Olin Corporation

Wilmington, Massachusetts Facility

Supplemental Phase II Report

Volume III

June 1997

Prepared by:

ABB Environmental Services, Inc.

Geomega

PTI Environmental Services

SMITH Technology Corporation

Olin Corporation

Wilmington, MA

Supplemental Phase II Report

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ABB Environmental Services, Inc.

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PTI Environmental Services

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Smith Technology Corporation

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Appendix A

SMITH

APPENDIX A

BORING LOGS

Smith Environmental Technologies Corp. — Subsurface Log

Sheet: 1 of 1

Project: OLIN, WILMINGTON MA FACILITY Well/Boring No.: LPB-1
Project No.: 00 7074 0102 Date(s): 1/18/95 Logged By: A.E. PERRY
Well/Boring Location: LAKE POLY
Drilling Method: 4 1/4" AUGER DRILL Drilling Contractor: SOIL EX
Depth to Groundwater: ~ 4' BGS Date: 1/18/96 Reference: SURFACE = 86.2 FT MSL
Elevations - Ground Surface: 86.2' MSL Inner Casing: NA Outer Casing: NA
Water Table: ~ 82.2' MSL Date: 1/18/95 Reference: Surface
Remarks: BORING GROUTED SURFACE
SOIL SAMPLES TAKEN FOR LAB ANALYSIS

Depth of Samp.(ft)	Sample No.	Blows	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Graphical Logs: Strata	Graphical Logs: Well Construction	Organic Vapor Headspace Analysis (ppm)	Comments	Elevation
1		3 4 5 7	0-3" TOP SOIL 3"-2' LGT YELLOW-BROWN FINE SAND					
2			2'-4'					
3		4 3 3 3	WET MED. BROWN FINE SAND W/ SOME DARKER LAMINAE					
4							▼ GROUND-WATER SURFACE	
5		2 2 1 1	4'-6' MOTTLED, DK BROWN-BLACK FINE SAND					
6		50	6-7'- DK. BRWN, FINE SAND					
7			7-8' YELLOW-BRWN CLAY & SILT W/ 3" LAYER OF BLK. CRUSHED STONE W/ SILT & SAND					
8		100/4"	8-10'					
9			DK. GRAY GRAVEL, SOME SAND					
10		23	10-12'					
11		35	DK. BLUE-GRAY GRAVEL SOME SAND AND SILT					
12		100/4"	11.5' SLIGHTLY WEATHERED ROCK					
			END OF HOLE @ 12'					
15								

Note: Not all portions of this form are applicable to all projects 11/94

Smith Environmental Technologies Corp. — Subsurface Log

Sheet: 1 of 1

Project: OLIN WILMINGTON, MA FACILITY
Well/Boring No.: LPB-2
Project No.: 00 7074 0102
Date(s): 1/18/95
Logged By: A.E. PERRY
Well/Boring Location: LAKE POLY
Drilling Method: 4 1/4" AUGER
Drilling Contractor: SOIL EX
Depth to Groundwater: ~ 4' BGS
Date: 1/18/95
Reference: GROUND = 86.7 FT MSL
Elevations - Ground Surface: 86.7' msl
Inner Casing: NA
Outer Casing: NA
Water Table: ~82.7' msl
Date: 1/18/95
Reference: surface
Remarks: BORING GROUTED TO SURFACE
SOIL SAMPLES TAKEN FOR LAB. ANALYSIS

Depth of Samp.(ft)	Sample No.	Blows	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Graphical Logs: Strata	Graphical Logs: Well Construction	Organic Vapor Headspace Analysis (ppm)	Comments	Elevation
1		3 5 9 10	0-3" DK. BROWN SILT AND SAND 3"-1' MED BROWN FINE SAND 1'-1.5' BLK. GRAVEL					
2		9 8 8 15	1.5-2.' DK. BRWN SAND (FINE) 2-4' WET, LGT BROWN, FINE SAND					
3								
4		7 3 3 4	4-6' MOTTLED LIGHT-DARK BRWN FINE SAND. TRACE GRAVEL, LAYER OF CRUSHED STONE				▽ GW SURFACE	
5								
6		3 2 2 4	6-7' SATUR. LGT BRWN. FINE SAND SOME MOTTLING					
7								
8		12 15 85 50	7-8' DK. BRWN FINESAND, SOME GRAVEL.					
9			8-9' DK. GRAY-DK. BROWN, MED-FINE SAND SOME ORGANICS					
10		REFUSAL	9-10' WHITE-LGT GRAY GRAVEL AND SAND				→ OIL SHEEN ON SPOON	
11			10-12' BEDROCK - GRAY MUD W/ OIL SHEEN ON SURFACE WATER IN SPOON					
12			END OF HOLE @ 12'					

Note: Not all portions of this form are applicable to all projects

11/94

Smith Environmental Technologies Corp. — Subsurface Log

Sheet: 1 of 2

Project: OLIN CORP - WILMINGTON, MASS — Well/Boring No.: CB # 1
Project No.: 00-7074-0102 — Date(s): 11-24-96 — Logged By: E. PINTO
Well/Boring Location: ADJACENT TO CHESTNUT ST ALONG ACCESS ROAD TO PUMPHOUSE
Drilling Method: Rotasonic — Drilling Contractor: GOART LONG YEAR
Depth to Groundwater: NA — Date: NA — Reference: NA
Elevations - Ground Surface: 94.4' msl — Inner Casing: NA — Outer Casing: NA
Water Table: NA — Date: NA — Reference: NA
Remarks: NIR = No instrument response

Depth of Samp.(ft)	Sample No.	Blows	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Graphical Logs: Strata	Graphical Logs: Well Construction	Health and Safety Screen (CGI)	Comments	Elevation
5			0-5' CORE SAND AND GRAVELS, DK-BROWN to light brown, with subrounded cobbles and gravels, dry, some fine-grained to med. grained sand.		No Well Constructed to Surface	NIR	0-5' REC = 100%	
			5-10.. sand and gravel continue				5-10' Rec: 100%	
10			10-15' core same... some coarsening of sand to med. to-coarse at 13-15' b.g.				10-15' REC = 100%	
15			15-20' core No RECovery... PUSHING SAND AND COBBLES/GRAVELS				15-20' REC = 0%	
20			20-25' core Same as above: Gravel/Cobbles				20-25' REC = 20%	
25			25-30' core SAND (27') mod. well sorted finer grained sand., light-brown, trace gravel and medium sand, trace mica flakes..				25-30' REC = 100%	
30			30-35 core fine sand continues.. color change to dk. brown at 34'.				30-35' REC = 100%	
35			35-40 core same..				35-40' REC = unKnown	
40			40-45 core. BASAL TILL (44') Green-gray silt w/ cobbles and gravel embedded, mod. hard., some subrounded cobbles of mafic mylonites also in core barrel. BEDROCK (47') MAFIC MYLONITE, Aphanitic w/ Chlorite veining + Qtz				40-45' REC = 100% rig jumping ~ 44' 45-50' REC = 80% smooth, slow drill ~ 47'	

Note: Not all portions of this form are applicable to all projects — 11/94

Smith Environmental Technologies Corp. — Subsurface Log

Sheet: 2 of 2

Project: Olin Corporation — Well/Boring No.: ~~GW~~ CB#1

Project No.: 00-7074-0102 — Date(s): — Logged By E. Pinto

Well/Boring Location: Maple Meadow Brook Wetland

Drilling Method: Rotasonic — Drilling Contractor: Maher

Depth to Groundwater: — Date: — Reference:

Elevations - Ground Surface: — Inner Casing: — Outer Casing:

Water Table: — Date: — Reference:

Remarks: NIR = No instrument Response

Depth of Samp. (ft)	Sample No.	Blows	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Graphical Log: Strata	Graphical Log: Well Construction	Health and Safety Screen (CGI)	Comments	Elevation
55	X		veining.. fragmented angular chips, green-chlorite fragments, med. crystal w/ 1/2 veining from 50-52'.		NONE	NIR ↓	50-55' = 20% rec	
60			End of Borehole @ 55' bgs.					
65								
70								
75								
80								
85								
90								
95								
100								

Note: Not all portions of this form are applicable to all projects

11/94

Smith Environmental Technologies Corp. — Subsurface Log

Sheet: 1 of 2

Project: Olin Corporation — Well/Boring No.: CB-2
Project No.: 00-7074-0102 — Date(s): 11-25-96 — Logged By: E. PINTO
Well/Boring Location: Maple Meadow Brook Wetland - CHESTNUT ST BORING - on access road to pumphouse
Drilling Method: Rotasonic — Drilling Contractor: Maher / Boart Longyear
Depth to Groundwater: NA — Date: NA — Reference: NA
Elevations - Ground Surface: 88.8' msl — Inner Casing: NA — Outer Casing: NA
Water Table: NA — Date: NA — Reference: NA
Remarks: NIR = No instrument response

Depth of Samp.(ft)	Sample No.	Blows	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Graphical Log: Strata	Graphical Log: Well Construction	Health and Safety Screen (CGI)	Comments	Elevation
5			SILTY-SAND (0-2') - brown, trace roots, some fine sand, little silt, dry. SAND (2'-14') - fine-grained, mod. well-sorted, yellow-brown, trace gravel			NIR	0-4' core = 100% rec.	
10			and medium sands, dry, some mottling of sand.				4-9' core = 100% rec	
15			sand and gravels continue. gravel and cobbles size and intensity increasing ~12' CLAYEY-SILT WITH SAND (14'-42'). light brown,		Well constructed		9-14' core = 100% rec.	
20			mottled fine-sand, with gravels and cobbles in a clayey-silt matrix, wet, some dk grey sands lenses in silty fabric				14-19' core = 100% rec	
25			same gravels and cobbles in orange-brown silty fabric, dry, angular to subrounded cobbles and gravels.				19-24' core = 100% rec	
30					No Grouted to Surface		24-29' core = 0% rec	
35							29-34' core = 0% rec	
40			Ormsby, sandy-silt w/ gravels and cobbles, yellow to orange-brown, some lensing of grey sand in silty matrix				34-39' core = 60% rec	
45			silt continues.. some weathering of sand grains evident w/ mottled appearance SAND + COBBLE (42'-48') - brown, fine				39-44' core = 100%	
50			sand w/ gravels and cobbles, subrounded, loose, wet. BEDROCK (48') FELSIC MYLONITE, WITH CHLORITE AND QUARTZ MINING, FINE-GRAINED TEXTURE,				44-50' core = 90%	

Note: Not all portions of this form are applicable to all projects — 11/94

Smith Environmental Technologies Corp.

Subsurface Log

Sheet: 2 of 2

Project: Olin Corporation
Well/Boring No.: CB-2
Project No.: 00-7074-0102
Date(s):
Logged By E. Pinto
Well/Boring Location: Maple Meadow Brook Wetland
Drilling Method: Rotasonic
Drilling Contractor: Maher / Boart Longyear
Depth to Groundwater:
Date:
Reference:
Elevations - Ground Surface:
Inner Casing:
Outer Casing:
Water Table:
Date:
Reference:
Remarks: NIR = No instrument response

Depth of Samp.(ft)	Sample No.	Blows	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Graphical Log: Strata	Graphical Log: Well Construction	Health and Safety Screen (GI)	Comments	Elevation
55			poor recovery of broken and pulverized rock fragments of felsic mylonite (continue.		No well constr.	NIR	50-56' CORE = 20% rec	
60			EOB @ 56' bgs.					
65								
70								
75								
80								
85								
90								
95								
100								

Note: Not all portions of this form are applicable to all projects

11/94

Smith Environmental Technologies Corp. — Subsurface Log

Sheet: 1 of 3

Project: Olin Corporation — Well/Boring No.: CB-3

Project No.: 00-7074-0102 — Date(s): 11/18/96 — Logged By: E. PINTO

Well/Boring Location: Maple Meadow Brook Wetland - CHESTNUT ST BORING (on access road to pumphouse, N of CB-2

Drilling Method: Rotasonic — Drilling Contractor: Maher (Boart Longyear)

Depth to Groundwater: NA — Date: NA — Reference: NA

Elevations - Ground Surface: 82.7' msl — Inner Casing: NA — Outer Casing: NA

Water Table: NA — Date: NA — Reference: NA

Remarks: NIR = No instrument response

Depth of Samp. (ft)	Sample No.	Blows	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Graphical Logs: Strata	Graphical Logs: Well Construction	Health and Safety Screen (CGI)	Comments	Elevation
5			SAND AND GRAVEL - fine- to-med, some coarse, light brown - to-dk-brown, some mottling, little gravel		No well constructed to Surface	NIR	0-5' (95% rec)	
10			and cobbles, trace, gray medium-sands. med. sands + gravel continue.. wet, trace mica flakes				5-10' (50%)	
15			13-14' - gravel layer (increased)				10-15' (80%)	
20			reddish-brown poorly sorted sands and gravels, wet.. subrounded.				15-20' (20%)	
25			sand and gravels cont., large cobble density decreasing to trace at 23'.				20-25' (100%)	
30			SAND (25') - medium- to coarse, reddish-brown, no cobbles, trace gravels and mica.				25-30' (100%)	
35			med. sand continues, grey at 32', mod. well sorted., gravels at 35'.				30-35 (100%)	
40			med. sand., reddish-brown.				35-40' (100%)	
45			GRAVEL Lens (44-46') of angular-to Subrounded, qtz and feldspar frags., igneous rx., fragmented.				40-45' (100%)	
50			med-to coarse gray sands., trace gravels and cobbles				45-50' (100%)	

Note: Not all portions of this form are applicable to all projects

11/94

Smith Environmental Technologies Corp. — Subsurface Log

Sheet: 2 of 3

Project: Olin Corporation — Well/Boring No.: CB-3

Project No.: 00-7074-0102 — Date(s): — Logged By: E. Pinto

Well/Boring Location: Maple Meadow Brook Wetland

Drilling Method: Rotasonic — Drilling Contractor: Maher / Boart Longyear

Depth to Groundwater: — Date: — Reference:

Elevations - Ground Surface: — Inner Casing: — Outer Casing:

Water Table: — Date: — Reference:

Remarks: NIR = No instrument response

Depth of Samp. (ft)	Sample No.	Blows	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Strata	Well Construction	Health and Safety Screen (CGI)	Comments	Elevation
55			med. to - coarse sand. continues, trace cobbles and gravels,,		No well constructed Grouted to Surface	NIR	50-55' (rec = 100%)	
60			SAND AND GRAVELS (55') grey-green some clay and silt., large cobbles embedded into clayey-silt.,				55-60' (100%)	
65			mostly med. sand + gravel. BOULDER - ROCK (63') - granite or diorite, w/ chlorite mineralization on some faces., garnets on exposed faces, core of rock continues to 67'				60-62' (100%) 63 - BOULDER	
70			WEATHERED ROCK - (67') chalky, crumbly w/ occassional red-brown oxidation banding, dry, chlorite faces (trace), pulverized rx to white powder,,				64-69 (90%) 69-76 (80%)	
75			laminations of iron continue, crumbly,,				76-85 (100%)	
80			weathered rock - clayey matrix continues					
85							85-96 (100%)	
90			94-96 greenish grey clay, some interspersed coarse sands angular.					
95			weathered, clayey, crumbly rock continues, some weathering on faces and in matrix.				96-102 (50%)	
100								

Note: Not all portions of this form are applicable to all projects

11/94

Smith Environmental Technologies Corp. — Subsurface Log

Sheet: 3 of 3

Project: Olin Corporation — Well/Boring No.: CB-3

Project No.: 00-7074-0102 — Date(s): — Logged By: E. Pinto

Well/Bonng Location: Maple Meadow Brook Wetland

Drilling Method: Rotasonic — Drilling Contractor: Maher / Boart Longyear

Depth to Groundwater: — Date: — Reference:

Elevations - Ground Surface: — Inner Casing: — Outer Casing:

Water Table: — Date: — Reference:

Remarks: NIR = No instrument response

Depth of Samp.(ft)	Sample No.	Blows	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Strata	Well Construction	Health and Safety Screen (CGI)	Comments	Elevation
105			BEDROCK (102) rock fragments of felsic mylonite, angular shards, chlorite and feldspathic pink faces on rock surfaces, rough surface faces, trace garnet w/s on faces,		No well constructed	NIR	102-109 (80%)	
110								
115			End of borehole @ 109' bgs					
120								
125								
130								
135								
140								
145								
150								

Note: Not all portions of this form are applicable to all projects

11/94

Smith Environmental Technologies Corp. — Subsurface Log

Sheet: 1 of 2

Project: OLIN CORP WILMINGTON, MA — Well/Boring No.: MB-1
Project No.: 00-7074-0102 — Date(s): 10/7/96 — Logged By: R. BLEVINS
Well/Boring Location: RUTLAND CORP - BEHIND GARAGE
Drilling Method: ROTOSONIC RIG — Drilling Contractor: BOART LONGYEAR / MAHER
Depth to Groundwater: NA — Date: NA — Reference: NA
Elevations - Ground Surface: 95.3' msl — Inner Casing: NA — Outer Casing: NA
Water Table: NA — Date: NA — Reference: NA
Remarks: NIR - No instrument response

Depth of Samp. (ft)	Sample No.	Blows	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Graphical Logs: Strata	Graphical Logs: Well Construction	Health and Safety Screening (CGI)	Comments	Elevation
			0-1: DK. brown, f. grained sand + soil poorly graded, w/ f. to c. sub-rounded gravel, loose + dry.		TREMIE GROUTED TO SURFACE — No Well Constructed	NIR	100 % recovery to 20' bgs.	
			1-2: Orange-brn, f. to m. grained sand, well graded w/ subrounded pebbles, loose + dry.					
5			2-4: Tan, f. grained sand, poorly graded, w/ f. to c. subrounded gravel + few subrounded cobbles, loose and dry.					
			4-10: Same as above, but to white color w/ some 3" thick orange segments ≈ 5½ bgs.					
10			10-11½: Tan to orange, m. to c. sand, poorly graded, angular to subrounded, w/ common F. to c. angular to subr. gravel + F. suba. cobbles, loose +					
			11½-15: Suba. to subr. f. to c. gravel + cobbles, w/ f. to c. sand, white to tan, loose + dry.					
15			15-18½: F. to m. sand, orange to buff, w/ f. to c. f. to c. suba. to subr. gravel, v. few suba. to subr. cobbles, poorly graded, loose + dry.					
			18½-20': coarse suba. to subr. to rounded sand + f. to c. gravel w/ subr. cobbles, poorly graded, wet, pH 7 to 8					
20			20-25: f. to m. grained sand + silt, buff to orange brown, poorly graded, w/ common f. to c. suba. to subr. gravel, loose + dry.				20-25 bgs: 50% recovery	
25			25-30: suba. to subr. cobbles, w/ f. to c. common subr. to a. gravel, + f. grained sand + silt, poorly graded, loose + wet, most fines washed out, pH = 8.				25-30 bgs: 50% recovery	
30			30-35': m. to c., suba. to subr. sand, w/ common f. to c. suba to subr. gravel, and few suba. to subr. cobbles, poorly graded, wet + loose, gross color = gray to brown. pH = 8 @ 35' bgs.				30-35 bgs': 100% recovery	
35			35-41: suba. to subr. to angular, gravel + cobbles, w/ silt and f. to c. sand, poorly graded, gray, wet + loose, pH = 8.				35-40 bgs: 80% recovery	
40			41-44: angular to subr. gravel + cobbles bound w/ clay w/ some silt and f. to c. sand, gray, poorly graded, wet.				40-45 bgs: 100% recovery	
45			44-45': coarse sand w/ some f. to m. sand + silt, suba. to subr. to rounded, w/ f. to c. gravel + cobbles, a. to subr., poorly graded, loose + wet, pH = 8.				45-50 bgs': 25% recovery	
50			45-50: suba. to subr. c. sand + gravel, w/ cobbles common, gray to tan, gravel is f. to c., poorly graded, loose + wet. pH @ 46' = 8.					

Note: Not all portions of this form are applicable to all projects

11/94

Smith Environmental Technologies Corp. — Subsurface Log

Sheet: 2 of 2

Project: OLIN CORP WILMINGTON, MA — Well/Boring No.: MB-1
Project No.: 00-7074-0102 — Date(s): 10/7/96 — Logged By: R. BLEVINS
Well/Boring Location: RUTLAND CORP - BEHIND GARAGE
Drilling Method: ROTOSONIC RIG — Drilling Contractor: BOART LONGYEAR / MAHER
Depth to Groundwater: — Date: — Reference:
Elevations - Ground Surface: — Inner Casing: — Outer Casing:
Water Table: — Date: — Reference:
Remarks: NIR = No instrument response

Depth of Samp. (ft)	Sample No.	Blows	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Graphical Logs: Strata	Graphical Logs: Well Construction	Health and Safety Screening (CGI)	Comments	Elevation
			50-55: same as above.		Tremie Grouted to Surface → No Well Constructed	NIR	50-55 bgs: 100% recovery	
55			55-64.5: coarse gravel + cobbles, a. to subr. w/ coarse sand, wet + loose, poorly graded.				55-65' bgs: 100% recovery	
60			64.5-65: clay and angular rock fragments, pH = 8, (clay is pulverized rock),					
65			65-69. Bedrock angular mixed with subangular cobbles + gravel washed down from above	Bedrock @ 65' bgs			BEDROCK @ ~65 bgs	
70			69-70: Bedrock chunks, cobble-sized, sub angular.				65-77' bgs - Poor recovery, bedrock pulverized	
75			70-77: Pulverized rock + angular rock (65-77'; bedrock is dark gray, mafic, + fine grained).					
			End of borehole @ 77' bgs					
80								
85								
90								
95								
100								

Note: Not all portions of this form are applicable to all projects 11/94

Smith Environmental Technologies Corp. — Subsurface Log

Sheet: 1 of 2

Project: OLIN CORP WILMINGTON, MA — Well/Boring No.: MB-2
Project No.: 00-7074-0102 — Date(s): 10/8/96 — Logged By: P. NEWDECK
Well/Boring Location: LEO PROPERTY (NORTH OF GARDEN)
Drilling Method: ROTOSONIC RIG/CORE — Drilling Contractor: BOART LONGYEAR/MAHER
Depth to Groundwater: NA — Date: NA — Reference: NA
Elevations - Ground Surface: 96.6' msl — Inner Casing: NA — Outer Casing: NA
Water Table: NA — Date: NA — Reference: NA
Remarks: NIR = No instrument response

Depth of Samp. (ft)	Sample No.	Blows	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Graphical Logs: Strata	Graphical Logs: Well Construction	Health and Safety Screen (CGI)	Comments	Elevation
5			0-5' BGS (100% RECOVERY) 0-0.5' ORGANIC SOIL (TOPSOIL) 0.5'-5' V. POORLY SORTED, YELLOW-ORANGE-TAN, FINE SAND/SILT AND GRAVEL (SUBA - PEA SIZE -> 3") DRY		No well Constructed — Grouted to Surface	NIR		
10			5-10' (100% RECOVERY). YELLOW ORANGE-TAN MIX FINE SAND W/ TRACE SUBR - SUBA GRAVEL. DRY					
15			10-15' (100% RECOVERY). 10-11' SAME AS ABOVE 11-15' V. FINE, WELL SORTED, YELLOW BROWN, TAN SAND					
20			15-25' (100% RECOVERY) V. POORLY SORTED, BROWN, FINE GRAIN SAND W/ SOME SUBR - SUBA, PEA GRAVEL GRADING DOWN TO MED-COARSE GRAIN SAND W/ SOME SUBR. GRAVEL (1" AVG) LAST 5' WET.					
25			25-35' (100% RECOVERY) SAME AS ABOVE W/ SOME LARGE PIECES OF GRAVEL AND SMALL LENSES OF FINE SAND.					
30								
35			35-45' (75% RECOVERY) WELL SORTED, MED GRAIN SAND GRADING DOWN TO A FINE GRAIN SAND. LIGHT BROWN. BOTTOM 1' = POORLY SORTED, FINE GRAIN SAND AND VARIABLE SIZE (1/2"-2"), SUBR-SUBA, GRAVEL.					
40								
45			45-55' (75% RECOVERY) TOP 2' = V. FINE, WELL SORTED, LGT BROWN SAND. MIDDLE 3' = SORTED. MED-COARSE GRAIN SAND & PEA SIZE GRAVEL.					
50								

Note: Not all portions of this form are applicable to all projects. 11/94

Smith Environmental Technologies Corp. — Subsurface Log

Sheet: 2 of 2

Project: OLIN CORP WILMINGTON, MA — Well/Boring No.: MB-2
Project No.: 00-7074-0102 — Date(s): — Logged By:
Well/Boring Location:
Drilling Method: ROTOSONIC RIG — Drilling Contractor: BOART LONGYEAR / MAHER
Depth to Groundwater: — Date: — Reference:
Elevations - Ground Surface: — Inner Casing: — Outer Casing:
Water Table: — Date: — Reference:
Remarks: NIR = No instrument response

Depth of Samp.(ft)	Sample No.	Blows	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Graphical Logs: Strata	Graphical Logs: Well Construction	Health and Safety Screen (CGI)	Comments	Elevation
55			45-55' BOTTOM 2' ROCK DIORITE BOULDER (DRILLER FEELS SOFT SED 53-55').		No well constr.	NIR		
			55-58' LITTLE RECOVERY DRILLED THROUGH ROCK AND DESTROYED CORE BARREL & BIT	No recovery			55-58' bgs - No recovery: Rig broke down	
60			End of borehole @ 58' bgs					

Note: Not all portions of this form are applicable to all projects. 11/94

Smith Environmental Technologies Corp. — Subsurface Log

Sheet: 1 of 1

Project: Olin Corporation — Well/Boring No.: MB-3
Project No.: 00-7074-0102 — Date(s): — Logged By: E. PINTO
Well/Boring Location: Maple Meadow Brook Wetland / Dillon Property
Drilling Method: Rotasonic — Drilling Contractor: Maher / Boart Longyear
Depth to Groundwater: NA — Date: NA — Reference: NA
Elevations - Ground Surface: 94.9' msl — Inner Casing: NA — Outer Casing: NA
Water Table: NA — Date: NA — Reference: NA
Remarks: NIR = No instrument response

Depth of Samp.(ft)	Sample No.	Blows	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Graphical Logs: Strata	Graphical Logs: Well Construction	Health and Safety Screen (HASS)	Comments	Elevation
5			SILT - Brown, w/ cobbles, dry			NIR	0-2' (100% rec)	
			SAND AND GRAVELS (2') poorly sorted, sub-round to angular, grey-brown, wet,				2-5' (80% rec)	
10			predominant sand fine-to-med., little silt and opaques.				5-10' (50% rec)	
15			same, dk brown - to - tan., better sorting of med. sands at 14'.				10-15' (90% rec)	
20			same, occassional cobbles		Constructed		15-20' (90%)	
			... gravels diminished..					
25			23' SAND - fine grained, light brown- to red-brown, trace gravel, mica flakes and opaques, well sorted.				20-25' (90%)	
30			25' SAND AND GRAVEL, med. brown sand, w/ angular gravel., 27' CLAYEY-SILT BASAL-TILL"		Surface to Well Grouted		25-30 (100%)	
35			grey-brown, w/ cobbles embedded into silt matrix, trace mica flakes, slightly cohesive fabric., rock fragments widely ranging in composition .. angular frags.				30-35 (100%)	
40			35' BEDROCK - GABBRO/MYLONITE? of chlorite comp., aphanitic, some reddish-oxidation staining., minute quartz		No		35-40' (100%)	
45			veins, angular fragments, some foldspathic veining.. - crushed rock fragments, black in				40-45'; (?%)	
			40-45' core., qtz and feldspars ..				45-47'; (100%)	
50			45 - rock frags of mafic mylonite, w/ feldspathic or/and quartz veining. EOB @ 47 bgs					

Note: Not all portions of this form are applicable to all projects — 11/94

SMITH

HISTORICAL BORINGS / WELL LOGS

D. L. MAHER CO.

LOG OF TEST WELL

Log of Well for National Polychemical Inc. Test No. 1

Address E Cross street Willington

Well located at East of plant in low land in Middlesex County, State of Mass.

Date Drilling started Tues. 7/28/64 Date Test Hole Completed Wed. 7/29/64

Total depth to bottom of Well 32'-4" Diameter Test Hole 2½"

Water stands when not pumping 2' feet 6" inches from the surface of the ground.

