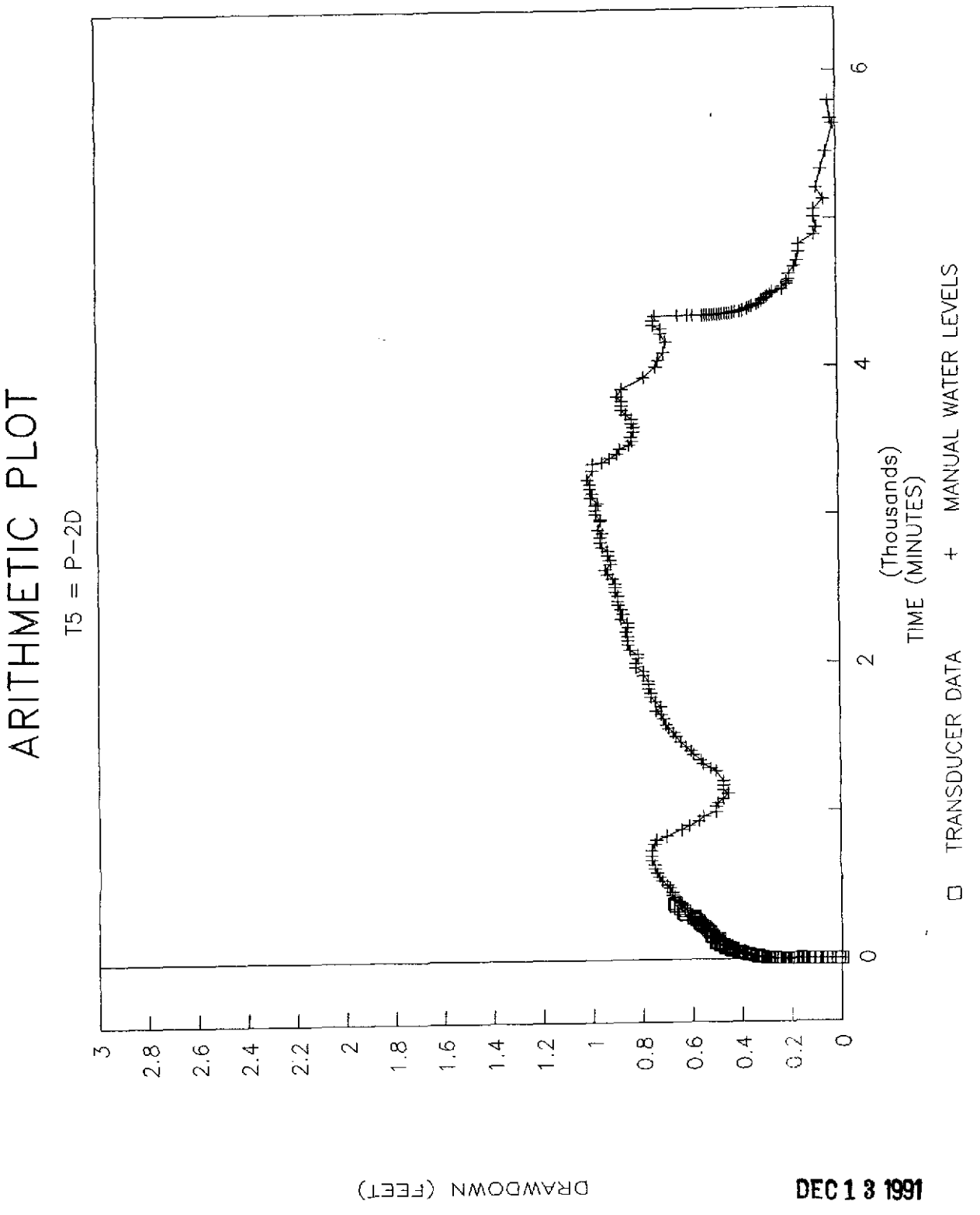
DEC 1 3 1991

JOB No.: 913-6744	SCALE: AS SHOWN	**ARITHMETIC PLOT MONITORING POINT P-2S**		
DRAWN: FG	DATE: 11/08/91			
CHECKED: RSW	FILE No.: MA03-002			
Golder Associates		INDUSTRI-PLEX SITE REMEDIAL TRUST	FIGURE	G-2



DEC 1 3 1991

JOB No.: 913-6744	SCALE: AS SHOWN	ARITHMETIC PLOT MONITORING POINT P-21		
DRAWN: FG	DATE: 11/08/91			
CHECKED: RSW	FILE No.: MA03-003			
Golder Associates		INDUSTRI-PLEX SITE REMEDIAL TRUST	FIGURE G-3	



DEC 1 3 1991

JOB No.: 913-6744	SCALE: AS SHOWN	**ARITHMETIC PLOT MONITORING POINT P-2D**		
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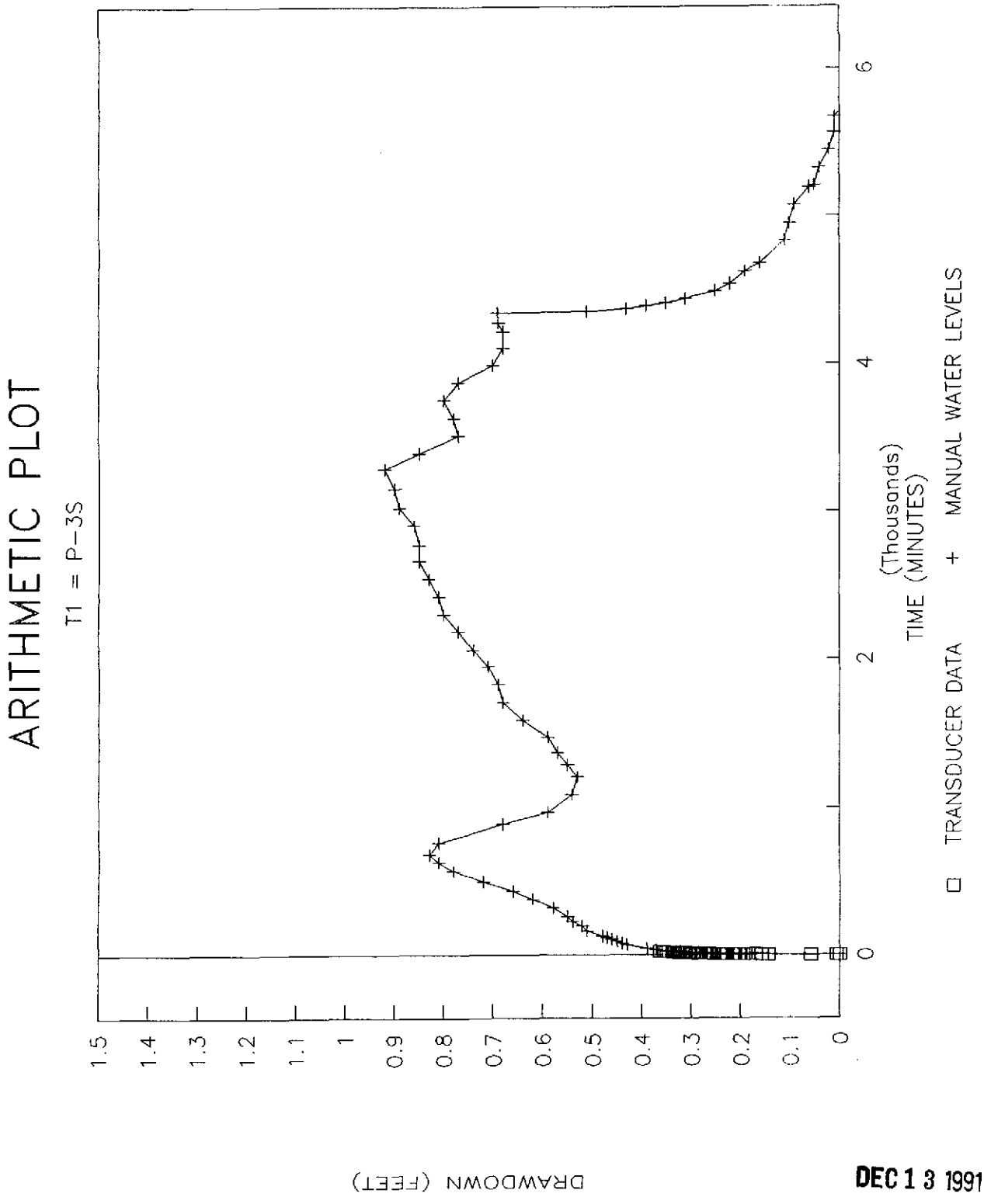

DEC 1 3 1991

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CHECKED: RSW	FILE No.: MA03-005			
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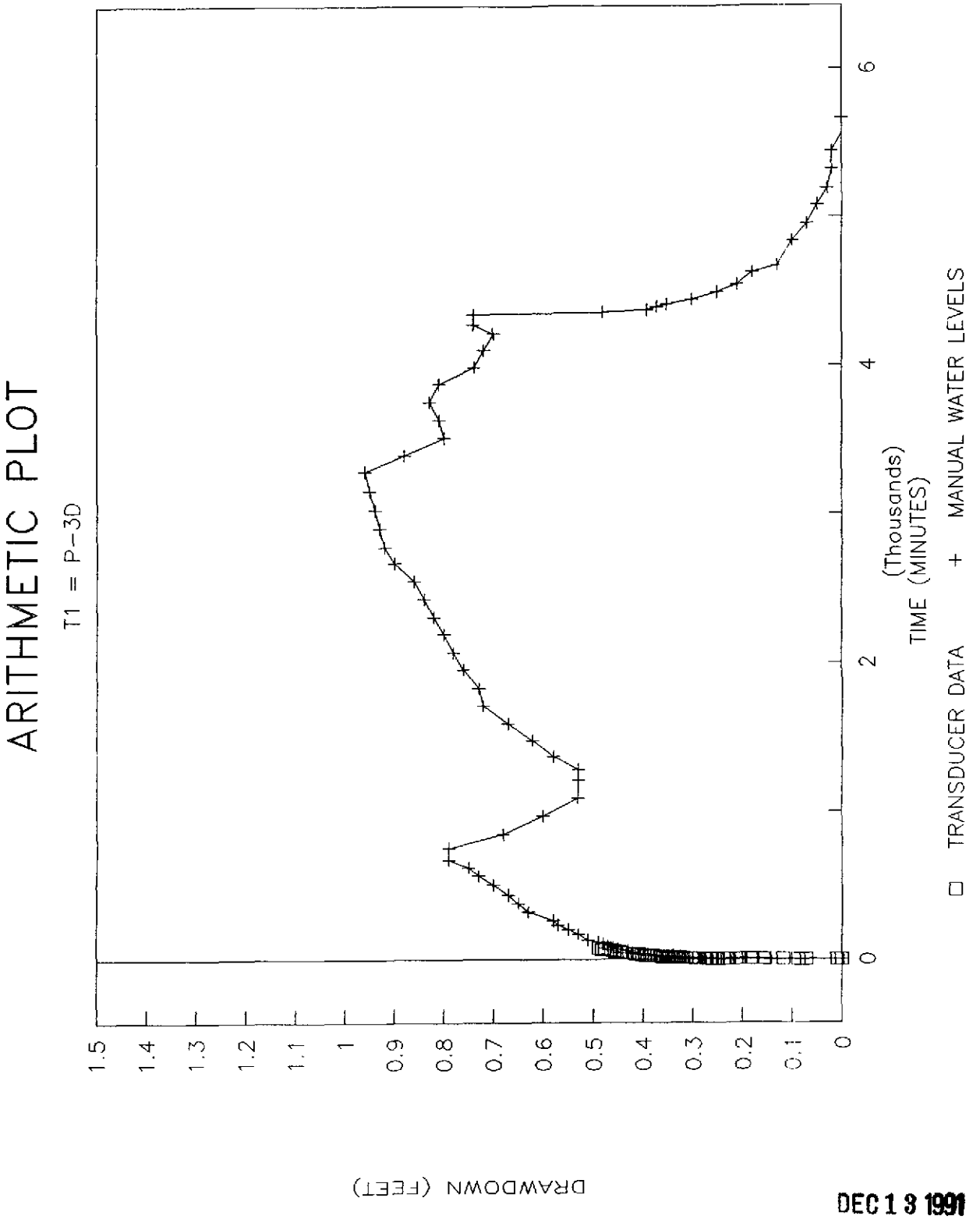

DEC 1 3 1991

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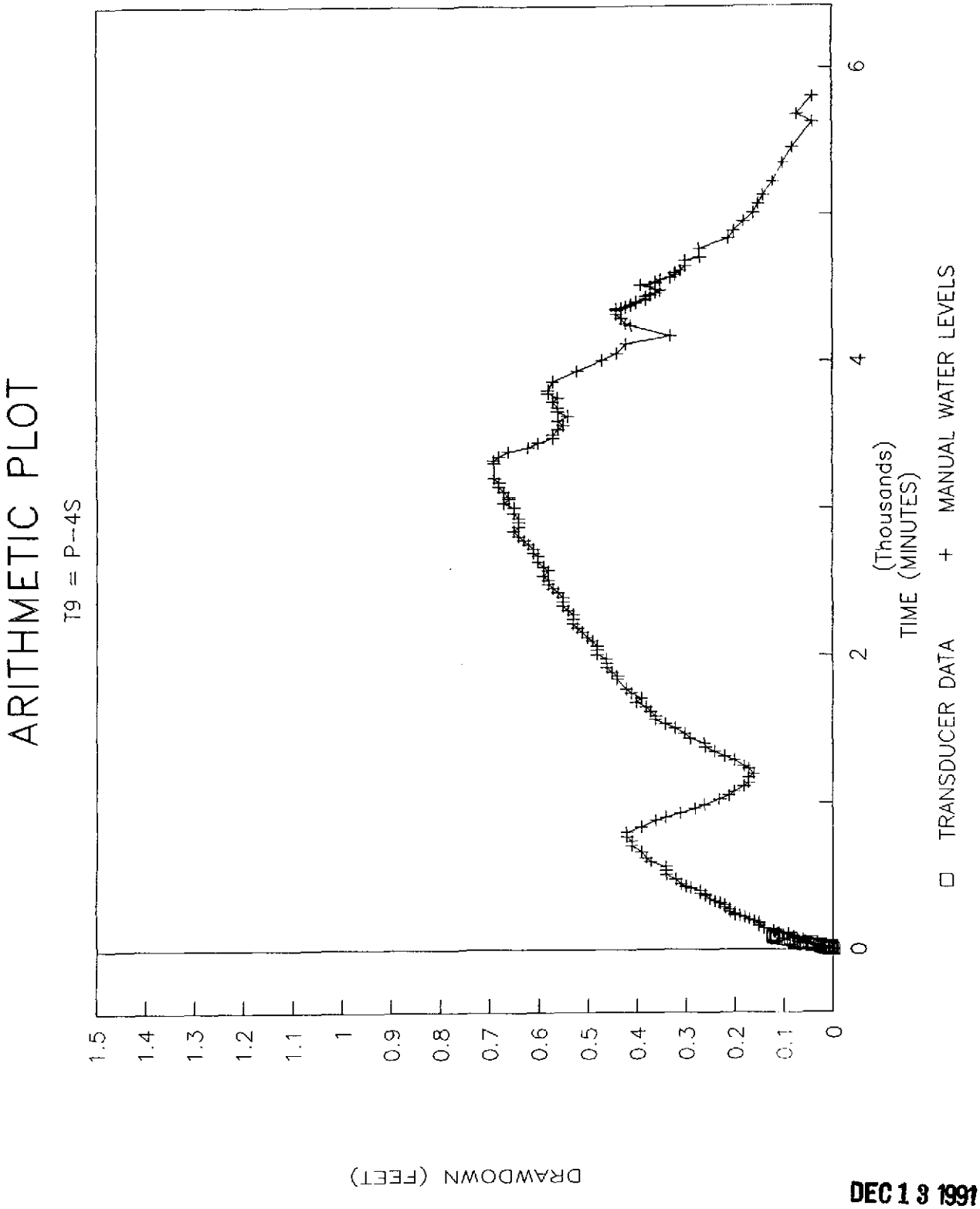

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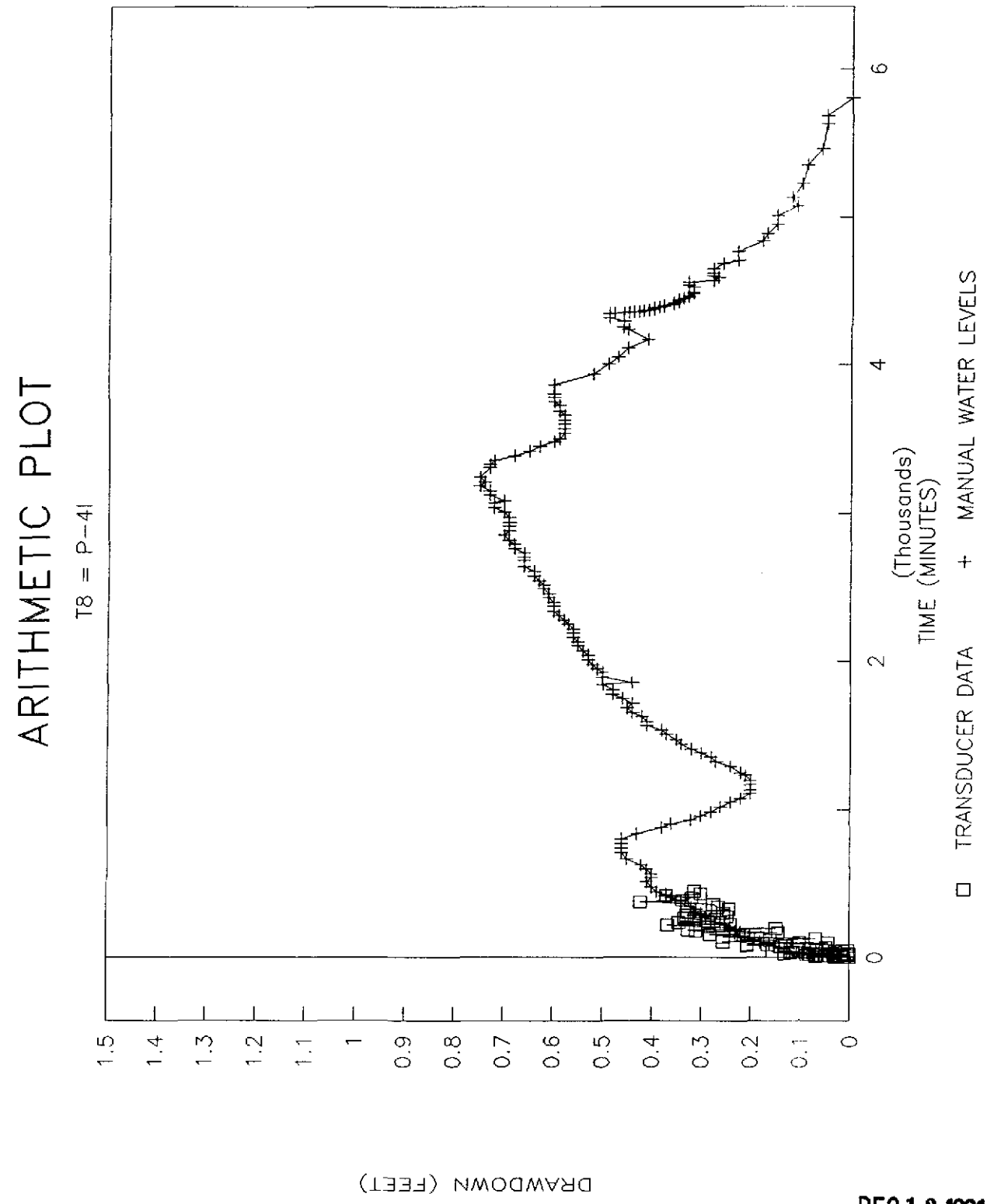

