35791

DRAFT
PHASE III REMEDIAL INVESTIGATION REPORT
BALLY ENGINEERED STRUCTURES SITE
BALLY, PENNSYLVANIA

VOLUME II
APPENDICES A THROUGH I

PREPARED FOR

ALLEGHENY INTERNATIONAL, INC.
PITTSBURGH, PENNSYLVANIA

DECEMBER 1988

PROJECT NO. 88548.18

REMCOR, INC.
PITTSBURGH, PENNSYLVANIA

AR300781

"REALISTIC SOLUTIONS FOR HAZARDOUS WASTE PROBLEMS"

REMCOR

AR300782

APPENDIX A

ERM PHASE II GROUND WATER QUALITY DATA

300783

"REALISTIC SOLUTIONS FOR HAZARDOUS WASTE PROBLEMS"

REMCOR

TABLE 3-3
ON-/OFF-SITE WELLS - SAMPLING RESULTS
(all results ppb)
(blank = none detected)

Well #	Date Sampled (1986)	Total Chlorinated Volatiles	1,1-Dichloro-ethene	1,1-Dichloro-ethane	Trans-1,2 Dichloro-ethene	Chloro-form	1,2-Dichloro-ethane	1,1,1-Trichloro-ethane	Trichloro-ethene	Tetra-chloro-ethene
86-1	5/12									
86-2	5/13									
86-3S	5/12	1482	170	8				1300	4	
86-3D	5/12	670	130	240				210	90	
86-4	5/13	7244	570	7	11	7	2	2300	4300	47
86-5S	5/12	3						3		
86-5D	5/12	145	4					31	110	
Plant Site Well	5/13	240	10		12			11	170	37
Farm Products	5/13									
Gr. Amer. Knit.	5/13	43	3					26	14	
Bally Rib. Mill	5/13	39	2					27	4	6
G. Smith Res.	5/13									
Kehs Bros.	5/13									
C. Conrad Res.	5/13									
L. Bauer Res.	5/13									
Moser Res.	5/13									
Gehman Res.	5/14	304	34					160	110	
Longacre Dairy	5/14									
Nace Residence	5/14									
Munic. Well #1	5/14	61	5					46	10	
Munic. Well #3	5/14	3509	360	4		1	1	2500	640	3
PMLC*			7				5	200	5	5

*PMLC: EPA Proposed Maximum Contaminant Levels (11/85)

NOTE: Well locations shown on Figures 3-3 and 3-6.

Source:
"Hydrogeologic Investigation of the Bally Engineered Structures, Inc. Facility, Bally, Pennsylvania, Phase II Report," October 27, 1986, Environmental Resources Management, West Chester, Pennsylvania

AR300784

300785

AR300785

APPENDIX B

BORING LOGS

300736

AR300786

REMCOR

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 8731/3	PROJECT NAME: Bally Engineered Structures (RI)	
BORING NUMBER: SS 1	COORDINATES:	DATE: 12/30/87
ELEVATION:	GWL: Depth Dry Date/Time 11/18 (10:20)	DATE STARTED: 11/18/87
ENGINEER/GEOLOGIST: P. Swallow	Depth Date/Time	DATE COMPLETED: 11/18/87
DRILLING METHODS: Hollow Stem Auger + Split Spoon		PAGE 1 OF 1

DEPTH (Ft.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6")	RECOVERY (Ft.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS Sample #, Time
1	SS	2 4 11 43	1.4	Soft, Brown, Clayey Silt, Moist	ML		
2				Black to Grey, Silty Gravel, (aug. Ls.)	GM		
3	SS	12 9 11 15	1.3	Stiff, Mottled Brown to Grey (Variable), Clayey Silt, Moist, Trace Rounded Gravel (Quartz, Gneiss, Quartzite) → Colluvium/Alluvium	ML		RBB-SS-SS1-001 9:40
4							
5	SS	6 13 17 22	1.8				
6							
7	SS	10 14 15 14	1.8				
8							
9	SS	6 11 11 14	1.4				
10							
11	SS	7 9 14 17	1.6				RBB-SS-SS1-002 10:15
12				Stiff, Reddish Brown, Clayey Silt, Damp → Residual Shale / Fanglomerate	MH		
13	SS	8 15 15 17	1.5				RBB-SS-SS1-003 10:20
14				Bottom of Boring @ 14.0 ft.			

NOTES:

300787

AR300787

REMCOR

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 87313	PROJECT NAME: Bally Engineered Structures (RI)	
BORING NUMBER: SS 2	COORDINATES:	DATE: 12/30/87
ELEVATION:	GWL: Depth Dry Date/Time 11/18 (9:00)	DATE STARTED: 11/18/87
ENGINEER/GEOLOGIST: P. Swallow	Depth Date/Time	DATE COMPLETED: 11/18/87
DRILLING METHODS: Hollow Stem Auger + Split Spoon		PAGE 1 OF 1

DEPTH (Ft.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6")	RECOVERY (Ft.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS Sample # Time
1	SS	3 3 4 35	1.2	Soft, Brown, Clayey Silt, Moist	ML		RBB-SS-SS2-001 8:10
2	SS	43 22 16 20	0.2	Dark Grey, Silty Gravel, (aug. Ls., Qtz.	GM		
3				Medium Stiff to Very Stiff, Mottled Brown to Yellow Brown, Clayey Silt, Moist, Trace Weathered Gravel (Ls., Quartz) → Colluvium/Alluvium	ML		
4							
5	SS	7 9 14 7	1.3				RBB-SS-SS2-003 8:32
6							
7	SS	7 10 24 24	1.2				RBB-SS-SS2-004 8:40
8							
9	SS	12 12 10 11	1.3	Stiff, Brown, Sandy Silt, Trace Angular Gravel (Quartz) → Colluvium/Alluvium	ML		RBB-SS-SS2-005 8:50
10							
11	SS	5 10 12 14	1.5	Stiff, Reddish Brown, Clayey Silt, Moist, Little Shale Frags. → Residual Shale	ML		RBB-SS-SS2-006 9:00
12				Bottom of Boring @ 12.0 ft.			
13							
14							

NOTES:

300788

AR300788

REMCOR

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 87313	PROJECT NAME: Bally Engineered Structures (RI)	
BORING NUMBER: SS 3	COORDINATES:	DATE: 12/30/87
ELEVATION:	GWL: Depth Dry Date/Time 11/17 (17:40)	DATE STARTED: 11/17/87
ENGINEER/GEOLOGIST: Kasper + Swallow	Depth Date/Time	DATE COMPLETED: 11/17/87
DRILLING METHODS: Hollow Stem Auger + Split Spoon		PAGE 1 OF 1

DEPTH (Ft.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6")	RECOVERY (Ft.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS Sample # Time
1	S-1	4 5 21 53	1.1	Med. Stiff, Brown, Clayey Silt, Moist	ML		RBB-SS-553-001 16:25
2				Dark Grey, Silty Gravel	GM		
3	S-2	17 13 11 14	0.8	Med. Stiff, Brown, Silty Clay, Trace Rock Frags. (Shale) → Soil Horizon	CL		RBB-SS-553-002 16:36
4							
5	S-3	7 13 16	1.5	Med Stiff, Mottled Brown to Grey, Clayey Silt, Moist, Trace Angular Gravel (Quartz, Quartzite, shale) → Colluvium/Alluvium	ML		RBB-SS-553-003 16:40
6	S-4	5 10 15	1.2				RBB-SS-553-004 16:47
7							
8	S-5	8 13 23 20 15	1.8				RBB-SS-553-005 16:55
9							
10	S-6	6 7 8 10 13	1.5	Med. Stiff, Reddish Brown, Clayey Silt, Damp, Trace Rock Frags. (Shale, Ls.) → Residual Shale/Fanglomerate	ML		RBB-SS-553-006 17:20
11							
12							
13	S-7	8 10 15	1.2				RBB-SS-553-007
14		10 11 13	1.3	Bottom of Boring @ 15.0 ft			

NOTES:

300789

AR300789

REMCOR

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 87313	PROJECT NAME: Bally Engineered Structures (RI)	
BORING NUMBER: SS 4	COORDINATES:	DATE: 12/30/87
ELEVATION:	GWL: Depth Dry Date/Time 11/18 (16:45)	DATE STARTED: 11/18/87
ENGINEER/GEOLOGIST: P. Swallow	Depth Date/Time	DATE COMPLETED: 11/18/87
DRILLING METHODS: Hollow Stem Auger & Split Spoon		PAGE 1 OF 1

DEPTH (Ft.)	SAMPLE TYPE & NO	BLOWS ON SAMPLER PER 6"	RECOVERY (Ft.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS Sample # Time
1 2	S1	6 12 12 11	1.3	Stiff, Brown, Silt, Damp, Trace Rounded Gravel (Quartz).	ML		RBB-SS-SS4-001 15:53
3 4	S2	4 5 5 7	1.1	Black, Peat, (Thin Mat)			RBB-SS-SS4-002 16:00
				Med. Stiff, Dk. Brown, Clayey Silt, Moist	ML		
5 6	S3	2 6 12 14	1.5	Soft to Stiff, Brown, Clayey Silt, Moist, Trace Angular Gravel (Gneiss, Quartz, Shale). → Colluvium/Alluvium	ML		RBB-SS-SS4-003 16:05
7 8	S4	6 9 11 12	1.5				RBB-SS-SS4-004 16:10
9 10	S5	6 10 10 14	1.3	Stiff, Reddish Brown, Clayey Silt, Damp, Trace Rock Fragments (Shale, Ls.) → Residual shale/ Fanglomerate	ML		RBB-SS-SS4-005 16:35
11 12	S6	8 10 12 14	1.7				RBB-SS-SS4-006 16:40
13 14				Bottom of Boring @ 12.0 ft.			

NOTES:

000700

AR300790

REMCOR

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 87313	PROJECT NAME: Bally Engineered Structures (RI)	
BORING NUMBER: SS 5	COORDINATES:	DATE: 12/31/87
ELEVATION:	GWL: Depth Dry Date/Time	DATE STARTED: 11/30/87
ENGINEER/GEOLOGIST: P. Swallow	Depth Date/Time	DATE COMPLETED: 11/30/87
DRILLING METHODS: Hand Power Auger & Hand Bucket Auger		PAGE 1 OF 1

DEPTH (Ft.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	HNU (ppm)	REMARKS Sample & Time
				Concrete			
1				Med. Stiff to Stiff, Brown Silt w/ some to little Rounded Gravel (Quartzite, Gneiss) Trace Clay, Dry → Colluvium/Alluvium	ML	5ppm	
2							
3							
4				Damp		5ppm	RBB-SS-SS5-001 12:50
5				Bottom of Boring @ 4.8' Cobble at 4.8' Prevented Further Advancement of Hole. Head space of hole gave 200ppm HNU reading at 14:20. (11/30/87)			
6							
7							
8							
9							
10							

NOTES:

300731

AR300791

REMCOR

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 87313	PROJECT NAME: Bally Engineered Structures	
BORING NUMBER: SS6	COORDINATES:	DATE: 12/31/87
ELEVATION:	GWL: Depth Dry Date/Time	DATE STARTED: 11/30/87
ENGINEER/GEOLOGIST: P. Swallow	Depth Date/Time	DATE COMPLETED: 11/30/87
DRILLING METHODS: Hand Powered Auger + Hand Bucket Auger		PAGE 1 OF 1

DEPTH (Ft.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER - - -	RECOVERY - - -	DESCRIPTION	USCS SYMBOL	HNU (ppm)	REMARKS Sample + Time
				Concrete			
1				Coarse Angular Gravel, Dry	GP		
2				Med. Stiff, Brown, Silt w/ Some Rounded Gravel (Quartzite Gneiss), Trace Clay, Damp	ML	6ppm	RBB-SS-SS6-001 9:02
3							
4				Same, w/ More Rounded Gravel. → Colluvium/Alluvium			
5				Med. Stiff, Reddish Brown, Silt w/ Little Clay, Trace Rock Frags. (Shale), Damp → Shale Residum	ML	25ppm	RBB-SS-SS6-002 + 002A 9:40
6						5ppm	
7						20ppm	RBB-SS-SS6-003 10:08
8				Bottom of Boring @ 7.3' Head space of hole gave an HNU reading of 200ppm at 14:15 (11/30/87)			
9							
10							

NOTES:

SS0783

AR300792

REMCOR

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 87313	PROJECT NAME: Bally Engineered Structures (RI)	
BORING NUMBER: SS 7	COORDINATES:	DATE: 12/31/87
ELEVATION:	GWL: Depth Dry Date/Time	DATE STARTED: 11/29/87
ENGINEER/GEOLOGIST: P. Swallow	Depth Date/Time	DATE COMPLETED: 11/30/87
DRILLING METHODS: Hand Power Auger & Hand Bucket Auger		PAGE 1 OF 1

DEPTH (Ft.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	HNU (ppm)	REMARKS Sample + Time
				Concrete			
1				Coarse Angular Gravel, Dry	GP	5ppm	
2				Stiff, Brown, Silt w/ Trace of Clay, Dry, Little Rounded Gravel (Gneiss, Quarteite, shale). → Colluvium/Alluvium	ML	3ppm	RBB-SS-SS7-001 15:45
3							
4						5ppm	RBB-SS-SS7-002 16:35
				- Damp		4ppm	RBB-SS-SS7-003 16:50
5							
6				Stiff, Reddish Brown, Silt w/ Little Clay, Damp, Trace Rock Frags (Shale + Ls.) → Residum	ML		RBB-SS-SS7-004 17:11
7						20ppm	RBB-SS-SS7-005 17:26
				Hole Covered over night		>20ppm	RBB-SS-SS7-006 8:10
8				Same → Shale Residum		9ppm	RBB-SS-SS7-007 8:15
9				Bottom of Boring @ 8.0'			
10				Headspace of hole gave an HNU reading of 200ppm at 7:50 (11/30/87).			

NOTES:

800733

AR300793

REMCOR

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 87313	PROJECT NAME: Bally Engineered Structures (RI)	
BORING NUMBER: SS 8	COORDINATES:	DATE: 12/31/87
ELEVATION:	GWL: Depth Dry Date/Time	DATE STARTED: 11/29/87
ENGINEER/GEOLOGIST: P. Swallow	Depth Date/Time	DATE COMPLETED: 11/29/87
DRILLING METHODS: Hand Power Auger + Hand Bucket Auger		PAGE 1 OF 1

DEPTH (Ft.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
				Concrete			
1				Course Angular Gravel, Dry	GP		
2				Stiff, Brown, Grey Mottles, Silt w/ a Little Clay, Some Rounded Quartzite Gravel, Damp	ML		
							RBB-SS-SS8-001 18:25
3				Bottom of Boring @ 2.8' Cobble at 2.8' prevented further advancement of hole.			
4							
5							
6							
7							
8							
9							
10							

NOTES:

REMCOR

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 87313	PROJECT NAME: Bally Engineered Structures (RI)	
BORING NUMBER: SS 9	COORDINATES:	DATE: 12/30/87
ELEVATION:	GWL: Depth ~26' Date/Time 11/18 (14:20)	DATE STARTED: 11/18/87
ENGINEER/GEOLOGIST: P. Swallow	Depth > 13' Date/Time 11/19 (7:30)	DATE COMPLETED: 11/18/87
DRILLING METHODS: Hollow Stem Auger + Split Spoon		PAGE 1 OF 3

DEPTH (Ft.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6"	RECOVERY (Ft.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS Sample # Time
				Two Layers of Asphalt + Gravel			
1	Grab			Loose to Med. Dense, Brown to Grey (Variable), Silty Angular Gravel (Gneiss, Quartz), Wet → Fill	GM		
2							
3	SS	6 12 23 38	0.8				
4							
5	SS	9 13 15 15	1.9	Stiff, Brown to Red Brown (Variable Color), Silty Clay, Moist, Trace Rock Frags. (Shale, Ls.) → Colluvium/Alluvium	CL		RBTB-SS-SS9-001 RBTB-SS-SS9-001A (Duplicate) 11:30
6							
7	SS	9 15 16 18	1.5				RBTB-SS-SS9-002 11:40
8							
9	SS	5 9 12 14	0.4	Stiff, Brown, Clayey Silt, Moist → Colluvium/Alluvium	ML		
10							
11	No Split Spoons — Augered to 15 Ft.			Contact Location Unknown — Between 10' & 15'			
12				? ?			
13							
14							

NOTES:

REMCOR

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 87313	PROJECT NAME: Bally Engineered Structures (RI)	
BORING NUMBER: SS 9	COORDINATES:	DATE: 12/30/87
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 11/18/87
ENGINEER/GEOLOGIST: P. Swallow	Depth Date/Time	DATE COMPLETED: 11/18/87
DRILLING METHODS: Hollow Stem Auger + Split Spoon		PAGE 2 OF 3

DEPTH (Ft.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6"	RECOVERY (Ft.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
16	SS	15 17 1-2Ft.	1.8	Stiff to Very Soft, Reddish Brown, Clayey Silt, Damp, Trace Rounded Gravel (Quartz, Shale, Ls.) → Residual Shale/Fanglomerate	ML		
17							
18							
19							
20							
21	SS	6 8 10 14	1.9	Med. Dense, Reddish Brown, Silt, Sand, Moist, Some Angular Rock Frags (Shale)	SM		
22							
23							
24							
25							
26	SS	6 8 22 17	1.7	Weathered Shale/Fanglomerate. Reddish Brown shale Fragments + Decomposed Ls., Soft, Wet.			
27							
28							
29							

NOTES:

300796

AR300796

REMCOR

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 87313	PROJECT NAME: Bally Engineered Structures (RI)	
BORING NUMBER: SS 9	COORDINATES:	DATE: 12/30/87
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 11/18/87
ENGINEER/GEOLOGIST: P. Swallow	Depth Date/Time	DATE COMPLETED: 11/18/87
DRILLING METHODS: Hollow Stem Auger + Split Spoon		PAGE 3 OF 3

DEPTH ( )	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER ( )	RECOVERY ( )	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
31		6 15 15 17		Weathered shale/Fanglomerate, Wet			
32				Bottom of Boring @ 32.0'			

NOTES:

300797

AR300797

REMCOR

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 87313	PROJECT NAME: BAILY	
BORING NUMBER: SS-10	COORDINATES:	DATE:
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 1/4/88
ENGINEER/GEOLOGIST: J. KASPER	Depth Date/Time	DATE COMPLETED: 1/4/88
DRILLING METHODS: H.S. AUGER		PAGE 1 OF 1

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6")	RECOVERY (%)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
	S-1	4-9 58-49	33	CONCRETE AND SUBBASE MATERIAL			
	S-2	15	66	BROWN SILT WITH ROCK AND SLAG FILL, DRY TO DAMP			ZONE OF LARGE FILL (Boulders, concrete) AT 2.5 TO 3.0' - VERY TOUGH DRILLING
	S-3	26-35 46-28	29				
5	S-4	23-18 12-21	70	STIFF BROWN TO RED CLAYEY SILT (FILL) DAMP	M_L		
				BROWN SILT AND ROCK FILL WITH COAL FRAGS, SLAG.			
	S-5	46-38 32-41	0	MEDIUM STIFF TO STIFF BROWN CLAYEY SILT WITH shale FRAGMENTS AND WEATHERED LIMESTONE NODS. DAMP TO WET.	M_L		
10	S-6	10-12 12-13	85				
	S-7	28-21 26-14	65				
				T.D. = 14.0'			

NOTES:

220738

REMCOR

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 87313	PROJECT NAME: BAILY		
BORING NUMBER: SS-11	COORDINATES:		DATE:
ELEVATION:	GWL: Depth	Date/Time	DATE STARTED: 1-5-88
ENGINEER/GEOLOGIST: J. KASPER	Depth	Date/Time	DATE COMPLETED: 1-5-88
DRILLING METHODS: H.S. AUGER			PAGE 1 OF 1

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6")	RECOVERY (%)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
	S-1	26-100/3"	50	CONCRETE AND SUBBASE MAT.			
				BROWN SILT AND ROCK FILL (QUARTZITE COBBLES) DAMP			BOULDER SIZE FILL A 3.0' - TOUGH DRILLING
	S-2	63-48 45-47	100	MEDIUM STIFF RED BROWN CLAYEY SILT WITH SHALE AND QUARTZITE FRAGMENTS (FILL) DAMP			
5	S-3	27-18 19-11	0				
	S-4	8-14 13-21	65	MEDIUM STIFF BROWN CLAYEY SILT OCCASIONAL SHALE FRAGMENTS DAMP TO WET AT BASE	M_L		
10	S-5	7-9 12-14	75				
				T.D. = 12.0'			

NOTES:

300799

AR300799

REMCOR

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 87313	PROJECT NAME: BALLY R.I.	
BORING NUMBER: SS-12 (87-135)	COORDINATES:	DATE:
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 1-5-88
ENGINEER/GEOLOGIST: J. KASPER	Depth Date/Time	DATE COMPLETED: 1-6-88
DRILLING METHODS: H.S. AUGER		PAGE 1 OF 1

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6"	RECOVERY (%)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
	S-1	4-6 10-100/4"	83	CONCRETE AND SUBBASE BROWN CLAYEY SILT FILL DAMP ROCK FILL (CONCRETE? AT 1.8')			TOUGH DRILLING 1.8-30'
	S-2	28-31 38-40	90	MEDIUM STIFF BROWN SILT, SOME CLAY, TRACE SAND, LITTLE ROCK FRAG'S			
5	S-3	7-15 ~~17-28~~	90	MEDIUM STIFF TO STIFF RED BROWN SILT, LITTLE CLAY, TRACE SHALE ROCK FRAGMENTS DAMP TO 12.0', WET THEREAFTER			
10	S-4	6-4 18-21	75				
15	S-5	6-10 11-8	70				
20							
21.5				BEDROCK AT 21.5' (AUGER REFUSAL) T.D. = 21.5'			

NOTES:

330080

AR300800

REMCOR

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: BALLY	PROJECT NAME: BALLY R.I.	
BORING NUMBER: SS-13	COORDINATES:	DATE:
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 1-6-88
ENGINEER/GEOLOGIST: J. KASPER	Depth Date/Time	DATE COMPLETED: 1-6-88
DRILLING METHODS: H. S. AUGER		PAGE 1 OF 1

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6")	RECOVERY (%)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
				CONCRETE AND SUBBASE			
				SILT AND ROCK FILL W/ GRAVEL, DAMP			HARD DRILLING 1.0-3.0'
	S-1	220-21 14-10	20				
5	S-2	21-14 16-20	40	MEDIUM STIFF BROWN SILT LITTLE CLAY, TRACE ROCK FRAGS (QUARTZITE AND SHALE) (FILL) DAMP	ML		
	S-3	38-41 45-50	85				
10	S-4	8-4 12-13	70	MEDIUM STIFF RED BROWN CLAYEY SILT TO SILT WITH LITTLE CLAY, SH FRAGS. DAMP	ML		
12				T.D. = 12.0'			

NOTES:

000001

AR300801

REMCOR

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 87313	PROJECT NAME: BALLY R.I.		
BORING NUMBER: SS-14	COORDINATES:		DATE:
ELEVATION:	GWL: Depth	Date/Time	DATE STARTED: 1-6-88
ENGINEER/GEOLOGIST: J. KASPER	Depth	Date/Time	DATE COMPLETED: 1-6-88
DRILLING METHODS: H. S. AUGER			PAGE 1 OF 1

DEPTH (FT.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6")	RECOVERY (%)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
	S-1	6-inch	75	CONCRETE AND SUBBASE MATERIAL			
				ROCK FILL with SILT MATRIX			
	S-2	11-12 10-18	80	MEDIUM STIFF RED BROWN SILT, LITTLE CLAY, TRACE SHALE FRAGMENTS, DAMP	ML		
5	S-3	11-12 18-11	60				
	S-4	13-26 31-18	70				
10	S-5	40-30 32-53	80				
				T.D. = 11.0'			

NOTES:

000002

AR300802

REMCOR

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 87313	PROJECT NAME: Bailey Engineered Structures	
BORING NUMBER: E-1	COORDINATES:	DATE:
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 11/10/87
ENGINEER/GEOLOGIST: J. Kasper	Depth Date/Time	DATE COMPLETED: 11/16/87
DRILLING METHODS: H.S. Auger / Rock (NX) Coring		PAGE 1 OF 5

DEPTH (ft.)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 in.)	RECOVERY (%)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
				Sandy Silt, granitic pebbles, quartz fragments, damp.			
5.0	S-1	15-14 -14-16	83				
7.0				Red Brown clayey silt with siltstones fragments, dry to damp.			
10	S-2	7-11 12-15	100				
12							
15	S-3	6-12 16-20	100				
17							
20	S-4	6-14 18-26	100	Red-Brown clayey silt, stiff.			
22							
25	S-5	3-7 -9-15		Weathered siltstone, iron-stained along bedding planes			11/11/87
27							11/12/87

NOTES:

000003

AR300803

REMCOR

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: 87313	PROJECT NAME: Bally	
BORING NUMBER: E-1	COORDINATES:	DATE:
ELEVATION:	GWL: Depth Date/Time	DATE STARTED: 11/6/87
ENGINEER/GEOLOGIST: J. KASPER	Depth Date/Time	DATE COMPLETED: 11/16/87
DRILLING METHODS:		PAGE 2 OF 5

DEPTH (ft)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6")	RECOVERY (%)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
32	S-6	7-17-22-31	75	AS ABOVE			
40	S-7	9-13 16-15		AS ABOVE, Light GRAY			
42.0							
55.0							
55.5	S-8	50		WEATHERED SILTSTONE BEGIN ROCK CORING			

NOTES:

REMCOR

VISUAL CLASSIFICATION OF ROCK

PROJECT NUMBER 87313 FIELD ENG./GEO. JGR PAGE 3 OF 5
PROJECT NAME Baily BORING NO. E-1
APPROX. ELEV. CORE SIZE NX DATE
DRILLING METHOD CORING DATE STARTED 11/11/87
COORDINATES DATE COMPLETED 11/16/87

CASING INFORMATION		GROUNDWATER LEVEL DATA			
SIZE	DEPTH	ACTUAL TIME	DEPTH	ACTUAL TIME	DEPTH

RUN NUMBER	DEPTH ( )	RECOVERY ( )	% RECOVERY	% RQD	DESCRIPTION	JOINT SPACING MAXIMUM	MINIMUM	AVERAGE	REMARKS
	55.5				H.S. AUGERING - SEE SOILS LOG				
	60	—	—	—	WEATHERED SILTSTONE, RED				ROTARY DRILLING TO 600'
1		7.0	100	16	SILTSTONE, SHALEY, RED/BROWN, VERY BROKEN THROUGHOUT, VERTICAL AND HIGH ANGLE FRACTURES VERY COMMON, IRONSTAINED, NUMEROUS HORIZONTAL PARTINGS ALONG BEDDING PLANES, BECOMING BRECCIATED W/ LIMESTONE FRAGS 69.0-72.5' SOFT TO HARD				CLAYEY ZONE (SOFT) 62.4-64.2'
2	70	5.5	73	0					
	72.5								
---		—	—	—	LIMESTONE FANGLOMERATE, RED SILTSTONE MATRIX, LIMESTONE AND SHALE FRAGMENTS BRECCIATED THROUGHOUT, LOW TO MODERATE ANGLE FRACTURES COMMON THROUGHOUT, INTERBEDDED SILTSTONE 76.3'-77.6', BROKEN, BOTTOM CONTACT GRADATIONAL				INTERVAL 72.5-75.0' NOT CORED DUE TO REAMING OF BOREHOLE TO IMPROVE CIRCULATION (CUTTING REMOVAL)
3	80	10.0	52	16.5					
	85								
4	90	10.0	48	0	SILTSTONE, RED, VERY BROKEN THROUGHOUT, HIGH AND LOW ANGLE FRACTURES COMMON, CALCITE VEINS OCCASIONAL, OCCASIONAL LIMESTONE FRAGMENTS, BOTTOM CONTACT SHARP				
5	100	10.0	56	18					

000365

AR300805

REMCOR

VISUAL CLASSIFICATION OF ROCK

PROJECT NUMBER 87313	FIELD ENG./GEO. JGK	PAGE 4	OF 5
PROJECT NAME Bally		BORING NO. E-1	
APPROX. ELEV.	CORE SIZE NX	DATE	
DRILLING METHOD CORING		DATE STARTED 11/11/87	
COORDINATES		DATE COMPLETED 11/16/87	

CASING INFORMATION		GROUNDWATER LEVEL DATA			
SIZE	DEPTH	ACTUAL TIME	DEPTH	ACTUAL TIME	DEPTH

RUN NUMBER	DEPTH (FT.)	RECOVERY (FT.)	% RECOVERY	% RQD	DESCRIPTION	JOINT SPACING MAXIMUM	MINIMUM	AVERAGE	REMARKS
6	150	10.0	68	7	SILTSTONE -CONTINUED				
7	120	10.0	46	4	LIMESTONE FANGLOMERATE BRECCIATED LIMESTONE, SHALE AND QUARTZ FRAGMENTS THROUGHOUT, BROKEN DECREASING DOWNWARD, HORIZONTAL PARTINGS AND HIGH ANGLE FRACTURES COMMON TO FREQUENT THROUGHOUT, BRECCIA DIAMETER INCREASING↓, IRONSTAINED PARTING WITH CALCITE CRYSTALS AT 190.0', LOWER ENERGY ENVIRONMENT (SMALLER BRECCIA) 171.2'-173.5', LOWER 6.0' VERY BROKEN, BOTTOM CONTACT NOT ENCOUNTERED.				120.0
8	130	10.0	76	13.5					130.0
9	140	10.0	91	27					VERTICAL IRONSTAINED FRACTURE 136.85'-139.70' 140.0
10	150	10.0	96.5	64					150.0
11	160	9.25	100	78					000006 160.0
12	170	9.25	81	41					IRONSTAINED VERTICAL FRACTURES 163.3'-164.7' 165.2'-165.7'

AR300806

REMCOR

VISUAL CLASSIFICATION OF ROCK

PROJECT NUMBER 87313 FIELD ENG./GEO. JGK PAGE 5 OF 5
PROJECT NAME BAILY BORING NO. E-1
APPROX. ELEV. CORE SIZE NX DATE
DRILLING METHOD CORING DATE STARTED 11/11/87
COORDINATES DATE COMPLETED 11/16/87

CASING INFORMATION		GROUNDWATER LEVEL DATA			
SIZE	DEPTH	ACTUAL TIME	DEPTH	ACTUAL TIME	DEPTH

RUN NUMBER	DEPTH ( )	RECOVERY ( )	% RECOVERY	% RQD	DESCRIPTION	JOINT SPACING MAXIMUM	MINIMUM	AVERAGE	REMARKS
13	180	9.5	100	89	LIMESTONE FANGLOMERATE, CONTINUED				
14	190	9.5	100	82					
15	198.5	6.0	91	15	TOTAL DEPTH = 198.50'				very broken 192.50'-198.50'

300807

AR300807

APPENDIX C

000358

AR300808

APPENDIX C

GEOPHYSICAL WELL LOGS

000039

AR000809

UNSCANNED ITEM(S)

ONE OR MORE OF THE FOLLOWING ITEMS MAY BE ASSOCIATED
WITH THIS DOCUMENT:

PHOTOGRAPHS
DRAWINGS
OVERSIZED MAPS
ROLLED MAPS

PLEASE CONTACT THE CERCLA RECORDS CENTER TO VIEW THE ITEM(S)

APPENDIX

AR300812

APPENDIX D

DRILLING AND MONITORING WELL CONSTRUCTION LOGS

300813

REMCOR

DRILLING AND WELL CONSTRUCTION LOG

WELL NUMBER 87-4I WELL LOCATION N.E. Parking Lot, BES

PROJECT NAME Bally Eng. Struc. PROJECT NO. 87313 GEO./ENG. P. Swallow

TOTAL DEPTH 120.0' DIA. 5 5/8" WATER LEVEL 9.6' DATE/TIME 12/6 (13:35

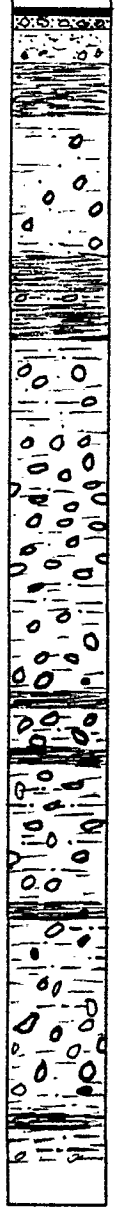
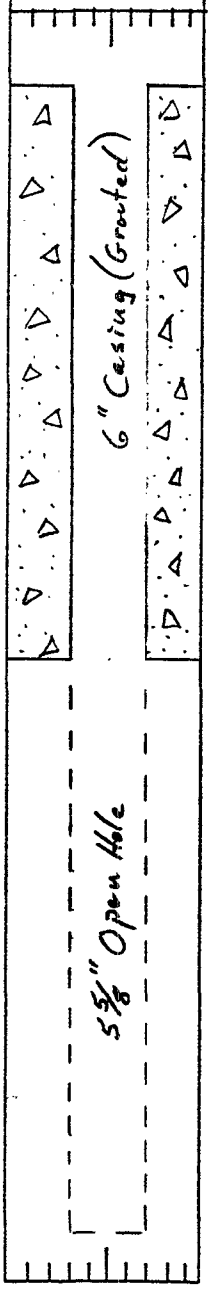
SCREEN DIA. – LENGTH – SLOT SIZE – REF. PT. ELEV.

CASING DIA. 8" ID LENGTH 21' TYPE Temp. (Removed)

CASING DIA. 6" ID LENGTH 60' TYPE Steel STICKUP Flush -0.2'

DRILLING CO. Mckay + Gould DRILLING METHOD Air Rotary GROUND ELEV.

DRILLER P. Ortz DRILL AND CONST. DATES 12/1 - 12/2/87 LOCK NO. 3753

DEPTH (FEET)	GRAPHIC LOG	WELL CONST.	SAMPLE NO.	LOG
0				0'-2' - Asphalt over Brown Silty Clay & Grey Angular Gravel
10				2'-6' - Dark Greenish Brown, Silty Clay, Damp
20				6'-11½' - Reddish Brown, Silty Clay w/ Trace of Rounded Gravel (Gneiss) + Shale Frags., Moist.
30				11½'-120' - Reddish Brown Shale + Grey Limestone. → Fanglomerate Hardness + Ls. Content Increasing w/ Increasing Depth.
40				18' - 3gpm of Water From Hole
50				26'-30' - Soft, Weathered Zone, Clay + Silt
60				30'-31' - Hard
				31'-34' - Soft
70				36' - 5gpm
				42' - 15gpm
80				53' - 20gpm
				60' - Stop to Set + Grout 6" Casing
90				63' - 2gpm
				72'-73.5' - Soft
100				77' - 20 gpm
				77'-79' - Soft
110				94'-95' - Soft
				100' - 100gpm
				116'-117' - Soft
120				120' - Bottom of Hole, Developed 10min, 100gpm

6" Casing (Grouted)

5 5/8" Open Hole

PAGE 1 OF 1

AR300814

REMCOR

DRILLING AND WELL CONSTRUCTION LOG

WELL NUMBER 87-7S WELL LOCATION Across From Bally Fire Dept.

PROJECT NAME Bally Eng. Struc. PROJECT NO. 87313 GEO./ENG. J.K. P.S.

TOTAL DEPTH 40.6 DIA. 2" WATER LEVEL 23.07' DATE/TIME 11/24/87 (15:

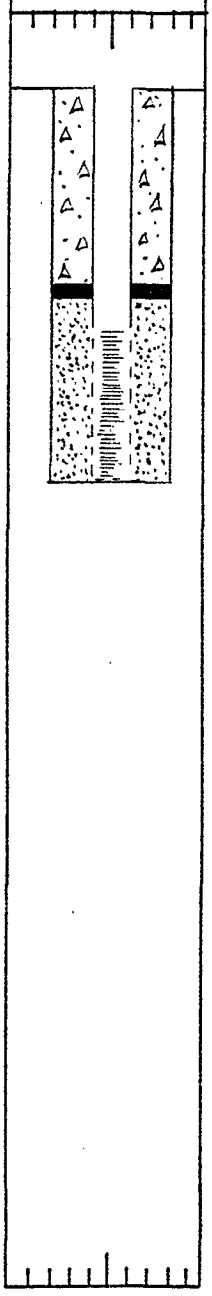
SCREEN DIA. 2" PVC LENGTH 15' SLOT SIZE 10 REF. PT. ELEV.

CASING DIA. 2" PVC LENGTH 26' TYPE PVC Solid

CASING DIA. 6" LENGTH 30' TYPE Temp (Removed) STICKUP 0.2'

DRILLING CO. Mckay & Gould DRILLING METHOD Air Rotary GROUND ELEV.

DRILLER P. Ortz DRILL AND CONST. DATES 11/19 - 11/20/87 LOCK NO. 3753

DEPTH (FEET)	GRAPHIC LOG	WELL CONST.	SAMPLE NO.	LOG
0				0'-8½' - Dark Grey Sandy Silt w/ Some Angular Gravel & Slag → Fill, Damp
10				8½'-10½' - Brown Clayey Silt, Moist → Soils
20				10½'-41' - Reddish Brown Clayey Silt w/ Trace of Shale Rock Frags. Moist. → Residual Material
30				
40				30' - Cuttings very muddy - NO Free Water
				41' - Bottom of Hole. After Installing Well Developed by Air Surging For 45 min. Bailed Also. Bend In 2" PVC At 25' Will Jam Long Bailers. Final Rate <1gpm.

0'-26' 2" Solid PVC Riser
26'-40.6' 2" 10 Slot PVC Screen

Anulus
0'-20' Bentonite Grout
20'-22' Bentonite Seal (Pellets)
22'-41' Sand Pack.

AR300815

REMCOR

DRILLING AND WELL CONSTRUCTION LOG

WELL NUMBER 87-7I WELL LOCATION Across From Bally Fire Dept.

PROJECT NAME Bally Eng. Struc. PROJECT NO. 87313 GEO./ENG. J.K + P.S

TOTAL DEPTH 132.5' DIA. 5 5/8" WATER LEVEL 25.2' DATE/TIME 11/19/87

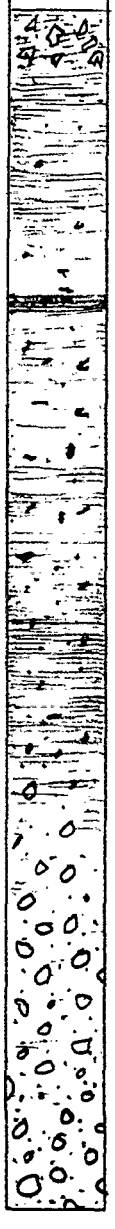
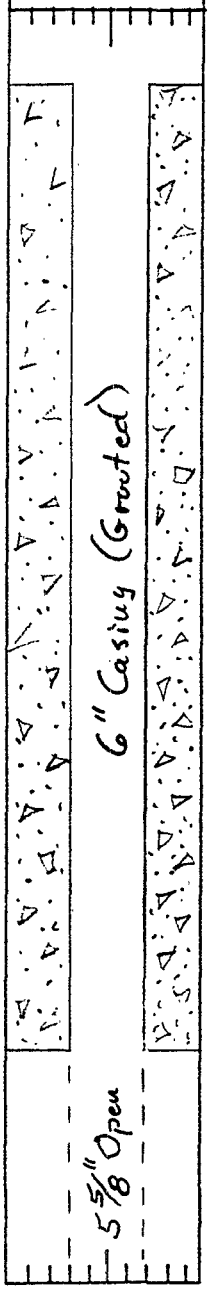
SCREEN DIA. – LENGTH – SLOT SIZE – REF. PT. ELEV.

CASING DIA. 6" ID LENGTH 102' TYPE Steel

CASING DIA. 8" ID LENGTH 21' TYPE Temp. (Removed) STICKUP 0.6'

DRILLING CO. Mckay + Gould DRILLING METHOD Air Rotary GROUND ELEV.

DRILLER P. Ortz DRILL AND CONST. DATES 11/18 – 11/20/87 LOCK NO. 3753

DEPTH (FEET)	GRAPHIC LOG	WELL CONST.	SAMPLE NO.	LOG
0				0'-7' - Grey Gravel + Slag w/ Silt → Fill
10				7'-9' - Brown Silty Clay → Top soil
20				9'-79' - Reddish Brown Clayey Silt w/ A Little Rock Frags (Shale + Siltstone), Damp
30				30' - Damp Clay
40				- Grey Ls. Rock Frags + Siltstone + Shale Increasing w/ Increasing Dept. Moist - Wet
50				
60				
70				
80				80' - Grey Limestone Conglomerate in Reddish Brown Shale - Sand Stone Matrix. Interbedded Reddish Brown Shale + Siltstone Common. → Fanglomerate
90				
100				
110				102' Stopped to Set + Grout 6" Casing. 105' Hole Yielding 4gpm 111' 40 gpm
120				113' 100 gpm

6" Casing (Grouted)

5 5/8" Open

DRILLING AND WELL CONSTRUCTION LOG

WELL NUMBER 87-7I WELL LOCATION

PROJECT NAME Bally Eng. Struc. PROJECT NO. 87313 GEO./ENG. J.K. + P.S

TOTAL DEPTH 132.5' DIA. WATER LEVEL DATE/TIME

SCREEN DIA. LENGTH SLOT SIZE REF. PT. ELEV.

CASING DIA. LENGTH TYPE

CASING DIA. LENGTH TYPE STICKUP

DRILLING CO. DRILLING METHOD GROUND ELEV.

DRILLER DRILL AND CONST. DATES LOCK NO.

DEPTH (FEET)	GRAPHIC LOG	WELL CONST.	SAMPLE NO.	LOG
120		Open Hole		123'-124' - Soft. Rate Jumps Up To 200-250gpm
130				133' - Bottom of Hole. 5min Development Final Yield 250 gpm.

AR300817 PAGE 2 OF 2

REMCOR

DRILLING AND WELL CONSTRUCTION LOG

WELL NUMBER 87-8I WELL LOCATION At The Proposed Intersection 8th St. & Popl

PROJECT NAME Bally Eng. Struc. PROJECT NO. 87313 GEO./ENG. P. Swallow

TOTAL DEPTH 132.8' DIA. 5 5/8" WATER LEVEL 14.00' DATE/TIME 12/17/87 (10:

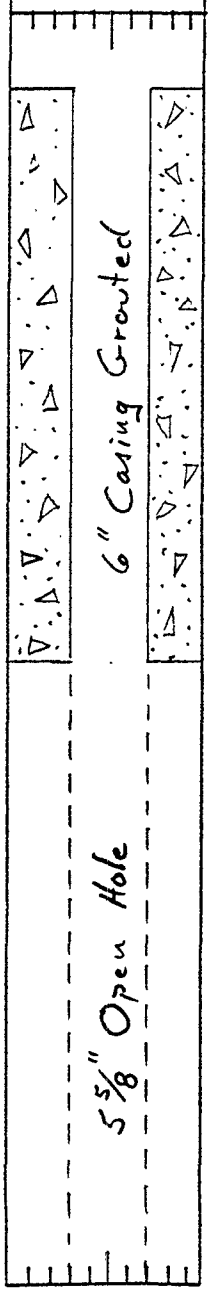
SCREEN DIA. — LENGTH — SLOT SIZE — REF. PT. ELEV.

CASING DIA. 6" ID LENGTH 60' TYPE Steel

CASING DIA. 8" ID LENGTH 30' TYPE Temp. (Removed) STICKUP 2.95'

DRILLING CO. McCay & Gould DRILLING METHOD Air Rotary GROUND ELEV.

DRILLER P. Ortz DRILL AND CONST. DATES 12/16-12/17/87 LOCK NO. 3753

DEPTH (FEET)	GRAPHIC LOG	WELL CONST.	SAMPLE NO.	LOG
0				0'-7' - Brown Silt w/ Trace Clay, Damp
10				7'-28' - Reddish Brown Clayey Silt w/ Little - Trace Rock Frags (Shale & Ls.), Damp.
20				18' - Cuttings Moist
30				28'-133' - Grey Ls. Conglomerate in Reddish Brown Shale & Siltston Matrix. Interbedded Reddish Brown Shale, Silt Stone & Sand Stone, Wet, Hard.
40				
50				
60				60' - Stopped to set & Grout 6" Casing.
70				71'-72' - Soft, Water at 71' ~ 2gpm
80				
90				
100				100'-105' - High Shale Content
				105' - 5gpm
110				109'-111' - Soft, Weathered Zone
120				120'-125' - High Shale Content
				121'-123' - Soft, Water at 123' at 7gpm

AR300818

REMCOR

DRILLING AND WELL CONSTRUCTION LOG

WELL NUMBER 87-8I Cont. WELL LOCATION

PROJECT NAME Bally Eng. Struc. PROJECT NO. 87313 GEO./ENG. P. Swallow

TOTAL DEPTH 132.8' DIA. 5 5/8" WATER LEVEL DATE/TIME

SCREEN DIA. LENGTH SLOT SIZE REF. PT. ELEV.

CASING DIA. LENGTH TYPE

CASING DIA. LENGTH TYPE STICKUP

DRILLING CO. DRILLING METHOD GROUND ELEV.

DRILLER DRILL AND CONST. DATES LOCK NO.

DEPTH (FEET)	GRAPHIC LOG	WELL CONST.	SAMPLE NO.	LOG
120		Open Hole		
130				133.' - Bottom of Hole. Developed for 50 min. Final Rate 12gpm

300819

AR300819

DRILLING AND WELL CONSTRUCTION LOG

WELL NUMBER 87-9I WELL LOCATION At End of S. 4th St.

PROJECT NAME Bally Eng. Struc. PROJECT NO. 87313 GEO./ENG. P. Swallo

TOTAL DEPTH 177.5' DIA. 5 5/8" WATER LEVEL 64.96' DATE/TIME 12/6/88 (14:2

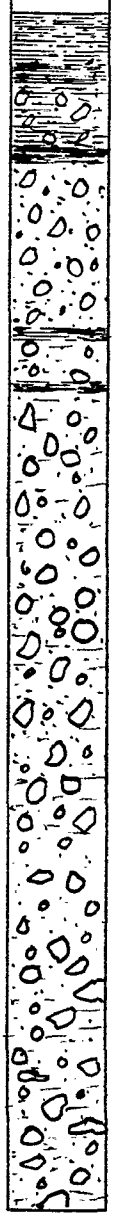
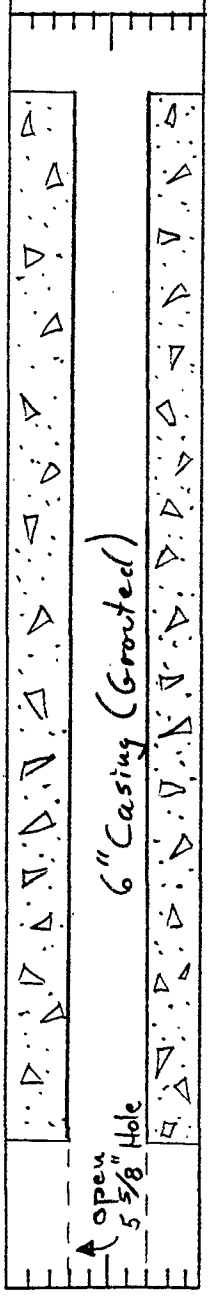
SCREEN DIA. — LENGTH — SLOT SIZE — REF. PT. ELEV.

CASING DIA. 6" ID LENGTH 100' TYPE Steel

CASING DIA. 8" ID LENGTH 10' TYPE Temp. (Removed) STICKUP 1.9'

DRILLING CO. Mckay & Gould DRILLING METHOD Air Rotary GROUND ELEV.

DRILLER P. Ortz DRILL AND CONST. DATES 11/23 - 11/25/88 LOCK NO. 3753

DEPTH (FEET)	GRAPHIC LOG	WELL CONST.	SAMPLE NO.	LOG
0				0'-4' - Brown. Silt w/ Trace Clay, Damp 4'-7' - Reddish Brown Clayey Silt w/ Little Amounts of Rock Frags (Shale & Ls.), Damp 7'-12' - Grey Ls. Conglomerate w/ Interbedded Reddish Brown Shale. → Fanglomerate. 12'-16' - Soft Zone, Clayey Silt, Damp 16'-177.5' - Grey Ls. Conglomerate w/ Matrix of Reddish Brown Shale & Siltstone Occational Interbedded Reddish Brown Shales. Hard, Dry 33'-34' - Soft, Moist 38'-39' - Soft, Moist 98' - Moist Cuttings 100' - Stop to Set & Grout 6" Casing 100'-177.5' - Cuttings Same, Wet.
10				
20				
30				
40				
50				
60				
70				
80				
90				
100				
110				
120				

000020

AR300820

REMCOR

DRILLING AND WELL CONSTRUCTION LOG

WELL NUMBER 87-9I Cont. WELL LOCATION

PROJECT NAME Bally Eng. Struc. PROJECT NO. 87313 GEO./ENG. P. Swallow

TOTAL DEPTH 177.5' DIA. WATER LEVEL DATE/TIME

SCREEN DIA. LENGTH SLOT SIZE REF. PT. ELEV.

CASING DIA. LENGTH TYPE

CASING DIA. LENGTH TYPE STICKUP

DRILLING CO. DRILLING METHOD GROUND ELEV.

DRILLER DRILL AND CONST. DATES LOCK NO.

DEPTH (FEET)	GRAPHIC LOG	WELL CONST.	SAMPLE NO.	LOG
120		5 5/8" Open Hole		- Continued Grey Ls. Conglomerate w/ Reddish Brown, shale + Siltstone Matrix → Fanglomerate Wet Cuttings, Hard.
130				
140				
150				
160				
170				
180				177.5' - Bottom of Hole. Developed for 30 Minutes. Final Rate 10gpm.

000021

AR300821

DRILLING AND WELL CONSTRUCTION LOG

WELL NUMBER 87-10I WELL LOCATION ~75' SE Intersection 4th St. + Mai

PROJECT NAME Bally Eng. Struc. PROJECT NO. 87313 GEO./ENG. P. Swallow

TOTAL DEPTH 120.9 DIA. 5 5/8" WATER LEVEL 4.01' DATE/TIME 12/6/87 (15:2

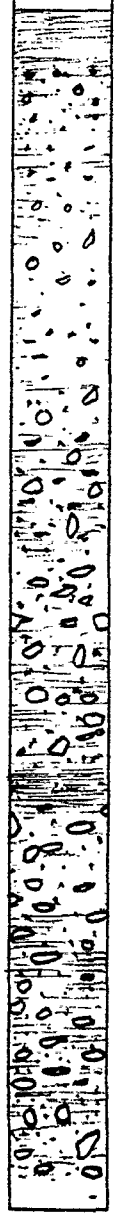
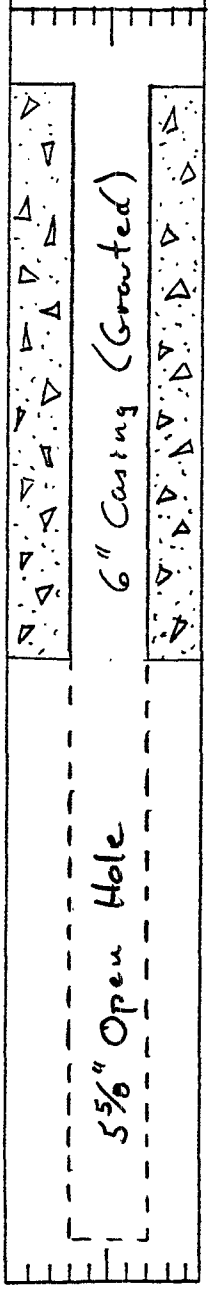
SCREEN DIA. – LENGTH – SLOT SIZE – REF. PT. ELEV.