EACH STRATUM	DEPTH OF STRATA	FORMATION FOUND EACH STRATUM
28'	28'	Fine to medium brown sand and gravel specks of clay. Compact fair
4'-4'	32'-4"	Fine gray sand with large dark gray gravel and clay. Tight
		Refusal at 32'-4"

Did Well Clear Up? Not in color

How Long?

Time Pumped? 1 hour

Drawdown Ft. In.

Capacity 12 G.P.M. vac. 25"

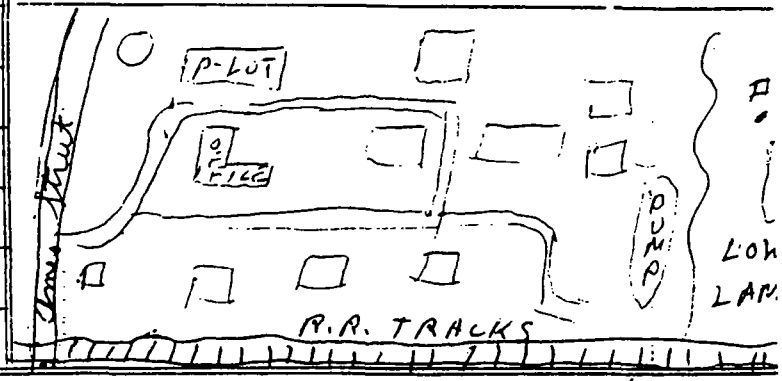
Time Required for Recovery?

Was Well Pulled? Yes - Back to 28'

Observation None What Depth?

Was Observation Well Pulled?

Map of Location



Remarks and opinion of Test Drove hard from 24' on. Water is green in color and has odor to it.

Driller Charles Mackey

Helpers C. H. Kelly

Appendix B

SMITH

APPENDIX B

CAMERA VIDEO LOGS AND ANNOTATED GEOPHYSICAL LOGS

SMITH
ENVIRONMENTAL TECHNOLOGIES CORPORATION

CAMERA LOG

Well: GW-61BR

Date: 10/31/95, Tape 1 of 2

Logged by: D. Williams

DEPTH (ft.)	CASING/DTW	FRACTURES: CEMENTED	FRACTURES: CLOSED	FRACTURES: OPEN	TURBIDITY: CLEAR	TURBIDITY: CLOUDY	TURBIDITY: V. CLOUDY	STAINING: GRAY/BLACK	STAINING: YELLOW	STAINING: RED	STAINING: BROWN	STAINING: GREEN	BOREHOLE COLOR	(-2 feet adjustment for depth below ground surface) NOTES
	▽				X								White to H. gray PVC Casing	Surface completion - stick-up
					X									DTW @ 2'
					X									PVC CASING - 0 - 74'
					X									
10					X									
	CJ				X									@ 13' CASING JOINT
					X									
					X									
					X									
20					X									
	CJ				X									@ 23' CASING JOINT
					X									
					X									
					X									
30					X									
	CJ				X									@ 33' CASING JOINT
					X			X			X		Gray-brown stain on one side casing	
					X			X			X			
					X			X			X			
40					X			X			X			
	CJ				X			X			X			@ 43' CASING JOINT
					X									
					X									
					X									
50					X									
	CJ				X									@ 53' CASING JOINT
						X								
						X								
60					X									
	CJ				X									@ 63' CASING JOINT
					X									
					X									
					X									
70					X									
					X									@ 74' BOTTOM OF PVC CASING
	CASING TD	D	D		X									ledge where casing meets corehole with smaller diameter
					X								Bedrock	
		D	D	D	X								Lt. to M. gray with clipping	Particles cascading from above clear water
80		D		D	X									@ 78' clipping fracture walked bit over
				D	X								white in-filled	@ 82' open dip fracture, open one side
				D		X							fractures	@ 83' steeply dipping closed-open fracture
							X							
							X						↓ in-filled	@ 87' Discharge tubing
90	EOR												↓ Fractures increase	@ 89' End of Video Log @ sediment pool?

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ENVIRONMENTAL TECHNOLOGIES CORPORATION

CAMERA LOG

Well: GW-62BR
Date: 10/31/95, tape 1 of 2
Logged by: D. WILLIAMS

DEPTH (ft.)	CASING/DTW	FRACTURES: CEMENTED	FRACTURES: CLOSED	FRACTURES: OPEN	TURBIDITY: CLEAR	TURBIDITY: CLOUDY	TURBIDITY: V. CLOUDY	STAINING: GRAY/BLACK	STAINING: YELLOW	STAINING: RED	STAINING: BROWN	STAINING: GREEN	BOREHOLE COLOR	(DEPTHS FROM GROUND SURFACE) NOTES
	▽				X				X				PVC CASING white w/ lt. yellow staining.	PVC CASING 0-76' DTW @ 2'
	CJ				X				X					CASING JOINTS @ 0'-95'
10					X	X			X					
						X				X			H. orange staining	
	CJ					X				X	X		iron ppt. on casing joint	@ 15' CASING JOINT
20						X				X				
	CJ					X				X			iron ppt. on casing joint	@ 25' CASING JOINT
30						X				X				
	CJ					X	X			X	X		vertical streak of iron ppt.	@ 35' CASING JOINT
						X				X				
40						X				X				
	CJ					X				X	X		iron ppt. on casing joint	@ 46' CASING JOINT
						X				X				
50						X				X				
	CJ					X				X	X		iron ppt. on casing joint	@ 56' CASING JOINT
60						X				X				
	CJ					X				X	X		vertical streak of iron ppt. at casing joint	@ 66' CASING JOINT
70						X				X				
	CASING TD					X				X	X		iron ppt. on the bottom of casing. Gray bedrock criss-crossed by white in-filled fractures and open fractures	@ 76' Bottom of CASING, NOTE CASING DOES NOT EXTEND TO BOTTOM OF 5" ROCK BOREHOLE
			DVD			X				X				
80			DVD			X				X				78'-80' fracture zone, v. broken-up
			D			X				X				@ 80', 81', 82' steeply dip. VF, open
			DVD			X				X				@ 83-84' fracture zone
						X				X			↓	@ 84 & 85' closed steeply dip. VF
90						X				X				

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ENVIRONMENTAL TECHNOLOGIES CORPORATION

CAMERA LOG

Well: GW-62BR
Date: 10/31/95
Logged by: D. WILLIAMS

DEPTH (ft.)	CASING/DTW	FRACTURES: CEMENTED	FRACTURES: CLOSED	FRACTURES: OPEN	TURBIDITY: CLEAR	TURBIDITY: CLOUDY	TURBIDITY: V. CLOUDY	STAINING: GRAY/BLACK	STAINING: YELLOW	STAINING: RED	STAINING: BROWN	STAINING: GREEN	BOREHOLE COLOR	NOTES
90			D			X					*		Gray bedrock	@92' dipping closed fracture
			D			X					*		w/ white	@94' steep dipping closed fracture
				D		X					*		infilled fracs.	@96' steeply dipping open fracture
						X								
100				D D		X								@99' dipping open fracture
					X								White	
					X					*			orange staining	
						X							DK gray	
					X					*			orange staining	
110	EOB												Gray	CAMERA LOG TD @ 109'
														Terminates at sediment pool.
														NOTE DRILLING LOG TD @ 105'
120														
130														
140														
150														
160														
170														
180														

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ENVIRONMENTAL TECHNOLOGIES CORPORATION

CAMERA LOG

Well: GW-62BRD
Date: 10/31/95, tape 1 of 2
Logged by: D. Williams

DEPTH (ft.)	CASING/DTW	FRACTURES: CEMENTED	FRACTURES: CLOSED	FRACTURES: OPEN	TURBIDITY: CLEAR	TURBIDITY: CLOUDY	TURBIDITY: V. CLOUDY	STAINING: GRAY/BLACK	STAINING: YELLOW	STAINING: RED	STAINING: BROWN	STAINING: GREEN	BOREHOLE COLOR	(-2 foot adjustment for depth below ground surface) NOTES
	▼				X				X		X		CASING w/ lt. yellow-brown staining	Surface completion: Stick-up
	CJ				X				X		X			DTW @ 3'
					X				X		X			CASING: 0-107'
					X				X		X			Casing Joint @ 5'
10					X				X		X			
					X				X		X			
	CJ				X				X		X			@15' CASING JOINT
					X				X		X			
20					X				X		X			
					X				X		X			
	CJ				X				X		X			@25' CASING JOINT
					X				X		X			
30					X				X		X			
					X				X		X			
	CJ				X				X		X			@35' CASING JOINT
					X				X		X			
40					X				X		X			
					X				X		X			
	CJ				X				X		X			@45' CASING JOINT
					X				X		X			
50					X				X		X			
					X				X		X			
	CJ				X				X		X			@55' CASING JOINT
					X				X		X			
60					X				X		X			
					X				X		X			
	CJ				X				X		X			@65' Darker staining 1-2' above and below casing joint
					X				X		X			
70					X				X		X			
					X			X	X		X			GREY-BROWN SCALING 74-78'
	CJ				X			X	X	X	X			@76' CASING JOINT
					X				X		X			
80						X			X		X			
						X	X	X	X	X	X			@ 82' scaling on casing
	CJ					X	X	X	X	X	X			@86'
						X	X	X	X	X	X			
90					X				X		X			

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CAMERA LOG

Well: GW-62BRD
Date: 10/31/95
Logged by: D. Williams

DEPTH (ft.)	CASING/DTW	FRACTURES: CEMENTED	FRACTURES: CLOSED	FRACTURES: OPEN	TURBIDITY: CLEAR	TURBIDITY: CLOUDY	TURBIDITY: V. CLOUDY	STAINING: GRAY/BLACK	STAINING: YELLOW	STAINING: RED	STAINING: BROWN	STAINING: GREEN	BOREHOLE COLOR	NOTES
90					X				X				CASING	
					X				X				Stained lt.	
	CJ				X				X				yellow	@ 96' CASING JOINT
					X				X					
					X				X					
100					X				X					
					X				X					@ 106' orange stain streak along casing
					X				X	X				@ 107' BOTTOM OF CASING
	CASING TD	D			X				X	X			GRAY BEDROCK w/ in-filled fractures	Ledge where casing meets smaller diameter corehole, iron ppt. at
110					X				X	X			Crossing borehole	opening where casing meets bedrock.
				D D	X						X			@ 111'+112' dipping open fracture w/ iron stain
			D		X								LITHO CONTACT light gray V. numerous	- 115+117' steeply dipping closed fractures
			D		X									
120			D	D									in-filled fractures cross corehole.	
			D											@ 123' Cithology =
				D						X			Lt to medium gray more massive.	
				D						X				@ 125' Zone of partially open fractures
130				D						X			to	Fe stains emanate from one 90° quadrant lt
				D							X			
	WEP			D							X		Lt. gray to white w/ angular darker gray lenses.	@ 133' Dipping fracture, open 1/4" with iron stain around circumference
				D										
140				D										
				D										
147				D										
150													END OF LOG	@ 147' END OF CAMERA LOG
														Sediment pool @ 147'
160														
170														
180														

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ENVIRONMENTAL TECHNOLOGIES CORPORATION

CAMERA LOG

Well: GW-65BR
Date: 10/31/95, tape 1 of 2
Logged by: D. WILLIAMS

DEPTH (ft.)	CASING/DTW	FRACTURES: CEMENTED	FRACTURES: CLOSED	FRACTURES: OPEN	TURBIDITY: CLEAR	TURBIDITY: CLOUDY	TURBIDITY: V. CLOUDY	STAINING: GRAY/BLACK	STAINING: YELLOW	STAINING: RED	STAINING: BROWN	STAINING: GREEN	BOREHOLE COLOR	(Depths from ground surface) NOTES
													PVC CASING	PVC CASING - 0 - 81'
													Dark - 0-2' white 2-11'	
10	▽													DTW @ 10'
	CJ					X		X						@ 11' CASING JOINT, casing medium gray, water appears cloudy but this may be due to dark colored casing
						X		X						
						X		X						
20	CJ					X		X						
					X									@ 19' CASING JOINT
					X				X					
					X									
					X									
30	CJ				X									@ 30' CASING JOINT
					X									
					X									
					X									
40	CJ				X									@ 40' CASING JOINT
					X									
					X									
					X									
					X									
50	CJ					X		X						@ 51' CASING JOINT Dark section of casing 51-61'
						X		X						
						X		X						
						X		X						
						X		X						
60	CJ					X								@ 61' CASING JOINT
						X								
						X								
						X								
						X								
70						X		X						@ 71' Casing JOINT Dark section of casing 71-81'
						X		X						
						X		X						
						X		X						
						X		X						
80							X							@ 81' END OF CAMERA LOG, terminates in sediment pool NO VISIBILITY TO TD @ 140'
							X							
							X							
							X							
90							X							

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ENVIRONMENTAL TECHNOLOGIES CORPORATION

CAMERA LOG

Well: GW-68BR
Date: 10/31/95, tape 1 of 2
Logged by: D. WILLIAMS

DEPTH (ft.)	CASING/DTW	FRACTURES: CEMENTED	FRACTURES: CLOSED	FRACTURES: OPEN	TURBIDITY: CLEAR	TURBIDITY: CLOUDY	TURBIDITY: V. CLOUDY	STAINING: GRAY/BLACK	STAINING: YELLOW	STAINING: RED	STAINING: BROWN	STAINING: GREEN	BOREHOLE COLOR	(-1' foot adjustment for depth below ground surface) NOTES
	CJ							X	X				PVC CASING discolored in top 11'	Surface completion-flushmount
								X	X					
	▽							X	X					DTW @ 8'; slight sheen on water surface
10						X		X	X					
	CJ					X								@ 11' CASING JOINT
						X								
						X								
						X								
20						X								
	CJ					X								@ 21' CASING JOINT
						X								
						X								
						X								
30						X								
	CASING TD					X							BEDROCK	@ 31' BOTTOM OF CASING
			D			X							M.-dk. gray	@ 31'-32' Fe stained grout?
			D			X								
						X							thicker in-filled fractures, low	@ 34 to 35' crevice on one side
40						X							dip	
						X								@ 44+45' closed dipping fractures
			D			X								
			D			X								
						X								
50						X							Lighter gray	
						X								
						X							In-filled fractures predominate	
						X								
						X								
60						X							from 60-70'	
						X								
						X								
						X								
						X								
70						X								
						X								@ 74' steep dipping open fracture Fe stained
				D		X				X				
						X				X				@ 76' CAMERA LOG TD terminates at sediment pool
						X								
80														
90														

SMITH
ENVIRONMENTAL TECHNOLOGIES CORPORATION

CAMERA LOG

Well: BR-1
Date: 10/31/95 Tape 2 of 2
Logged by: D. WILLIAMS

DEPTH (ft.)	CASING/DTW	FRACTURES: CEMENTED	FRACTURES: CLOSED	FRACTURES: OPEN	TURBIDITY: CLEAR	TURBIDITY: CLOUDY	TURBIDITY: V. CLOUDY	STAINING: GRAY/BLACK	STAINING: YELLOW	STAINING: RED	STAINING: BROWN	STAINING: GREEN	BOREHOLE COLOR	(Depths from ground surface) NOTES
	▽ DTW @ 5'				X								GROUT white to light gray	GROUT INSIDE PVC CASING 0-21'
					X									(Grout begins in steel protect. Casing
														@ 5' COREHOLE OBLONG SHAPE
10														@ 6' Some small pits in grout
	GROUT													@ 11' Pits in grout larger
								X						@ 14' grey streak one side
								X						@ 19' streak thickens into growth / ppt grey-red towards bottom grout
20								X		X				
					X								BEDROCK light gray criss-crossed by in-filled fractures	@ 21' Bottom of grout, slight ledge w/ 1/4" gap b/w rock & grout
			D		X									@ 23' dipping fracture w/ white streaks
					X									@ 24'-26' corehole bends
30					X									@ 28' corehole bends
			D										in-filled fract. near vertical	
														@ 35' horizontal ledge, litho. Δ?
													Lithology Δ to grey-massive w/ horizontal white bands	
40														@ 43-44' streaks that terminate at
				D										@ 45' at dipping fracture
													EOL	@ 49' CAMERA LOG TD
50														TERMINATES IN SED. POOL
60														
70														
80														
90														

SMITH
ENVIRONMENTAL TECHNOLOGIES CORPORATION

CAMERA LOG

Well: GW-80BR
Date: 10/31/95
Logged by: D. WILLIAMS

DEPTH (ft.)	CASING/DTW	FRACTURES: CEMENTED	FRACTURES: CLOSED	FRACTURES: OPEN	TURBIDITY: CLEAR	TURBIDITY: CLOUDY	TURBIDITY: V. CLOUDY	STAINING: GRAY/BLACK	STAINING: YELLOW	STAINING: RED	STAINING: BROWN	STAINING: GREEN	BOREHOLE COLOR	NOTES (DEPTHS FROM GROUND SURFACE)
	CJ												PVC CASING	SURFACE COMPLETION - FLUSH MOUNT
	▽												IS dark gray	@1' CASING JOINT
					X			X					below water	
						X		X					level	
10						X		X						
	CJ					X		X						@11' CASING JOINT
						X		X						*BLURY IMAGE ON VIDEO LOG
						X		X						BELOW 11' *
						X		X						
20						X		X						
	CJ					X		X						@22' CASING JOINT
						X		X						
						X		X						
						X		X						
30						X		X						@31-32' SCALING ON PVC CASING
	CASING					X		X						@32' BOTTOM OF CASING
	TD					X							BEDROCK	Ledge where hole diameter changes
						X							DK. gray	below casing; growth or ppt. on ledge
						X							massive,	
40						X							granular	
						X								
						X								
						X								
50						X								
			D			X								@52' Steeply dipping closed fracture
						X								
						X								
						X								
60		D				X								
						X							As above, w/	
						X							lighter bands	
						X							horizontal to	
						X							low dip.	
70														CAMERA LOG TD @ 69'
														Sediment Pool, leafy-looking
														debris on top.
80														
90														

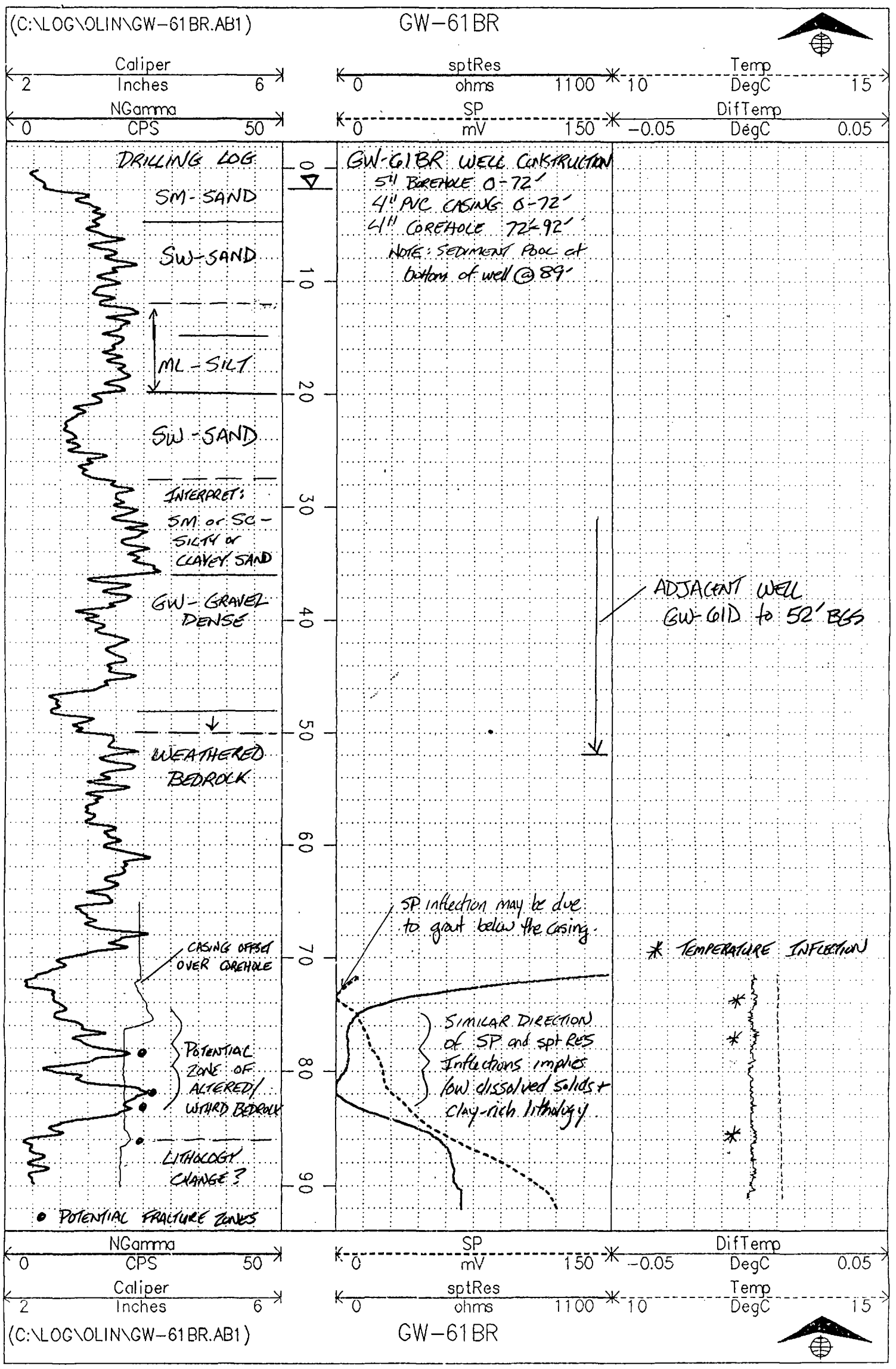
VIDEO LOG FOR THIS WELL ON 2 TAPES
END OF TAPE 1 OF 2: to 11'
START OF TAPE 2 OF 2: 12'-69'
VIDEO QUALITY IS POOR

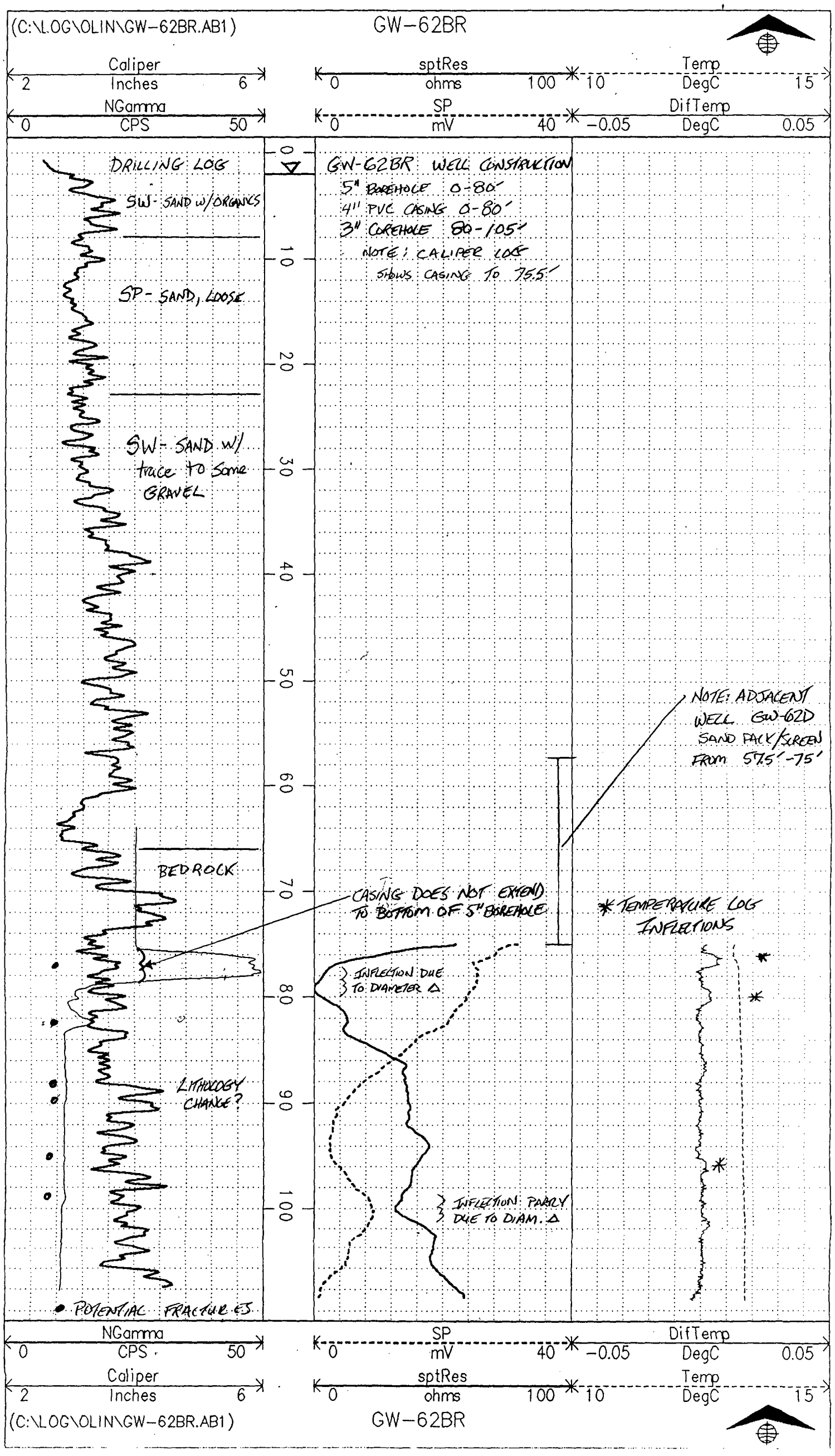
SMITH
ENVIRONMENTAL TECHNOLOGIES CORPORATION

CAMERA LOG

Well: GW-81BR
Date: 10/31/95 Tape 2 of 2
Logged by: D. Williams

DEPTH (ft.)	CASING/DTW	FRACTURES: CEMENTED	FRACTURES: CLOSED	FRACTURES: OPEN	TURBIDITY: CLEAR	TURBIDITY: CLOUDY	TURBIDITY: V. CLOUDY	STAINING: GRAY/BLACK	STAINING: YELLOW	STAINING: RED	STAINING: BROWN	STAINING: GREEN	BOREHOLE COLOR	(-2' to geophysical logs) NOTES
	CJ												PVC CASING White	SURFACE COMPLETION: FLUSH MOUNT
														@1' CASING JOINT
														PVC CASING - 0-20'
									X				yellow stain on casing	
10	CJ													
20	CASING													BOTTOM OF CASING @ 20'
	TD												BEDROCK	Bedrock ledge where casing meets small diameter borehole.
													Massive - granular w/ steep to mod. dipping infilled fractures	
			D											@28' CREVICE ONE-SIDE
30														
	▽		D											DTW @ 36'
						X								
40						X								
			D			X								@41' steeply dipping fracture w/ iron staining,
						X								white haze in water obscurs video.
			D			X								@41' steeply dipping fracture
						X								CAMERA LOG TD @ 49'
50														Terminates at sediment pool.
60														
70														
80														
90														





(C:\LOG\OLIN\GW-62BRD.AB1)

GW-62BRD

Caliper: 3 Inches 7 | sptRes: 0 ohms 150 | Temp: 10 DegC 15

NGamma: 0 CPS 50 | SP: 0 mV 40 | DifTemp: -0.05 DegC 0.05

DRILLING LOG

SW - SAND

SP - SAND
Fine-medium grained, loose

SW - SAND
fine - coarse, trace gravel
23-83'

Interpreted SM or SW w/ clay lenses

Interpret SW - SAND

INTERPRET SM to SW SAND with some silt and trace clay

WTHRD? BEDROCK

BEDROCK
POSSIBLY QUARTZITE
Reported in drilling log. moderately to highly fractured.

LITHOLOGY CHANGE to Mylonite?