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JOB No.: 913-6744	SCALE: AS SHOWN	**ARITHMETIC PLOT MONITORING POINT P-4I**		
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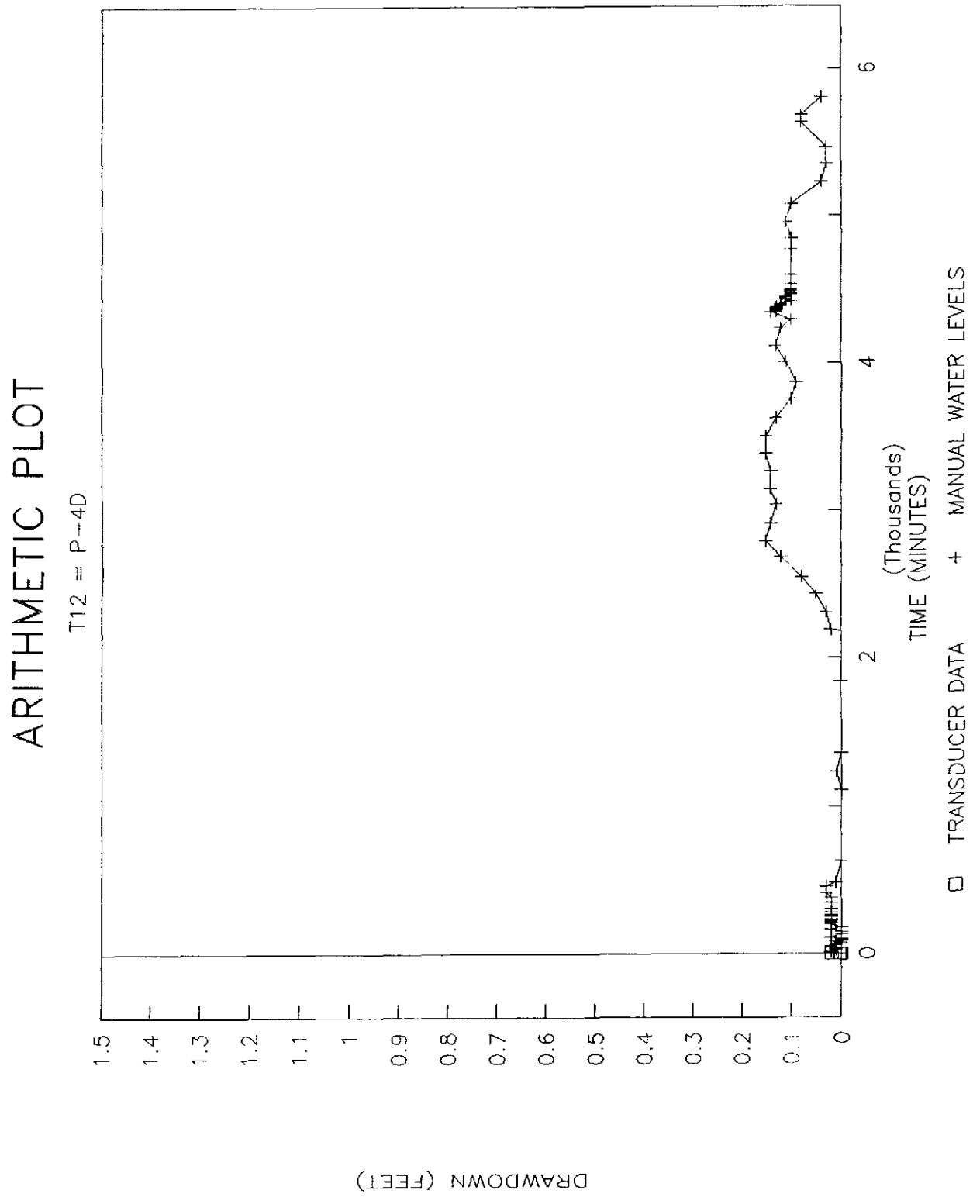

DEC 1 3 1991

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CHECKED: RSW	FILE No.: MA03-009			
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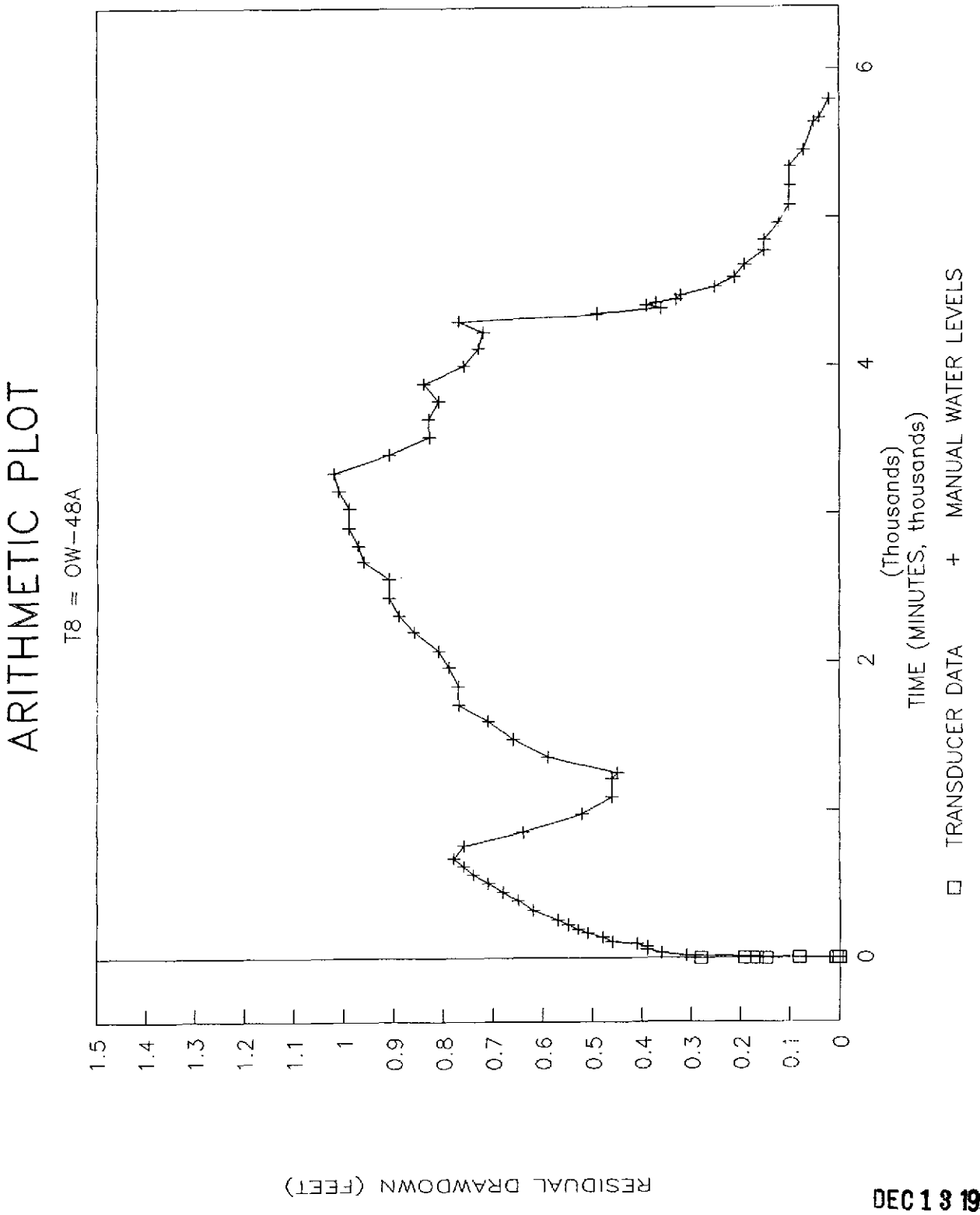

DEC 1 3 1991

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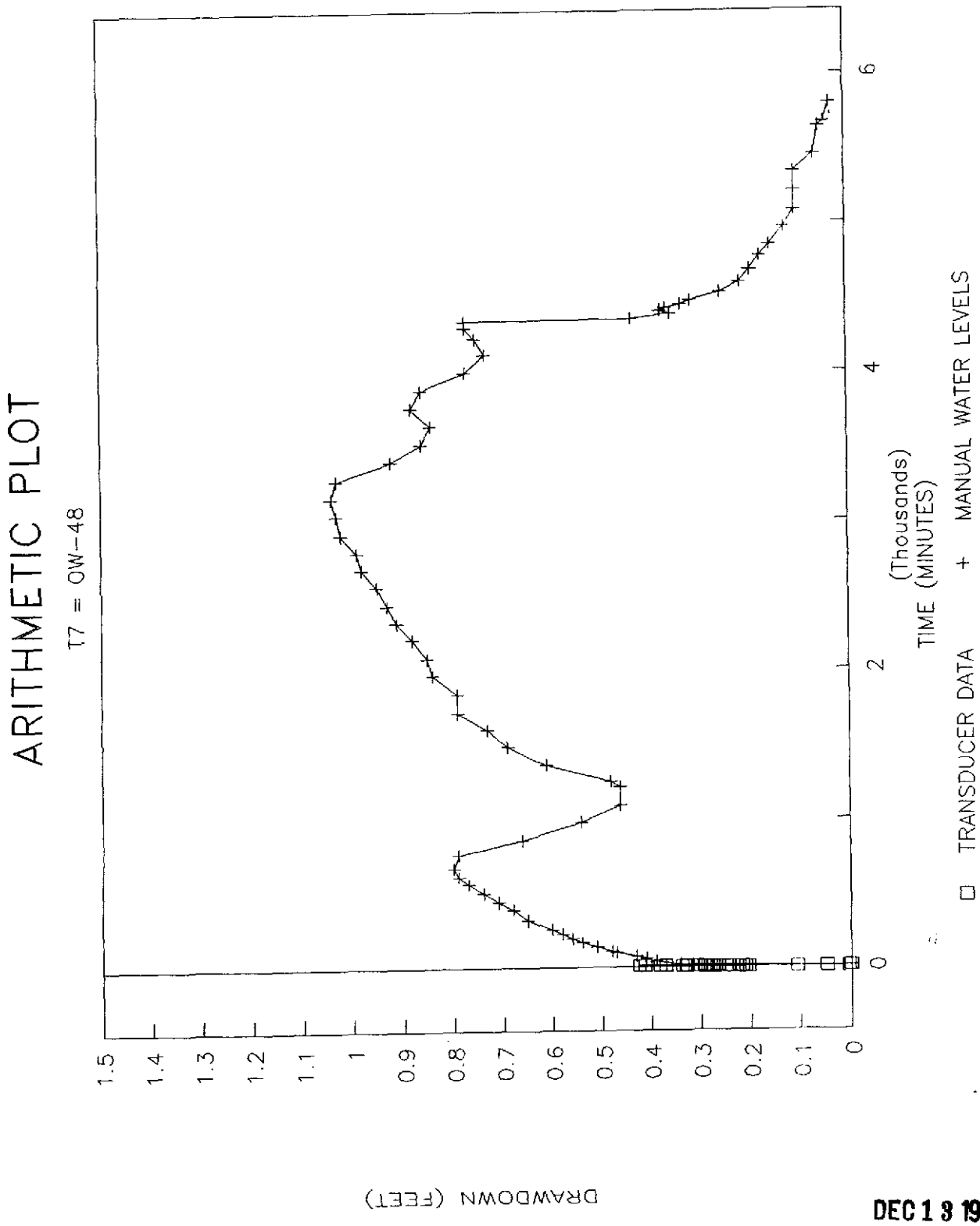

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CHECKED: RSW	FILE No.: MA03-011			
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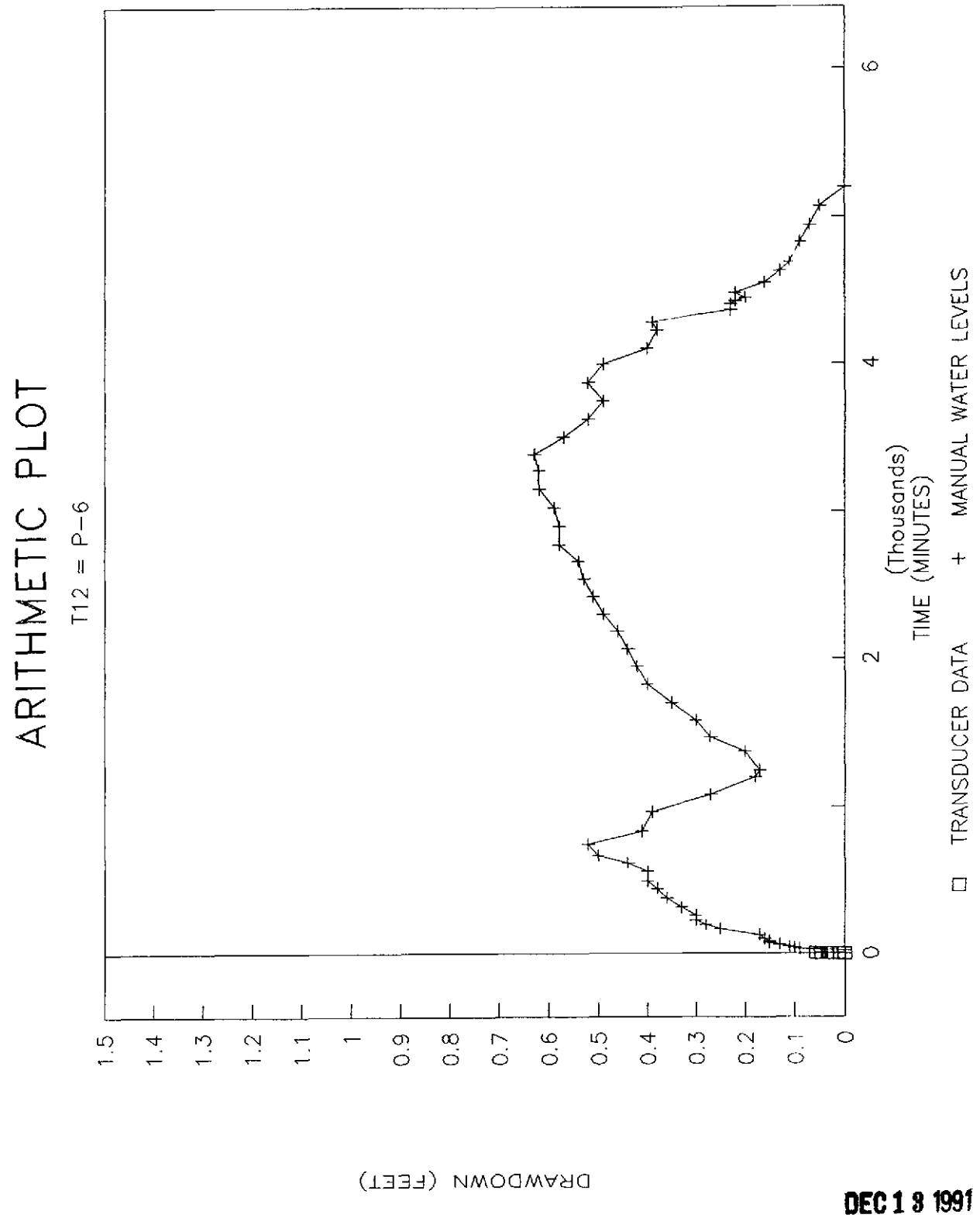

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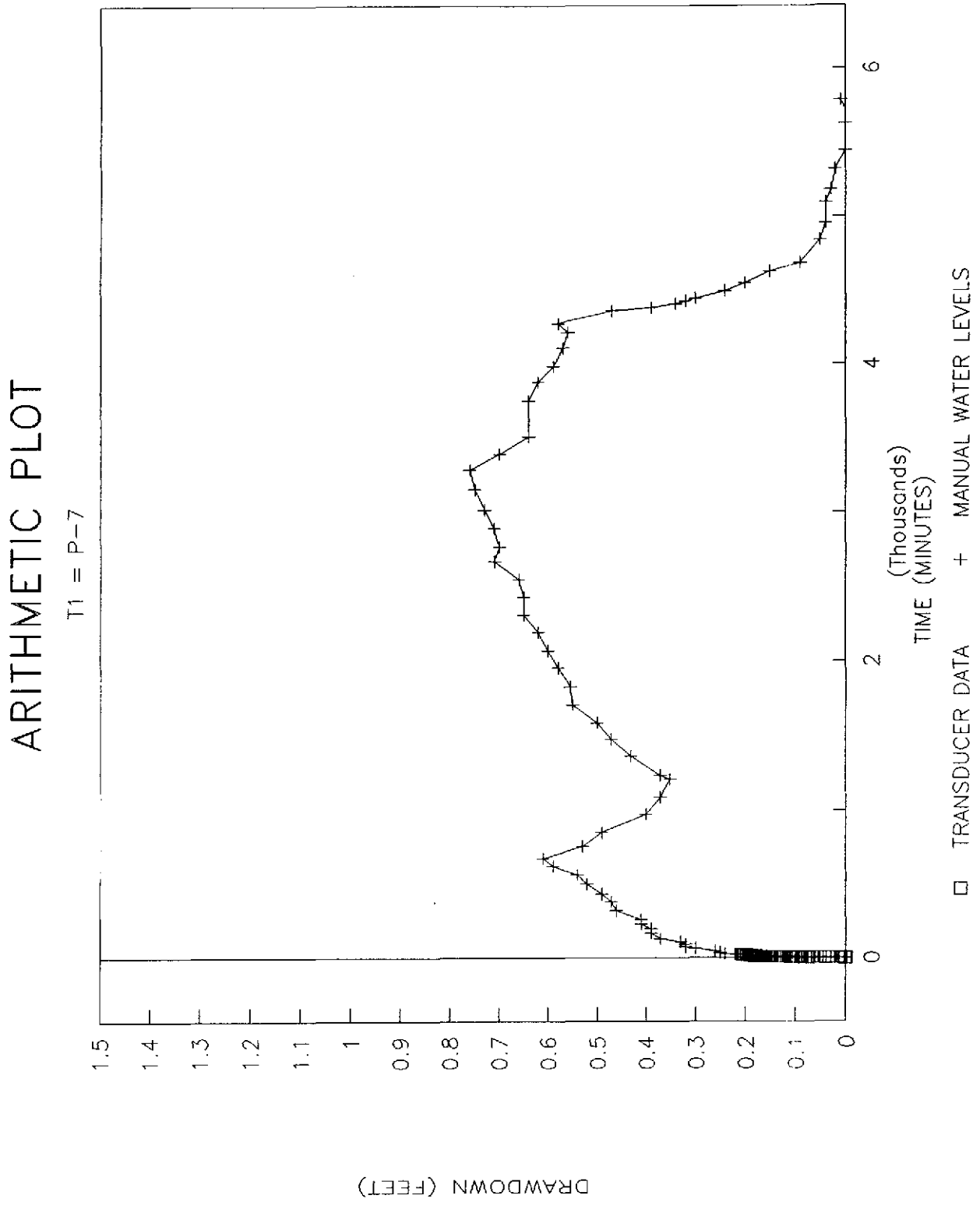

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CHECKED: RSW	FILE No.: MA03-013			
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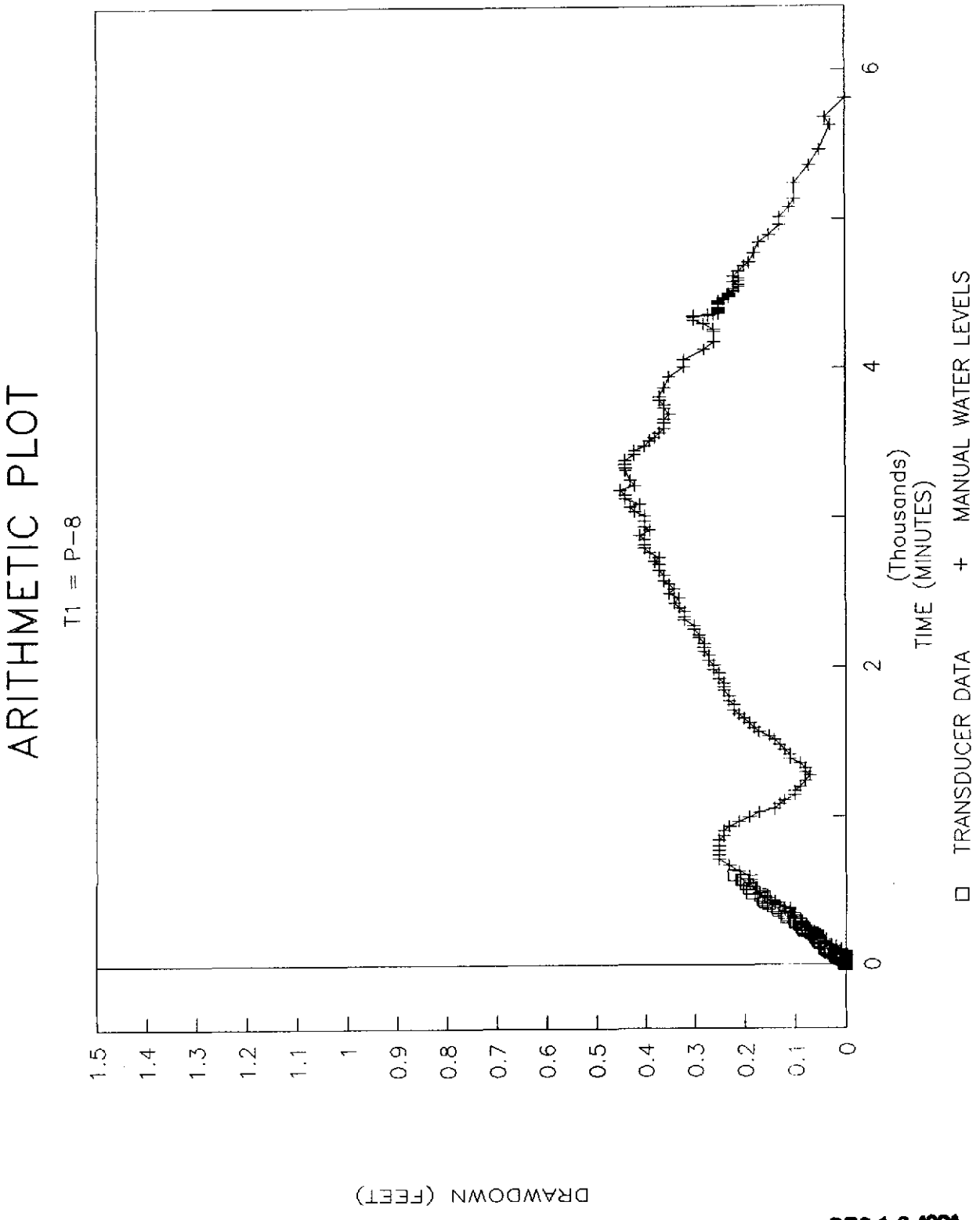