CASING DIA. 6" ID LENGTH 60' TYPE Steel

CASING DIA. 8" ID LENGTH 30' TYPE Temp. (Removed) STICKUP 1.6'

DRILLING CO. McKay + Gould DRILLING METHOD Air Rotary GROUND ELEV.

DRILLER P. Ortz DRILL AND CONST. DATES 12/4-12/6/87 LOCK NO. 3753

DEPTH (FEET)	GRAPHIC LOG	WELL CONST.	SAMPLE NO.	LOG
0				0'-5' - Dark Brown, Silt w/ Little Clay Damp.
10				5'-10' - Dark Brown Clayey Silt + Rounded Gravel (Quartz), Wet.
20				10'-18' - Reddish Brown Clayey Silt w/ Trace of Shale Frags. Wet
30				18'-38 - Weathered Reddish Brown Shale + Grey Ls. → Fanglomerate 38' 5gpm
40				38'-121' - Grey Limestone Conglomerate in a Reddish Brown Shale Matrix w/ Some Interbedded Reddish Brown Shale, Siltstone, + Sandstone. Moderatly Hard
50				45' - 15gpm
60				60' - 30gpm. Stopped to Set and Grout 6" Casing.
70				60'-62' - Dry
80				62'-66' - Damp to Worst Cuttings
90				68' - 1gpm
100				75' - 4gpm
110				80'-83' - Soft Zone, Sudden Increase to 60gpm
120				90' - 75gpm
				100' - 150 gpm
				106' - 225gpm
				120.9' - Bottom of Hole, Developed 5min, 250gpm

AR300822

REMCOR

DRILLING AND WELL CONSTRUCTION LOG

WELL NUMBER 87-10D WELL LOCATION ~100' SE. Intersection 4th St. + Main

PROJECT NAME Bally Eng. Struc. PROJECT NO. 87313 GEO./ENG. P. Swallow

TOTAL DEPTH 211.0 DIA. 5 5/8" WATER LEVEL 4.10' DATE/TIME 12/8/87 (13:

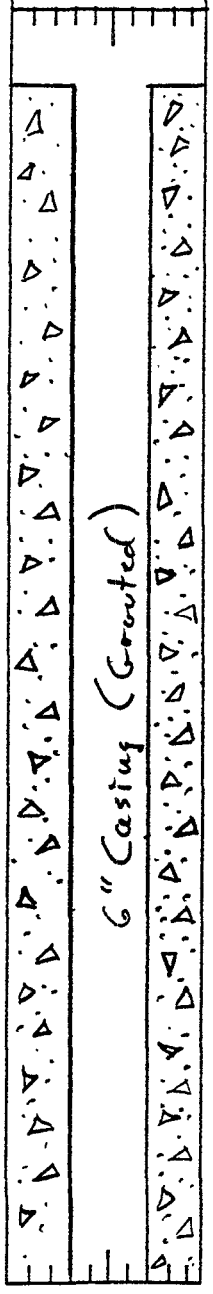
SCREEN DIA. - LENGTH - SLOT SIZE - REF. PT. ELEV.

CASING DIA. 6" ID LENGTH 150' TYPE Steel

CASING DIA. 8" ID LENGTH 30' TYPE Temp. (Removed) STICKUP 1.4'

DRILLING CO. McKay + Gould DRILLING METHOD Air Rotary GROUND ELEV.

DRILLER P. Ortz DRILL AND CONST. DATES 12/2 - 12/4/87 LOCK NO. 3753

DEPTH (FEET)	GRAPHIC LOG	WELL CONST.	SAMPLE NO.	LOG
0				0 - 3½' - Dark Brown, Silt w/ Little Clay Damp
10				3½' - 9' - Dark Brown, Silt w/ Little Clay + Little Rounded Cobble + Gravel (Quartzite, Gneiss), Wet.
20				9' - 21½' - Reddish Brown Clayey Silt w/ Trace of Angular Shale Frags. Wet.
30				21½' - 40' - Weathered Reddish Brown Shale + Grey Limestone → Fanglomerate. Water at 3gpm
40				40' - 211' - Grey Limestone Conglomerate in a Reddish Brown Shale Matrix w/ Some Interbedded Reddish Brown Shale, Siltstone + Sandstone. Hard, Water at 5gpm.
50				50' - 15gpm
60				65' - 35 gpm
70				75' - 45 gpm
80				92' - 50 gpm
90				
100				
110				
120				123' - 60 gpm

6" Casing (Grouted)

000083

DRILLING AND WELL CONSTRUCTION LOG

WELL NUMBER 87-10D Cont. WELL LOCATION

PROJECT NAME Ba - Eng. Struc. PROJECT NO. 87313 GEO./ENG. P. Swalla

TOTAL DEPTH 211.0' DIA. 5 5/8" WATER LEVEL DATE/TIME

SCREEN DIA. LENGTH SLOT SIZE REF. PT. ELEV.

CASING DIA. LENGTH TYPE

CASING DIA. LENGTH TYPE STICKUP

DRILLING CO. DRILLING METHOD GROUND ELEV.

DRILLER DRILL AND CONST. DATES LOCK NO.

DEPTH (FEET)	GRAPHIC LOG	WELL CONST.	SAMPLE NO.	LOG
120		6" Casing; 5 5/8" Open Hole		- Continued Fanglomerate & Interbedded Shale, Siltstone, & Sandstone Hard.
130				
140				139' - 75gpm
150				150' - 86 gpm. Stopped to set & Grout 6" Casing.
160				
170				169' - Less than 1gpm
180				174' - 2gpm
190				190' - 5gpm
200				203' - 10gpm
210				211' - Bottom of Hole, Developed For 10min. Final Rate 12gpm.
220				

300824

AR300824

REMCOR

DRILLING AND WELL CONSTRUCTION LOG

WELL NUMBER 87-115 WELL LOCATION ~50' NW of Walnut St. 100' NE of Zinc

PROJECT NAME Bally Eng. Struc. PROJECT NO. 87313 GEO./ENG. P. Swallow

TOTAL DEPTH 41.7' DIA. 5 5/8" WATER LEVEL 15.76' DATE/TIME 12/16/87 (10:4

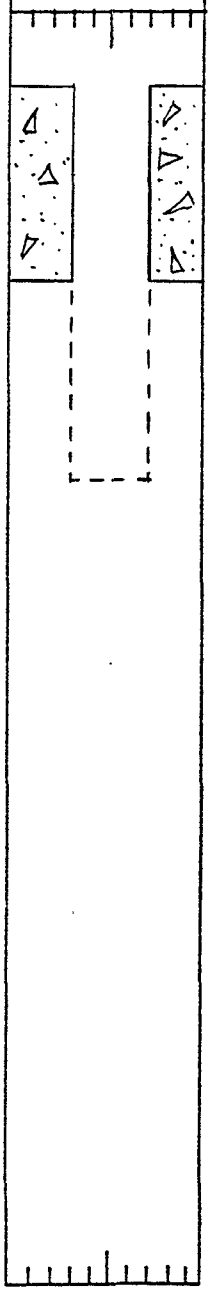
SCREEN DIA. — LENGTH — SLOT SIZE — REF. PT. ELEV.

CASING DIA. 6" ID LENGTH 20' TYPE Steel

CASING DIA. 8" ID LENGTH 20' TYPE Temp. (Removed) STICKUP 1.9

DRILLING CO. McKay & Gould DRILLING METHOD Air Rotary GROUND ELEV.

DRILLER P. Ortz DRILL AND CONST. DATES 12/8 - 12/9/87 LOCK NO. 3753

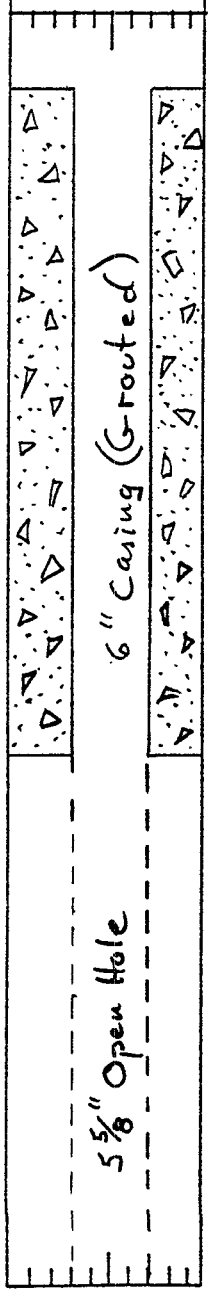
DEPTH (FEET)	GRAPHIC LOG	WELL CONST.	SAMPLE NO.	LOG
0				0'-7½' - Brown to Reddish Brown, Clayey Silt, Trace Gravel (Quartz + Shale)
10				7½'-42' - Grey Limestone Conglomerate in Reddish Brown Shale Matrix, Little Interbedded Reddish Brown Shale + Siltstone, Hard, Dry → Fanglomerate
20				13'-15' - Soft, Damp, Weathered Zone
30				20' - Stop to Set + Grout 6" Casing
40				25' - 8gpm of Water During Drilling
50				28'-32' - Soft
				32' - 15gpm
				41.7' - Bottom of Hole, Developed for 10 min. Final Rate 20gpm

800825

AR300825

DRILLING AND WELL CONSTRUCTION LOG

WELL NUMBER 87-11I WELL LOCATION ~25' NW of Walnut St, 100' NE of 2nd. S
PROJECT NAME Bully Eng. Struc. PROJECT NO. 87313 GEO./ENG. P. Swallow
TOTAL DEPTH 132.7' DIA. 5 5/8" WATER LEVEL 16.44' DATE/TIME 12/8/78 (15:
SCREEN DIA. – LENGTH – SLOT SIZE – REF. PT. ELEV.
CASING DIA. 6" ID LENGTH 70' TYPE Steel
CASING DIA. 8" ID LENGTH 10' TYPE Temp. (Removed) STICKUP 1.9'
DRILLING CO. Mckay + Gould DRILLING METHOD Air Rotary GROUND ELEV.
DRILLER P. Ortz DRILL AND CONST. DATES 12/7 - 12/8/87 LOCK NO. 3753

DEPTH (FEET)	GRAPHIC LOG	WELL CONST.	SAMPLE NO.	LOG
0				0'-8½' - Brown, Clayey Silt, Damp, Trace of Angular Gravel (Quartz + Gneiss)
10				8½'-133' - Grey Limestone Conglomerate in Reddish Brown Shale Matrix, Hard, Dry, Little Interbedded Reddish Brown Shale + Siltstone → Fanglomerate
20				12' - Moist Cuttings
30				16½'-17' - Soft Zone, Same but Broken + Wthd
40				17' - Cuttings Wet
50				23' - Hole Making 1gpm
60				23-24½' - Broken + Soft
70				28' - 3gpm
80				29'-30' - Soft, Hole Making 8gpm
90				36' - 22gpm
100				41'-43' - Soft, 35gpm
110				55' - 35gpm
120				60'-61' - Soft, At 62' 75gpm
				70' - Stop to Set 6" Casing + Grout, 75gpm
				83' - 5½ gpm
				90' - 10 gpm
				107' - 8gpm
				110'-117' - Very Broken. Rate Jumps Dramatically
				118' - Almost 300gpm

REXCOR

DRILLING AND WELL CONSTRUCTION LOG

WELL NUMBER 87-11I Cont. WELL LOCATION

PROJECT NAME Bally Eng. Struc. PROJECT NO. 87313 GEO./ENG. P. Swallow

TOTAL DEPTH 132.7' DIA. 5 5/8" WATER LEVEL DATE/TIME

SCREEN DIA. LENGTH SLOT SIZE REF. PT. ELEV.

CASING DIA. LENGTH TYPE

CASING DIA. LENGTH TYPE STICKUP

DRILLING CO. DRILLING METHOD GROUND ELEV.

DRILLER DRILL AND CONST. DATES LOCK NO.

DEPTH (FEET)	GRAPHIC LOG	WELL CONST.	SAMPLE NO.	LOG
120		5 5/8" Open		
130				133' -Bottom of Hole. Developed for 5 min. Final Rate Approx. 300gpm
140				

300827

AR300827

RETAGOR

DRILLING AND WELL CONSTRUCTION LOG

WELL NUMBER 87-12D WELL LOCATION Approx 200' NW. of BES

PROJECT NAME Bally Eng. Struc. PROJECT NO. 87313 GEO./ENG. P. Swallo

TOTAL DEPTH 203.3 DIA. 5 5/8" WATER LEVEL ~20' DATE/TIME 11/21 (13:

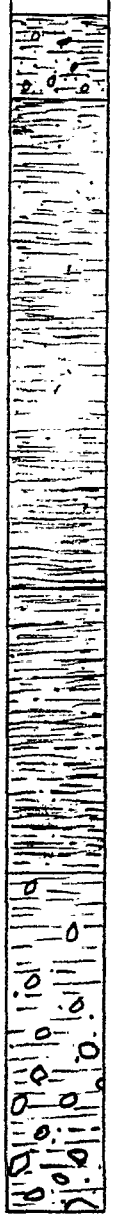
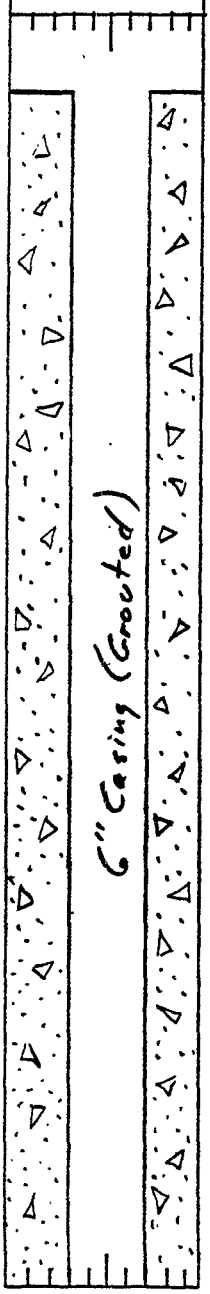
SCREEN DIA. – LENGTH – SLOT SIZE – REF. PT. ELEV.

CASING DIA. 8" ID LENGTH 60' TYPE Temp. (Removed)

CASING DIA. 6" ID LENGTH 163' TYPE Steel STICKUP 0.8'

DRILLING CO. Mckay + Gould DRILLING METHOD Air Rotary GROUND ELEV.

DRILLER P. Ortz DRILL AND CONST. DATES 11/21 - 11/23/87 LOCK NO. 3753

DEPTH (FEET)	GRAPHIC LOG	WELL CONST.	SAMPLE NO.	LOG
0				0'-8' - Brown, Clayey Silt w/ Trace of Rounded Gravel (Gneiss, Quartz
10				8'-60' - Reddish Brown Clayey Silts + Silty Clays w/ Trace of Shale Frags. Shale Frags. become more frequent with increasing depth.
20				
30				12' - Cuttings Moist
40				
50				
60				59' - 5gpm of Water from Hole
				60'-90' - Reddish Brown Shales + Silt Stones. No Limestone Frags. → Shales, Siltstone, + Weathered Ls. Conglomerate (Ls. has been dissolved)
70				
80				
90				78' - Harder, 20gpm.
				90'-203' - Grey Limestone Conglomerate w/ Interbedded Reddish Brown Shales. Hardness + Ls. Content Increasing w/ Increasing Depth.
100				
110				98' - 25gpm
120				

AR300828

REMCOR

DRILLING AND WELL CONSTRUCTION LOG

WELL NUMBER 87-12D Cont. WELL LOCATION

PROJECT NAME Bally Eng. Struc. PROJECT NO. 87313 GEO./ENG. P. Swallow

TOTAL DEPTH DIA. WATER LEVEL DATE/TIME

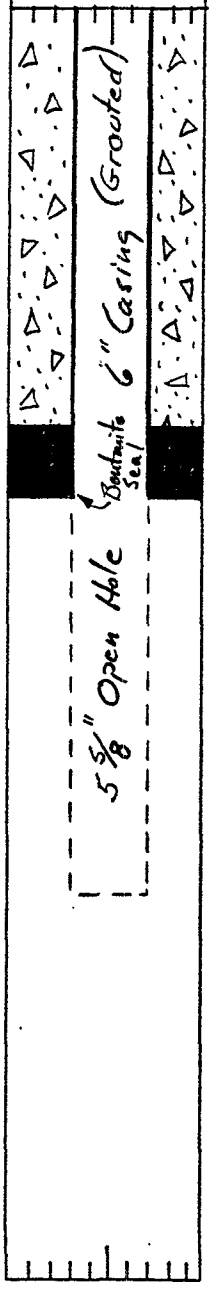
SCREEN DIA. LENGTH SLOT SIZE REF. PT. ELEV.

CASING DIA. LENGTH TYPE

CASING DIA. LENGTH TYPE STICKUP

DRILLING CO. DRILLING METHOD GROUND ELEV.

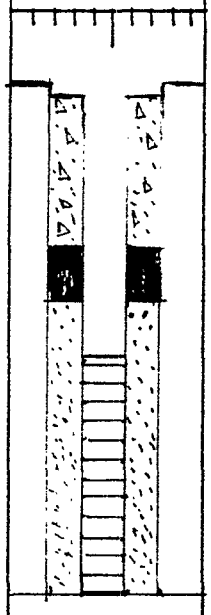
DRILLER DRILL AND CONST. DATES LOCK NO.

DEPTH (FEET)	GRAPHIC LOG	WELL CONST.	SAMPLE NO.	LOG
120				121'-123' - Soft
130				125' - 40gpm
140				
150				145' - 60gpm
160				162'-163' - Soft, Rate Jumps From 60-150gpm
170				163' - Stop to Set + Grout 6" Casing.
180				170' - 100gpm. Cuttings are 40% Ls. + 60% Shale + Siltstone.
190				
200				
210				205' - Bottom of Hole, Developed 10min. Final Rate 100-150 gpm.
220				
230				
240				

AR300829

DRILLING AND WELL CONSTRUCTION LOG

WELL NUMBER 87-13S
WELL LOCATION INSIDE CARPENTRY SHOP
PROJECT NAME Baily
PROJECT NO. 87313
GEO./ENG. JGK
TOTAL DEPTH 21.5'
DIA. 2" PVC
WATER LEVEL
DATE/TIME
SCREEN DIA. 2"
LENGTH 10'
SLOT SIZE 0.010"
REF. PT. ELEV.
CASING DIA. 2"
LENGTH 11.0'
TYPE Stainless Steel
CASING DIA.
LENGTH
TYPE
STICKUP 0.0'
DRILLING CO. EMPIRE
DRILLING METHOD H.S. AUGER
GROUND ELEV.
DRILLER
DRILL AND CONST. DATES 1-5/6-88
LOCK NO.

DEPTH (FEET)	GRAPHIC LOG	WELL CONST.	SAMPLE NO.	LOG	
0					
				BROWN CLAYEY SILT AND ROCK FILL (CONCRETE AND SUBBASE UPPER 1.0') DAMP	0
				MEDIUM STIFF BROWN SILT, SOME CLAY, TRACE SAND, LITTLE ROCK FRAGS	3.25
				MEDIUM STIFF TO STIFF BROWN SILT LITTLE CLAY, TRACE SHALE ROCK FRAGS, DAMP TO 12.0', WET THEREAFTER	5.0
10					10
20					20
21.5				T.D. = 21.5' AUGER REFUSAL	21.5

87-13S INSTALLED IN TEST BORING SS-12
See BORING LOG FOR SS-12 FOR SAMPLE INFORMATION.

ANNULUS:
0-6.50' CEMENT/BENTONITE GROUT
6.5-8.75' BENTONITE PELLETS
8.75'-21.5' MEDIUM GRAINED SAND

AR300831

APPENDIX E

CONTINUOUS RECORDER WATER LEVEL TRACES

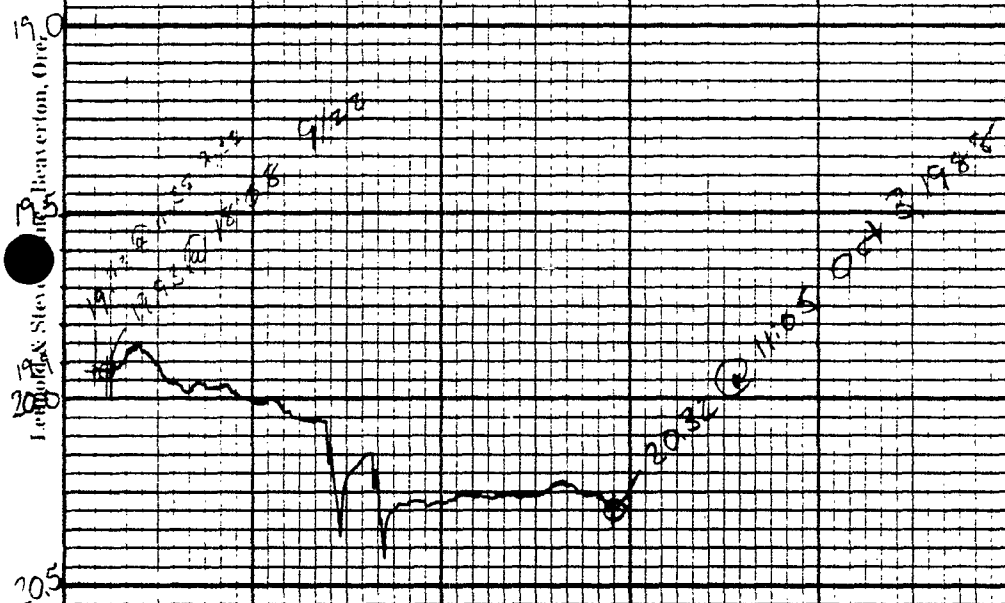
"REALISTIC SOLUTIONS FOR HAZARDOUS WASTE PROBLEMS"

REMCOR

Project Bally / Dugan — 32 - Day Clock

Monitoring Well 26-37D — 1:5

On	Off
Water Level -	Water Level -
Date - 9/24/88	Date -
Time - 11:55	Time -
Observer PVS	Observer -



Leeds, Northrup & Stevens, Inc. Beaverton, Ore.

Project Dagan / Teuli 4 - Day Clock 1.5

Monitoring Well 56-3D

On:

Water Level - 16.25

Date - 10/3/82

Time - 11:45

Observer - DVS, MM 4 14

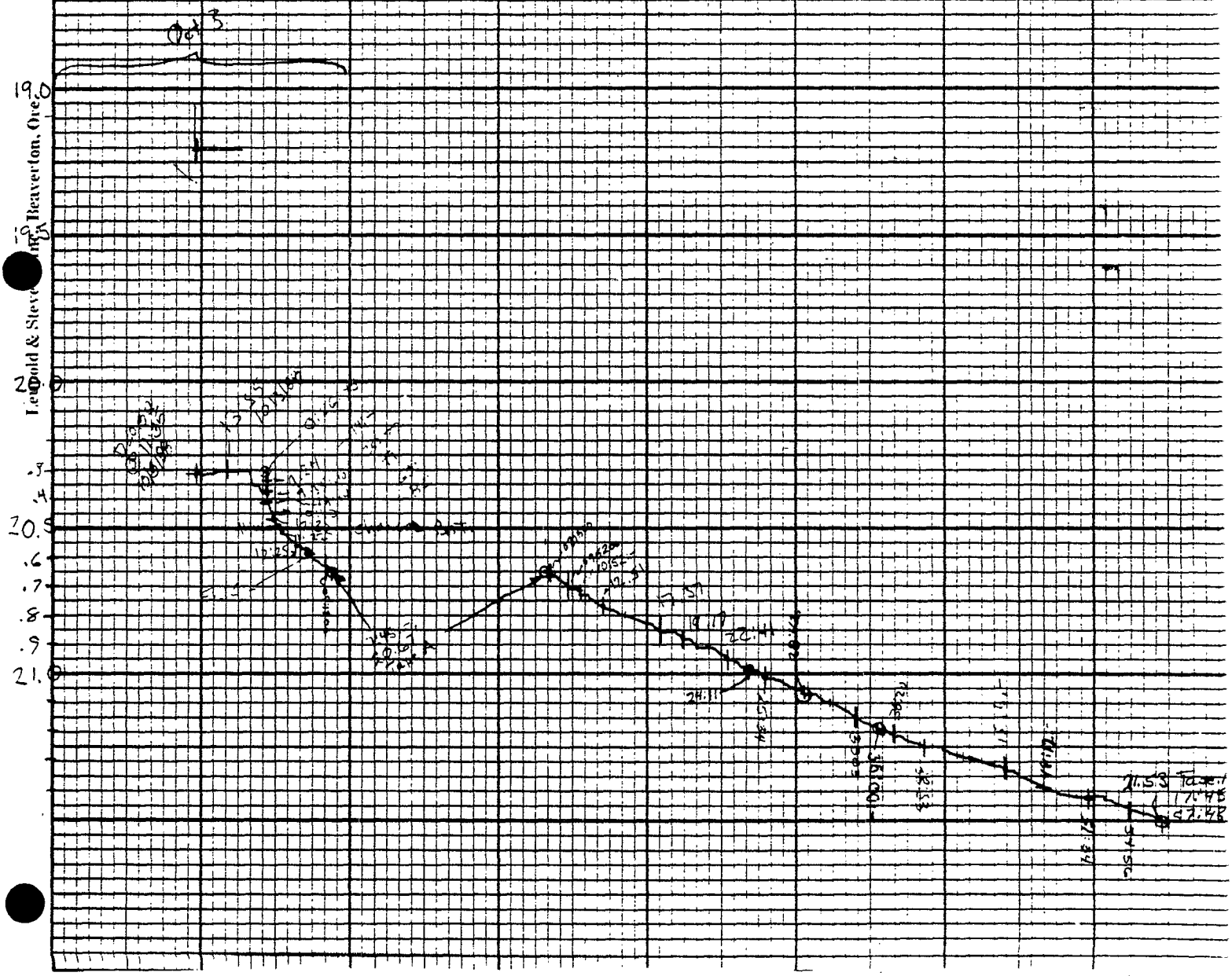
Off

Water Level -

Date -

Time -

Observer -

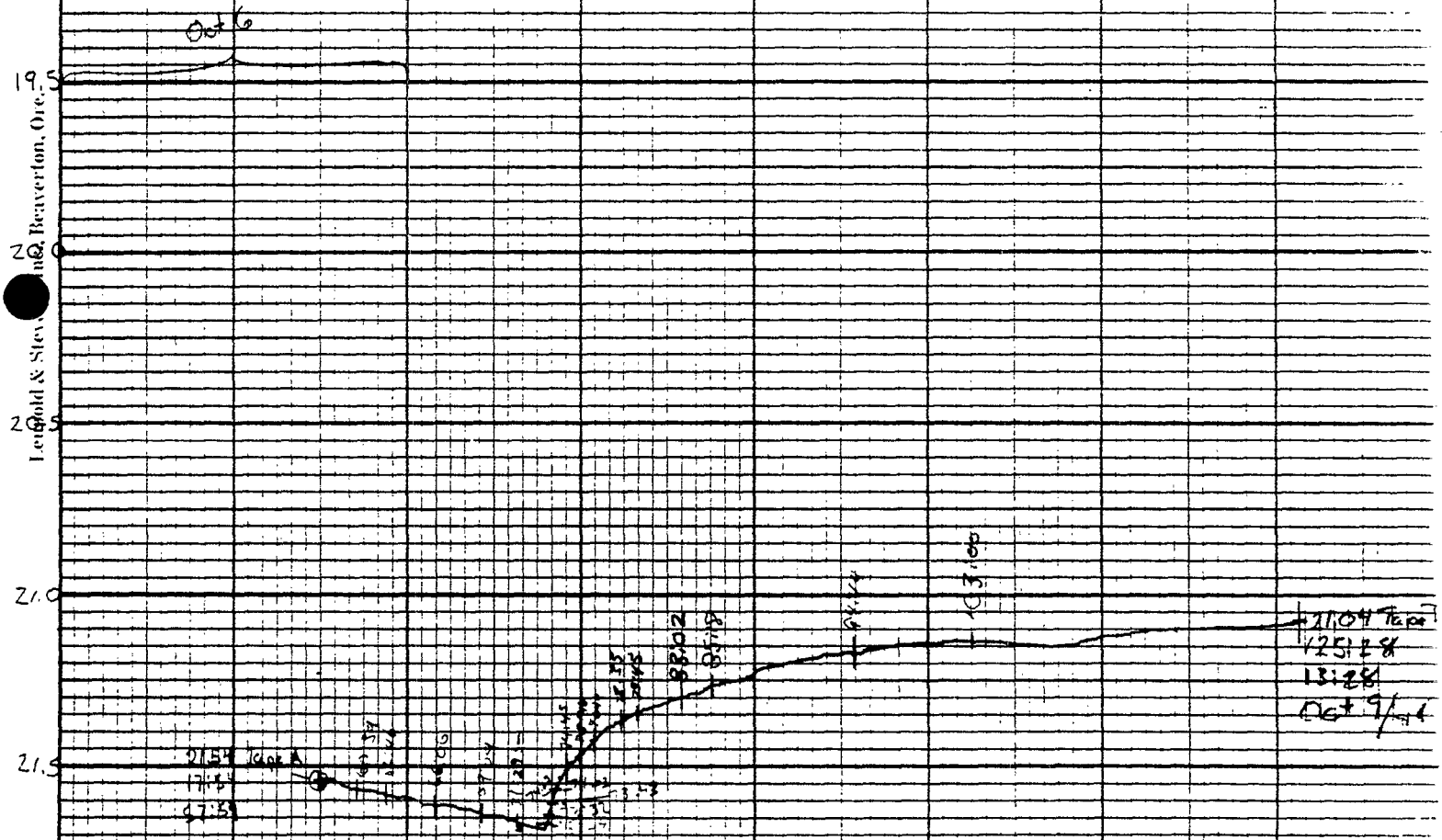


AR300834

Project Dugan/Baltig 4 - Day Clock.

Monitoring Well 86-3D

On	Off
Water Level -	Water Level -
Date - 10/6/88	Date -
Time -	Time -
Observer - PVS	Observer -



Leupold & Stevens, Inc. Beaverton, Ore.

Project Rally / Degner — 16 - Day Clock

Monitoring Well Planet Well

On

~~Water Level~~ - 7.5

Date - 8/24/88 Near Batteries

Time - 11:45 am

Observer - PVS

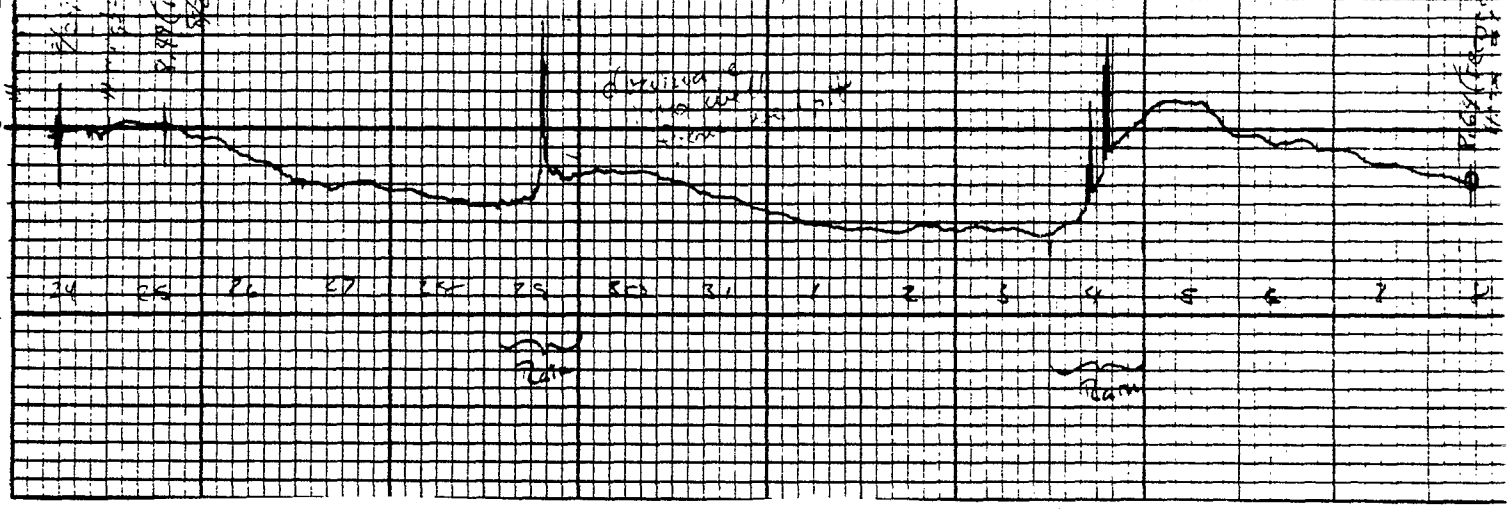
Off

~~Water Level~~ - 8.64

Date - 8/25

Time - 11:20

Observer - PVS



Rockfield & Stevens, Inc. Beaverton, Oregon

Project Brally Design Pump Test 18 - Day Clock

Monitoring Well Plant Well

On

Water Level - 8.60' Top of wood stick

Date - 9/8/88

Time - 11:25

Observer - PVS

Off

Water Level - 3.93

Date - 9/21/88

Time - 8:12 am

Observer - PVS

Leupold & Stevens, Inc. Beaverton, Ore.

Project Bally / Dagan 16 Day Clock 1.5 Vert

Monitoring Well Pilot Well

On

Water Level -

Date - 9/22/88

Time - 17:50

Observer - PVS

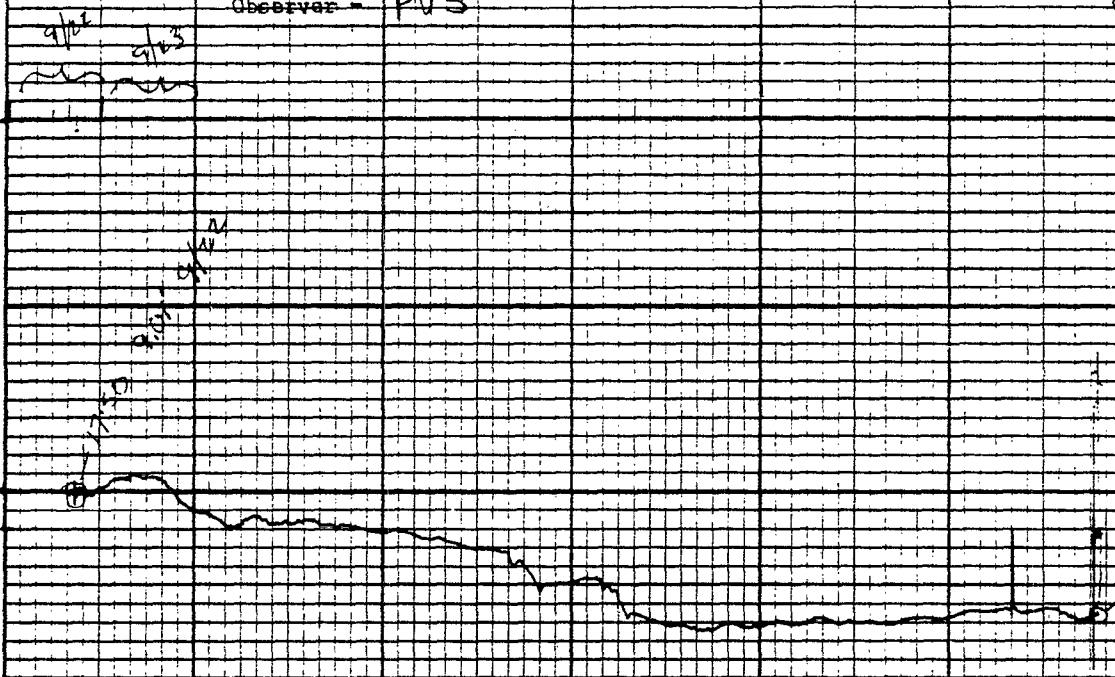
Off

Water Level -

Date -

Time -

Observer -



Leupold & Stevens, Inc. Beaverton, Ore.

Project Dequa / Bally — 4 - Day Clock 1:50

Monitoring Well 87-41

On

Water Level -

Date - 10/3/88

Time -

Observer - PVS / MLR

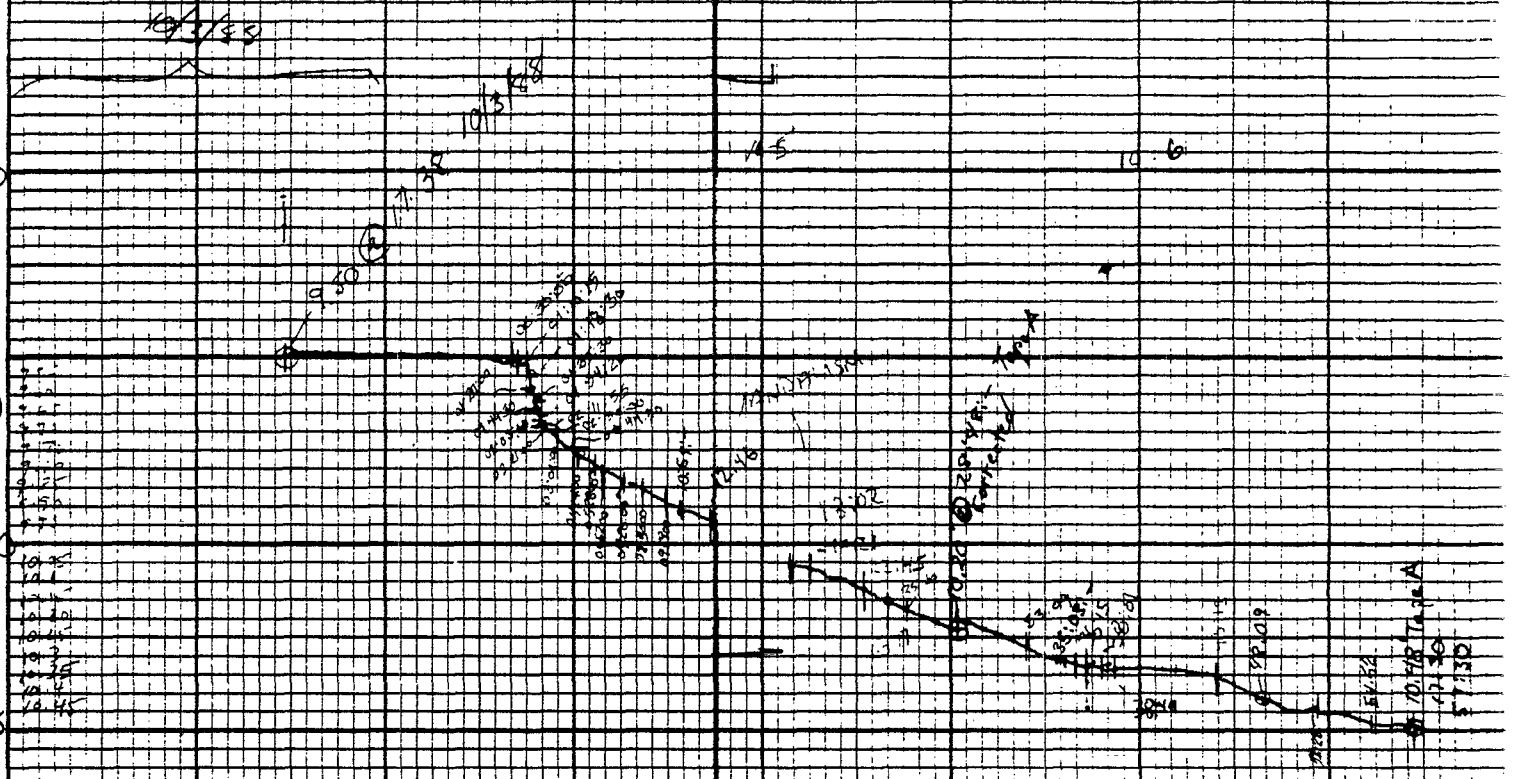
Off

Water Level -

Date -

Time -

Observer -



Leupold & Stevens, Inc. Beaverton, Ore.

Project Dogan / Baily — 4 - Day Clock 1.5

Monitoring Well 87-4T

On

Water Level -

Date - Oct 6 1993

Time -

Observer - PVS MLK

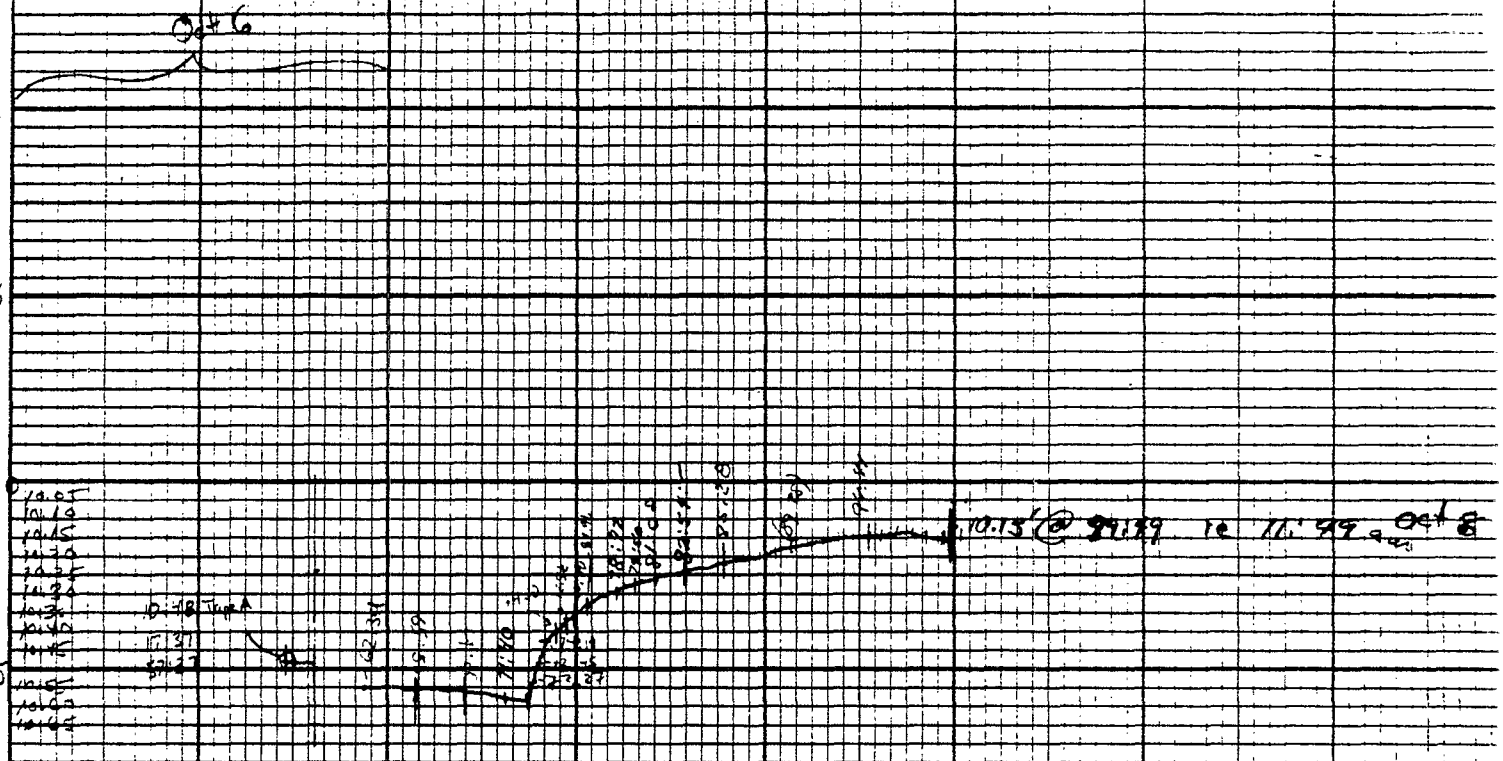
Off

Water Level -

Date -

Time -

Observer -



Leupold & Stevens, Inc. Beaverton, Oreg.

Project Bally/Dagsau

Monitoring Well 86-5D

16 - Day Clock

On

~~Water Level~~ - 23.8

Date - 9/26/88

Time - 16:20

Observer - PUS

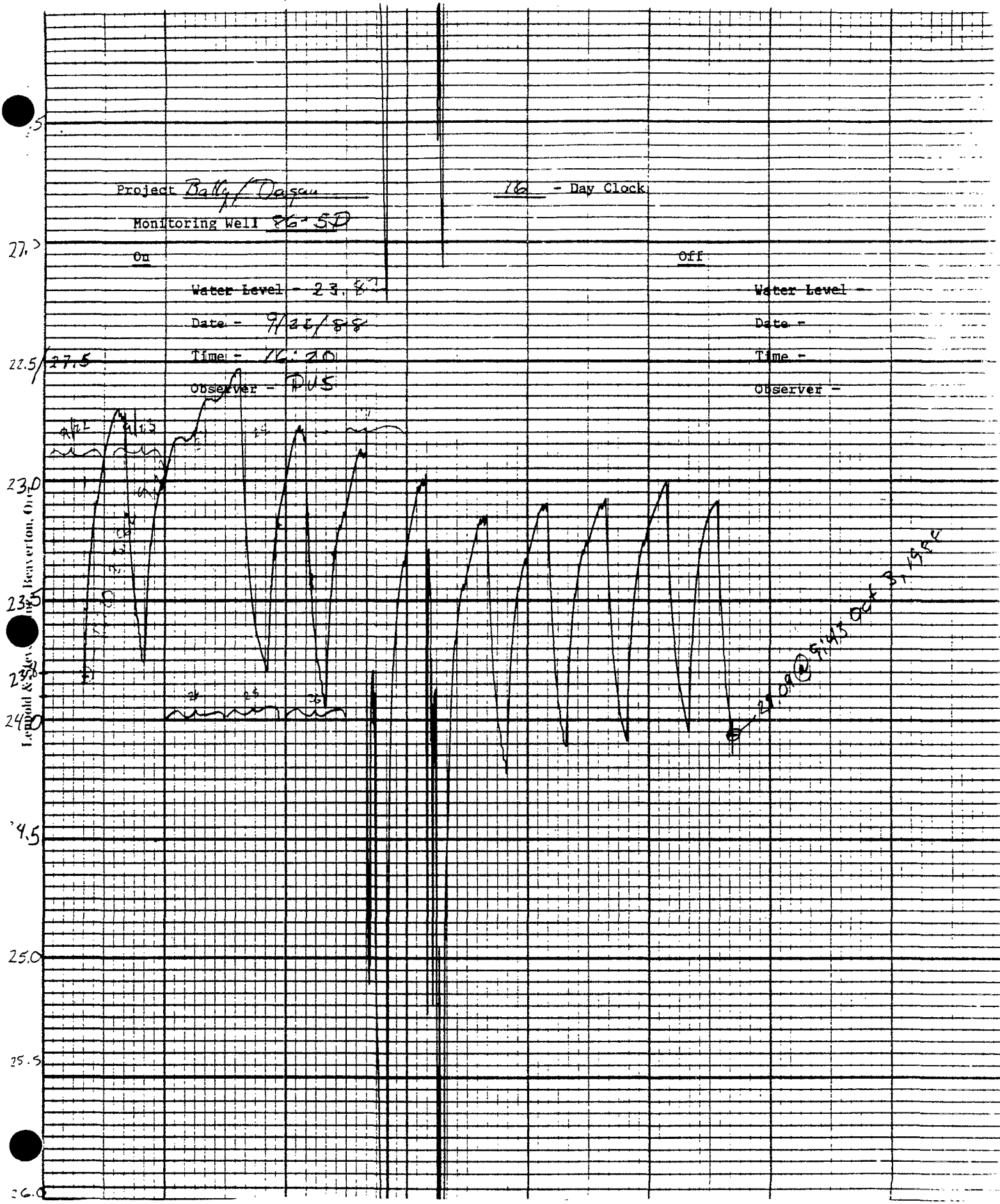
Off

~~Water Level~~ -

Date -

Time -

Observer -

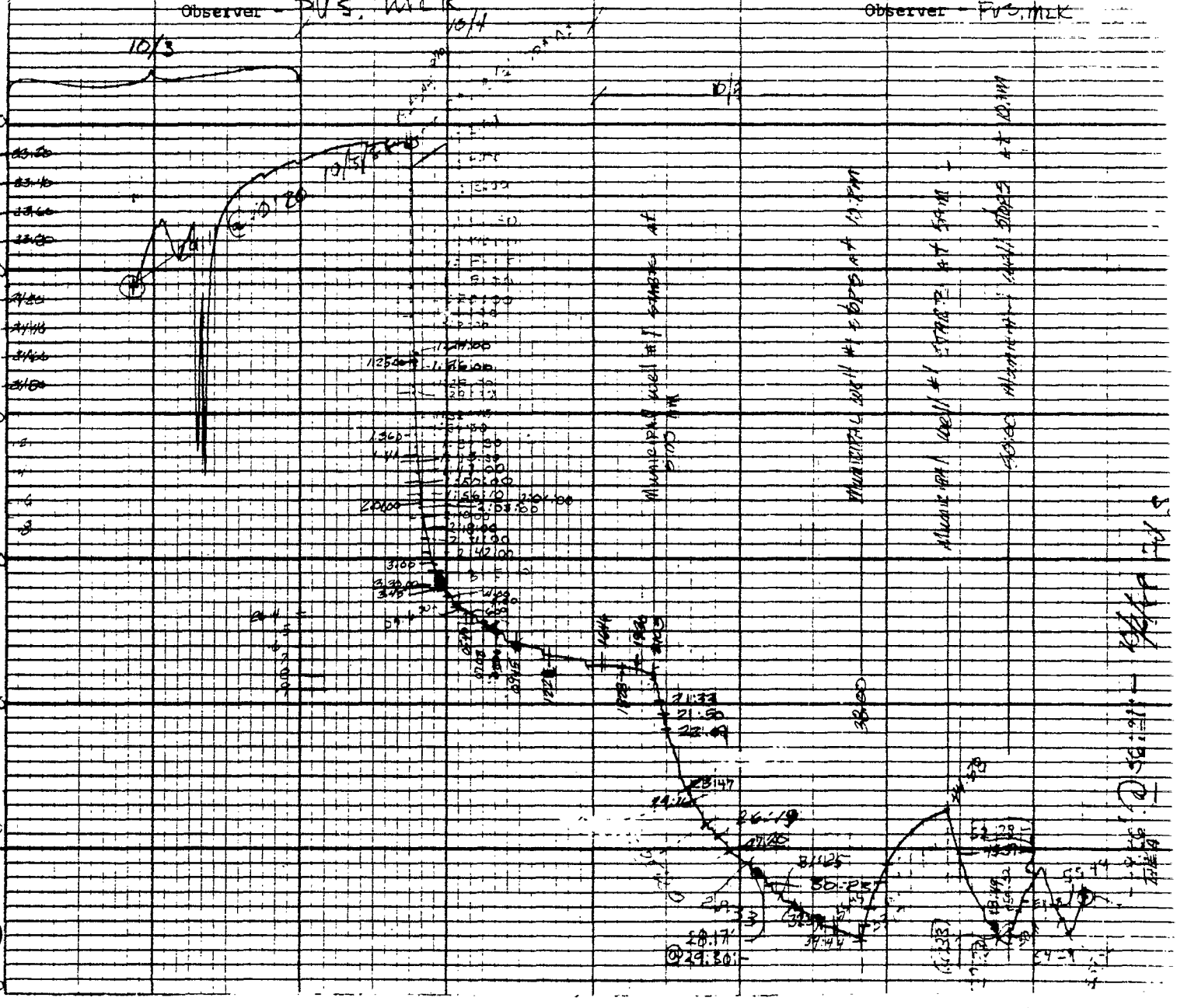


Leupold & Stevens, Inc. Beaverton, Oregon

Project Dagar / Batty — 4 - Day Clock — Vert. 1:10

Monitoring Well 86-5D

On	Off
Water Level - 29.11	Water Level - 13.32
Date - Oct. 3, 1988	Date - 10/3
Time - 10:20	Time - 56:21
Observer - PVS, WLK	Observer - PVS, WLK



AR300842

Project Dagan/Bailey — 4 — Day Clock Vert 1:10

Monitoring Well 86-50

On

Water Level -

Date - 10/6/86

Time -

Observer - PVS, WLK

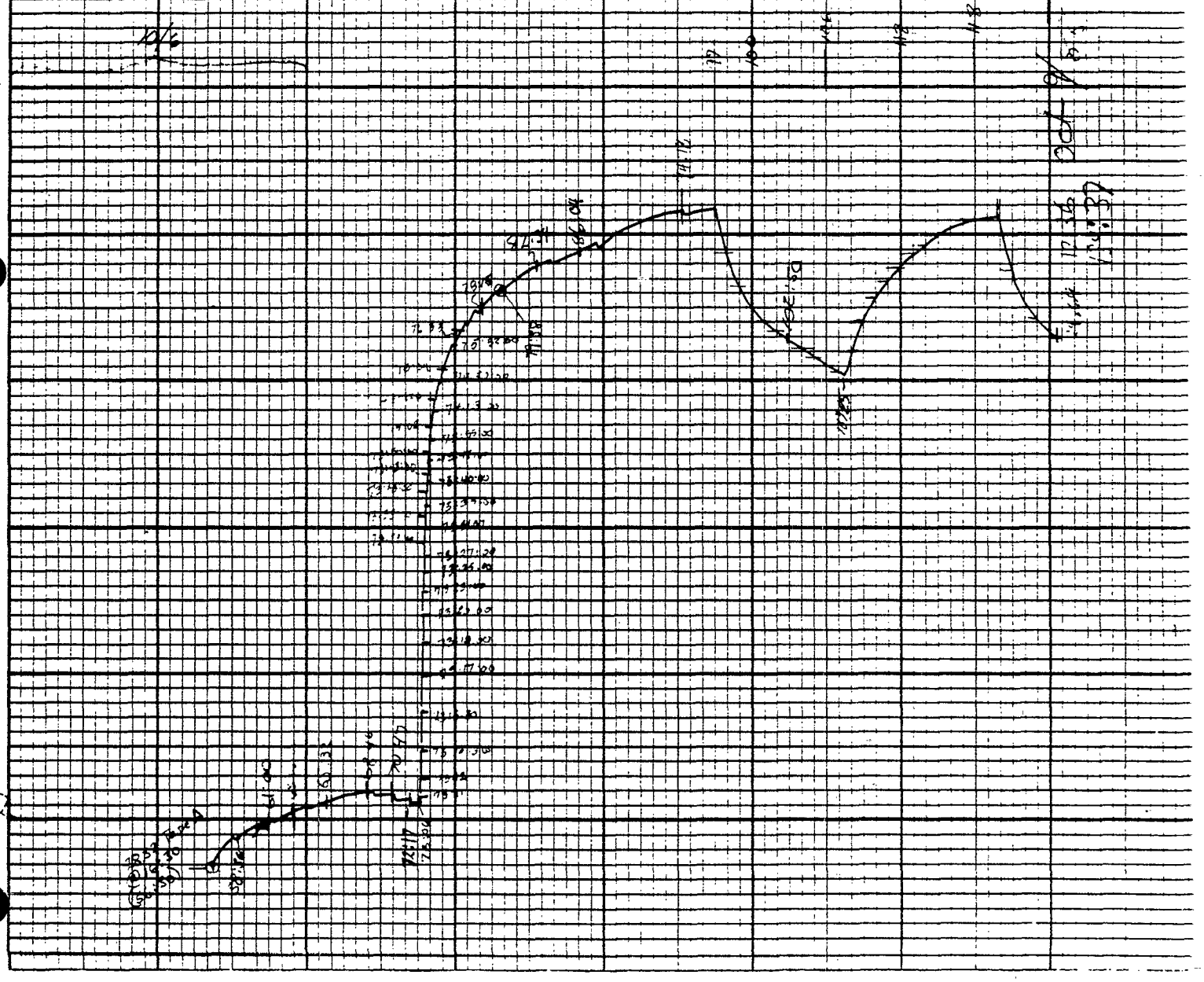
Off

Water Level -

Date -

Time -

Observer -



Leupold & Stevens, Inc. Beaverton, Oregon

Project Bally Design

Monitoring Well 87-77

Hg - Day Clock

On

Water Level - 7.02

Date - 9/8/88

Time - 12:37

Observer - PVS

Off

Water Level 22.[illegible]

Date - 9/21/88

Time - 7:30

Observer - PVS

Rowland & Stevens, Inc. Beaverton, Ore.