GW-62BRD WELL CONSTRUCTION

6" BOREHOLE 0-105'
5" PVC CASING 0-105'
4" HQ COREHOLE 105-145'

@ 66' REPORTED BEDROCK INTERFACE AT GW-62BRD

80' REPORTED BEDROCK INTERFACE AT GW-62BR

NOTE: DIFFERENT DIRECTIONS OF SP and spt RES Inflect imply relatively higher dissolved solids

ADJACENT WELL GW-62D WITH SAND PACK FROM 58'-75'

ADJACENT WELL GW-62BR WITH SAND PACK FROM 80'-105'

* TEMPERATURE LOG INFLECTIONS

• POTENTIAL FRACTURE ZONES

0 10 20 30 40 50 60 70 80 90 100 110 120 130 140

NGamma: 0 CPS 50 | SP: 0 mV 40 | DifTemp: -0.05 DegC 0.05

(C:\LOG\OLIN\GW-65BR.AB1)

GW-65BR

Caliper 2 Inches 6 | sptRes 0 ohms 300 | Temp 10 DegC 15

NGamma 0 CPS 60 | SP 0 mV 100 | DifTemp -0.05 DegC 0.05

DRILLING LOG

SP - SAND (FILL)

PT - PEAT
very soft, black

SW - SAND,
trace gravel

SP - SAND,
fine-grained sand
with some silt,
stiff.

as above with
very-fine sand

@ 37.5' as above w/
some laminar bedding

@ 57.5' as above w/
fine-medium sand

SW - SAND,
fine-coarse sand,
very stiff

SP-SAND with
f.-m. sand, some silt

SW - SAND w/
wthrd. bedrock frag.

Gravel, V. coarse
angular, green-
brown

wthrd. BEDROCK
gray to black
GRANITE

@ 126'-1 GPM

TRACE QUARTZ
CRYSTALS

• POTENTIAL FRACTURE ZONES

GW-65BR WELL CONSTRUCTION

10" BOREHOLE 0-108'
8" PVC 0-110'
6" BOREHOLE 110'-140'

NOTE: SUSPENDED SOLIDS
FROM 81' - 140'
WHEN WELL LOGGED

YIELD ≈ 150 gpm @ 101'

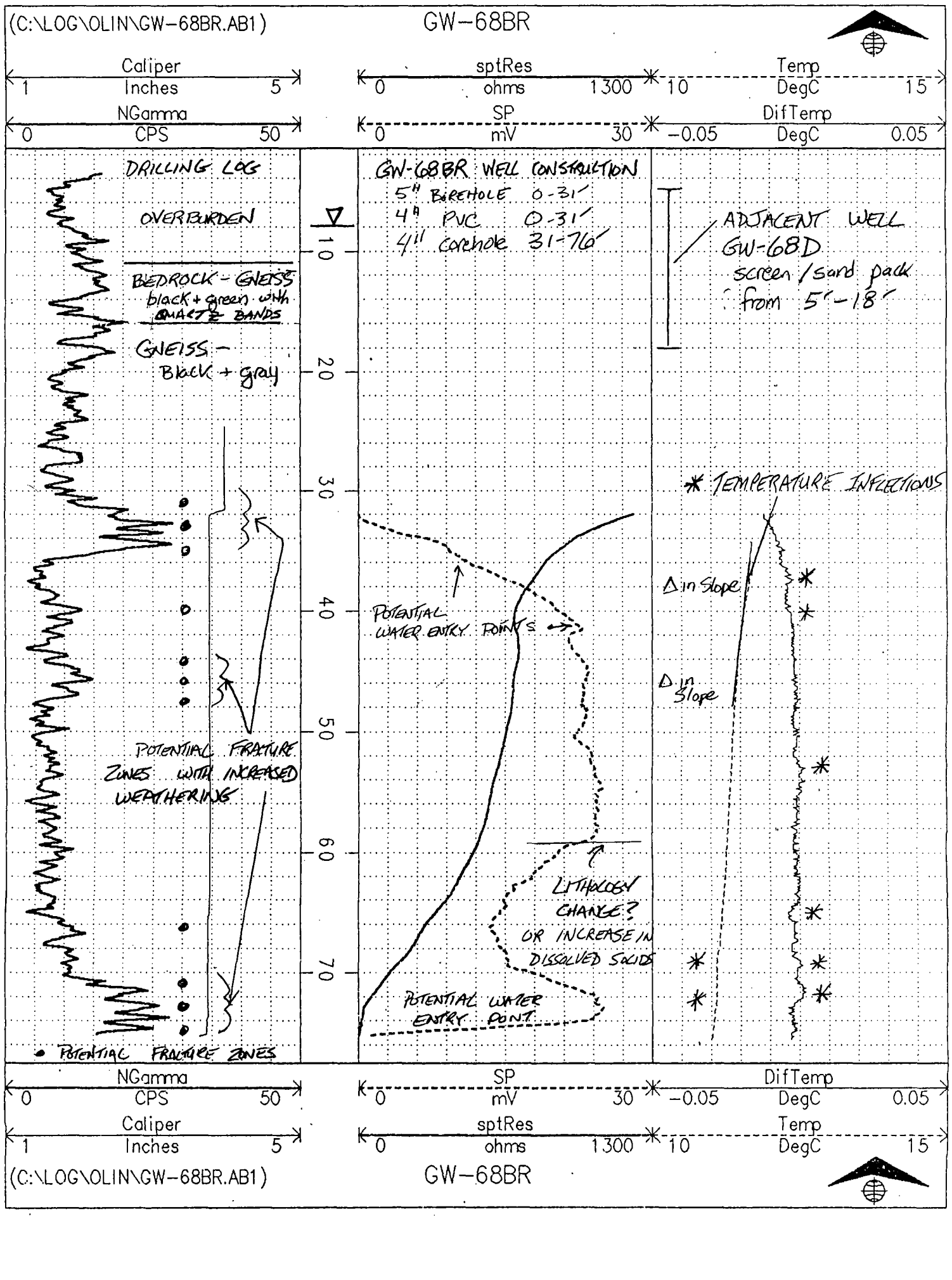
* TEMPERATURE LOG INFLECTION

POTENTIAL
LOWER
DISS. SOLIDS

POTENTIAL
HIGHER
DISSOLVED
SOLIDS

NGamma 0 CPS 60 | SP 0 mV 100 | DifTemp -0.05 DegC 0.05

Caliper 2 Inches 6 | sptRes 0 ohms 300 | Temp 10 DegC 15



(C:\LOG\OLIN\GW-80BR.AB1)

GW-80BR

Caliper: 4 Inches 8 | sptRes: 0 ohms 300 | Temp: 11 DegC 16

NGamma: 0 CPS 50 | SP: 0 mV 60 | DifTemp: -0.05 DegC 0.05

DRILLING LOGS

GP - Sand and Gravel

SW - Fine grained, dk gray sand @ 8-10' slight solvent odor

WEATHERED BEDROCK - Granite

BEDROCK - Fine to medium-grained, quartz with mafics

@ 44-46' soft drilling

BEDROCK - as above with higher qtz. content

● POTENTIAL FRACTURES

GW-80BR WELL CONSTRUCTION

0-30' 8" PVC CASING

27'-30' BENTONITE SEAL

30'-70' 6" BOREHOLE

ADJACENT WELL GW-80D

SAND PACK 7-22'

* TEMP. CURVE INFLECTIONS

Δ in slope

* Δ in slope

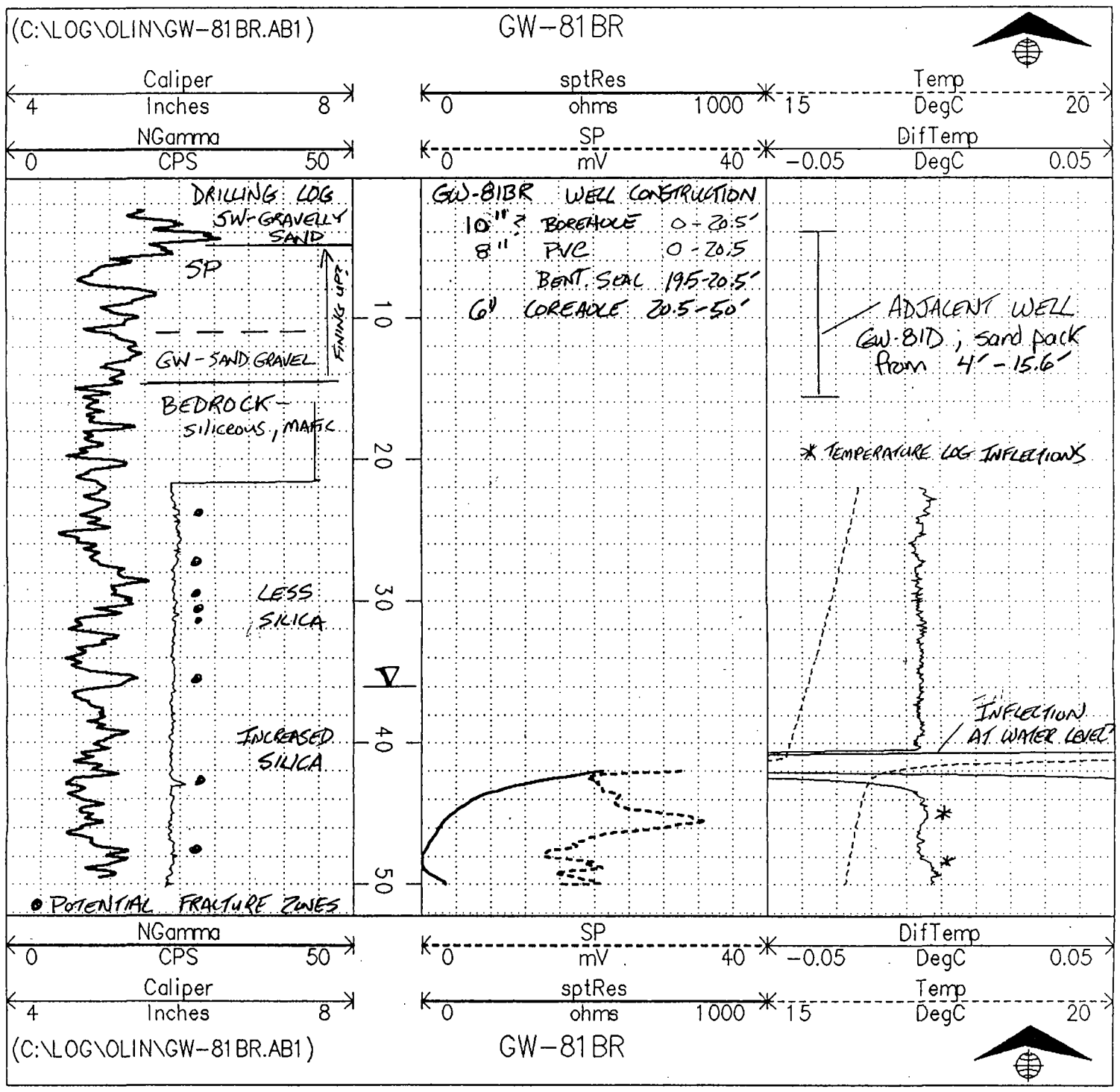
10 20 30 40 50 60 70

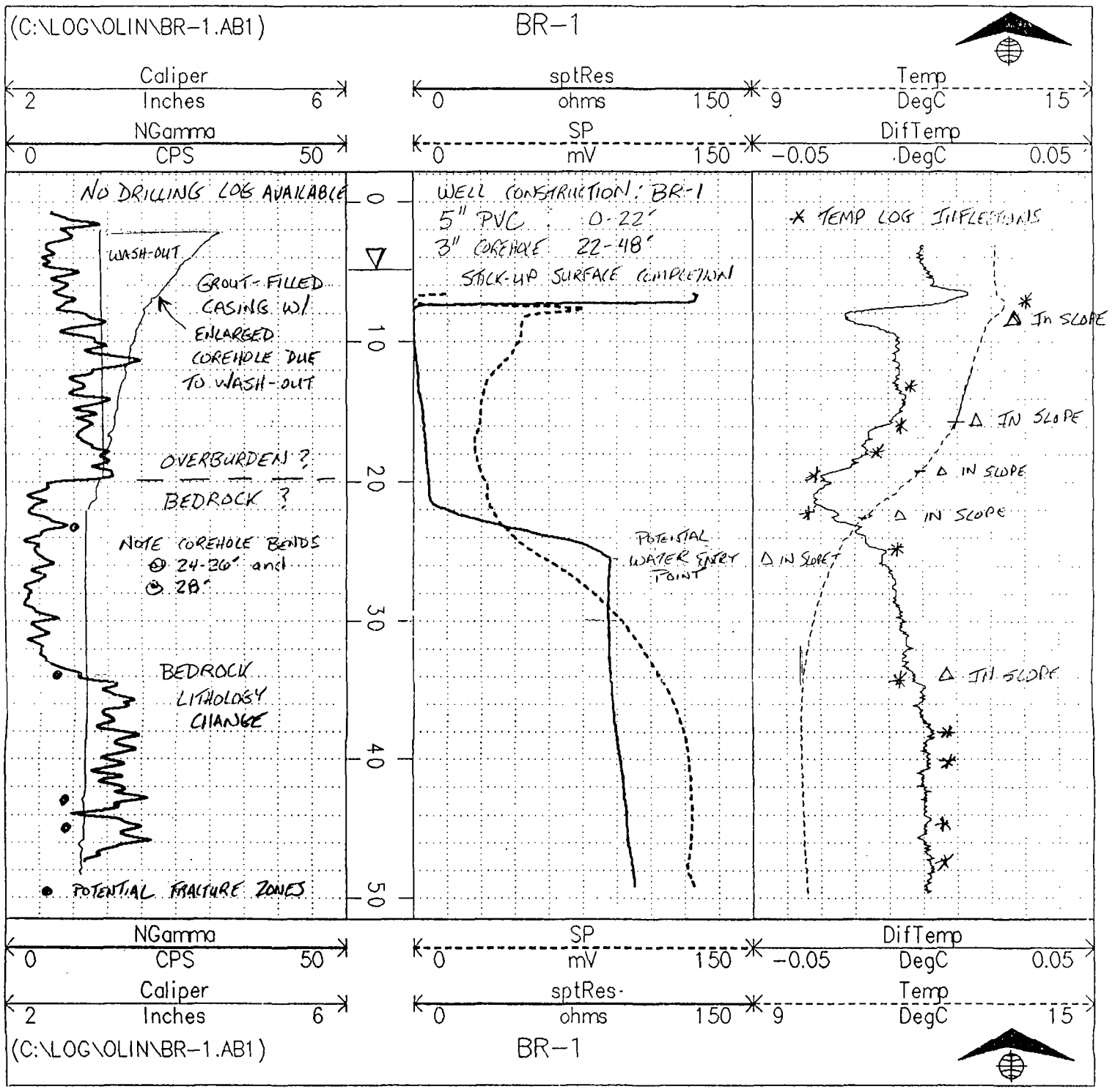
NGamma: 0 CPS 50 | SP: 0 mV 60 | DifTemp: -0.05 DegC 0.05

Caliper: 4 Inches 8 | sptRes: 0 ohms 300 | Temp: 11 DegC 16

(C:\LOG\OLIN\GW-80BR.AB1)

GW-80BR





Appendix C

SMITH

APPENDIX C

BOREHOLE GEOPHYSICS REPORT AND LOGS

GEOPHYSICAL BOREHOLE LOGGING AND VIDEO INSPECTION

OLIN SITE
WILMINGTON, MASSACHUSETTS

Presented to:

SMITH ENVIRONMENTAL TECHNOLOGIES CORPORATION
One Plymouth Meeting Mall
Plymouth Meeting, Pennsylvania 19462

Presented by:

GEOPHYSICS GPR INTERNATIONAL, INC.
13 Highland Circle, Suite E
Needham Heights, Massachusetts 02194

November, 1995

B95108

Introduction

Geophysics GPR International Inc. is pleased to submit this report of our borehole geophysical logging services at the Olin site, Eames Street, Wilmington, MA. We performed the services, including a borehole video inspection, during part of the period of October 24 to 31, 1995. The objectives of the surveys were to characterize the condition of the bedrock, fractures, etc., and film specified intervals in selected wells.

Geophysical Borehole Logging

The geophysical logging suite was performed in the following boreholes at the Olin site (Figure 1): BR-1, GW-61BR, GW-62BR, GW-62BRD, GW-65BR, GW-68BR, GW-80BR, and GW-81BR.

These eight boreholes, ranging in depth from about 50 to 145 feet, were logged. All of these boreholes were cased to depths ranging from 20 to 110 feet, depending on the depths to the top of bedrock. Due to the schedule of completion of the wells, the logging was done with one mobilization (callout) with a Smith representative onsite during the logging and video inspection.

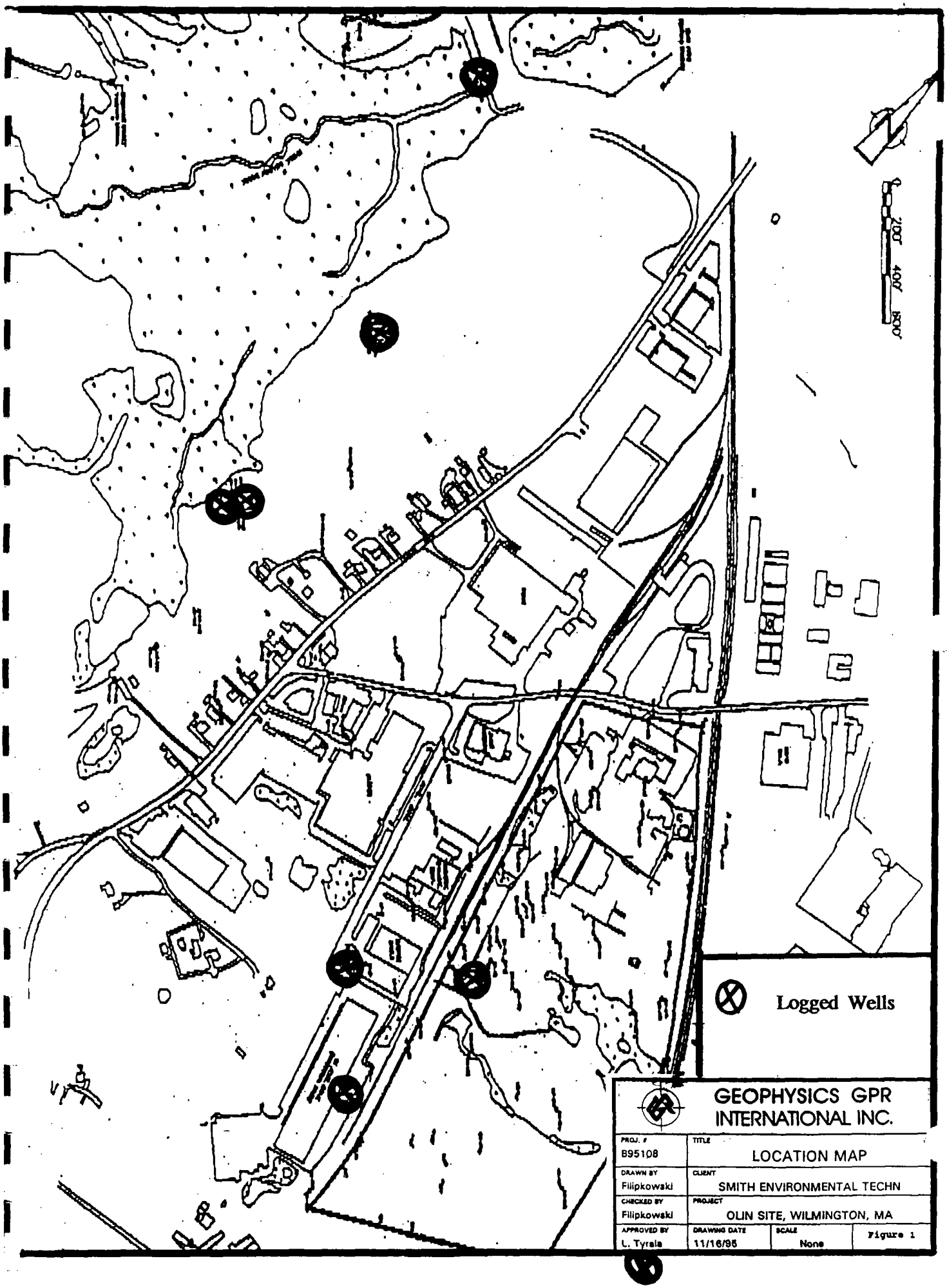
We employed our Mount Sopris MGX digital logging system. The logging suite was natural gamma, caliper, single-point resistivity, spontaneous potential, and temperature (absolute and differential). The work was carried out by a geophysicist with current 40 hour OSHA health and safety training.

Decontamination of our equipment was done using soapy and clean water scrubbings with collection of fluids into the driller's containers. The time required onsite for setup, logging, and decontamination were two full field days, plus traveltime. The well logging was completed using a number of probes lowered into each borehole, in this particular case, one probe at a time. No tandem probes were run. Borehole logging speeds ranged from 8 to 12 feet per minute, depending upon the probe used.

Each probe was calibrated prior to actual logging according to manufacture's requirements. The digital borehole logger collected the probe readings with data recorded on diskette for playback and processing. In addition to the requisite calibration of each probe, our quality control procedure required that each logging suite was checked via playback of each digitized curve on the monitor before demobilizing from the wellsite.

The results of borehole logging are displayed as profiles for each borehole (foldout Figures). Comments were taken from the borehole logs provided by Smith, and are shown on each log, together with our comments beside the trace of the readings from each probe performed in the borehole.

For ease of comparison, a scale of one inch equals ten feet is used for all printouts. The geophysical logs display the changes with depth below ground surface of each measured parameter. Features of interest are shown on the individual log.



Logging Suite

The natural gamma ray (G) probe is a widely applied borehole tool that measures the variations in the naturally occurring potassium isotope (counts per second, cps) found in sediments and sedimentary rocks. The record is used to determine fractured and weathered intervals in the boreholes, changes in lithology with depth, and correlation of strata in nearby boreholes.

The caliper (Cal) probe measures changes in the diameter (in inches) of the borehole. The caliper record is used to delineate fracture zones (and by inference rock quality) due to the increase of the borehole diameter. Alternatively, the record is used to delineate obstructions due to rock breakout lodgement and, where anticipated, scale accumulation due to the decrease in borehole diameter.

As a group, the electric logging probe used in environmental well logging, spontaneous potential and single-point resistivity, measure the potential differences in electrical currents in and around the borehole.

- The spontaneous potential (SP) sensor measures the changes in the naturally occurring electric potentials (in millivolts) of the surrounding material and groundwater flows. These SP changes are frequently related to rock fractures and groundwater flow. This unbalance of ions is caused by diffusion, adsorption, oxidation-reduction, and electro-filtration.

- The single-point resistance (SPR) sensor measures the smaller changes in the surrounding material (in ohms), and the record is used in conjunction with the resistivity and gamma traces to delineate permeable intervals and identify clayey zones.

The temperature probe measures the temperature (Temp) changes in the borehole fluids (in degrees C) and the differential temperature from the last reading (in degrees C). The probe was developed specifically to aid in detection of intervals of fluid inflow.

Borehole Video Inspection

The objectives of the borehole video inspection were to observe changes in the bedrock, identify fractures, and note fluid movement. The video inspection was performed in the specified wells. Our activity for the video inspection was confined to performing the data collection with no analysis of the imagery by us.

A color system was used at Smith's request. We brought to the site a GeoVision Micro system with onscreen depth counter. The forward looking attachment was used throughout the inspection due to the low to moderate reflectance of suspended matter in the water, good

imaging of the bedrock, and good recognition of bedrock fractures. For mobility the system uses 8 mm video tape and, at Smith's request, the tape was copied on to VHS video tape.

Results

The logging traces for each borehole have our comments appended to them. Most of the geophysical results, natural gamma and the electric logs, are indicative of stratigraphic changes in the glacial overburden (cased interval) and compositional changes in the bedrock (open hole interval).

It should be noted that terms such as clay, sand, etc. in a typical geophysical logging interpretation are generalized terms representing distinct, different property contrasts. The sand designation, for example, in our comments column delineates intervals of decreased natural gamma radiation.

Our interval of sand, for example, may or may not be sand, as defined geologically, but rather an interval with a change of certain values indicative of lower quantities of very fine-grained minerals which are frequently in the clay group of minerals.

The following comments can be made from the results of our investigation.

- Taken altogether, there is little evidence for intervals of highly fractured (breakouts) bedrock, significant temperature changes, or electrical responses to changes in the composition of the groundwater.

- The video inspection of boring GW-62BR showed what appeared to be a thin, discreet floating layer at a depth of about 99 feet.

- The caliper log and video both indicate a loss of integrity of the top few feet of the casing in boring BR-1. It is pitted and probably split.

- As to be expected, the caliper logs clearly show the uniform diameter produced by diamond coring and the irregular diameter produced by air-rotary drilling.

- Discreet individual stratigraphic layers were seldom observed in the natural gamma traces, underscoring the inhomogeneity of the glacial materials at this site.

- Glacial stratigraphic correlation from borehole to borehole is limited by the distances between boring locations and the relatively shallow depths of half of the borings.

GW-61BR

BORING GW-61BR

SMITH GPR COMMENTS COMMENTS

Sand

Sand

Bedrock Breakout

Bedrock Breakout at Bedrock Surface

Cored Bedrock Surface

Bottom of Casing

((CALOGXOLIIINGW-61BR.AB1)

Caliper Inches 2 6

Gamma CPS 0 50

K-

GW-61BR

splRes ohms 0 1100

Temp DegC 10 15

SP mV 0 150

DifTemp DegC -0.05 0.05

((CALOGXOLIIINGW-61BR.AB1)

Gamma CPS 0 50

Caliper Inches 2 6

GW-61BR

SP mV 0 150

splRes ohms 0 1100

DifTemp DegC -0.05 0.05

Temp DegC 10 15

GW-62BR

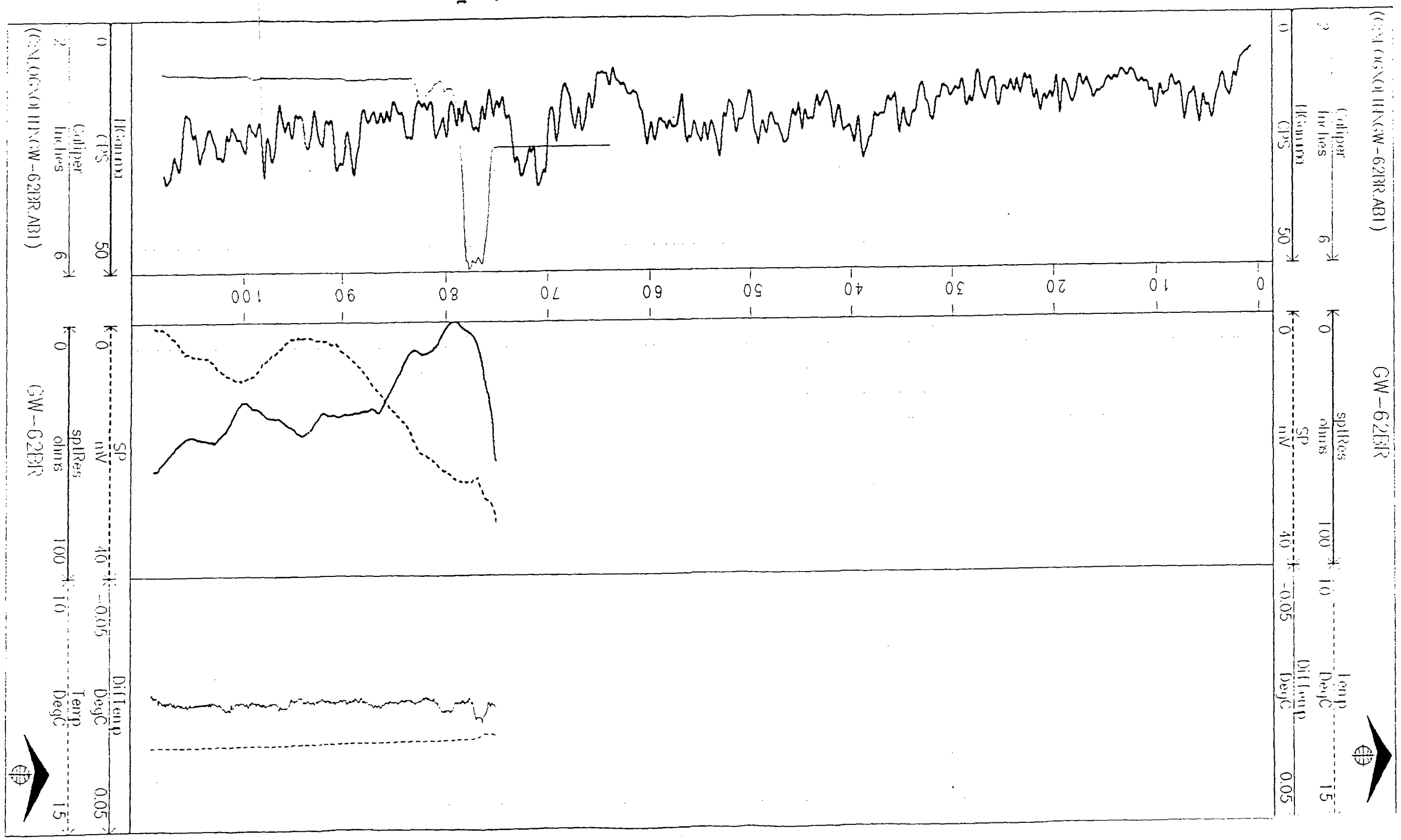
BORING GW-62BR

SMITH GPR
COMMENTS COMMENTS

Video Shows Possible Floating Layer Here

Cored Bedrock Breakout

Bottom of Casing



BOREHOLE LOGGING PLOTS

Borings: BR-1, GW-61BR, GW-62BR, GW-62BRD, GW-65BR, GW-68BR, GW-80BR, and GW-81BR

Note:

1. Abbreviations: Ngamma=natural gamma; Caliper=Caliper; SP=spontaneous potential; sptRes=single point resistivity; Temp=Temperature; Diff Temp=Differential Temperature.