DEC 1 3 1991

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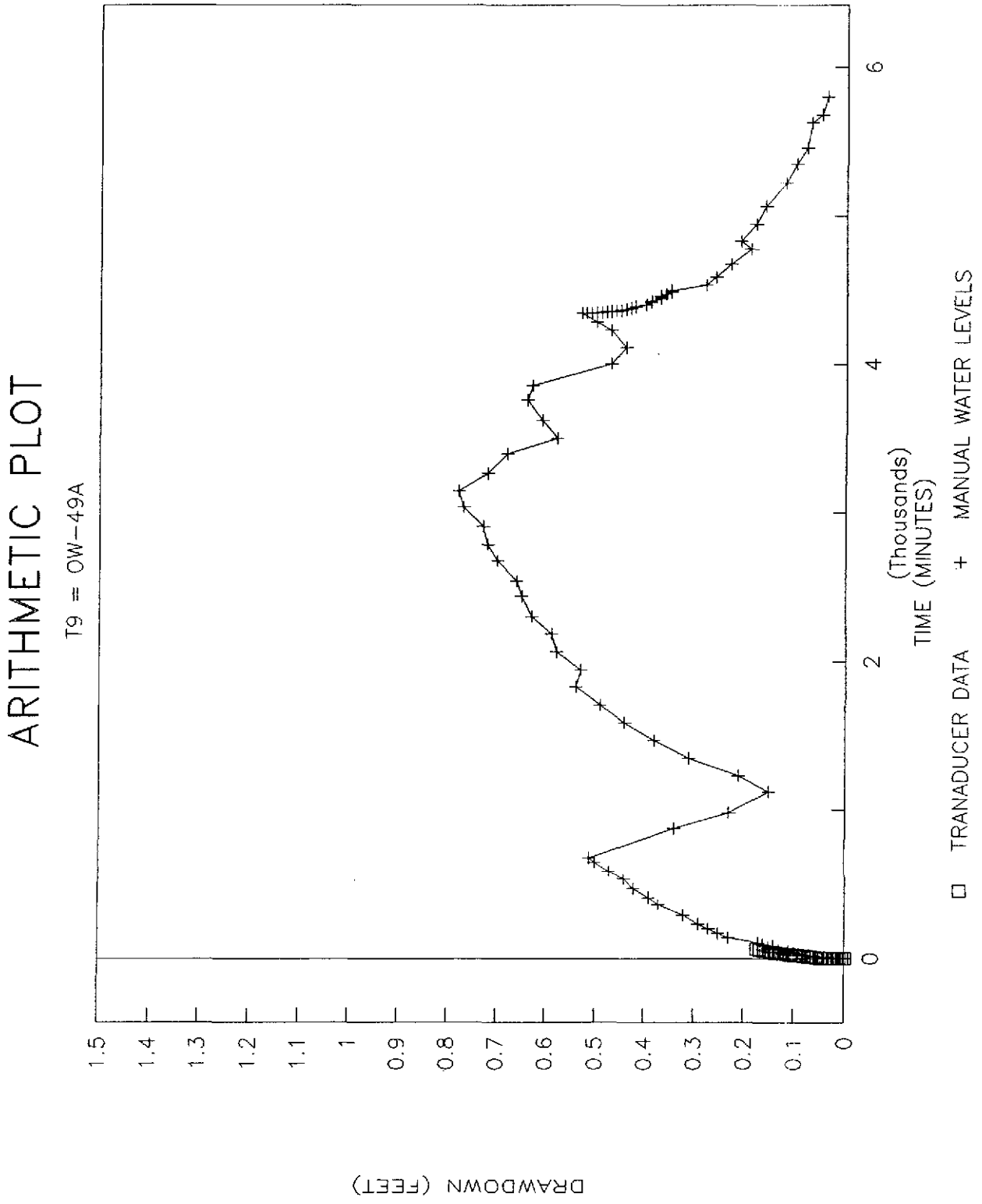

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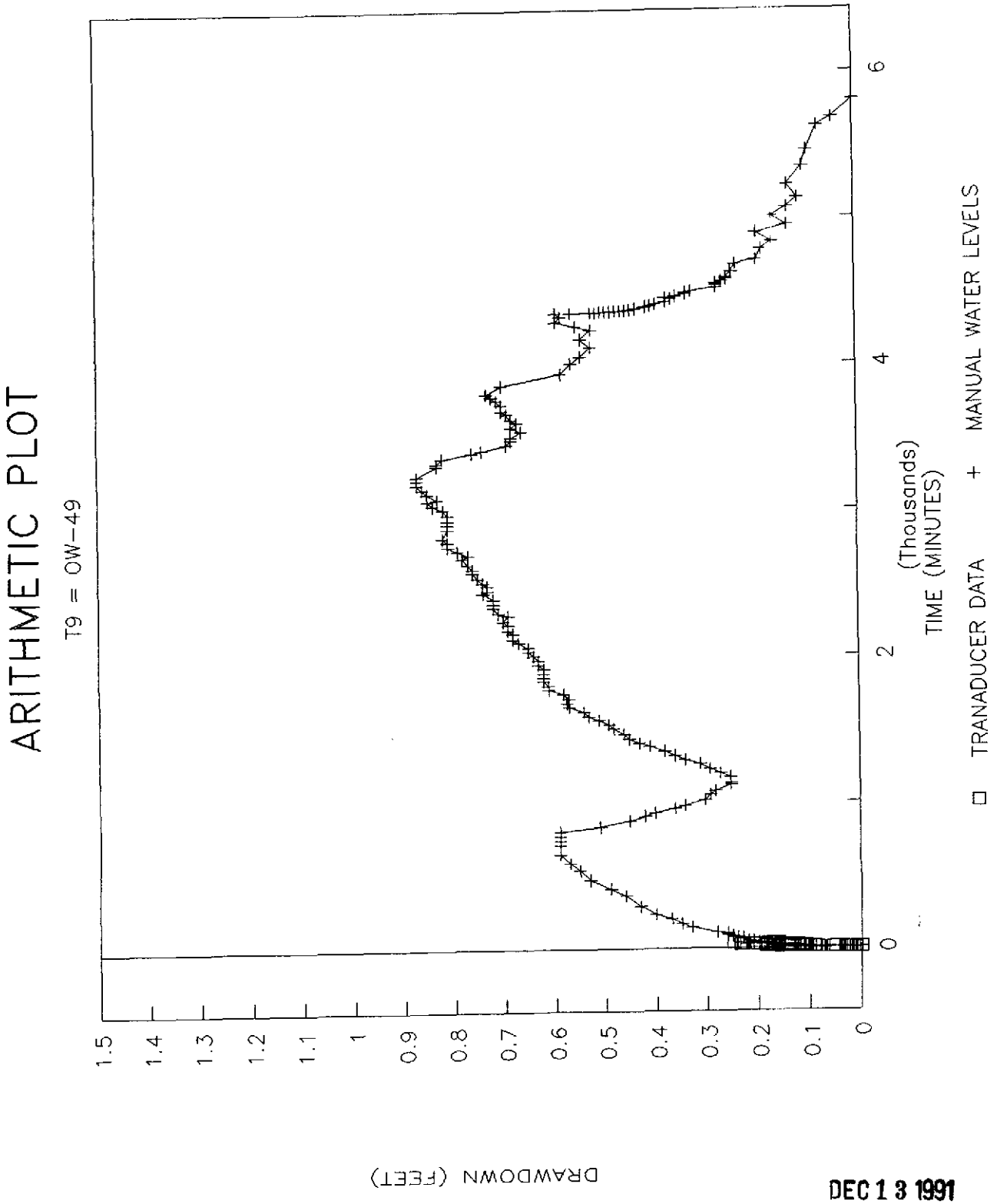
Golder Associates		INDUSTRI-PLEX SITE REMEDIAL TRUST	FIGURE **G-15**	



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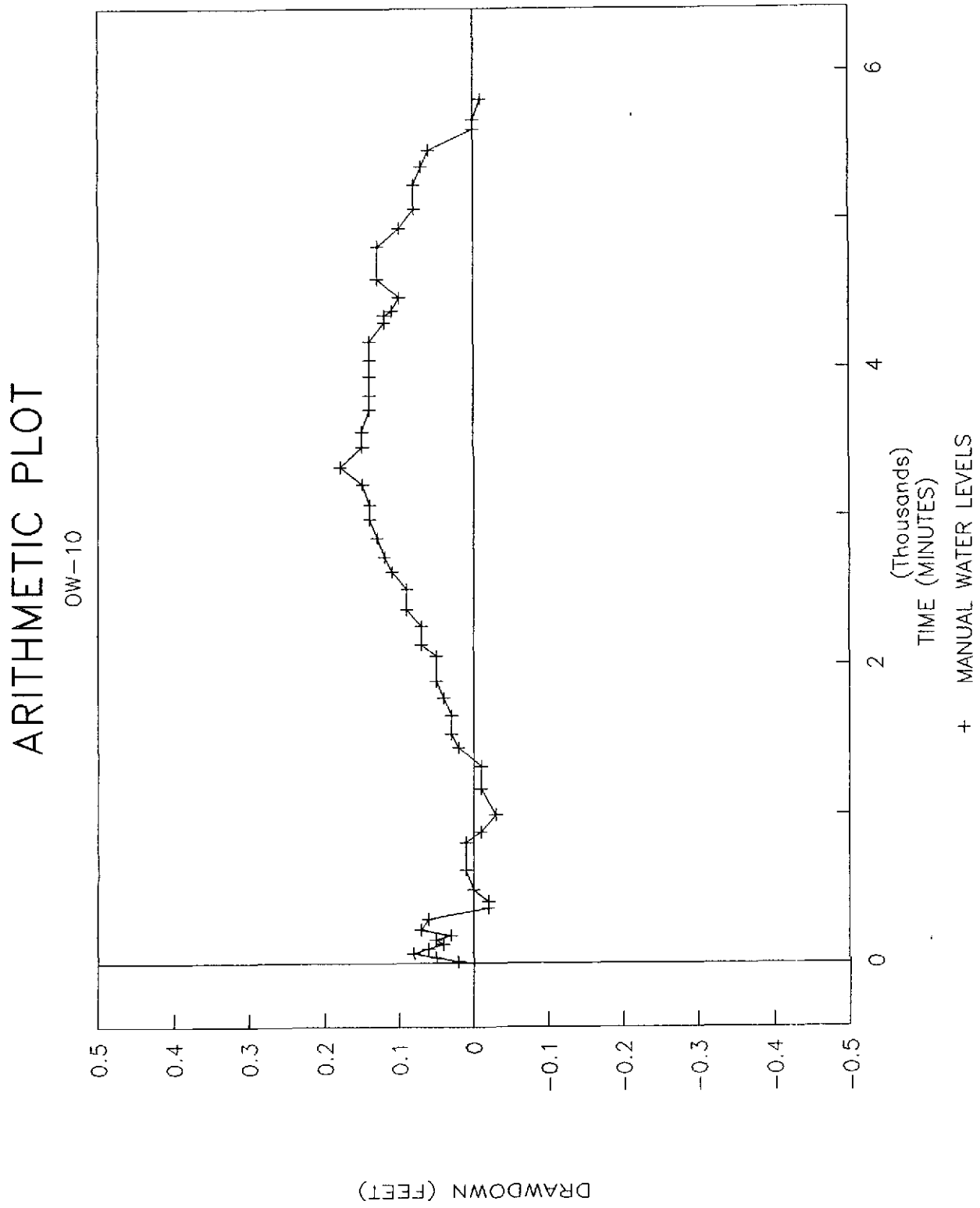
CHECKED: RSW	FILE No.: MA03-016		
Golder Associates		INDUSTRI-PLEX SITE REMEDIAL TRUST	FIGURE G-16



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JOB No.: 913-6744	SCALE: AS SHOWN	**ARITHMETIC PLOT MONITORING POINT OW-10**	
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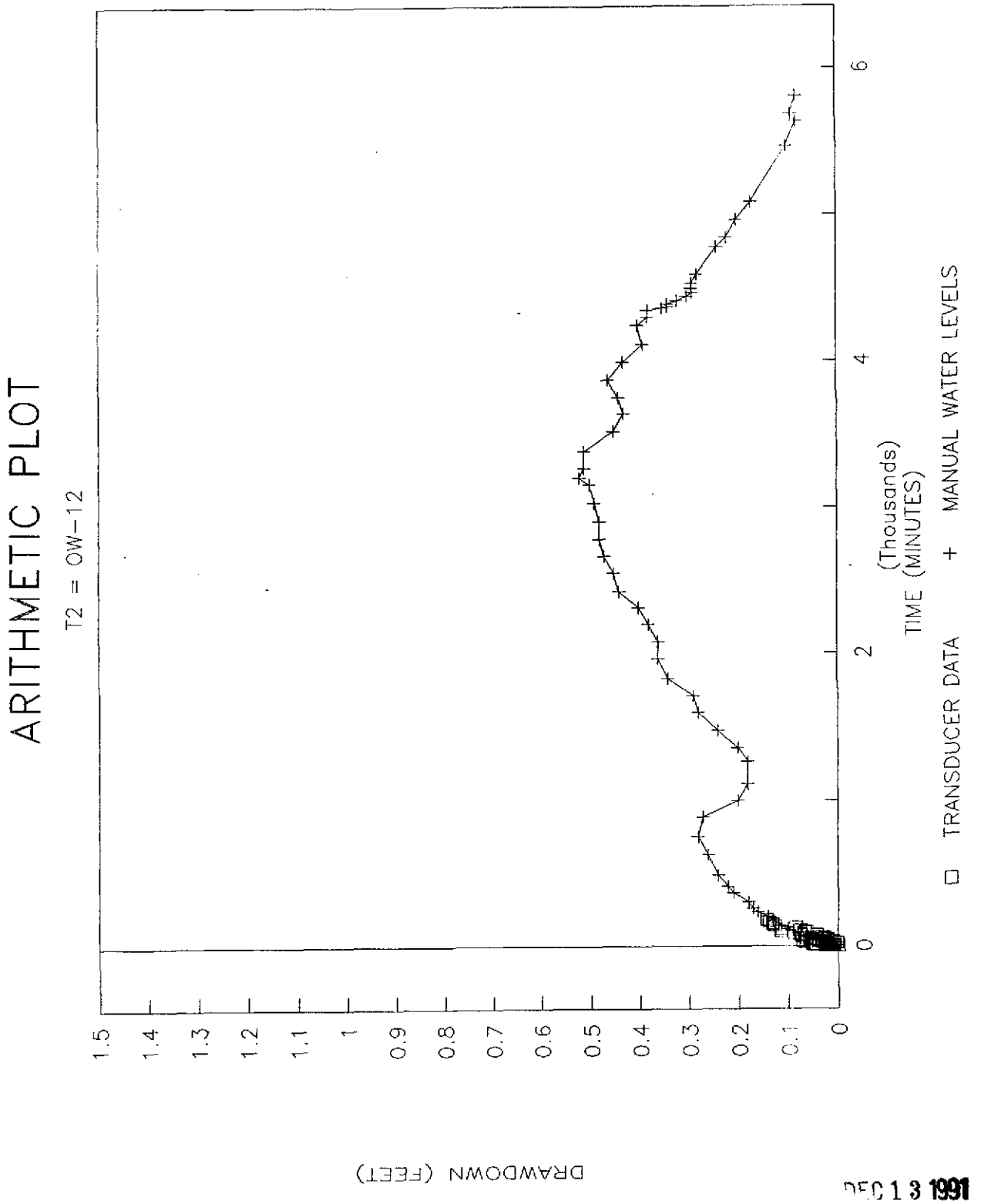

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JOB No.: 913-6744	SCALE: AS SHOWN	**ARITHMETIC PLOT MONITORING POINT OW-12**		
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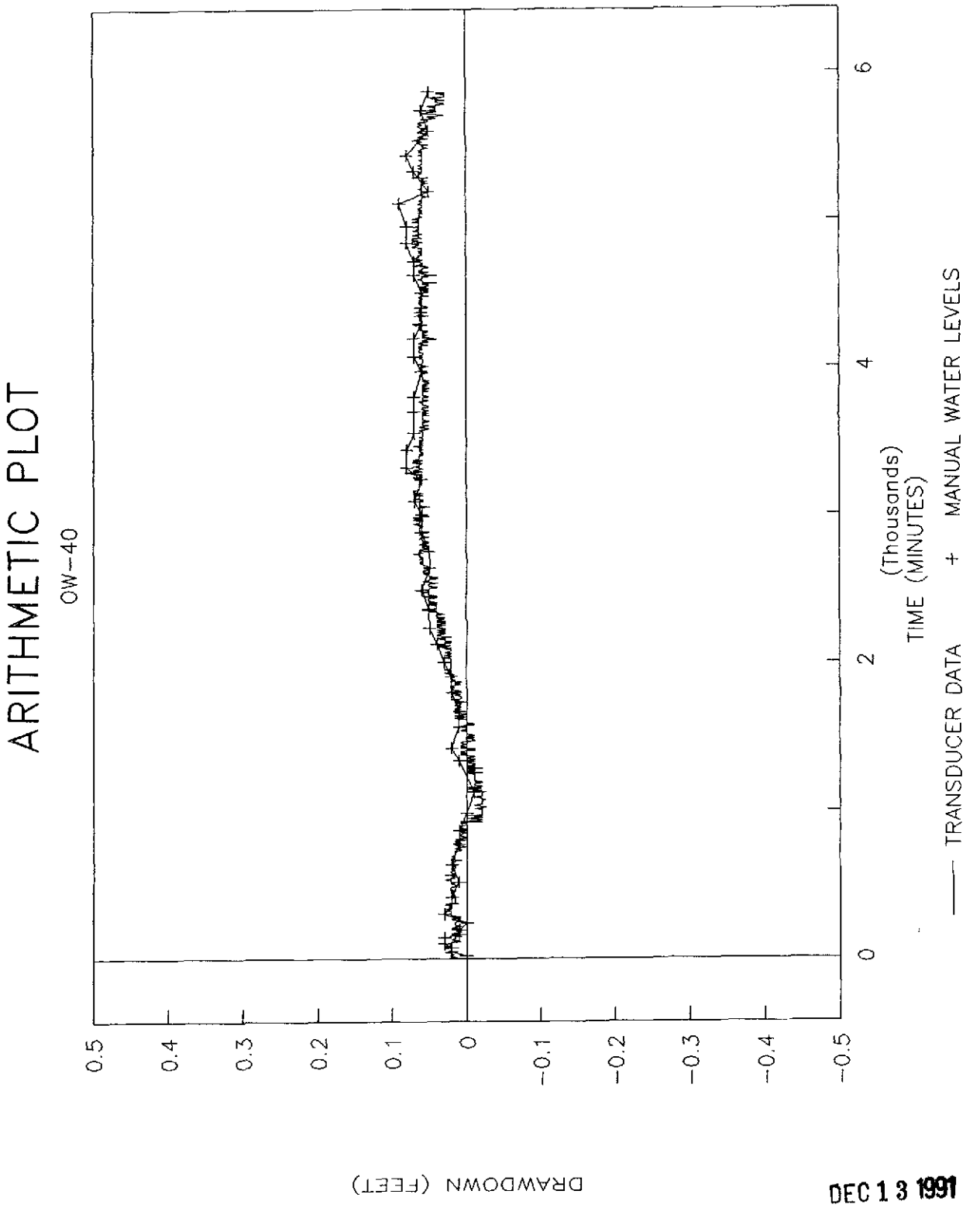