Project Salt Dagon 2 - Day Clock

Monitoring Well 77-7I

On

Water Level - 22.85

Date - 9/21/88

Time - 7:39

Observer - PVS

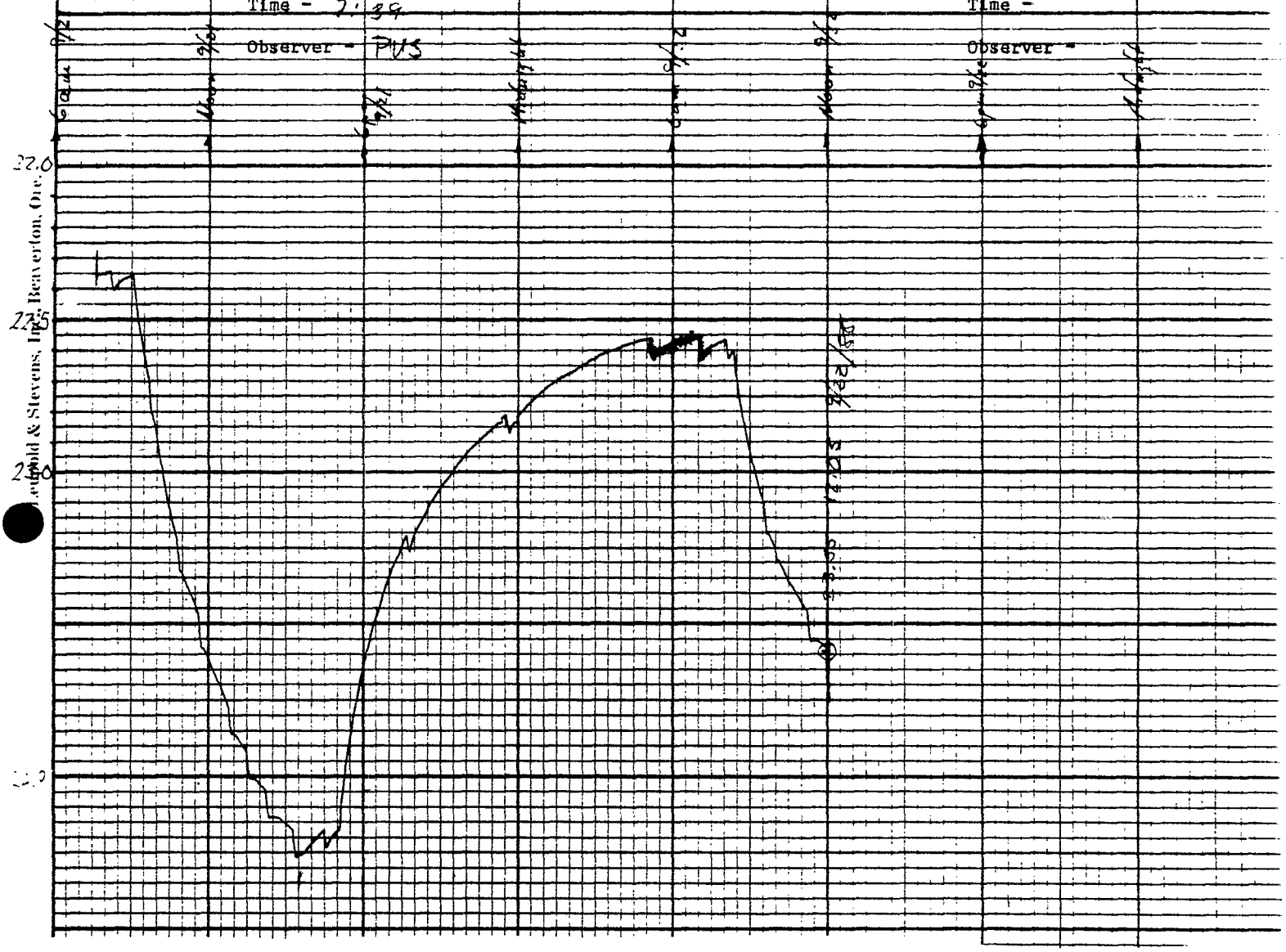
Off

Water Level -

Date -

Time -

Observer -



Leupold & Stevens, Inc. Beaverton, Ore.

Project Bally / Dagan 37 - Day Clock 115, ver 1

Monitoring Well 87-7I

On

Water Level -

Date - 9/7/

Time - 19:55

Observer - PWS

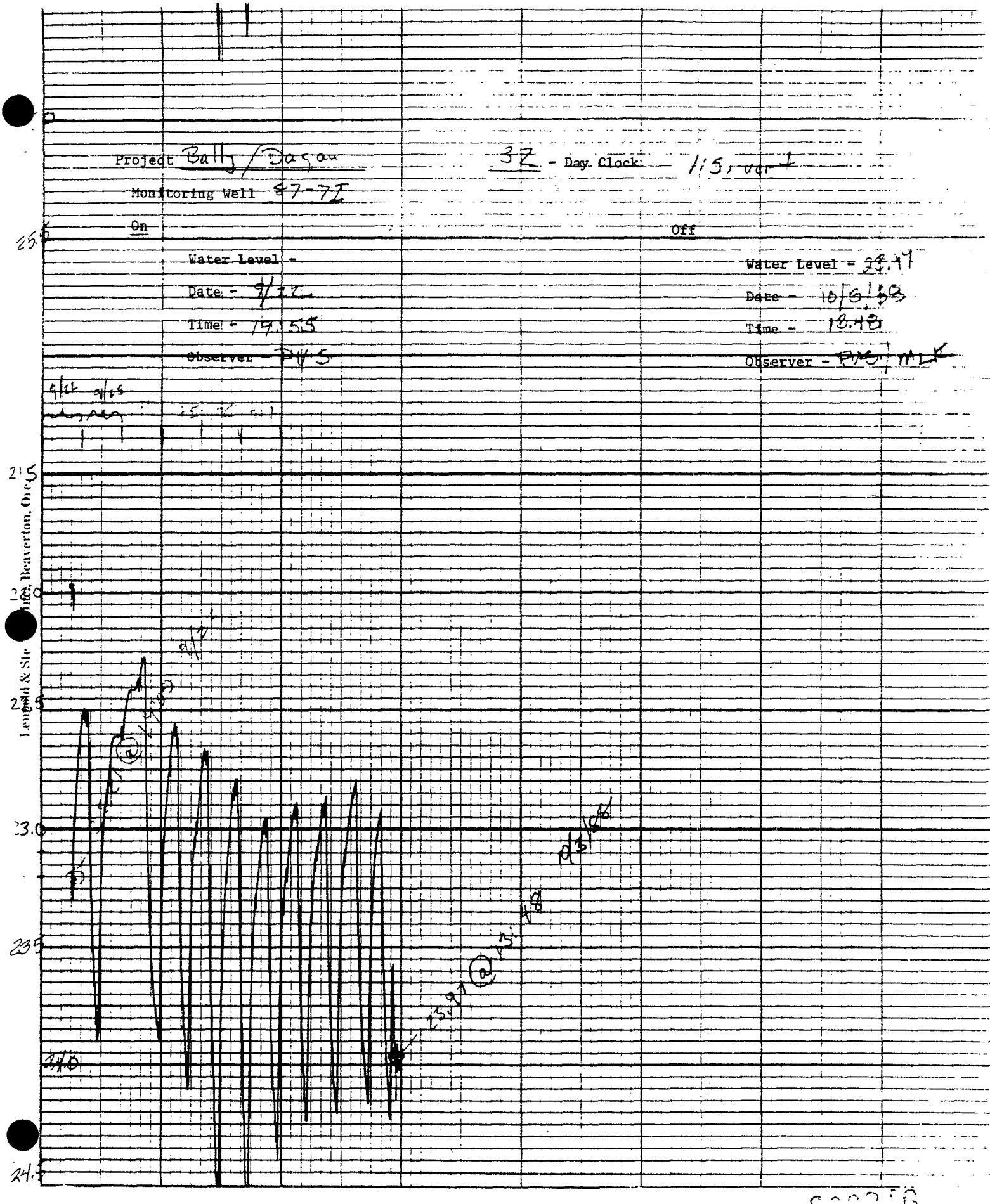
Off

Water Level - 28.17

Date - 10/6/88

Time - 18:40

Observer - PWS / MLK



Langdell & Sle Inc. Beaverton, Ore.

Project Dagan / Bally

Monitoring Well 87 - 7I

On

~~Water Level~~ -

Date - 10/3/88

Time -

Observer - PVS, MLK

4 - Day Clock

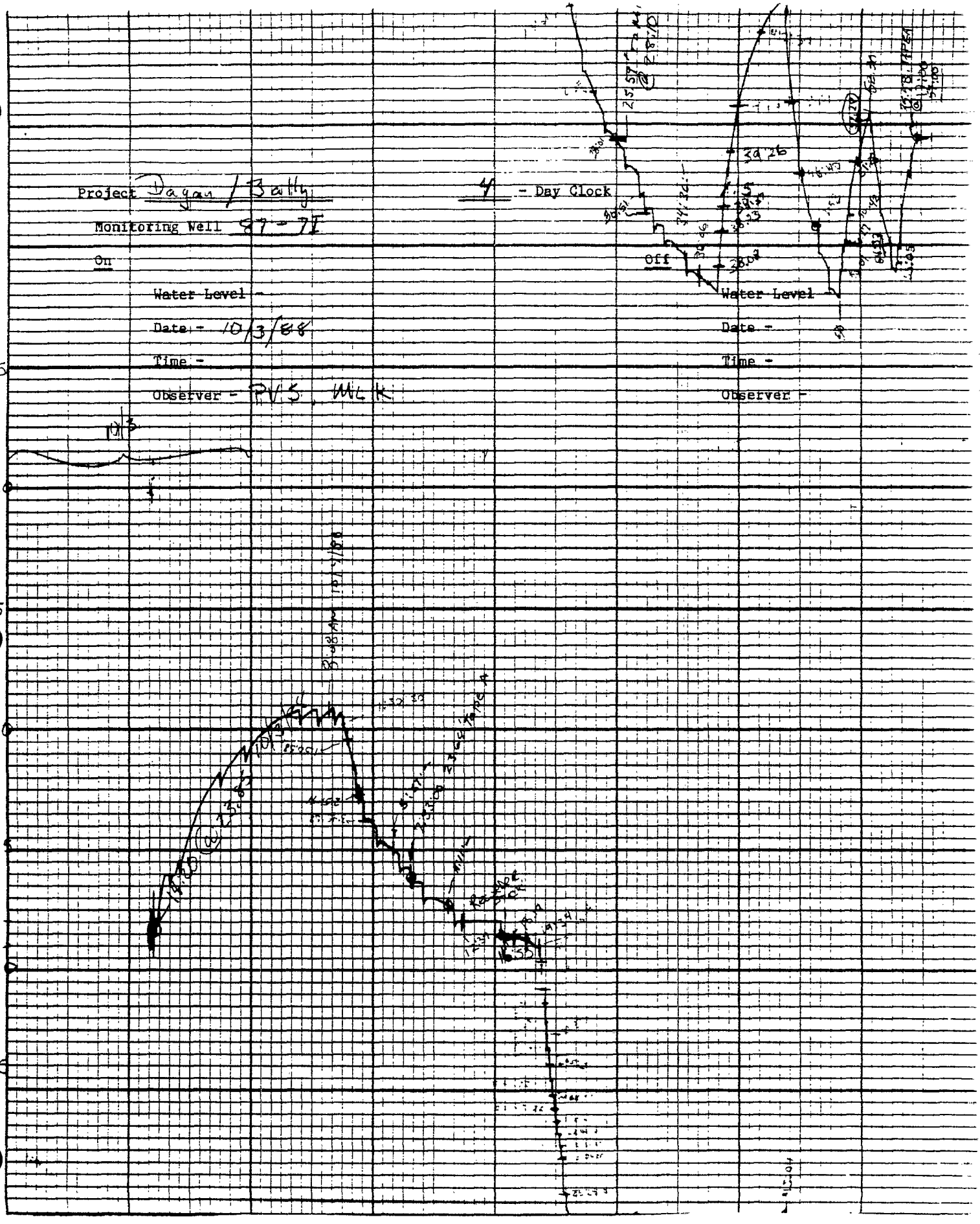
Off

~~Water Level~~ -

Date -

Time -

Observer -



Leupold & Stevens, Inc. Beaverton, Ore.

Project Dagan / Bally 4 - Day Clock 1:5

Monitoring Well 87-7I

On

Water Level -

Date - Oct. 6, 1988

Time -

Observer - PVS, MLK

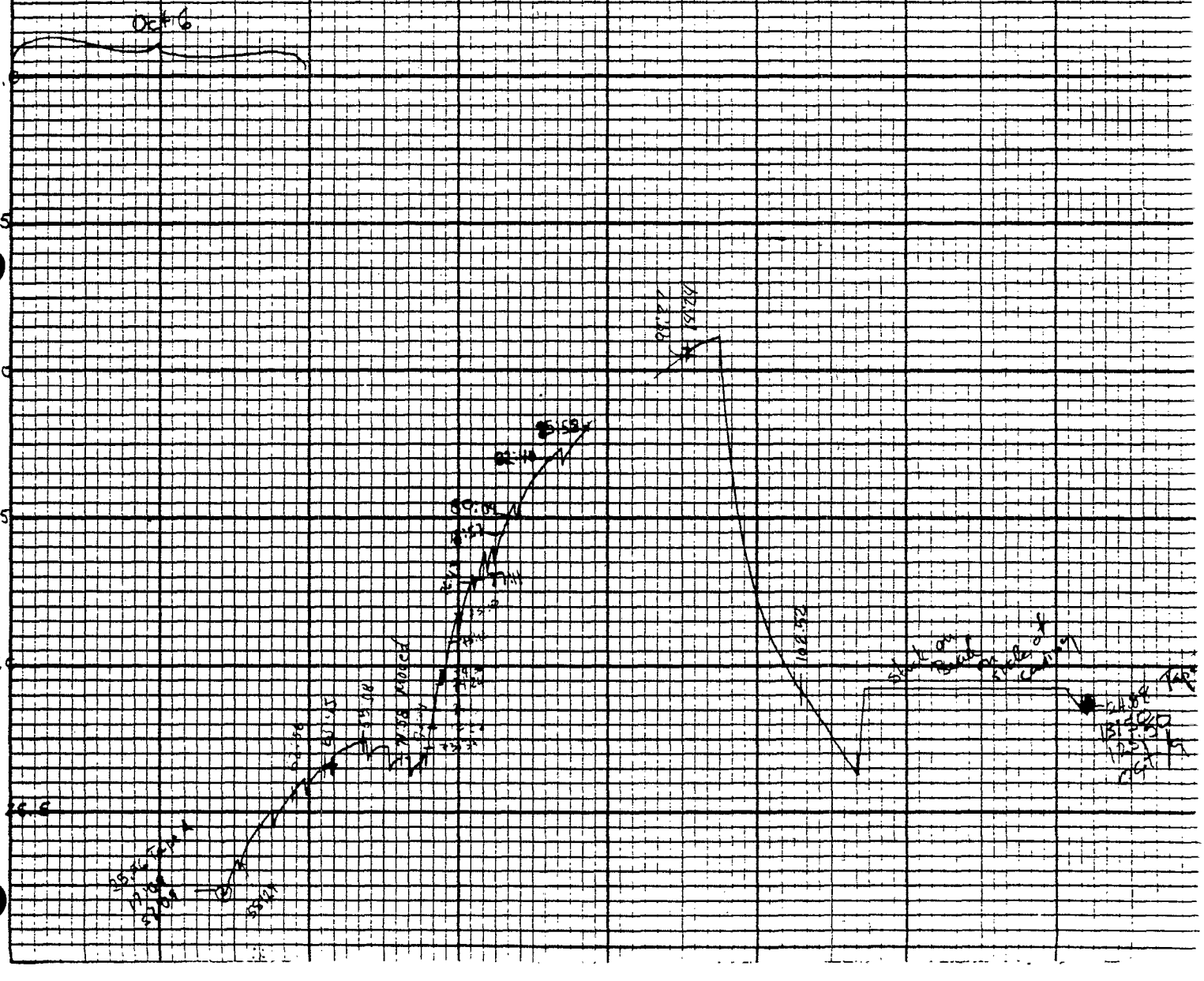
Off

Water Level -

Date -

Time -

Observer -



Leupold & Stevens, Inc. Beaverton, Oregon

Project: Bally / Dayton

Monitoring Well: 87-10D

10 - Day Clock Scale 1.5 (Inches/Foot)

On

Water Level - 3.63 (TOC)

Date - 5/24

Time - 8:20

Observer - PVS

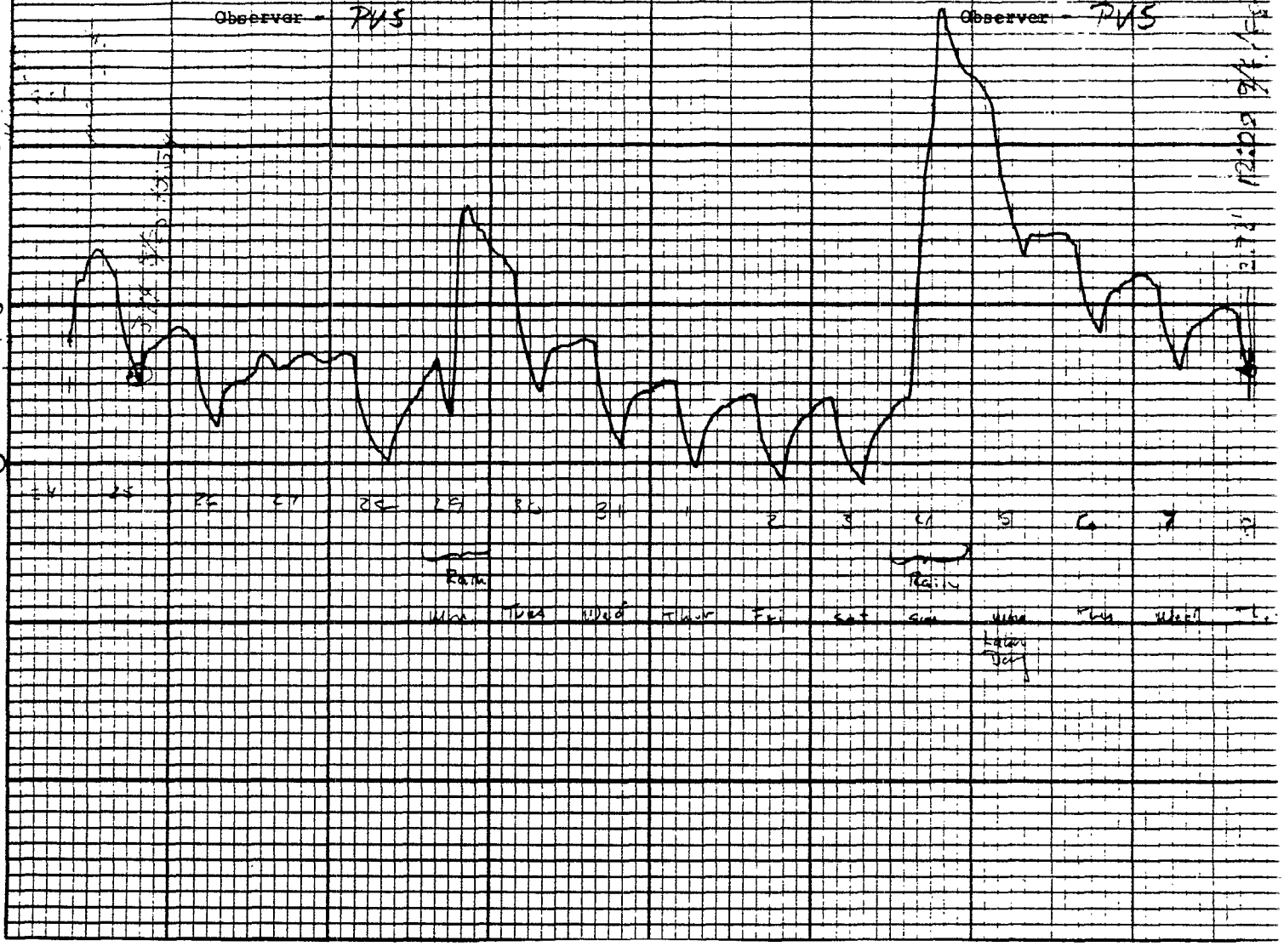
Off

Water Level - 3.72 TO

Date - 5/8/88

Time - 12:08

Observer - PVS



24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8
Rain
Rain
Mon Tues Wed Thur Fri Sat Sun Mon Tues Wed
Labor Day

Leupold & Stevens, Inc., Beaverton, Ore.

AR300849

Project Baltz/Dragon Pump #1 16 - Day Clock

Monitoring Well 87-10D

On

Water Level - 5.72

Date - 9/8/88

Time - 12:20

Observer - PWS

Off

Water Level - 3.90

Date - 9/21/88

Time - 7:50

Observer - PWS

Water Level 5.72

3.5

4.0

3.90 9/21/88 7:50am

Geppold & Stevens, Inc., Beaverton, Ore.

AR300850

000050

Project Bally / Dayton

Monitoring Well 87-10D

— Day Clock

On

Water Level -

Date - 9/22/88

Time - 8:00 am

Observer - PVS

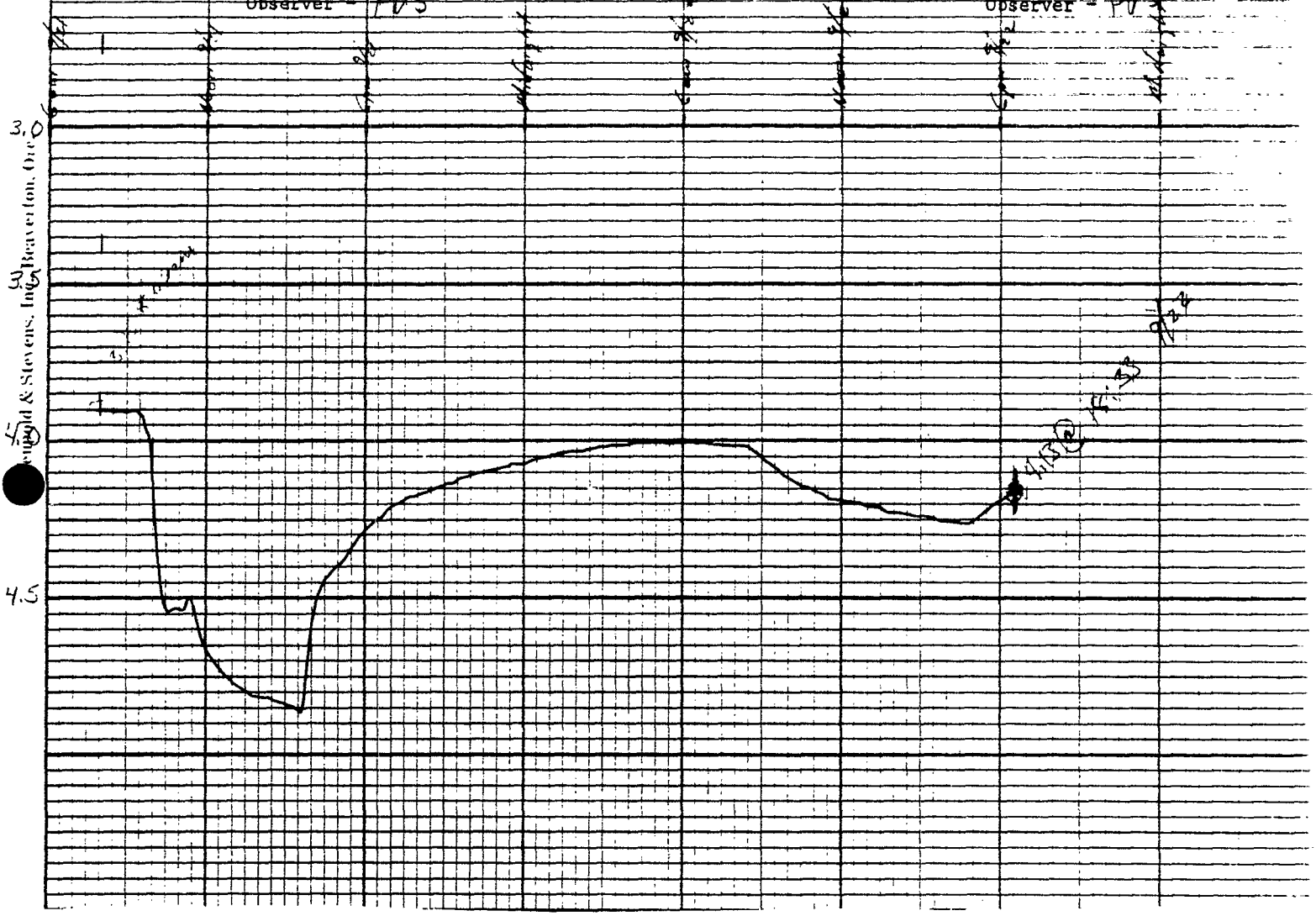
Off

Water Level - 4.15

Date - 9/22

Time - 18:33

Observer - PVS



Dodd & Stevens, Inc. Beaverton, Ore.

Project Batty / Dayton — 14 - Day Clock — 1.5 Vert

Monitoring Well 97-16D

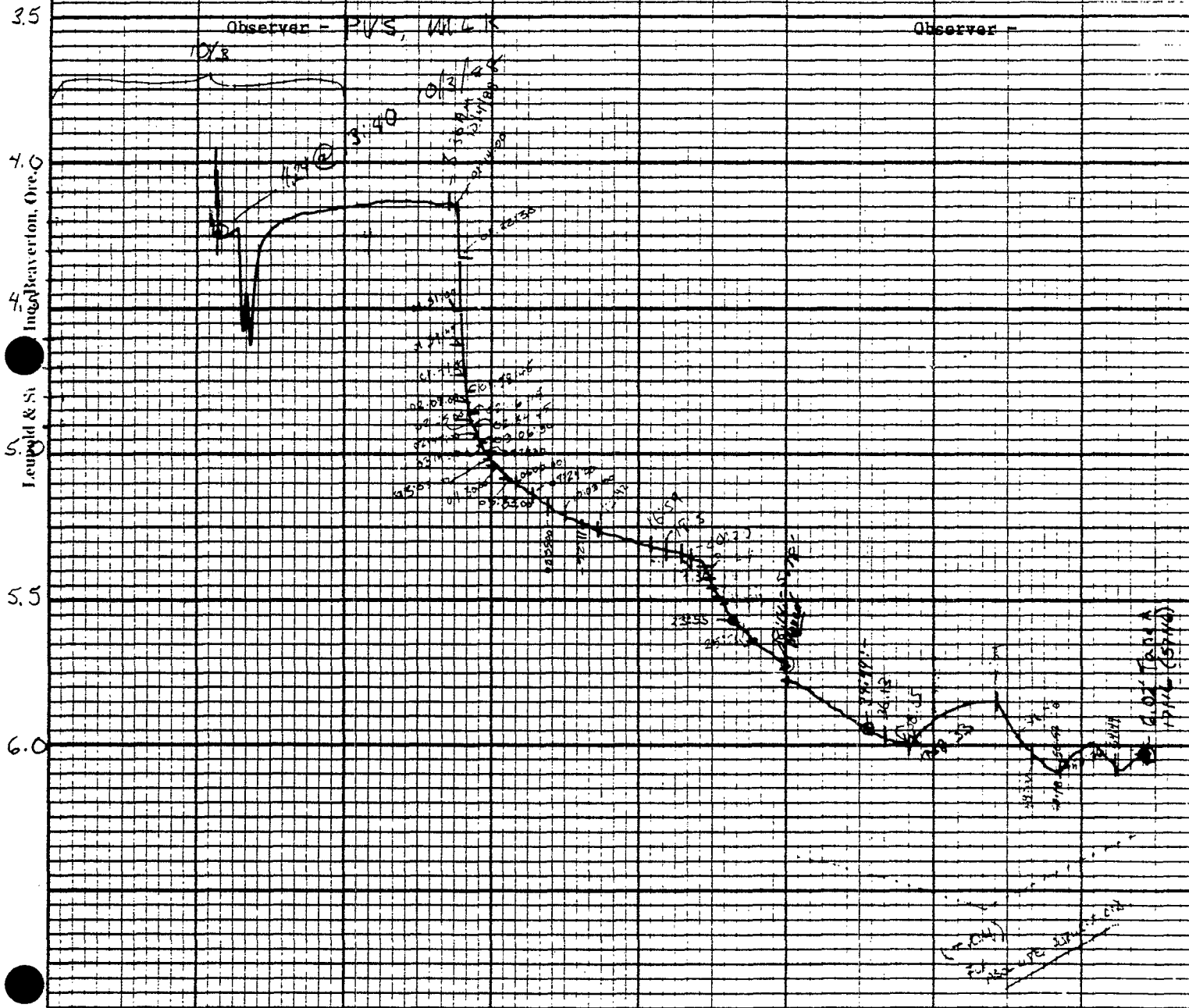
On	Off
Water Level -	Water Level - 4.27
Date - 9/22/88	Date - 10/3/88
Time - 18:40	Time - 18:10
Observer - PVS	Observer - PVS

Leupold & Stevens, Inc. Beaverton, Ore.

Project Dagan / Bally — 4 — Day Clock 1:5

Monitoring Well 87-10D

On	Off
Water Level - 4.24'	Water Level -
Date - 10/3/88	Date -
Time - 13:40	Time -
Observer - PVS, WLK	Observer -



Leupold & Stevens, Inc., Beaverton, Ore.

Project Dagan / Bally — 4 - Day Clock 1:5

Monitoring Well 87-100

On

~~Water Level~~ -

Date - 12/6/88

~~Time~~ -

Observer - PVS / MKK

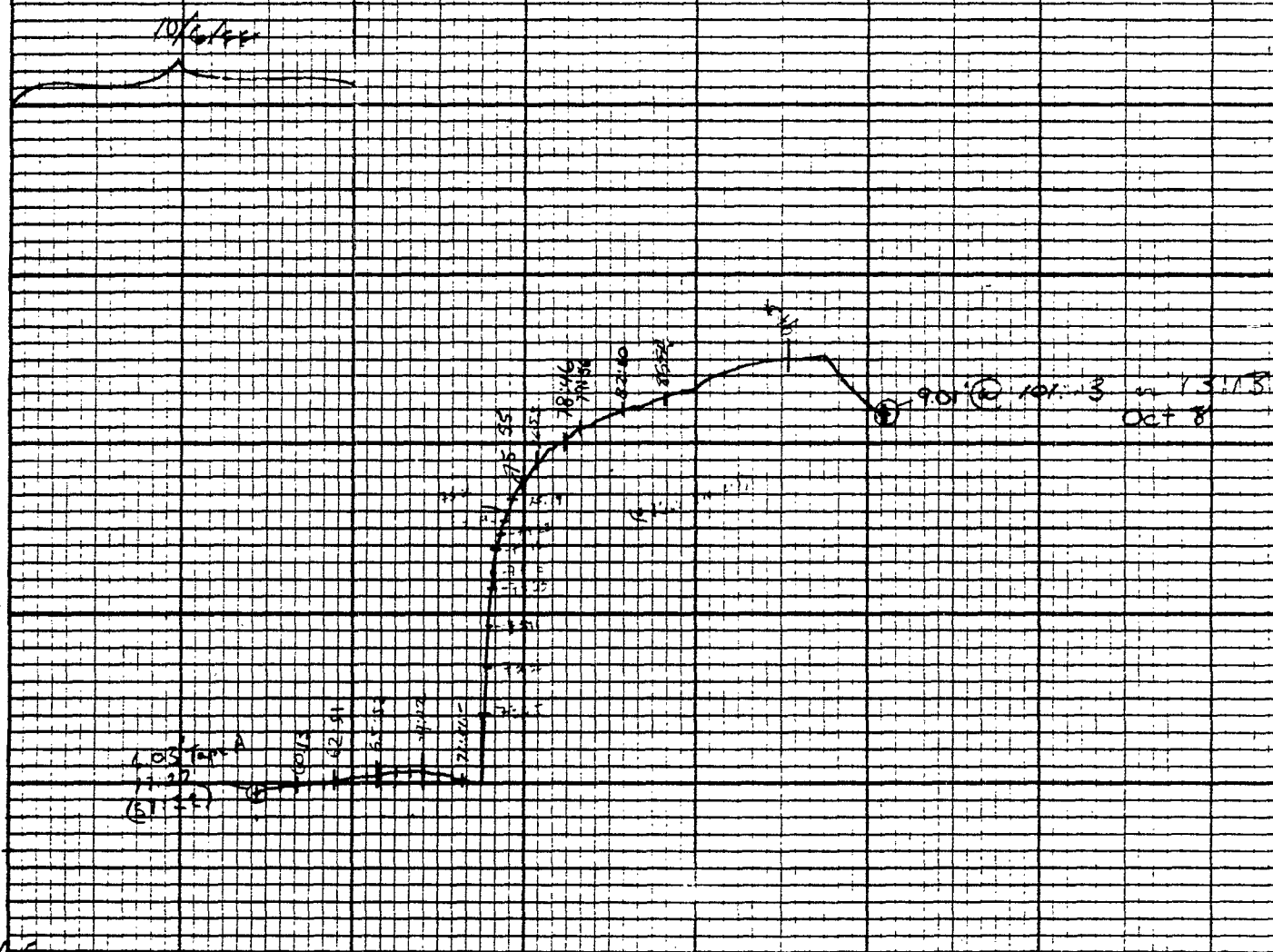
Off

Water Level -

Date -

~~Time~~ -

Observer -



Leupold & Stevens Inc. Beaverton, Oreg.

Project Bath/Dagan 32 - Day Clock 1:10 Vert.

Monitoring Well 37-12D

On

Water Level - 20.30

Date - 9/22/88

Time - 17:20

Observer - PVS

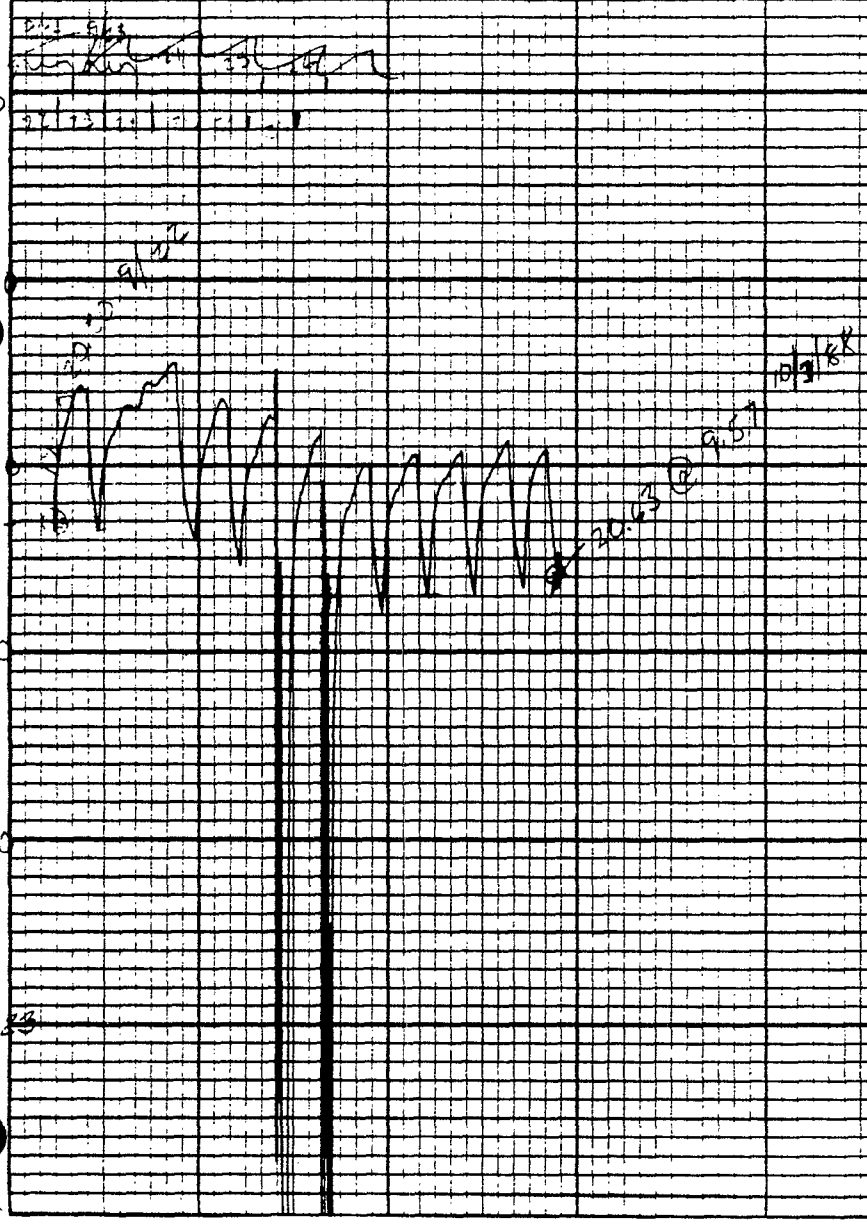
Off

Water Level - 20.63

Date - 10/3/88

Time - 9:57

Observer - PVS/MCK



Leupold & Stevens, Beaverton, Ore.

Project Dagau / Bally

Monitoring Well 87-12D

On

Water Level - 20.61

Date - Oct 3, 1988

Time -

Observer PVS / MLK

4 - Day Clock

Vent 1:10

Ward Time

Back 49:36

Prog 10:00

OFF

Water Level

Date -

Time -

Observer -

Leupold & Stevens, Inc. Beaverton, Oreg.

Project: Dagan / Fahly — 4 - Day Clock 1:10

Monitoring Well 87-12D

On

Water Level -

Date - Oct 6, 1988

Time -

Observer - Dils, Mick

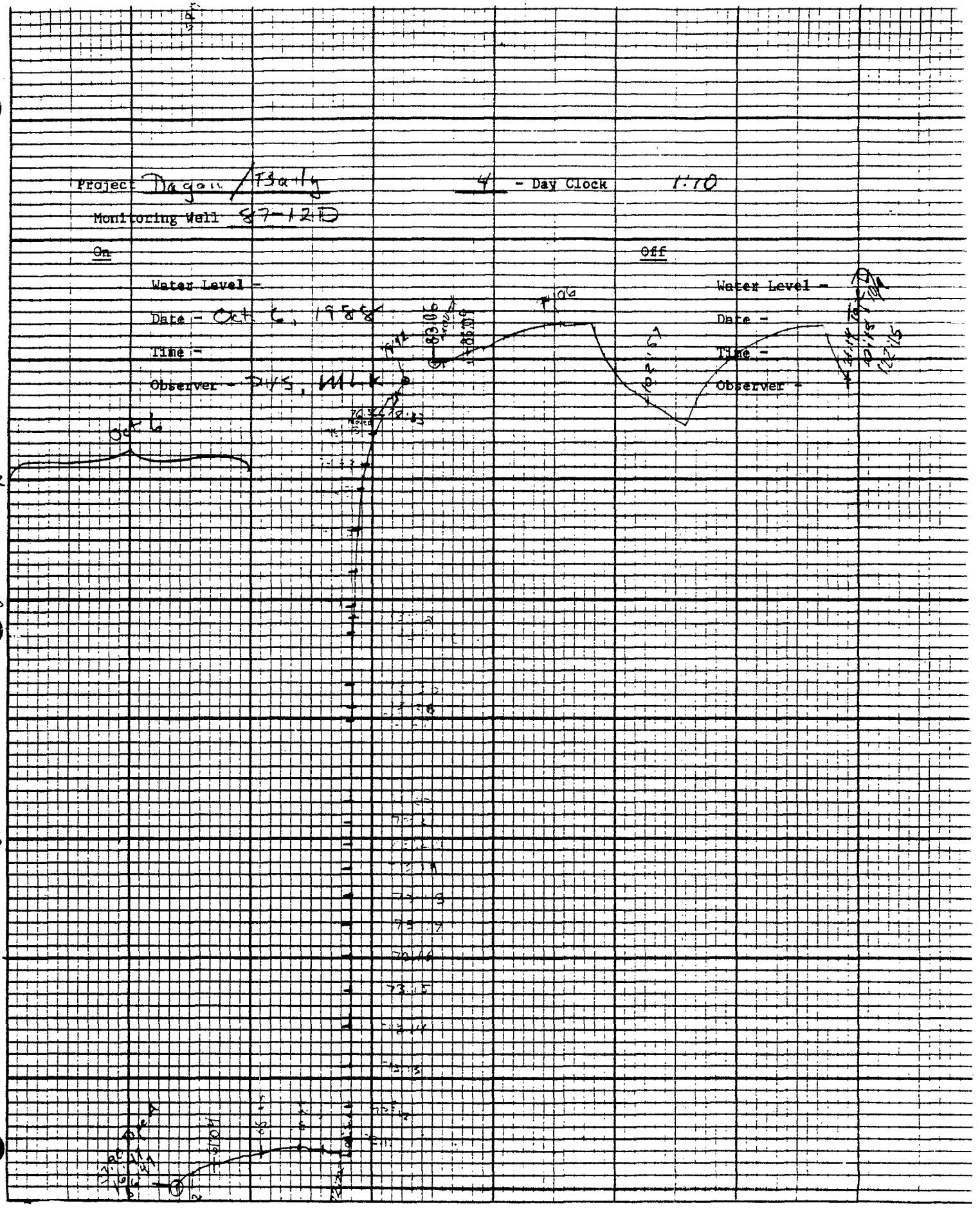
Off

Water Level -

Date -

Time -

Observer -



AR300857

APPENDIX F

SYSTEMS AUDITS AND VALIDATION LETTERS

MEMO

TO: J. A. George
J. G. Kasper
P. V. Swallow

December 23, 1987

FROM: J. A. Balint

Project No. 87313

SUBJECT: **FIELD AUDIT, BALLY ENGINEERED STRUCTURES RI/FS**

In accordance with the approved Field Sampling and Analysis Plan, an initial systems audit was conducted November 18 and 19, 1987 during the drilling and sampling activities conducted in the former waste lagoon and small parts degreasing areas. This systems audit encompassed appraising the performance and documentation of all field activities conducted during this period, which included installation of and split-spoon sampling of Borings SS1, SS2, SS4, and SS9. For this audit, the attached checklist was developed. Explanations of and corrective measures required for deviations from this checklist are provided after each item where required.

	YES	NO
Are samples collected in accordance with the procedure described in the Field Sampling and Analysis Plan (FSAP) (Remcor, September 1987)?	X	
Is each sample collected with properly decontaminated equipment as described in the FSAP?	X	
Are QA/QC samples prepared as described in the FSAP?	X	
Are samples stored on ice during storing and shipping?	X	
Are all samples labeled with project name, sample number, sample location, date and time?	X	
Is a sample log sheet completed for each sample? Each log sheet should include sample type, number, collector, container(s), preservative, location, laboratory, date/time collected, and date/time shipped.	X	
Is sample custody maintained?	X	
Has a chain-of-custody form been completed for each set of samples prior to transferring possession. Has the relinquishing and receiving party signed, dated, and noted times on the form?	X	
Is a summary of all site activities and levels of personal protection recorded during the day?	X	
Does the site log book summarize the contents of other site notebooks (geologists, sample log book, health and safety) and refer to page locations for detailed information?	X	
Is the sample log sheet for each sample collected referenced?		X
This has not been done and should be added to the log book if possible.		
Are field measurements and equipment used either recorded in the site log book or references made to another notebook?		X
Measurements such as water levels or organic vapor readings are recorded in the geologist log, but are not consistently recorded or referenced in the site log. Reference to where these readings can be found should be made.		

	YES	NO
At the beginning of the day, is each of the following recorded?		
- Date	X	
- Starting time	X	
- Weather	X	
- All field personnel present	X	
- Any visitors present	X	
Is the entry of data in the site log book accompanied by the signature of the site leader?	X	
Does the log book contain the following?		
- Arrival/departures of equipment	X	
- Sample pickup/delivery	X	
- Sample activities/sample log sheet numbers		X
Sampling activities are recorded but no reference to log sheet numbers is made.		
- Start or completion of borehole or monitoring well installation or sampling activities	X	
- Health and safety issues	X	
Is the site log book initiated at the start of first on-site activities?	X	
Are entries made for every day that on-site activities take place?	X	
Is one current log book maintained	X	
Is the site log book maintained as part of permanent site files?	X	
Is the site log book a bound notebook issued by the manager with pages consecutively numbered that cannot be removed?		X
This book is bound but the pages currently are not numbered consecutively. This should be done.		
Are all entries made in black ink?	X	

	YES	NO
Are incorrect entries crossed out with a single strike, initialed and dated?		X
This procedure has been followed except for the dating.		
At the completion of entries, is the log book signed by the individual?	X	

MEMO

TO: J. A. George
J. G. Kasper
P. V. Swallow

January 20, 1988

FROM: R. S. Markwell RSM

Project No. 87313

SUBJECT: **FIELD AUDIT, BALLY ENGINEERED STRUCTURES RI/FS**

In accordance with the approved Field Sampling and Analysis Plan, a second systems audit was conducted during the sampling episode conducted from January 4, 1988 through January 9, 1988. This systems audit encompassed appraising the performance and documentation of all field activities conducted during this period, which included ground water sampling, surface water and sediment sampling, and subsurface soil sampling. For this audit, the attached checklist was developed. Explanations of and corrective measures required for deviations from this checklist are provided after each item where required.