2. Scale is 1"=10 ft.

3. All plots corrected so that zero feet is ground surface.

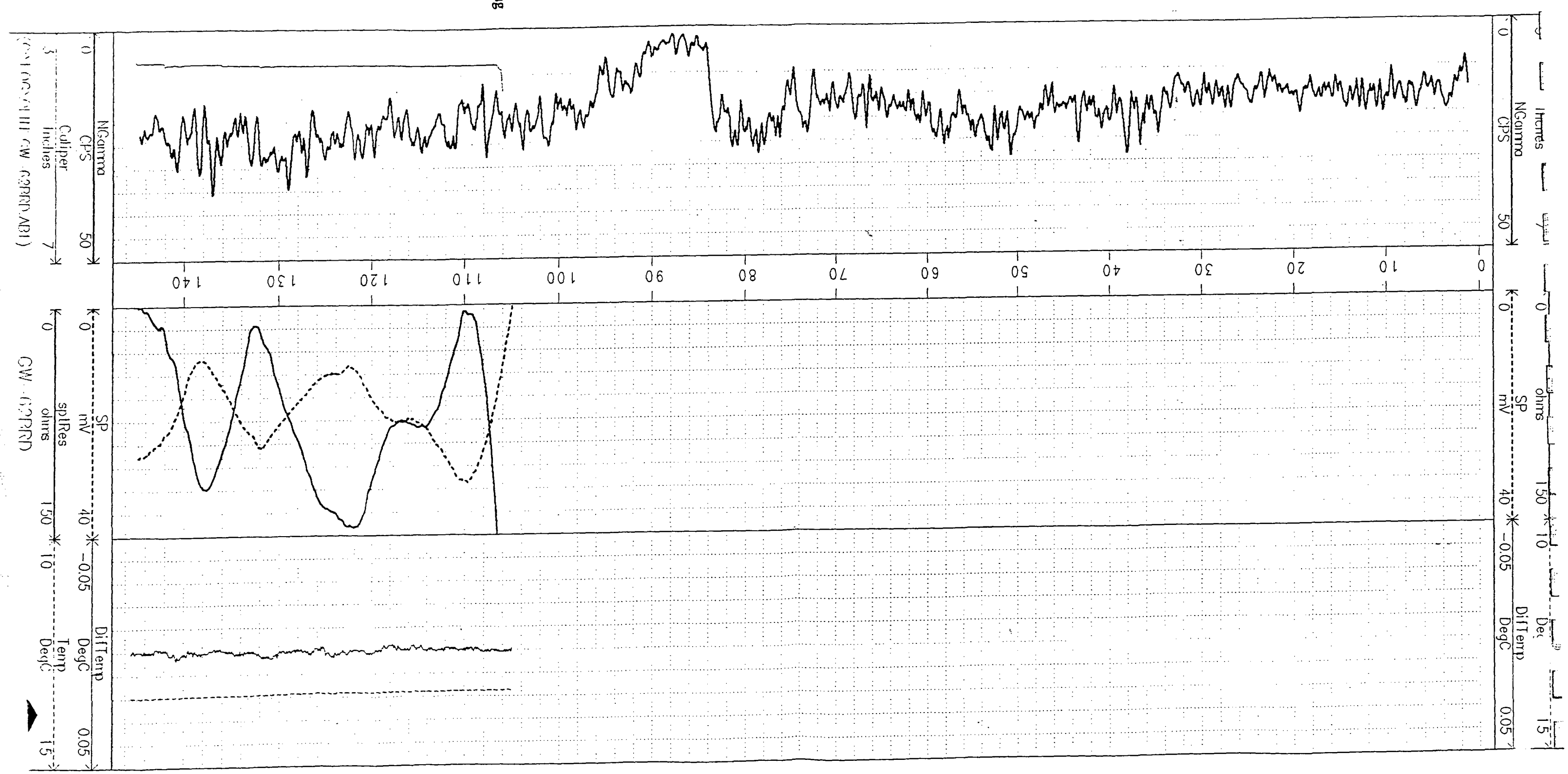
GW-62BRD

SMITH GPR COMMENTS COMMENTS

Cored

Bottom of Casing

Sand



BOI ; GW-65BR

SMITH GPR
COMMENTS COMMENTS

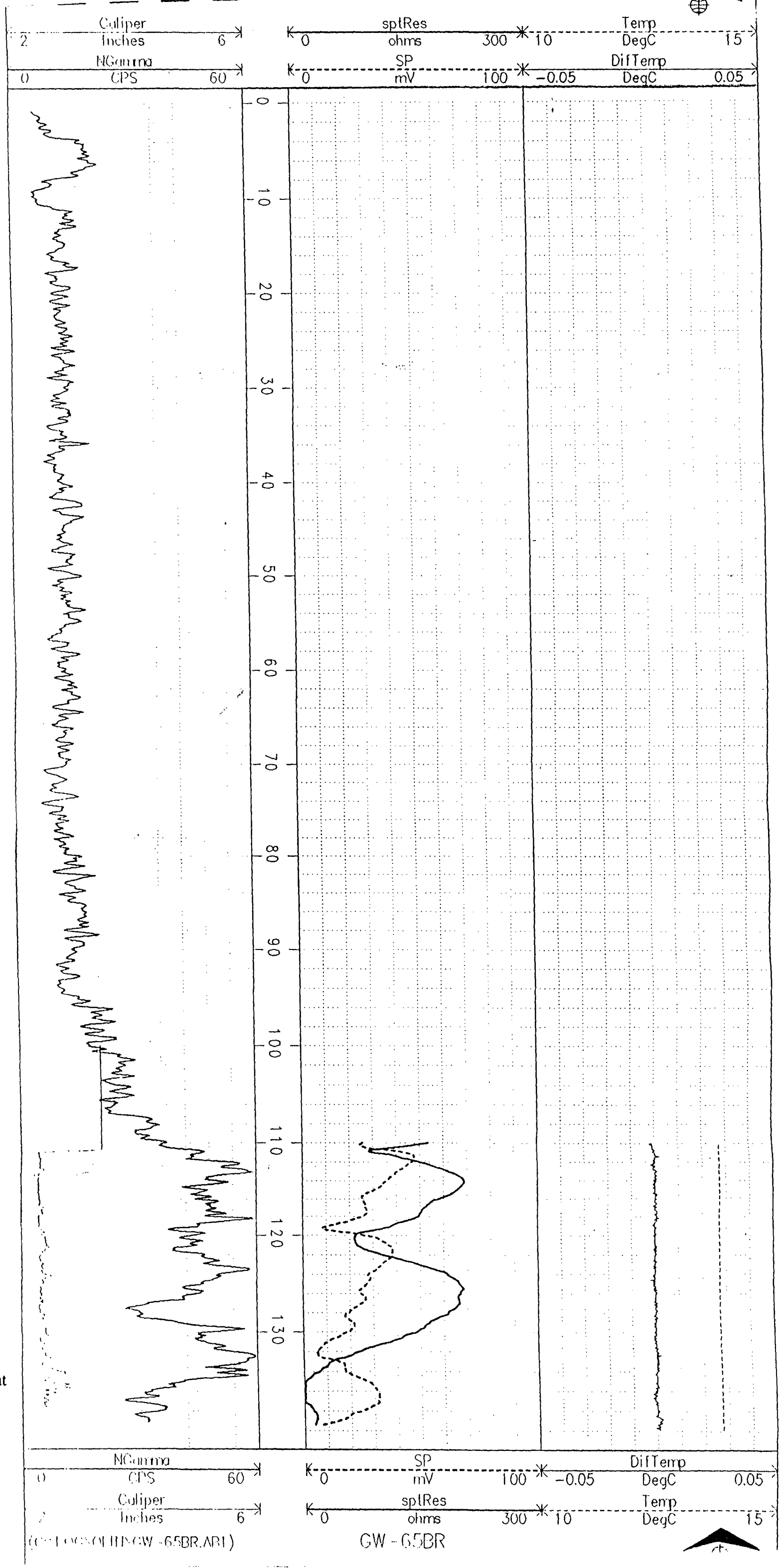
Sand

Bottom of Casing

Air Rotary

Fracture at 126 ft

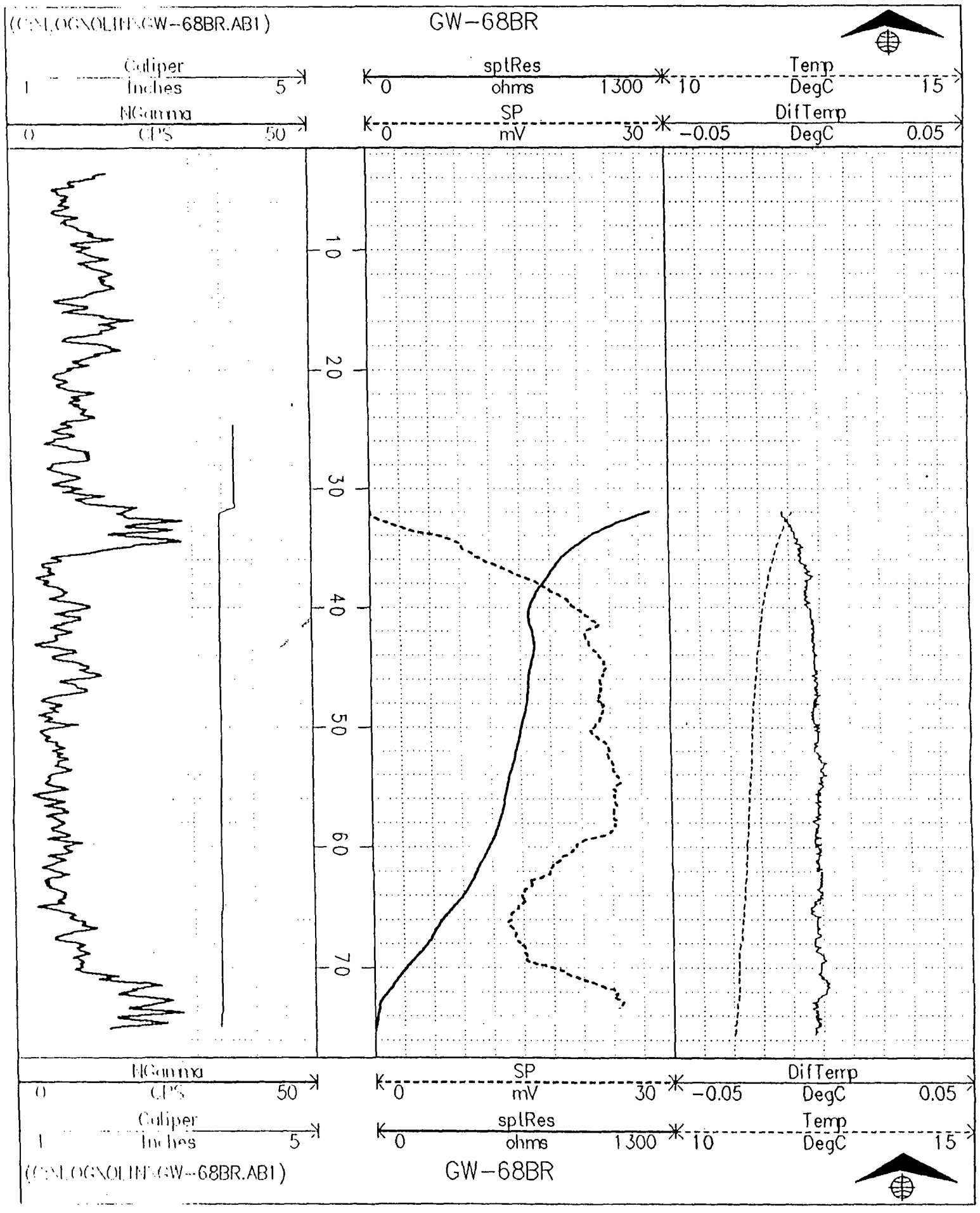
Bedrock Breakout



GW-65BR

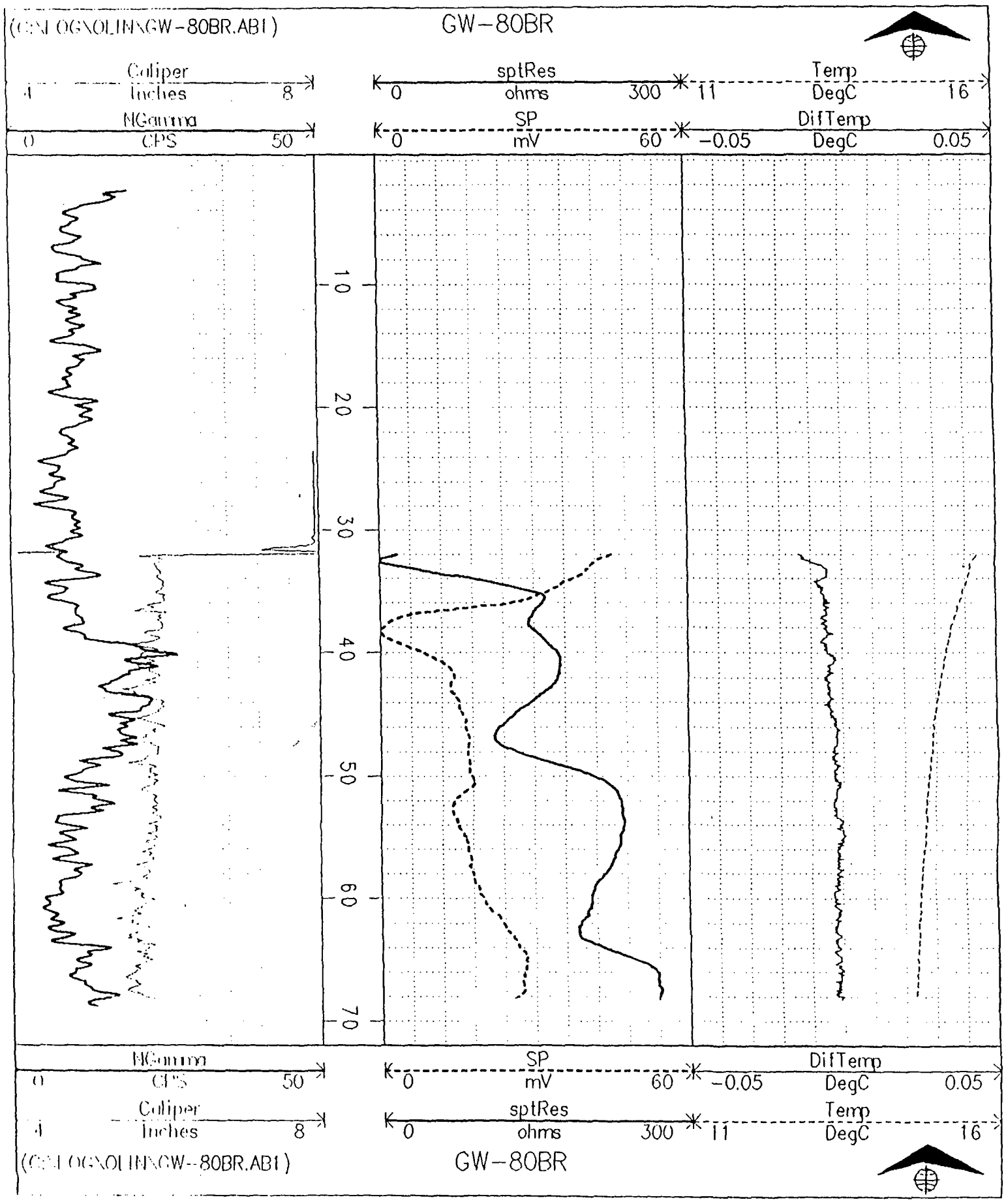
BORING GW-68BR

SMITH COMMENTS	GPR COMMENTS
Cored	Bottom of Casing



BORING GW-80BR

SMITH GPR
COMMENTS COMMENTS



Bottom of Casing

Air Rotary

Bedrock Breakout

Soft Drilling at
44-46 ft

GW-80BR

BORING GW-81BR

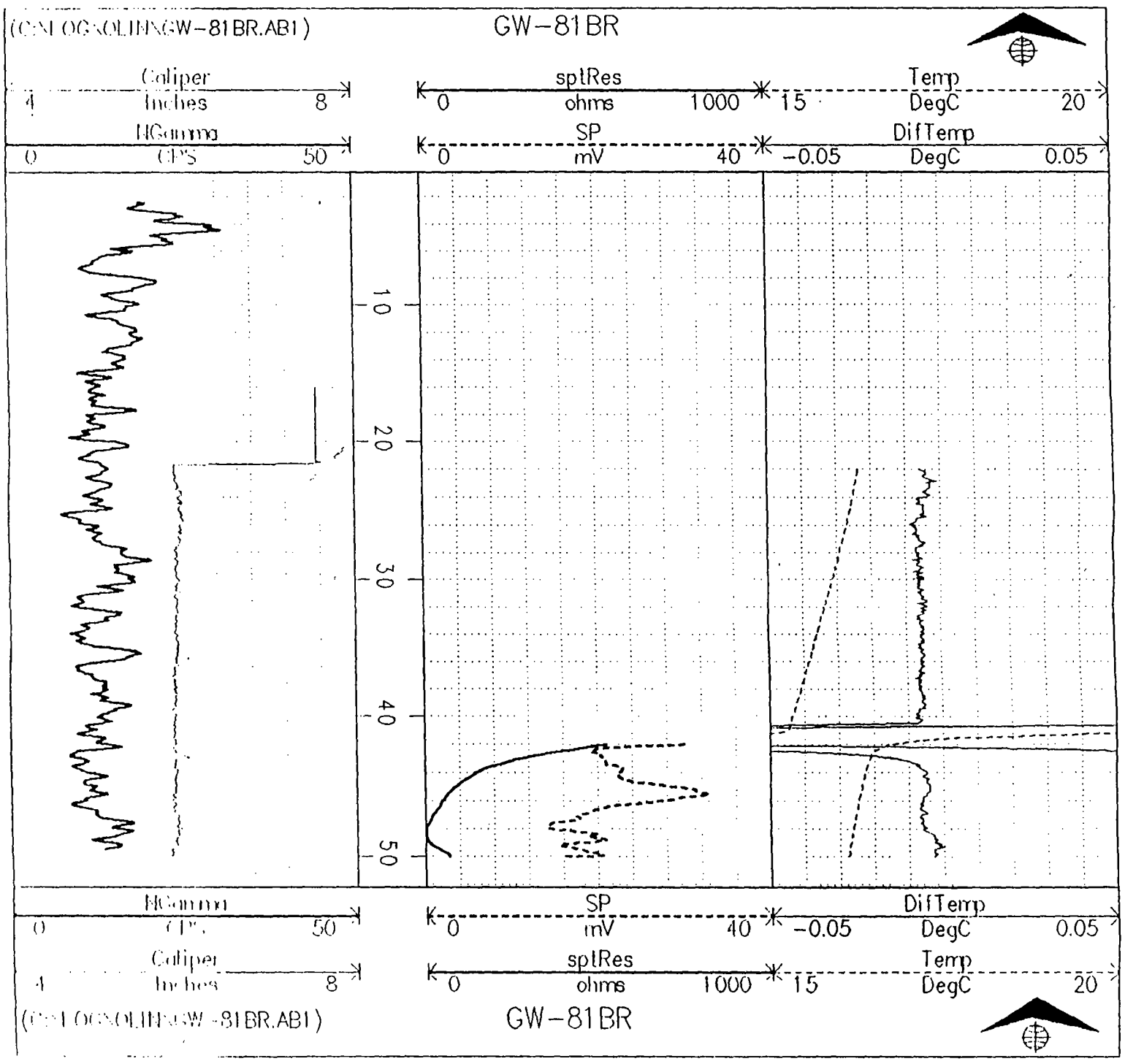
SMITH COMMENTS **GPR COMMENTS**

Bottom of Casing

Air Rotary

Probe Entered Water

Bedrock Breakout



Appendix D

SMITH

APPENDIX D

SEISMIC REFLECTION REPORT

APPENDIX D
SEISMIC REFLECTION REPORT
Discussion of Bedrock Contour Map

The bedrock contour map generated by the seismic reflection contractor, Raypath Inc., differs somewhat compared to the contour map in Section 2.1 of the Supplemental Phase II report (Plate 2-1). With one exception, the two maps do not actually disagree, but the criteria used for contouring are somewhat different. The disagreement occurs in the area of Eames Street where Raypath has mainly relied on the seismic data which shows a bedrock high; Plate 2-1 uses instead data from drilled wells to the north and south of Eames Street which show greater depths to bedrock. Outside this area, the following criteria were used to generate the contours in Plate 2-1:

- The existing bedrock elevation data were compiled, including seismic data, information from drilling logs, locations of bedrock outcrops, and interpretations from geophysical studies. This information was then contoured with a kriging program (Golden Software's Surfer, 1994) using an exponential semi-variogram, a 50-foot grid spacing, and a 2:1 anisotropy oriented at 45° (northeast-southwest), aligned with regional bedrock structure. Kriging provides an unbiased effective averaging of outliers and extreme data points.

- The computer-generated contours were examined and manually modified for smoothing, where the computer contours were peculiar, or where a slightly different interpretation was preferred.

As a result of this approach, the bedrock contours in Plate 2-1 reflect the overall character of the bedrock surface. In certain areas, individual outliers may have been averaged with surrounding data points to create smoother, more easily understood contours. Where data were sparse, the known structure of the bedrock formation and elevations from bedrock outcrops were included in the interpretation. In addition, geophysical information from regional and local studies was included (for example, regional aeromagnetic surveys, magnetometer survey on Olin property, fracture orientation and frequency, etc.).

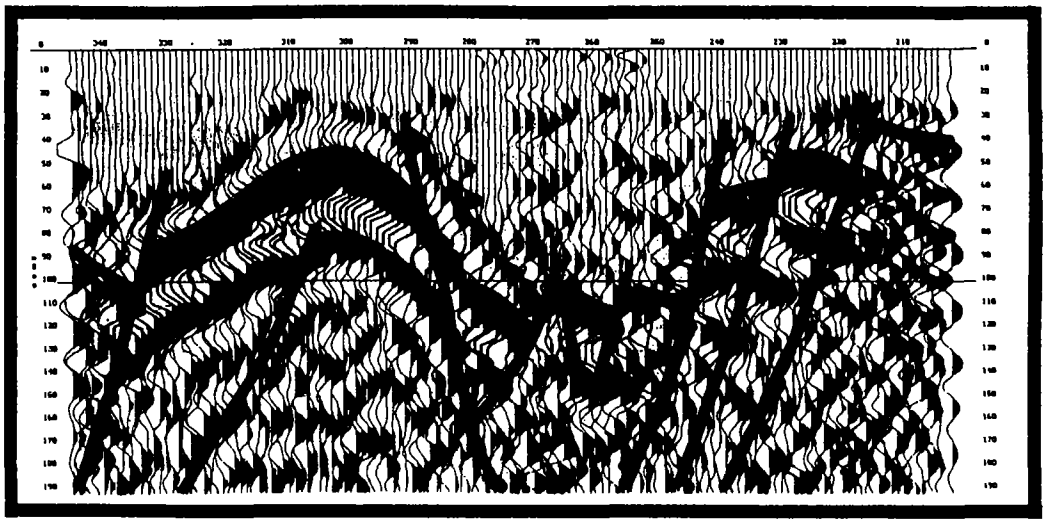
In contrast, the bedrock contour map prepared by Raypath (Figure 2-1 of this Appendix) includes much more of the local detail. Extreme data points and outliers are honored, so that the contour map includes a large number of closed contours surrounding isolated high or low points. For example, the bedrock surface east of the Chestnut Street well pumping station is shown as a group of knobs on the Raypath's map (Figure 2-1), while the bedrock contours in Plate 2-1 shows more contiguous "ridge" of bedrock highs (versus isolated knobs). The bedrock surface depicted by Raypath uses localized trends to project individual contours and well into areas where there is no data providing control. For example, the dashed 50-foot contour on Figure 2-1 in the attached report in the area northwest of GW-70D is not based on any subsurface data. The bedrock contours depicted on Plate 2-1 of the Supplemental Phase II Report are generalized to show both local features and information about the regional geologic structure.

SUMMARY REPORT OF

THE SEISMIC REFLECTION INTERPRETATION

CONDUCTED IN AREAS CONTIGUOUS TO

THE OLIN FACILITY IN WILMINGTON, MA



(Western Bedrock Valley profiled along line BCM-94-3)

SUBMITTED BY: RAYPATH, INC.
(215) 782-1863

TO: SMITH ENV. TECHNOLOGIES INC.

DATE: December 19, 1996

INDEX

SECTION A

TABLE OF CONTENTS:

Summary:

A 17,103 line feet 12/24 fold seismic reflection survey was conducted at a 200 acre site in a wetlands area contiguous to the Olin facility in Wilmington, MA, for the purpose of mapping the topography of the top of Pre-Cambrian metamorphic bedrock. Seismic lines were positioned to "tie" selected wells/borings where average velocity measurements could be made to constrain the top of the bedrock surface on the seismic profile at the well/boring "tie". The 12/24 fold seismic data were collected using shotgun/impact energy sources and 40 Hz amphibious/marsh geophones as recievers. Processing of these data was performed using conventional CDP (see attached glossary of geophysical terms) methods. In addition to the seismic survey, down hole velocity surveys were performed in 16 of the wells in the mapping area in order to determine the average velocity gradient to the top of bedrock. The velocity survey information was used along with 4 additional extrapolations to construct an average velocity gradient map from which seismic travel times were converted to a depth structure map of the top of the bedrock. Average velocity gradient mapping indicated that the velocity field is influenced by the heterogeneity of the recent, glacial sediments. Depth structure mapping of the bedrock surface delineated four distinct bedrock valleys referred to as the Western, Upper Western, Southwestern and Eastern bedrock valleys. The Western bedrock valley was previously considered 1 valley, but is now recognized as 2 valleys based on criteria discussed in this report. These bedrock valleys have been interpreted to be discretely separated by structurally high saddles or ridges.

The Western, Upper Western and Southwestern Bedrock Valleys appear to be closed lows, the Eastern Bedrock Valley appears to plunge westward, "connecting" with the Upper Western Bedrock Valley. The bedrock valleys have been defined by either mapped structurally high ridges or saddles. The bedrock valleys exhibit orthogonal differences in structural strike as well as differences in structural wavelengths with a range of 300 feet to 400 feet. The Western Bedrock Valley, covering an area of approximtately 62 acres, is comprised of three converging structural lows contained within the +20.0 feet contour. The lowest closing contour is approximately -40.0 feet. The Upper Western Bedrock Valley defined by the +30.0 feet contour contains a series of three generally north-south oriented closed structural lows having an area of roughly 14.3 acres. The lowest closing contour is approximately -20.0 feet.The Eastern Bedrock Valley is a narrow, east-west trending 14 acre synclinal fairway which does not appear as a closed low in the mapping. The +50.0 feet contour is the defining contour for the Eastern Bedrock Valley. The Southwestern Bedrock Valley, with an areal extent of approximately 36.3 acres, is a structural low defined by the +70.0 contour. The lowest closing contour is approximately +40.0 feet. Results from confirmation drilling support the structural mapping interpretation.

Geology:

It is beyond the scope of this study to discuss in detail the local geology of the site, therefore, only a cursory examination of the site geology is given. The geology within the general study area consisted of glacial deposits of the Late Wisconsinian deglaciation of New England overlying metamorphic rocks comprised primarily of slates and quartzites. The metamorphics have been significantly affected by two separate periods of orogenic activities. These include both the Taconic and Acadian orogenies.