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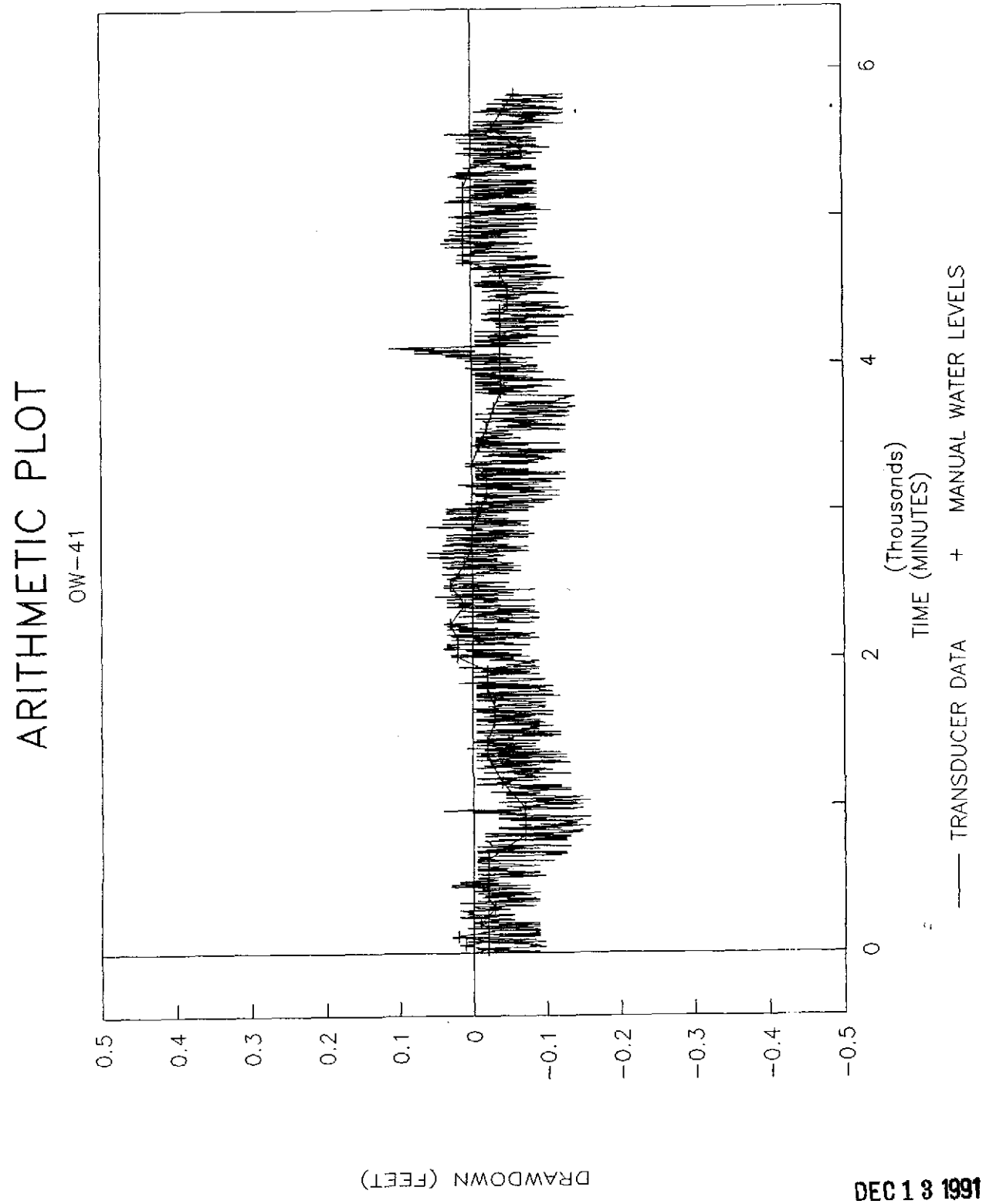

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JOB No.: 913-6744	SCALE: AS SHOWN	**ARITHMETIC PLOT MONITORING POINT OW-41**		
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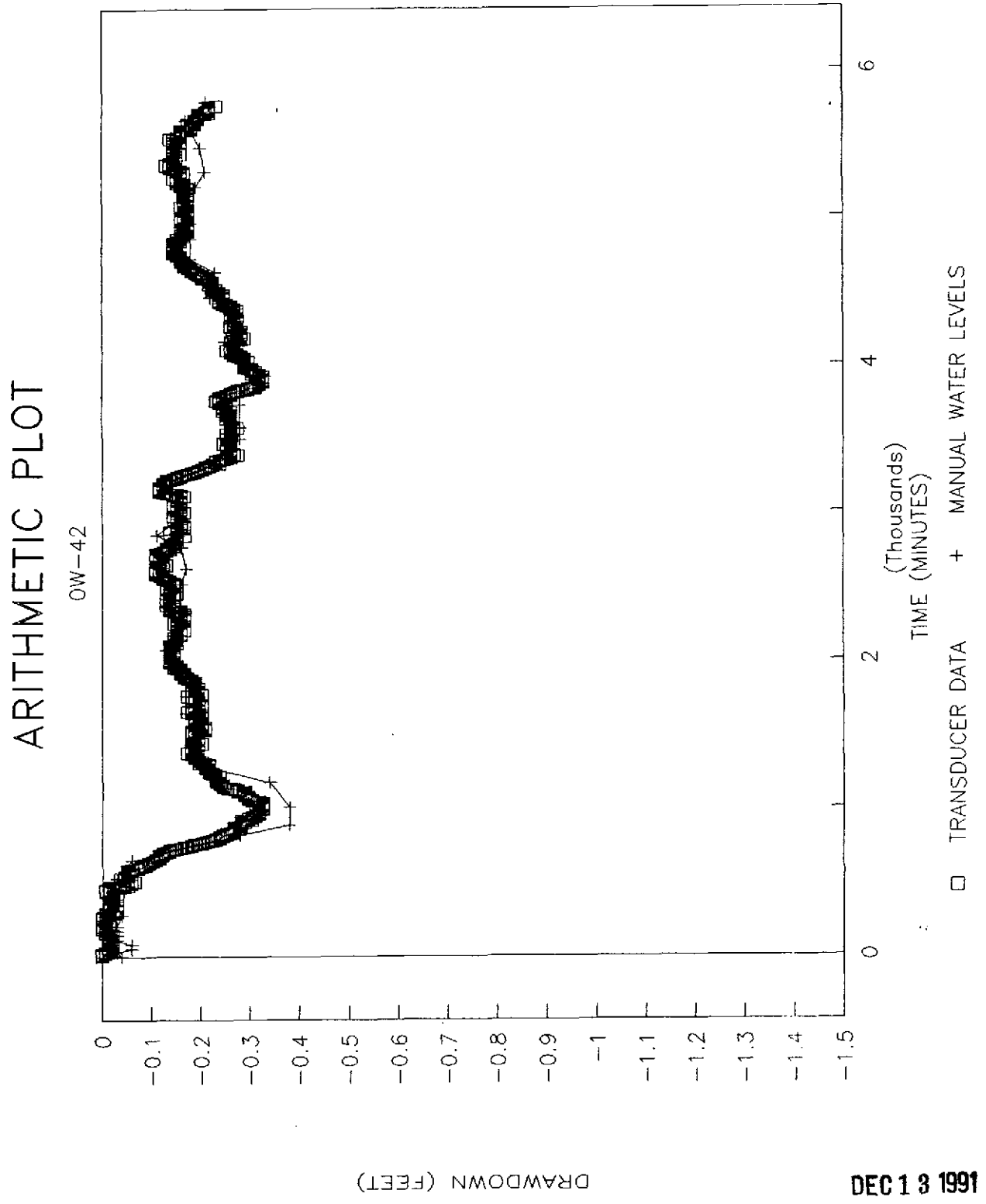

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JOB No.: 913-6744	SCALE: AS SHOWN	**ARITHMETIC PLOT MONITORING POINT OW-42**		
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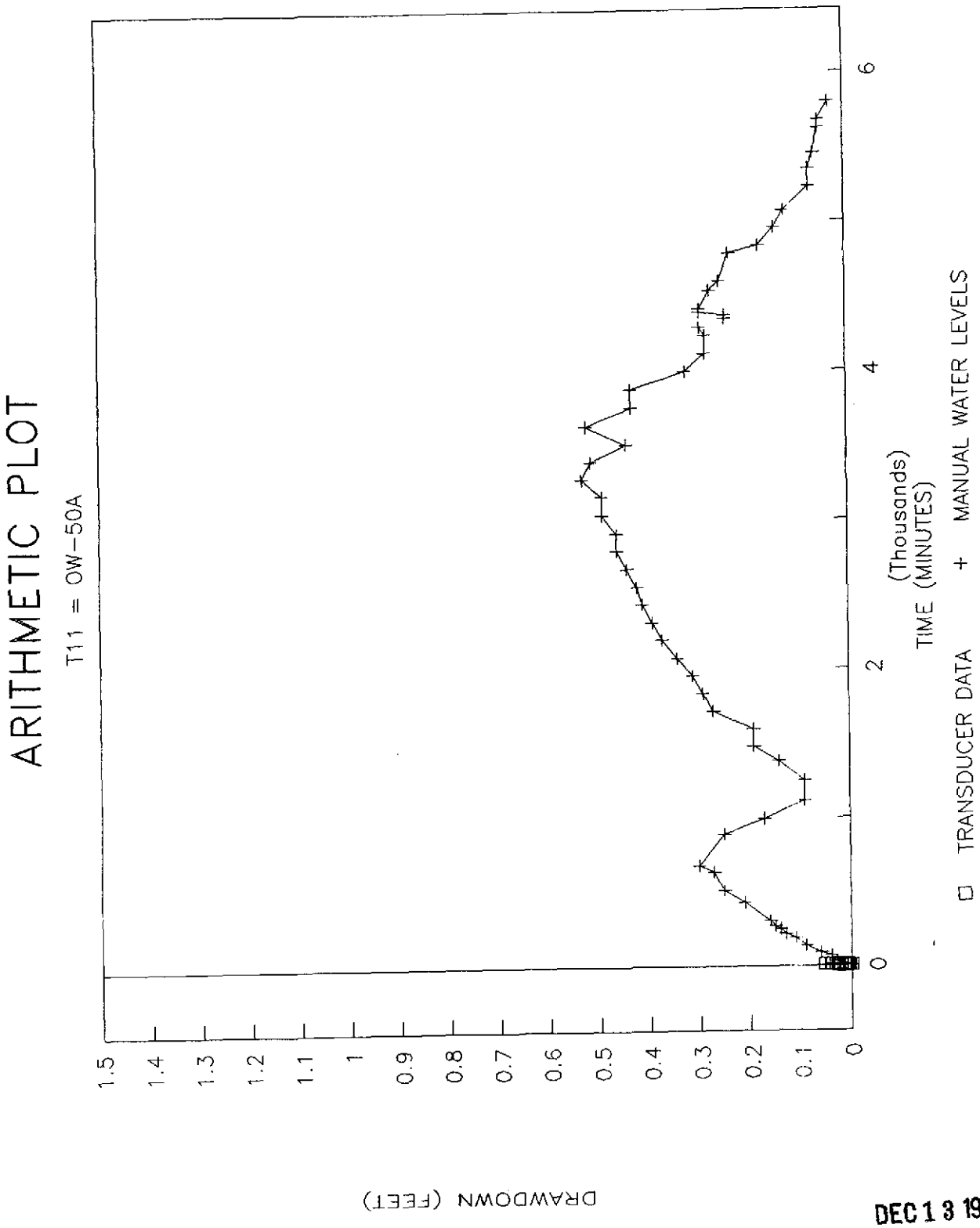
CHECKED: RSW	FILE No.: MA03-021			
Golder Associates		INDUSTRI-PLEX SITE REMEDIAL TRUST	FIGURE G-21	



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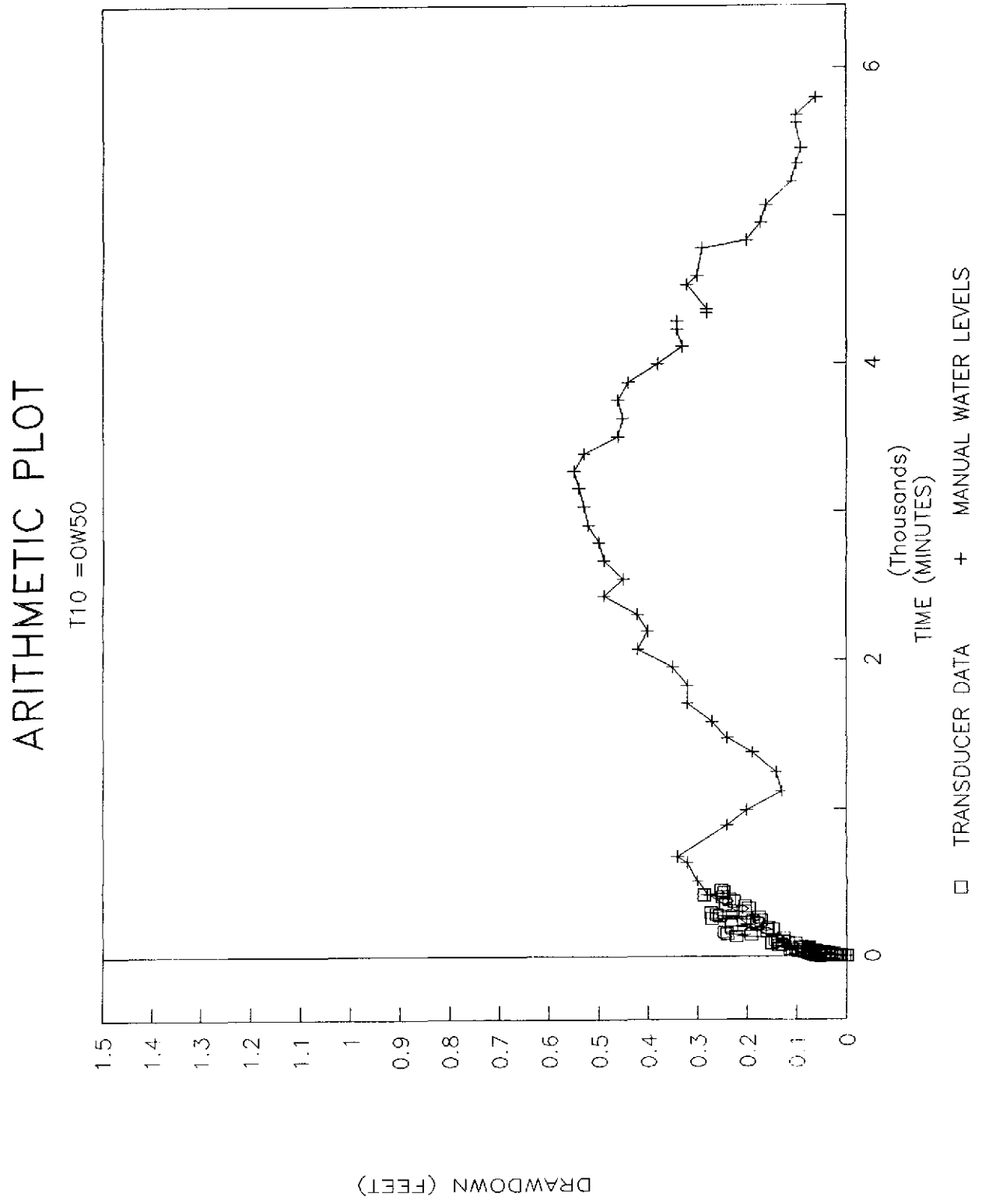
Golder Associates		INDUSTRI-PLEX SITE REMEDIAL TRUST	FIGURE **G-22**	



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CHECKED: RSW	FILE No.: MA03-023			
Golder Associates		INDUSTRI-PLEX SITE REMEDIAL TRUST	FIGURE **G-23**	

APPENDIX H

Neuman Type Curve Analysis
Theory and Type Curve Development

APPENDIX H

Neuman Type Curve Analysis - Theory and Type Curve Development

Theory

Neuman (1972) developed a theory of delayed water table response which is based on defined physical parameters for unconfined aquifers. Neuman treats unconfined aquifers as compressible systems and the water table as a moving upper boundary. Neuman (1975) developed type-curve methods to analyze pumping test data for fully and partially penetrating pumping and observations wells based on his theories. The general solution for drawdown is a function of both the distance from the well and the elevation head. Using this method, the horizontal hydraulic conductivity, vertical hydraulic conductivity, storage coefficient, and specific yield can be determined.

Delayed water table response (delayed yield) trends are evidenced on log drawdown versus log time graphs by the presence of the following three segments (Price, 1985).

1. In the first segment, covering a short period immediately after start of pumping, the unconfined aquifer reacts in the same way as a confined aquifer. Water is released instantaneously from storage by the elastic deformation of the aquifer and by the expansion of the water itself. Gravity drainage has not yet started.

2. The second segment of the drawdown versus time graph shows a decrease in slope due to the replenishment by gravity drainage from the interstices above the depression cone.

3. The third segment has a steeper slope and the trend approaches the Theis curve. In the third segment there is equilibrium between gravity drainage and the rate of water table drawdown.

The full development of these segments depends on the pumping period, pumping rate, distance from the pumping well and the boundaries (heterogeneities) encountered by the cone of depression during its expansion.

In Neuman's analysis, when the pumping well or the observation wells perforate only a portion of the saturated thickness of the aquifer, the drawdown at any point in the aquifer is given by (Neuman, 1975, p.337, Eq.26)

$$s(r,t) = \frac{Q}{4\pi T} s_D \tag{1}$$

where:

s: drawdown (L);

r: radial distance from the pumping well (L);

t: time since pumping started (T);

Q: pumping rate (L^3/T);

T: transmissivity (L^2/T); and,

s_D: Neuman well function (dimensionless).

The Neuman well function, s_D, is a complex integral function that can only be evaluated numerically. s_D may be expressed in terms of three independent dimensionless parameters: σ, β, and t_s (dimensionless time with respect to the specific elastic storage) or t_y (dimensionless time with respect to the specific yield). The dimensionless time parameters are related to each other by the equation:

$$t_y = \sigma \; t_s \tag{2}$$

The parameters σ and β are defined as follows.

$$\sigma = \frac{S}{S_y} \tag{3}$$

$$\beta = K_D \; \frac{r^2}{b^2} \tag{4}$$

The dimensionless time parameters are defined as follows.

$$t_s = \frac{Tt}{Sr^2} \tag{5}$$

$$t_y = \frac{Tt}{S_y r^2} \tag{6}$$

where:

S: elastic storage coefficient = S_s b (dimensionless):

S_s: specific elastic storage (L^{-1});

S_y: specific yield (dimensionless);

b: saturated thickness of the aquifer (L);

K_D: degree of vertical anisotropy = K_z (vertical hydraulic conductivity)/K_r (horizontal hydraulic conductivity) (dimensionless); and,

r: radial distance from the pumping well (L).

When σ approaches zero (S is much less than S_y) the number of independent variables is reduced to two and s_D can be integrated for different values of β. The results are two asymptotic families of type curves: Type A (s_D versus t_s) and Type B (s_D versus t_y).

The method employed to determine aquifer parameters using the Neuman type curves is presented stepwise below.

1. Plot the family of Neuman type curves of s_D versus t_s and t_y for a practical range of β values on log scales. In the present case of partially penetrating wells, type curves were generated using the computer program DELAY2 originally developed by Neuman.

2. Plot the drawdown s versus the corresponding time also on log scales for a given observation well at a distance r from the pumping well.

3. Keeping the coordinate axes parallel, superimpose the time-drawdown field data curve on Type B curves. Adjust the superimposition until as much late time-drawdown field data as possible fall on one of the Type B curves. Note the β value of the selected Type B curve.

4. Select an arbitrary point B and note the coordinates s_D^*, t_y^* and s^*, t^*.

5. Calculate the transmissivity (T) and the specific yield (S_y) using the equations:

$$T = \frac{Q}{4\pi} \frac{s_D^*}{s^*} \tag{7}$$

$$S_y = \frac{Tt^*}{t_y^* r^2} \tag{8}$$

6. Superimpose the field data on the Type A curves, keeping the coordinate axes of both graphs parallel to each other and matching as much of the early time-drawdown data as possible to a particular type curve. The value ß corresponding to this type curve must be the same as that obtained previously from the Type B curves.

7. Select an arbitrary point A on the superimposed curves and note its coordinates s_D^*, t_s^*, and s^*, t^*.

8. Calculate the transmissivity from Eq. (7) and the elastic storage coefficient from the following equation:

$$S = \frac{Tt^*}{t_s^* r^2} \tag{8}$$

9. Having assessed the transmissivity, usually as the average from the early and late data, unless boundary effects occurred, the horizontal hydraulic conductivity (K_r) can be determined using the formula:

$$K_r = \frac{T}{b} \tag{9}$$

10. The degree of vertical anisotropy (K_D) is obtained from the value of ß according to:

$$K_D = \beta \frac{b^2}{r^2} \tag{10}$$

11. By knowing the values of K_r and K_D, the vertical hydraulic conductivity (K_z) can be determined using the relationship:

$$K_z = K_D K_r \tag{11}$$

12. The specific elastic storage of the aquifer is calculated from:

$$S_s = \frac{S}{b} \tag{12}$$

Type Curve Development

Type curves were generated using the computer program DELAY2 for the two aquifer thickness scenarios discussed in Section 5.2.2 In the first case, the base of the aquifer was considered to be at the top of bedrock/till. Geometric data for the pumping well and observation wells are presented in Table 5. Based on these parameters, a set of type curves was prepared (Neuman type curves A and B) using DELAY 2 for each of the following geometries. These type curves are presented in Appendix H-1.

- Type curves 1A and 1B for observation wells screened in the upper part of the aquifer close to the phreatic surface (P-2S).
- Type curves 2A and 2B for observation wells screened in the middle part of the aquifer (P-2I, OW-48, OW-50A).
- Type curves 3A and 3B for observation wells screened in the upper part of the aquifer but over a larger interval than type curves 1A and 1B (P-4S, OW-48A, OW-49A).
- Type curves 4A and 4B for observation wells screened in the lower half of the aquifer (P-1, P-2D, P-3S, P-4I, P-6, P-7, P-8, OW-49, OW-50).
- Type curves 5A and 5B for observation wells screened in the middle part of the aquifer but over a larger interval than type curves 2A and 2B (OW-12).