	YES	NO
Are samples collected in accordance with the procedure described in the Field Sampling and Analysis Plan (FSAP) (Remcor, September 1987)?	X	
Is each sample collected with properly decontaminated equipment as described in the FSAP?	X	
Are QA/QC samples prepared as described in the FSAP?		X
Field blanks, rinsate blank, and field replicates were prepared as described in the FSAP; there was one modification in terms of location. A replicate was collected from the municipal well (No. 3) instead of from a residential well. The number of replicates required, however, has still been met: two for 32 ground water samples collected.		
Trip blanks were not prepared in the laboratory, but instead were prepared shortly after arriving at the site. The trip blanks were stored in coolers used for storing and shipping samples for the duration of the week.		
Are samples stored on ice during storing and shipping?	X	
Are all samples labeled with project name, sample number, sample location, date and time?	X	
Is a sample log sheet completed for each sample? Each log sheet should include sample type, number, collector, container(s), preservative, location, laboratory, date/time collected, and date/time shipped.	X	
Is sample custody maintained?	X	
Has a chain-of-custody form been completed for each set of samples prior to transferring possession. Has the relinquishing and receiving party signed, dated, and noted times on the form?	X	
Is a summary of all site activities and levels of personal protection recorded during the day?	X	
Does the site log book summarize the contents of other site notebooks (geologists, sample log book, health and safety) and refer to page locations for detailed information?	X	

	YES	NO
Is the sample log sheet for each sample collected referenced?		X
This has not been done and should be added to the log book if possible.		
Are field measurements and equipment used either recorded in the site log book or references made to another notebook?		X
Measurements such as water levels or organic vapor readings are recorded in the geologist log, but are not consistently recorded or referenced in the site log. Reference to where these readings can be found should be made.		
At the beginning of the day, is each of the following recorded?		
- Date	X	
- Starting time	X	
- Weather	X	
- All field personnel present	X	
- Any visitors present	X	
Is the entry of data in the site log book accompanied by the signature of the site leader?	X	
Does the log book contain the following?		
- Arrival/departures of equipment	X	
- Sample pickup/delivery	X	
- Sample activities/sample log sheet numbers		X
Sampling activities are recorded but no reference to log sheet numbers is made.		
- Start or completion of borehole or monitoring well installation or sampling activities	X	
- Health and safety issues	X	
Is the site log book initiated at the start of first on-site activities?	X	
Are entries made for every day that on-site activities take place?	X	
Is one current log book maintained	X	

	YES	NO
Is the site log book maintained as part of permanent site files?	X	
Is the site log book a bound notebook issued by the manager with pages consecutively numbered that cannot be removed?	X	
Are all entries made in black ink?	X	
Are incorrect entries crossed out with a single strike, initialed and dated?		X
This procedure has been followed except for the dating.		
At the completion of entries, is the log book signed by the individual?	X	

19 July 1988

Support Systems Incorporated
3749 Silverthorne Drive
Ft. Collins, Colorado 80526

Mr. Rob Markwell
REMCOR CORPORATION
701 Alpha Drive
Pittsburgh, Pennsylvania 15238

Subject: NUS Organic Data Validation

Dear Mr. Markwell:

A level 1 validation was performed on the organic data from REMCOR samples dated January 6, 1988 through January 8, 1988 and January 22, 1988. The samples were analyzed for volatile HSL compounds plus semivolatile compounds (three samples).

The data evaluation was based on the EPA Functional Guidelines for Evaluating Organic Analyses and the EPA Contract Laboratory Program Statement of Work.

RESULTS

Completeness - All CLP deliverables were present except for a organic analysis data sheet (OAD) for sample RBB-GW-IW-001. Support Systems Inc. has prepared an OAD for this sample. However, the laboratory should submit this form for final validation.

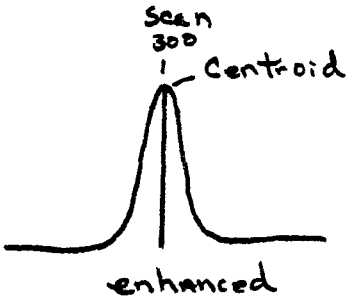
Holding Times - Five soil samples were analyzed outside the VOA holding time limit of 10 days from verified time of sample receipt. Support Systems Inc. believes that the data quality for these samples has not been compromised as the analysis times were late by one day and as their has been no validation study for holding times with soils. However, under CLP specifications, results from samples analyzed outside holding times should be approximated. The late holding times samples are listed as follows:

REMCOR SAMPLE NO.	DATE RECEIVED	DATE ANALYZED
RBB-SS-SS-TB-001	01/08/88	01/18/88
RBB-SS-SS14-001	01/08/88	01/18/88
RBB-SS-SS14-003	01/08/88	01/18/88
RBB-SS-SS13-001	01/08/88	01/18/88
RBB-SS-SS13-002	01/08/88	01/18/88
RBB-SD-SD1-001A	01/09/88	01/19/88

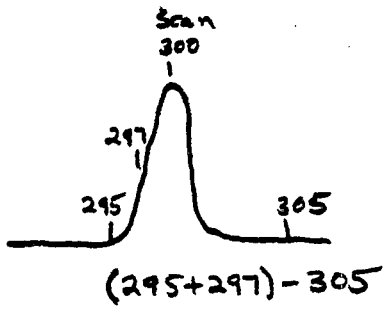
Mass calibrations - All mass calibrations of BFB and DFTPP are reported correctly. However, the calibration spectra for the "tunes were obtained incorrectly. The analysis laboratory obtained correct mass intensity ratios by post acquisition mass background summation and subtraction. The correct procedure is to use the enhanced spectra algorithm using the spectra at the centroid of the calibration

"REALISTIC SOLUTIONS FOR HAZARDOUS WASTE PROBLEMS"
REMCOR

Correct Procedure



Incorrect Procedure



Therefore, the instruments were not properly tuned to the CLP specifications.

The impact of the instruments not being "in tune" is probably minimal as the laboratory could demonstrate adequate target compound response, linearity, detection limits, and spectral identification at detection limit. It is when detection is below the contract required detection limits that spectral identification might be effected. In order to properly evaluate data quality, spectra for the acquired calibrations should be re-submitted by the laboratory using the enhanced spectra algorithm as described above.

Initial Calibrations - All initial calibrations met CLP specifications.

Continuing Calibrations - All continuing calibrations met CLP specifications.

Internal Standard Area Summary - All internal standard areas met CLP specifications except for sample RBB-SS-SS-FB-001. Upon re-analysis the laboratory demonstrated a matrix effect. Quantitation results for this sample were not effected as the matrix spike results for this sample met all specifications.

Surrogate Recovery - All surrogate recovery specifications were met except for 1,2-dichloroethene-d4 in sample RBB-SS-SS-FB-001. Upon re-analysis of the sample, the laboratory demonstrated a matrix effect as discussed above.

Blank results - A general background of methylene chloride and acetone was observed above the contract required detection limits. Additionally, the ketones of 2-butanone, 4-methyl-2-pentanone, and 2-hexanone were observed. Listed below are the samples that are affected and the action recommended:

REMCOR SAMPLE NO.	Recommended Action
RBB-GW-BW-001	Reject acetone and methylene chloride values
RBB-GW-BW-003	Reject acetone and methylene chloride values
RBB-GW-BW-003A	Reject acetone value
RBB-GW-MW-03D	Reject acetone value
RBB-GW-MW-03S	Reject acetone value
RBB-GW-MW-03SA	Reject acetone value

"REALISTIC SOLUTIONS FOR HAZARDOUS WASTE PROBLEMS"
REMCOR

RBB-GW-MW-101	Reject acetone value
RBB-GW-MW-120	Reject acetone value
RBB-GW-KW-007	Reject acetone and methylene chloride values
RBB-SD-SD-2002	Reject acetone and methylene chloride values
RBB-SD-SD-3003	Approximate acetone value
RBB-SS-SS-11001	Reject acetone value
RBB-SS-SS-11002	Reject acetone value
RBB-SS-SS-11003	Reject acetone value
RBB-SS-SS-13001	Reject acetone value
RBB-SS-SS-13002	Reject acetone value
RBB-SS-SS-14001	Reject acetone value
RBB-SS-SS-14003	Reject acetone value
RBB-SS-SS-FB-001	Approximate methylene chloride (present in blank) and acetone (out of linear range) values
RBB-SS-SS-TB-001	Reject acetone and methylene chloride values.

Submitted by,

Cary B. Jackson

Cary B. Jackson

"REALISTIC SOLUTIONS FOR HAZARDOUS WASTE PROBLEMS"

REMCOR

15 February 1988

Support Systems Incorporated
3249 Silverthorne Drive
Ft. Collins, Colorado 80526

Mr. Rob Markwell
REMCOR CORPORATION
701 Alpha Drive
Pittsburgh, Pennsylvania 15238

Subject: NUS Organic Data Validation
Samples Received on 12/01/87

Dear Mr. Markwell:

A level I validation was performed on the organic data from REMCOR samples dated December 1, 1987. The samples were analyzed for volatile HSL compounds by NUC Corporation and included the following samples:

RBB-SS-FB-001	RBB-SS-SS6-001
RBB-SS-SS6-002	RBB-SS-SS6-002A
RBB-SS-SS6-003	RBB-SS-SS7-002
RBB-SS-SS7-005	RBB-SS-TB-001

The data evaluation was based on the EPA Functional Guidelines for Evaluating Organic Analyses document.

RESULTS

The data package was complete as received.

All sample analysis holding times were met.

Initial and continuing standards calibration of system performance calibration compounds and continuing calibration compounds met CLP requirements except for the following:

Continuing Calibration - 12/08/87
Chloromethane (SPCC) 0.290/)0.300

No action is recommended as contract required detection limits for chloromethane could be achieved.

All volatile soil surrogate and matrix spike recoveries met CLP requirements except for the following:

Sample RBB-SS-TB-001
Toluene-d8 (surrogate)

No action is recommended as the laboratory demonstrated a matrix effect caused the recovery to be outside the QC limits.

Mass calibrations of BFB for each 12 hours that samples were analyzed met CLP requirements.

A reagent blank was prepared and analyzed each 12 hours that samples were analyzed. The following method blank summary list the compounds that were detected and the associated samples that were analyzed with the blank:

Method Blank Summary

Method Blank - REMC1207L

Methylene Chloride	- 12 ug/Kg
Acetone	- 14 ug/Kg

Associated Samples

RBB-SS-TB-001	RBB-SS-SS7-002
RBB-SS-TB-001RA	RBB-SS-SS7-005
RBB-SS-SS6-002	RBB-SS-SS6-002A

Method Blank - REMC120BL

Methylene Chloride	- 10 ug/Kg
Acetone	- 18 ug/Kg

Associated Samples

RBB-SS-SS6-003	RBB-SS-FB-001
RBB-SS-SS6-001	RBB-SS-SS6-003MS
RBB-SS-SS6-003MSD	

Sample results for the above compounds should be rejected as detected concentrations were not greater than 10 times the reagent blank values.

In conclusion, all results for this data package should be accepted except for the following:

1) Methylene Chloride and Toluene results in each sample should be rejected as these compounds were detected in the associated blanks. Results in the samples were less than 10 times the reagent blank values.

2) Continuing calibration criteria was not met in the standard analyzed on 12/08/87. The SPCC chloromethane did meet the required response factor of 0.300. No action is recommended as the detection limit for chloromethane could be achieved.

3) Surrogate recovery for Toluene-d8 in sample RBB-SS-TB-001 was outside QC recovery limits. No action is recommended as the

laboratory demonstrated the recovery was influenced by a matrix effect.

Submitted by,

Cary B. Jackson

Cary B. Jackson

5 February 1988

Support Systems Incorporated
3249 Silverthorne Drive
Ft. Collins, Colorado 80526

Mr. Rob Markwell
REMCOR CORPORATION
701 Alpha Drive
Pittsburgh, Pennsylvania 15238

Subject: NUS Organic Data Validation
Samples Received on 11/19/87

Dear Mr. Markwell:

A level I validation was performed on the organic data from REMCOR samples dated November 19, 1987. The samples were analyzed for volatile HSL compounds by NUC Corporation and included the following samples:

RBB-SS-FB1-000	RBB-SS-SS1-002
RBB-SS-SS1-003	RBB-SS-SS2-004
RBB-SS-SS3-005	RBB-SS-SS9-001
RBB-SS-SS9-001A	RBB-SS-SS9-002
RBB-SS-TB1-000	

The data evaluation was based on the EPA Functional Guidelines for Evaluating Organic Analyses document.

RESULTS

The data package was complete as received.

The following samples were analyzed beyond the CLP required 10 days for volatile soils (10 days from verified time of sample receipt VTSR):

RBB-SS-TB1-000	RBB-SS-FB1-000
RBB-SS-SS9-001MS	RBB-SS-SS9-001MSD

No action is recommended as holding times have not been fully evaluated for soil-sediment matrices.

All initial and continuing standards calibration of system performance calibration compounds and continuing calibration compounds met CLP requirements.

All volatile soil surrogate and matrix spike recoveries met CLP requirements. Relative percent differences between matrix spike and matrix spike duplicate resutls were satisfactory.

Mass calibrations of BFB for each 12 hours that samples were analyzed met CLP requirements.

A reagent blank was prepared and analyzed each 12 hours that samples were analyzed. The following method blank summary list the compounds that were detected and the associated samples that were analyzed with the blank:

Method Blank Summary

Method Blank - REM11281

Methylene Chloride	- 12 ug/Kg
Acetone	- 17 ug/Kg
1,1,1-Trichloroethane	- 3 ug/Kg
Toluene	- 5 ug/Kg

Associated Samples

RBB-SS-SS3-005	RBB-SS-SS2-004
RBB-SS-SS1-003	RBB-SS-SS1-002

Method Blank - REM11291

Methylene Chloride	- 11 ug/Kg
Acetone	- 6 ug/Kg
Toluene	- 1 ug/Kg

Associated Samples

RBB-SS-SS9-001	RBB-SS-SS9-001A
RBB-SS-SS9-002	RBB-SS-SS4-005

Method Blank - REM1130L

Methylene Chloride	- 13 ug/Kg
Acetone	- 10 ug/Kg
Toluene	- 2 ug/Kg

Associated Samples

RBB-SS-TB1-000	RBB-SS-FB1-000

Method Blank - REM1201L

Methylene Chloride	- 9 ug/Kg
Acetone	- 34 ug/Kg
Toluene	- 3 ug/Kg

Associated Samples

RBB-SS-SS9-001MS	RBB-SS-SS9-001MSD

Sample results for the above compounds should be rejected as detected

concentrations were not greater than 10 times the reagent blank values.

In conclusion, all results for this data package should be accepted except for the following:

1) Methylene Chloride, Acetone, and Toluene results in each sample should be rejected as these compounds were detected in the associated blanks. Results in the samples were less than 10 times the reagent blank values.

2) Four samples were analyzed outside the 10 day holding time requirement in the CLP Statement of Work. No action is recommended as holding times on soil-sediment matrices have not been fully evaluated.

Submitted by,

Cary B. Jackson

Cary B. Jackson

Support Systems Incorporated
3249 Silverthorne Drive
Fort Collins, Colorado 80526
(303) 226-3561

October 2, 1988

Mr. Robert Markwell
Remcor Inc.
701 Alpha Drive
Pittsburgh, Pa 15238-8310

Dear Rob:

Enclosed is the additional review and recommended action for information supplied on September 22, 1988. Should you have any questions or require additional data review services, please feel free to call me.

Sincerely yours,

Cary B. Jackson

Cary B. Jackson

RESULTS AND RECOMMENDATIONS

Trip Blank	Results	Associated Samples
RBB-GW-TB-002	Methylene chloride - 2 ug/L Acetone - 8 ug/L Toluene - 1 ug/L	RBB-GW-BW-003A RBB-GW-IW-003 RBB-GW-MW-08I RBB-SS-SS11-001 RBB-SS-SS11-002 RBB-SS-SS11-003 RBB-SS-SS12-002 RBB-SS-SS12-003
RBB-GW-TB-003	Methylene chloride - 4 ug/L Acetone - 180 ug/L	RBB-GW-MW-011S RBB-GW-MW-011I RBB-GW-MW-07I RBB-GW-MW-05S RBB-GW-MW-002 RBB-GW-MW-001 RBB-GW-RW-008
RBB-GW-TB-005	Acetone - 14 ug/L	RBB-SD3-003

CONCLUSIONS AND RECOMMENDATIONS

1) The methylene chloride, acetone, and toluene results for trip blank RBB-GW-TB-002 appear to be from laboratory background as the quantitative numbers are below contract required quantitation limits. Although methylene chloride, acetone, and toluene are detected in the above associated samples, it is unlikely that their quantitative results were contributed from the trip blank. Therefore no further action is recommended.

2) The methylene chloride detected in trip blank RBB-GW-TB-003 appears to be from laboratory background as the quantitative number is below contract required quantitation limits. Therefore no further action is recommended for methylene chloride. Acetone was detected in the trip blank at 180 ug/L. This amount of acetone is considerably high and could adversely affect any samples that were in transit with the trip blank. Only one sample however (RBB-GW-MW-05S), had a acetone result greater than the contract required quantitation limit. This result should be rejected.

3) Acetone was detected in trip blank RBB-GW-TB-005 at 14 ug/L and the associated sample RBB-SD-SD3-003 at 200 ug/L. It is unlikely that acetone detected in the trip blank contributed to the sample result. Therefore no further action is recommended.

4) In regards to the soil field blank that was collected three days after the associated sample RBB-SS-SS10-001: It appears that random contamination is occuring from the laboratory or out in the sampling field. It does not however appear that cross contamination from the field blank is grossly affecting the sample. Therefore no result rejection is required based on the soil field blank.

SUPPORT SYSTEMS
3249 Silverthorne Drive
Fort Collins, Colorado 80526
303-226-3561

October 26, 1988

Mr. Robert Markwell
Remcor Inc.
701 Alpha Drive
Pittsburgh, Pa 15238-8310

Dear Rob:

Enclosed is the revised report you requested last week. Should you have any further questions please feel free to call me.

Sincerely yours,

Cary B. Jackson

Cary B. Jackson

"REALISTIC SOLUTIONS FOR HAZARDOUS WASTE PROBLEMS"
REMCOR

RESULTS AND RECOMMENDATIONS

Trip Blank	Results	Associated Samples
RBB-GW-TB-002	Methylene chloride - 2 ug/L Acetone - 8 ug/L Toluene - 1 ug/L	RBB-GW-BW-003A RBB-GW-IW-003 RBB-GW-MW-08I RBB-SS-SS11-001 RBB-SS-SS11-002 RBB-SS-SS11-003 RBB-SS-SS12-002 RBB-SS-SS12-003
RBB-GW-TB-003	Methylene chloride - 4 ug/L Acetone - 180 ug/L	RBB-GW-MW-011S RBB-GW-MW-011I RBB-GW-MW-07I RBB-GW-MW-05S RBB-GW-MW-002 RBB-GW-MW-001 RBB-GW-RW-008
RBB-GW-TB-005	Acetone - 14 ug/L	RBB-SD3-003

CONCLUSIONS AND RECOMMENDATIONS

1) The methylene chloride, acetone, and toluene results for trip blank RBB-GW-TB-002 appear to be from laboratory background as the quantitative numbers are below contract required quantitation limits. Although methylene chloride, acetone, and toluene are detected in the above associated samples, it is unlikely that their quantitative results were contributed from the trip blank. It is recommended that the trip blank results be rejected.

2) The methylene chloride detected in trip blank RBB-GW-TB-003 appears to be from laboratory background as the quantitative number is below contract required quantitation limits. Acetone was detected in the trip blank at 180 ug/L. This amount of acetone is considerably high and could adversely affect any samples that were in transit with the trip blank. Only one sample however (RBB-GW-MW-05S), had a acetone result greater than the contract required quantitation limit. It is recommended that methylene chloride chloride be rejected in the trip blank and acetone be rejected in sample RBB-GW-MW-05S.

3) Acetone was detected in trip blank RBB-GW-TB-005 at 14 ug/L and the associated sample RBB-SD-SD3-003 at 200 ug/L. It is unlikely that acetone detected in the trip blank contributed to the sample result as the sample result was 14 times higher than the trip blank. Therefore no further action is recommended.

4) In regards to the soil field blank that was collected three days after the associated sample RBB-SS-SS10-001: Methylene chloride should be rejected as it was reported at a level 9 times higher than the associated reagent blank. Acetone should be accepted as it was reported at a level 20 times higher than the reagent blank.

REMCOR, Inc. • 701 Alpha Drive • P.O. Box 38310 • Pittsburgh, PA 15238-8310 • 412-963-1106

September 22, 1988

Project No. 88548

Mr. Cary Jackson
Support Systems
3249 Silverthorne Drive
Fort Collins, CO 80526

Dear Cary,

Enclosed is a summation of the sample results I spoke with you about on Wednesday, September 21, 1988.

I have listed the trip blanks for which contaminants were reported along with the samples accompanying each of the blanks for which these same contaminants were reported. Please, as we discussed, provide a write-up indicating the necessary actions. One additional item is this: One soil sample (RBB-SS-SS10-001) was reported to contain methylene chloride (7B) and acetone (94B). A soil field blank was collected three days later; the results for this sample indicated methylene chloride (91BJ) and acetone (360 EJ). Does this necessitate rejecting the results for the aforementioned soil sample? If so, please indicate this in your letter also. Please call with any questions. Thank you very much for your time and effort.

Best regards,

Robert S. Markwell

Robert S. Markwell
Environmental Scientist

RSM:jll
Enclosures

REMCOR

By _____ Date _____ Subject _____ Sheet No. 1 of 2

Chkd. By _____ Date _____ Proj. No. _____

TRIP BLANK

RBB-GW-TB-002

Methylene Chloride	2 BJ
Acetone	8 BJ
Toluene	1 BJ

ACCOMPANYING SAMPLES	RBB-GW-BW-003A	RBB-GW-IW-003	RBB-GW-MW-08I	RBB-GW-MW-09I	RBB-SS-SS11-001	RBB-SS-SS11-002	RBB-SS-SS11-003	RBB-SS-SS12-002	RBB-SS-SS12-
Methylene Chloride	20BJ	2 J	3 BJ	2 BJ	5	5 BJ	6B	6B	8B
Acetone	—	13	6BJ	5BJ	—	50B	—	—	—
Toluene	—	—	—	—	43	6	5J	13	36

REMCOR

By _____ Date _____ Subject _____ Sheet No. 2 of 2

Chkd. By _____ Date _____ Proj. No. _____

TRIP BLANK

RBB-GW-TB-003

Methylene Chloride 4BJ
Acetone 180

ACCOMPANYING SAMPLES	RBB-GW-MW-011S	MW-011I	MW-07I	MW-05S	MW-05D	MW-002	MW-001	RBB-GW-RW-008
Methylene Chloride	—	2BJ	2 BJ	4 BJ	3 BJ	2 BJ	3 BJ	2 BJ
Acetone	5 BJ	4 BJ	—	21	7 J	—	7 J	—

TRIP BLANK

RBB-GW-TB-005

Acetone 14

ACCOMPANYING SAMPLES	RBB-SD-SD3-003
Acetone	200 BJ

AR300883

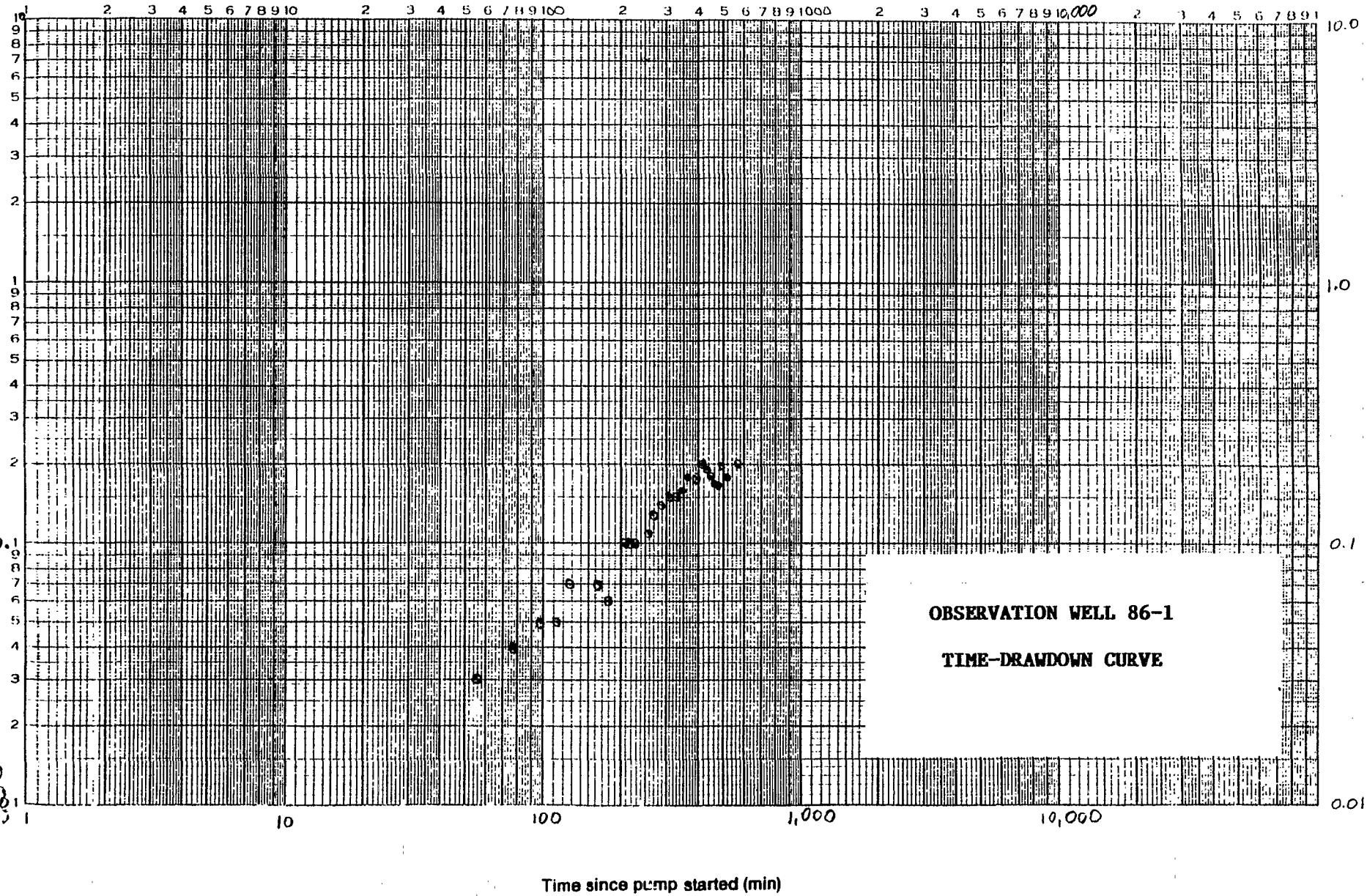
000234

AR300884

APPENDIX G

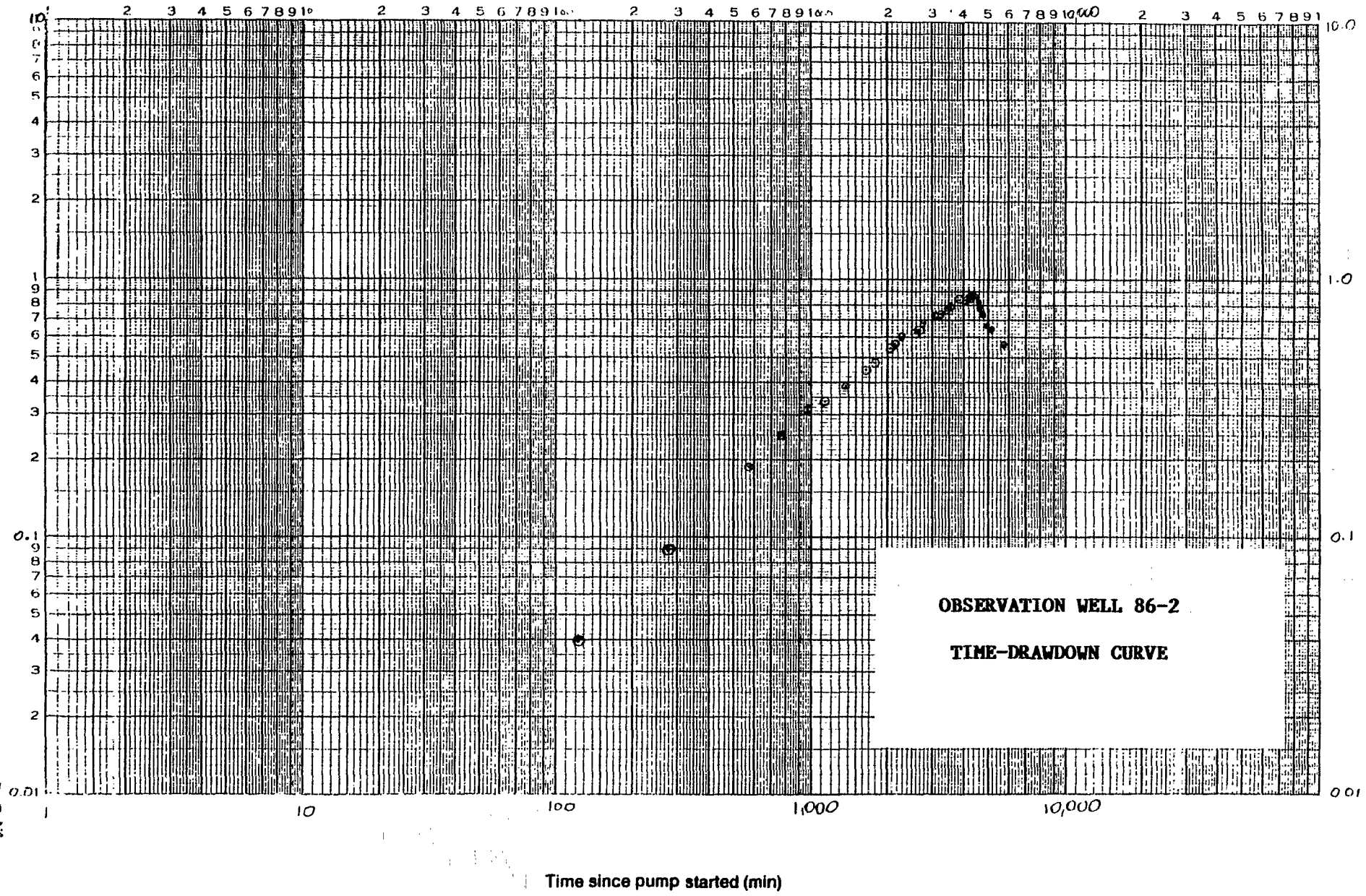
PUMPING TEST DATA

AR300885



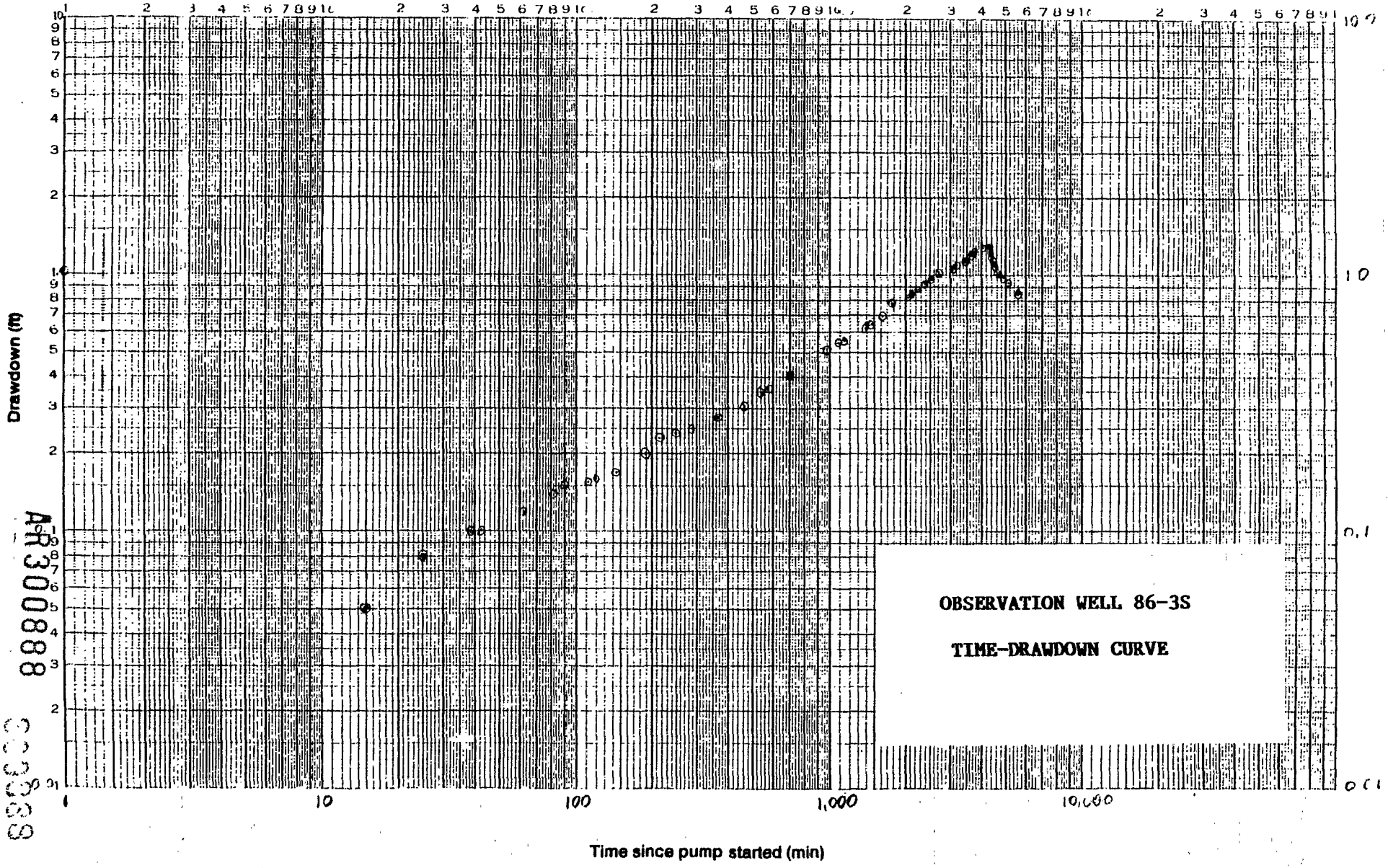
Full Logarithmic, 3 x 5

AR300886

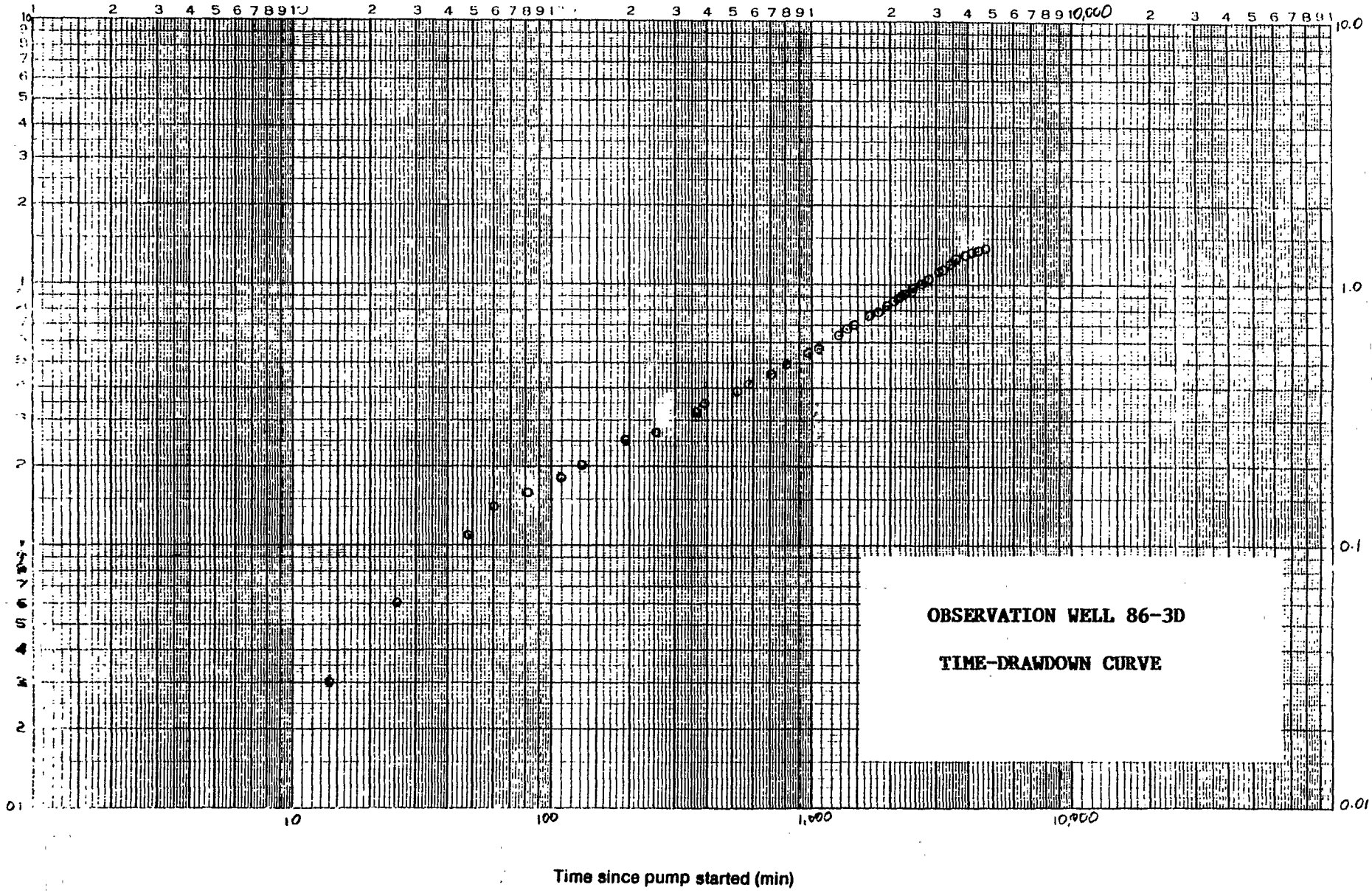


Full Logarithmic, 3 × 5

AR300887

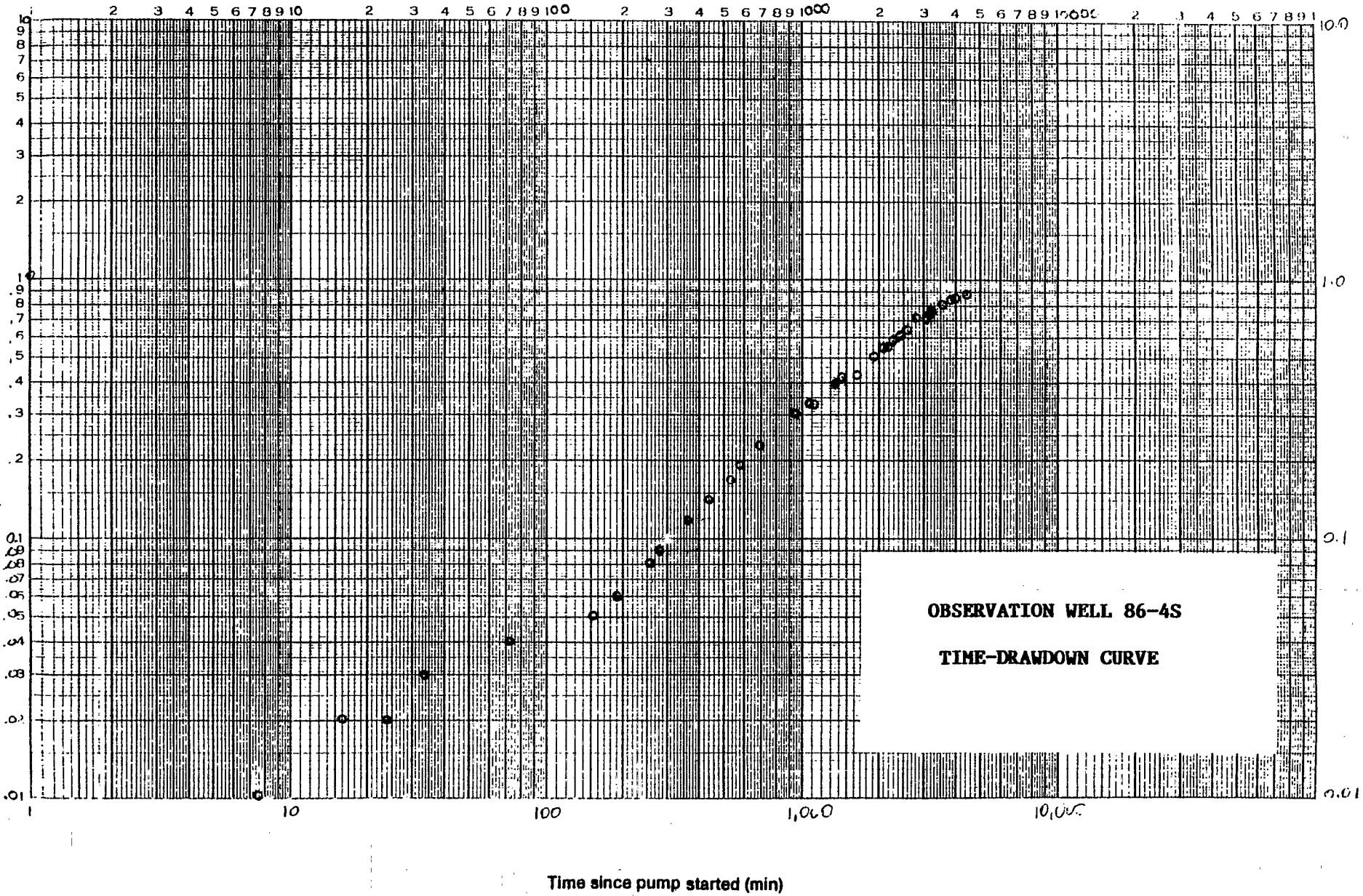

OBSERVATION WELL 86-3S
TIME-DRAWDOWN CURVE
Drawdown (ft)
Time since pump started (min)
1
10
100
1,000
10,000
0.1
0.01