Data Acquisition:

The 24/12 fold seismic data were acquired in two different types of terrain: upland (upper Western, Eastern, and Southwestern bedrock valleys) and lowland (Western bedrock valley and part of the Eastern bedrock valley). The upland program was acquired where there was very little standing water present. For this program 40 Hz geophones in land cases were used. Source testing indicated that no increase in bandwidth was gained by the use of a shotgun source. Cultural constraints were also a consideration regarding the choice of the source. Therefore, the source for this portion of the program was a sledge hammer. Station elevations were surveyed by Raypath Inc. Stations were positioned such that 2.5, 3.75, and 5 feet subsurface sampling intervals were attained.

The data acquired in the lowland or marsh environment (those areas covered in 2-4 feet of standing water) required special equipment. The geophones for this environment were also 40 Hz, but were mounted in marsh casings. The source for this portion of the program was a shotgun, built by Raypath and called the RayGun. Marsh cables were used as well, and mechanisms for floating the cable and planting the geophones in water were designed and constructed by Raypath Inc. As part of the field acquisition, all stations were surveyed for elevation changes by Raypath Inc. The stations were positioned such that subsurface sampling intervals of 4 and 5 feet were achieved. The shallow seismic reflection source and receiver parameters used were as follows:

Source: 12 gauge shot gun (land/marsh) (firing blanks) and impact (land)
Receivers: 40 Hz geophones, vertical component, amphibious/marsh cases
Recorder: .2 ms sample rate
Group intervals: 5, 7, 8, and 10 feet / point receivers
Shot intervals: 5, 7, 8, and 10 feet / off end
Spread lengths: 60, 84, 96, and 120 feet respectively
Fold: 12/24 (12 or 24 traces vertically summed)
Subsurface sampling intervals: 2.4, 3.75, 4, and 5 feet
Seismic Grid: 17,103 feet

Surveying:

Station surface elevations were surveyed by Raypath, Inc. at the respective station spacings of 5.0, 7.5, 8.0 and 10.0 feet along the seismic lines for data processing purposes only. The recorded surface elevations have been plotted on each seismic profile.

Data Processing:

Processing of the seismic lines followed petroleum industry standard CMP methodologies. In general, the quality of the data was very good; however, data quality varied between the upland and marsh programs. Somewhat lower frequency data was recorded in the marsh probably due to high frequency attenuation by the low velocity muds and "muck". Computer generated synthetic seismograms representative of the lowland and upland theoretical seismic reflection responses produced a good correlation to the respective stacked data. The upland data exhibited ground roll while little or no ground roll was present in the marsh data. Ground roll in the upland data was attenuated utilizing a low cut frequency filter. Low cut frequency filtering was not necessary for the data shot in the marsh. Data in all cases were subject to a spatially varying first arrival mute to remove direct arrivals and refracted waves. The data were then sorted to CMP order. Normal move-out corrections were made based on a velocity function determined from several iterations of constant velocity stack analysis. The elevations measurements made during the acquisition stage were used to correct data to a seismic reference elevation of 84.1 ft. This datum was chosen somewhat arbitrarily to represent the highest elevation encountered in the marsh area. Final stacks were produced and F-K migrations were performed on those data that exhibited significant dip. Seismic data were processed to final stack and migration (when deemed necessary) using the following hypothetical processing sequence:

Reformat
Edit
Amplitude correction
Muting
Noise suppression / filtering: frequency and F-K
Deconvolution
Sort
Datum statics
Velocity analysis
Residual statics correction
2nd pass velocity analysis
2nd pass residual statics correction
Stack
Post stack scaling / filtering
Migration
Post migration scaling / filtering

TERRA MAR, INC. SYNTHETICS PLUS (10.0)

BCM65D MONITOR WELL
WETLANDS AREA
WILMINGTON, MA.

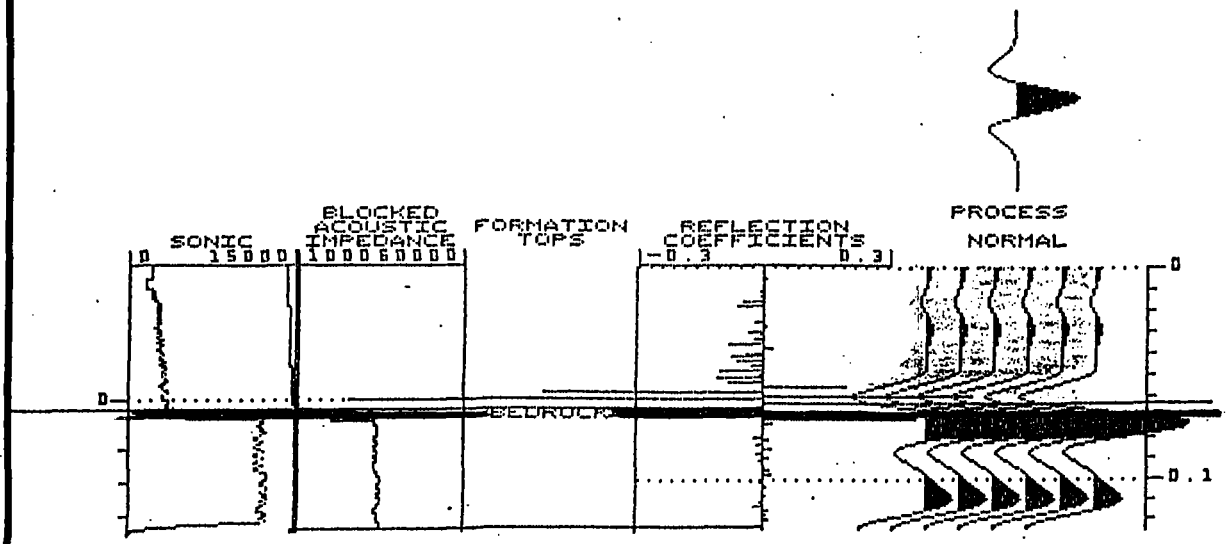
Sonic Log File Name..: \TERRAMAR\DATA\BCM65D.S
Correctional Velocity: 2000.0
Inches Per Second....: 12.50
Traces Per Inch......: 5.0
Traces Per 1.0 Peak..: 4.00
Sample Rate..........: 2.0 msecs.

KB Elevation.........: 84.1 feet.
Datum Elevation......: 84.1 feet.

Depths are relative to SEA LEVEL.

Process:

Wavelet: RICKER
Frequencies Phase Shift
30 0 0 0 0.00
Peak Size: 1.00 TC: 0.00 TW: 0.00



SYNTHETIC SEISMOGRAM SHOWING REPRESENTATIVE THEORETICAL RESPONSE

OF SEISMIC DATA RECORDED IN LOWLANDS.

TERRA MAR, INC. SYNTHETICS PLUS (10.0)

BCM40D MONITOR WELL
SOUTHWEST BEDRX VALLEY
WILMINGTON, MA.

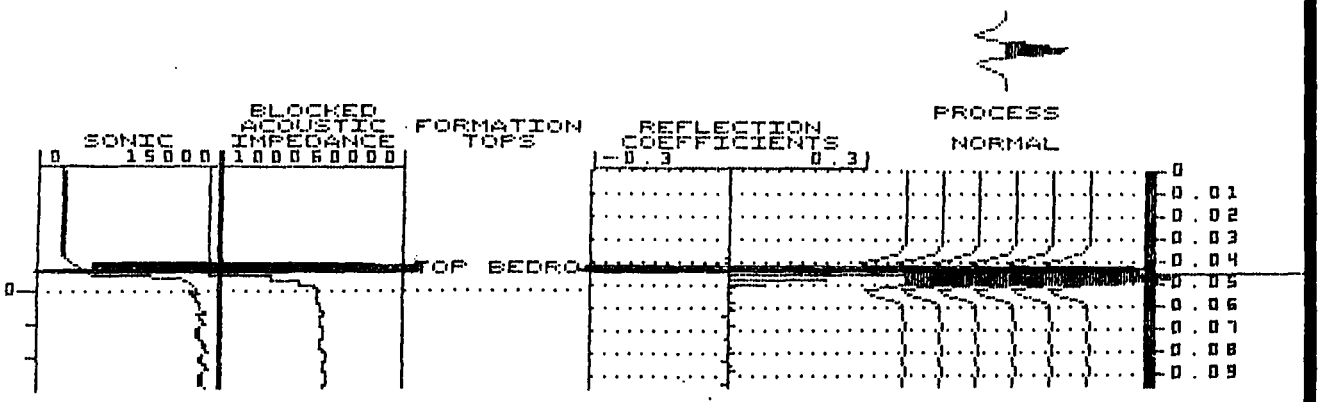
Sonic Log File Name..: \TERRAMAR\DATA\BCM40A.S
Correctional Velocity: 2000.0
Inches Per Second....: 12.50
Traces Per Inch.....: 5.0
Traces Per 1.0 Peak..: 4.00
Sample Rate.....: 2.0 msecs.

KB Elevation.....: 86.1 feet.
Datum Elevation.....: 84.1 feet.

Depths are relative to SEA LEVEL.

Process:

Wavelet: RICKER
Frequencies Phase Shift
75 0 0 0 0.00
Peak Size: 1.00 TC: 0.00 TW: 0.00



SYNTHETIC SEISMOGRAM SHOWING REPRESENTATIVE THEORETICAL RESPONSE

OF SEISMIC DATA RECORDED IN HIGHLANDS.

Four preliminary reports were compiled from December 1994 to April 1996. These provisional, interum reports discuss in detail the acquisition, processing, interpretation, and mapping of the seismic data in successive phases. Additional clarification of the processing of the data is referenced in these provisional, interum reports.

Velocity Survey / Seismic Well Tie and Depth Conversion

A. Velocity Survey Data-

Seismic reflection data are recorded and displayed as a function of distance (x axis in feet) versus two-way travel time (y axis in milliseconds). Seismic lines are a continuous profile showing the structural geometry of subsurface layers. Velocity maps or time / velocity / depth graphs based on measured or extrapolated velocity data may be used to convert seismic two-way travel times to depths. Subsurface layers penetrated in wells/borings can be "tied" to seismic data where the seismic profile crosses or intersects the location of a boring/well. A velocity survey tool is lowered into the well bore and receives energy from a source initiated at the surface near the well. The tool is positioned at subsurface depths within the well bore corresponding to layers of interest such as the top of bedrock. The "reflection time" to the surface(s) of interest can be recorded, and the average velocity of the overlying material can then be calculated. Subsequent to datum adjustments, the reflection time of the target(s) can be determined at each well tie on the seismic line grid. The structural changes of the layer(s) or horizon(s) of interest can then be interpreted along the seismic profiles.

An average velocity gradient map to the top of the target layers(s) can be prepared that demonstrates variations in the velocity field due to lithologic changes in the overlying material and changes due to depth of burial. The interpreted seismic reflection travel times for the target horizon(s) can be converted to depths using the average velocity gradient map. Using this method of depth conversion, the resultant depth map is based on data values that have been determined in recognition of observed, lateral velocity heterogeneity.

B. Average Velocity Gradient Map-

Velocity surveys were performed in 16 boreholes that tied the seismic survey. Depth conversion of the seismic data for the Western Bedrock Valley was achieved using an average velocity gradient map to the top of the metamorphic bedrock. Depth conversion for the Eastern and Southwestern bedrock valleys was accomplished using average velocities calculated at well ties, indexed to velocity surveys and synthetic seismogram information.

Figure 1, an average velocity gradient map to the top of the Pre-Cambrian bedrock has been generated using the velocity survey data and to a minor extent, velocity data extrapolated

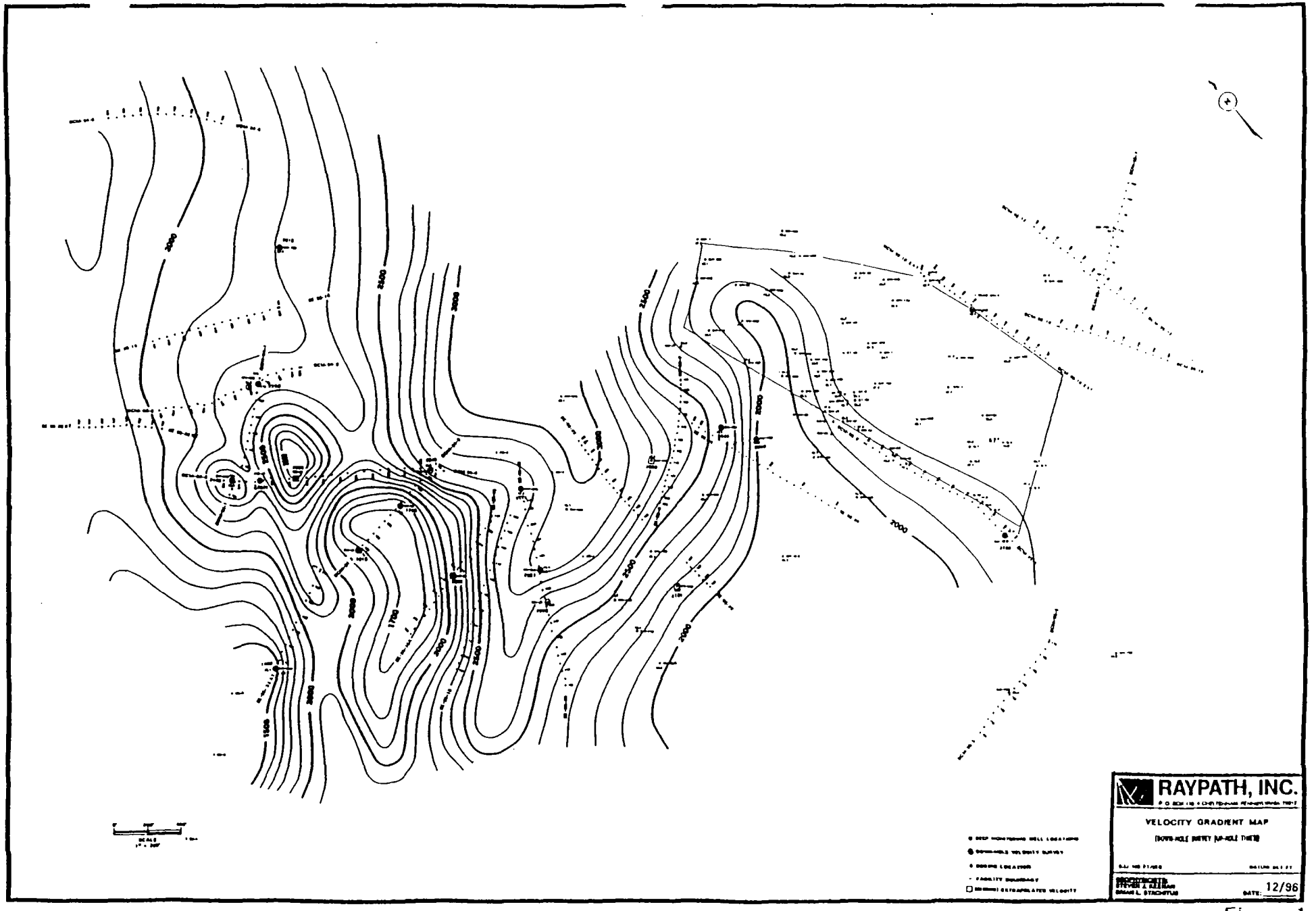


Figure 1

from a known depth at a well and an intersecting two-way travel time contour. The velocity map has been corrected to a datum of +84.1 feet. The contour interval is 100 feet per second. The velocity map reveals a *low frequency / longer wavelegth* gradient of approximately 1500 feet per second within the area of the mapping, ranging from approximately 1500 to 3000 feet per second. This gradation in the velocity field is a function of the heterogeneity within the recent sediments (overburden) as well as the depth of burial of the bedrock.

Changes in the thickness and velocity of the fluvial-glacial sands and organic muds or "muck" deposited along and adjacent to the glacial streams appear to be the principle factors affecting the *high frequency / shorter wavelength* variatons seen in the average velocity gradient mapping particularly in the Western bedrock valley. The coarse grained clastics/sands are relatively high velocity while the organic muds and "muck" are relatively low velocity. The overprint of these lithologic variations with attendant velocity characteristics can produce significant differences (+ \ - 10 to 15 feet) in calculated depth values. Adequate velocity control is therefore necessary to provide a high level of confidence in the determination of the absolute depth values. Velocity mapping outside of the marsh area indicate a smoother velocity field with less high frequency variation.

Seismic interpretation and structural mapping of the bedrock surface:

Depth structure mapping to the top of the Pre-Cambrian bedrock surface has been generated in the manner previously descriped in this text. The mapping interpretation has intergrated all available boring log information, velocity data from 16 down-hole surveys and 17,103 line feet of 12/24 fold seismic reflection data.

A. General discussion-

Interpretational analysis of the seismic lines by the authors indicates the possibility that the bedrock vallys have been formed by early, pre-glacial rifting and by late, glacial erosion. Presently the Pre-Cambrian, Paleozoic, Mesozoic and Cenozoic rock sequences have been stripped off by the processes of erosion, and the eroded top of the bedrock surface is in a relatively low structural position. Minor post glacial fault movements appear to be in evidence due to the thickness changes of recent sediments observed across the faults/fractures and observed breaks in the reflection continuity of the recent sediments, assumed to be the result of earth movements. Apparently, the movement of the glaciers was in part controlled by the presence of pre-existing structural lows (rift valleys) providing a preferential pathway of ice movement. The withdrawal of the very large and extremely heavy glaciers may have induced minor rebound or

rejuvenated fault movements along older faults/fractures which were pre-existing planes of weakness .

Four bedrock valleys have been delineated by the seismic survey; These are: the Western, Upper Western, Southwestern and Eastern bedrock valleys. These valleys have been interpreted to be discretely separated by structurally high saddles or ridges. The Western, Upper Western and Southwestern valleys appear to be closed lows , the Eastern bedrock valley appears to plunge westward "connecting" to the Upper Western bedrock valley; A minor, 0.62 acre closed low is present in the vicinity of GW-50D. Figure 2, a depth structure map to the top of the Pre-Cambrian bedrock contoured at a 10 feet interval and referenced to a sealevel datum, shows the relative position of the buried bedrock valleys. Faults/fractures shown on the seismic profiles have been omitted on this map pursuant to client request in order to facilitate greater ease in viewing the bedrock surface; A work in progress depth structure map generated 09/95 shows the location of the faults depicted on the seismic lines. The faults are colored red.

The "bedrock valleys" are structural lows or synclines that collectively exhibit several prominent changes in structural strike. The synclinal axes trend: predominantly east-west within the Eastern and the parallel Southwestern Bedrock Valleys and north-south within the Western Bedrock Valley. The Upper Western Bedrock Valley exhibits both north-south and east-west structural trends. This valley is situated closest to an apparent structural hinge zone and may indicate the location of either a major structural buttress, which was relatively unyielding to tectonic stresses, causing a deflection of orogenic stress fields, or a point where major fault zones deep within the bedrock intersect at nearly right angles, producing significant changes in structural lineations. The strike has been observed to be northeast-southwest north of the canal, and north of the Western Bedrock Valley near GW-73D. The observed present day structural geometries of the sub-basins or valleys are in all probability a consequence of a complex history of tectonic movement and major erosion which has occurred over a 400 million year period and remain open to conjecture.

B. Structural definition of the bedrock valleys-

(a) The (lower)Western Bedrock Valley: The Western Bedrock Valley is located north and west of the Olin facility and is generally situated within a marsh area. Interpretation of the seismic reflection mapping indicates that the approximate structural boundary of the Western Bedrock Valley is the +20.0 feet contour. This boundary is defined to the north by a saddle located approximately 250 feet north of line SE-95-14 in the vicinity of well GW 73D . The boundary is defined to the south by a saddle location seen at the structurally high ridge or saddle mapped between lines SE-95-20 and SE-96-22, also mapped between wells 58D and 70D. The