A second set of type curves was developed based on an effective aquifer thickness of 65 feet including the Glacial Till (5 feet) and a conservative estimate of the thickness of the fractured and weathered bedrock (10 feet). Based on this approach, another set of observation well geometries is presented in Table 7. Based on these parameters a further set of type curves were prepared (Neuman type curves A' and B') using DELAY2 for each of the following observation well geometries. These type curves are presented in Appendix H-2.

- Type curves 1A' and 1B' for observation wells screened in the upper part of the aquifer close to the phreatic surface (P-2S).

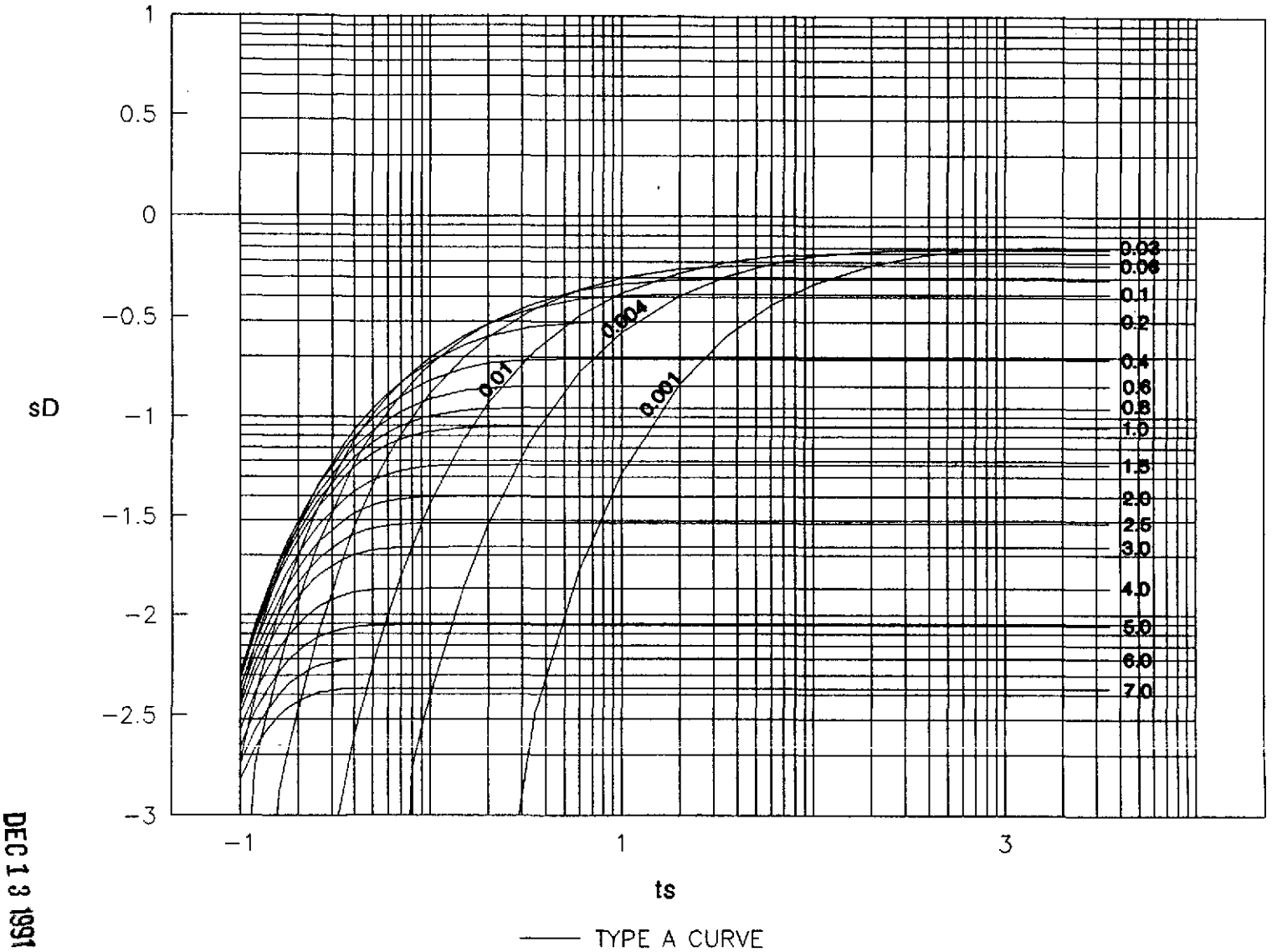
- Type curves 2A' and 2B' for observation wells screened in the middle part of the aquifer (P-2I, OW-48, OW-50A).
- Type curves 3A' and 3B' for observation wells screened in the upper part of the aquifer but over a larger interval than type curves 1A' and 1B (P-4S, OW-48A, OW-49A).
- Type curves 4A' and 4B' for observation wells screened in the lower half of the aquifer (P-1, P-2D, P-3S, P-4I, P-6, P-7, P-8, OW-49, OW-50, P-3D).
- Type curves 5A' and 5B' for observation wells screened in the middle part of the aquifer but over a larger interval than type curves 2A' and 2B' (OW-12).

APPENDIX H1

Neuman Type Curves (Approach 1)

NEUMAN TYPE A CURVES

SERIES 1



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JOB No.: 913-6744	SCALE: AS SHOWN
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CHECKED: RSW	FILE No.: MA03-024

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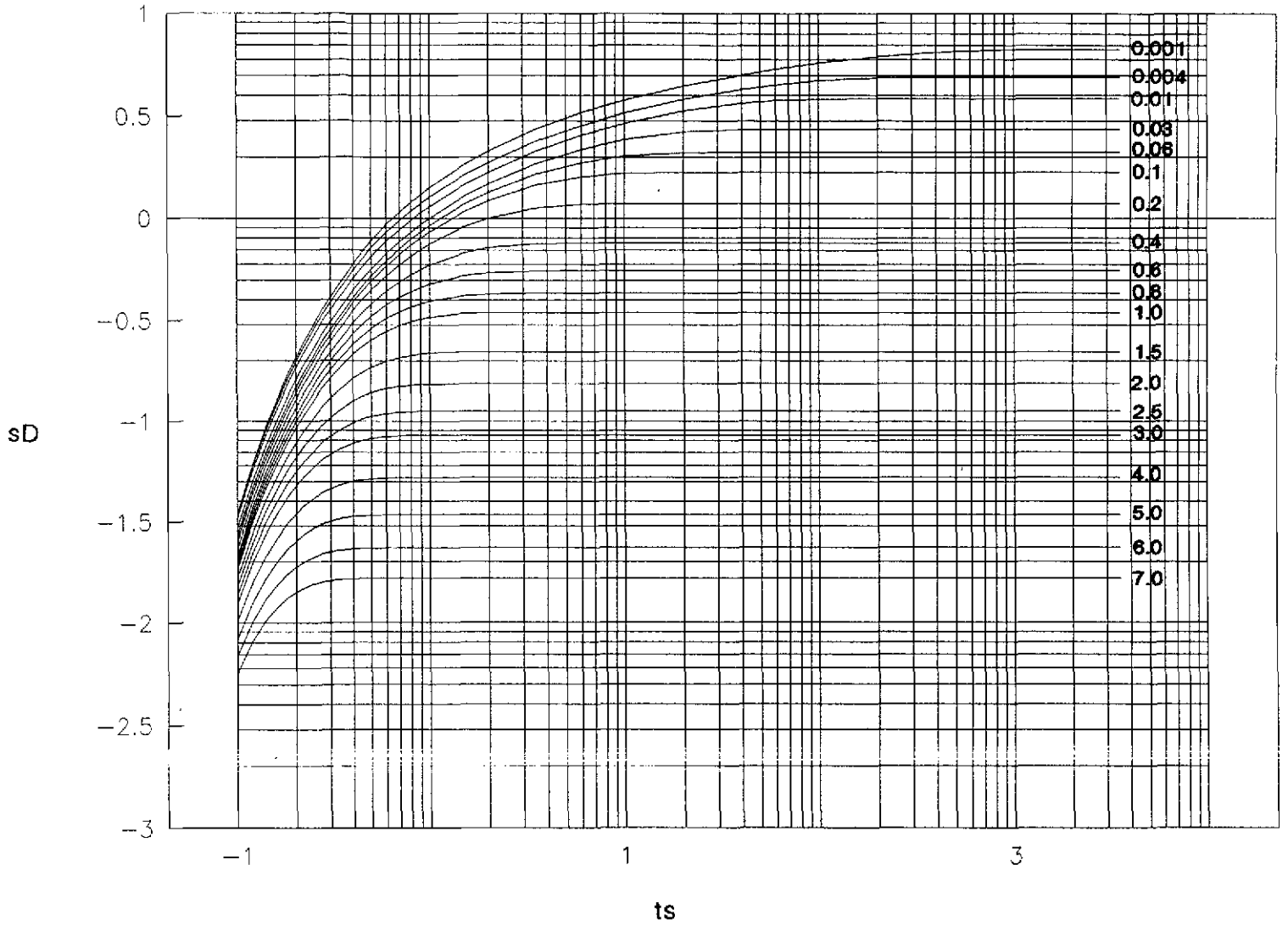
NEUMAN TYPE A CURVES
SERIES 1

INDUSTRI-PLEX SITE REMEDIAL TRUST

FIGURE **H1-1**

NEUMAN TYPE A CURVES

SERIES 2



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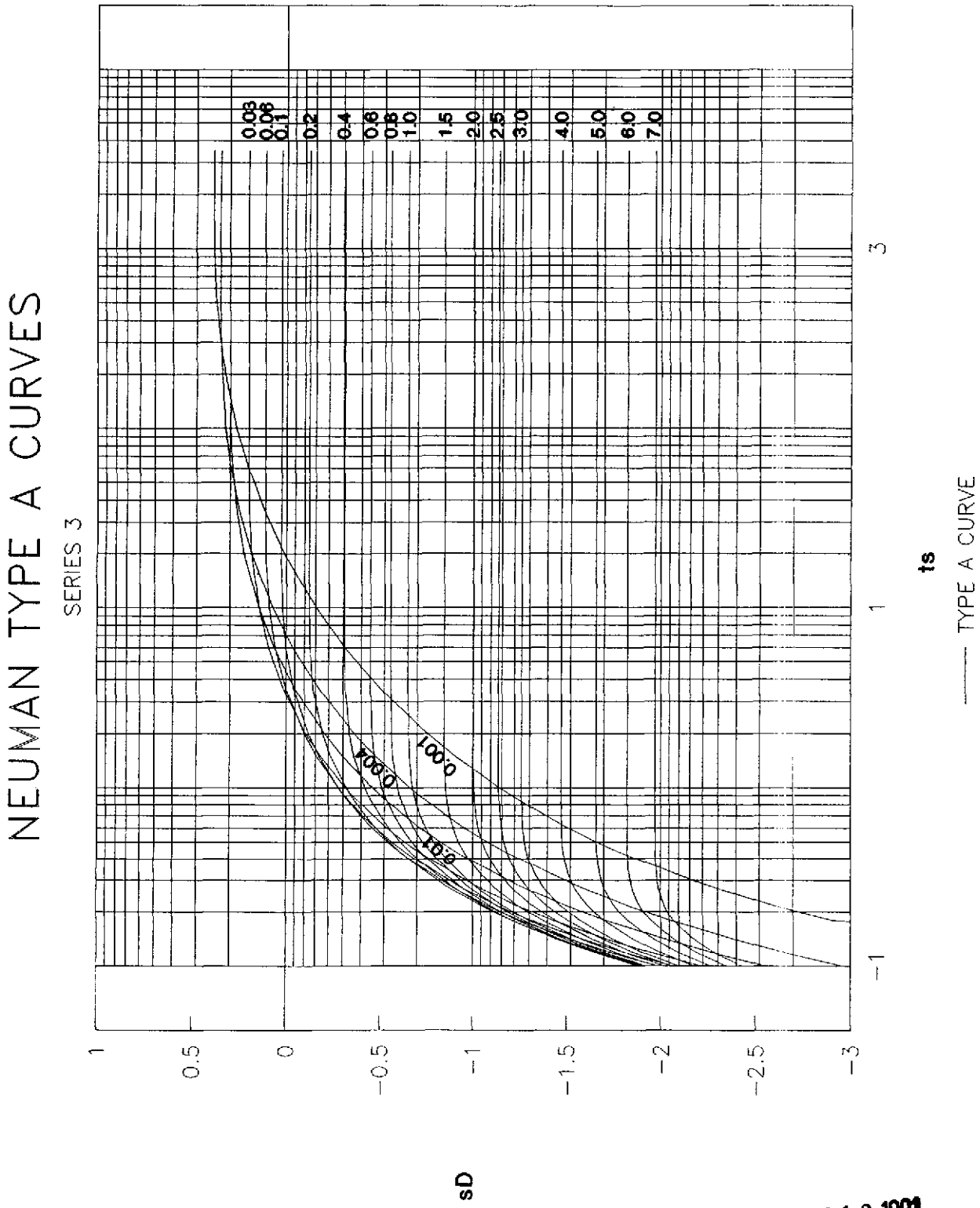
JOB No.: 913-6744	SCALE: AS SHOWN
DRAWN: FG	DATE: 11/08/91
CHECKED: RSW	FILE No.: MA03-025

Golder Associates

NEUMAN TYPE A CURVES
SERIES 2

INDUSTRI-PLEX SITE REMEDIAL TRUST

FIGURE **H1-2**



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JOB No.: 913-6744	SCALE: AS SHOWN	**NEUMAN TYPE A CURVES SERIES 3**		
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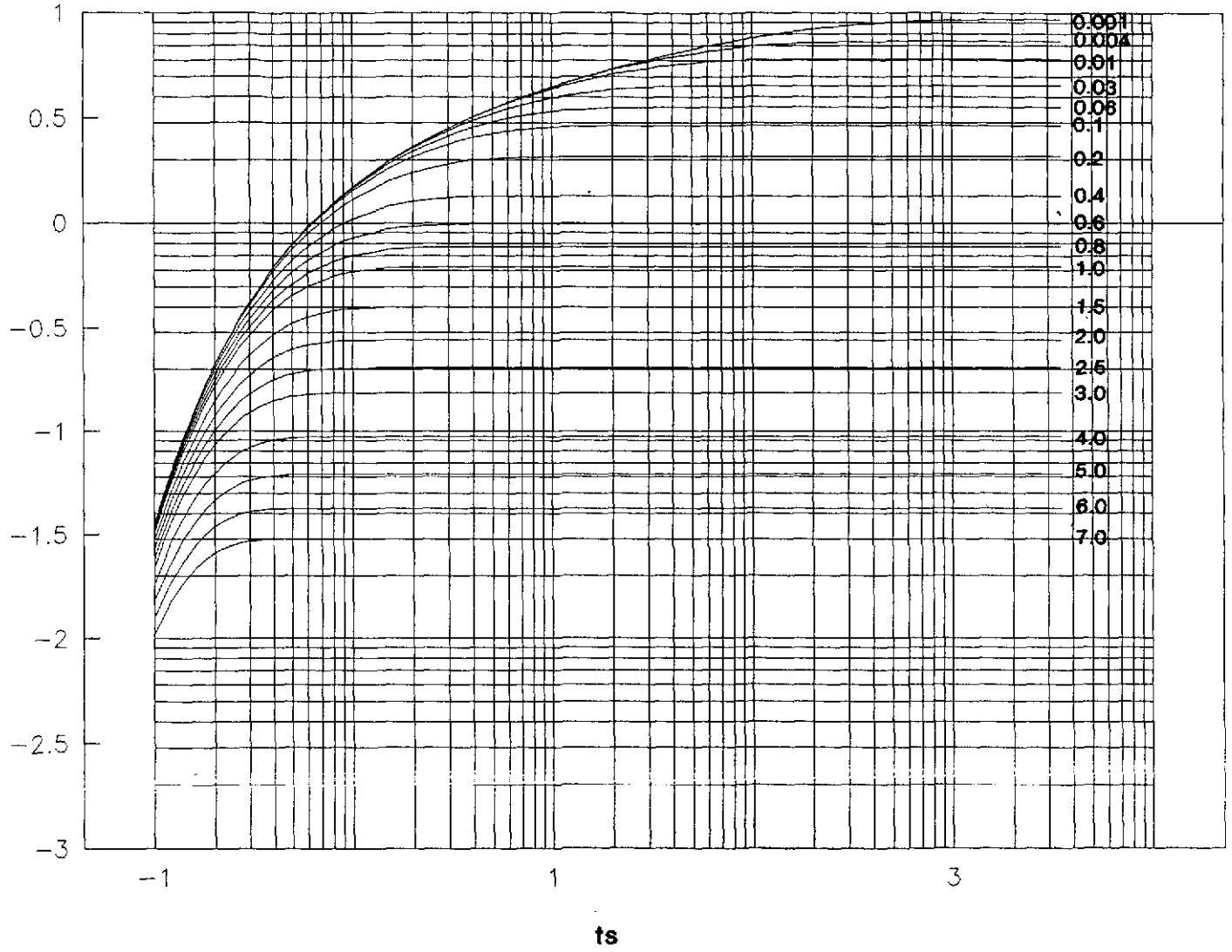
CHECKED: RSW	FILE No.: MA03-026			
Golder Associates		INDUSTRI-PLEX SITE REMEDIAL TRUST	FIGURE **H1-3**	

NEUMAN TYPE A CURVES

SERIES 4



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JOB No.: 913-6744	SCALE: AS SHOWN
DRAWN: FG	DATE: 11/08/91
CHECKED: RSW	FILE No.: MA03-027

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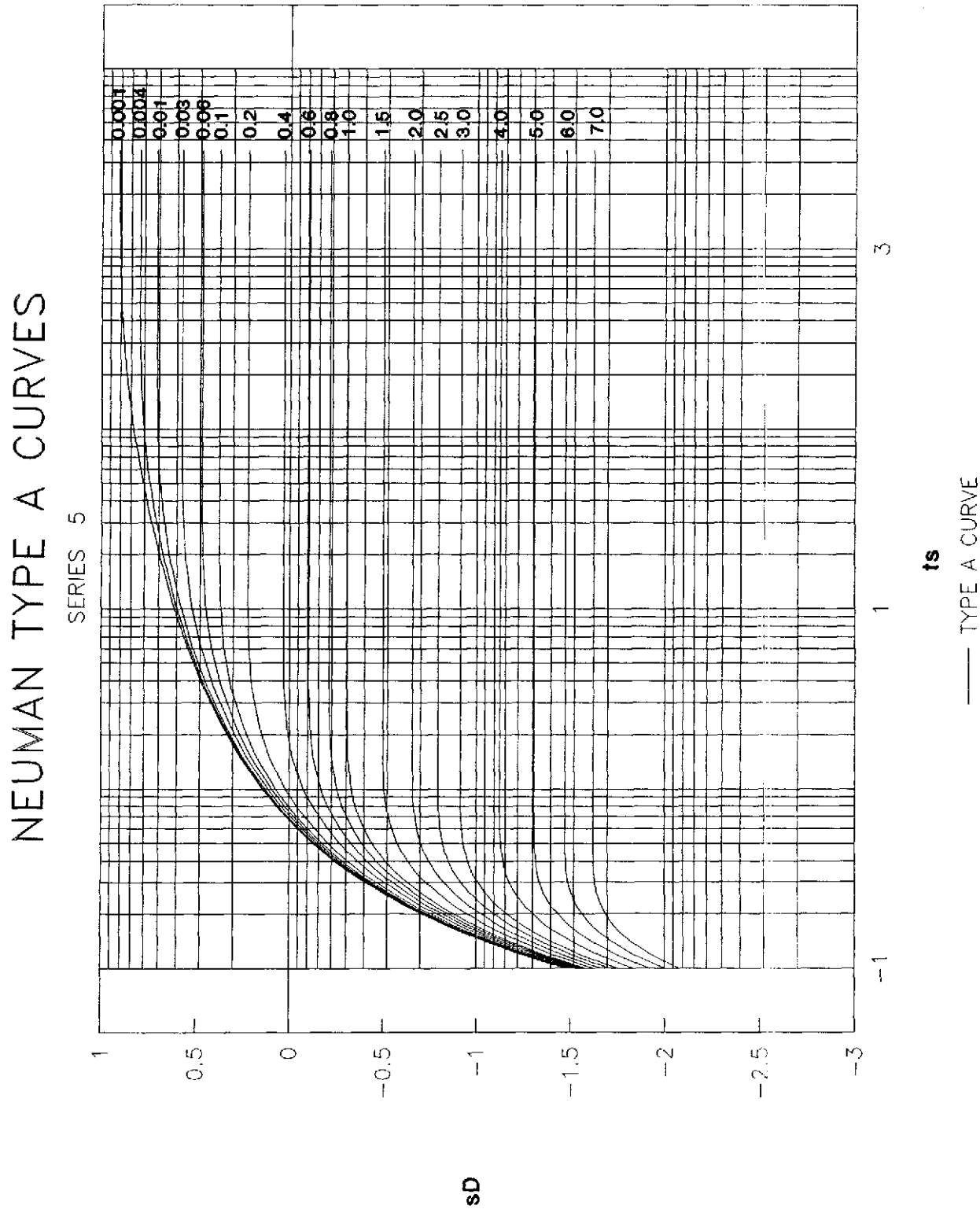
NEUMAN TYPE A CURVES SERIES 4