AR300888



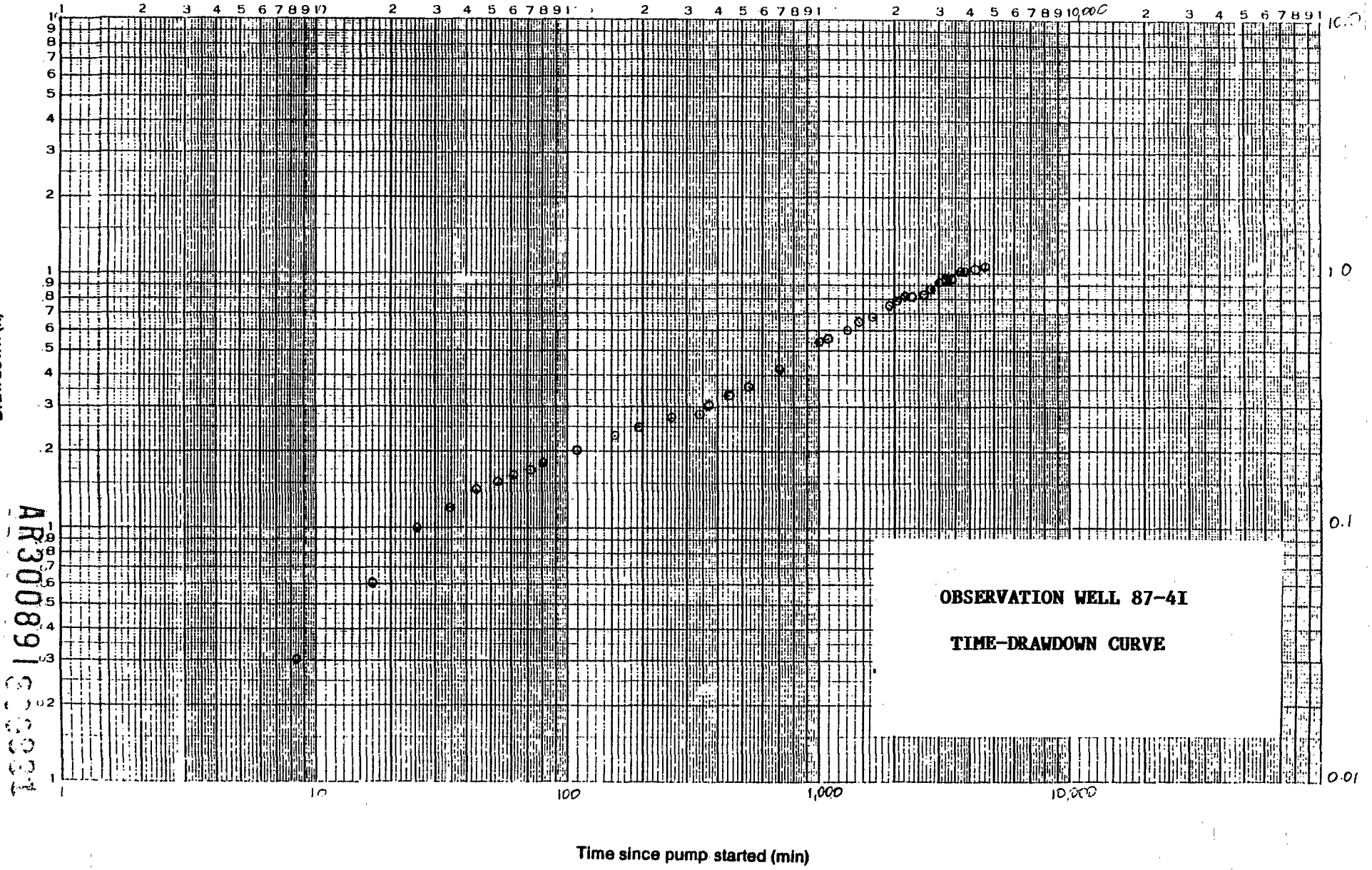
Full Logarithmic, 3 x 5

AR300889



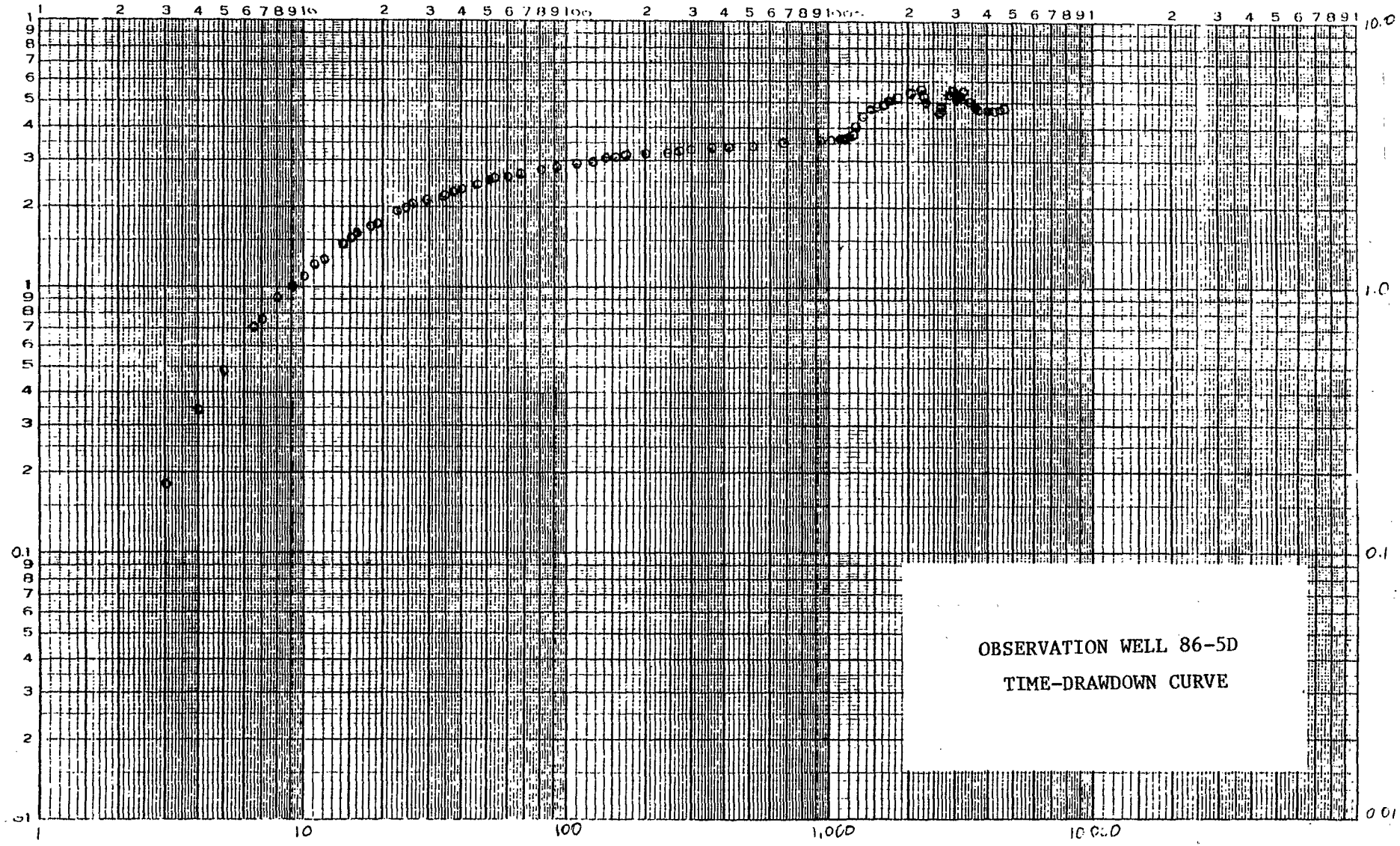
Full Logarithmic, 3 x 5

AR300890



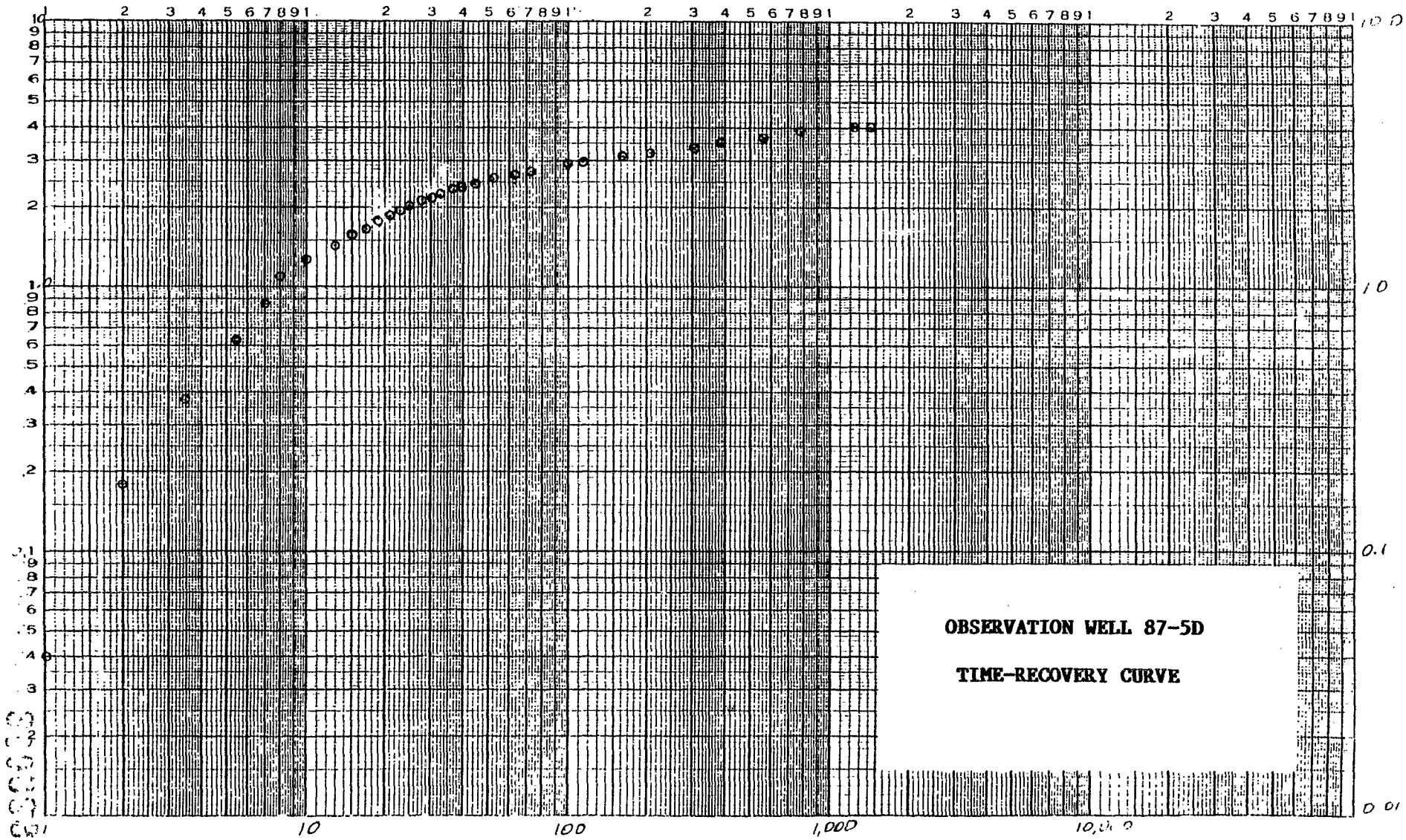
AR300891

Full Logarithmic 2 x 5
NATIONAL 12-191



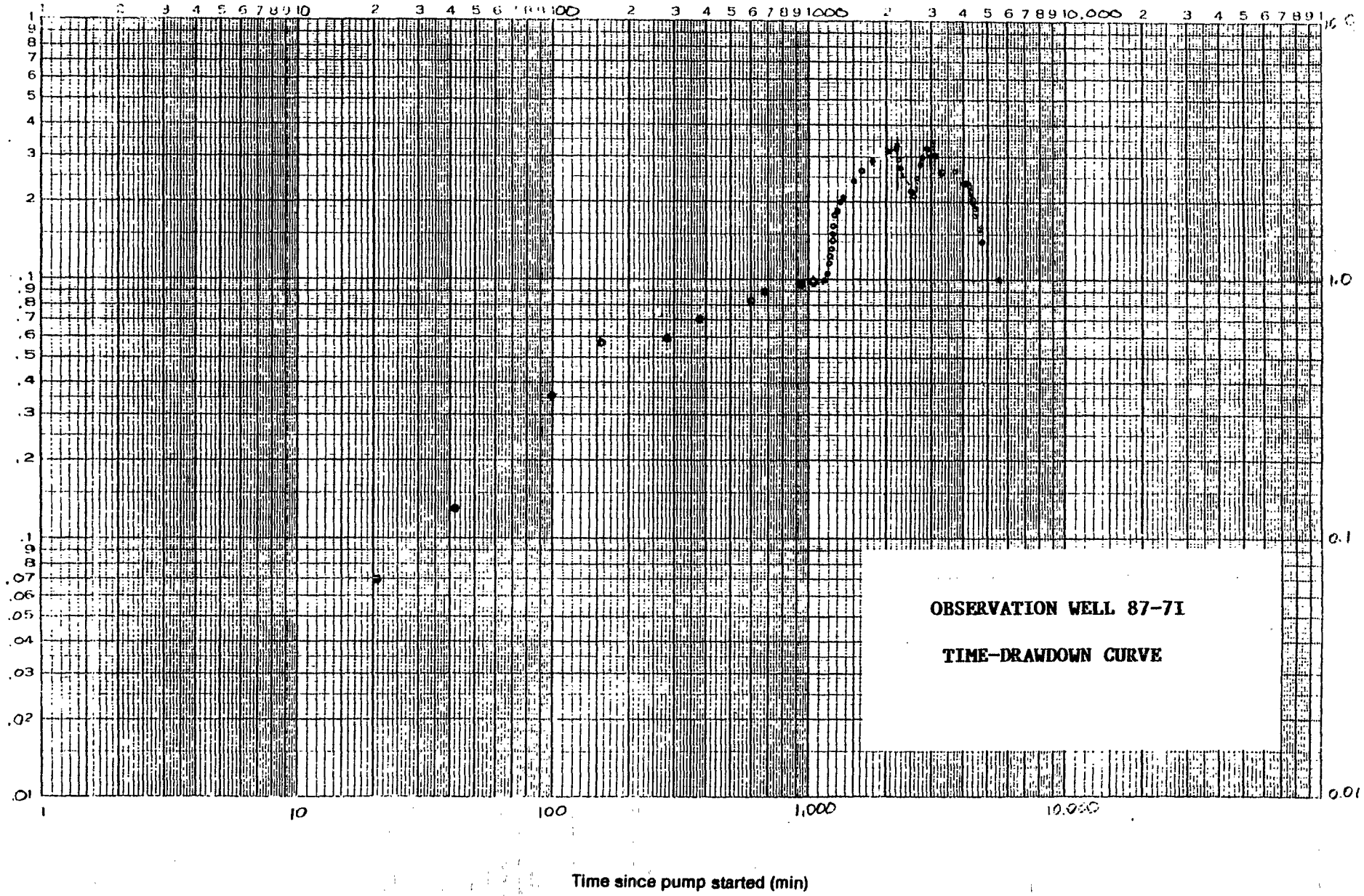
Full Logarithmic, 3 x 5

AR300892



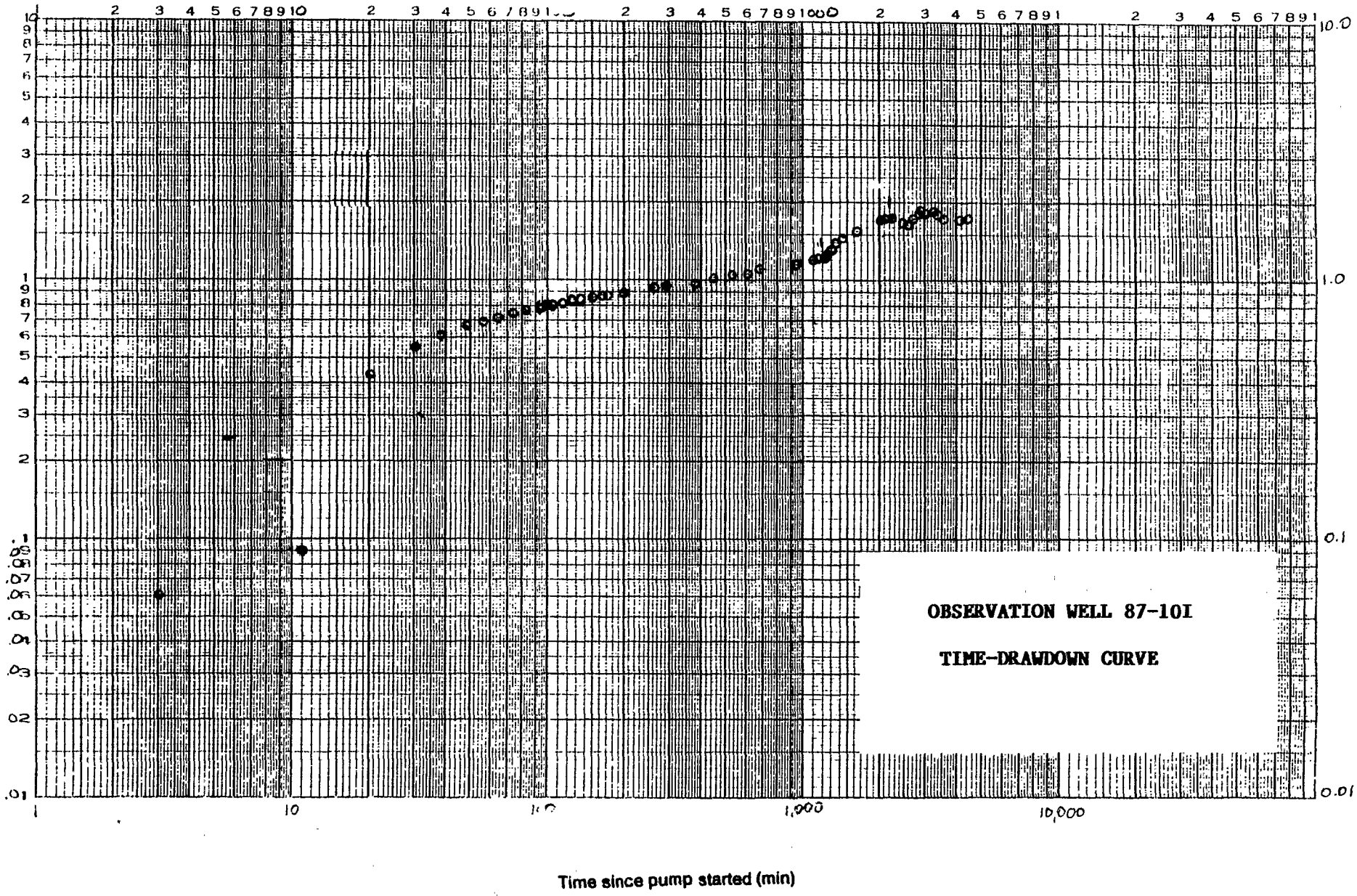
Full Logarithmic, 3 x 5

AR300893



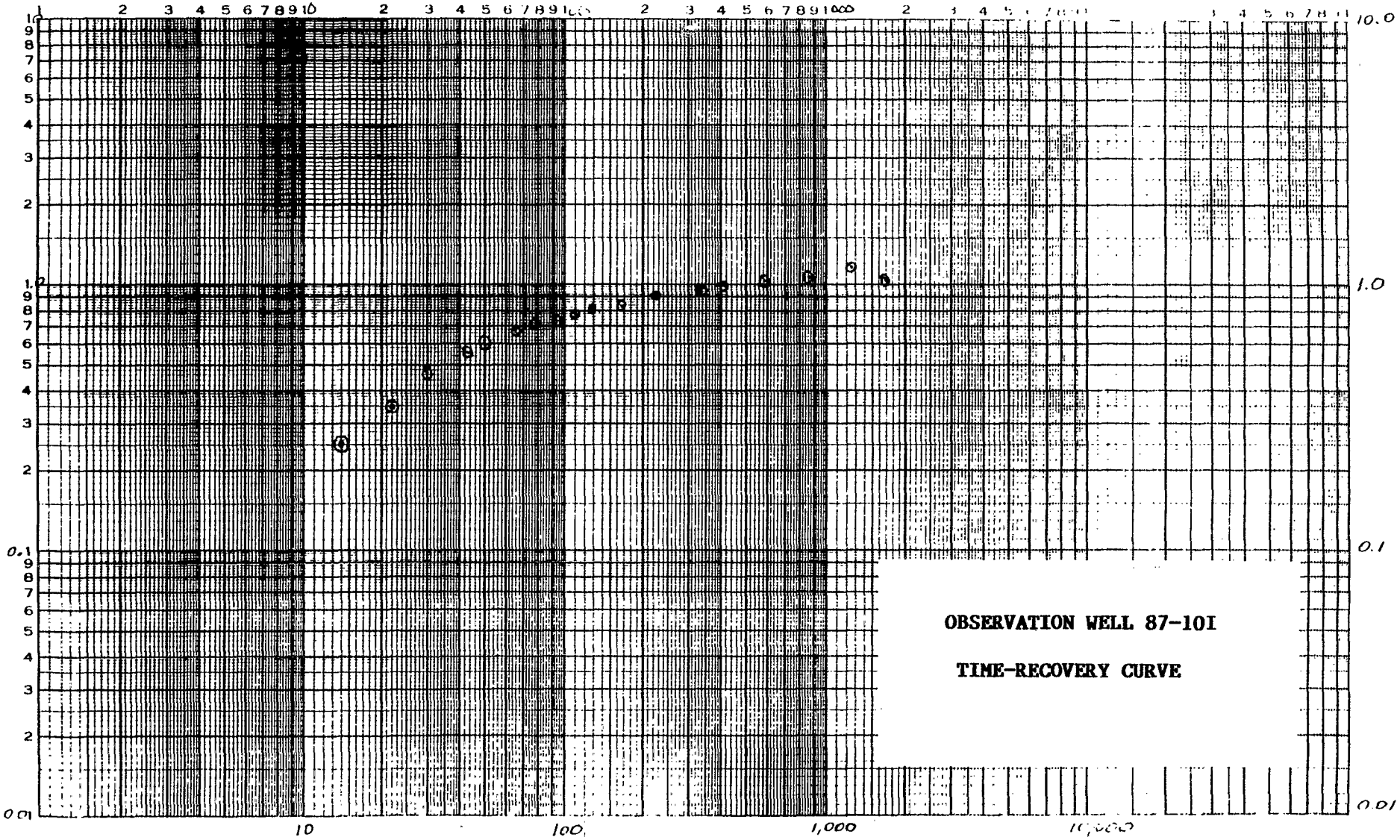
Full Logarithmic, 3 x 5

AR300894



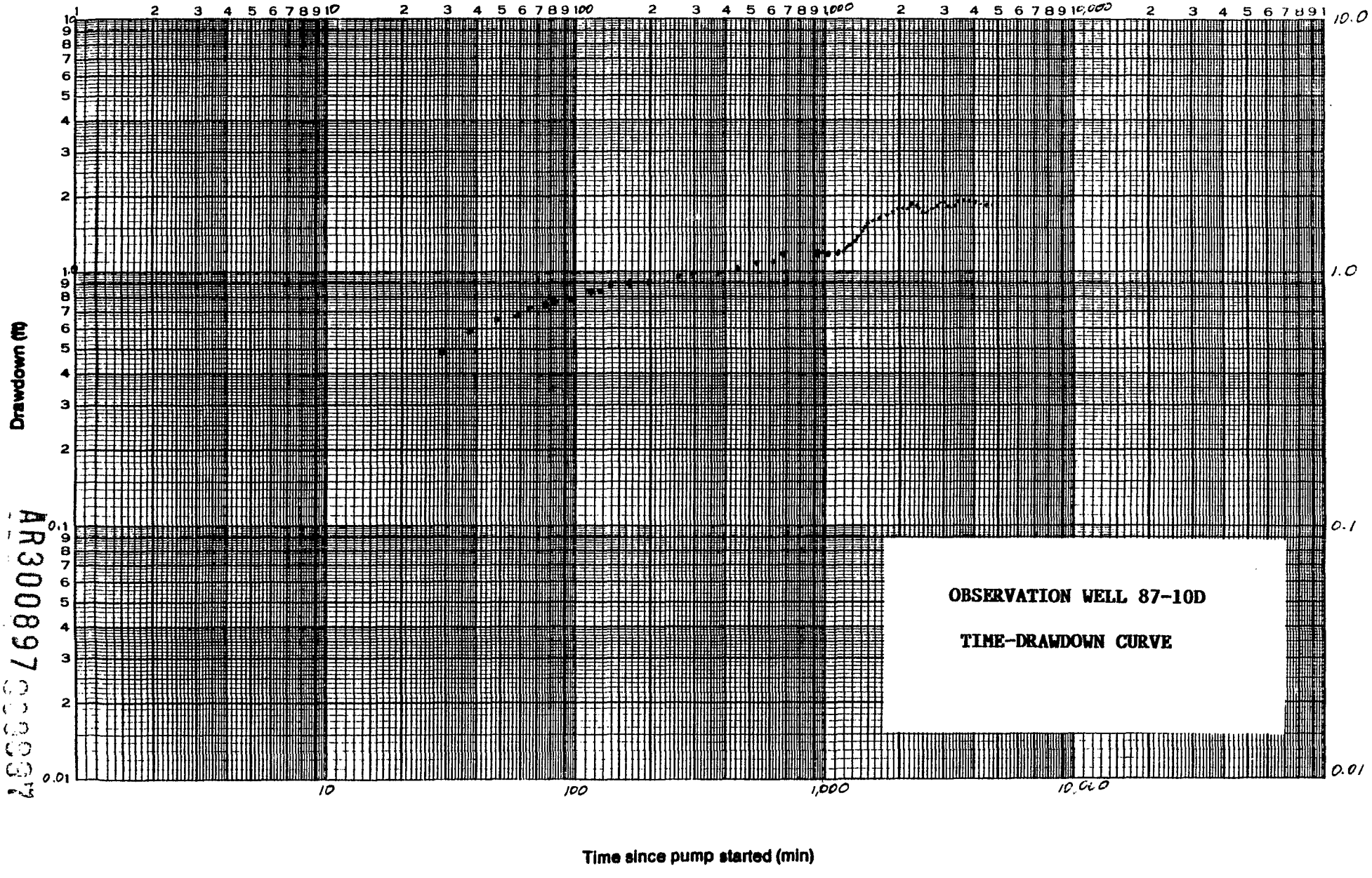
Full Logarithmic, 3 x 5

AR300895



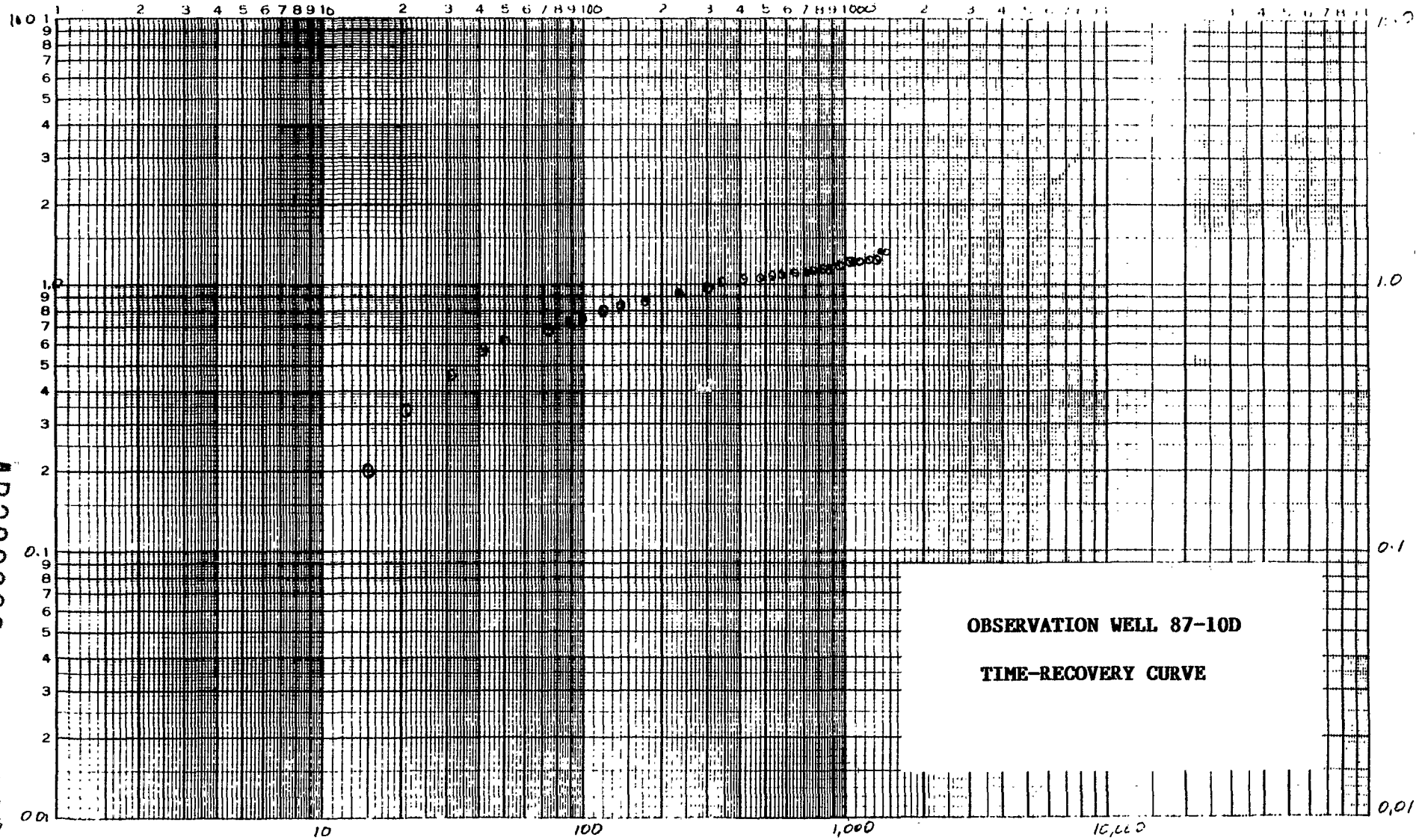
Full Logarithmic, 3 x 5

AR300896



Full Logarithmic, 3 x 5

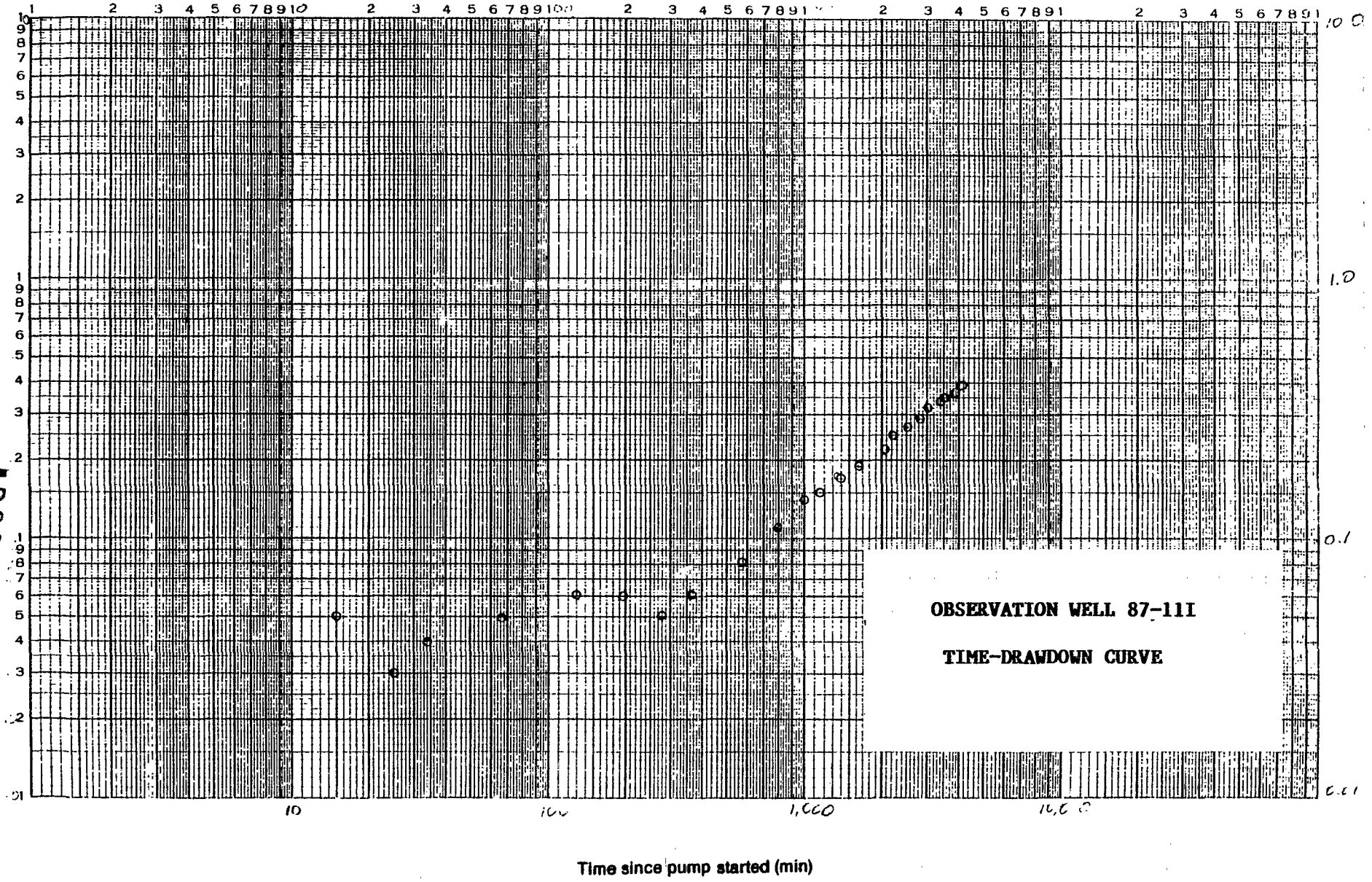
AR300897



Full Logarithmic, 3 × 5

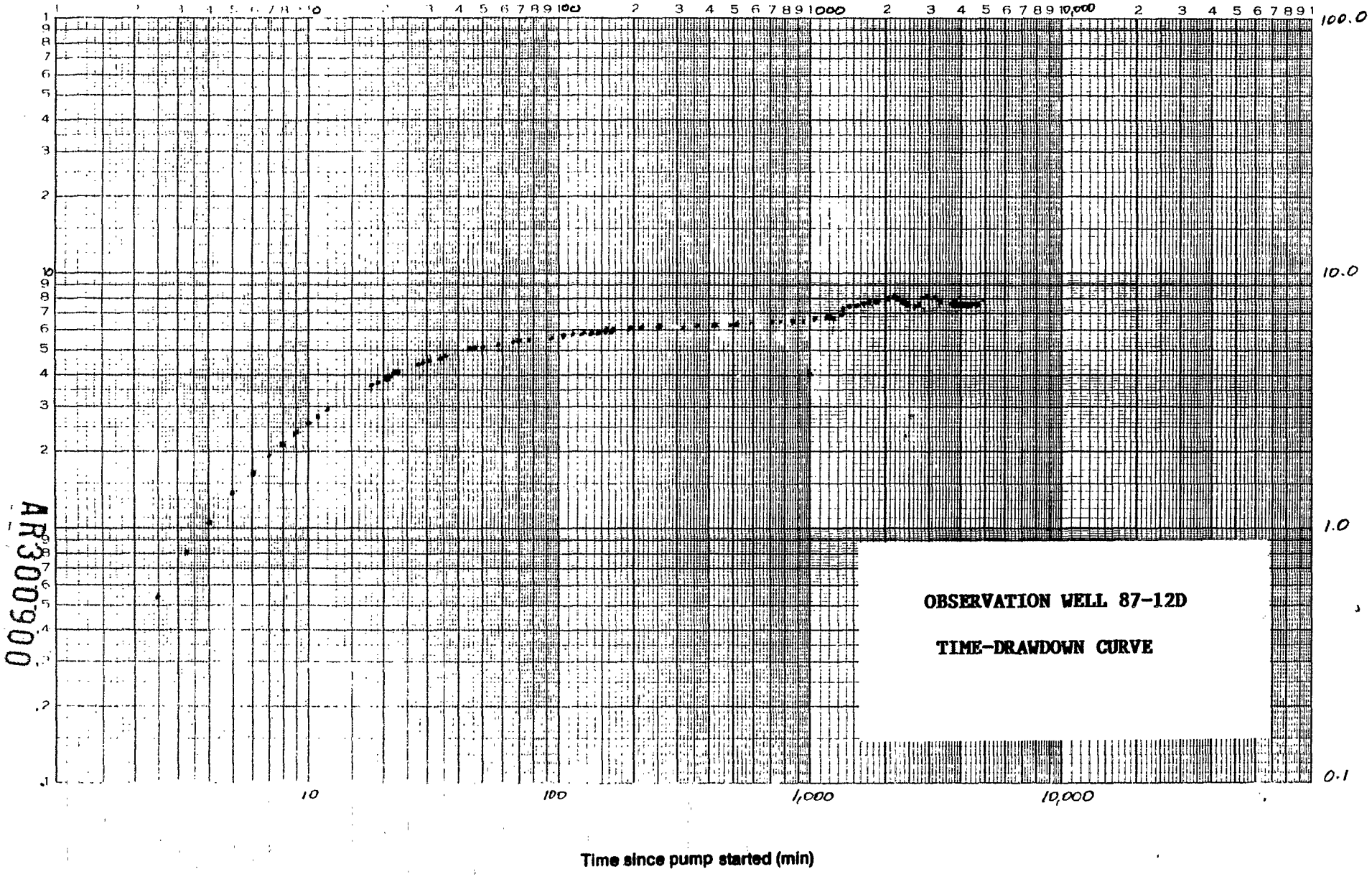
12-191

AR300898



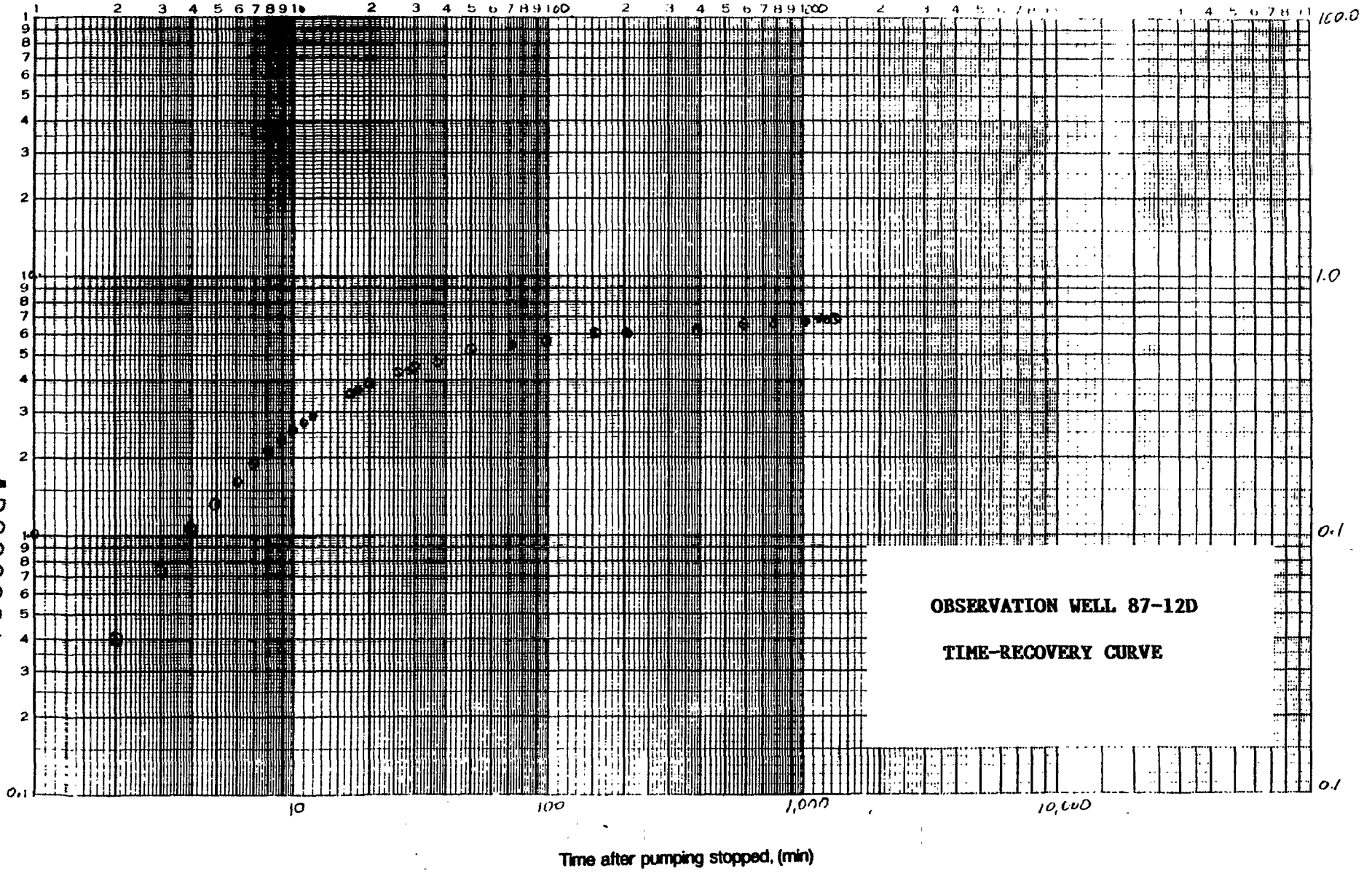
Full Logarithmic, 3 x 5

AR300899



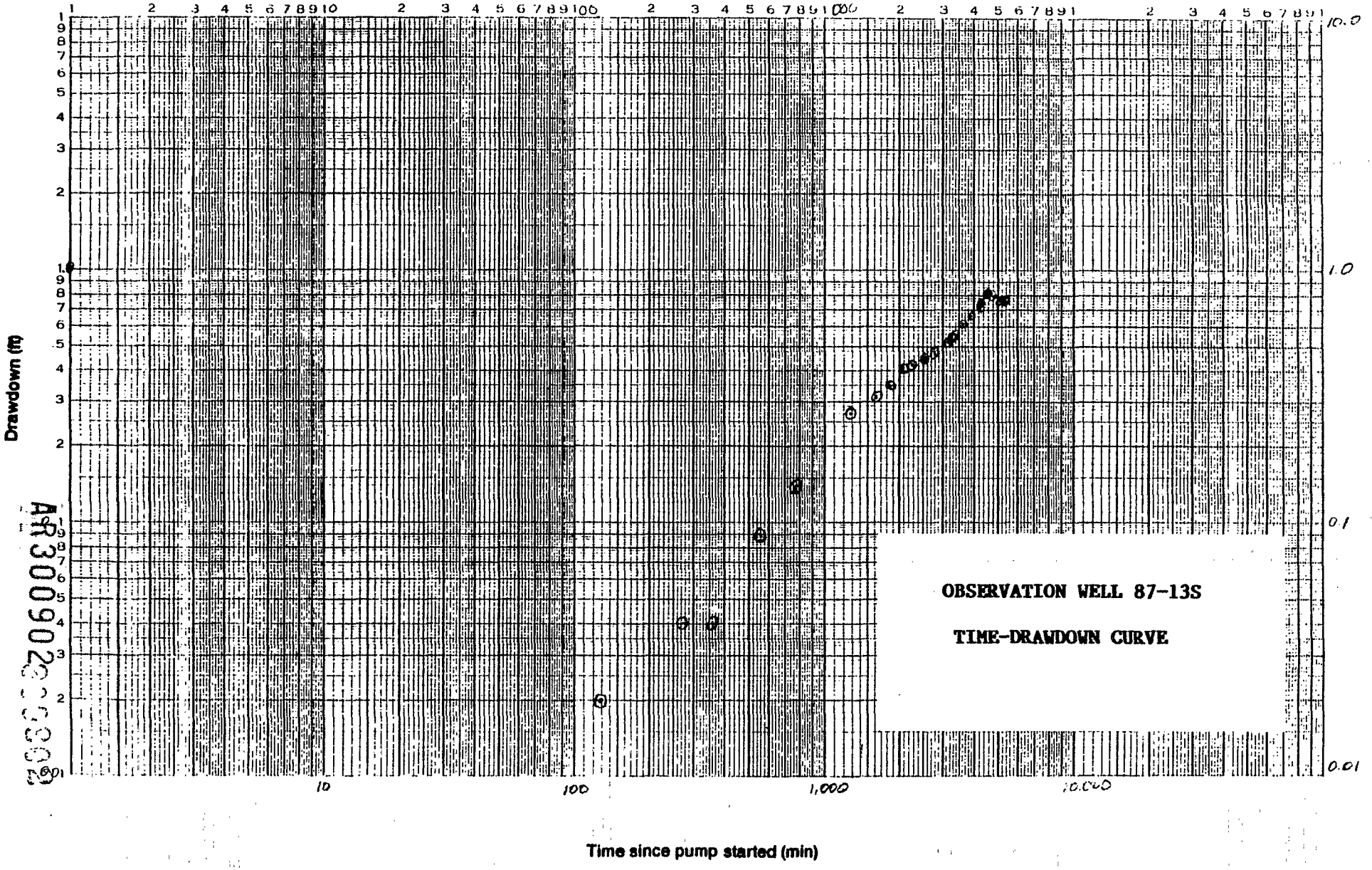
Full Logarithmic, 3 x 5

AR300900

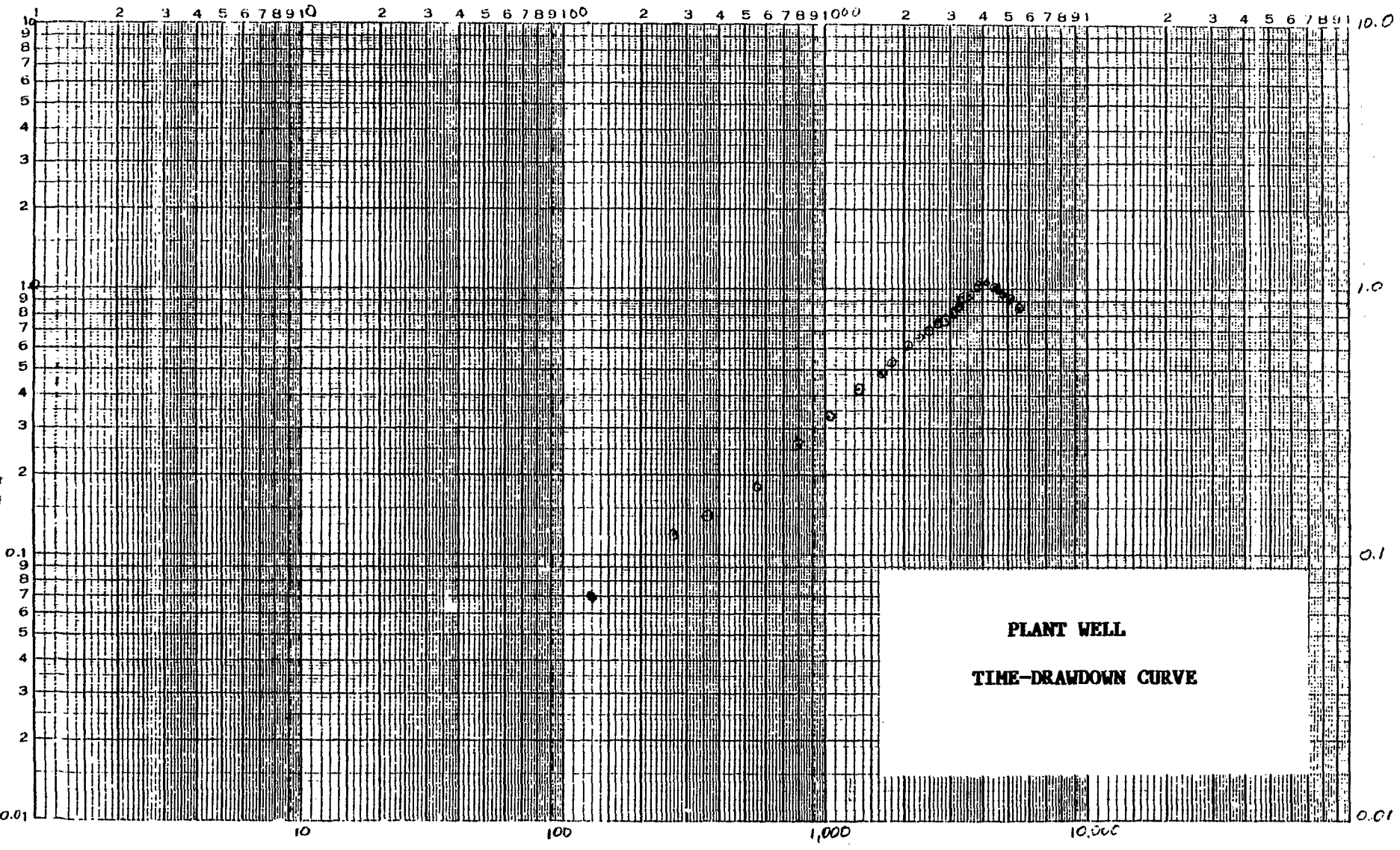


Full Logarithmic, 3 x 5

AR300901

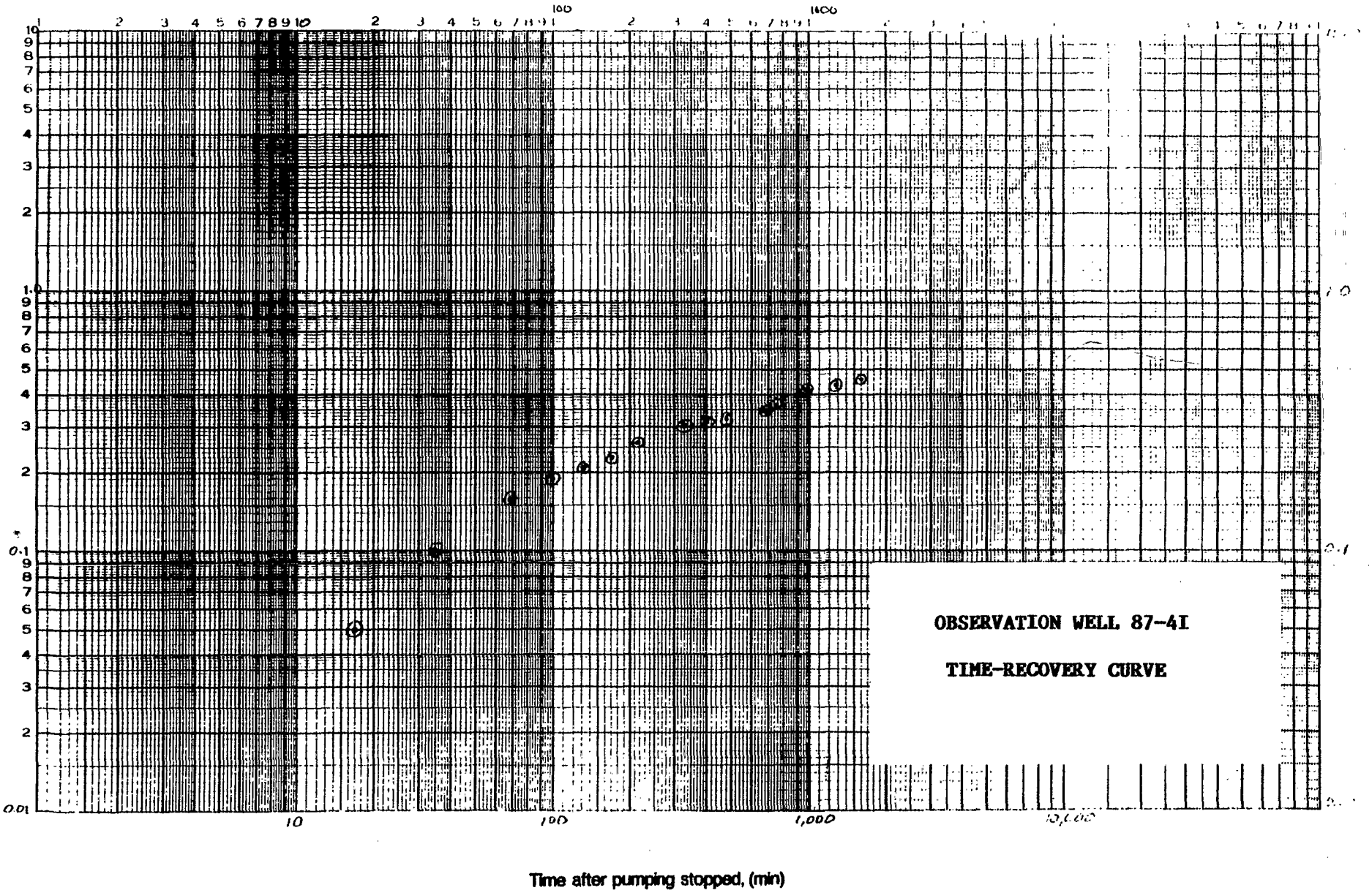

OBSERVATION WELL 87-13S
TIME-DRAWDOWN CURVE
Drawdown (ft)
Time since pump started (min)
10.0
1.0
0.1
0.01
10
100
1,000
10,000

AR300902



Full Logarithmic, 3 x 5

AR300903



Full Logarithmic, 3 x 5

AR300904

REMCOR

By AN Date 10/27/88 Subject Belly Sheet No. 1 of 15
Chkd. By DAR Date 11-21-88 Pumping Test Analysis Proj. No. 88548

Thies Equation

$$s = \frac{114.6\,Q}{T}\,(W u)$$

$$u = \frac{1.87 \times r^2 \times S}{T t}$$

where

s = drawdown, in ft, at any point in the vicinity of well

Q = pumping rate, in gpm

T = transmissivity, in gpd/ft

W(u) = well function of u

S = storage coefficient (dimensionless)

t = time since pumping started, in days

r = distance, in ft, from the wells to a point where the drawdown is measure

REMCOR

By AN Date 11/08/88 Subject Boulton Sheet No. 2 of 15
Chkd. By DAR Date 11-21-88 Pumping Test Analysis Proj. No. 88548

Boulton's Solution

$$s = \frac{114.6\,Q}{T}\,W(u_{AY}, r/B)$$

$$u_A = \frac{1.87 \times r^2 \times S_A}{T\,t}$$

$$u_Y = \frac{1.87 \times r^2 \times S_Y}{T\,t}$$

$$\gamma = 1 + \frac{S_Y}{S_A} \quad ; \quad B = \sqrt{\frac{T}{\alpha S_Y}}$$

$$\alpha t_{wt} = r/B$$

where

$W(u_{AY}, r/B)$ = well function of Boulton

S_A = early time coefficient of storage – dimensionless

S_Y = specific yield – dimensionless

B = drainage factor, in feet

$1/\alpha$ = the "Boulton delay index". It is expressed in days and is used in combination with the Boul

REMCOR

By AJ Date [illegible] Subject [illegible] Sheet No. 2 of 15
Chkd. By JAR Date 11-21-88 Pumping Test Analysis Proj. No. 88548

delay index curve to determine the time t_{wt} that the delayed yield ceases to affect the drawdown.

Boulton - Streltsova Method

$$s = \frac{114.6Q}{T} W(r, \theta_1)$$

$$\theta_1 = \frac{1.87 \times r^2 \times S_1}{T t}$$

where

$W(r, \theta_1)$ - well function of θ_1

S_1 - coefficient of storage of fissure

REMCOR

By AN Date 11/1/88 Subject Bally Sheet No. 4 of 15
Chkd. By OAR Date 11-21-88 Pumping Test Analysis Proj. No. 88548

Well 3D

Boulton - Streltsova

Type (c) r = 5.0 curve

$W(r\theta_1) = 1$; $\theta_1 = 1$; $s = 0.5'$; $t = 270\,min = 0.19\,day$

$$T = \frac{114.6 \times 243}{0.5} = 55696\ gpdft$$

$$S = \frac{55696 \times 0.19}{1.87 \times (686)^2} = 1.2 \times 10^{-2}$$

AR300908

300908

REMCOR

By AN Date 10/28/88 Subject Bally Sheet No. 5 of 15
Chkd. By OAR Date 11-21-88 Pumping Test Analysis Proj. No. 88548

Well-4I

Boulton - Streltsova

Type (C) r=5-0 curve

$W(r/\theta_1) = 1$; $\theta_1 = 1$; $S = 0.42'$; $t = 200 min = 0.139$

$$T = \frac{114.6 \times 243}{0.42} = 66304 \text{ gpd/ft}$$

$$S = \frac{66304 \times 0.139}{1.87 \times (1021)^2} = 4.4 \times 10^{-3}$$

REMCOR

By AN Date 10/28/88 Subject Bally Sheet No. 6 of 15
Chkd. By DAR Date 11-21-88 Pumping Test Analysis Proj. No. 88548

Well 5D

Boulton

Type $r/B = 0.4$ curve

$W(u_A) = 1$; $1/u_A = 1$; $s = 1.4'$; $t = 3.4$ min = $= 0.0023$ day

$$T = \frac{114.6 \times 243}{1.4} = 19{,}891 \text{ gpd/ft}$$

$$S_A = \frac{19891 \times 0.0023}{1.87 \times (307)^2} = 2.6 \times 10^{-4}$$

$W(u_Y) = 1$ $1/u_Y = 1$ $s = 1.4'$ $t = 3200$ min $= 2.22$ day

$$T = \frac{114.6 \times 243}{1.4} = 19{,}891 \text{ gpd/ft}$$

$$S = \frac{19891 \times 2.22}{1.87 \times (307)^2} = 2.5 \times 10^{-1}$$

$$B = \frac{r}{r/B} = \frac{307}{0.4} = 767.5'$$

$$\alpha = \frac{19891}{2.5 \times 10^{-1} \times (767.5)^2} = 0.14 \text{ day}^{-1}$$

$\alpha t_w = 3.2$

$$t_{wt} = \frac{3.2}{0.14} = 22.8 \text{ day}$$

REMCOR

By HJ Date 10/28/88 Subject Boulton Sheet No. 7 of 15
Chkd. By DAR Date 11-21-88 Pumping Test Analysis Proj. No. 88548

$$\gamma = 1 + \frac{S_Y}{S_A} = 1 + \frac{2.5 \times 10^{-1}}{2.6 \times 10^{-4}} = 1 + 961 = 962$$

Boulton-Streltsova

Type (c) r=2.0 curve

$W(r\theta_1) = 1$; $\theta_1 = 1$; $s = 2.0$; $t = 540\,min = 0.375\,da$

$$T = \frac{114.6 \times 243}{2.0} = 13{,}924\ gpd/ft$$

$$S = \frac{13{,}924 \times 0.375}{1.87 \times (307)^2} = 3 \times 10^{-2}$$

REMCOR

By AN Date 10/31/88 Subject Bally Sheet No. 8 of 15
Chkd. By DAR Date 11-21-88 Pumping Test Analysis Proj. No. 88548

Well 7D

this curve was attempted to match

$W(u) = 1$; $1/u = 1$; $s = 0.3$; $t = 19\,min = 0.013\,day$

$$T = \frac{114.6 \times 243}{0.3} = 92826\ gpd/ft\ (?)$$

$$S = \frac{92826 \times 0.013}{1.87 \times (945)^2} = 7.2 \times 10^{-4}$$

Boulton, Boulton-Streltsova family curves do not much.