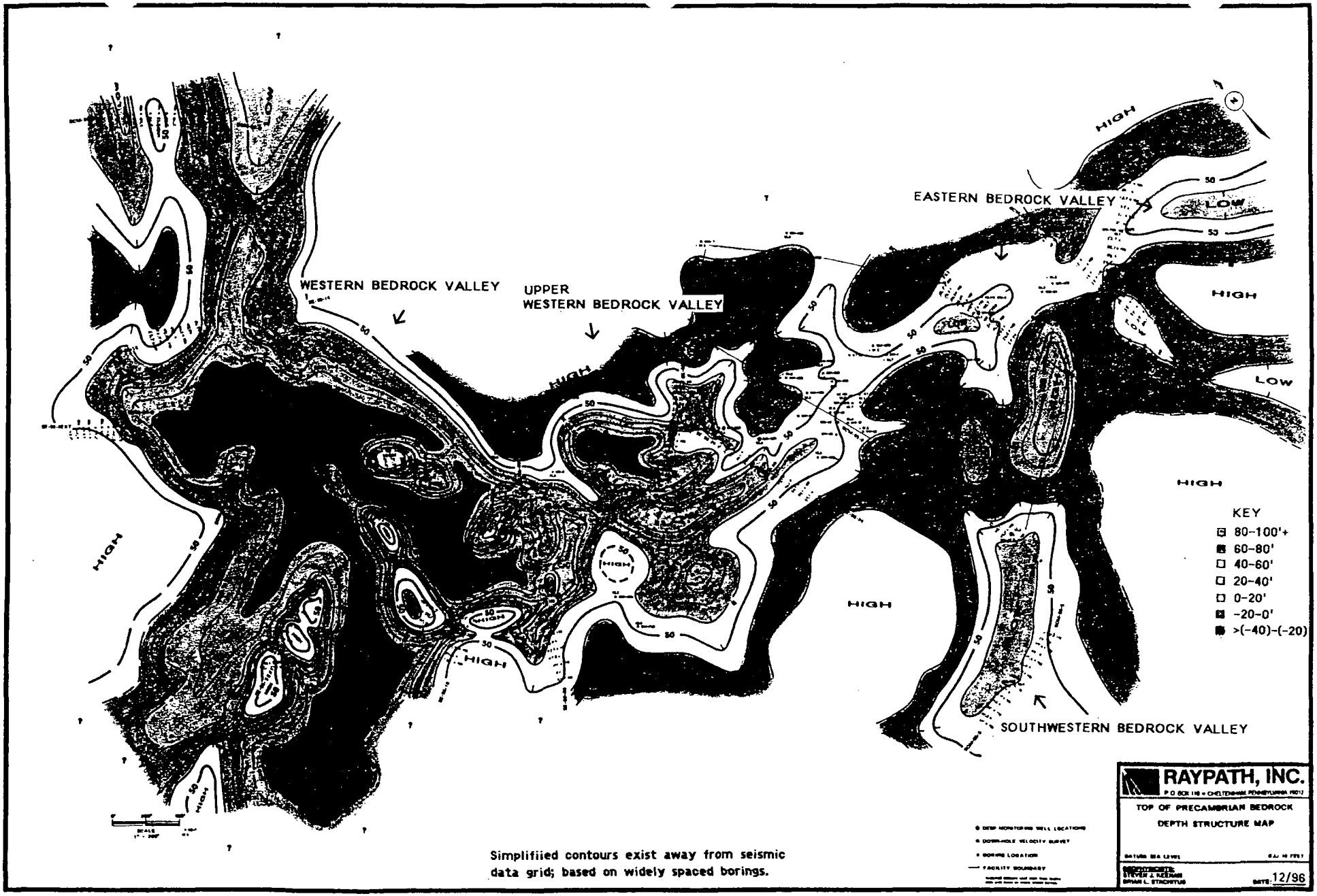


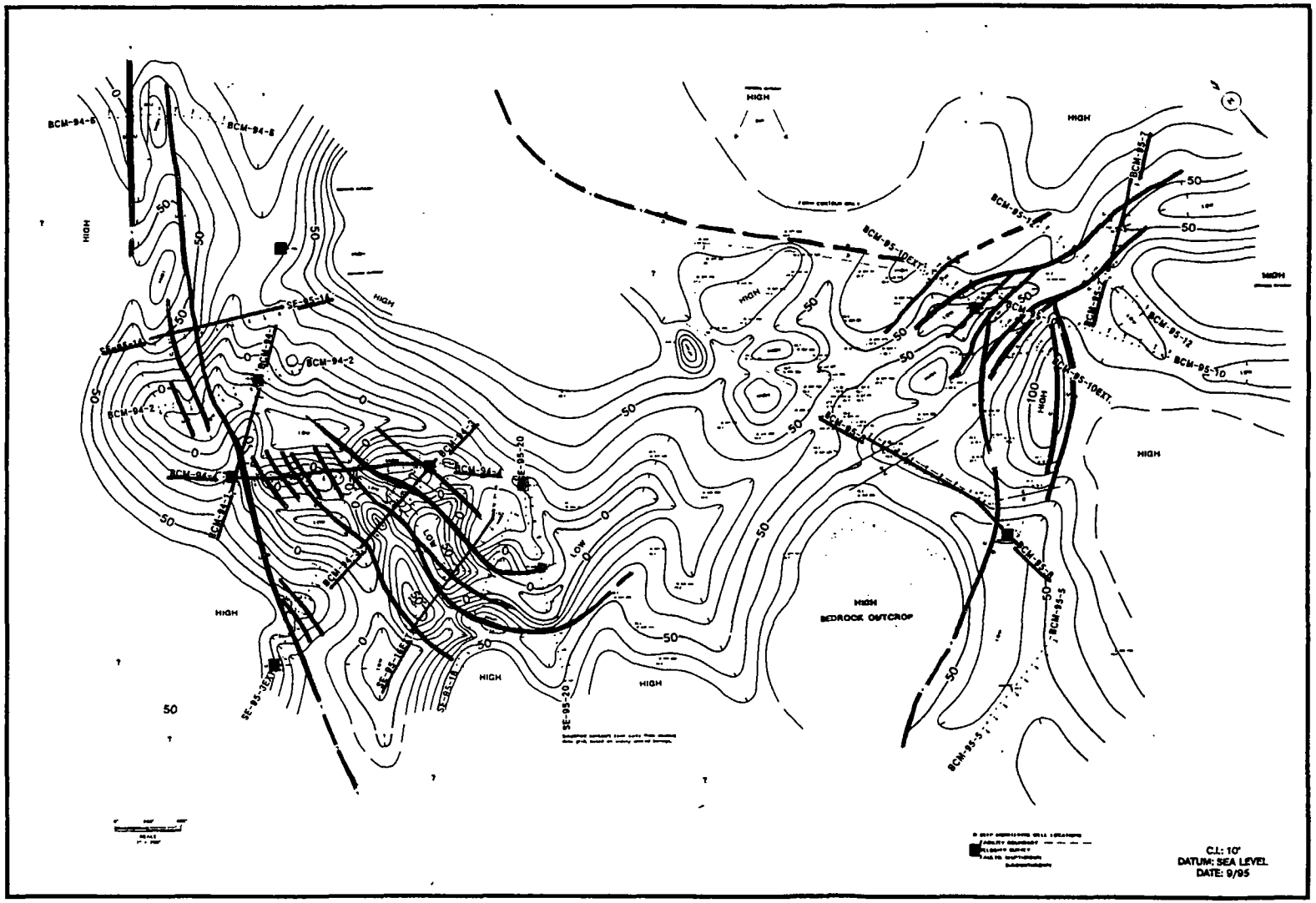
Figure 2

68

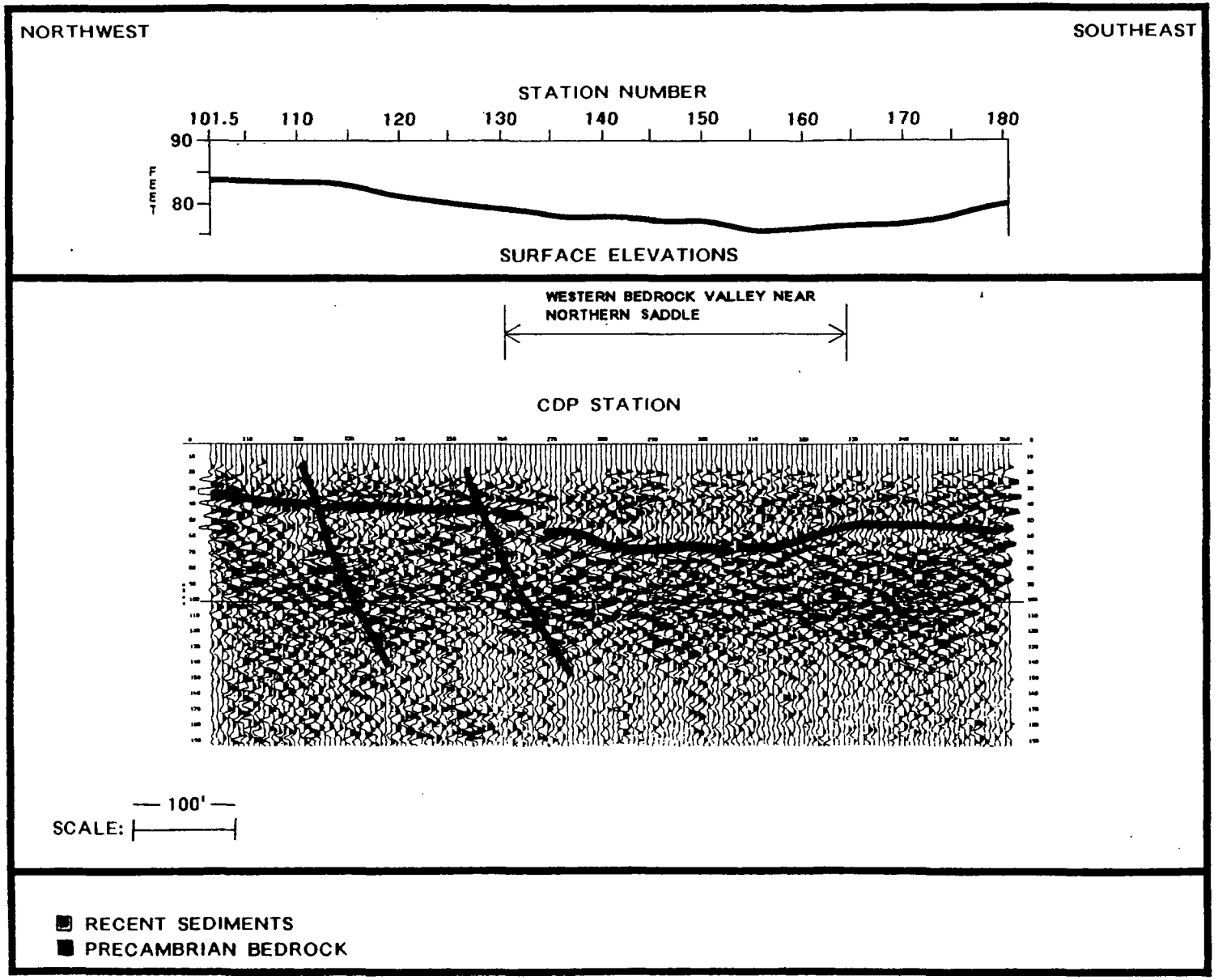
WORK IN PROGRESS MAP

SHOWING POSTULATED FAULTS IN RED 09/95

DEPTH STRUCTURE MAP TO THE TOP OF PRE-CAMBRIAN BEDROCK



SEISMIC LINE SE-95-14
12 FOLD STACK



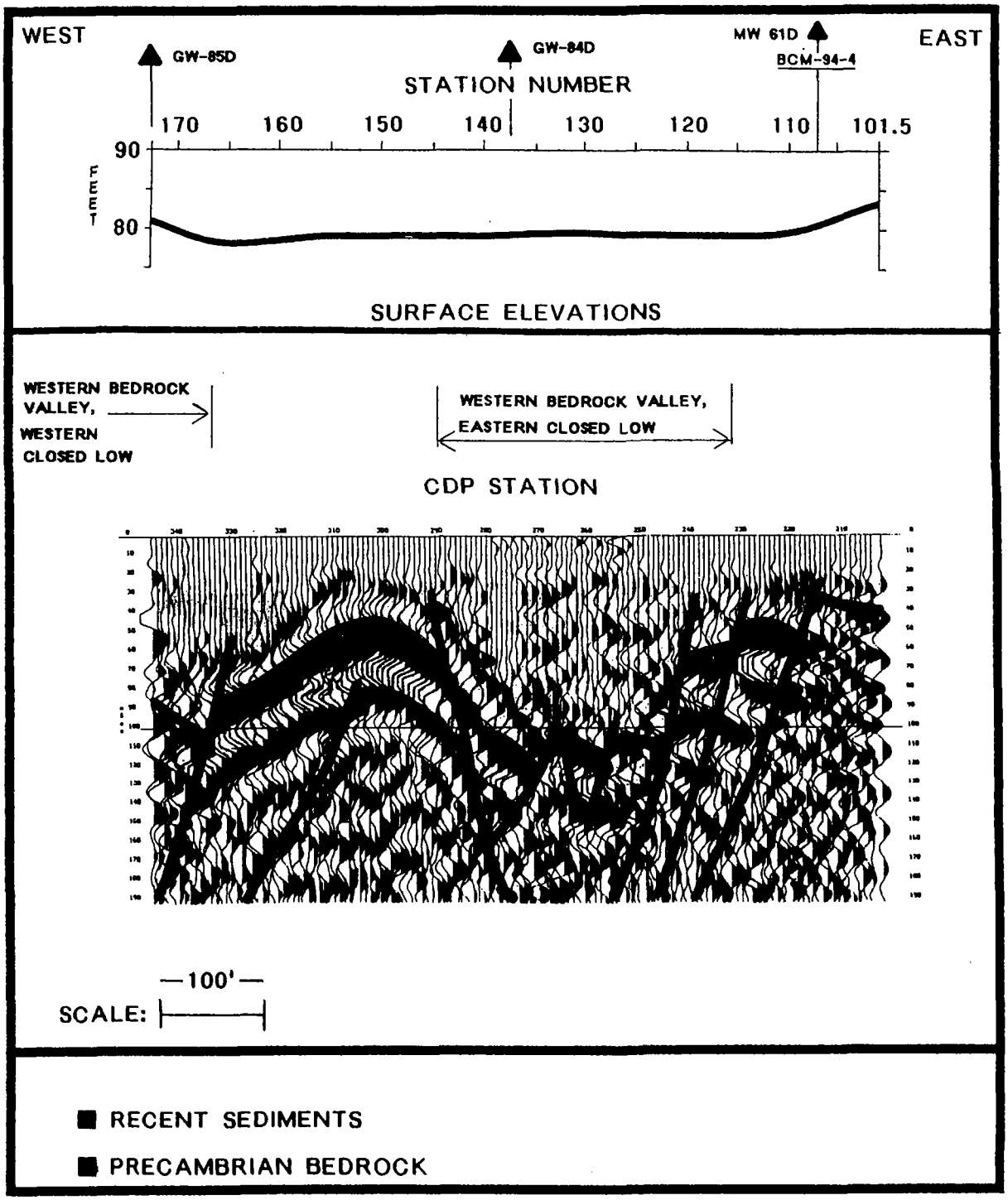
area below **+20.0 feet** is thought to be contained in a closed structural low or syncline with an areal extent of approximately 61.8 acres. The mapping within this general area exhibits a horizontal wavelength of structural change equal to approximately 300 feet.

The deepest portion of the valley, buried approximately -40.0 feet, appears to be located between seismic lines BCM-94-3, seen at station 135 and line SE-95-16X, seen at station 145. Well MW-83D has confirmed this low. A parallel low, located approximately 600 feet to the west near the Chestnut street pumping station can be seen at station 172, line BCM-94-3; An intervening anticline or structural high, seen at station 110 on line SE-95-16X and line BCM-94-3 at station 153, separates the two structural lows. The southern boundary of the western low (near the Chestnut street pumping station) is totally unconstrained by seismic or well data at this time. These bifurcated lows trend northward and converge into a prominent low where the lowest closing contour of -40.0 feet is located approximately 250 feet north of line BCM-94-4. The presence of this low portion of the valley has been confirmed by wells 86D and 87D. The northern extent of this low can been seen on line BCM-94-1 at station 155. The northwest-southeast orientation of this low represents a change in the structural strike seen immediatley to the south suggesting the possibility of an intersecting structural lineament conceivably associated with the high saddle mapped to the north near well 73D.

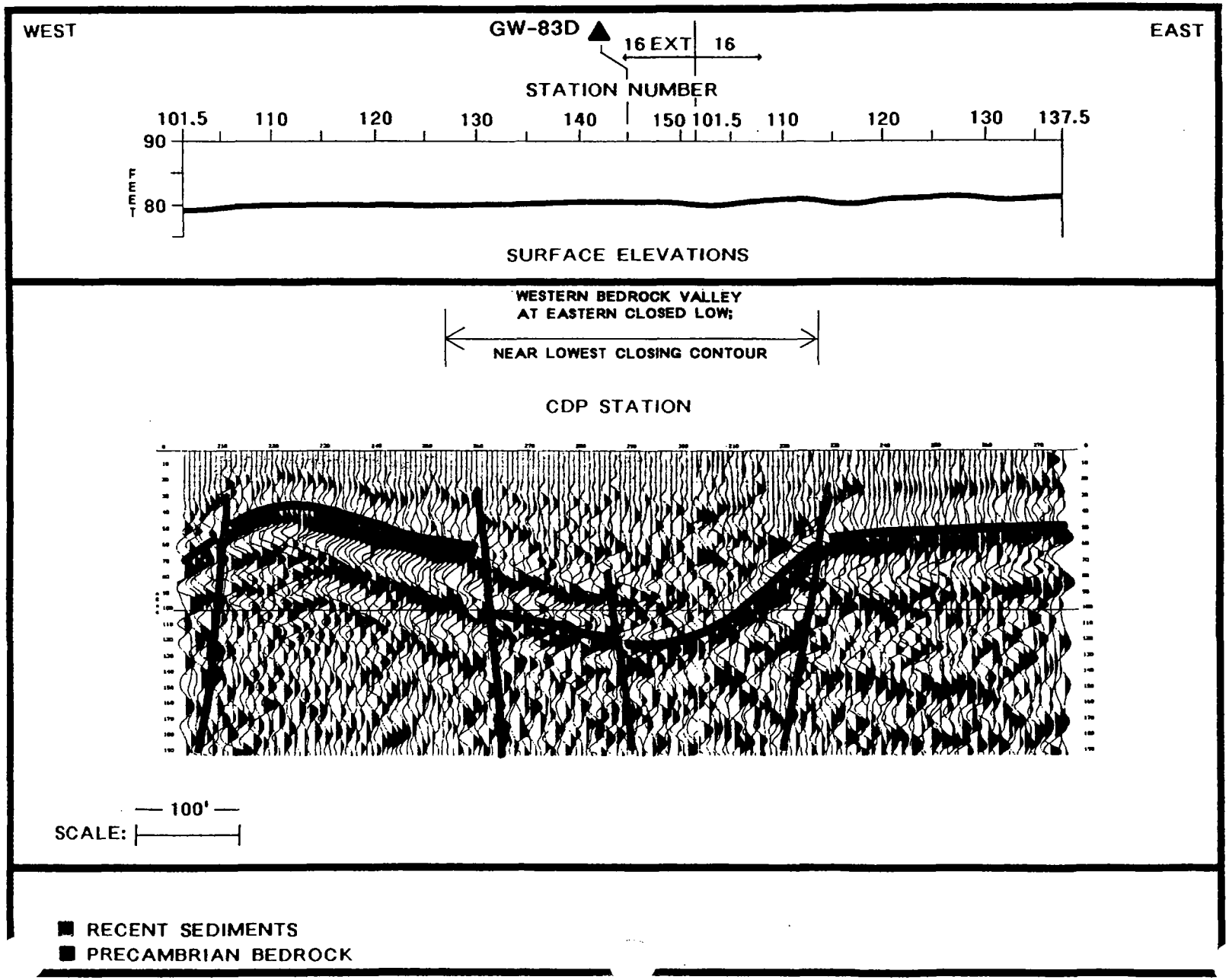
(b). Upper Western Bedrock Valley: The Upper Western Bedrock Valley extends to the west from the Olin facility and converges with a generally north-south oriented series of closed structural lows. An east-west lineation is also apparent as previously discussed in this report. Interpretation of the seismic reflection mapping indicates that the approximate structural boundary of the Upper Western Bedrock Valley is coincident with the +30.0 feet contour. This boundary has been identified by the saddle located at the structurally high ridge mapped between lines SE-95-20 and SE-96-22, also mapped between wells 58D and 70D. The area below ***+30.0 feet*** is thought to be contained in contiguous closed lows or synclines with a combined areal extent of roughly 14.3 acres. The mapping within this general area exhibits a horizontal wavelength of structural change equal to approximately 400 feet. This wavelength is longer than that observed in the (lower) Western Bedrock Valley and may indicate a somewhat different genesis, such as more extensive erosion. The increase in wavelength may also be a consequence of a decrease in control points for the mapping.

The deepest portion of this valley extends to approximately -20.0 feet, and lies within the northern most part of the Upper Western Bedrock Valley within the +30.0 feet contour. This northern low is positioned between lines SE-96-22 at station 255 and line SE-96-9 at station 135 extending approximately 300 feet to the east of the intersection of lines SE-96-9 and SE-96-24. A central low is mapped at the western ends of lines SE-96-22 and SE-96-9; This narrow closed

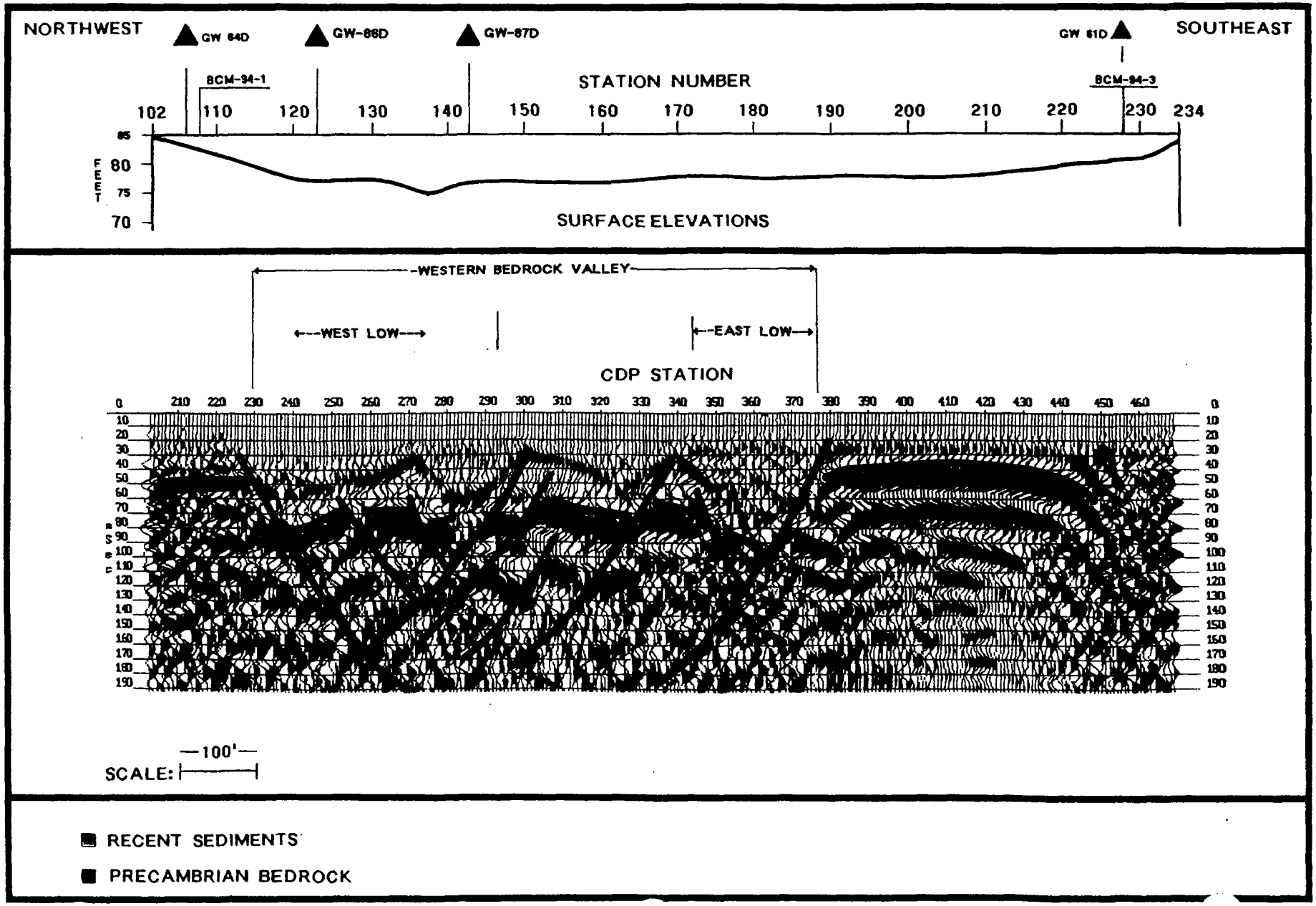
SEISMIC LINE BCM-94-3
12 FOLD STACK



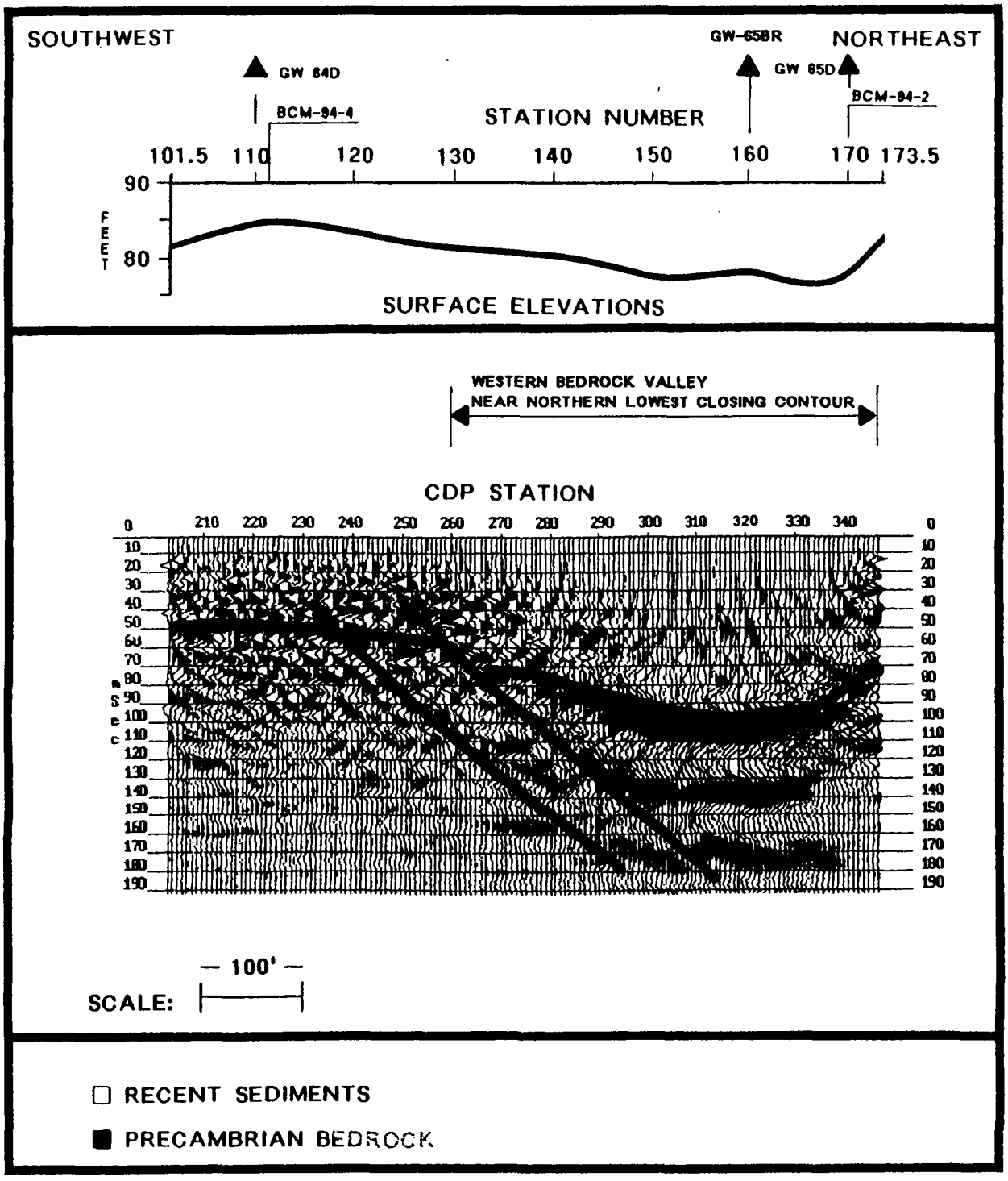
SEISMIC LINE SE-95-16EXT., 16
12 FOLD STACK



SEISMIC LINE BCM-94-4
24 FOLD STACK



SEISMIC LINE BCM-94-1
24 FOLD STACK



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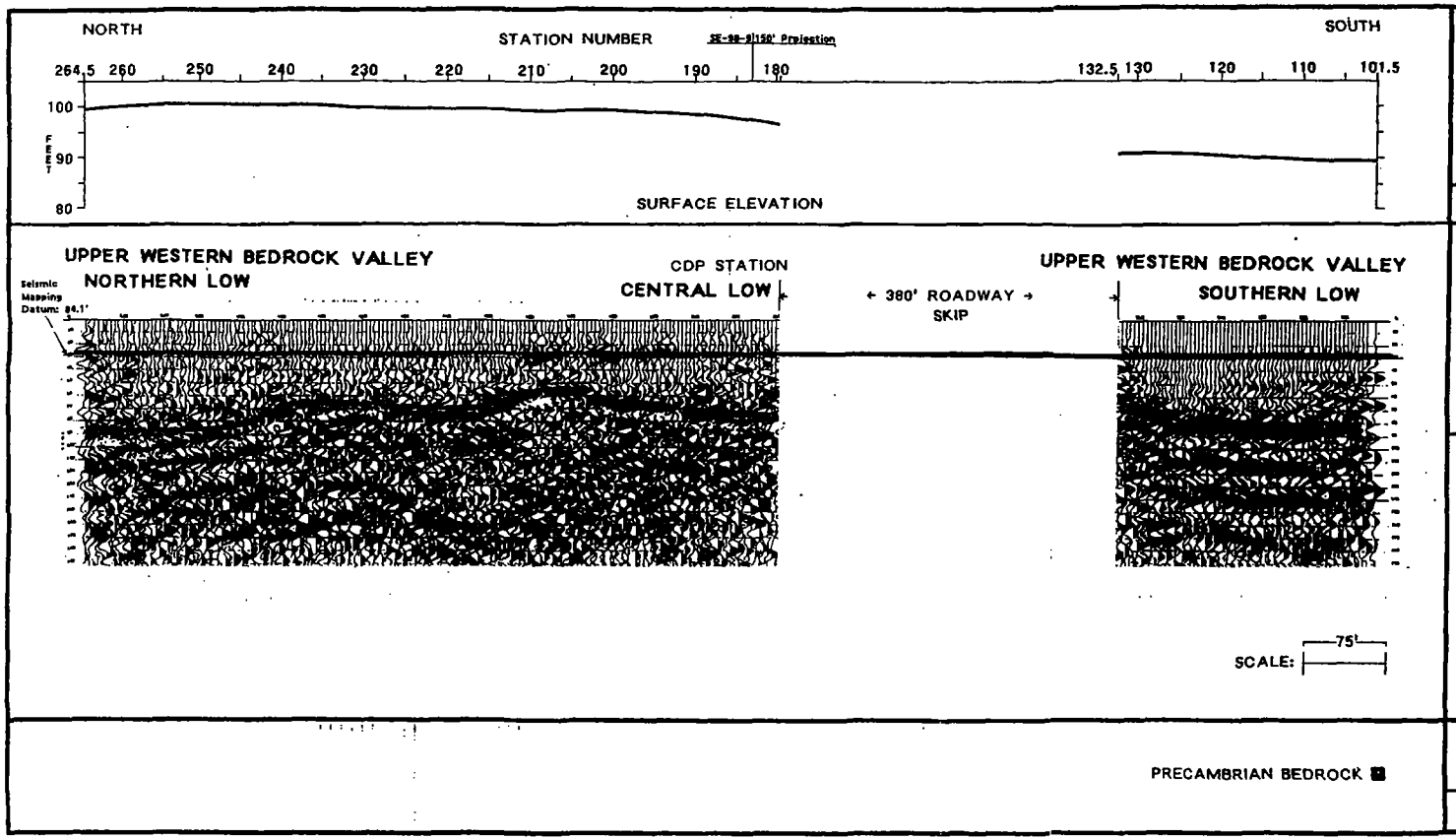

RAYPATH INCORPORATED

AREA: OLIN FACILITY
LINE: SE-96-22 DATE: 4-96
LOCATION: WILMINGTON, MA
CLIENT: SMITH ENVIRONMENTAL

GEOPHYSICISTS:
STEVEN J. KEENAN BRIAN L. STACHITUS

FIELD PARAMETERS

INSTRUMENTS: BISON
POLARITY: NORMAL
RECORD LENGTH: 192 MS
SAMPLE: .2 MS

SOURCE:
TYPE: IMPACT
S.P. INTERVAL: 7.5'
S.P. OFFSET: 7.5'

CABLE: LAND
GROUP INTERVAL: 7.5'
GEOPHONES: 40 HZ AMP
SPREAD LENGTH: 98'

FIELD FILTER:
LOW CUT: 35 HZ
HI CUT: 1000 HZ
NOTCH: OUT

PROCESSING SEQUENCE

1. FREQUENCY FILTER:
2. PRE-STACK F/K FILTER: ± 4-8 MS/TR
3. TRACE EDIT
4. FIRST ARRIVAL MUTE: SPATIAL
5. DECONVOLUTION: N/A
6. CDP SORT
7. APPLICATION OF DATUM STATICS:
   DATUM= +100 FT VEL= 1200 FT/SEC
8. NMO CORRECTION
9. SURFACE CONSISTENT AUTO RESIDUAL STATICS: 2 PASSES
10. FINAL NMO CORRECTION
11. TRIM STATICS : ±0.5 MS
12. CDP STACK; FOLD: 12
13. POST STACK F/K FILTER: N/A
14. MIGRATION: N/A
15. FREQUENCY FILTER:
16. TRACE SCALING: 100 MS AGC

PRINTER DISPLAY

VERTICAL: 12.5 INCHES/SEC
HORIZONTAL: 25 TR/INCH
STACK

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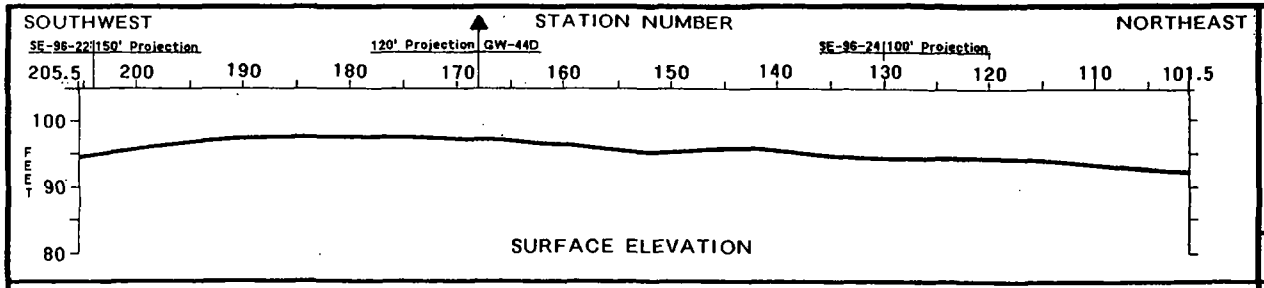
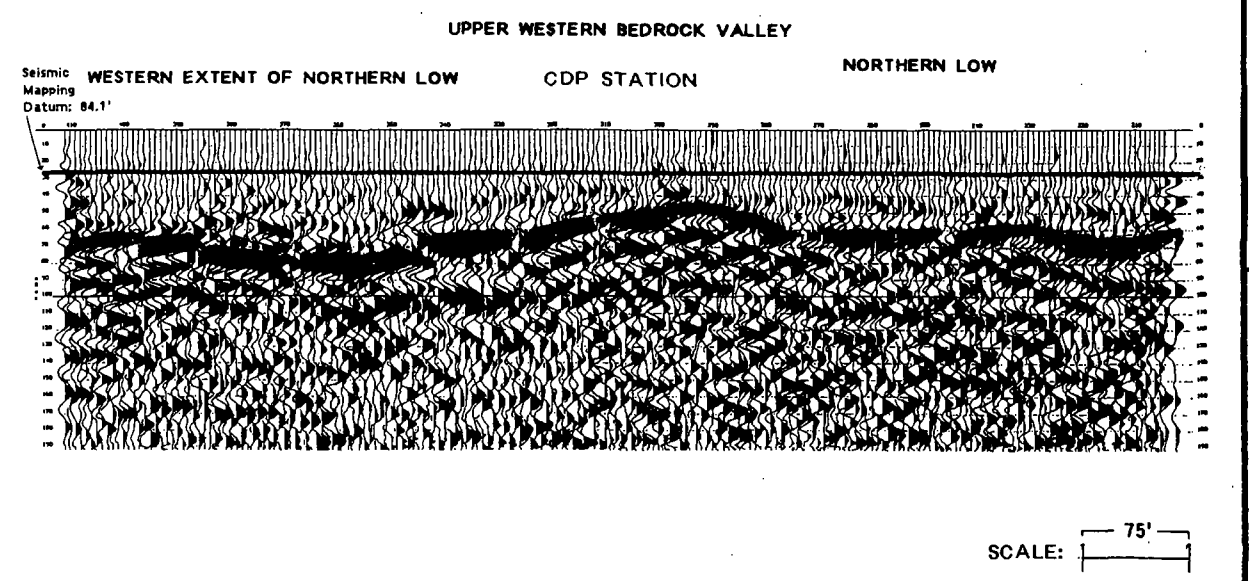
Phone: (215) 782-1863

7F





PRECAMBRIAN BEDROCK ■

RAYPATH INCORPORATED

AREA: OLIN FACILITY
LINE: SE-96-9 **DATE:** 4-96
LOCATION: WILMINGTON, MA
CLIENT: SMITH ENVIRONMENTAL

GEOPHYSICISTS:
STEVEN J. KEENAN BRIAN L. STACHITUS

FIELD PARAMETERS

INSTRUMENTS: BISON RECORD LENGTH: 192 MS
POLARITY: NORMAL SAMPLE: .2 MS

SOURCE:
TYPE: IMPACT S.P. OFFSET: 7.5'
S.P. INTERVAL: 7.5'

CABLE: LAND GEOPHONES: 40 HZ AMP
GROUP INTERVAL: 7.5' SPREAD LENGTH: 90'

FIELD FILTER:
LOW CUT: 35 HZ NOTCH: OUT
HI CUT: 1000 HZ

PROCESSING SEQUENCE

1. FREQUENCY FILTER:
2. PRE-STACK F/K FILTER: ± 4-8 MS/TR
3. TRACE EDIT
4. FIRST ARRIVAL MUTE: SPATIAL
5. DECONVOLUTION: N/A
6. CDP SORT
7. APPLICATION OF DATUM STATICS:
   DATUM= +100 FT VEL= 1200 FT/SEC
8. NMO CORRECTION
9. SURFACE CONSISTENT AUTO RESIDUAL STATICS: 2 PASSES
10. FINAL NMO CORRECTION
11. TRIM STATICS : ±0.5 MS
12. CDP STACK; FOLD: 12
13. POST STACK F/K FILTER: N/A
14. MIGRATION: N/A
15. FREQUENCY FILTER:
16. TRACE SCALING: 180 MS AGC

PRINTER DISPLAY

VERTICAL: 12.5 INCHES/SEC STACK
HORIZONTAL: 25 TR/INCH

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Phone: (215) 782-1863

low is oriented east-west and connects the Upper Western Bedrock Valley to the Eastern Bedrock Valley and is seen on line SE-96-24 from station 180 to 230. A southern most closed low has been mapped within the +30.0 feet contour and is located in the vicinity of well 59D at station 115 on line SE-96-22.