INDUSTRI-PLEX SITE REMEDIAL TRUST

FIGURE **H1-4**



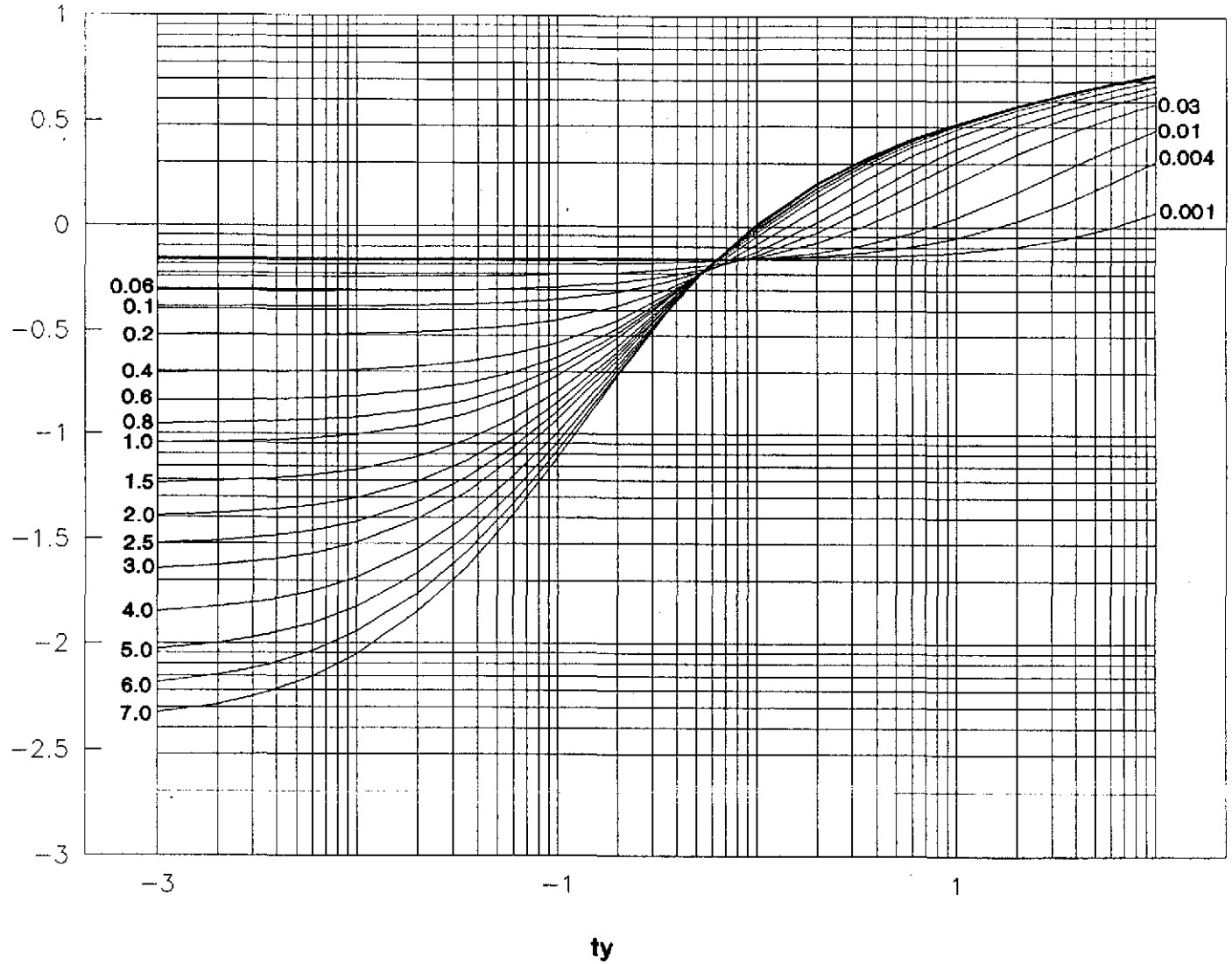
DEC 13 1991

JOB No.: 913-6744	SCALE: AS SHOWN	NEUMAN TYPE A CURVES SERIES 5		
DRAWN: FG	DATE: 11/20/91			
CHECKED: RSW	DWG. No.: MA03-028			
Golder Associates		INDUSTRI-PLEX SITE REMEDIAL TRUST	FIGURE H1-5	