REMCOR

By AN Date 10/31/88 Subject Bally Sheet No. 1 of 15
Chkd. By DAR Date 11-21-88 Pumping Test Analysis Proj. No. 88548

Well-10I

Boulton

Type $r/B = 0.3$ curve

$W(u_A) = 1$; $1/u_A = 1$; $s = 0.35'$; $t = 3.2\,min = 0.002$

$$T = \frac{114.6 \times 243}{0.35} = 79,565\ gpd/ft$$

$$S_A = \frac{79,565 \times 0.002}{1.87 \times (1040)^2} = 7.8 \times 10^{-5}$$

$W(u_y) = 1$; $1/u_y = 1$; $s = 0.35'$; $t = 2900\,min = 2\,da$

$$T = \frac{114.6 \times 243}{0.35} = 79,565\ gpd/ft$$

$$S = \frac{79,565 \times 2}{1.87 \times (1040)^2} = 7.7 \times 10^{-2}$$

$\alpha = r/B$

$$B = \frac{1040}{0.3} = 3466'$$

$$\alpha = \frac{79565}{7.7 \times 10^{-2} \times (3466)^2} = 0.08\ day^{-1}$$

$\alpha_{tot} = 3.1$

$$t_{tot} = \frac{3.1}{0.08} = 387.5\ day$$

AR300913 000013

REMCOR

By AN Date 10/31/88 Subject Bally Sheet No. 10 of 15
Chkd. By DAR Date 11-21-88 Pumping Test Analysis Proj. No. 88548

$$\gamma = 1 + \frac{7.7 \times 10^{-2}}{7.8 \times 10^{-5}} = 988$$

Boulton-Streltsova

Type (c) r=0.5 curve

$W(r, \alpha_1) = 1$; $\alpha_1 = 1$; $s = 2.1'$; $t = 1400 \text{ min} = 0.97 \text{ day}$

$$T = \frac{114.6 \times 243}{2.1} = 13{,}260 \text{ gpd/ft}$$

$$S = \frac{13{,}260 \times 0.97}{1.87 \times (1040)^2} = 6.3 \times 10^{-3}$$

REMCOR

By AJJ Date 10/31/88 Subject Bally Sheet No. 11 of 15
Chkd. By DAR Date 11-21-88 Pumping Test Analysis Proj. No. 88548

Well 10D

Boulton

Type 1.0 curve

$W(u_A) = 1$; $1/u_A = 1$; $s = 1.0'$; $t = 11 min = 0.00$ da

$$T = \frac{114.6 \times 243}{1.0} = 27,848 \text{ gpd/ft}$$

$$S = \frac{27,848 \times 0.0076}{1.87 \times (1074)^2} = 9.8 \times 10^{-5}$$

$W(u_Y) = 1$; $1/u_Y = 1$; $s = 1.0'$; $t = 400 min = 0.28$ day

$$T = \frac{114.6 \times 243}{1.0} = 27,848 \text{ gpd/ft}$$

$$S = \frac{27,848 \times 0.28}{1.87 \times (1074)^2} = 3.6 \times 10^{-3}$$

$$B = \frac{r}{r/B} = \frac{1074}{1.0} = 1074'$$

$$\alpha = \frac{27,848}{3.6 \times 10^{-3} \times (1074)^2} = 6.7 \text{ day}^{-1}$$

$$\alpha_{tot} = 4.5$$

REMCOR

By AN Date 10/31/88 Subject Bally Sheet No. 12 of 15
Chkd. By DAR Date 11-21-88 Pumping Test Analysis Proj. No. 88548

$$t_{wt} = \frac{4.5}{6.7} = 0.67$$

$$\gamma = 1 + \frac{3.6 \times 10^{-3}}{9.8 \times 10^{-5}} \approx 37$$

Boulton-Streltsove

Type (C) r=5.0 curve

$W(r\,Q_1) = 1$; $Q_1 = 1$; $s = 22'$; $t = 1600\,min = 1.11\,day$

(recovery curve $t = 2600\,min = 1.39\,day$

$$T = \frac{114.6 \times 243}{2.2} = 12{,}658\ gpd/ft$$

$$S = \frac{12658 \times 1.11}{1.87 \times (1074)^2} = 6.5 \times 10^{-3}$$

$S = 8.0 \times 10^{-3}$ (recovery curve)

REMCOR

By AN Date 10/31/88 Subject Bally Sheet No. 13 of 15
Chkd. By DAR Date 11-21-88 Pumping Test Analysis Proj. No. 88548

Well - 11I

Boulton

Type $r/B = 2.5$ curve

$W(u_A) = 1$; $1/u_A = 1$; $s = 0.46'$; $t = 27\,min = 0.019\,day$

$$T = \frac{114.6 \times 243}{0.46} = 60{,}539\,gpd/ft$$

$$S = \frac{60{,}539 \times 0.019}{1.87 \times (1591)^2} = 2.4 \times 10^{-4}$$

$W(u_y) = 1$; $1/u_y = 1$; $s = 0.47'$; $t = 1500\,min = 1.04\,day$

$$T = \frac{114.6 \times 243}{0.47} = 59251\,gpd/ft$$

$$S = \frac{59251 \times 1.04}{1.87 \times (1591)^2} = 1.3 \times 10^{-2}$$

$$B = \frac{1591}{2.5} = 636.4'$$

$$\alpha = \frac{59251}{1.3 \times 10^{-2} \times (636.4)^2} = 11.25\,day^{-1}$$

$\alpha t_{wr} = 8.2$

$$t_w = \frac{8.2}{11.25} = 0.73$$

$$\gamma = 1 + \frac{1.3 \times 10^{-2}}{2.4 \times 10^{-4}} = 55$$

Boulton-Stehfest curves did not match

AR300917

REMCOR

By AN Date 11/01/88 Subject Bally Sheet No. 14 of 15
Chkd. By DAR Date 11-21-88 Pumping Test Analysis Proj. No. 88548

Well 12D

Type $r/B = 0.4$ curve

$W(u_A) = 1$; $1/u_A = 10$; $s = 2.8'$; $t = 27\,min = 0.0187\,day$

$$T = \frac{114.6 \times 243}{2.8} = 9945\ gpdft$$

$$S = \frac{9945 \times 0.0187 \times 0.1}{1.87 \times (396)^2} = 6.3 \times 10^{-5}$$

$W(u_y) = 1$; $1/u_y = 1$; $s = 6.0'$; $t = 300\,min = 0.2\,d$

$$T = \frac{114.6 \times 243}{6.0} = 4641\ gpdft$$

$$S = \frac{4641 \times 0.2}{1.87 \times (396)^2} = 3 \times 10^{-3}$$

$$B = \frac{396}{0.4} = 990'$$

$$\alpha = \frac{4641}{3 \times 10^{-3} \times (990)^2} = 1.58\ day^{-1}$$

$\alpha t_{wt} = 3.2$

$$t_{wt} = \frac{3.2}{1.58} = 2.02\ day$$

$$\gamma = 1 + \frac{3 \times 10^{-3}}{6.3 \times 10^{-5}} = 48.6$$

REMCOR

By AN Date 11/01/88 Subject Bolly Sheet No. 15 of 15
Chkd. By DAR Date 11-21-88 Pumping Test Analysis Proj. No. 88548

Boulton - Streltsova

Type ⊙ r=2.0 curve

$W(r, \theta_1) = 1$; $Q_1 = 1$; $s = 4.0'$; $t = 400\,min = 0.28\,day$

$$T = \frac{114.6 \times 243}{4.0} = 6962\ gpd/ft$$

$$S = \frac{6962 \times 0.28}{1.87 \times (396)^2} = 6.7 \times 10^{-3}$$

Distance to Observation Wells

WELL	EASTING	NORTHING	ELEVATION (feet, MSL)	Dist. to Mun. Well No.3 (feet)
86-1	9583.57	9009.82	463.46	1743.7
86-2	9572.41	10077.48	479.48	891.8
86-3S	10153.78	9926.73	467.96	690.1
86-3D	10144.55	9932.64	467.96	686.3
86-4	10559.07	9630.55	457.52	1007.8
87-4I	10574.37	9621.18	454.93	1020.9
86-5S	10594.58	10571.13	468.46	303.0
86-5D	10599.35	10575.19	468.99	307.4
87-7S	11220.46	10849.93	468.74	959.7
87-7I	11200.41	10869.36	468.86	945.6
87-8I	12930.52	11084.36	449.42	2681.0
87-9I	12033.97	9053.74	493.79	2330.1
87-10I	10978.59	9821.02	449.26	1039.6
87-10D	11005.59	9798.89	449.06	1074.0
87-11S	10930.24	9160.69	461.73	1576.4
87-11I	10942.49	9150.64	462.17	1590.6
87-12D	10295.74	10206.46	466.90	396.2
87-13S	10307.94	9600.26	457.78	1002.5
Plant Well	10283.97	9679.30	456.84	923.4
Mun. Well No. 1	12064.65	11429.38	471.59	1954.9
Mun. Well No. 3	10293.20	10602.63	475.86	0.0

Tape Correction

A = 0.00
B = 0.00
C = +0.02
D = +0.03
E = +0.03

Municipal Pumping During Pumping Test

10/3 Mon BW # 1 off ≈10:00 am
BW # 3 on 3:15 pm – 3:30 pm
on 4:00 – 4:10 pm

10/4 Tues BW # 3 on 9:10 am (00:00) (0.0)

10/5 Wed BW #1 on 5:03 am (21:03) (1193)
off 10:00 pm (38:00) (2210)

10/6 Thur BW #1 on 5:00 am (45:00) (2630)
off 10:00 am (50:00) (2930)
on 12:40 pm (52:40) (3050)
off 3:00 pm (55:00) (3230)

10/7 Fri BW # 3 off 9:10 am (73:10) (4320)

10/8 Sat BW #1 on 9:00 am (97:00) (5750)
BW #1 off 7:25 pm (107:25) (6375)

10/9 Sun BW #1 on 7:50 am (119:50) (7120)

BW – Borough Well

PERMEABILITY TEST DATA SHEET

Project Name: BAILY/DAGAN No.: 88548.13

Team: RENCOR Date: 10-4-88 | 10-8-88

Well No.: MUNICIPAL WELL #3 Type of Test: CONTINUOUS PUMPING - MUNICIPAL WELL #3

Watch Time	Test Time	Water Level	ΔS			Remarks
8:00AM		31.94				
8:45AM		31.93				
9:10AM	0	31.94				MUNICIPAL WELL #3 STA
	17SECS	60.00	28.06			Q = 300GPM TO 1MI
	31 SECS	70.00	38.06			Q = 270GPM TO 1MIN S
	2MIN 57Sec	90.00	58.06			
	3MIN 42Sec	91.15	59.21			
	4MIN 32Sec	92.04	60.10			
	4MIN 59Sec	92.41	60.47			
	5MIN 19Sec	92.67	60.73			
	5MIN 38Sec	92.87	60.93			Q=265GPM AT 5MIN
	5MIN 58Sec	93.07	61.13			
	6MIN 19Sec	93.27	61.33			
	6MIN 40Sec	93.43	61.49			
	6MIN 56Sec	93.61	61.67			
	7MIN 10Sec	93.71	61.77			
	7MIN 25Sec	93.83	61.89			
	7MIN 45Sec	93.98	62.04			
	8MIN 7Sec	94.11	62.17			Q=263GPM
	8MIN 27Sec	94.22	62.28			
	8MIN 41Sec	94.31	62.37			
	9MIN 9Sec	94.47	62.53			
	9MIN 27Sec	94.60	62.66			
	9MIN 56Sec	94.66	62.72			
	10MIN 13Sec	94.83	62.89			Q=262GPM
	10MIN 29Sec	94.91	62.97			
	10MIN 42Sec	94.95	63.01			
	11MIN 01Sec	95.02	63.08			Q=263GPM
	11MIN 16Sec	95.09	63.15			
	11MIN 32Sec	95.16	63.22			
	11MIN 53Sec	95.24	63.30			
	12MIN 31Sec	95.41	63.47			Q=263GPM
	12MIN 57Sec	95.48	63.54			
	13MIN 16Sec	95.55	63.61			
	13MIN 31Sec	95.60	63.66			
	13MIN 50Sec	95.66	63.72			
	14MIN 37Sec	95.79	63.85			
	15MIN 0Sec	95.87	63.93			
	15MIN 27Sec	95.92	63.98			
	18MIN 08Sec	96.32	64.38			Q=260GPM
	18MIN 55Sec	96.42	64.48			

AR300922

PERMEABILITY TEST DATA SHEET

Project Name: BAlly | DAGAN No.:

Team: Date:

Well No.: MUNICIPAL Well #3 Type of Test:

Watch Time	Test Time	Water Level	ΔS			Remarks
	19MIN 42SEC	96.51	64.57			
	20MIN 17SEC	96.58	64.64			Q=261 GPM
	20MIN 49SEC	96.63	64.69			
	22MIN 23SEC	96.81	64.87			Q=260 GPM
	24MIN 09SEC	96.95	65.01			
	24MIN 39SEC	97.02	65.08			Q=262 GPM
	24MIN 57SEC	97.05	65.11			
	28MIN 48SEC	97.32	65.38			Q=261 GPM AT 30MI
	32MIN 4SEC	97.51	65.57			Q=254 GPM AT 33M
	34MIN 30SEC	97.60	65.66			Q=261 AT 34MIN
	38MIN 17SEC	98.08	66.14			Q=258 GPM AT 36MI
	38MIN 55SEC	98.12	66.18			Q=261 GPM
	41MIN 28SEC	98.26	66.32			
	43MIN 40SEC	98.40	66.46			Q=260 GPM AT 46M
	47MIN 08SEC.	98.49	66.55			Q=261 GPM AT 50M
	52MIN 16SEC	98.67	66.73			Q=261 GPM AT 53MI
	57MIN 16SEC	98.81	66.87			Q=260 GPM AT 62M
	65MIN 02SEC	98.97	67.03			Q=261 GPM AT 64M
	68MIN 32SEC	99.04	67.10			
	71MIN 52SEC	99.08	67.14			Q=261 GPM
	86MIN 0SEC	99.23	67.29			Q=261 GPM B.P.=29.
	96MIN 45SEC	99.39	67.45			Q=260 GPM AT 106M
	113MIN	99.52	67.58			Q=260 GPM AT 116M
	131MIN	99.58	67.64			Q=260 GPM AT 130MI
	141MIN	99.66	67.72			Q=260 GPM
	156MIN	99.73	67.79			Q=259 AT 155MIN/260 AT
	173MIN	99.84	67.90			Q=260 AT 166MIN/259 AT 17
	187MIN	99.87	67.93			
	200MIN	99.90	67.96			Q=260 GPM AT 197MIN
	215MIN	99.92	67.98			Q=260 GPM
	240MIN	99.98	68.04			Q=260 GPM
	253MIN	100.00	68.06			Q=260 GPM
	270MIN	100.03	68.09			Barometric Pressure=29.
	280MIN	100.05	68.11			Q=261 GPM
	295MIN	100.07	68.13			Q=261 GPM
	309MIN	100.06	68.12			
	320MIN	100.10	68.16			Q=259 GPM
	334MIN	100.12	68.18			Q=260 GPM
	353MIN	100.15	68.21			Q=260 GPM
	376MIN	100.18	68.24			Q=261 GPM
	400MIN	100.24	68.30			Q=260 GPM B.P.=29

AR300923

PERMEABILITY TEST DATA SHEET

Project Name: Bally/DAGAN No.:

Team: Date:

Well No.: Municipal Well #3 Type of Test:

Watch Time	Test Time	Water Level	ΔS			Remarks
	420MIN	100.25	68.31			Q = 260GPM
	451MIN	100.27	68.33			Q=260GPM
	492MIN	100.33	68.39			Q = 260 GPM
	549MIN	100.37	68.43			Q=260 B.P.=29.65
	586MIN	100.37	68.43			Q=259GPM
	619MIN	100.38	68.44			
	637MIN	100.40	68.46			Q=261GPM
	670MIN	100.41	68.47			Q=261GPM
	717MIN	100.45	68.51			Q=261GPM
	762MIN	100.47	68.53			Q=261GPM
	809MIN	100.55	68.61			Q=261GPM
	855MIN	100.58	68.64			Q=261GPM
	931MIN	100.58	68.64			Q=261 GPM
	1033MIN	100.60	68.66			Q=261GPM
	1055MIN	100.62	68.68			Q=261 GPM
	1117MIN	100.61	68.67			Q=261 GPM
	1180MIN	100.66	68.72			Q=261 GPM
10/5/88 5:03AM	1193MIN					Municipal Well #1 STA
	1200MIN	100.62	68.68			5/100" of RAIN ~1160-120
	1227MIN	100.72	68.78			
	1234MIN	100.74	68.80			Q=261 GPM
	1247MIN	100.79	68.85			Q=261GPM
	1255MIN	100.81	68.87			Q=261 GPM
	1266MIN	100.83	68.89			Q=261GPM
	1275MIN	100.82	68.88			Q=261 GPM
	1306MIN	100.93	68.99			Q=261 GPM
	1375MIN	101.08	69.14			Q=260GPM B.P.=29.7
	1447MIN	101.20	69.26			Q=260GPM
	1475MIN	101.23	69.29			Q=260GPM B.P.=29.7
	1503MIN	101.28	69.34			Q=260 GPM
	1565MIN	101.36	69.42			Q=260 GPM
	1618MIN	101.38	69.44			Q=258GPM
	1633MIN	101.56	69.62			Q=260GPM (ADJUSTED)
	1640MIN	101.60	69.66			Q=259GPM
	1664MIN	101.54	69.60			Q=258GPM
	1683MIN	101.62	69.68			Q=258GPM B.P.=29.75
	1704MIN	101.65	69.71			Q=258GPM
	1751MIN	101.72	69.78			Q=258GPM
	1805MIN	101.75	69.81			Q=258.5GPM
	1879MIN	101.84	69.90			Q=261GPM B.P.=29.8
	1895MIN	101.85	69.91			Q=261GPM

PERMEABILITY TEST DATA SHEET

Project Name: BAILY / DAGAN No.:

Team: Date:

Well No.: MUNICIPAL Well # 3 Type of Test:

Watch Time	Test Time	Water Level	ΔS			Remarks
	1945 MIN	101.90	69.96			Q=261 GPM
	2008 MIN	101.90	69.96			Q=261 GPM
	2041 MIN	101.92	69.98			Q=261 GPM
	2071 MIN	101.94	70.00			Q=261 GPM
	2121 MIN	102.01	70.07			Q=257 GPM
	2152 MIN	102.06	70.12			Q=258 GPM
	2180 MIN	102.07	70.13			Q=258 GPM
	2204 MIN	102.05	70.11			Q=257 GPM
10/5/88 10:00PM	2210 MIN					MUNICIPAL Well #1 STOPPE
	2222 MIN	102.02	70.08			Q=261 GPM
	2250 MIN	102.00	70.06			Q=260 GPM
	2299 MIN	101.90	69.96			Q=257 GPM
	2335 MIN	101.85	69.91			Q=257 GPM
	2361 MIN	101.80	69.86			Q=257 GPM
	2423 MIN	101.75	69.81			Q=261 GPM
	2473 MIN	101.71	69.77			Q=261 GPM
	2541 MIN	101.80	69.86			Q=257 GPM
	2577 MIN	101.87	69.93			Q=257 GPM
10/6/88 5:00AM	2630 MIN					MUNICIPAL Well #1 STARTE
	2692 MIN	101.80	69.86			Q=261 GPM
	2711 MIN	101.89	69.95			Q=260 GPM
	2749 MIN	101.96	70.02			Q=260 GPM
	2831 MIN	102.08	70.14			Q=258 (OVER 1000 GAL) B.P.:
10/6/88 10:00AM	2930 MIN					MUNICIPAL Well #1 STOPPE
	2933 MIN	102.15	70.21			Q=257.8 GPM (OVER 100
	2948 MIN	102.13	70.19			Q=257.6 GPM (OVER 30
	2955 MIN	102.13	70.19			Q=257.3 GPM (OVER 1
	2970 MIN	102.15	70.21			Q=257.7 GPM (OVER 3
	2973 MIN					OPEN MAIN VALVE 1/8 TURN
	2990 MIN	102.26	70.32			Q=258.2 GPM (OVER 3500
	3009 MIN	120.25	70.31			
	3026 MIN	102.22	70.28			
	3050 MIN	102.22	70.28			Q=258.4 GPM (OVER 3500 G
	3090 MIN					MUNICIPAL Well #1 STARTE
	3188 MIN	102.28	70.34			
	3192 MIN	102.27	70.33			Q=258.1 GPM (OVER 4500 G
	3230 MIN					MUNICIPAL Well #1 STOP
	3250 MIN	102.28	70.34			
	3265 MIN	102.32	70.38			Q=258.1 GPM (OVER 4500
	3285 MIN	102.21	70.27			
	3303 MIN	102.10	70.16			Q=260.8 GPM B.P.=3

AR300925

PERMEABILITY TEST DATA SHEET

Project Name: BALLY/DAGAN No.:

Team: Date:

Well No.: MUNICIPAL Well #3 Type of Test:

Watch Time	Test Time	Water Level	ΔS			Remarks
	3466 MIN	102.11	70.17			Q=258.36 PM (over spout
	3509 MIN	102.09	70.15			Q=261 GPM
	3599 MIN	102.08	70.14			Q=261 GPM
	3654 MIN	102.10	70.16			Q=257 GPM
	3709 MIN	102.11	70.17			Q=257 GPM
	3855 MIN	102.10	70.16			Q=261 GPM
	3921 MIN	102.11	70.17			Q=261 GPM
	4050 MIN	102.05	70.11			Q=257 GPM
	4087 MIN	102.05	70.11			Q=261 GPM
	4241 MIN	102.09	70.15			Q=261 GPM
	4293 MIN	102.10	70.16			B.P.=30.03
	4310 MIN	102.12	70.18			Q=258.3 GPM (over 40000
	4319 MIN	102.09	70.15			
	4320 MIN					MUNICIPAL Well #3 STOP
	4320 MIN 5 SEC	96.0	64.06			
	" " 19 SEC	67.0	35.06			
	" " 33 SEC	53.0	21.06			
	" " 42 SEC	49.0	17.06			
	" " 59 SEC	48.4	16.46			
	4321 MIN 15 SEC	48.33	16.39			
	" " 26 SEC	48.15	16.21			
	" " 30 SEC	48.00	16.06			
	" " 35 SEC	47.9	15.96			
	" " 40 SEC	47.7	15.76			
	" " 52 SEC	47.3	15.36			
	4322 MIN 0 SEC	47.0	15.06			
	" " 12 SEC	46.65	14.71			
	" " 20 SEC	46.30	14.36			
	" " 27 SEC	46.1	14.16			
	" " 33 SEC	45.9	13.96			
	" " 38 SEC	45.7	13.76			
	" " 46 SEC	45.45	13.51			
	" " 52 SEC	45.20	13.26			
	4323 MIN 0 SEC	45.05	13.11			
	" " 8 SEC	44.80	12.86			
	" " 15 SEC	44.60	12.66			
	" " 20 SEC	44.50	12.56			
	" " 28 SEC	44.30	12.36			
	" " 35 SEC	44.10	12.16			
	" " 39 SEC	44.0	12.06			
	" " 45 SEC	43.9	11.96			

PERMEABILITY TEST DATA SHEET

Project Name: Bally/DAGAN No.: _____

Team: _____ Date: _____

Well No.: Municipal Well #3 Type of Test: _____

Watch Time	Test Time	Water Level	ΔS			Remarks
	4323MIN 50SEC	43.8	11.86			
	" " 54SEC	43.7	11.76			
	4324MIN 0SEC	43.6	11.66			
	" " 04 SEC	43.5	11.56			
	" " 12 SEC	43.3	11.36			
	" " 18SEC	43.2	11.26			
	" " 22SEC	43.1	11.16			
	" " 28SEC	43.0	11.06			
	" " 33SEC	42.9	10.96			
	" " 45SEC	42.7	10.76			
	" " 51SEC	42.6	10.66			
	" " 58SEC	42.5	10.56			
	4325MIN 04SEC	42.4	10.46			
	" " 11 SEC	42.3	10.36			
	" " 18SEC	42.2	10.26			
	" " 26SEC	42.1	10.16			
	" " 32SEC	42.0	10.06			
	" " 38SEC	41.9	9.96			
	" " 47SEC	41.8	9.86			
	" " 54SEC	41.7	9.76			
	4326MIN 03SEC	41.6	9.66			
	" " 10SEC	41.5	9.56			
	" " 19 SEC	41.4	9.46			
	" " 26 SEC	41.3	9.36			
	" " 35SEC	41.2	9.26			
	" " 44SEC	41.1	9.16			
	" " 55 SEC	41.0	9.06			
	4327MIN 05SEC	40.9	8.96			
	" " 15SEC	40.8	8.86			
	" " 26SEC	40.7	8.76			
	" " 37SEC	40.6	8.66			
	" " 48SEC	40.5	8.56			
	4328MIN 0SEC	40.4	8.46			
	" " 11SEC	40.3	8.36			
	" " 24SEC	40.2	8.26			
	" " 37SEC	40.1	8.16			
	" " 50SEC	40.0	8.06			
	4329MIN 20SEC	39.8	7.86			
	" " 49SEC	39.6	7.66			
	4330MIN 0SEC	39.5	7.56			
	" " 33SEC	39.3	7.36			

PERMEABILITY TEST DATA SHEET

Project Name: Bally/DAGAN No.:

Team: Date:

Well No.: Municipal Well #3 Type of Test:

Watch Time	Test Time	Water Level	ΔS			Remarks
	4330MIN 50SEC	39.2	7.26			
	4331MIN 10SEC	39.1	7.16			
	" " 26SEC	39.0	7.06			
	" " 56SEC	38.9	6.96			
	4332MIN 05SEC	38.8	6.86			
	" " 26SEC	38.7	6.76			
	" " 47SEC	38.6	6.66			
	4333MIN 06SEC	38.5	6.56			
	" " 27SEC	38.4	6.46			
	" " 51SEC	38.3	6.36			
	4334MIN 20SEC	38.2	6.26			
	" " 42SEC	38.1	6.16			
	4335MIN 06SEC	38.0	6.06			
	" " 33SEC	37.9	5.96			
	" " 51SEC	37.8	5.86			
	4336MIN 35SEC	37.7	5.76			
	" " 49SEC	37.65	5.71			
	4337MIN 05SEC	37.60	5.66			
	" " 20SEC	37.55	5.61			
	" " 57SEC	37.45	5.51			
	4338MIN 30SEC	37.35	5.41			
	" " 46SEC	37.30	5.36			
	4339MIN 03SEC	37.25	5.31			
	" " 23SEC	37.20	5.26			
	" " 45SEC	37.15	5.21			
	4340MIN 05SEC	37.10	5.16			
	4340MIN 33SEC	37.05	5.11			
	4341MIN 26SEC	36.90	4.96			
	" " 47SEC	36.85	4.91			
	4342MIN 12SEC	36.80	4.86			
	" " 40SEC	36.75	4.81			
	4343MIN 0SEC	36.70	4.76			
	" " 25SEC	36.65	4.71			
	" " 53SEC	36.60	4.66			
	4344MIN 16SEC	36.55	4.61			
	" " 44SEC	36.50	4.56			
	4345MIN 18SEC	36.45	4.51			
	" " 42SEC	36.40	4.46			
	4346MIN 09SEC	36.35	4.41			
	" " 34SEC	36.30	4.36			
	4347MIN 12SEC	36.25	4.31			

PERMEABILITY TEST DATA SHEET

Project Name: BALLY/DAGAN No.:

Team: Date:

Well No.: MUNICIPAL Well #3 Type of Test:

Watch Time	Test Time	Water Level	ΔS			Remarks
	4347MIN 41SEC	36.20	4.26			
	4348 MIN 55SEC	36.10	4.16			
	4350MIN 12SEC	36.00	4.06			
	4350MIN 51SEC	35.95	4.01			
	4351MIN 30SEC	35.90	3.96			
	4352MIN 07SEC	35.85	3.91			
	" " 48SEC	35.80	3.86			
	4353MIN 39SEC	35.75	3.81			
	4354MIN 17SEC	35.70	3.76			
	4355MIN 03SEC	35.65	3.71			
	" " 54SEC	35.60	3.66			
	4356MIN 51SEC	35.55	3.61			
	4366MIN 20SEC	35.10	3.16			
	4367MIN 37SEC	35.05	3.11			
	4368MIN 55SEC	35.00	3.06			
	4370 MIN	34.95	3.01			
	4372MIN 30SEC	34.88	2.94			
	4373MIN 05SEC	34.87	2.93			
	" " 43SEC	34.85	2.91			
	4375MIN	34.80	2.86			
	4380MIN	34.70	2.76			
	4386MIN	34.54	2.60			
	4389MIN	34.50	2.56			
	4394MIN	34.41	2.47			
	4395MIN	34.40	2.46			
	4400MIN	34.31	2.37			
	4402MIN	34.30	2.36			
	4411MIN	34.20	2.26			
	4415MIN	34.15	2.21			
	4420MIN	34.11	2.17			
	4430MIN	34.03	2.09			
	4536MIN	33.60	1.66			
	4550MIN	33.49	1.55			
	4572 MIN	33.44	1.50			
	4592MIN	33.40	1.46			
	4634MIN	33.33	1.39			
	4680MIN	33.27	1.33			
	4704MIN	33.24	1.30			
	4745MIN	33.18	1.24			
	4757MIN					
	4768MIN	33.16	1.22			

AR300929

B.P. 29.98

PERMEABILITY TEST DATA SHEET

Project Name: BAILY DAGAN No.:

Team: Date:

Well No.: MUNICIPAL WELL #3 Type of Test:

Watch Time	Test Time	Water Level	ΔS			Remarks
	4795MIN	33.07	1.13			
	4865MIN	33.02	1.08			
	5101MIN	32.93	0.99			B.P. = 29.89
	5573MIN	32.69	0.75			B.P. = 29.80 RAIN 1/100" AT 5
	5747MIN	32.67	0.73			
	7384MIN	32.23	0.29			B.P. = 29.79

PERMEABILITY TEST DATA SHEET

Project Name: BAlly/DAGAN No.: 88548.13

Team: REMCOR Date: 10-4-88 / 10-8-88

Well No.: 86-1 Type of Test: CONTINUOUS PUMPING MUNICIPAL Well #3

Watch Time	Test Time (MIN)	Water Level	ΔS			Remarks
8:10AM	0	15.82				
9:10AM	0					PUMPING #3 STARTED
	125	15.80	+0.02			
	266	15.82	0.00			
	357	15.82	0.00			
	554	15.85	0.03			
	769	15.86	0.04			
	998	15.87	0.05			
	1133	15.87	0.05			
10/5/88 5:03AM	1193					MUNICIPAL Well #1 STAR
	1368	15.89	0.07			
	1636	15.89	0.07			
	1779	15.88	0.06			
	2017	15.92	0.10			
	2116	15.92	0.10			
10/5/88 10:00PM	2210					MUNICIPAL WELL #1 STOPPE
	2276	15.92	0.10			
	2504	15.93	0.11			
10/6/88 5:00AM	2630					MUNICIPAL Well #1 STARTE
	2660	15.95	0.13			
	2839	15.96	0.14			
10/6/88 10:00AM	2930	—				MUNICIPAL WELL #1 ST
	3012	15.97	0.15			
	3242	15.97	0.15			MUNICIPAL Well #1 ON
	3416	15.98	0.16			3090 – 3230 MIN
	3556	16.00	0.18			
	3901	16.00	0.18			
	4207	16.02	0.20			
10/7/88 9:10AM	4320					MUNICIPAL Well #3 STOPPE
	4384	16.01	0.19			
	4425	16.00	0.18			
	4507	16.00	0.18			
	4727	16.00	0.18			
	4906	16.02	0.20			
	5034	16.00	0.18			
	5634	16.02	0.20			

PERMEABILITY TEST DATA SHEET

Project Name: BALLY/DAEAN No.: 88548.13

Team: REMCOR Date: 10-4-88 / 10-8-88

Well No.: 86-2 Type of Test: CONTINUOUS PUMPING - MUNICIPAL Well #3

Watch Time	Test Time (MIN)	Water Level	ΔS			Remarks
8:24AM	0	30.98				
9:10AM	0					PUMPING #3 STARTED
	123	31.02	0.04			
	276	31.07	0.09			
	578	31.17	0.19			
	772	31.23	0.25			
	992	31.30	0.32			
	1130	31.32	0.34			
10/5/88 5:03AM	1193					MUNICIPAL Well #1 STARTE
	1379	31.37	0.39			
	1648	31.43	0.45			
	1789	31.46	0.48			
	2029	31.53	0.55			
	2113	31.55	0.57			
10/5/88 10:30PM	2210					MUNICIPAL Well #1 STOPP
	2273	31.58	0.60			
	2506	31.61	0.63			
10/6/88 5:00AM	2630					MUNICIPAL Well #1 STARTE
	2649	31.63	0.65			
	2827	31.67	0.69			
10/6/88 10:00AM	2930					MUNICIPAL Well #1 STOPP
	3028	31.71	0.73			
	3230	31.72	0.74			MUNICIPAL Well #1 O
	3414	31.75	0.77			3090-3230 MIN
	3566	31.78	0.80			
	3898	31.82	0.84			
	4082	31.82	0.84			
	4216	31.82	0.84			
10/7/88 9:10AM	4320					STOPPED PUMPING WELL=
	4386	31.84	0.86			
	4411	31.84	0.86			
	4465	31.80	0.82			
	4546	31.77	0.79			
	4725	31.69	0.71			
	4901	31.65	0.67			
	5043	31.64	0.66			
	5626	31.56	0.58			

Ref Elev = 467.96

PERMEABILITY TEST DATA SHEET

Project Name: BAILY/DAGAN

No.: 88548.13

Team: REMCOR

Date: 10-4-88/10-7-8

Well No.: 86-35

Type of Test: CONTINOUS PUMPING - MUNIC WELL #3

Watch Time	Test Time	Water Level	ΔS	ELEVATION		Remarks
8:10AM	0	20.27		447.69		
9:10AM	0					PUMPING #3 STARTED
	15	20.32	0.05	447.64		
	25	20.35	0.08	447.61		
	39	20.37	0.10	447.59		
	43	20.37	0.10	447.59		
	63	20.39	0.12	447.57		
	81	20.41	0.14	447.55		
	90	20.42	0.15	447.54		
	112	20.425	0.155	447.53		
	120	20.43	0.16	447.53		
	145	20.44	0.17	447.52		
	189	20.47	0.20	447.49		
	217	20.50	0.23	447.46		
	253	20.51	0.24	447.45		
	278	20.52	0.25	447.44		
	365	20.55	0.28	447.41		
	465	20.58	0.31	447.38		
	525	20.62	0.35	447.34		
	581	20.63	0.36	447.33		
	702	20.68	0.41	447.28		
	989	20.79	0.52	447.17		
	1089	20.82	0.55	447.14		
	1137	20.83	0.56	447.13		
10/5/88 5:00AM	1193					MUNICIPAL Well #1 START
	1381	20.90	0.63	447.06		
	1464	20.94	0.67	447.02		
	1651	20.97	0.70	446.99		
	1735	21.06	0.79	446.90		
	2030	21.10	0.83	446.86		
	2109	21.12	0.85	446.84		
10/5/88 10:00PM	2210					MUNICIPAL Well #1 STOPP
	2262	21.16	0.89	446.80		
	2492	21.20	0.93	446.76		
	2646	21.23	0.96	446.73		
	2824	21.29	1.02	446.67		
10/6/88 5:00AM	2630					MUNICIPAL Well #1 START
10/6/88 10:00AM	2930					MUNICIPAL Well #1 STOPP
	3023	21.33	1.06	446.63		
	3226	21.37	1.10	446.59		MUNICIPAL Well #10
	3480	21.41	1.14	446.55		3000-3230 MIN.

PERMEABILITY TEST DATA SHEET

Project Name: Bally/DAGAN No.: 88548.13

Team: Remcor Date:

Well No.: 86-3S Type of Test: CONTINUOUS PUMPING - MUNICIPAL WELL #3

Watch Time	Test Time	Water Level	ΔS			Remarks
	3569	21.46	1.19	446.50		
	3696	21.47	1.20	446.49		
	3895	21.51	1.24	446.45		
	4079	21.54	1.27	446.42		
	4221	21.56	1.29	446.40		
10/7/88 9:10AM	4320					STOPPED PUMPING WELL #3
	4335	21.56	1.29	446.40		
	4343	21.53	1.26	446.43		
	4353	21.52	1.25	446.44		
	4376	21.49	1.22	446.47		
	4390	21.46	1.19	446.50		
	4407	21.45	1.18	446.51		
	4417	21.44	1.17	446.52		
	4436	21.43	1.16	446.53		
	4476	21.43	1.16	446.53		
	4532	21.36	1.09	446.60		
	4647	21.30	1.03	446.66		
	4717	21.28	1.01	446.68		
	4911	21.24	0.97	446.72		
	5046	21.21	0.94	446.75		
	5614	21.12	0.85	446.84		

REF ELEV 467.96 + 0.05
= 468.01

PERMEABILITY TEST DATA SHEET

Project Name: Dagan / Bally
No.: 88548
Team: Remcor
Date: 10/4/88
Well No.: 86-3D
Type of Test: Constant Rate Pump Test @ Municipal Well #3.

Watch Time	Test Time	Water Level	ΔS	ELEVATION		Remarks
0:26:45	0	20.31	0.00	447.70		
1:10:00	0					Pumping Well Starts 9:1
1:24:00	14.00	20.34	0.03	447.67	✓	
1:35:40	25.67	20.37	0.06	447.64	✓	
1:59:14	49.23	20.42	0.11	447.59	✓	
2:10:-	60.0	20.45	0.14	447.56	✓	
2:32:-	82.0	20.47	0.16	447.54	✓	
3:01:-	111.0	20.49	0.18	447.52	✓	
3:22:-	132	20.51	0.20	447.50		
4:25:-	195	20.56	0.25	447.45		
5:22:-	252	20.58	0.27	447.43	✓	
7:13:-	363	20.63	0.32	447.38		
7:45:-	395	20.66	0.35	447.35		
9:52:-	522	20.70	0.39	447.31		
10:52:-	582	20.73	0.42	447.28		
12:51:-	701	20.77	0.46	447.24		
14:30:-	800	20.80	0.49	447.21		
17:37:-	987	20.86	0.55	447.15		
19:17:-	1087	20.88	0.57	447.13	✓	
21:03:-	1193					Munic. Well #1 Starts 5:03
22:41:-	1291	20.95	0.64	447.06		
24:11:-	1381	20.98	0.67	447.03		
25:34:-	1464	21.01	0.70	447.00		
28:42:-	1652	21.07	0.76	446.94		
31:00:-	1790	21.10	0.79	446.91		
33:03:-	1913	21.14	0.83	446.87		
35:00:-	2030	21.19	0.88	446.82		
36:20:-	2110	21.21	0.90	446.80		
38:00:-	2210					Munic. Well #1 Stops 10:00p
38:53:-	2263	21.24	0.93	446.77		
42:00:-	2450	21.28	0.97	446.73		
45:00:-	2630					Munic. Well #1 Starts 5:00am
45:16:-	2646	21.32	1.01	446.69		
48:12:-	2822	21.38	1.07	446.63		
50:00:-	2930					Munic Well #1 Stops 10:00a
51:34:-	3024	21.42	1.11	446.59		
52:40:-	3090					Munic. Well #1 Starts 12:40p
54:56:-	3226	21.46	1.15	446.55		
55:00:-	3230					Munic Well #1 Stops 3:00p
57:45:-	3395	21.51	1.20	446.50		
60:39:-	3569	21.57	1.26	446.44	✓	

AR300935

PERMEABILITY TEST DATA SHEET

Project Name: Dagan / Bally No.: 88548

Team: Remcor Date: 10/4/88

Well No.: 86-3D Type of Test: Constant Rate Pump Test @ Municipal Well # 3

Watch Time	Test Time	Water Level				Remarks
62:46:-	3696	21.58	1.38	446.41		
66:06:-	3896	21.62	1.31	446.38		
69:09:-	4079	21.64	1.33	446.36		
71:29:-	4219	21.66	1.35	446.34		
73:00:-	4310	21.68	1.37	446.32		
73:10:-	4320					Pumping Well Off 9:10 am
73:24:-	4334	21.67	1.36	446.33		
73:32:-	4342	21.64	1.33	446.36		
73:43:-	4353	21.61	1.30	446.39		
74:03:-	4373	21.57	1.26	446.43		
74:45:-	4415	21.51	1.20	446.49		
75:40:-	4470	21.47	1.16	446.53		
76:40:-	4530	21.43	1.12	446.57		
78:35:-	4645	21.37	1.06	446.63		
79:45:-	4715	21.34	1.03	446.66		
83:02:-	4912	21.30	0.99	446.70		
85:18:-	5048	21.27	0.96	446.73		
89:18:-	5288	21.21	0.90	446.79		
94:44:-	5614	21.17	0.86	446.83		
97:00:-	5750					Munic. Well #1 Starts 9:00
97:44:-	5794	21.15	0.84	446.86		
103:00:-	6110	21.13	0.82	446.87		
107:25:-	6375					Munic Well #1 Stops 7:25
117:00:-	6950	21.15	0.84	446.85		
119:50:-	7120					Munic Well #1 Starts 7:50
125:28:-	7458	21.08	0.77	446.92		

PERMEABILITY TEST DATA SHEET

Project Name: BAlly/DAGAN No.: 88548.13

Team: REMCOR Date: 10-4-88/10-8-8

Well No.: 86-4 Type of Test: CONTINUOUS PUMPING — MUNICIPAL Well # 3

ELEV 457.52

Watch Time	Test Time	Water Level	ΔS			Remarks
8:31AM	0	11.31				
9:10AM	0	11.32				
	7.5	11.33	0.01			
	16	11.34	0.02			
	24.3	11.34	0.02			
	33.5	11.35	0.03			
	43	11.35	0.03			
	52	11.35	0.03			
	60	11.35	0.03			
	73	11.36	0.04			
	78	11.36	0.04			
	91	11.36	0.04			
	110	11.36	0.04			
	131	11.36	0.04			
	152	11.37	0.05			
	181	11.38	0.06			
	193	11.38	0.06			
	257	11.40	0.08			
	282	11.41	0.09			
	369	11.44	0.12			
	439	11.46	0.14			
	528	11.49	0.17			
	585	11.51	0.19			
	698	11.55	0.23			
	951	11.62	0.30			
	1091	11.65	0.33			
	1139	11.65	0.33			
10/5/88 5:03AM	1193					MUNICIPAL Well #1 START
	1384	11.72	0.40			
	1460	11.74	0.42			
	1656	11.75	0.43			
	1918	11.82	0.50			
	2032	11.87	0.55			
	2105	11.88	0.56			
10/5/88 10:00pm	2210					MUNICIPAL Well #1 STOPP
	2260	11.91	0.59			
	2489	11.93	0.61			
10/6/88 5:00AM	2630					MUNICIPAL Well #1 STAR
	2642	11.98	0.66			
	2819	12.03	0.71			MUNICIPAL Well #1 STOPP
	3016	12.04	0.72			AT 20

AR300937

PERMEABILITY TEST DATA SHEET

Project Name: BAILY/DAGAN No.: 88548.13

Team: PEMCOR Date: 10-4-88/10-8-8

Well No.: 86-45 Type of Test: CONTINUOUS PUMPING - MUNICIPAL well #3

Watch Time	Test Time	Water Level	ΔS			Remarks
	3090					MUNICIPAL Well #1 ST
	3221	12.06	0.74			
	3230					MUNICIPAL Well #1 ST
	3379	12.10	0.78			
	3690	12.13	0.81			
	3886	12.17	0.85			
	4076	12.19	0.87			
	4230	12.21	0.89			
10/7/88 9:10AM	4320					MUNICIPAL well #3 STO
	4339	12.21	0.89			
	4354	12.21	0.89			
	4366	12.20	0.88			
	4389	12.19	0.87			
	4402	12.18	0.86			
	4420	12.17	0.85			
	4454	12.16	0.84			
	4489	12.15	0.83			
	4537	12.14	0.82			
	4651	12.12	0.80			
	4721	12.10	0.78			
	4907	12.09	0.77			
	5057	12.09	0.77			
	5609	12.02	0.70			
	5936	12.00	0.68			

PERMEABILITY TEST DATA SHEET

Project Name: Dagan / Bally No.: 88548.13

Team: PVS, JGK, MDB, MLK Date: 10-4-88

Well No.: 87-4I Type of Test: Constant Rate Pumping Test of Municipal Well #3 at 242gpm

Static: 9.51

Watch Time	Test Time	Water Level (min)	ΔS (ft)		Remarks
00:30:15	—	9.51			
01:10:15	0.25	9.52	0.00		
	8.5	9.55	0.03		
	17.0	9.58	0.06		
	25.5	9.62	0.10		
	34.5	9.64	0.12		
	44.3	9.66	0.14		
02:03:00	53.0	9.67	0.15		
	61.0	9.68	0.16		
	71.0	9.69	0.17		
02:30:00	80	9.70	0.18		
	110	9.72	0.20		
	154	9.75	0.23		
	194	9.77	0.25		
05:28:00	258	9.79	0.27		
	342	9.80	0.28		
	370	9.83	0.31		
	440	9.85	0.33		
	529	9.88	0.36		
	584	9.91	0.39		
12:46:00	696	9.94	0.42		
	700 to 1010				No Record - Recorder Vandalized
	1010	10.06	0.54		
	1091	10.07	0.55		
	1295	10.12	0.60		
	1387	10.15	0.63		
	1460	10.17	0.65		
28:48:00	1658	10.20	0.68		Reset Float Took Hand Meas
	1919	10.27	0.75		
	2033	10.31	0.79		
	2105	10.33	0.81		
	2211	10.34	0.82		
	2391	10.34	0.82		
45.12.00	2642	10.35	0.83		
48:09:00	2819	10.41	0.89		
	3018	10.44	0.92		
	3222	10.48	0.96		
57:30:00	3380	10.48	0.96		Reset Float Took Hand Meas
62.39:00	3689	10.55	1.03		
	3886	10.55	1.03		
	4075	10.56	1.04		

PERMEABILITY TEST DATA SHEET

Project Name: Dagan / Bally No.: 88548.13

Team: PVS, JGK, MOB, MLK Date: Start 10-4-88

Well No.: 87-4I Type of Test: Constant Rate Pumping Test of Municipal Well #3 @ 243 GPM

Static: 9.50

Watch Time	Test Time (min)	Water Level	ΔS	Δs'	t'	t/t'	Remarks
	4223	10.58	1.06				
	4303	10.59	1.07				
	4320	10.59	1.07	-0-	-0-	-0-	
	Recovery Measurements						Municipal Well #3 Stopp' at 4320
	4337	10.54	1.02	.05	17	255.1	
	4355	10.49	0.97	.10	35	124.4	
	4389	10.43	0.91	.16	69	63.6	
	4420	10.40	0.88	.19	100	44.2	
75:24:00	4454	10.38	0.86	.21	134	33.2	
	4490	10.36	0.84	.23	170	26.4	
	4538	10.33	0.81	.26	218	20.8	
	4652	10.29	0.77	.30	332	14.0	
	4720	10.27	0.75	.32	400	11.8	
	4778	10.26	0.74	.33	478	10.0	
82:54:00	4904	10.24	0.72	.35	584	8.4	
	5058	10.22	0.70	.37	738	6.9	
	5298	10.17	0.65	.42	978	5.4	
94:41:00	5611	10.15	0.63	.44	1291	4.3	
	5919	10.13	0.61	.46	1599	3.7	

PERMEABILITY TEST DATA SHEET

Project Name: DAGAN / Bally No.: 88548

Team: REMCOR Date: 10/4/88

Well No.: 86-5D Type of Test: Cont Pump. Municipal Well #3

	Watch Time	Test Time	Water Level				Remarks
	09:45	515	26.57	3.45	442.42		
	12:28	678	26.67	3.55	442.32		10/4/88
	16:46	936	26.73	3.61	442.26		10/5/88
	18:28	1038	26.74	3.62	442.25		
	19:30	1100	26.76	3.64	442.23		
5:33AM	21.03	1193	26.79	3.67	442.20	—	Municipal well #1 STAR
	21.33	1223	26.98	3.86	442.01		@ 21:03 - Watch Tim
	21:50	1240	27.07	3.95	441.92		
	22:09	1259	27.18	4.06	441.81		—
	23:47	1357	27.58	4.46	441.41		
	24:16	1386	27.67	4.55	441.32		
	25:20	1450	27.83	4.71	441.16		
	26:19	1509	27.91	4.79	441.08		
	27:20	1570	28.02	4.90	440.97		
	28.33	1643	28.10	4.98	440.89		
	29:30	1700	28.17	5.05	440.82		
	30:23	1753	28.25	5.13	440.74		
	31.25	1815	28.31	5.19	440.68		
	32:37	1887	28.38	5.26	440.61		
	34:44	2014	28.49	5.37	440.50		
	35:45	2,075	28.56	5.44	440.43		
	38:00	2210	28.62	5.50	440.37		Munic Well #1 STOPS
	38:17	2227	28.53	5.41	440.46		
	38:43	2253	28.41	5.29	440.58		
	39.31	2301	28.33	5.21	440.66		
	40.08	2,338	28.11	4.99	440.88		
	44:58	2628	27.73	4.61	441.26		
	45:00	2630	—				Municip Well #1 strt
	45:59	2689	28.03	4.91	440.96		
	48:49	28.59	28.56	5.44	440.43		
	50:00	2,930	28.64	5.52	440.35		Munic. Well #1 STOPS
	50.11	2941	28.60	5.48	440.39		
	50:23	2,953	28.56	5.44	440.43		
	50.33	2,963	28.52	5.40	440.47		
	50:52	2,982	28.43	5.31	440.56		
	51:13	3003	28.36	5.24	440.63		
	52.23	3073	28.18	5.06	440.81		
	53:48	3158	28:39	5.27	440.60		
	54:29	3,199	28:48	5.36	440.51		
	55:02	3232	28.58	5.46	440.41		
	56:21	3,311	28.36	5.24	440.63		

468.99-0.00

Sheet 1 of _

PERMEABILITY TEST DATA SHEET

Ref. Elev

Project Name: DAGAW | BAILY No.: 88548

Team: RENCOR Date: 10/4/88

Well No.: 86-5D Type of Test: Cont Pump. Municipal Well #3

Watch Time	Test Time	Water Level	ΔS feet	ELEVATION		Remarks
00:44:45	0	23.12	0	445.87		PUMPING WELL START AT WATCH TIME 1.10
1:13:00	3.00	23.30	0.18	445.69		
1:14.00	4.00	23.46	0.34	445.53		
1:15:00	5.00	23.66	0.48	445.39		
1.16.30	6.50	23.82	0.70	445.17		
1.17.00	7.00	23.89	0.77	445.10		
1:18:00	8.00	24.02	0.90	444.97		
1:19	9.00	24.12	1.00	444.87		
1:20	10.0	24.22	1.10	444.77		
1:21	11.0	24.32	1.20	444.67		
1:22	12.0	24.40	1.28	444.59		
1:24	14.0	24.57	1.45	444.42		
1:25	15.0	24.63	1.51	444.36		
1:26	16.0	24.70	1.58	444.29		
1:28	18.0	24.81	1.69	444.18		
1:29	19.0	24.86	1.74	444.13		
1:32.45	22.75	25.03	1.91	443.96		
1:34.30	24.5	25.09	1.97	443.90		
1:36.0	26	25.15	2.03	443.84		
1:39.30	29.5	25.24	2.12	443.75		
1:43.30	33.5	25.34	2.20	443.60		
1:47.00	37.0	25.41	2.29	443.58		
1:50	40.0	25.48	2.36	443.51		
1:56.10	46.0	25.57	2.45	443.42		
2:01.00	51.0	25.63	2.51	443.36		
2:03.00	53.0	25.65	2.53	443.34		
2:10.00	60.0	25.72	2.60	443.27		
2:18.00	68.0	25.79	2.67	443.20		
2:31.00	81.0	25.87	2.75	443.12		
2:42.00	92.0	25.95	2.83	443.04		
3:00	110	26.04	2.92	442.95		
3:15	125	26.09	2.97	442.90		
3:30	140	26.19	3.07	442.80		
3:45	155	26.21	3.09	442.78		
4:00	170	26.26	3.14	442.73		
4:30	200	26.31	3.19	442.68		
5:16	246	26.34	3.22	442.65		
5:40	270	26.38	3.26	442.61		
6:09	299	26.39	3.27	442.60		
7:08	358	26.45	3.33	442.54		
8:06	416	26.50	3.38	442.49	✓	

AR300942

PERMEABILITY TEST DATA SHEET

Project Name: DAGAN/Bally No.: 88548

Team: Remcor Date: 10/4/88 - 10/9/8

Well No.: 86-5D Type of Test: Cont. Pump, Municipal We #1

Watch Time	Test Time	Water Level	ΔS (feet)			Remarks
56:30	3320	28.32	5.20	440.67		
58:36	3446	28.13	5.01	440.86		
61:00	3590	28.00	4.88	440.99		
63:02	3712	27.94	4.82	441.05		
65:32	3862	27.88	4.76	441.11		
68:46	4056	27.82	4.70	441.17		
70:47	4177	27.83	4.71	441.16		
72:17	4267	27.87	4.75	441.12		
73:06	4316	27.89	4.77	441.10		
73:11	4321	27.85	4.73	0.04	441.14	- Well #1 shut off at 73:10 (432
73:12	4322	27.71	4.59	0.18	441.28	
73:13.5	4323.5	27.52	4.46	0.37	441.47	
73:15.5	4325.5	27.27	4.15	0.62	441.72	
73:17	4327	27:01	3.89	0.88	441.98	
73:18	4328	26.79	3.67	1.10	442.20	
73:20	4330	26.66	3.48	1.29	442.39	
73:23	4333	26:44	3.32	1.45	442.55	
73:25	4335	26.31	3.19	1.58	442.68	
73:27	4337	26.20	3.08	1.69	442.79	
73:29	4339	26.11	2.99	1.78	442.88	
73:31	4341	26:01	2.89	1.88	442.98	
73:33	4343	25.93	2.81	1.96	443.06	
73:35	4345	25.86	2.74	2.03	443.13	
73:38	4348	25.76	2.64	2.13	443.23	
73:40	4350	25.70	2.58	2.19	443.29	
73:43	4353	25.63	2.51	2.26	443.36	
73:47	4357	25.54	2.42	2.35	443.46	
7350	4360	25.49	2.37	2.40	443.50	
73:55	4365	25.41	2.29	2.48	443.58	
74:02	4372	25.31	2.19	2.58	443.68	
74:13	4383	25.21	2.09	2.68	443.78	
74:22.5	4392.5	25.13	2.01	2.76	443.86	
74:50	4420	25.00	1.88	2.89	443.99	
75:04	4434	24.92	1.80	2.97	444.07	
2552	4482	24.76	1.64	3.13	444.23	
76:33	4523	24.67	1.55	3.22	444.32	
78:15	4625	24.50	1.38	3.39	444.49	
79:38	4708	24.39	1.27	3.50	444.60	
82:34	4884	24.22	1.10	3.67	444.77	
86:04	5094	24.11	0.99	3.78	444.88	
94:18	5588	23.84	0.72	4.05	445.15	

PERMEABILITY TEST DATA SHEET

Project Name: Dagan/Bully

No.: 88548

Team: 1 Rescue

Date: 10/4/88 - 10/9/8

Well No.: 86-5D

Type of Test: Cont. Rate Pump Test @ Municipal Well #3

Watch Time	Test Time	Water Level	ΔS			Remarks
9700	5750	23.82	0.70	445.17		
100:00	5930	24.50	1.38	444.49		
107.25	6,375	24.96	1.84	444.03		
112.00	6,650	24.23	1.11	444.76		
118.00	7,010	23.98	0.78	445.09		
119.53	7,120	23.88	0.76	445.11		
121.60	7,190	24.24	1.12	444.75		
123.00	7,310	24.58	1.46	444.41		
124.36	7,406	24.69	1.57	444.30		12:36 PM LAST READING

AR300944

Ref. Elev - 468.46

Sheet 1 of

PERMEABILITY TEST DATA SHEET

468.46 - 21.90

Project Name: Bally / Dagan

No.: 88548.13

Team: Remcor

Date: 10/4/88 - 10/8

Well No.: 86-56
* CORRECTED.