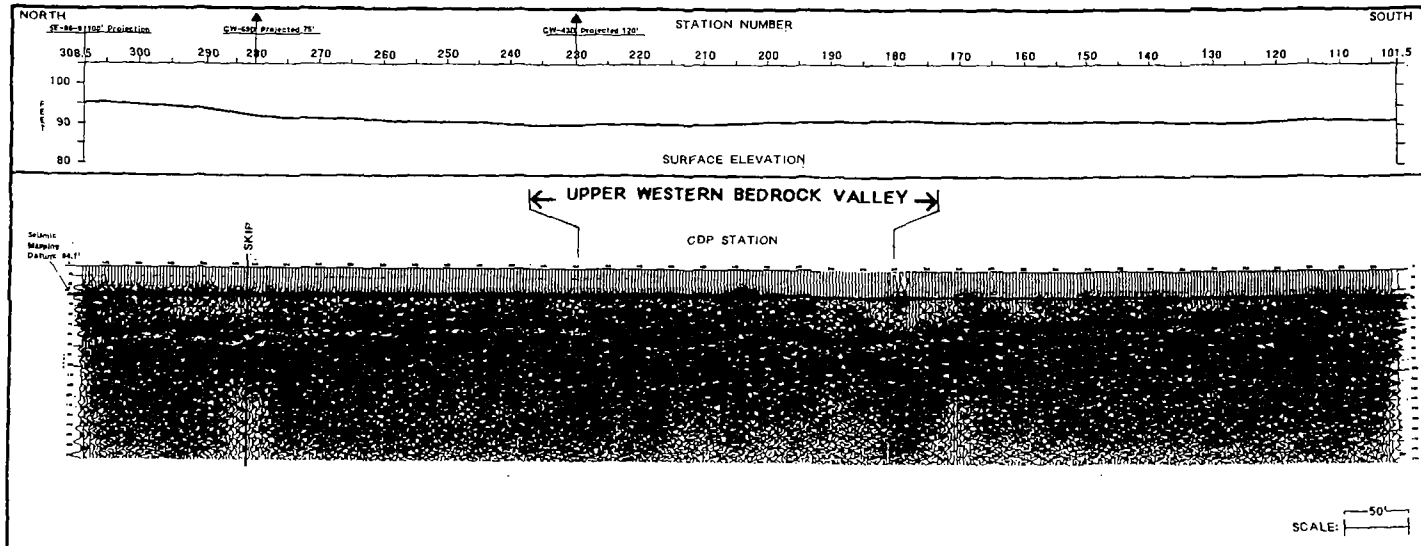
(c). Eastern Bedrock Valley: The Eastern Bedrock Valley is a narrow, east-west trending synclinal fairway which extends from the center of the Olin facility eastward to a saddle near Woburn street and then eastward to a largely uncontrolled area east of well 74D. This structural trough does not appear as a closed low in the mapping, with the exception of a 0.62 acre closure in the vicinity of well GW 50D. The eastern margins of the Upper Western Bedrock Valley could, therefore, be considered "connected" updip along this structural trough to the Eastern Bedrock Valley. The Eastern Bedrock Valley is constrained predominantly by well/boring data, particularly within the Olin facility where no seismic reflection data was acquired. The boundary of the Eastern Bedrock Valley has been identified by the saddle mapped in the vicinity of well 49D, and supported by additional drilling. Those portions of the bedrock buried ***+50.0 feet and deeper*** cover an area of approximately 14 acres. The mapping within this general locale exhibits a horizontal wavelength of structural change equal to approximately 350 feet.

The Eastern Bedrock Valley dips to the west away from the saddle located near well 49D. The axis of this plunging low can be seen at station 168 on line BCM-95-10EXT. An eastwardly dipping extention of the valley can be seen at station 135, line BCM-95-7; This part of the map is very speculative due to the limited number of control points.

(d). The Southwestern Bedrock Valley: The Southwestern Bedrock Valley is situated approximately 200 feet west of the southwest corner of the Olin facility. Interpretation of the seismic reflection mapping indicates that the approximate structural boundary of the Southwestern Bedrock Valley is the +70.0 feet contour. The boundary is defined at the saddle located approximately 500 feet north of well 40D. The area below ***+70.0 feet*** is thought to be within a structural low having an areal extent of approximately 36.3 acres. The lowest closing contour is the +40.0 feet contour which falls between the seismic lines. This valley is the least constrained by seismic and well\boring data; The southern and eastern flanks of the valley are highly conjectural. Line BCM-95-8 shows the location of the saddle at station 195. Drilling has supported the presence of the saddle. Line BCM-95-5 shows the axis of the closed low at station 123.

Data Limitations and 11/96 confirmation drilling:

8A



RAYPATH INCORPORATED

AREA: OLIN FACILITY
LINE: SE-96-24 DATE: 4-96
LOCATION: WILMINGTON, MA
CLIENT: SMITH ENVIRONMENTAL

GEOPHYSICISTS: STEVEN J. KEENAN, BRIAN L. STACHITUS

FIELD PARAMETERS

INSTRUMENTS: BISON — RECORD LENGTH: 192 MS
POLARITY: NORMAL — SAMPLE: .2 MS

SOURCE:
TYPE: IMPACT — S.P. OFFSET: 5'
S.P. INTERVAL: 5'

CABLE: LAND — GEOPHONES: 40 HZ AMP
GROUP INTERVAL: 5' — SPREAD LENGTH 60'

FIELD FILTER:
LOW CUT: 30 HZ — NOTCH: OUT
HI CUT: 1000 HZ

PROCESSING SEQUENCE

1. FREQUENCY FILTER: LC 75/85 PRE-STACK
2. PRE-STACK F/K FILTER: N/A
3. TRACE EDIT
4. FIRST ARRIVAL MUTE: SPATIAL
5. DECONVOLUTION: N/A
6. CDP SORT
7. APPLICATION OF DATUM STATICS:
   DATUM: +100 FT — VEL: 1200 FT/SEC
8. NMO CORRECTION
9. SURFACE CONSISTENT AUTO RESIDUAL STATICS: 2 PASSES
10. FINAL NMO CORRECTION
11. TRIM STATICS: ±0.5 MS
12. CDP STACK; FOLD: 12
13. POST STACK F/K FILTER: N/A
14. MIGRATION: N/A
15. FREQUENCY FILTER:
16. TRACE SCALING: 100 MS AGC

PRINTER DISPLAY

VERTICAL: 12.8 INCHES/SEC — STACK
HORIZONTAL: 25 TR/INCH

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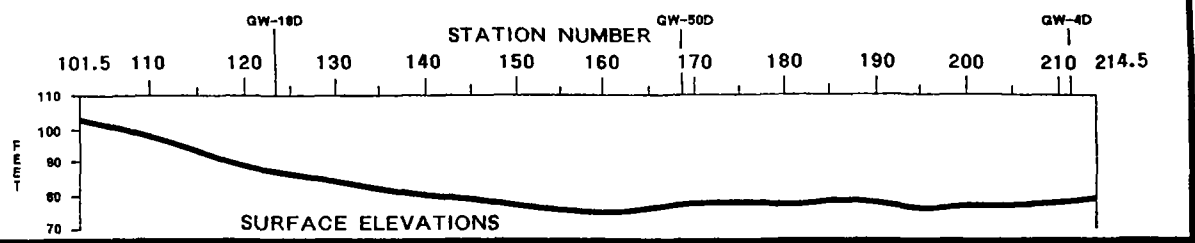
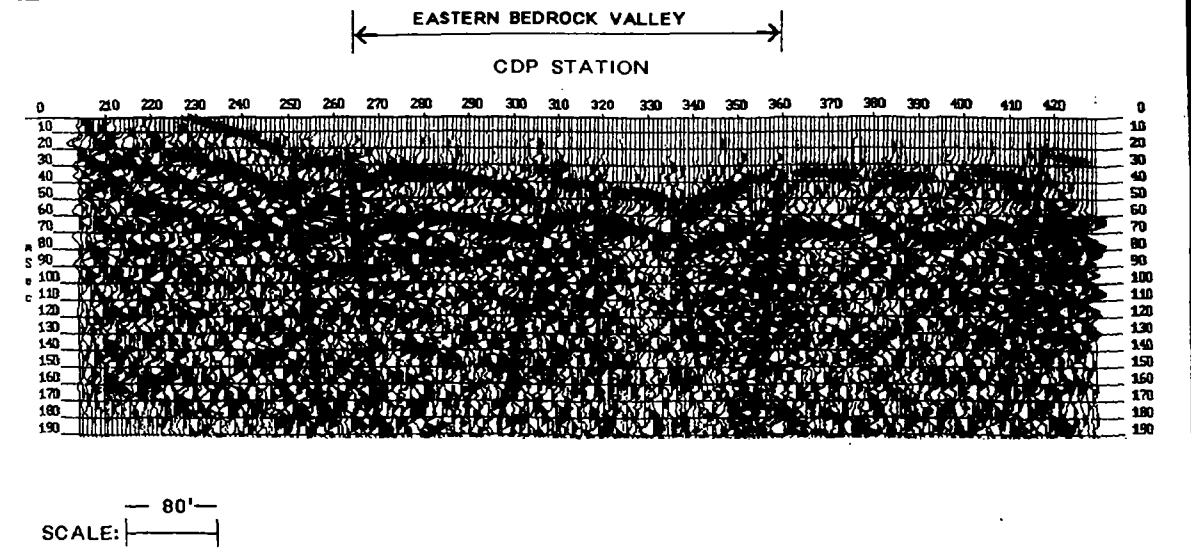
Phone: (215) 782-1883

8B





□ RECENT SEDIMENTS

■ PRECAMBRIAN BEDROCK

RAYPATH INCORPORATED

AREA: EAST BEDROCK VALLEY
LINE: BCM-95-10 EXT DATE: 3-95
LOCATION: WILMINGTON, MA.
CLIENT: BCM ENGINEERS

GEOPHYSICISTS:
STEVEN J. KEENAN BRIAN L. STACHITUS

FIELD PARAMETERS

INSTRUMENTS: BISON
RECORD LENGTH: 192 MS
POLARITY: NORMAL
SAMPLE: .2 MS

SOURCE: SHOTGUN-MARSH
TYPE: SLEDGEHAMMER & PLATE S.P. OFFSET: 8'
S.P. INTERVAL: 8'

CABLE: LAND /MARSH
GEOPHONES: 40 HZ AMP.
GROUP INTERVAL: 8'
SPREAD LENGTH: 96'

FIELD FILTER:
LOW CUT: 35 HZ
NOTCH: OUT
HI CUT: 1000 HZ

PROCESSING SEQUENCE

1. FREQUENCY FILTER: 45 HZ LC
2. PRE-STACK F/K FILTER: N/A
3. TRACE EDIT
4. FIRST ARRIVAL MUTE: SPATIAL
5. DECONVOLUTION: PREDICTIVE
6. CDP SORT
7. APPLICATION OF DATUM STATICS;
   DATUM= +84.1 FT VEL= 1250 FT/SEC
8. NMO CORRECTION
9. SURFACE CONSISTENT AUTOMATIC RESIDUAL STATICS
10. FINAL NMO CORRECTION
11. TRIM STATICS
12. CDP STACK; FOLD: 12
13. POST STACK F/K FILTER: N/A
14. MIGRATION:
15. FREQUENCY FILTER:
16. TRACE SCALING: 180 MS AGC

PRINTER DISPLAY

DATE: 3/95
VERTICAL: 12.5 INCHES/SEC
HORIZONTAL: 25 TR/INCH
STACK

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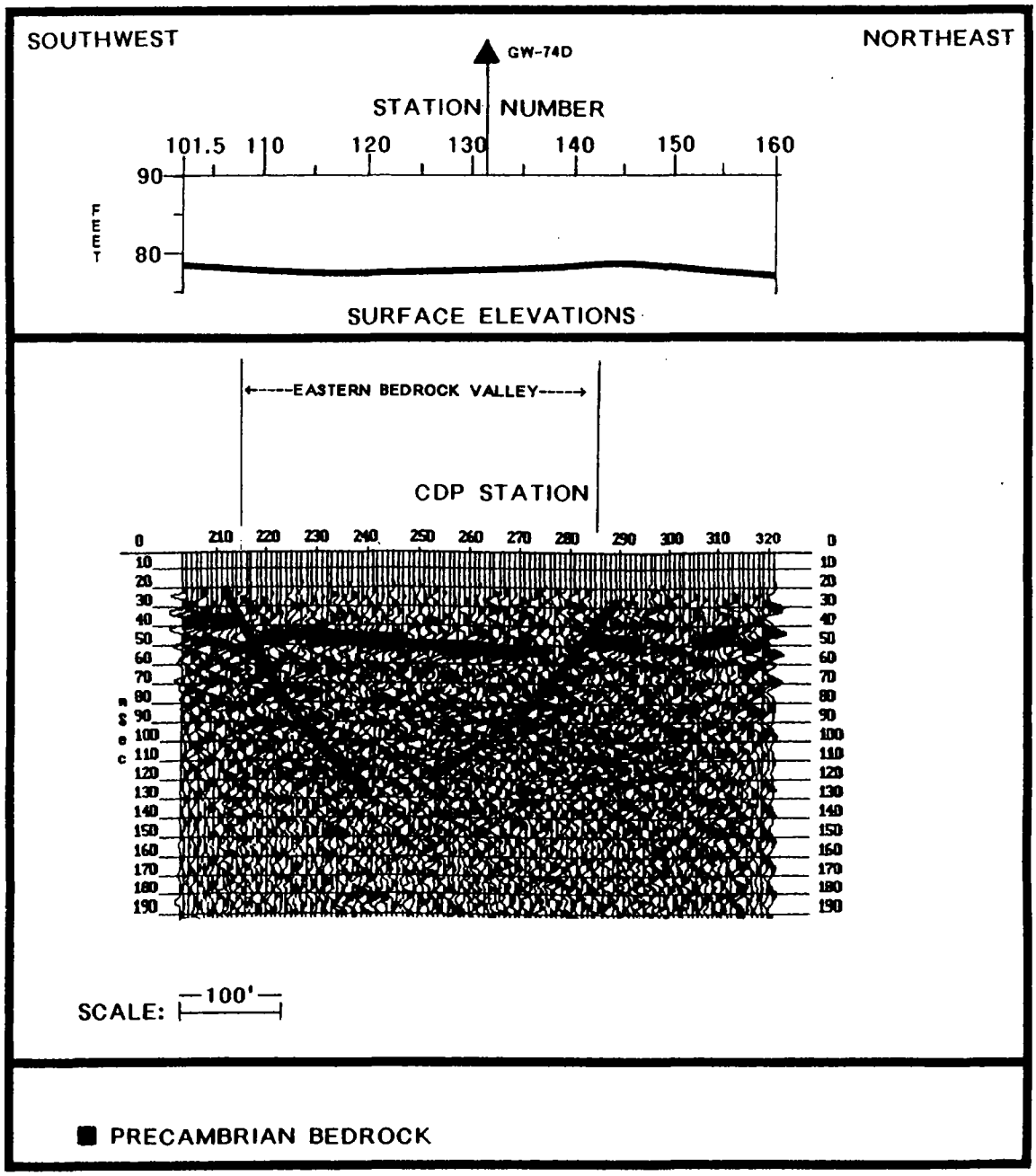
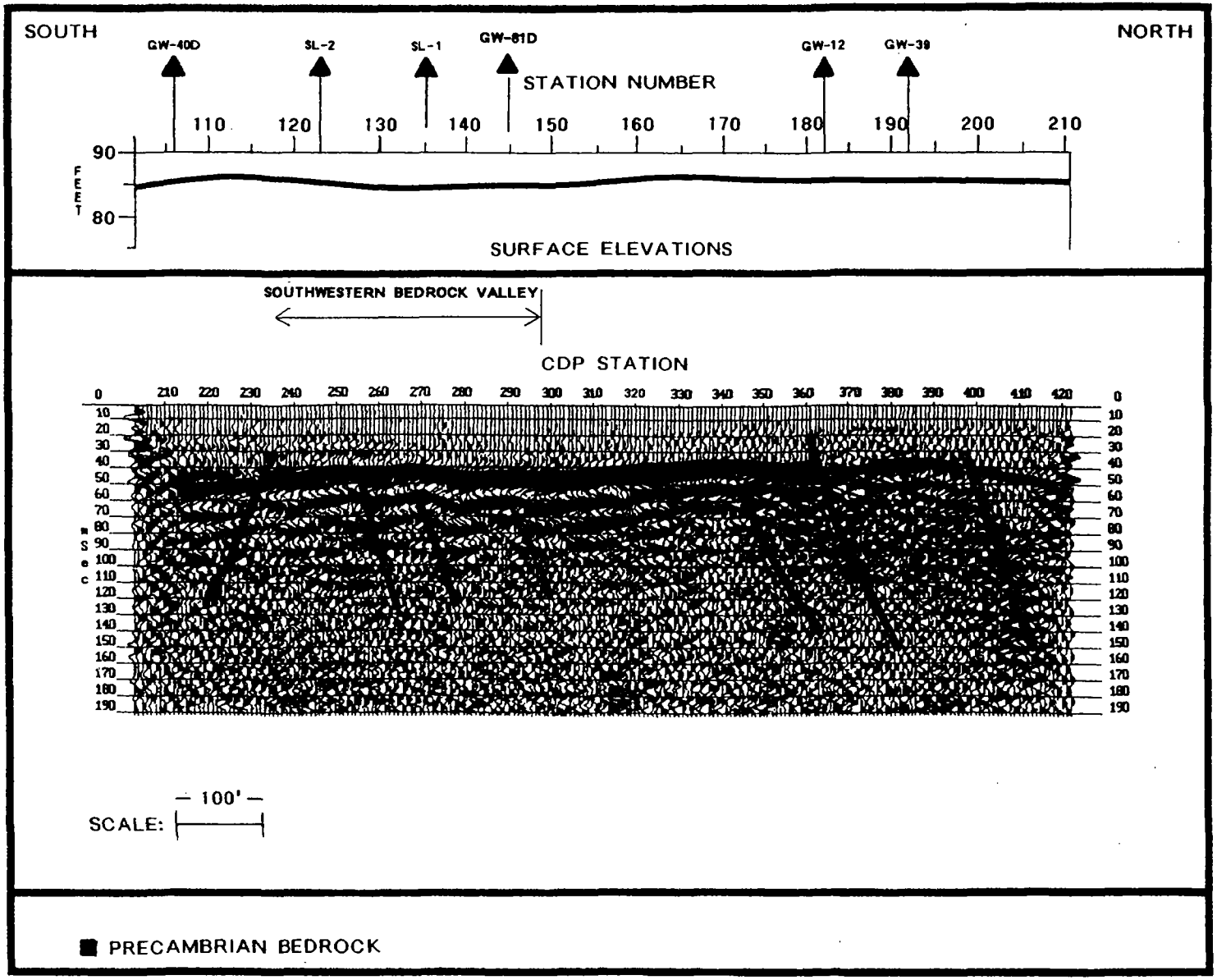
SEISMIC LINE BCM-95-7
12 FOLD STACK

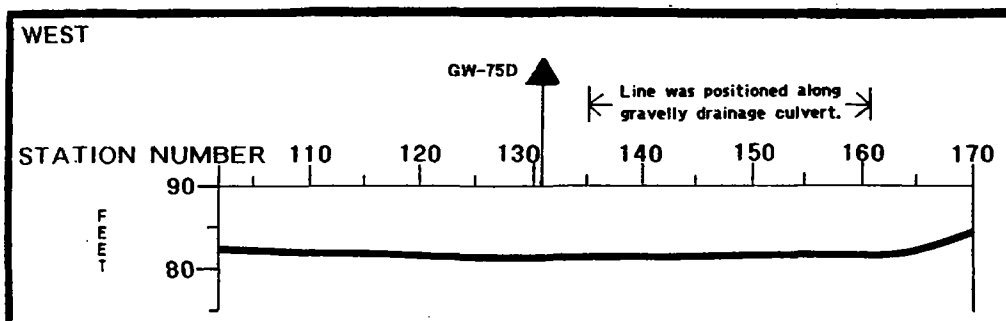


8D

SEISMIC LINE BCM-95-8
24 FOLD STACK



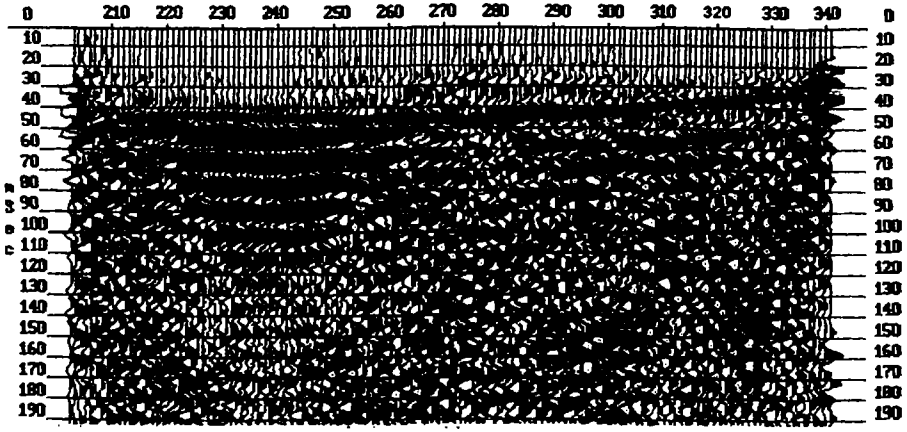
8E



SURFACE ELEVATIONS

SOUTHWESTERN BEDROCK VALLEY

CDP STATION



SCALE: 100'

PRECAMBRIAN BEDROCK

RAYPATH INCORPORATED

AREA: SOUTHWEST BEDROCK VALLEY
LINE: BCM-95- 5 DATE: 1-95
LOCATION: WILMINGTON, MA.
CLIENT: BCM ENGINEERS

GEOPHYSICISTS:
STEVEN J. KEENAN BRIAN L. STACHITUS

FIELD PARAMETERS

INSTRUMENTS: BISON RECORD LENGTH: 192 MS
POLARITY: NORMAL SAMPLE: .2 MS

SOURCE:
TYPE: SLEDGEHAMMER & PLATE S.P. OFFSET: VARIABLE
S.P. INTERVAL: 10'

CABLE: LAND GEOPHONES: 40 HZ AMP.
GROUP INTERVAL: 10' SPREAD LENGTH: 130'

FIELD FILTER:
LOW CUT: 35 HZ NOTCH: OUT
HI CUT: 1000 HZ

PROCESSING SEQUENCE

1. FREQUENCY FILTER: 75 HZ LC
2. PRE-STACK F/K FILTER: N/A
3. TRACE EDIT
4. FIRST ARRIVAL MUTE: SPATIAL
5. DECONVOLUTION: N/A
6. CDP SORT
7. APPLICATION OF DATUM STATICS;
   DATUM= +84.1 FT VEL= 1200 FT/SEC
8. NMO CORRECTION
9. SURFACE CONSISTENT AUTOMATIC RESIDUAL STATICS
10. FINAL NMO CORRECTION
11. TRIM STATICS
12. CDP STACK; FOLD: 24
13. POST STACK F/K FILTER: N/A
14. MIGRATION: F/K
15. FREQUENCY FILTER:
16. TRACE SCALING: 180 MS AGC

PRINTER DISPLAY

DATE: 2-95
VERTICAL: 12.5 INCHES/SEC
HORIZONTAL: 25 TR/INCH
STACK

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The depth structure map showing the geometry of the bedrock surface is the product of the integration of boring and well log information, velocity survey data and seismic reflection data. Numerous inferential steps and data interpretation have transpired in the course of the generation of the map. The map is therefore subject to resolution limitations that are a function of the procedures producing the final result. The accuracy of the mapping is predicated upon the following factors:

(1) the seismic data quality; The ability of the seismic interpreter to interpret the data is dependent upon the quality of the seismic data, and the experience level of the interpreter.

(2). the proximity to unambiguous well data; The determination of the depth of the bedrock surface must be correct and should be mitigated by a constrained seismic data grid.

(3). the structural complexity and the wavelength of structural variation; The spatial sampling along the seismic lines and the line spacing between the seismic lines within the seismic line grid must be indexed to the structural complexity in order to as accurately as possible, depict the subsurface structural changes.

(4). the velocity control; The velocity control must be sufficient to incorporate local changes in the velocity field; Incorrect average velocities, or incorrect mapping of the velocity gradient can produce significant errors in the conversion from time to depth.

(5). experience in mapping; Subsurface mapping requires experience and insight. Values of equal depth are not simply connected in map view, an interpretation of the data is made in the contouring of the map.