158698

NEUMAN TYPE B CURVES

SERIES 1



—— TYPE B CURVE

DEC 13 1991

JOB No.: 913-6744	SCALE: AS SHOWN
DRAWN: FG	DATE: 11/08/91
CHECKED: RSW	FILE No.: MA03-029

Golder Associates

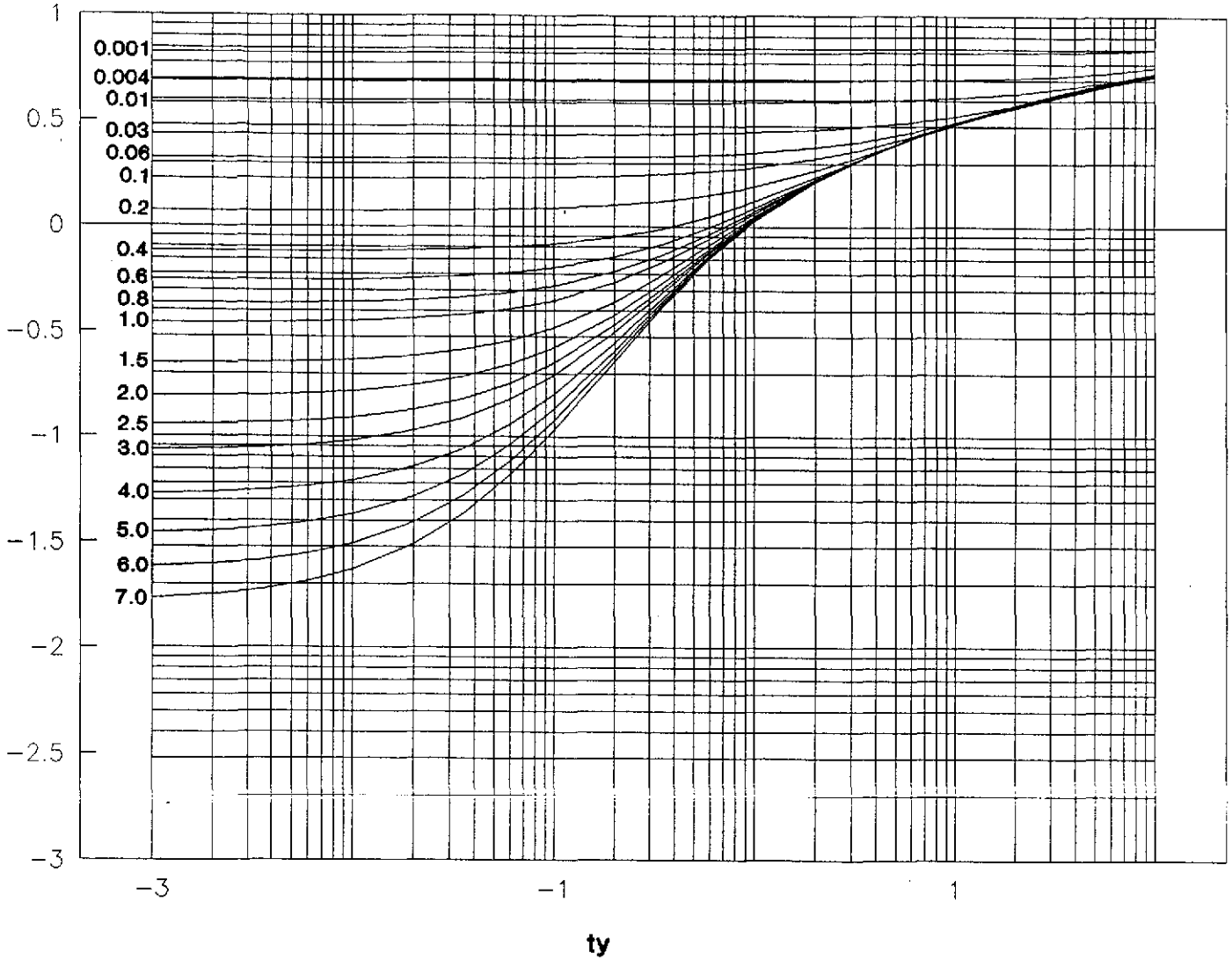
NEUMAN TYPE B CURVES SERIES 1

INDUSTRI-PLEX SITE REMEDIAL TRUST

FIGURE **H1-6**

NEUMAN TYPE B CURVES

SERIES 2



DEC 13 1991

JOB No.: 913-6744	SCALE: AS SHOWN
DRAWN: FG	DATE: 11/08/91
CHECKED: RSW	FILE No.: MA03-030

Golder Associates

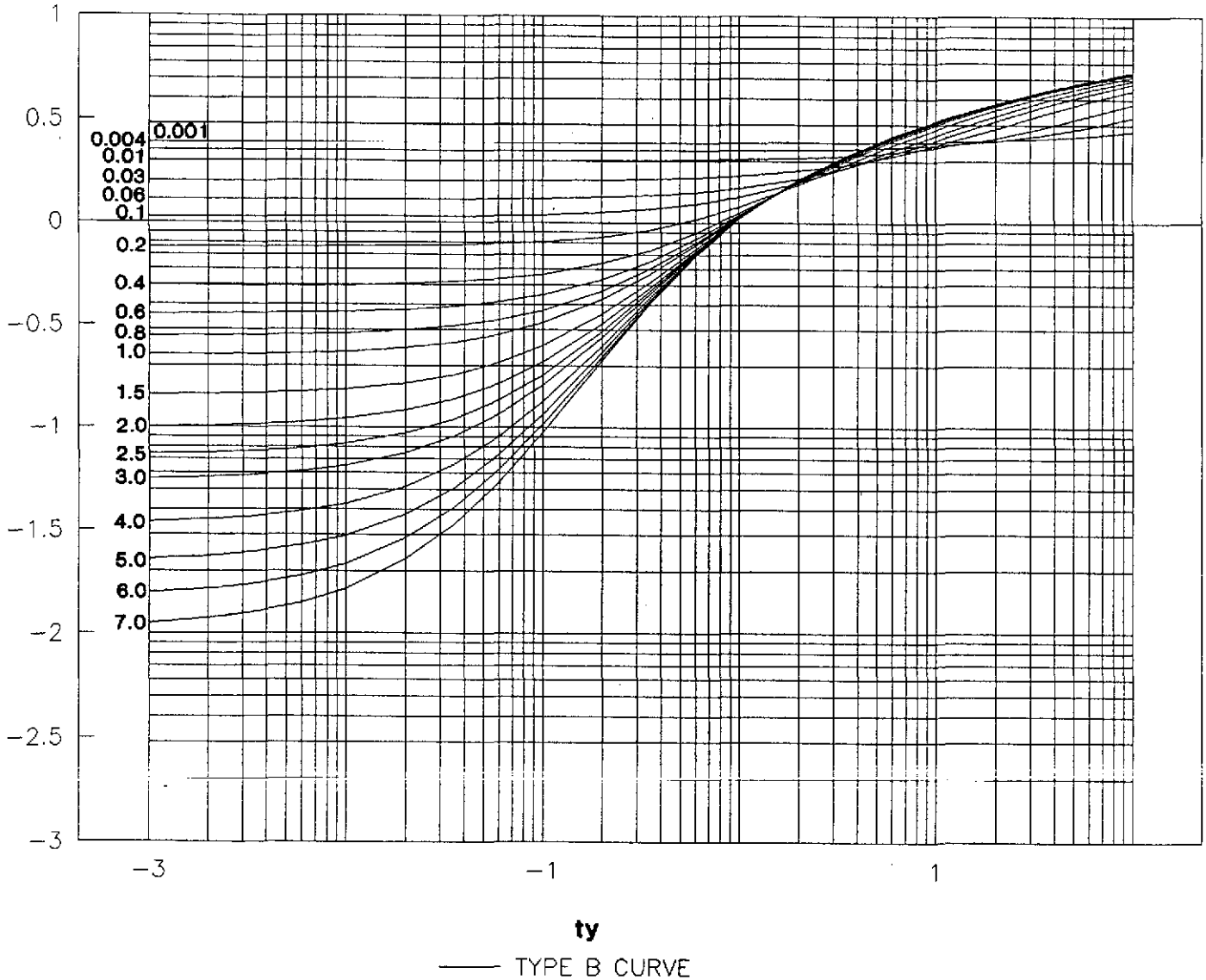
NEUMAN TYPE B CURVES SERIES 2

INDUSTRI-PLEX SITE REMEDIAL TRUST

FIGURE **H1-7**

NEUMAN TYPE B CURVES

SERIES 3



DEC 13 1991

JOB No.: 913-6744	SCALE: AS SHOWN
DRAWN: FG	DATE: 11/08/91
CHECKED: RSW	FILE No.: MA03-031

Golder Associates

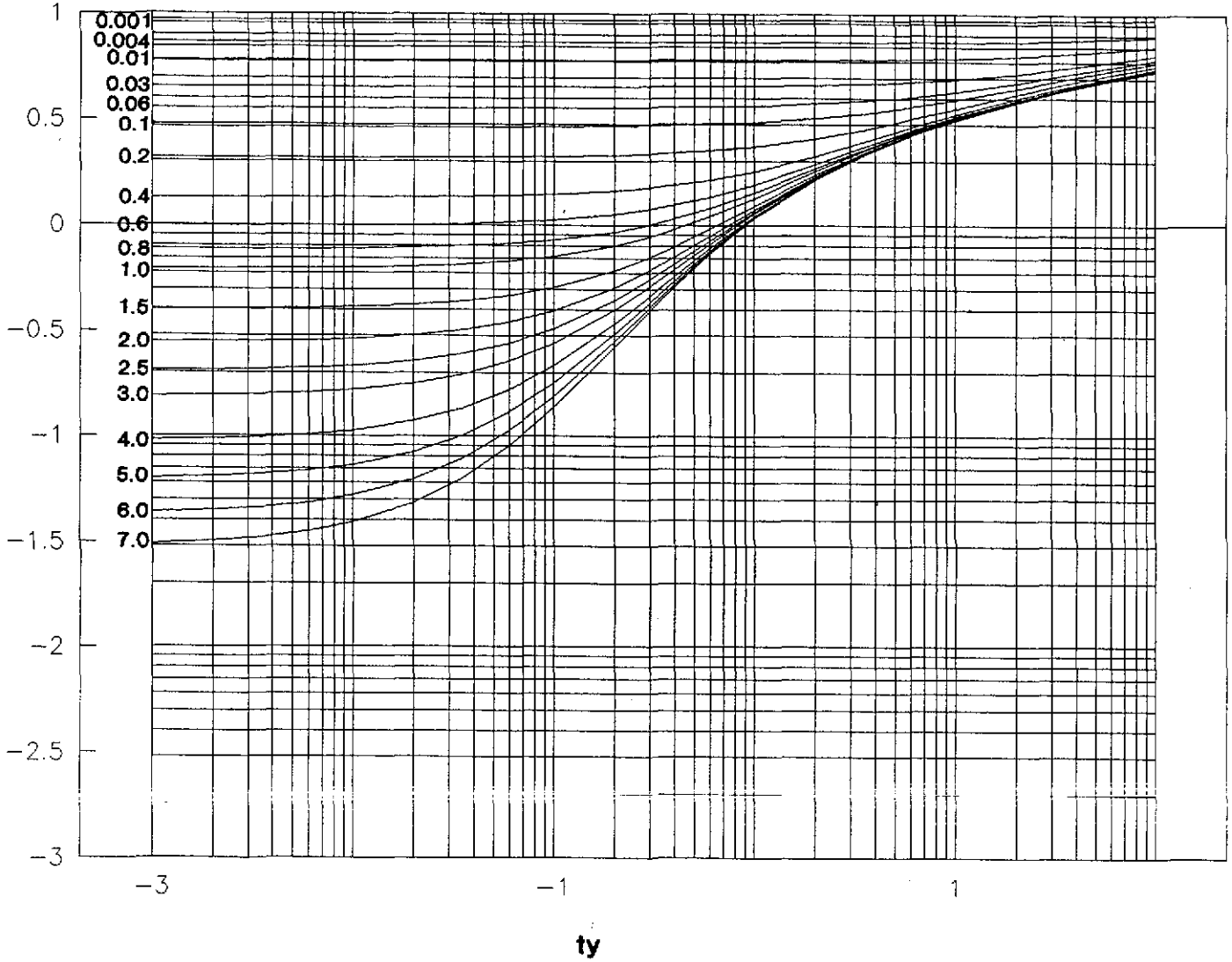
NEUMAN TYPE B CURVES SERIES 3

INDUSTRI-PLEX SITE REMEDIAL TRUST

FIGURE **H1-8**

NEUMAN TYPE B CURVES

SERIES 4



—— TYPE B CURVE

DEC 13 1991

JOB No.: 913-6744	SCALE: AS SHOWN
DRAWN: FG	DATE: 11/08/91
CHECKED: KSW	FILE No.: MA03-032

Golder Associates

NEUMAN TYPE B CURVES SERIES 4

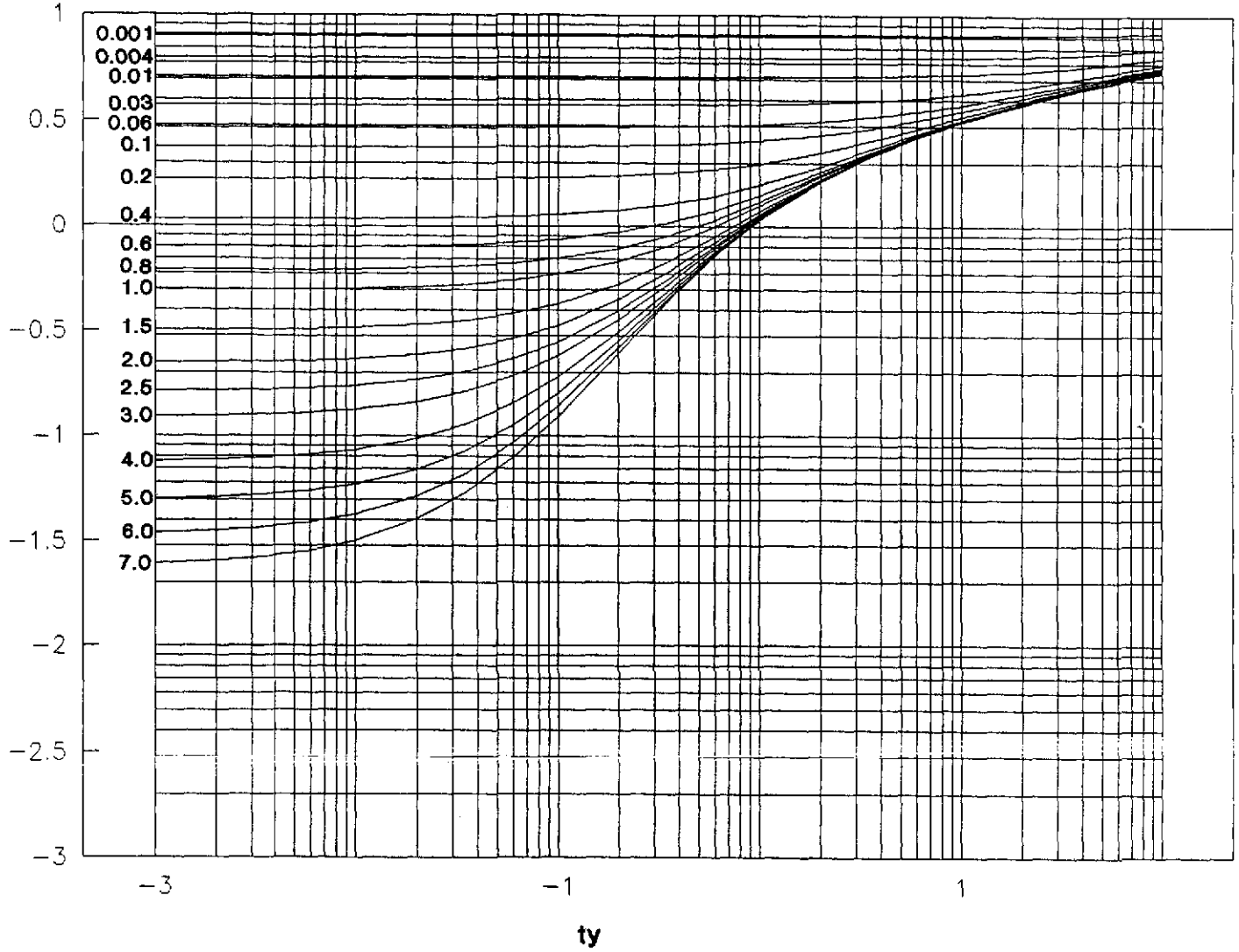
INDUSTRI-PLEX SITE REMEDIAL TRUST

FIGURE **H1-9**

158696

NEUMAN TYPE B CURVES

SERIES 5



DEC 13 1991

JOB No.:	913-6744
DRAWN:	FG
CHECKED:	RSW
SCALE:	AS SHOWN
DATE:	11/20/91
DWG. No.:	MA03-033

Golder Associates

NEUMAN TYPE B CURVES
SERIES 5

INDUSTRI-PLEX SITE REMEDIAL TRUST

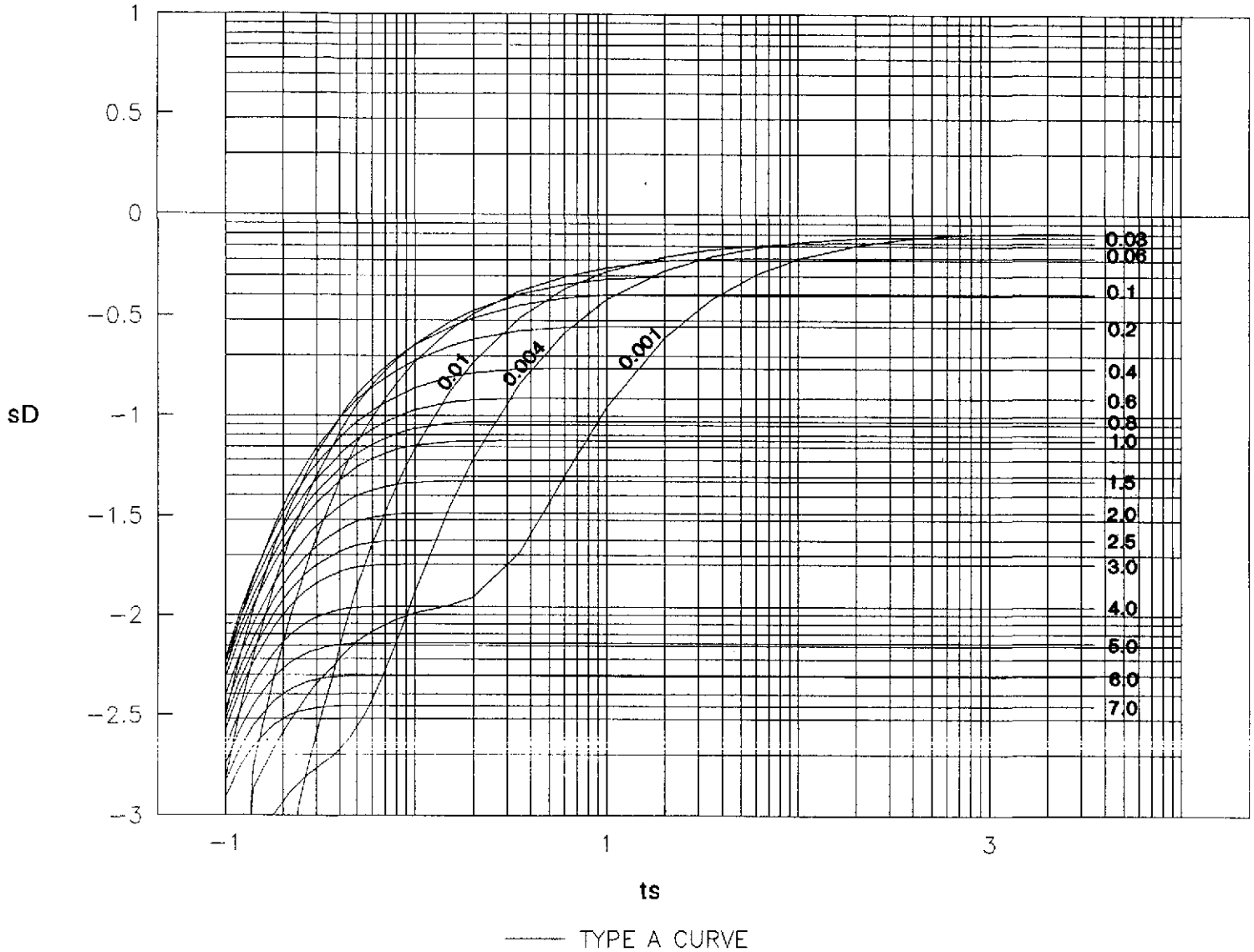
FIGURE **H1-10**

APPENDIX H2

Neuman Type Curves (Approach 2)

NEUMAN TYPE A' CURVES

SERIES 1'



DEC 13 1991

JOB No.: 913-6744	SCALE: AS SHOWN
DRAWN: FG	DATE: 11/08/91
CHECKED: RSW	FILE No.: MA03-034

Golder Associates

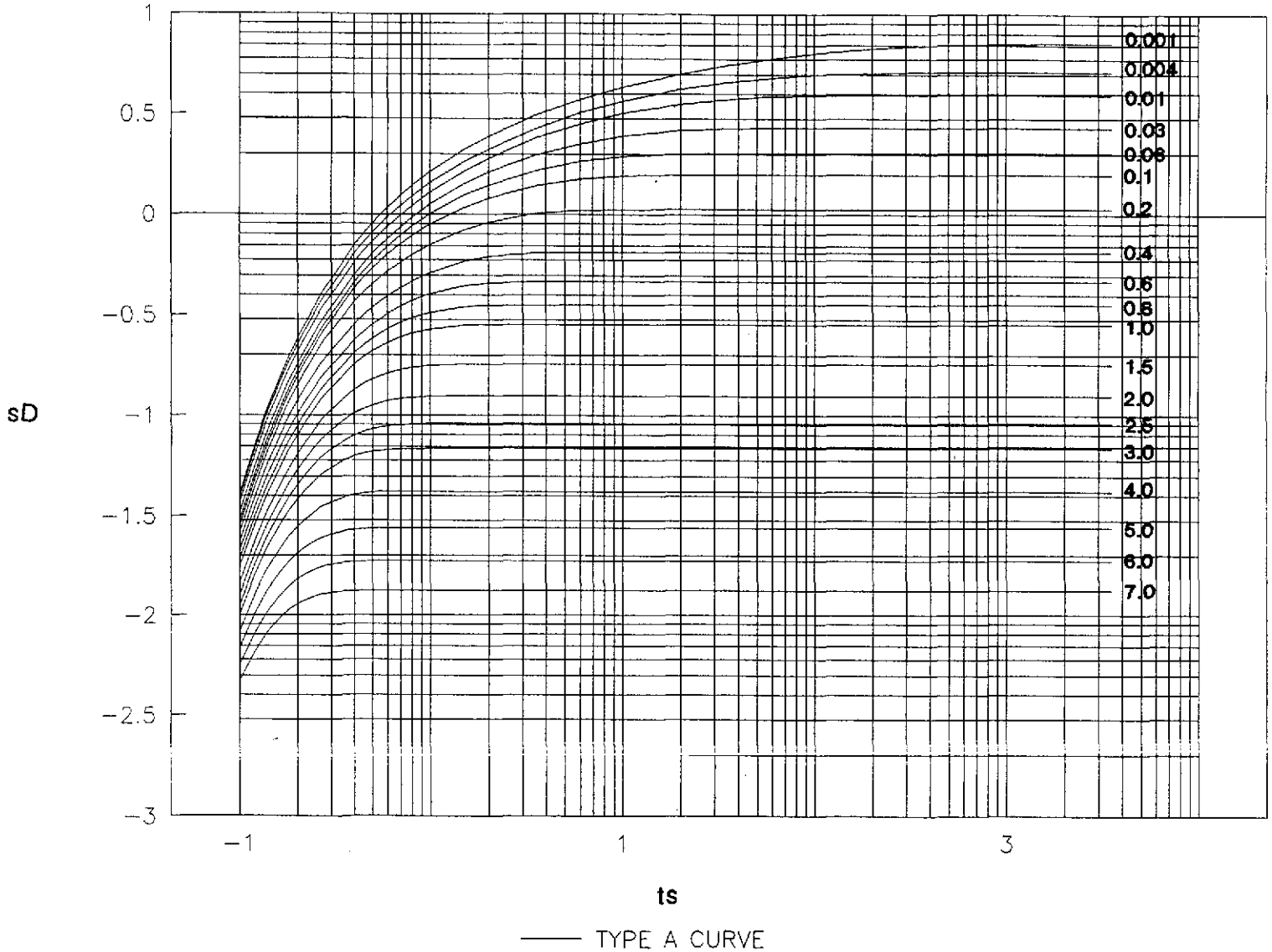
NEUMAN TYPE A' CURVES
SERIES 1'

INDUSTRI-PLEX SITE REMEDIAL TRUST

FIGURE **H2-1**

NEUMAN TYPE A' CURVES

SERIES 2'



DEC 13 1991

JOB No.:	913-6744
DRAWN:	FG
CHECKED:	RSW
SCALE:	AS SHOWN
DATE:	11/08/91
FILE No.:	MA03-035

Golder Associates

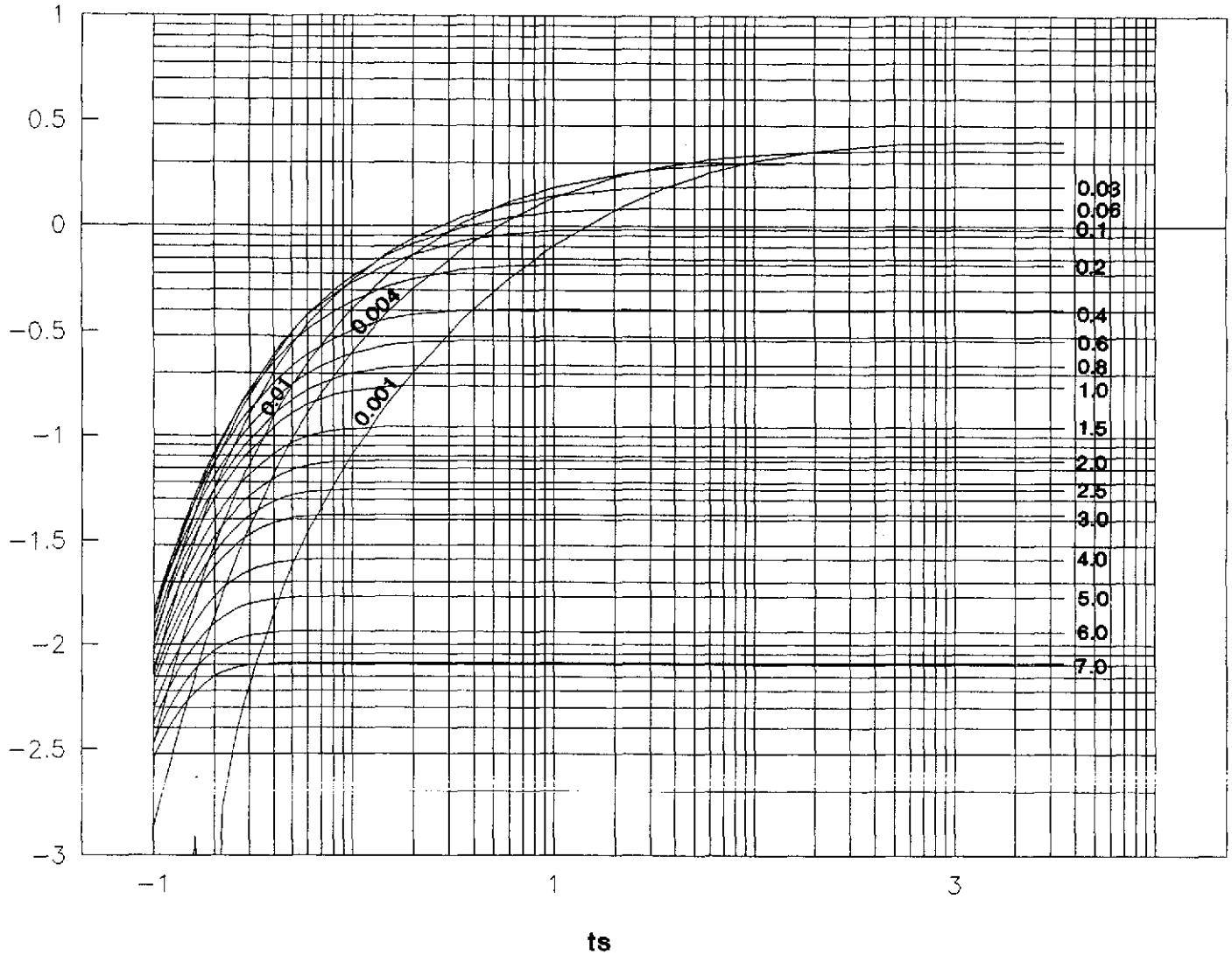
NEUMAN TYPE A' CURVES
SERIES 2'

INDUSTRI-PLEX SITE REMEDIAL TRUST

FIGURE **H2-2**

NEUMAN TYPE A' CURVES

SERIES 3'



—— TYPE A CURVE

DEC 1 3 1991

JOB No.: 913-6744	SCALE: AS SHOWN
DRAWN: FG	DATE: 11/08/91
CHECKED: RSW	FILE No.: MA03-036

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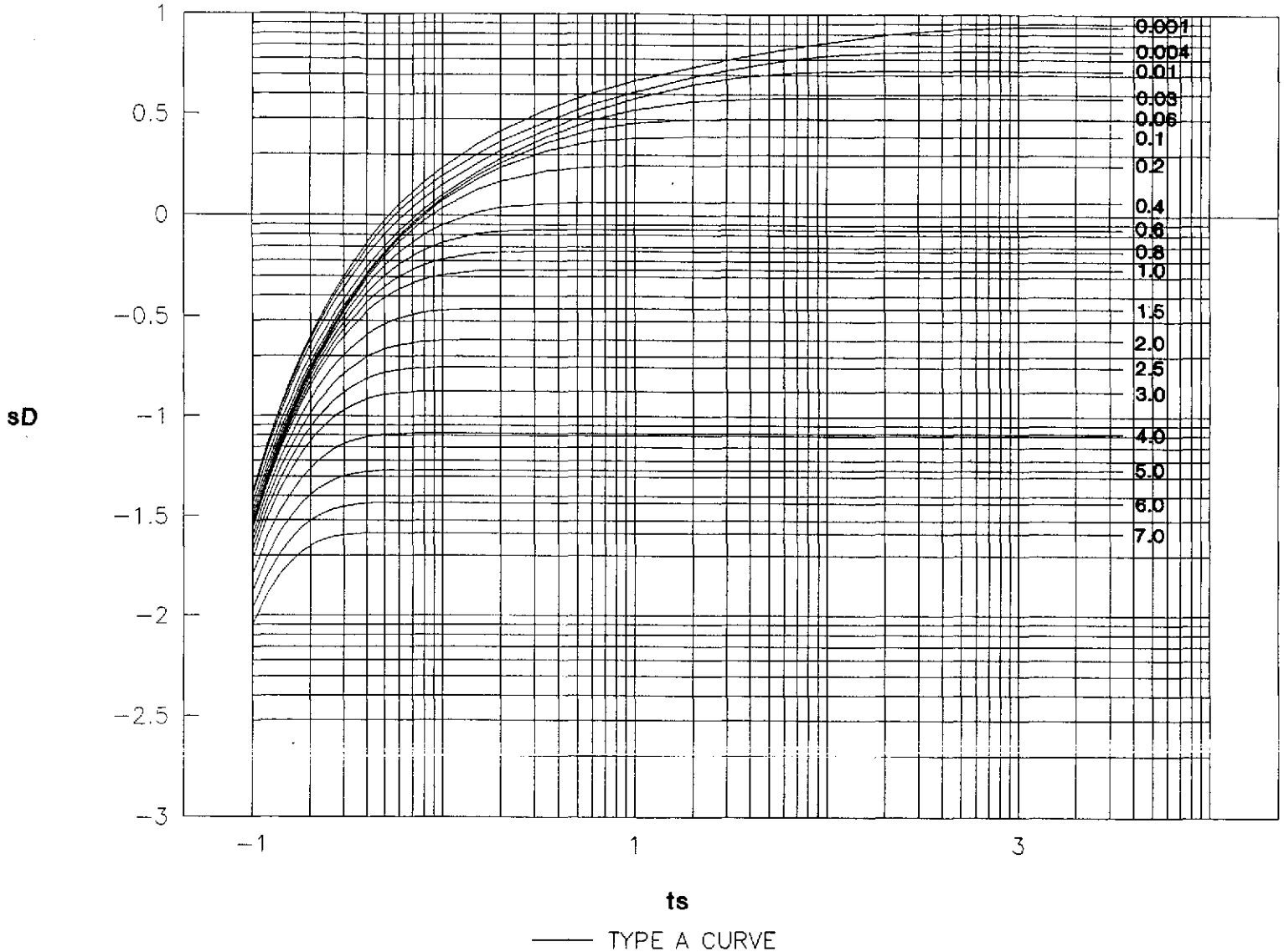
NEUMAN TYPE A' CURVES
SERIES 3'

INDUSTRI-PLEX SITE REMEDIAL TRUST

FIGURE **H2-3**

NEUMAN TYPE A' CURVES

SERIES 4'



DEC 18 1991

JOB No.:	913-6744
DRAWN:	FG
CHECKED:	RSW
SCALE:	AS SHOWN
DATE:	11/08/91
FILE No.:	MA03-037

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NEUMAN TYPE A' CURVES SERIES 4'

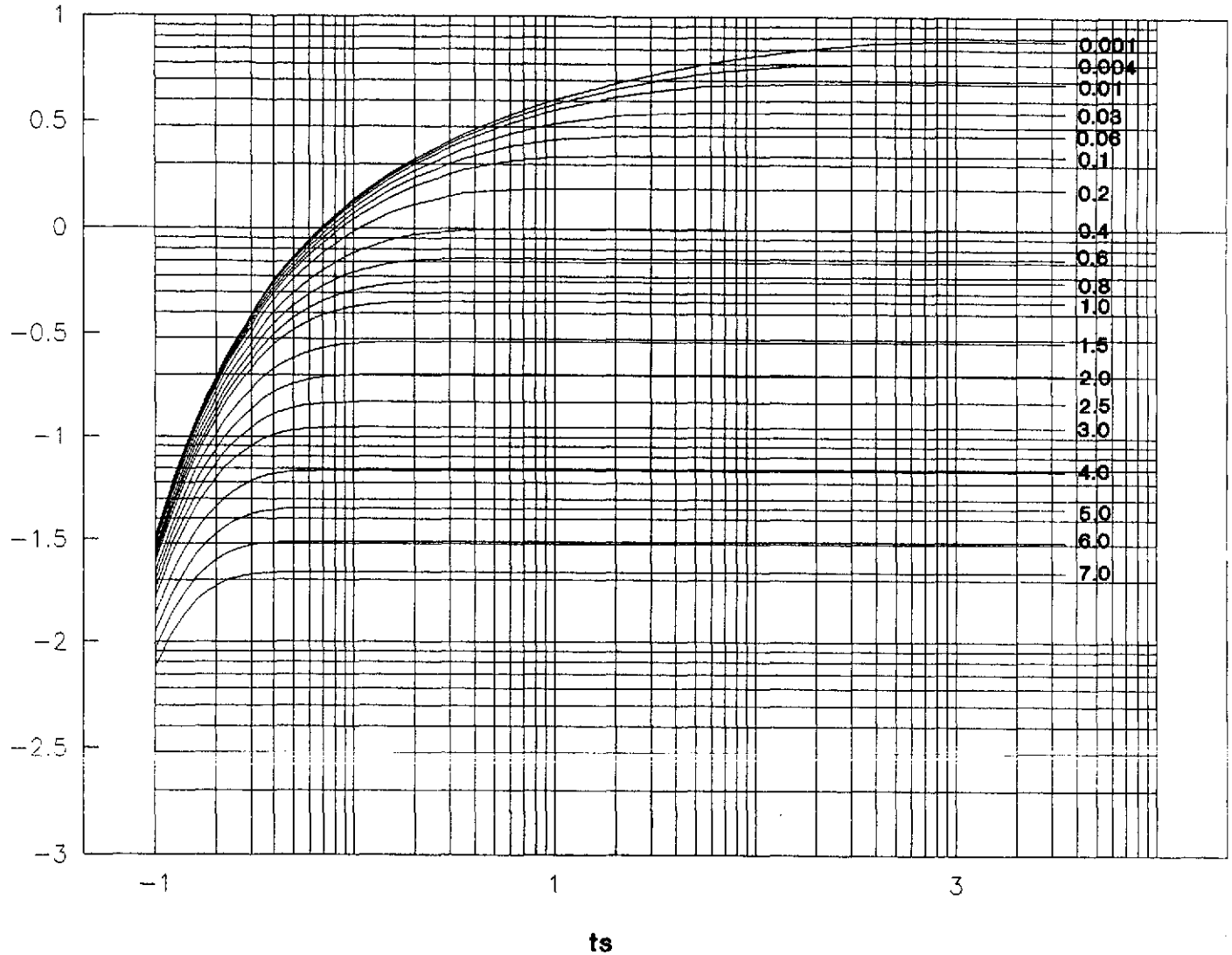
INDUSTRI-PLEX SITE REMEDIAL TRUST

FIGURE **H2-4**

158696

NEUMAN TYPE A' CURVES

SERIES 5'