Type of Test: Continuous Pumping, Municipal Well #3

Watch Time	Test Time MIN	Water* Level (ft)	ΔS (feet)	ELEV		Remarks
8:56AM	0	21.90	0	446.56		10/4/88
9:08.00	0	21.90	0	446.56		
9:10:30	00:50	21.89	-0.01	446.57		Test START 09:10:00
	02.50	21.90	0	446.56		
	06.00	21.88	-0.02	446.58		
	09:50	21.88	-0.02	446.58		
	11:50	21.87	-0.03	446.59		
	13:00	21.86	-0.04	446.60		
	15:50	21.86	-0.04	446.60		
	18:50	21.86	-0.04	446.60		
	24:00	21.88	-0.02	446.58		
	27:50	21.91	+0.01	446.55		
	29:50	21.93	+0.02	446.54		
	30:50	21.94	+0.03	446.53		
	31:50	21.96	+0.05	446.51		
9:42:30	32:50	21.97	+0.06	446.50		
	32:00	21:97	+0.06	446.50		
	34:00	21:98	+0.07	446.49		
	37:50	22.03	+0.13	446.43		
	39.00	22.05	+0.15	446.41		
	39:50	22.06	+0.16	446.40		
	41:00	22.08	+0.18	446.38		
	42:50	22.10	+0.20	446.36		
	45:00	22.15	+0.25	446.31		
	47:00	22.16	+0.26	446.30		
	48:00	22.18	+0.28	446.28		
10:00:00	50:00	22.22	+0.32	446.24		
	52:00	22.24	+0.34	446.22		
	52:50	22.25	+0.35	446.21		
	54:50	22.28	+0.38	446.18		
	57:50	22.33	+0.43	446.13		
	59:50	22.36	+0.46	446.10		
	61:00	22.38	+0.48	446.08		
	62.50	22.41	+0.51	446.05		
	64.00	22.43	+0.53	446.03		
	65.50	22.45	+0.55	446.01		
	67.00	22.48	+0.58	445.98		
	68.50	22.50	+0.60	445.96		
10:20AM	70.00	22.52	+0.62	445.94		
	73.50	22.57	+0.67	445.89		
	74.00	22.58	+0.68	445.88		

AR300945

PERMEABILITY TEST DATA SHEET

Project Name: Bally IDAGAW No.: 88548.13

Team: REMCOR Date: 10/4/88-10/8/8

Well No.: 86-5s Type of Test: Continuous Pumping, Municipal Well #3

Watch Time	Test Time	Water Level*	ΔS (feet)			Remarks
	79	22.65	+0.75	445.81		
	80.5	22.66	+0.76	445.80		
	85.0	22.73	+0.83	445.73		
	85.5	22.74	+0.84	445.72		
	86.5	22.75	+0.85	445.71		
	88.5	22.78	+0.88	445.68		
	89.3	22.79	+0.89	445.67		
	91.0	22.81	+0.91	445.65		
	93.5	22.84	+0.94	445.62		
	95.0	22.86	+0.96	445.60		
	99.0	22.90	+1.00	445.56		
	105.00	22.98	1.08	445.48		
	109.00	23.02	1.12	445.44		
	112.0	23.05	1.15	445.41		
11:05AM	115.0	23.08	1.18	445.38		
	117.0	23.10	1.20	445.36		
	122.0	23.16	1.26	445.30		
	125.0	23.19	1.29	445.27		
	128.0	23.22	1.32	445.24		
	131.0	23.24	1.34	445.22		
	134.0	23.27	1.37	445.19		
	137	23.30	1.40	445.16		
	140	23.32	1.42	445.14		
	146	23.37	1.47	445.09		
	149	23.39	1.49	445.07		
	152	23.42	1.52	445.04		
	155	23.44	1.54	445.02		
	160	23.48	1.58	444.98		
	165	23.52	1.62	444.94		
	170	23.55	1.65	444.91		
	175	23.59	1.69	444.87		
12:10PM	180	23.62	1.72	444.84		
	185	23.65	1.75	444.81		
	195	23.71	1.81	444.75		
	200	23.73	1.83	444.73		
	210	23.79	1.89	444.67		
	221	23.84	1.94	444.62		
	230	23.88	1.98	444.58		
	245	23.94	2.04	444.52		
	269	24.03	2.13	444.43		
2:09PM	299	24.13	2.23	444.33		

AR300946

PERMEABILITY TEST DATA SHEET

Project Name: Bally / Dagan No.: 88548.13

Team: Remcor Date: 10/4/88 - 10/8/88

Well No.: 86-5S Type of Test: Cont. Pumping, Municipal Well #3

Watch Time	Test Time	Water Level	ΔS	ELEV		Remarks
	319	24.29	2.39	444.17		
	414	24.40	2.50	444.06		
	516	24.88	2.98	443.58		
12.26	676	24.80	2.90	443.66		10/4/88
	846	25.00	3.10	443.46		10/5/88
	967	25.06	3.16	443.40		
	1039	25.09	3.19	443.37		
	1187	25.07	3.17	443.39		
	1129	25.08	3.18	443.38		
	1136	25.08	3.18	443.38		
	1153	25.09	3.19	443.37		
	1169	25.10	3.20	443.36		
	1188	25.12	3.22	443.34		
	1214	25.16	3.26	443.30		
50	1233	25.19	3.29	443.27		
5:03AM	1263	—	—		—	Start of well #1
	1284	25.29	3.39	443.17		
	1303	25.32	3.42	443.14		
	1316	25.35	3.45	443.11		
	1374	25.45	3.55	443.01		
	1434	25.55	3.65	442.91		
	1495	25.63	3.73	442.83		
	1568	25.71	3.81	442.75		
	1662	25.76	3.86	442.70		
	1753	25.82	3.92	442.64		
	1815	25.88	3.98	442.58		
	1887	25.95	4.05	442.51		
	2011	26.06	4.16	442.40		
	2085	26.15	4.25	442.31		
10:00 PM	2 210	—				Well #1 STOPS
	2229	26.21	4.31	442.25		PUMPING
	2250	26.22	4.32	442.24		
11:30PM	2300	26.31	4.41	442.15		10/5/88
	2337	26.19	4.29	442.27		10/6/88
	2457	26.10	4.20	442.36		
	2526	26.05	4.15	442.41		
	2627	26.00	4.10	442.46		
	2630	—				Start of Well #1
	2688	26.03	4.13	442.43		
	2723	26.05	4.15	442.45		
	2758	26.21	4.31	442.25		

AR300947

PERMEABILITY TEST DATA SHEET

Project Name: Bally / Dagan No.: 88548

Team: Date: 10/4 - 10/8/88

Well No.: 56-5S Type of Test: Cont. Pumping, Municipal Well #3

Watch Time	Test Time	Water Level	Δs (feet)			Remarks
9:10 AM	2930	—				Munic. W #3 stopped
	2941	26.31	4.41	442.15		
	2952	26.33	4.43	442.13		
	2962	26.33	4.43	442.13		
	2982	26.35	4.45	442.11		
	2999	26.35	4.45	442.11		
	3071	26.31	4.41	442.15		
	3198	26.29	4.39	442.17		
	3232	2631	4.41	442.15		
	3322	62.36	4.46	442.10		
	3447	26.31	4.41	442.15		
	3590	26.32	4.42	442.14		
	3712	26.30	4.40	442.16		10/6/88
	3862	26.27	4.37	442.13		10/7/88
	4055	26.27	4.37	442.13		
	4177	26.27	4.37	442.13		
	4268	26.22	4.32	442.24		
	4315	26.23	4.33	442.23		
	4319	26.23	4.33	442.23		
9:10AM	4320	—				Munic. Well #1 stopped
	4321	26.23	4.33	442.23		
	4323	26.23	4.33	442.33		
	4325	26.23	4.33	442.33		
	4328	26.26	4.36	442.20		
	4329	26.27	4.37	442.19		
	4332	26.27	4.37	442.19		
	4334	26.27	4.37	442.19		
	4336	26.27	4.37	442.19		
	4338	26.27	4.37	442.19		
	4340	26.26	4.36	442.20		
	4342	26.26	4.36	442.20		
	4344	26.24	4.34	442.22		
	4345.5	26.23	4.33	442.23		
	4346.75	26.22	4.32	442.24		
	4348.25	26.21	4.31	442.25		
	4349.5	26.20	4.30	442.26		
	4351.5	26.18	4.28	442.28		
	4353.25	26.16	4.26	442.30		
	4354.8	26.13	4.23	442.33		
	4359.6	26.08	4.18	442.38		
	4363.5	26.03	4.13	442.43		

000048
AR300948

PERMEABILITY TEST DATA SHEET

Project Name: Bally / Dagan No.: 88548

Team: Date: 10/4/88 - 10/8/8

Well No.: 86-55 Type of Test: Cont. Pumping, Municipal Well #3

Watch Time	Test Time	Water Level				Remarks
	4366.75	25.98	4.08	442.48		
	4373.25	25.88	3.98	442.58		
	4383.75	25.73	3.83	442.73		
	4391.5	25.62	3.72	442.84		
	4398	25.53	3.63	442.93		
	4404	25.44	3.54	443.02		
	4407	25.37	3.47	443.09		
	4417	25.28	3.38	443.18		
	4422	25.23	3.33	443.23		
	4427	25.18	3.28	443.28		
	4434	25.09	3.19	443.37		
	4444	24.97	3.07	443.49		
	4446	24.89	2.99	443.57		
	4463	24.80	2.90	443.66		
	4480	24.67	2.77	443.79		
	4533	24.55	2.65	443.91		
	4562	24.36	2.46	444.10		
	4625	23.89	1.99	444.57		
	4709	23.68	1.78	444.78		
	4886	23.38	1.48	445.08		
	5095	23.21	1.31	445.25		10/7/88
7.19 AM	5579	22.91	1.01	445.55		10/8/88

PERMEABILITY TEST DATA SHEET

468.86 + 0.004 = 468.90

Project Name: DAGAN / BAILY

No.: 88548

Team: PEMCOR

Date: 10/4/88 - 10/9/88

Well No.: 89-7I

Type of Test: Continuous Pumping, Municipal Well #3

Watch Time	Test Time	Water Level	ΔS			Remarks
0.00	0	22.91	0	445.99		Munic. Well #3 START
1.305	2050	22.98	0.07	445.92		
1.51	41	23.04	0.13	445.86		
2.51	101	23.27	0.36	445.63		
3.45	155	23.48	0.57	445.42		
5.57	287	23.50	0.59	445.40		
7.33	383	23.61	0.70	445.29		
11.11	601	23.74	0.83	445.16		
12.37	687	23.80	0.89	445.10		
16.53	943	23.86	0.95	445.04		
18.19	1029	23.87	0.96	445.03		
19.34	1104	23.88	0.97	455.04		
20.54	1,184	23.90	0.99	445.02		
	1.193					Munic Well #1 START
21.07	1,197	23.96	1.05	444.96		
21.16	1206	24.07	1.16	444.85		
21.21	1211	24.14	1.23	444.76		
21.31	1221	24.22	1.31	444.68		
21.45	1,235	24.33	1.42	444.57		
21.54	1,244	24.39	1.48	444.51		
22.04	1,254	24.46	1.55	444.44		
22.19	1,269	24.52	1.61	444.38		
22.24	1,274	24.58	1.67	444.32		
22.34	1,284	24.63	1.72	444.27		
22.44	1,294	24.68	1.77	444.22		
22.54	1,304	24.73	1.82	444.17		
23.04	1,314	24.78	1.87	444.12		
23.24	1,334	24.93	2.02	444.67		
23.51	1,361	25.02	2.11	443.98		
26:05	1,495	25.36	2.45	443.54		
28.01	1,611	25.56	2.65	443.34		
30.51	1,781	25.81	2.90	443.09		
34.36	2,006	26.05	3.14	442.85		
36.06	2,096	26.14	3.23	442.76		
38.00	2,210	26.20	3.29	442.70		Munic. Well stops
38.08	2,218	26.08	3.17	442.82		
38.23	2,233	25.94	3.03	442.96		
38.37	2,247	25.84	2.93	443.06		
39.26	2,296	25.67	2.71	443.28		
40.16	2,346	25.43	2.52	443.47		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		

AR300950

PERMEABILITY TEST DATA SHEET

Project Name: DAGAN / Bally No.:

Team: REMCOR Date: 10/4 - 10/9/88

Well No.: 87-7I Type of Test: Continuous Pumping Municipal Well #3

Watch Time	Test Time	Water Level	ΔS			Remarks
45:04	2634	24.98	2.07	443.92		
45:57	2687	25.41	2.50	443.49		
46:40	2730	25.71	2.80	443.19		
47:52	2802	25.92	3.01	442.98		
50:00	2930	26.22	3.31	442.68		
50:07	2937	26.10	3.19	442.80		
50:27	2957	25.99	3.08	442.91		
50:42	2972	25.88	2.97	443.02		
51:28	3018	25.66	2.75	443.24		
52:28	3078	25.48	2.57	443.42		
52:40	3090	25.45	2.54	443.45		
55:05	3235	26.07	3.16	442.83		
57:00	3350	25.58	2.67	443.32		
57:09	3359	25.56	2.65	443.34		
62:56	3706	25.68	2.77	443.22		
65:45	3875	25.34	2.43	443.56		
68:58	4068	25.26	2.35	443.64		
71:59	4248	25.20	2.29	443.70		MW#3 off -
73:37	4347	25.28	2.37	443.62		
73:58	4368	25.21	2.30	443.69		
74:03	4373	25.15	2.24	443.75		
74:24	4394	25.06	2.15	443.84		
74:36	4406	25.02	2.11	443.88		
75:15	4445	24.92	2.01	443.98		
75:50	4480	24.83	1.92	444.07		
76:43	4533	24.73	1.82	444.17		
77:11	4561	24.70	1.79	444.20		
78:57	4667	24.55	1.64	444.35		
80:04	4734	24.50	1.59	444.40		
82:40	4890	24.30	1.39	444.60		
85:58	5088	24.19	1.28	444.71		
94:27	5597	23.92	1.01	444.98		
97:00	5750	23.89	0.98	445.01		
98:00	5810	24.35	1.44	444.55		
99:00	5870	24.60	1.69	444.30		
100:00	5930	24.77	1.86	444.13		
102:00	6050	24.97	2.06	443.93		000951
102:52	6102	25.08	2.17	443.82		
107:00	6350	24.88	1.97	444.02		AR300951
54:32	3202	26.00	3.09	442.90		

Sheet 1 of _

PERMEABILITY TEST DATA SHEET

ELEV 468.74

Project Name: BALLY/DAGEN

No.: 8 S 2.13

Team: REMCOR

Date: 10-4-88/10-8-88

Well No.: 87-7S

Type of Test: CONTINUOUS PUMPING MUNICIPAL WELL #3

Watch Time	Test Time (min)	Water Level (ft)	Δs'	ELEV		Remarks
2:12 AM	0	22.45		445.79		
9:10 AM	0					MUNICIPAL WELL #3 STARTED
		22.88	-.07	445.86		
	22	22.88	-.07	445.86		
	32	22.88	-.07	445.86		
	40	22.88	-.07	445.86		
	56.5	22.90	-.05	445.84		
	75	22.90	-.05	445.84		
	98	22.88	-.07	445.86		
	106	22.85	-.10	445.89		
	155	22.85	-.10	445.89		
	193	22.85	-.10	445.89		
	289	22.82	-.13	445.92		
	386	22.84	-.11	445.90		
	604	22.97	-.03	445.82		
	685	22.97	.02	445.77		
	941	23.11	.16	445.63		
	1022	23.16	.21	445.58		
	1103	23.19	.24	445.55		
	1184	23.22	.27	445.52		
	1192	23.22	.27	445.52		
(10/5/88 5:03 AM)	1193					MUNICIPAL WELL #1 STARTED
	1201	23.22	.27	445.52		
	1204	23.22	.27	~~445.52~~		
	1206	23.23	.28	445.51		
	1211	23.23	.28	445.51		
	1221	23.23	.28	445.51		
	1226	23.24	.29	445.50		
	1235	23.24	.29	445.50		
	1244	23.25	.30	445.49		
	1254	23.25	.30	445.49		
	1264	23.25	.30	445.49		
	1274	23.26	.31	445.48		
	1284	23.26	.31	445.48		
	1295	23.27	.32	445.47		
	1314	23.28	.33	445.46		
	1334	23.29	.34	445.45		
	1359	23.31	.36	445.43		
	1497	23.50	.45	445.34		
	1615	23.71	.76	445.03		
	1720	[illegible]	1.09	444.70		

AR300952

PERMEABILITY TEST DATA SHEET

Project Name: BALLY / ALDEN
No.: 88548.13
Team: REMCOR
Date: 10-4-88 / 10-8-88
Well No.: 87-7S
Type of Test: CONTINUOUS PUMPING MUNI WELL #3

Watch Time	Test Time min	Water Level ft	ΔS'			Remarks
	2009	24.50	1.55	444.24		
	2095	24.66	1.71	444.08		
10/5/88 3:00 PM	2210					MUNICIPAL WELL #1 STARTED
	2219	24.83	1.88	443.91		
	2213	24.86	1.91	443.88		
	2256	24.87	1.92	443.87		
	2302	24.93	1.98	443.81		
	2345	24.98	2.03	443.76		
	2480	25.05	2.10	443.69		
10/6/88 8:00 AM	2630					MUNICIPAL WELL #1 STARTED
	2632	25.05	2.10	443.69		
	2681	25.04	2.09	443.70		
	2730	25.01	2.06	443.73		
	2804	25.00	2.05	443.74		
10/6/88 10:00 AM	2930					MUNICIPAL WELL #1 STARTED
	2939	25.05	2.10	443.69		
	2959	25.06	2.11	443.68		
	2974	25.06	2.11	443.68		
	3019	25.08	2.13	443.66		
	3080	25.10	2.15	443.64		(MUNICIPAL WELL #1
	3203	25.14	2.19	443.60		STARTED @ 3090 MIN)
	3360	25.18	2.23	443.56		(MUNICIPAL WELL #1
	3440	25.20	2.25	443.54		STARTED @ 3290)
	3539	25.20	2.25	443.54		
	3705	25.16	2.21	443.58		
	3875	25.08	2.13	443.60		
	4068	24.97	2.02	443.77		
	4246	24.85	1.90	443.89		
	4315	24.83	1.88	443.91		
10/7/88 9:00 AM	4320					MUNICIPAL WELL #3 PUMPING STOPPED
	4332	24.83	1.88	443.91		
	4346	24.81	1.86	443.93		
	4360	24.81	1.86	443.93		
	4374	24.80	1.85	443.94		
	4393	24.79	1.84	443.95		
	4407	24.79	1.84	443.95		
	4426	24.78	1.83	443.96		
	4446	24.79	1.84	443.95		
	4484	24.76	1.81	443.98		
	4534	24.78	1.83	443.96		
	4563	24.76	1.81	443.98		

PERMEABILITY TEST DATA SHEET

Project Name: BALLY / DAGEN No.: 8854213

Team: REMCOR Date: 10-4-88 / 10-8-88

Well No.: 87-7S Type of Test: CONTINUOUS PUMPING MUNICIPAL WELL #3

Watch Time	Test Time (MIN)	Water Level H'	ΔS'			Remarks
	4670	24.62	1.67	444.12		
	4737	24.55	1.60	444.19		
	4899	24.40	1.45	444.34		
	5089	24.22	1.27	444.52		
	5598	23.72	.77	445.02		

PERMEABILITY TEST DATA SHEET

Project Name: BALLY / [illegible]EN No.: 88542.13

Team: REMSOR Date: 10-4-88 / 10-8-88

Well No.: 87-8I Type of Test: CONTINUOUS PUMPING MUNICIPAL WELL #3

Watch Time	Test Time MIN	Water Level ft'	Δs'		Remarks
[illegible] AM	0	15.20			
[illegible] AM	0		0		MUNICIPAL WELL #3 PUMPING STARTED
	159	15.18	-.02		
	294	15.16	-.04		
	597	15.19	-.01		
	612	15.21	.01		
	1007	15.22	.02		
	1.24	15.21	.01		
10/5/88 [illegible] AM	1193				MUNICIPAL WELL #1 STARTS PUMPING
	1393	15.25	.05		
	1675	15.24	.04		
	1812	15.23	.03		
	2044	15.28	.08		
	2138	15.30	.10		
10/5/88 [illegible] PM	2210				MUNICIPAL WELL #1 STARTS PUMPING
	2308	15.27	.09		
	2517	15.28	.08		
10/6/88 5:00 AM	2630				MUNICIPAL WELL #1 STARTS PUMPING
	2677	15.30	.10		
	2861	15.34	.14		
10/6/88 10:00 AM	2930				MUNICIPAL WELL #1 STOPS PUMPING
	3060	15.30	.10		(MUNICIPAL WELL #1 STARTED @ 3090)
	3262	15.30	.10		(MUNICIPAL WELL #1 STOPPED @ 3230)
	3445	15.33	.13		
	3582	15.36	.16		
	3915	15.32	.12		
	4257	15.31	.11		
10/7/88 9:10 AM	4320				MUNICIPAL WELL #3 STOPS PUMPING
	4402	15.31	.11		
	4494	15.29	.09		
	4745	15.27	.07		
	4927	15.31	.11		
	5079	15.32	.12		
	5658	15.25	.05		

PERMEABILITY TEST DATA SHEET

Project Name: BALLY/LAGEN No.: 28548.13

Team: RUMCOR Date: 10-4-88 / 10-8-88

Well No.: 87-9I Type of Test: 80 HR NON PUMPING MUNICIPAL WELL #3

Watch Time	Test Time MIN	Water Level ft'	ΔS'		Remarks
9:10 AM	0	66.31	0		MUNICIPAL WELL #3 STARTS PUMPING
	150	66.30	-.01		
	283	66.30	-.01		
	373	66.30	-.01		
	593	66.30	-.01		
	804	66.32	.01		
	1001	66.34	.03		
	1145	66.33	.02		
10/5/88 8:43 AM	1193				MUNICIPAL WELL #1 STARTS PUMPING
	1393	66.32	.01		
	1568	66.32	.01		
	1805	66.32	.01		
	2038	66.34	.03		
10/5/88 10:00 AM	2210				MUNICIPAL WELL #1 STOPS PUMPING
	2282	66.34	.03		
	2511	66.34	.03		
10/6/88 8:40 AM	2630				MUNICIPAL WELL #1 STARTS PUMPING
	2846	66.35	.04		
10/6/88 [illegible] AM	2930				MUNICIPAL WELL #1 STOPS PUMPING
	3052	66.36	.05		(MUNICIPAL WELL #1 STARTED @ 3090)
	3254	66.35	.04		(MUNICIPAL WELL #1 STOPPED @ 3230)
	3430	66.36	.05		
	3551	66.36	.05		
	4239	66.35	.04		
10/8/88 9:10 AM	4320				MUNICIPAL WELL #3 STOPS PUMPING
	4397	66.36	.05		
	4480	66.35	.04		
	4553	66.36	.05		
	4738	66.37	.06		
	4918	66.37	.06		
	5070	66.38	.07		
	5649	66.38	.07		

PERMEABILITY TEST DATA SHEET

Project Name: TALLY / [illegible] No.: 88548 13

Team: [illegible] Date: 10-4-88 / 10-8-88

Well No.: 27-10I Type of Test: CONTINUOUS PUMPING MUNICIPAL WELL #3

Watch Time	Test Time (min)	Water Level h'	Δs'		Remarks
8:00	0	4.40	0		
8:10	0				MUNICIPAL WELL #3 STARTS PUMPING
	3	4.43	.03		
	11	4.46	.06		
	20	4.80	.40		
	30.5	4.92	.52		
	38	4.99	.59		
	47	5.03	.63		
	56	5.06	.66		
	65	5.09	.69		
	73	5.11	.71		
	82	5.14	.74		
	95	5.16	.76		
	105	5.17	.77		
	115	5.19	.79		
	127	5.21	.81		
	137	5.22	.82		
	149	5.23	.83		
	166	5.25	.85		
	177	5.25	.85		
	198	5.26	.86		
	261	5.31	.91		
	289	5.32	.92		
	374	5.36	.97		
	444	5.39	.99		
	532	5.43	1.03		
	613	5.45	1.05		
	692	5.49	1.09		
	948	5.55	1.15		
	1095	5.57	1.17		
	1099	5.58	1.18		
	1149	5.59	1.19		
10/5/88 5:03 AM	1193				MUNICIPAL WELL #1 STARTS PUMPING
	1212	5.60	1.20		
	1240	5.65	1.25		
	1269	5.68	1.28		
	1292	5.70	1.30		
	1309	5.71	1.31		
	1364	5.78	1.38		
	1454	5.86	1.46		
	1675	5.92	1.52		

PERMEABILITY TEST DATA SHEET

Project Name: RALLY / [illegible] No.: 88548.13

Team: RUMCOR Date: 10-4-88 / 10-8-88

Well No.: 87 10I Type of Test: CONTINUOUS PUMPING MUNICIPAL WELL #3

Watch Time	Test Time (min)	Water Level h'	Δs'				Remarks
	2013	6.09	1.69				
	2100	6.13	1.73				
10/3/88 10:00 AM	2210						MUNICIPAL WELL #1 STOPS PUMPING
	2214	6.15	1.75				
	2242	6.12	1.72				
	2291	6.09	1.69				
	2354	6.11	1.71				
	2485	6.06	1.66				
10/6/88 5:00 PM	2630						MUNICIPAL WELL #1 STARTS PUMPING
	2639	6.02	1.62				
	2673	6.06	1.66				
	2706	6.12	1.72				
	2880	6.17	1.77				
10/6/88 10:00 AM	2930						MUNICIPAL WELL #1 STOPS PUMPING
	2949	6.23	1.83				
	2965	6.22	1.82				
	2981	6.21	1.81				
	3013	6.17	1.77				MUNICIPAL WELL #1
	3215	6.22	1.82				STARTS PUMPING #3.
	3365	6.17	1.77				MUNICIPAL WELL #1
	3543	6.15	1.75				STOPS PUMPING #3
	3701	6.15	1.75				
	3881	6.15	1.75				
	4072	6.14	1.74				
	4240	6.15	1.75	RECOVERY	TIME	t/t'	
10/7/88 9:10 AM	4320			-0-	-0-	-0-	MUNICIPAL WELL #3 STARTS PUMPING
	4334	5.90	1.50	.25	14	309.6	
	4342	5.78	1.38	.37	22	197.4	
	4350	5.68	1.28	.47	30	145.0	
	4363	5.59	1.19	.56	43	101.5	
	4370	5.55	1.15	.60	50	87.4	
	4385	5.48	1.08	.67	65	67.5	
	4398	5.44	1.04	.71	78	56.4	
	4416	5.42	1.02	.73	94	47.0	
	4425	5.38	0.98	.77	109	40.6	
	4449	5.35	.95	.80	129	34.5	
	4485	5.31	.91	.84	165	27.2	
	4542	5.25	.85	.90	222	20.5	
	4656	5.20	.80	.95	336	13.9	
	4726	5.16	.76	.99	406	11.6	
	4900	5.12	.72	1.03	580	8.4	

PERMEABILITY TEST DATA SHEET

Project Name: BALLY/DAGON No.: 88548 13

Team: REMCOR Date: 10-4-88/10-8-88

Well No.: 8710I Type of Test: CONTINUOUS PUMPING MUNICIPAL WELL #3

Watch Time	Test Time (MIN)	Water Level h'	Δs'	RECOVERY	t'	t/t'	Remarks
	5080	5.07	.67	1.08	764	6.7	
	5605	4.96	.56	1.19	1285	4.4	
	6020	5.12	.72	1.03	1700	3.5	

PERMEABILITY TEST DATA SHEET

Project Name: TALLY/DAGEN No.: 88548.13

Team: REMCOR Date: 10-4-88/10-8-88

Well No.: 87-10D Type of Test: CONTINOUS PUMPING MUNICIPAL WE

Watch Time	Test Time	Water Level	ΔS (ft.)			Remarks
836 AM		4.14				
910 AM	0					PUMPING #3 STARTS
	4	4.14	0.00			
	12	4.32	0.18			
	21	4.51	0.37			
	29	4.62	0.48			
	39	4.73	0.59			
	48	4.78	0.64			
	59	4.82	0.68			
	66	4.86	0.72			
	75	4.88	0.74			
	84	4.90	0.76			
	97	4.93	0.79			
	116	4.96	0.82			
	125	4.98	0.84			
	138	5.00	0.86			
	163	5.02	0.88			
	200	5.04	0.90			
	263	5.09	0.95			
	290	5.10	0.96			
	374	5.14	1.00			
	445	5.17	1.03			
	533	5.22	1.08			
	616	5.24	1.10			
	692	5.27	1.13			
	949	5.32	1.18			
	1025	5.33	1.19			
	1106	5.34	1.20			
	1150	5.36	1.22			
	1190	5.37	1.23			
10/5/88 5:13AM	1193					MUNICIPAL #1 START
	1214	5.39	1.25			
	1241	5.43	1.29			
	1268	5.46	1.32			
	1290	5.49	1.35			
	1308	5.52	1.38			
	1340	5.55	1.41			
	1365	5.58	1.44			
	1400	5.60	1.46			
	1430	5.62	1.48			
	1456	5.64	1.50			

AR300960

PERMEABILITY TEST DATA SHEET

Project Name: BALLY/DAGEN No.: 88543 13

Team: RENCOR Date: 10-4-88 / 10-8-88

Well No.: 87-10D Type of Test: CONTINUOUS PUMPING MUNICIPAL WELL # 2

Watch Time	Test Time	Water Level	Δs (ft.)			Remarks
	1490	5.67	1.53			
	1550	5.69	1.55			
	1624	5.73	1.57			
	1670	5.74	1.60			
	1730	5.77	1.63			
	1790	5.82	1.68			
	1850	5.84	1.70			
	1910	5.87	1.73			
	1970	5.89	1.75			
	2014	5.90	1.76			
	2103	5.93	1.79			
10/5/88 10:00pm	2210	5.97	1.83			MUNICIPAL #1 STOP
	2243	5.93	1.79			
	2270	5.91	1.77			
	2330	5.87	1.73			
	2390	5.84	1.70			
	2450	5.83	1.69			
	2510	5.82	1.68			
	2570	5.81	1.67			
10/6/88 5:00AM	2630	5.81	1.67			MUNICIPAL #1 START
	2690	5.87	1.73			
	2750	5.93	1.79			
	2810	5.99	1.85			
	2870	6.02	1.88			
10/6/88 10:00AM	2930	6.05	1.91			MUNICIPAL #1 STOP
	2948	6.04	1.90			
	2966	6.03	1.89			
	2982	6.02	1.88			
	2990	6.01	1.87			
	3050	5.98	1.84			
	3020	5.95	1.81			(3090 MIN MUNICIPAL # STARTED)
	3110	5.96	1.82			
	3170	6.00	1.86			
	3217	6.04	1.90			(3230 MIN MUNICIP.
	3230	6.04	1.90			#1 STOPPED)
	3290	6.02	1.88			
	3350	5.99	1.85			
	3366	5.98	1.84			
	3392	6.03	1.89			
	3420	6.02	1.88			
	3543	6.01	1.87			

AR300961

PERMEABILITY TEST DATA SHEET

Project Name: Bally/Ashland No.: 8854813

Team: RAMCOR Date: 10-4-88/10-8-88

Well No.: 87-10-1 Type of Test: Continuous Pumping Municipal Well #2

Watch Time	Test Time	Water Level	Δs (ft)				Remarks
	3590	6.00	1.86				
	3650	6.00	1.86				
	3701	5.99	1.85				
	3770	5.98	1.84				
	3830	5.98	1.84				
	3890	5.97	1.83				
	3950	5.96	1.82				
	4010	5.96	1.82				
	4070	5.96	1.82				
	4130	5.97	1.83				
	4190	5.98	1.84				
	4241	6.00	1.86				
	4310	6.00	1.86		t'	t/t'	
10/7/88 9:10AM	4320	6.00	1.86	-0-	-0-	-0-	MUNICIPAL # 3 STOP
	4335	5.80	1.66	.20	15	289.0	
	4342	5.66	1.52	.34	22	197.4	
	4351	5.54	1.40	.46	31	140.4	
	4363	5.43	1.29	.57	41	106.4	
	4370	5.38	1.24	.62	50	87.4	
	4385	5.31	1.17	.69	75	58.5	
	4398	5.27	1.13	.73	88	50.0	
	4409	5.24	1.10	.76	99	44.5	
	4430	5.20	1.06	.80	120	36.9	
	4449	5.16	1.02	.84	139	32.0	
	4485	5.13	0.99	.87	175	25.6	
	4543	5.06	0.92	.94	233	19.5	
	4610	5.02	0.88	.98	300	15.4	
	4656	4.99	0.85	1.01	336	13.9	
	4726	4.95	0.81	1.05	406	11.6	
	4790	4.94	0.80	1.06	470	10.2	
	4850	4.92	0.78	1.08	530	9.2	
	4900	4.90	0.76	1.10	580	8.4	
	4970	4.89	0.75	1.11	650	7.6	
	5030	4.87	0.73	1.13	710	7.1	
	5084	4.86	0.72	1.14	764	6.7	
	5150	4.85	0.71	1.15	830	6.2	
	5210	4.84	0.70	1.16	890	5.9	
	5270	4.82	0.68	1.18	950	5.5	
	5330	4.79	0.65	1.21	1010	5.3	
	5390	4.78	0.64	1.22	1070	5.0	
	5450	4.77	0.63	1.23	1130	4.8	

PERMEABILITY TEST DATA SHEET

Project Name: Bailey/Arnold No.: 28548 13

Team: [illegible] Date: 10-6-88/10-8-88

Well No.: 87-101D Type of Test: Constant Pumping Test #3

Watch Time	Test Time	Water Level	ΔS (ft)		t'	t/t'	Remarks
	5510	476	0.62	1.24	1190	4.6	
	5570	475	0.61	1.25	1250	4.5	
	5630	475	0.61	1.25	1310	4.3	
	5690	469	0.55	1.31	1370	4.2	
	5750	468	0.54	1.32	1430	4.0	

PERMEABILITY TEST DATA SHEET

Project Name: BALLY/DAGEN No.: 2254813

Team: REWCOR Date: 10-4-88/10-8-88

Well No.: 87-115 Type of Test: CONTINUOUS PUMPING MUNICIPAL WELL #3

Watch Time	Test Time min	Water Level ft	Δs'		Remarks
8 25	0	16.51			
9 10	0		0		MUNICIPAL WELL #3 START PUMPING
	1	16.53	.02		
	4	16.51	0		
	8	16.51	0		
	16	16.51	0		
	25	16.51	0		
	36	16.51	0		
	47	16.51	0		
	57	16.52	.01		
	92	16.52	.01		
	111	16.52	.01		
	131	16.53	.02		
	150	16.54	.03		
	200	16.54	.03		
	280	16.53	.02		
	370	16.54	.03		
	589	16.57	.06		
	801	16.60	.09		
	999	16.63	.12		
	1097	16.64	.13		
	1142	16.65	.14		
10.5.88 5:00 AM	1193				MUNICIPAL WELL #1 START PUMPING
	1391	16.66	.15		
	1663	16.68	.17		
	1803	16.70	.19		
	2036	16.73	.22		
10.5.88 10:00 AM	2210				MUNICIPAL WELL #1 STOPPED PUMPING
	2280	16.76	.25		
	2508	16.78	.27		
10/6/88 5:00 AM	2630				MUNICIPAL WELL #1 START RUNNING
	2669	16.80	.29		
	2843	16.81	.30		
10/6/88 10:00 AM	2930				MUNICIPAL WELL #1 STOPPED PUMPING
	3048	16.84	.33		(MUNICIPAL WELL #1 START @ 3090 MIN
	3249	16.83	.32		(MUNICIPAL WELL #1 STOPPED @ 3290 MIN
	3428	16.85	.34		
	3548	16.87	.36		
	3909	16.89	.38		
	4234	16.90	.39		
10/7/88 9:10 AM	4320				MUNICIPAL WELL #1 PUMPING STOPPED

AR300964

PERMEABILITY TEST DATA SHEET

Project Name: BALLY/DAGEN No.: 88548.13

Team: REMCOR Date: 10-4-88/10-8-88

Well No.: 87-115 Type of Test: CONTINUOUS PUMPING MUNICIPAL WELL #3

Watch Time	Test Time MIN	Water Level ft	Δs'		Remarks
	4394	16.90	.39		
	4467	1690	.39		
	4550	16.89	.38		
	4732	16.87	.38		
	4911	16.87	.38		
	5068	16.87	.38		
	5645	16.84	.33		

PERMEABILITY TEST DATA SHEET

Project Name: BALLY / DAKON No.: 88542.13

Team: REMCOR Date: 10-4-88/10-8-88

Well No.: 87-11I Type of Test: CONTINUOUS PUMPING OF MUNICIPAL WELL #3

Watch Time	Test Time MN	Water Level H'	JS'		Remarks
8:24	-0-	16.85			
9:10	0	16.83	0.00		MUNICIPAL WELL #1 PUMPING STARTED
	3	16.83	0.00		
	5	16.83	0.00		
	15	16.88	0.05		
	25	16.86	0.03		
	34	16.87	0.04		
	46	16.87	0.04		
	67	16.88	0.05		
	91	16.88	0.05		
	108	16.88	0.05		
	130	16.89	0.06		
	148	16.89	0.06		
	196	16.89	0.06		
	279	16.88	0.05		
	369	16.89	0.06		
	587	16.91	0.08		
	800	16.94	0.11		
	997	16.97	0.14		
	1095	16.97	0.14		
	1141	16.98	0.15		
10/5/88 5:03 AM	1193				MUNICIPAL WELL #1 STARTS PUMPING
	1350	17.00	0.17		
	1663	17.02	0.19		
	1802	17.02	0.19		
	2035	17.05	0.22		
10/5/88 10 AM	2210				MUNICIPAL WELL #1 STOPPING PUMPING
	2278	17.08	0.25		
	2507	17.10	0.27		
10/6/88 [illegible]	2630				MUNICIPAL WELL #1 STARTS PUMPING
	2668	17.11	0.28		
	2842	17.12	0.29		
10/6/88 10:00 AM	2930				MUNICIPAL WELL #1 STOPS PUMPING
	3046	17.15	0.32		(MUNICIPAL WELL #1 STARTS @ 3090 MIN)
	3247	17.15	0.32		(MUNICIPAL WELL #1 STOPPING @ 3290 MIN)
	3426	17.16	0.33		
	3547	17.18	0.35		
	3909	17.20	0.37		
	4233	17.22	0.39		
10/7/88 9:11 AM	4320				MUNICIPAL WELL #1 STARTS
	4393	17.20	0.37		

AR300966

PERMEABILITY TEST DATA SHEET

Project Name: BALLY / [illegible] No.: 88548.13

Team: REMCOR Date: 10-4-88, 10-8-88

Well No.: 87-11 I Type of Test: CONTINUOUS PUMPING OF MUNICI WELL #3

Watch Time	Test Time min	Water Level ft'	Δs'		Remarks
	4464	17.20	0.37		
	4550	17.20	0.37		
	4732	17.18	0.35		
	4911	17.19	0.36		
	5066	17.19	0.36		
	5644	17.13	0.30		

PERMEABILITY TEST DATA SHEET

Project Name: BALLY/DACON No.: 8854813

Team: REMCOR Date: 10-4-88/10-8-88

Well No.: 89 12 L Type of Test: CONTINUOUS PUMPING MUNICIPAL WELL #3

Watch Time	Test Time	Water Level	Δs (ft.)			Remarks
9:10 AM	-0-	19.98	0.00			MUNICIPAL WELL #3 STARTED
	2.5	20.52	0.54			
	3.25	20.80	0.82			
	4	21.04	1.06			
	5	21.37	1.39			
	6	21.63	1.65			
	7	21.91	1.93			
	8	22.14	2.16			
	9	22.38	2.40			
	10	22.58	2.60			
	11	22.72	2.74			
	12	22.91	2.93			
	18	23.68	3.70			
	19	23.79	3.81			
	21	23.95	3.97			
	22	24.02	4.04			
	23	24.10	4.12			
	28	24.40	4.42			
	29	24.47	4.49			
	31	24.57	4.59			
	34	24.69	4.71			
	36	24.77	4.79			
	45	25.02	5.04			
	47	25.09	5.11			
	50	25.15	5.17			
	58	25.30	5.32			
	66	25.41	5.43			
	70	25.47	5.49			
	78	25.54	5.56			
	94	25.70	5.72			
	106	25.78	5.80			
	117	25.82	5.84			
	127	25.87	5.89			
	137	25.91	5.93			
	147	25.96	5.98			
	157	26.00	6.02			
	167	26.02	6.04			
	192	26.09	6.11			
	221	26.15	6.17			
	250	26.20	6.22			

PERMEABILITY TEST DATA SHEET

Project Name: BALLY / DAGLIN No.: 8854813

Team: REMCOR Date: 10-4-88/10-8-88

Well No.: 87-12D Type of Test: CONTINUOUS PUMPING MUNICIPAL WELL #3

Watch Time	Test Time	Water Level	Δs (ft.)			Remarks
	360	26.30	6.32			
	421	26.36	6.38			
	519	26.45	6.47			
	711	26.52	6.54			
	862	26.58	6.60			
	1042	26.62	6.64			
	1113	26.64	6.66			
	1130	26.65	6.67			
	1190	26.67	6.69			
10/5/88 5:03 AM	1193	-	—			MUNICIPAL WELL #1 STARTED
	1219	26.76	6.78			
	1250	26.85	6.87			
	1310	27.03	7.05			
	1366	27.28	7.30			
	1457	27.45	7.47			
	1514	27.52	7.54			
	1572	27.60	7.62			
	1645	27.65	7.67			
	1753	27.77	7.79			
	1847	27.87	7.89			
	2017	28.80	8.82			
	2088	28.05	8.07			
	2186	28.10	8.12			MUNICIPAL WELL #1 STOPPED
10/5/88 10:00AM	2210	-	—			
	2237	28.01	8.03			
	2330	27.75	7.77			
	2460	27.58	7.60			
10/6/88 5:00 AM	2630	-	—			MUNICIPAL WELL #1 STARTED
	2670	27.48	7.50			
	2696	27.70	7.72			
	2858	2808	8.10			
10/6/88 10:00AM	2930	28.16	8.18			MUNICIPAL WELL #1 STOPPED
	2944	28.13	8.15			
	2966	28.08	8.10			
	2986	28.02	8.04			
	3050	27.80	7.82			MUNICIPAL WELL #1 STARTED 3090
	3115	28.02	8.04			
	3240	28.10	8.12			MUNICIPAL WELL #1 STOPPED @ 3250
	3327	27.92	7.94			
	3337	27.90	7.92			
	3429	27.78	7.80			

PERMEABILITY TEST DATA SHEET

Project Name: BALLY / DANGER No.: 88548.13

Team: REMCOR Date:

Well No.: 87-12D Type of Test: CONTINUOUS PUMPING MUNICIPAL WELL #3

Watch Time	Test Time	Water Level	ΔS (ft)				Remarks
	3594	27.70	7.72				
	3867	27.61	7.63				
	4059	27.59	7.61				
	4180	27.60	7.62				
	4272	27.61	7.63		t'	t/t'	
10/7/89 9:10AM	4320	27.62	7.64	-0-		-0-	MUNICIPAL #3
	4321	27.50	7.52	.12	1	4321.0	STOPPED
	4322	27.22	7.24	.40	2	2161.0	
	4323	26.90	6.92	.72	3	1441.0	
	4324	26.58	6.60	1.04	4	1081.0	
	4325	26.28	6.30	1.34	5	865.0	
	4326	26.00	6.02	1.62	6	721.0	
	4327	25.71	5.73	1.91	7	618.1	
	4328	25.49	5.51	2.13	8	541.0	
	4329	25.23	5.25	2.39	9	481.0	
	4330	25.05	5.07	2.57	10	433.0	
	4331	24.88	4.90	2.74	11	393.7	
	4332	24.70	4.72	2.92	12	361.0	
	4337	24.02	4.04	3.60	17	255.1	
	4338	23.90	3.92	3.72	18	241.0	
	4340	23.72	3.74	3.90	20	217.0	
	4346	23.28	3.30	4.34	26	167.2	
	4348	23.15	3.17	4.47	28	155.3	
	4350	23.05	3.07	4.57	30	145.0	
	4357	22.77	2.79	4.85	37	117.8	
	4370	22.42	2.44	5.20	50	87.4	
	4393	22.08	2.10	5.54	73	60.2	
	4418	21.89	1.91	5.73	98	45.1	
	4473	21.62	1.64	6.00	153	29.2	
	4526	21.48	1.50	6.14	206	22.0	
	4712	21.18	1.20	6.44	392	12.0	
	4913	21.02	1.04	6.60	593	8.3	
	5099	20.95	0.97	6.67	779	6.5	
	5330	20.80	0.82	6.82	1010	5.3	
	5450	20.75	0.77	6.87	1130	4.8	
	5510	20.73	0.75	6.89	1190	4.6	
	5570	20.71	0.73	6.91	1250	4.5	
	5670	20.70	0.72	6.92	1350	4.2	

PERMEABILITY TEST DATA SHEET

Project Name: BALLY / DAGEN No.: 88548.13

Team: REMCOR Date: 10-4-88 / 10-8-88

Well No.: 87-135 Type of Test: CONTINUOUS PUMPING MUNICIPAL WELL #3

Watch Time	Test Time MIN	Water Level ft'	ΔS'		Remarks
8:19 AM	0	10.11			
7:10 AM	0		0		MUNICIPAL WELL #3 PUMPING STARTED
	130	10.13	.02		
	272	10.15	.04		
	361	10.15	.04		
	563	10.20	.09		
	789	10.25	.14		
10/5/88 5:02 AM	1193				MUNICIPAL WELL #1 STARTED
	1373	10.38	.27		
	1643	10.42	.31		
	1784	10.46	.35		
	2025	10.52	.41		
10/5/88 10:00 AM	2210				MUNICIPAL WELL #1 STOPPED
	2268	10.53	.42		
10/6/88 5:00 AM	2630				MUNICIPAL WELL #1 STARTED
	2655	10.65	.54		
	2835	10.67	.58		
10/6/88 10:00 AM	2930				MUNICIPAL WELL #1 STOPPED
	3036	10.72	.61		(MUNICIPAL WELL #1 STARTED @ 3090 MIN
	3242	10.74	.63		(MUNICIPAL WELL #1 STOPPED @ 3230 MIN
	3422	10.78	.67		
	3574	10.82	.71		
	3892	10.88	.77		
	4212	10.92	.81		
10/7/88 9:00	4320				MUNICIPAL WELL #3 STOPPED
	4387	10.93	.82		
	4431	10.93	.82		
	4541	10.92	.81		
	4717	10.92	.81		
	4884	10.92	.81		
	5051	10.90	.79		
	5620	10.89	.78		

PERMEABILITY TEST DATA SHEET

Project Name: BALLY / DAGEN No.: [illegible] 3

Team: REMCOR Date: 10-4 88 / 10-8-88

Well No.: PLANT WELL Type of Test: CONTINUOUS PUMPING MUNICIPAL WELL #3

Watch Time	Test Time (MIN)	Water Level (ft)	ds'		Remarks
8.16 AM	0	9.23			
9:10 AM	0				MUNICIPAL WELL #3 STARTS PUMPING
	128	9.30	.07		
	270	9.35	.12		
	359	9.37	.14		
	560	9.41	.18		
	794	9.49	.26		
	1021	9.56	.33		
10/5/88 5:[illegible]AM	1193				MUNICIPAL WELL #1 STARTS PUMPING
	1371	9.66	.43		
	1641	9.72	.49		
	1782	9.76	.53		
	2020	9.84	.61		
10/5/88 10:[illegible]PM	2210				MUNICIPAL WELL #1 STOPS PUMPING
	2287	9.90	.67		
	2500	9.93	.70		
10/6/88 5:00 AM	2630				MUNICIPAL WELL #1 STARTS PUMPING
	2670	9.98	.75		
	2832	10.03	.80		
10/6/88 [illegible]:00 AM	2930				MUNICIPAL WELL #1 STOPS PUMPING
	3034	10.07	.84		MUNICIPAL WELL #1 STARTS @ 3090 MIN
	3235	10.10	.87		MUNICIPAL WELL #1 STOPS @ 3290 MIN
	3418	10.15	.92		
	3560	10.18	.95		
	3905	10.24	1.01		
	4210	10.29	1.06		
10/7/88 9:10AM	4320				MUNICIPAL WELL #3 STOPS PUMPING
	4386	10.26	1.03		
	4428	10.25	1.02		
	4540	10.22	.99		
	4709	10.17	.94		
	4895	10.18	.95		
	5038	10.14	.91		
	5633	10.07	.84		

APPENDIX H

TOXICITY PROFILES

TRICHLOROETHYLENE

Summary

Trichloroethylene (TCE) induced hepatocellular carcinomas in mice and was mutagenic when tested using several microbial assay systems. Chronic inhalation exposure to high concentrations caused liver, kidney, and neural damage and dermatological reactions in animals.