DEC 13 1991

JOB No.:	913-6744
DRAWN:	FG
CHECKED:	RSW
SCALE:	AS SHOWN
DATE:	11/20/91
DWG. No.:	MA03-038

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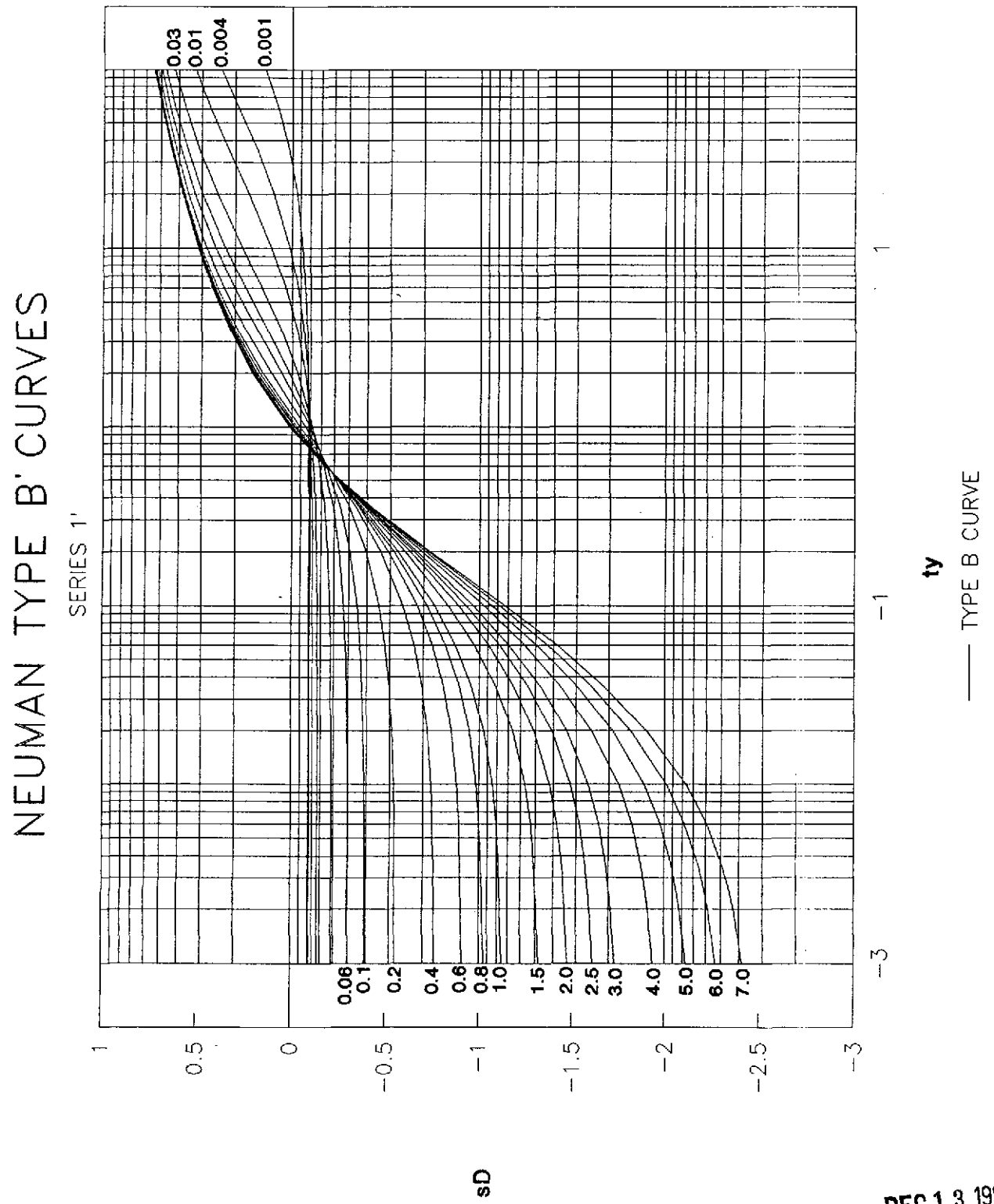
NEUMAN TYPE A' CURVES
SERIES 5'

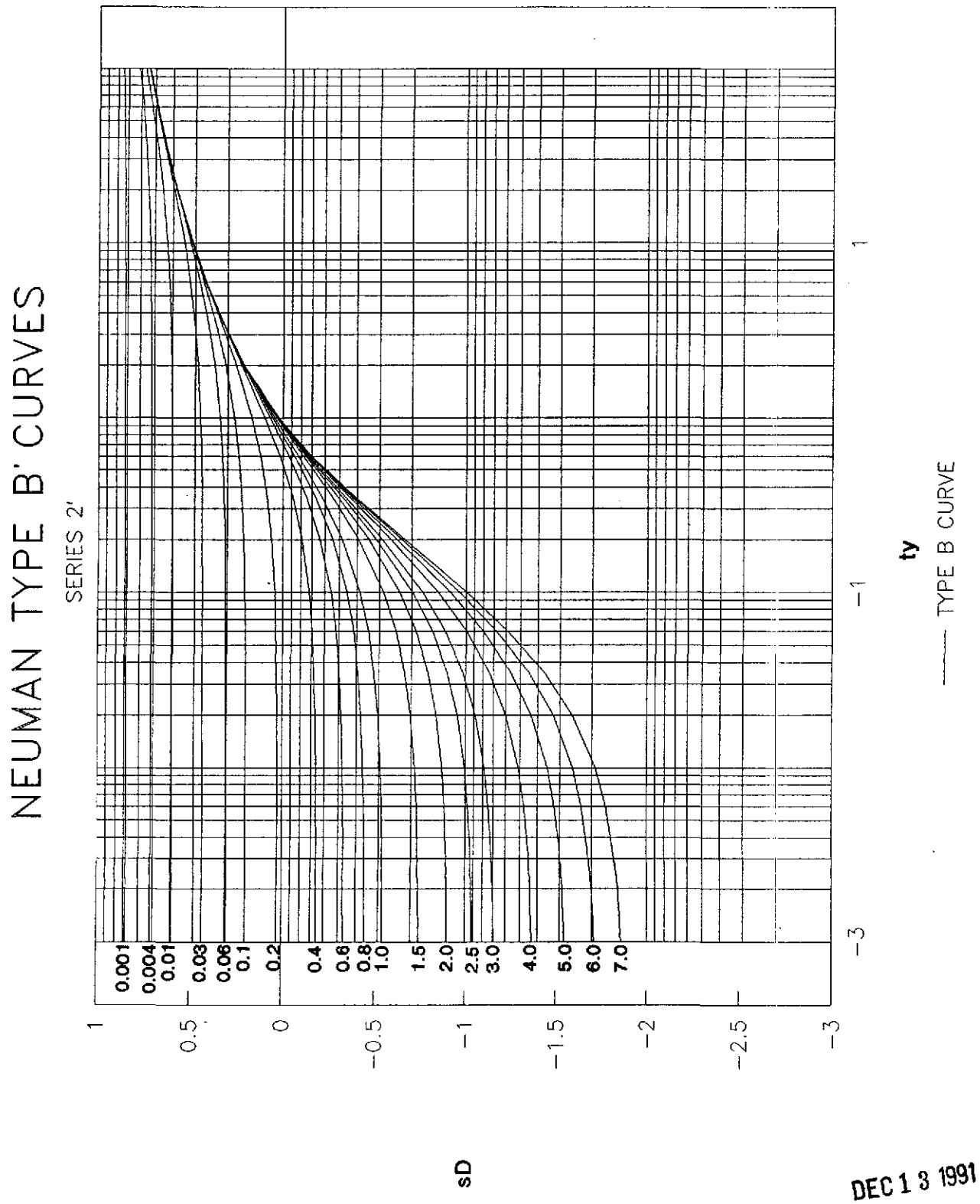
INDUSTRI-PLEX SITE REMEDIAL TRUST

FIGURE: **H2-5**



DEC 13 1991

JOB No.: 913-6744	SCALE: AS SHOWN	**NEUMAN TYPE B' CURVES SERIES 1'**		
DRAWN: FG	DATE: 11/08/91			
CHECKED: RSW	FILE No.: MA03-040			
Golder Associates		INDUSTRI-PLEX SITE REMEDIAL TRUST	FIGURE **H2-6**	

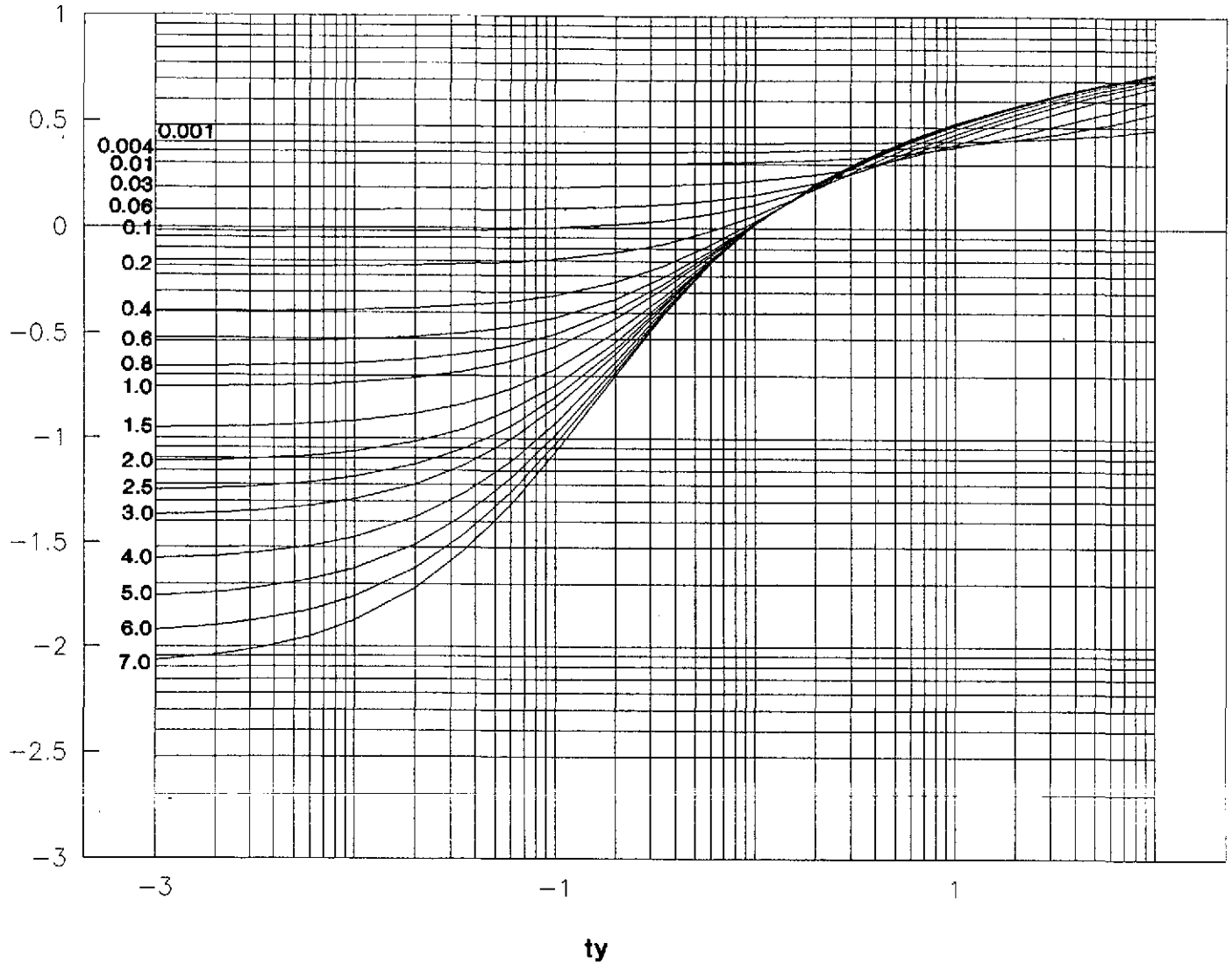


DEC 1 3 1991

JOB No.: 913-6744	SCALE: AS SHOWN	**NEUMAN TYPE B'CURVES SERIES 2'**		
DRAWN: FG	DATE: 11/08/91			
CHECKED: RSW	FILE No.: MA03-041			
Golder Associates		INDUSTRI-PLEX SITE REMEDIAL TRUST	FIGURE **H2-7**	

NEUMAN TYPE B' CURVES

SERIES 3'



TYPE B CURVE

DEC 13 1991

JOB No.: 913-6744	SCALE: AS SHOWN
DRAWN: FG	DATE: 11/08/91
CHECKED: RSW	FILE No.: MA03-042

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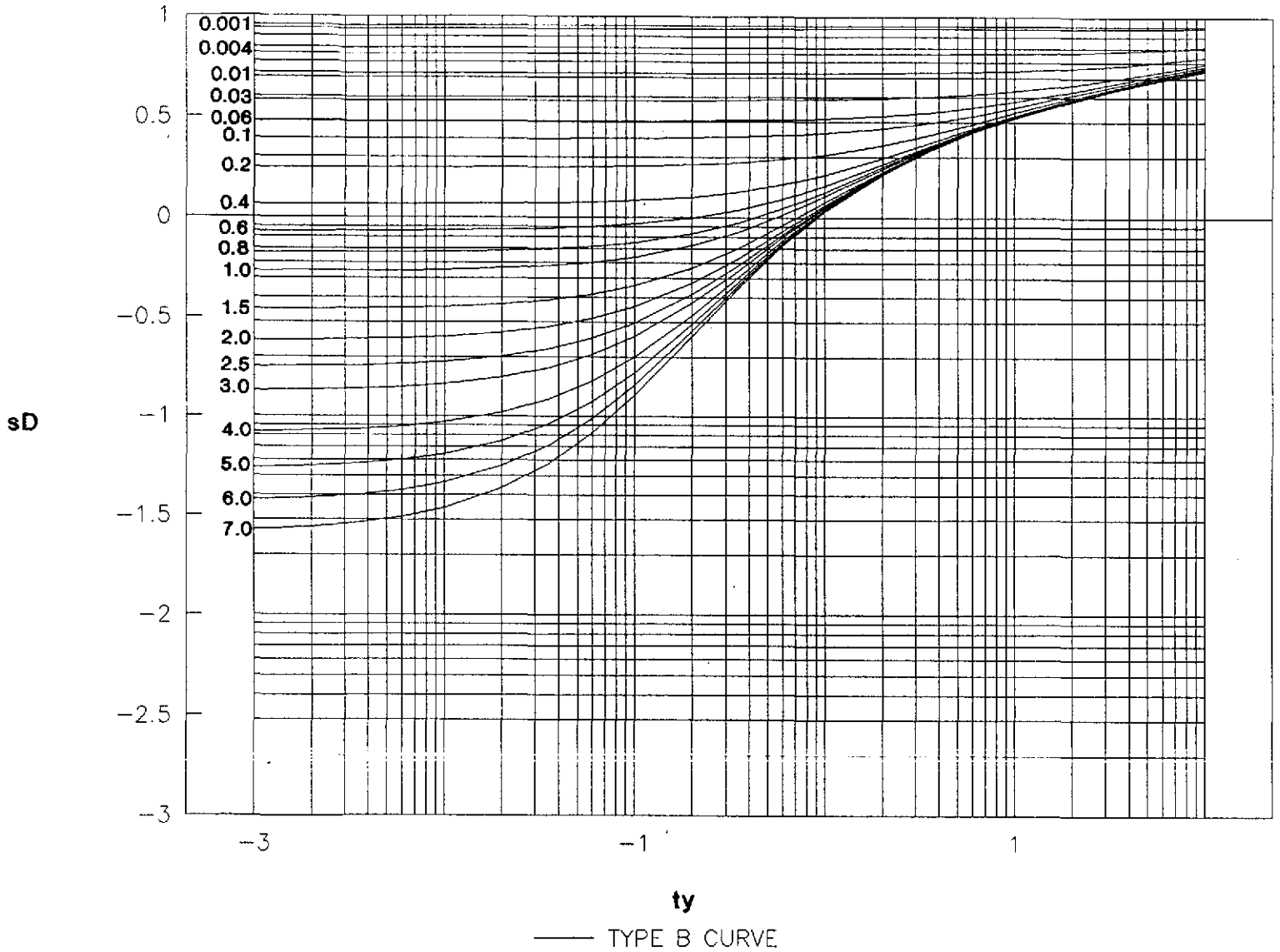
NEUMAN TYPE B'CURVES SERIES 3'

INDUSTRI-PLEX SITE REMEDIAL TRUST

FIGURE **H2-8**

NEUMAN TYPE B' CURVES

SERIES 4'



DEC 13 1991

JOB No.: 913-6744	SCALE: AS SHOWN
DRAWN: FG	DATE: 11/08/91
CHECKED: RSW	FILE No.: MA03-043

Golder Associates

NEUMAN TYPE B'CURVES SERIES 4'

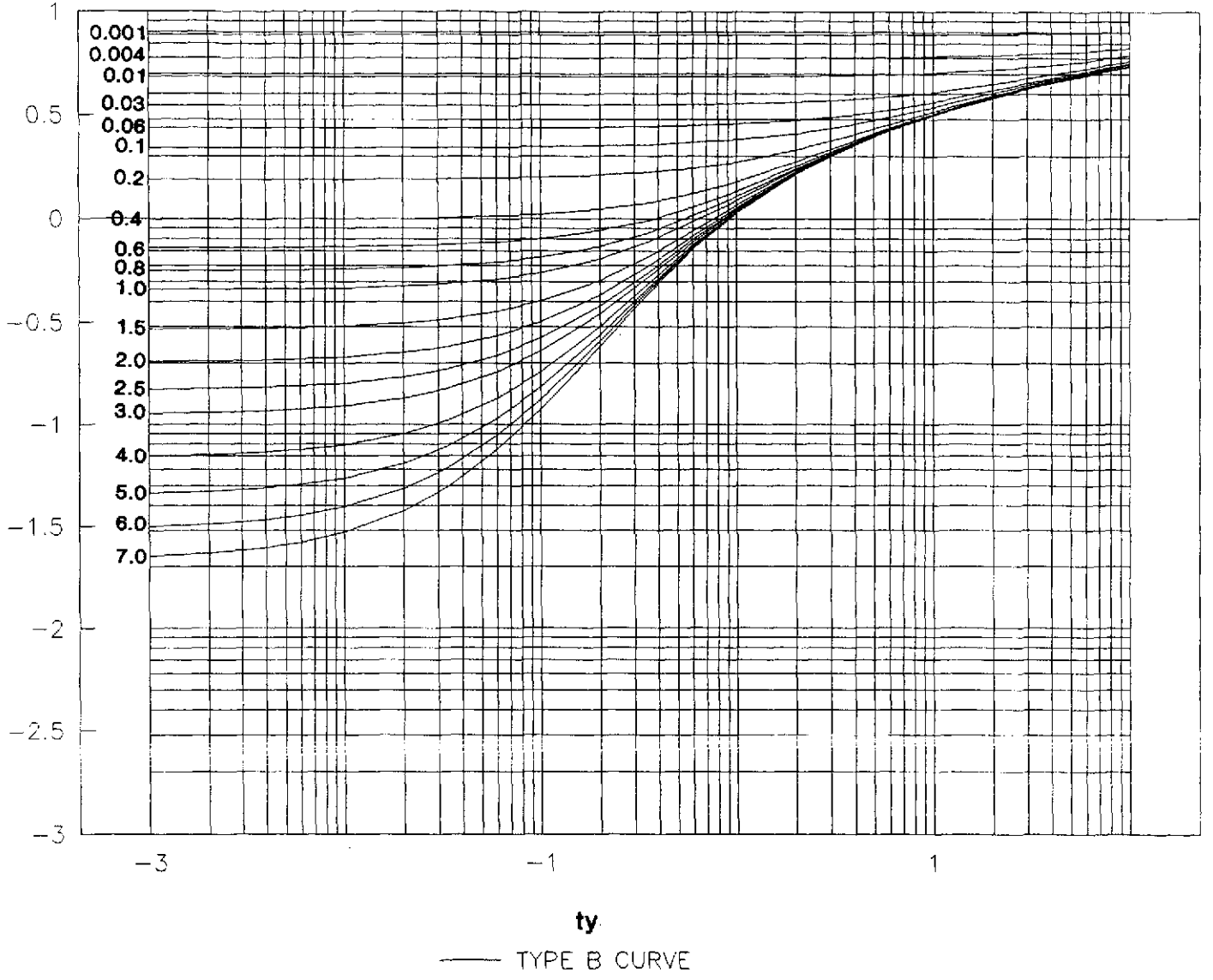
INDUSTRI-PLEX SITE REMEDIAL TRUST

FIGURE **H2-9**

158696

NEUMAN TYPE B' CURVES

SERIES 5'



DEC 1 8 1991

JOB No.: 913-6744	SCALE: AS SHOWN
DRAWN: FG	DATE: 11/20/91
CHECKED: RSW	DWG. No.: MA03-044

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NEUMAN TYPE B'CURVES SERIES 5'

INDUSTRI-PLEX SITE REMEDIAL TRUST

FIGURE H2-10