CAS Number: 79-01-6

Chemical Formula: C_2HCl_3

IUPAC Name: Trichloroethene

Important Synonyms and Trade Names: Trichloroethene, TCE, and ethylene trichloride

Chemical and Physical Properties

Molecular Weight: 131.5

Boiling Point: 87°C

Melting Point: -73°C

Specific Gravity: 1.4642 at 20°C

Solubility in Water: 1,000 mg/liter

Solubility in Organics: Soluble in alcohol, ether, acetone, and chloroform

Log Octanol/Water Partition Coefficient: 2.29

Vapor Pressure: 60 mm Hg at 20°C

Vapor Density: 4.53

Transport and Fate

Trichloroethylene (TCE) rapidly volatilizes into the atmosphere where it reacts with hydroxyl radicals to produce hydrochloric acid, carbon monoxide, carbon dioxide, and carboxylic acid. This is probably the most important transport and fate process for trichloroethylene in surface water and in the upper

Clement Associates

AR300975

layer of soil. TCE adsorbs to organic materials and can be bioaccumulated to some degree. However, it is unclear whether trichloroethylene bound to organic material can be degraded by microorganisms or must be desorbed to be destroyed. There is some evidence that higher organisms can metabolize TCE. Trichloroethylene leaches into the groundwater fairly readily, and it is a common contaminant of groundwater around hazardous waste sites.

Health Effects

Trichloroethylene is carcinogenic to mice after oral administration, producing hepatocellular carcinomas (NCI 1976, NTP 1982). It was found to be mutagenic using several microbial assay systems. Trichloroethylene does not appear to cause reproductive toxicity or teratogenicity. TCE has been shown to cause renal toxicity, hepatotoxicity, neurotoxicity, and dermatological reactions in animals following chronic exposure to levels greater than 2,000 mg/m^3 for 6 months. Trichloroethylene has low acute toxicity; the acute oral LD_{50} value in several species ranged from 6,000 to 7,000 mg/kg.

Toxicity to Wildlife and Domestic Animals

There was only limited data on the toxicity of trichloroethylene to aquatic organisms. The acute toxicity to freshwater species was similar in the three species tested, with LC_{50} values of about 50 mg/liter. No LC_{50} values were available for saltwater species. However, a dose of 2 mg/liter caused erratic swimming and loss of equilibrium in the grass shrimp. No chronic toxicity tests were reported.

No information on the toxicity of trichloroethylene to domestic animals or terrestrial wildlife was available in the literature reviewed.

Regulations and Standards

Ambient Water Quality Criteria (USEPA):

Aquatic Toxicity

The available data are not adequate for establishing criteria. However, EPA did report the lowest values known to be toxic in aquatic organisms.

Freshwater

Acute toxicity: 45 mg/liter
Chronic toxicity: No available data

AR300975-A

Saltwater

Acute toxicity: 2 mg/liter
Chronic toxicity: No available data

Human Health

Estimates of the carcinogenic risks associated with lifetime exposure to various concentrations of trichloroethylene in water are:

Risk	Concentration
10^{-5}	27 µg/liter
10^{-6}	2.7 µg/liter
10^{-7}	0.27 µg/liter

CAG Unit Risk (USEPA): 1.1×10^{-2} $(mg/kg/day)^{-1}$

NIOSH Recommended Standards (air): 540 mg/m^3 TWA
760 mg/m^3 10-min Ceiling Level

OSHA Standards (air): 540 mg/m^3 TWA
1,075 mg/m^3/15-min Ceiling Level
1,620 mg/m^3 for 5 min every 3 hr, Peak Concentration

REFERENCES

INTERNATIONAL AGENCY FOR RESEARCH ON CANCER (IARC). 1979. IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Humans. Vol. 20: Some Halogenated Hydrocarbons. World Health Organization, Lyon, France. Pp. 545-572

NATIONAL CANCER INSTITUTE (NCI). 1976. Bioassay of Trichloroethylene for Possible Carcinogenicity. CAS No. 79-01-6. NCI Carcinogenesis Technical Report Series No. 2, Washington, D.C. DHEW Publication No. (NIH) 76-802

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH). 1983. Registry of Toxic Effects of Chemical Substances. Data Base. Washington, D.C. October 1983

NATIONAL TOXICOLOGY PROGRAM (NTP). 1982. Carcinogenesis Bioassay of Trichloroethylene. CAS No. 79-01-6. NTP 81-84, NIH Publication No. 82-1799

U.S. ENVIRONMENTAL PROTECTION AGENCY (USEPA). 1979. Water-Related Environmental Fate of 129 Priority Pollutants. Washington, D.C. December 1979. EPA 440/4-79-029

U.S. ENVIRONMENTAL PROTECTION AGENCY (USEPA). 1980. Ambient Water Quality Criteria for Trichloroethylene. Office of Water Regulations and Standards, Criteria and Standards Division, Washington, D.C. October 1980. EPA 400/5-80-077

U.S. ENVIRONMENTAL PROTECTION AGENCY (USEPA). 1983. Health Assessment Document for Trichloroethylene. Review Draft. Washington, D.C. EPA 600/8-82-0068

U.S. ENVIRONMENTAL PROTECTION AGENCY (USEPA). 1984. Health Effects Assessment for Trichloroethylene. Final Draft. Environmental Criteria and Assessment Office, Cincinnati, Ohio. September 1984. ECAO-CIN-H009

U.S. ENVIRONMENTAL PROTECTION AGENCY (USEPA). 1985. Health Assessment Document for Chloroform. Office of Health and Environmental Assessment, Washington, D.C. September 1985. EPA 600/8-84/004F

VERSCHUEREN, K. 1977. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Co., New York. 659 pages

WATERS, E.M., GERSTNER, H.B., and HUFF, J.E. 1977. Trichloroethylene: 1. An overview. J. Toxicol. Environ. Health 2:674-700

WEAST, R.E., ed. 1981. Handbook of Chemistry and Physics. 62nd ed. CRC Press, Cleveland, Ohio. 2,332 pages

1,1,1-TRICHLOROETHANE

Summary

Preliminary results suggest that 1,1,1-trichloroethane (1,1,1-TCA) induces liver tumors in female mice. It was shown to be mutagenic using the Ames assay, and it causes transformation in cultured rat embryo cells. Inhalation exposure to high concentrations of 1,1,1-TCA depressed the central nervous system; affected cardiovascular function; and damaged the lungs, liver, and kidneys in animals and humans. Irritation of the skin and mucous membranes has also been associated with human exposure to 1,1,1-trichloroethane.

CAS Number: 71-55-6

Chemical Formula: CH_3CCl_3

IUPAC Name: 1,1,1-Trichloroethane

Important Synonyms and Trade Names: Methyl chloroform, chlorothene, 1,1,1-TCA

Chemical and Physical Properties

Molecular Weight: 133.4

Boiling Point: 74.1°C

Melting Point: -30.4°C

Specific Gravity: 1.34 at 20°C (liquid)

Solubility in Water: 480-4,400 mg/liter at 20°C (several divergent values were reported in the literature)

Solubility in Organics: Soluble in acetone, benzene, carbon tetrachloride, methanol, ether, alcohol, and chlorinated solvents

Log Octanol/Water Partition Coefficient: 2.17

Vapor Pressure: 123 mm Hg at 20°C

Vapor Density: 4.63

Transport and Fate

1,1,1-Trichloroethane (1,1,1-TCA) disperses from surface water primarily by volatilization. Several studies have indicated that 1,1,1-trichloroethane may be adsorbed onto organic materials in the sediment, but this is probably not an important route of elimination from surface water. 1,1,1-Trichloroethane can be transported in the groundwater, but the speed of transport depends on the composition of the soil.

Photooxidation by reaction with hydroxyl radicals in the atmosphere is probably the principal fate process for this chemical.

Health Effects

1,1,1-Trichloroethane was retested for carcinogenicity because in a previous study by NCI (1977), early lethality precluded assessment of carcinogenicity. Preliminary results indicate that 1,1,1-TCA increased the incidence of combined hepatocellular carcinomas and adenomas in female mice when administered by gavage (NTP 1984). There is evidence that 1,1,1-trichloroethane is mutagenic in Salmonella typhimurium and causes transformation in cultured rat embryo cells (USEPA 1980). These data suggest that the chemical may be carcinogenic.

Other toxic effects of 1,1,1-TCA are seen only at concentrations well above those likely in an open environment. The most notable toxic effects of 1,1,1-trichloroethane in humans and animals are central nervous system depression, including anesthesia at very high concentrations and impairment of coordination, equilibrium, and judgment at lower concentrations (350 ppm and above); cardiovascular effects, including premature ventricular contractions, decreased blood pressure, and sensitization to epinephrine-induced arrhythmia; and adverse effects on the lungs, liver, and kidneys. Irritation of the skin and mucous membranes resulting from exposure to 1,1,1-trichloroethane has also been reported. The oral LD_{50} value of 1,1,1-trichloroethane in rats is about 11,000 mg/kg.

Toxicity to Wildlife and Domestic Animals

The acute toxicity of 1,1,1-trichloroethane to aquatic species is rather low, with the LC_{50} concentration for the most sensitive species tested being 52.8 mg/l. No chronic toxicity studies have been done on 1,1,1-trichloroethane, but acute-chronic ratios for the other chlorinated ethanes ranged from 2.8 to 8.7. 1,1,1-Tricholoroethane was only slighty bioaccumulated with a steady-state bioconcentration factor of nine and an elimination half-life of two days.

AR300979

No information on the toxicity of 1,1,1-trichloroethane to terrestrial wildlife or domestic animals was available in the literature reviewed.

Regulations and Standards

Ambient Water Quality Criteria (USEPA):

Aquatic Life

The available data are not adequate for establishing criteria. However, EPA did report, the lowest values of the two trichloroethanes (1,1,1 and 1,1,2) known to be toxic in aquatic organisms.

Freshwater

Acute toxicity: 18 mg/liter
Chronic toxicity: 8.4 mg/liter

Saltwater

Acute toxicity: 31.2 mg/liter
Chronic toxicity: No available data

Human Health

Criterion: 18.4 mg/liter

NIOSH Recommended Standard: 350 ppm (1,910 mg/m^3)/15 min Ceiling Level

OSHA Standard: 350 ppm (1,910 mg/m^3) TWA

REFERENCES

INTERNATIONAL AGENCY FOR RESEARCH ON CANCER (IARC). 1979. IARC Monographs on the Evaluation of the Carcinogenic Risks of Chemicals to Humans. Vol. 20: Some Halogenated Hydrocarbons. World Health Organization, Lyon, France. Pp. 515-531

NATIONAL CANCER INSTITUTE (NCI). 1977. Bioassay of 1,1,1-Trichloroethane for Possible Carcinogenicity. CAS No. 71-55-6. NCI Carcinogenesis Technical Report Series No. 3. Washington, D.C. DHEW Publication No. (NIH) 77-803

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH). 1976. Criteria for a Recommended Standard--Occupational Exposure to 1,1,1-Trichloroethane (Methyl Chloroform). Washington, D.C. DHEW Publication No. (NIOSH) 76-184

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH). 1983. Registry of Toxic Effects of Chemical Substances. Data Base. Washington, D.C. October 1983

NATIONAL TOXICOLOGY PROGRAM (NTP). 1984. Annual Plan for Fiscal Year 1984. Research Triangle Park, N.C. DHHS Public Health Service. NTP-84-023

U.S. ENVIRONMENTAL PROTECTION AGENCY (USEPA). 1979. Water-Related Environmental Fate of 129 Priority Pollutants. Washington, D.C. December 1979. EPA 440/4-79-029

U.S. ENVIRONMENTAL PROTECTION AGENCY (USEPA). 1980. Ambient Water Quality Criteria for Chlorinated Ethanes. Office of Water Regulations and Standards, Criteria and Standards Division, Washington, D.C. October 1980. EPA 440/5-80-029

U.S. ENVIRONMENTAL PROTECTION AGENCY (USEPA). 1984. Health Effects Assessment for 1,1,1-Trichloroethane. Environmental Criteria and Assessment Office, Cincinnati, Ohio. September 1984. ECAO-CIN-H005 (Final Draft)

VERSCHUEREN, K. 1977. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Co., New York. 659 pages

WEAST, R.E., ed. 1981. Handbook of Chemistry and Physics. 62nd ed. CRC Press, Cleveland, Ohio. 2,332 pages

AR300981

1,1-DICHLOROETHYLENE

Summary

1,1-Dichloroethylene (VDC, vinylidene chloride) caused kidney tumors (in males only) and leukemia in one study of mice exposed by inhalation, but the results of other studies were equivocal or negative. 1,1-Dichloroethylene is mutagenic, and it caused adverse reproductive effects when administered to rats and rabbits by inhalation. Chronic exposure causes liver damage, and acute exposure to high doses produces nervous system damage.

CAS Number: 75-35-4

Chemical Formula: CH_2CCl_2

IUPAC Name: 1,1-Dichloroethene

Important Synonyms and Trade Names: Vinylidene chloride, VDC, 1,1-dichloroethene, 1,1-DCE

Chemical and Physical Properties

Atomic Weight: 96.94

Boiling Point: 37°C

Melting Point: -122.1°C

Specific Gravity: 1.218 at 20°C

Solubility in Water: 400 mg/liter at 20°C

Solubility in Organics: Sparingly soluble in alcohol, ether, acetone, benzene, and chloroform

Log Octanol/Water Partition Coefficient: 1.48

Vapor Pressure: 500 mm Hg at 20°C

Vapor Density: 3.25

Transport and Fate

Volatilization appears to be the primary transport process for 1,1-dichloroethylene (VDC), and its subsequent photooxida-

Clement Associates
300982
AR300982

tion in the atmosphere by reaction with hydroxyl radicals is apparently the predominant fate process. Information on other transport and fate mechanisms was generally lacking for 1,1-dichloroethylene. However, by inference from related compounds, hydrolysis, sorption, bioaccumulation, biotransformation, and biodegradation probably all occur but at rates too slow to be of much significance.

Health Effects

1,1-Dichloroethylene caused kidney tumors in males and leukemia in males and females in one study of mice exposed by inhalation, gave equivocal results in other inhalation studies, and gave negative results in rats and mice following oral exposure and in hamsters following inhalation exposure. VDC was mutagenic in several bacterial assays. 1,1-Dichloroethylene did not appear to be teratogenic but did cause embryotoxicity and fetotoxicity when administered to rats and rabbits by inhalation. Chronic exposure to oral doses of VDC as low as 5 mg/kg/day caused liver changes in rats. Acute exposure to high doses causes central nervous system depression, but neurotoxicity has not been associated with low-level chronic exposure. The oral LD_{50} value for the rat is 1,500 mg/kg, and for the mouse it is 200 mg/kg.

Toxicity to Wildlife and Domestic Animals

1,1-Dichloroethylene is not very toxic to freshwater or saltwater species, with acute LC_{50} values generally ranging from 80 to 200 mg/liter. A chronic study in which no adverse effects were observed indicated that the acute-chronic ratio was less than 40; a 13-day study that produced an LC_{50} of 29 mg/liter indicated that the acute-chronic ratio is greater than 4.

No reports of the toxicity of 1,1-dichloroethylene to terrestrial wildlife or domestic animals were found in the literature reviewed.

Regulations and Standards

Ambient Water Quality Criteria (USEPA):

Aquatic Life

The available data are inadequate for establishing criteria. However, EPA did report the lowest values known to cause toxicity in aquatic organisms.

AR300983

Freshwater

Acute toxicity: 11,600 µg/liter
Chronic toxicity: No available data

Saltwater

Acute toxicity: 224,000 µg/liter
Chronic toxicity: No available data

Human Health

Estimates of the carcinogenic risks associated with lifetime exposure to various concentrations of 1,1-dichloroethylene in water are:

Risk	Concentration
10^{-5}	0.33 µg/liter
10^{-6}	0.033 µg/liter
10^{-7}	0.0033 µg/liter

CAG Unit Risk (USEPA): 1.16 $(mg/kg/day)^{-1}$

REFERENCES

INTERNATIONAL AGENCY FOR RESEARCH ON CANCER (IARC). 1979. IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Humans. Vol. 19: Some Monomers, Plastics and Synthetic Elastomers, and Acrolein. World Health Organization, Lyon, France

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH). 1983. Registry of Toxic Effects of Chemical Substances. Data Base. Washington, D.C. October 1983

NATIONAL TOXICOLOGY PROGRAM (NTP). 1982. Carcinogenesis Bioassay of Vinylidene Chloride (CAS No. 75-35-4) in F344 Rats and $B6C3F_1$ Mice (Gavage Study). NTP Technical Report Series No. 228. Washington, D.C. DHHS Publication No. (NIH) 82-1784

U.S. ENVIRONMENTAL PROTECTION AGENCY (USEPA). 1979. Water-Related Environmental Fate of 129 Priority Pollutants. Washington, D.C. December 1979. EPA 440/4-79-029

U.S. ENVIRONMENTAL PROTECTION AGENCY (USEPA). 1980. Ambient Water Quality Criteria for Dichloroethylenes. Office of Water Regulations and Standards, Criteria and Standards Division, Washington, D.C. October 1980. EPA 440/5-80-041

U.S. ENVIRONMENTAL PROTECTION AGENCY (USEPA). 1984. Health Effects Assessment for 1,1-Dichloroethylene. Final Draft. Environmental Criteria and Assessment Office, Cincinnati, Ohio. September 1984. ECAO-CIN-H051

U.S. ENVIRONMENTAL PROTECTION AGENCY (USEPA). 1985. Health Assessment Document for Chloroform. Office of Health and Environmental Assessment, Washington, D.C. September 1985. EPA 600/8-84/004F

VERSCHUEREN, K. 1977. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Co., New York. 659 pages

WEAST, R.E., ed. 1981. Handbook of Chemistry and Physics. 62nd ed. CRC Press, Cleveland, Ohio. 2,332 pages

AR300985

METHYLENE CHLORIDE

Summary

Methylene chloride increased the incidence of lung and liver tumors and sarcomas in rats and mice. It was found to be mutagenic in bacterial test systems. In humans, methylene chloride irritates the eyes, mucous membranes, and skin. Exposure to high levels adversely affects the central and peripheral nervous systems and the heart. In experimental animals, methylene chloride is reported to cause kidney and liver damage, convulsions, and paresis.

CAS Number: 75-09-2

Chemical Formula: CH_2Cl_2

IUPAC Name: Dichloromethane

Important Synonyms and Trade Names: Methylene dichloride, methane dichloride

Chemical and Physical Properties

Molecular Weight: 84.93

Boiling Point: 40°C

Melting Point: -95.1°C

Specific Gravity: 1.3266 at 20°C

Solubility in Water: 13,200-20,000 mg/liter at 25°C

Solubility in Organics: Miscible with alcohol and ether

Log Octanol/Water Partition Coefficient: 1.25

Vapor Pressure: 362.4 mm Hg at 20°C

Vapor Density: 2.93

Transport and Fate

Volatilization to the atmosphere appears to be the major mechanism for removal of methylene chloride from aquatic systems

300986

Clement Associates

AR300986

and its primary environmental transport process (USEPA 1979). Photooxidation in the troposphere appears to be the dominant environmental fate of methylene chloride. Once in the troposphere the compound is attacked by hydroxyl radicals, resulting in the formation of carbon dioxide, and to a lesser extent, carbon monoxide and phosgene. Phosgene is readily hydrolyzed to HCl and CO_2. About one percent of tropospheric methylene chloride would be expected to reach the stratosphere where it would probably undergo photodissociation resulting from interaction with high energy ultraviolet radiation. Aerial transport of methylene chloride is partly responsible for its relatively wide environmental distribution. Atmospheric methylene chloride may be returned to the earth in precipitation.

Photolysis, oxidation, and hydrolysis do not appear to be significant environmental fate processes for methylene chloride, and there is no evidence to suggest that either adsorption or bioaccumulation are important fate processes for this chemical. Although methylene chloride is potentially biodegradable, especially by acclimatized microorganisms, biodegradation probably only occurs at a very slow rate.

Health Effects

Methylene chloride is currently under review by the National Toxicology Program (NTP 1984, USEPA 1985). Preliminary results indicate that it produced an increased incidence of lung and liver tumors in mice and mammary tumors in female and male rats. In a chronic inhalation study, male rats exhibited an increased incidence of sarcomas in the ventral neck region (Burek et al. 1984). However, the authors suggested that the relevance and toxicological significance of this finding were uncertain in light of available toxicity data. Methylene chloride is reported to be mutagenic in bacterial test systems. It also has produced positive results in the Fischer rat embryo cell transformation test. However, it has been suggested that the observed cell-transforming capability may have been due to impurities in the test material. There is no conclusive evidence that methylene chloride can produce teratogenic effects.

In humans, direct contact with methylene chloride produces eye, respiratory passage, and skin irritation (USEPA 1985). Mild poisonings due to inhalation exposure produce somnolence, lassitude, numbness and tingling of the limbs, anorexia, and lightheadedness, followed by rapid and complete recovery. More severe poisonings generally involve correspondingly greater disturbances of the central and peripheral nervous systems. Methylene chloride also has acute toxic effects on the heart, including the induction of arrhythmia. Fatalities reportedly

AR300987

due to methylene chloride exposure have been attributed to cardiac injury and heart failure. Methylene chloride is metabolized to carbon monoxide in vivo, and levels of carboxyhemoglobin in the blood are elevated after acute exposures. In experimental animals, methylene chloride is reported to cause kidney and liver damage, convulsions, and distal paresis. An oral LD_{50} value of 2,136 mg/kg, and an inhalation LC_{50} value of 88,000 mg/m^3/30 min are reported for the rat.

Toxicity to Wildlife and Domestic Animals

Very little information concerning the toxicity of methylene chloride to domestic animals and wildlife exists (USEPA 1980). Acute values for the freshwater species *Daphnia magna*, the fathead minnow, and the bluegill are 224,000, 193,000, and 224,000 µg/liter, respectively. Acute values for the saltwater species, mysid shrimp and sheepshead minnow, are 256,000 and 331,000 µg/liter, respectively. No data concerning chronic toxicity are available. The 96-hour EC_{50} values for both freshwater and saltwater algae are greater than the highest test concentration 662,000 µg/liter.

Regulations and Standards

Ambient Water Quality Criteria (USEPA):

Aquatic Life

The available data are not adequate for establishing criteria.

Human Health

Criterion: 12.4 mg/liter (for protection against the noncarcinogenic effects of methylene chloride)

CAG Unit Risk (USEPA): 1.4×10^{-2} $(mg/kg/day)^{-1}$

NIOSH Recommended Standards:

261 mg/m^3 TWA in the presence of no more than 9.9 mg/m^3 of CO
1,737 mg/m^3/15 min Peak Concentration

OSHA Standards: 1,737 mg/m^3 TWA
3,474 mg/m^3 Ceiling Level
6,948 mg/m^3 Peak Concentration (5 min in any 3 hr)

ACGIH Threshold Limit Values: 350 mg/m^3 TWA
1,740 mg/m^3 STEL

300988

Clement Associates
AR300988

REFERENCES

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH). 1980. Documentation of the Threshold Limit Values. 4th ed. Cincinnati, Ohio. 488 pages

BUREK, J.D., NITSCHKE, K.D., BELL, T.J., WACKERLE, D.L., CHILDS, R.C., BEYER, J.E., DITTENBER, D.A., RAMPY, L.W., and MCKENNA, M.J. 1984. Methylene chloride: A two-year inhalation toxicity and oncogenicity study in rats and hamsters. Fundam. Appl. Toxicol. 4:30-47

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH). 1976. Criteria for a Recommended Standard--Occupational Exposure to Methylene Chloride. March 1976. DHEW Publication No. (NIOSH) 76-138

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH). 1983. Registry of Toxic Effects of Chemical Substances. Data Base. Washington, D.C.

NATIONAL TOXICOLOGY PROGRAM (NTP). 1984. NTP Technical Report on the Toxicology and Carcinogenesis Studies of Methylene Chloride (CAS No. 75-09-2) in F344/N Rats and B6C3F$_1$ Mice (Inhalation Studies) NTP Technical Report No. 291. Research Triangle Park, North Carolina. USDHHS (NIH) Publication No. 85-2562

SAX, N.I. 1975. Dangerous Properties of Industrial Materials. 4th ed. Van Nostrand Reinhold Co., New York. 1,258 pages

U.S. ENVIRONMENTAL PROTECTION AGENCY (USEPA). 1979. Water-Related Environmental Fate of 129 Priority Pollutants. Washington, D.C. December 1979. EPA 440/4-79-029

U.S. ENVIRONMENTAL PROTECTION AGENCY (USEPA). 1980. Ambient Water Quality Criteria for Halomethanes. Office of Water Regulations and Standards, Criteria and Standards Division, Washington, D.C. October 1980. EPA 440/5-80-051

U.S. ENVIRONMENTAL PROTECTION AGENCY (USEPA). 1984. Health Effects Assessment for Methylene Chloride . Environmental Criteria and Assessment Office, Cincinnati, Ohio. September 1984. ECAO-CIN-H028 (Final Draft)

U.S. ENVIRONMENTAL PROTECTION AGENCY (USEPA). 1985. Health Assessment Document for Chloroform. Office of Health and Environmental Assessment, Washington, D.C. September 1985. EPA 600/8-84/004F

WEAST, R.E., ed. 1981. Handbook of Chemistry and Physics. 62nd ed. CRC Press, Cleveland, Ohio. 2,332 pages

AR300989
000839

TETRACHLOROETHYLENE

Summary

Tetrachloroethylene (PCE, perchloroethylene) induced liver tumors when administered orally to mice and was found to be mutagenic using a microbial assay system. Reproduction toxicity was observed in pregnant rats and mice exposed to high concentrations. Animals exposed by inhalation to tetrachloroethylene exhibited liver, kidney, and central nervous system damage.

CAS Number: 127-18-4

Chemical Formula: C_2Cl_4

IUPAC Name: Tetrachloroethene

Important Synonyms and Trade Names: Perchloroethylene, PCE

Chemical and Physical Properties

Molecular Weight: 165.83

Boiling Point: 121°C

Melting Point: -22.7°C

Specific Gravity: 1.63

Solubility in Water: 150 to 200 mg/liter at 20°C

Solubility in Organics: Soluble in alcohol, ether, and benzene

Log Octanol/Water Partition Coefficient: 2.88

Vapor Pressure: 14 mm Hg at 20°C

Transport and Fate

Tetrachloroethylene (PCE) rapidly volatiziles into the atmosphere where it reacts with hydroxyl radicals to produce HCl, CO, CO_2 and carboxylic acid. This is probably the most important transport and fate process for tetrachloroethylene in the environment. PCE will leach into the groundwater, especially in soils of low organic content. In soils with high levels of organics, PCE adsorbs to these materials and can

200990

Clement Associates

AR300990

be bioaccumulated to some degree. However, it is unclear if tetrachloroethylene bound to organic material can be degraded by microorganisms or must be desorbed to be destroyed. There is some evidence that higher organisms can metabolize PCE.

Health Effects

Tetrachloroethylene was found to produce liver cancer in male and female mice when administered orally by gavage (NCI 1977). Unpublished gavage studies in rats and mice performed by the National Toxicology Program (NTP) showed hepatocellular carcinomas in mice and a slight, statistically insignificant increase in a rare type of kidney tumor.[1] NTP is also conducting an inhalation carcinogenicity study. Elevated mutagenic activity was found in Salmonella strains treated with tetrachloroethylene. Delayed ossification of skull bones and sternebrae were reported in offspring of pregnant mice exposed to 2,000 mg/m^3 of tetrachloroethylene for 7 hours/day on days 6-15 of gestation. Increased fetal resorptions were observed after exposure of pregnant rats to tetrachloroethylene. Renal toxicity and hepatotoxicity have been noted following chronic inhalation exposure of rats to tetrachloroethylene levels of 1,356 mg/m^3. During the first 2 weeks of a subchronic inhalation study, exposure to concentrations of 1,622 ppm (10,867 mg/m^3) of tetrachloroethylene produced signs of central nervous system depression, and cholinergic stimulation was observed among rabbits, monkeys, rats, and guinea pigs.

Toxicity to Wildlife and Domestic Animals

Tetrachloroethylene is the most toxic of the chloroethylenes to aquatic organisms but is only moderately toxic relative to other types of compounds. The limited acute toxicity data indicate that the LC_{50} value for saltwater and freshwater species are similar, around 10,000 µg/liter; the trout was the most sensitive (LC_{50} = 4,800 µg/liter). Chronic values were 840 and 450 µg/liter for freshwater and saltwater species, respectively, and an acute-chronic ratio of 19 was calculated.

No information on the toxicity of tetrachloroethylene to terrestrial wildlife or domestic animals was available in the literature reviewed.

---

[1] J. Mennear, NTP Chemical Manager; personal communication, 1984.

AR300991

Regulations and Standards

Ambient Water Quality Criteria (USEPA):

Aquatic Life

The available data are not adequate for establishing criteria. However, EPA did report the lowest values known to be toxic to aquatic organisms.

Freshwater

Acute toxicity: 5,280 µg/liter
Chronic toxicity: 840 µg/liter

Saltwater

Acute toxicity: 10,200 µg/liter
Chronic toxicity: 450 µg/liter

Human Health

Estimates of the carcinogenic risks associated with lifetime exposure to various concentrations of tetrachloroethylene in water are:

Risk	Concentration
10^{-5}	8.0 µg/liter
10^{-6}	0.8 µg/liter
10^{-7}	0.08 µg/liter

CAG Unit Risk (USEPA): 5.1×10^{-2} $(mg/kg/day)^{-1}$

NIOSH Recommended Standards (air): 335 mg/m^3 TWA
670 mg/m^3 15-min Ceiling Level

OSHA Standards (air): 670 mg/m^3 TWA
1,340 mg/m^3 Ceiling Level
2,010 mg/m^3 for 5 min every 3 hr, Peak Level

REFERENCES

NATIONAL ACADEMY OF SCIENCE (NAS). 1977. Drinking Water and Health. Safe Drinking Water Committee, Washington, D.C.

NATIONAL CANCER INSTITUTE (NCI). 1977. Bioassay of Tetrachloroethylene for Possible Carcinogenicity. NCI Carcinogenesis Technical Report Series No. 13, Washington, D.C. DHEW Publication No. (NIH) 77-813

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH (NIOSH). 1983. Registry of Toxic Effects of Chemical Substances. Data Base. Washington, D.C. October 1983

U.S. ENVIRONMENTAL PROTECTION AGENCY (USEPA). 1979. Health Assessment Document for Tetrachloroethylene (Perchloroethylene). External Review Draft No. 1, April 1979

U.S. ENVIRONMENTAL PROTECTION AGENCY (USEPA). 1979. Water-Related Environmental Fate of 129 Priority Pollutants. Washington, D.C. December 1979. EPA 440/4-79-029

U.S. ENVIRONMENTAL PROTECTION AGENCY (USEPA). 1980. Ambient Water Quality Criteria for Tetrachloroethylene. Office of Water Regulations and Standards, Criteria and Standards Division, Washington, D.C. October 1980. EPA 440/5-80-073

U.S. ENVIRONMENTAL PROTECTION AGENCY (USEPA). 1984. Health Effects Assessment for Tetrachloroethylene. Final Draft. Environmental Criteria and Assessment Office, Cincinnati, Ohio. September 1984. ECAO-CIN-H009

U.S. ENVIRONMENTAL PROTECTION AGENCY (USEPA). 1985. Health Assessment Document for Chloroform. Office of Health and Environmental Assessment, Washington, D.C. September 1985. EPA 600/8-84/004F

VERSCHUEREN, K. 1977. Handbook of Environmental Data on Organic Chemicals. Van Nostrand Reinhold Co., New York. 659 pages

WEAST, R.E., ed. 1981. Handbook of Chemistry and Physics. 62nd ed. CRC Press, Cleveland, Ohio. 2,332 pages

AR300993

300994

AR300994

APPENDIX I

CALCULATED ESTIMATES OF VOC INHALATION DOSES DURING SHOWERING

300995

AR300995

REMCOR

By RSM Date 11/22/88 Subject _____ Sheet No. 1 of 14
Chkd. By ASR Date 11/28/88 _____ Proj. No. 88548

Problem: Estimate for the current Bally municipal water supply system (Municipal Well No 1.) the rate of VOC release into the air during showering, the buildup and decay of VOCs in shower room air, and the quantity of airborne VOCs inhaled (dose) during the time the shower is running and during the time spent in the shower room after showering.

Dose is estimated for the following VOCs and concentrations detected in Municipal Well No. 1 during the Phase III RI:

1,1,1-Trichloroethane (TCA) - 73 µg/l
Trichloroethene (TCE) - 15 µg/l
1,1-Dichloroethene (DCE) - 19 µg/l

Estimation of the VOC release rate is based on an adaptation of the two-film gas-liquid mass transfer theory (Liss and Slater, 1974). The two film boundary theory provides the basis for estimating the overall mass transfer coefficient (K_L) for each VOC according to the following equation:

$$K_L = \left(1/k_l + RT/Hk_g\right)^{-1} \qquad (1)$$

where

K_L = overall mass transfer coefficient (cm/hr),
H = Henry's Law Constant (atm-m^3/mol-K)
RT = 2.4×10^{-2} atm-m^3/mole (gas constant of $8.2 \times$ atm-m^3/mol-K times absolute temperature of 293
k_g = gas-film mass transfer coefficient (cm/hr), and
k_l = liquid-film mass transfer coefficient (cm/hr).

AR300996

REMCOR

By RSM Date 11/22/88 Subject _____ Sheet No. 2 of 14
Chkd. By ASA Date 11/28/88 _____ Proj. No. 88548

Values of k_l (20 cm/hr) and k_g (3000 cm/hr) for CO_2 and H_2O, respectively, can be used to estimate VOC-specific values for these parameters:

$$k_{g(TCE)} = k_g(H_2O)(18/MW_{(TCE)})^{0.5}, \text{ and}$$

$$k_{l(TCE)} = k_l(CO_2)(44/MW_{(TCE)})^{0.5}$$ where MW = molecular weight (g

thus $k_{g(TCE)} = 3000\,(18/131)^{0.5}$
$= 1112$ cm/hr

$k_{l(TCE)} = 20\,(44/131)^{0.5}$
$= 11.6$ cm/hr

$$K_L = \left(\frac{1}{11.6} + \frac{2.4\times10^{-2}}{1.0\times10^{-2}(1112)}\right)^{-1} = 11.3 \text{ cm/hr-k}$$

K_L is adjusted for shower water temperature as follows (shower water temperature is assumed to be 35°C):

$$K_{2L} = K_L\,(T_1\mu_s / T_s\mu_1)^{-0.5} \qquad (2)$$

where

T_1 = calibration water temp. (293 K)
T_s = shower water temp. (308 K)
μ_1 = water viscosity @ T_1 = 1.0 cp
μ_s = water viscosity @ T_s = 0.76 cp

AR300997

$K_{2L} = 13.3$ cm/hr

REMCOR

By RSM Date 11/22/88 Subject _____ Sheet No. 3 of 14
Chkd. By ASR Date 11/28/88 _____ Proj. No. 88548

The concentration leaving the shower droplet, C_{wd}, is obtained from an integrated rate equation based on a mass-balance approach:

$$C_{wd} = C_{wo}\left(1 - \exp\left[-K_{3L}\, t_s / 60d\right]\right) \quad (3)$$

where

C_{wd} = concentration leaving shower droplet after time t_s (µg/l),
C_{wo} = shower water concentration (µg/l),
d = shower droplet diameter = 1 mm
t_s = shower droplet drop time = 2 seconds

$$C_{wd} = 15\,\mu g/l\left(1 - \exp\left[-13.3\,(2)/60\,(1)\right]\right)$$
$$= 5.4\,\mu g/l$$

The VOC generation rate in the shower room, S, can then be calculated by the equation:

$$S = C_{wd}\,(FR)/SV \quad (4)$$

where

S = indoor VOC generation rate (µg/m³-min),
FR = shower water flow rate = 10 liters/min
SV = shower room air volume = 8 m³

$$S = 5.4\,\mu g/l\,(10\,l/min)/8\,m^3$$
$$= 6.75\,\mu g/m^3\text{-}min$$

AR300998

REMCOR

By RSM Date 11/22/88 Subject _____ Sheet No. 4 of 14
Chkd. By ASR Date 11/28/88 _____ Proj. No. 88548

A simple one-box indoor air pollution model is used to estimate VOC air concentrations in the shower room and can be expressed as a differential equation describing the rate of change of the indoor pollutant concentration with time:

$$dC_a/dt = -RC_a + S \qquad (5)$$

where

C_a = indoor VOC air concentration ($\mu g/m^3$)
R = air exchange rate = $\frac{1}{60 \text{ min}}$

Integrating equation 5, the indoor air concentration can be estimated as follows:

$$C_a(t) = (S/R)(1 - \exp[-Rt]) \quad \text{for } t \leq D_s$$

and

$$C_a(t) = (S/R)(\exp[RD_s] - 1)\exp(-Rt) \quad \text{for } t$$

where

$C_a(t)$ = indoor air VOC concentration @ time t (μ
D_s = shower duration = 15 min
t = time (min).

The inhalation exposure per shower (and day) can then calculated according to the equation:

$$E_{inh} = [V_r/(BW)(10^6)] \int_0^{D_t} C_a(t)\,dt \qquad (6)$$

where

AR300999

V_r = ventilation rate = 15 liters/min
BW = body weight = 70 Kg
D_t = total duration in shower room = 30 min

REMCOR

By RSM Date 11/22/88 Subject _____ Sheet No. 5 of 14
Chkd. By ASR Date 11/28/88 _____ Proj. No. 88548

This equation can be solved for both the duration of the shower and the duration in the room after the shower has been turned off as follows:

$$E_{inh_{(TCE)}} = (V_r)(S) / [(BW)(R)(10^6)]$$

$$[D_s + \exp(-RD_t)/R - \exp[R(D_s - D_t)]/R]$$

$$= (15)(0.75) / [(70)(\tfrac{1}{60})(10^6)]$$

$$[15 + \exp(-\tfrac{30}{60})60 - \exp[\tfrac{-15}{60}]60]$$

$$E_{inh_{(TCE)}} = \boxed{4.0 \times 10^{-4} \frac{mg}{Kg\text{-}day}}$$

Following are the inhalation dose estimates for DCE and TCA. The only variables that change are the Henry's Law Constants, the molecular weights, and the ground water concentrations.

Compound	Henry's Law Constant (atm-m³/mol-K)	Molecular Wt. (g/mol)	Concentra (µg/L)
DCE	0.19	97	19
TCA	0.03	134	73

AR301000

REMCOR

By RSM Date 11/22/88 Subject _____ Sheet No. 6 of 14
Chkd. By KSR Date 11/28/88 _____ Proj. No. 88548

DCE:

$$K_L = (1/k_l + RT/Hk_g)^{-1}$$

$$k_{g(DCE)} = 3000\,(18/97)^{0.5} = 1292 \text{ cm/hr}$$

$$k_{l(DCE)} = 20\,(44/97)^{0.5} = 13.5 \text{ cm/hr}$$

$$K_L = \left(\frac{1}{13.5} + \frac{2.4 \times 10^{-2}}{0.19\,(1292)}\right)^{-1} = 13.5 \text{ cm/hr}$$

$$K_{aL} = K_L\,(1.18) = 15.9 \text{ cm/hr}$$

$$C_{wd} = C_{wo}\,(1 - \exp[-K_{aL}\,t_s/60d])$$

$$C_{wd} = 19\,\mu g/l\,(1 - \exp[-15.9\,(2)/60(1)])$$

$$= 7.8\,\mu g/l$$

$$S = C_{wd}\,(FR)/SV$$

$$= 7.8\,(10)/8$$

$$= 9.75\,\mu g/m^3\text{-min}$$

REMCOR

By RSM Date 11/22/88 Subject _____ Sheet No. 7 of 14
Chkd. By KSR Date 11/28/88 _____ Proj. No. 88548

$$E_{inh_{(DCE)}} = (V_r)(S) / [(BW)(R)(10^6)]$$

$$[D_s + \exp(-RDt)/R - \exp[R(D_s - Dt)]/R$$

$$= (15)(9.75) / [(70)(\tfrac{1}{60})(10^6)]$$

$$[15 + \exp(-\tfrac{30}{60})(60) - \exp[-\tfrac{15}{60}](60)$$

$$E_{inh(DCE)} = \boxed{5.8 \times 10^{-4} \ \frac{mg}{kg\text{-}day}}$$

TCA:

$$K_L = (1/K_l + RT/HK_g)^{-1}$$

$$K_{g(TCA)} = 3000 \left(\frac{18}{134}\right)^{0.5} = 1100 \text{ cm/h}$$

$$K_{l(TCA)} = 20 \left(\frac{44}{134}\right)^{0.5} = 11.5 \text{ cm/h}$$

$$K_L = \left(\frac{1}{11.5} + \frac{2.4 \times 10^{-2}}{0.03(1100)}\right)^{-1} = 11.4 \text{ cm/h}$$

$$K_{aL} = K_L (1.18) = 13.5 \text{ cm/hr}$$

AR301002 [illegible]

REMCOR

By RSM Date 11/22/88 Subject _____ Sheet No. 8 of 14
Chkd. By ASR Date 11/28/88 _____ Proj. No. 88548

$$C_{wd} = C_{wo}\left(1 - \exp\left[-K_{aL}\, t_s / 60d\right]\right)$$

$$C_{wd} = 73\ \mu g/l\left(1 - \exp\left[-13.5\,(2)/60(9)\right]\right)$$

$$= 26.5\ \mu g/l$$

$$S = C_{wd}\,(F\ell)/SV$$

$$= 26.5\,(10)/8$$

$$= 33.1\ \mu g/m^3\text{-min}$$

$$E_{inh_{(TCA)}} = (15)(33.1)/\left[(70)\left(\tfrac{1}{60}\right)(10^6)\right]\left[4.66\right]$$

$$= \boxed{2.0 \times 10^{-3}\ \frac{mg}{kg\text{-day}}}$$

REMCOR

By RSM Date 11/22/88 Subject _____ Sheet No. 9 of 14
Chkd. By KR Date 11/28/88 _____ Proj. No. 88548

Problem: Estimate for the future Belly water supply system (Treated Municipal Well No. 3) the rate of VOC release into the air during showering, the buildup and decay of VOCs in shower room air, and the quantity of airborne VOCs inhaled during the time the shower is running and during the time spent in the shower room after showering. The contaminants are the same as in Problem 1; the concentrations are the lower of the maximum allowed by the Water Supply and NPDES permits. All assumptions are also the same as in Problem 1.

Compound	Concentration (µg/l)
TCE	5
DCE	0.63
TCA	200

$K_{L(TCE)} = 11.3$ cm/hr-K

$K_{aL(TCE)} = 13.3$ cm/hr

$C_{ws} = 5\ \mu g/l\ (1 - \exp[-13.3(2)/60(1)])$

$= 1.8\ \mu g/l$

$S = 1.8\ \mu g/l\ (10\ l/min)/8\ m^3$

$S = 2.2\ \mu g/m^3\text{-}min$

REMCOR

By RSM Date 11/22/88 Subject _____ Sheet No. 10 of 14

Chkd. By KSR Date 11/28/88 _____ Proj. No. 88548

$$E_{inh(TCE)} = (15)(2.2) / [(70)(\tfrac{1}{60})(10^6)]$$

$$[15 + \exp(\tfrac{-30}{60})60 - \exp[-\tfrac{15}{60}]60]$$

$$E_{inh(TCE)} = \boxed{1.3 \times 10^{-4} \frac{mg}{Kg\text{-}day}}$$

$$K_{L(DCE)} = 13.5 \text{ cm/hr}$$

$$K_{aL(DCE)} = 15.9 \text{ cm/hr}$$

$$C_{wd(DCE)} = 0.63 \text{ µg/l} \left(1 - \exp[-15.9(2)/60(1)]\right)$$

$$C_{wd(DCE)} = 0.26 \text{ µg/l}$$

$$S = 0.26 \text{ µg/l } (10 \text{ l/min}) / 8 \text{ m}^3$$

$$= 0.33 \text{ µg/m}^3\text{-min}$$

$$E_{inh(DCE)} = (15)(0.33) / [(70)(\tfrac{1}{60})(10^6)]$$

$$[15 + \exp(\tfrac{-30}{60})(60) - \exp[\tfrac{-15}{60}](60)]$$

$$E_{inh(DCE)} = \boxed{2.0 \times 10^{-5} \text{ mg}}$$

AR301005

REMCOR

By RSM Date 11/22/88 Subject _____ Sheet No. 11 of 14

Chkd. By KSL Date 11/28/88 _____ Proj. No. 88548

$K_{L\,(TCA)} = 11.4$ cm/hr

$K_{aL\,(TCA)} = 13.5$ cm/hr

$C_{wd} = 200\ \mu g/l\ (1 - \exp[-13.5(2)/60(1)])$

$= 72.5\ \mu g/l$

$S = 72.5\ (10)/8$

$= 90.6\ \mu g/m^3\text{-min}$

$E_{inh\,(TCA)} = (15)(90.6)/[(70)(\frac{1}{60})(10^6)]$ [4.66]

$= \boxed{5.4 \times 10^{-3}\ \frac{mg}{Kg\text{-day}}}$

REMCOR

By RSM Date 11/22/88 Subject _____ Sheet No. 12 of 14
Chkd. By ASR Date 11/28/88 _____ Proj. No. 88548

Problem: Estimate for the potential future use of the Mabel Gehman residential well the rate of VOC release into the air during showering, the buildup and decay of VOCs in shower room air, and the quantity of airborne VOCs inhaled during the time the shower is running and during the time spent in the shower room after showering. The contaminants and concentrations are those detected in this well during the Phase III RI; the contaminants are the same as those in the municipal supply system (Problems 1 & 2). All assumptions are the same as for Problem 1.

Compound	Concentration (µg/l)
TCE	190
DCE	120
TCA	420

$K_{L\,(TCE)} = 11.3$ cm/hr

$K_{aL\,(TCE)} = 13.3$ cm/hr

$C_{wt} = 190\ \mu g/l\ (1 - \exp[-13.3(2)/60(1)])$

$= 68.0\ \mu g/l$

$S = 68.0\ \mu g/l\ (10\ l/min)/8\ m^3$

$= 85.0\ \mu g/m^3\text{-}min$

AR301007

REMCOR

By RSM Date 11/22/88 Subject _____ Sheet No. 13 of 14

Chkd. By ASR Date 11/28/88 _____ Proj. No. 88548

$$E_{inh\,(TCE)} = (15)(85) / [(70)(\tfrac{1}{60})(10^6)] \quad [4.66]$$

$$= \boxed{5.1 \times 10^{-3} \frac{mg}{kg\text{-}day}}$$

$$K_{L\,(DCE)} = 13.5 \text{ cm/hr}$$

$$K_{aL\,(DCE)} = 15.9 \text{ cm/hr}$$

$$C_{wd\,(DCE)} = 120 \text{ µg/l} \left(1 - \exp[-15.9(2)/60(1)]\right)$$

$$= 49.4 \text{ µg/l}$$

$$S = 49.4 \text{ µg/l} \, (10 \text{ l/min}) / 8 \text{ m}^3$$

$$= 61.8 \text{ µg/m}^3\text{-min}$$

$$E_{inh\,(DCE)} = (15)(61.8) / [(70)(\tfrac{1}{60})(10^6)] \quad [4.66]$$

$$= \boxed{3.7 \times 10^{-3} \frac{mg}{kg\text{-}day}}$$

REMCOR

By RSM Date 11/22/88 Subject _____ Sheet No. 14 of 14

Chkd. By ASR Date 11/28/88 _____ Proj. No. 88548

$K_{L\,(TCA)} = 11.4$ cm/hr

$K_{aL\,(TCA)} = 13.5$ cm/hr

$C_{wd} = 420\ \mu g/l\ (1 - \exp[-13.5(2)/60(1)])$

$= 152\ \mu g/l$

$S = 152\ (10)/8$

$= 190\ \mu g/m^2\text{-min}$

$E_{inh\,(TCA)} = (15)(190) / [(70)(\frac{1}{60})(10^6)]\ (4.6$

$= \boxed{1.1 \times 10^{-2}\ \frac{mg}{kg\text{-day}}}$