The data quality of the seismic data varied principally between those data recorded in the lowlands and those data recorded in the highlands. The frequency content of the data recorded in the lowland was lower; The signal to noise ratio, however, was high producing good quality data for the structural interpretation. The highland data was subject to a lower signal to noise ratio due in part to the near surface geological conditions and in part due to proximity to cultural noise. The signal bandwidth for the highland data was higher than that of the lowland data, however the data quality was lower producing generally fair data. With the exception of the interpretation associated with well 82D, confirmation drilling and velocity survey logging conducted after the seismic interpretation have supported the seismic line interpretation.

The determination of the top of the bedrock surface can be a subjective assessment. Although well data is generally considered "hard data", it may in some cases be equivocal. It has not been the prerogative of the seismic interpreters to contest any perceived minor discrepancies

concerning the depth of the bedrock surface independently assessed from the well/boring information. However, at this time the seismic tie to well 82D remains contentious.

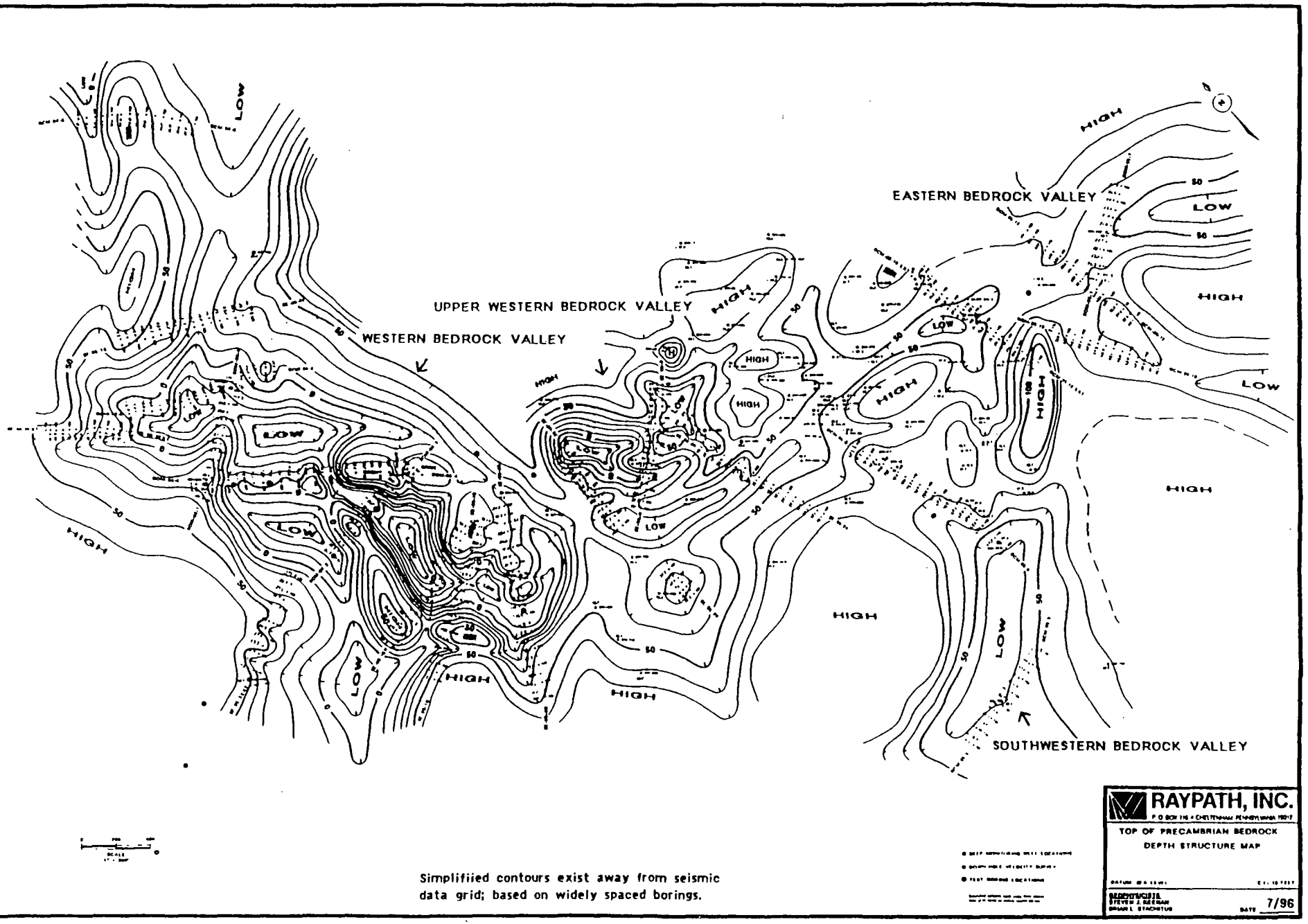
The spatial sampling along the seismic profiles is 4 to 5 feet. This spacing should resolve horizontal structural variations on the order of 10 to 15 feet given 2 to 3 samples per wavelength. Given the assumed structural wavelength variation of 300 to 400 feet, the line spacing of the seismic grid is variable and in places wide .

Travel times to, or very near, the top of the bedrock measured from velocity surveys performed after the generation of the mapping support the seismic interpretation made in *time* along the seismic profiles. The *depth* mapping, however, was subject to error in places. Velocity analyses indicate that the error in the conversion from time to depth was induced by changes in the velocity field that were not recognized in the average velocity gradient mapping produced prior to the 11/96 drilling program. Changes or aberations in the velocity field were apparently the result of local variations in the presence and thicknesses of stream(glacial) deposited muds and sands. The presence of an expanded section of very low velocity mud or "muck" that was less than 5 feet thick on the margins of the marsh and expanded to 25 to 30 feet within the marsh appears to produce significant changes in the average velocity gradient map. The depth map generated 12/96 incorporates the revised average velocity gradient map.

The potential error in the depth structure mapping is 1 or possibly 2 contour intervals in selected areas of the mapping in consideration of the fair to good seismic data quality, the subjective nature of the determination of the top of bedrock assessed from well and boring log information, the wide spacing of the seismic line grid and the potential error induced by variations in the velocity field. Figure 3 is the depth structure map to the top of the bedrock produced before the 11/96, 6 wells and 6 borings confirmation drilling program. Comparison of Figures 2 and 3, the before and after confirmation drilling maps, is an instructive means of establishing an empirical quantification of the possible error using the 17, 103 feet integrated seismic reflection survey at this site.

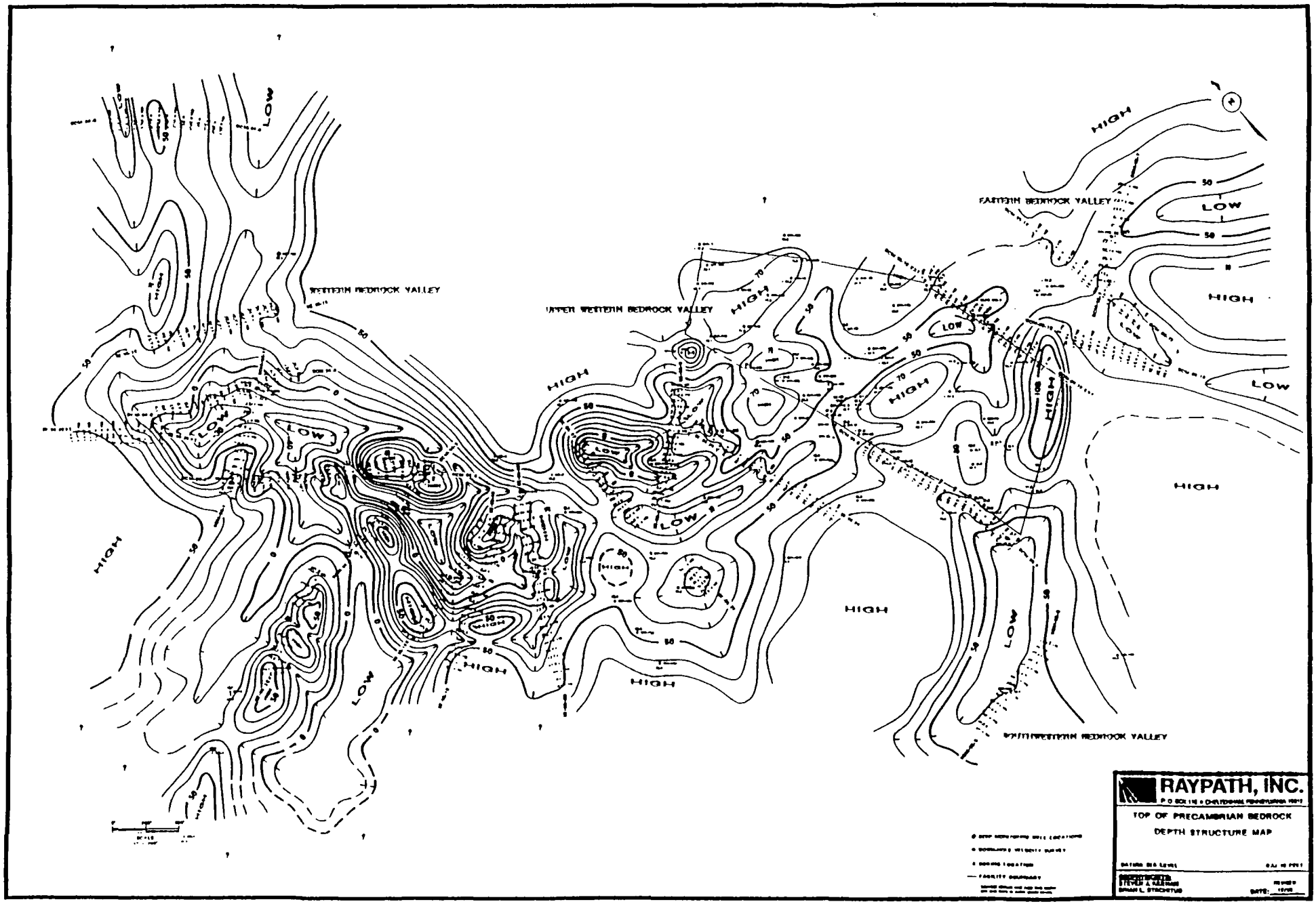
Conclusions:

A 17,103 line feet 12/24 fold seismic reflection survey was conducted at a 200 acre site in an area contiguous to the Olin facility in Wilmington, MA, for the purpose of mapping the topography of the top of Pre-Cambrian metamorphic bedrock. Down hole velocity surveys were performed in 16 of the wells in the mapping area in order to determine the average velocity gradient to the top of bedrock. The velocity survey information was used along with 4 additional



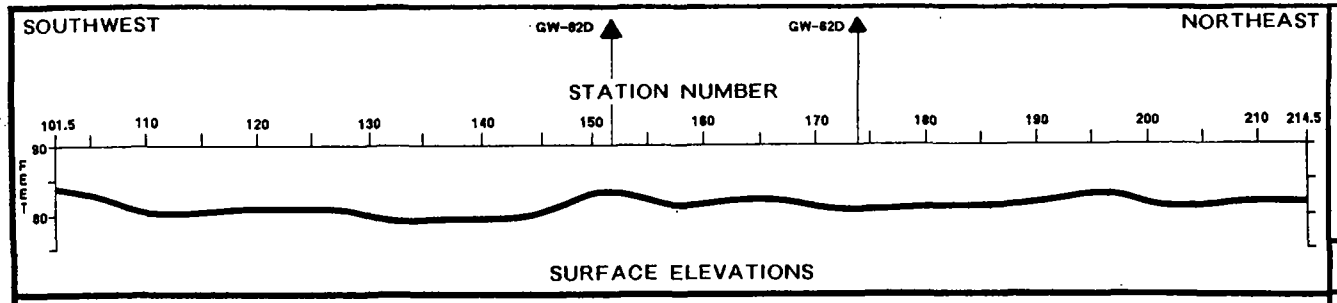
MAP GENERATED BEFORE 11/96
CONFIRMATION DRILLING PROGRAM

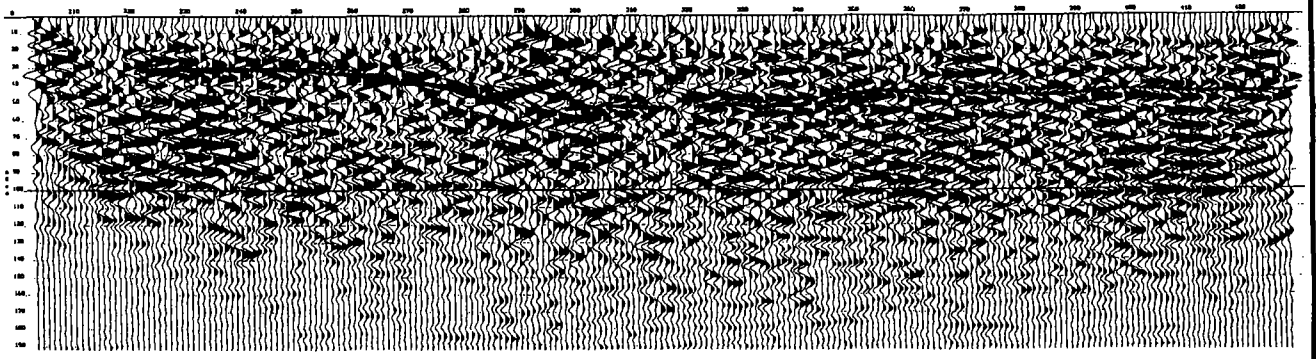
Figure 3



MAP GENERATED AFTER 11/96
CONFIRMATION DRILLING PROGRAM

Figure 2





SCALE: — 100' —

☐ RECENT SEDIMENTS
☒ PRECAMBRIAN BEDROCK

RAYPATH INCORPORATED

AREA: WETLANDS AREA / INFILL
LINE: SE-95-20 DATE: 7-95
LOCATION: WILMINGTON, MA.
CLIENT: SMITH ENVIRONMENTAL

GEOPHYSICISTS:
STEVEN J. KEENAN BRIAN L. STACHITUS

FIELD PARAMETERS

INSTRUMENTS: BISON
POLARITY: NORMAL
RECORD LENGTH: 192 MS
SAMPLE: .2 MS

SOURCE:
TYPE: SHOTGUN
S.P. INTERVAL: 10'
S.P. OFFSET: 10'

CABLE: LAND
GROUP INTERVAL: 10'
GEOPHONES: 40 HZ AMP.
SPREAD LENGTH: 130'

FIELD FILTER:
LOW CUT: 35 HZ
HI CUT: 1000 HZ
NOTCH: OUT

PROCESSING SEQUENCE

1. FREQUENCY FILTER: PRE-STACK 65/75 - 145/155 BAND PASS
2. PRE-STACK F/K FILTER:
3. TRACE EDIT
4. FIRST ARRIVAL MUTE: SPATIAL
5. DECONVOLUTION: POST STACK 2ND CROSSING
6. CDP SORT
7. APPLICATION OF DATUM STATICS;
   DATUM= +84.1 FT VEL= 1200 FT/SEC
8. NMO CORRECTION
9. SURFACE CONSISTENT AUTOMATIC RESIDUAL STATICS
10. FINAL NMO CORRECTION
11. TRIM STATICS ± .5 MS
12. CDP STACK; FOLD: 12
13. POST STACK F/K FILTER: N/A
14. MIGRATION:
15. FREQUENCY FILTER:
16. TRACE SCALING: 180 MS AGC

PRINTER DISPLAY

DATE: 9-95
VERTICAL: 12.5 INCHES/SEC
HORIZONTAL: 25 TR/INCH
MIGRATION

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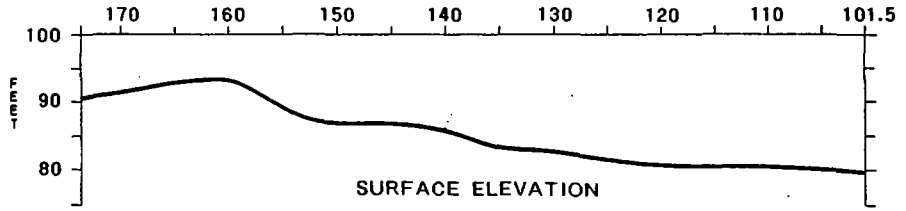
Phone: (215) 782-1863

extrapolations to construct an average velocity gradient map from which seismic travel times were converted to a depth structure map of the top of the bedrock. Average velocity gradient mapping indicated that the velocity field is influenced by the heterogeneity of the recent, glacial sediments. Depth structure mapping of the bedrock surface delineated four distinct bedrock valleys referred to as the (lower)Western, Upper Western, Southwestern and Eastern bedrock valleys. These bedrock valleys have been interpreted to be discretely separated by structurally high saddles or ridges .

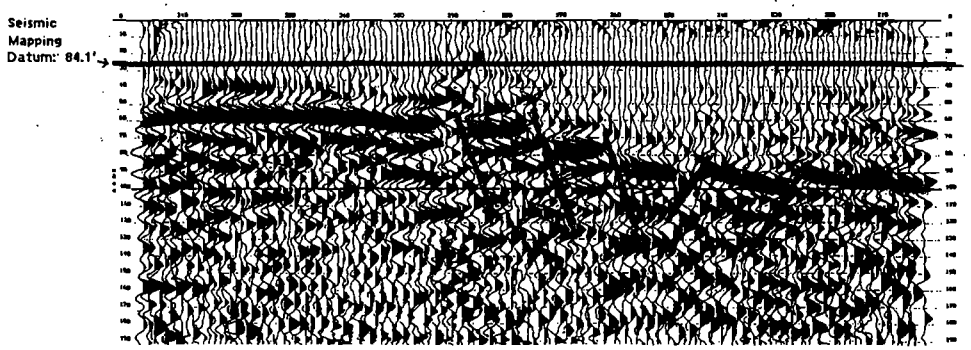
The Western, Upper Western and Southwestern Bedrock Valleys appear to be closed lows or synclines, the Eastern Bedrock Valley appears to plunge westward, "connecting" with the Upper Western Bedrock Valley. The bedrock valleys have been defined by either structurally high ridges or saddles. The bedrock valleys exhibit orthogonal differences in structural strike as well as differences in structural wavelengths with a range of 300 feet to 400 feet. The (lower)Western Bedrock Valley, covering an area of approximtately 62 acres, is comprised of three converging structural lows contained within the +20.0 feet contour. The lowest closing contour is approximately -40.0 feet. The Upper Western Bedrock Valley defined by the +30.0 feet contour contains a series of three generally north-south oriented closed structural lows having an area of roughly 14.3 acres. The lowest closing contour is approximately -20.0 feet.The Eastern Bedrock Valley is a narrow, east-west trending 14 acre synclinal fairway which does not appear as a closed low in the mapping with the exception of a 0.62 acre closure in the vicinity of well GW 50D. The +50.0 feet contour is the defining contour for the Eastern Bedrock Valley. The Southwestern Bedrock Valley, with an areal extent of approximately 36.3 acres, is a structural low defined by the +70.0 contour. The lowest closing contour is approximately +40.0 feet. Results from confirmation drilling supports the structural mapping interpretation. Comparison of the maps generated *before* and *after* the 11/96 confirmation drilling program establishes an empirical quantification of the possible error using the 17, 103 feet integrated seismic reflection survey at this site.

SECTION B

NORTHWEST STATION NUMBER SOUTHEAST



CDP STATION



SCALE: 75'

PRECAMBRIAN BEDROCK

RAYPATH INCORPORATED

AREA: OLIN FACILITY
LINE: SE-96-2EXT DATE: 4-96
LOCATION: WILMINGTON, MA
CLIENT: SMITH ENVIRONMENTAL

GEOPHYSICISTS:
STEVEN J. KEENAN BRIAN L. STACHITUS

FIELD PARAMETERS

INSTRUMENTS: BISON
POLARITY: NORMAL
RECORD LENGTH: 192 MS
SAMPLE: .2 MS

SOURCE:
TYPE: IMPACT
S.P. OFFSET: 7.5'
S.P. INTERVAL: 7.5'

CABLE: LAND
GEOPHONES: 40 HZ AMP
GROUP INTERVAL: 7.5'
SPREAD LENGTH: 90'

FIELD FILTER:
LOW CUT: 35 HZ
NOTCH: OUT
HI CUT: 1000 HZ

PROCESSING SEQUENCE

1. FREQUENCY FILTER:
2. PRE-STACK F/K FILTER: ± 5-8 MS/TR
3. TRACE EDIT
4. FIRST ARRIVAL MUTE: SPATIAL
5. DECONVOLUTION: N/A
6. CDP SORT
7. APPLICATION OF DATUM STATICS;
   DATUM= +95 FT VEL= 1200 FT/SEC
8. NMO CORRECTION
9. SURFACE CONSISTENT AUTO RESIDUAL STATICS: 2 PASSES
10. FINAL NMO CORRECTION
11. TRIM STATICS : ±0.5 MS
12. CDP STACK; FOLD: 12
13. POST STACK F/K FILTER: ±3.5 MS/TR
14. MIGRATION: N/A
15. FREQUENCY FILTER:
16. TRACE SCALING: 180 MS AGC

PRINTER DISPLAY

VERTICAL: 12.5 INCHES/SEC
HORIZONTAL: 25 TR/INCH
STACK

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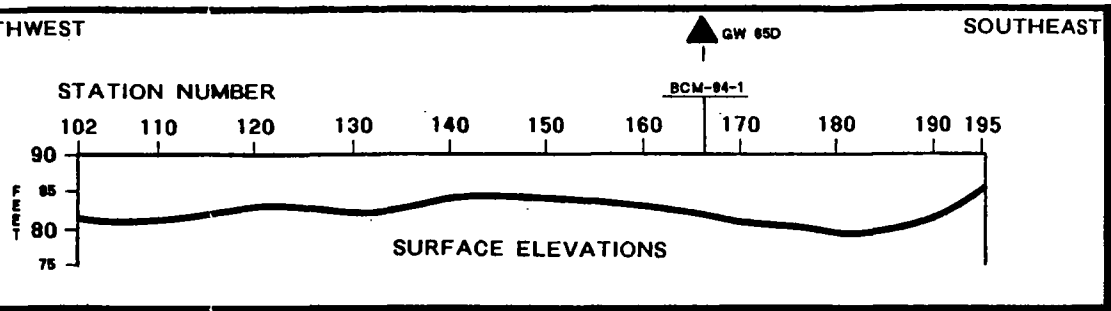

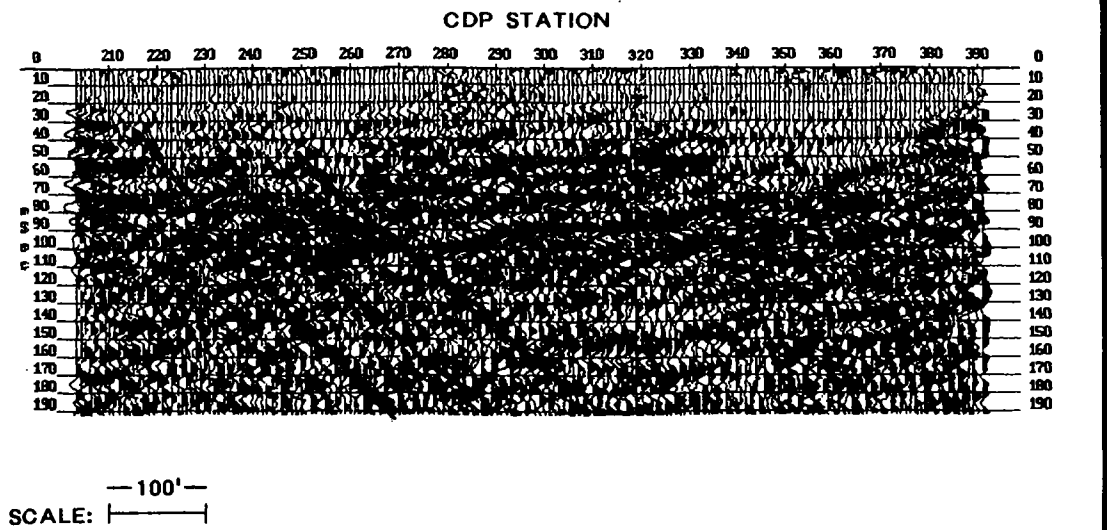

□ RECENT SEDIMENTS

▨ PRECAMRIAN BEDROCK

RAYPATH INCORPORATED

AREA: WETLANDS AREA / PHASE I
LINE: BCM-94-2 DATE: 12-94
LOCATION: WILMINGTON, MA.
CLIENT: BCM ENGINEERS

GEOPHYSICISTS:
STEVEN J. KEENAN BRIAN L. STACHITUS

FIELD PARAMETERS

INSTRUMENTS: BISON
POLARITY: NORMAL
RECORD LENGTH: 192 MS
SAMPLE: .2 MS

SOURCE:

TYPE: SLEDGEHAMMER + PLATE
S.P. INTERVAL: 10'
S.P. OFFSET: VARIABLE

CABLE: LAND

GROUP INTERVAL: 10'
GEOPHONES: 40 HZ AMP
SPREAD LENGTH: 130'

FIELD FILTER:

LOW CUT: 35 HZ
HI CUT: 1000 HZ
NOTCH: OUT

PROCESSING SEQUENCE

1. FREQUENCY FILTER: N/A
2. PRE-STACK F/K FILTER: N/A
3. TRACE EDIT
4. FIRST ARRIVAL MUTE: SPATIAL
5. DECONVOLUTION: N/A
6. CDP SORT
7. APPLICATION OF DATUM STATICS;
   DATUM= +84.1 FT VEL= 1200 FT/SEC
8. NMO CORRECTION
9. SURFACE CONSISTENT AUTOMATIC RESIDUAL STATICS
10. FINAL NMO CORRECTION
11. TRIM STATICS
12. CDP STACK; FOLD: 12
13. POST STACK F/K FILTER: N/A
14. MIGRATION: F/K
15. FREQUENCY FILTER: 110 HZ HC
16. TRACE SCALING: 180 MS AGC

PRINTER DISPLAY

DATE: 12/94
VERTICAL: 12.5 INCHES/SEC
HORIZONTAL: 25 TR/INCH
STACK

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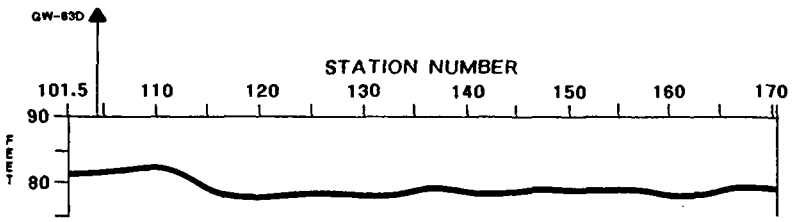
Phone: (215) 782-1863

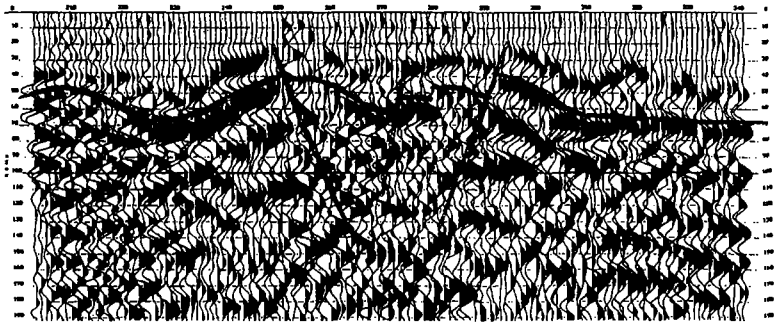
SOUTHWEST



NORTHEAST

SURFACE ELEVATIONS

CDP STATION



SCALE: — 100' —

RECENT SEDIMENTS
PRECAMBRIAN BEDROCK

RAYPATH INCORPORATED

AREA: WETLANDS AREA / INFILL
LINE: SE-95-3EXT DATE: 7-95
LOCATION: WILMINGTON, MA.
CLIENT: SMITH ENVIRONMENTAL

GEOPHYSICISTS:
STEVEN J. KEENAN BRIAN L. STACHITUS

FIELD PARAMETERS

INSTRUMENTS: BISON
POLARITY: NORMAL
RECORD LENGTH: 192 MS
SAMPLE: .2 MS

SOURCE:
TYPE: SHOTGUN
S.P. INTERVAL: 10'
S.P. OFFSET: 10'

CABLE: LAND
GROUP INTERVAL: 10'
GEOPHONES: 40 HZ AMP.
SPREAD LENGTH: 130'

FIELD FILTER:
LOW CUT: 35 HZ
HI CUT: 1000 HZ
NOTCH: OUT

PROCESSING SEQUENCE

1. FREQUENCY FILTER:
2. PRE-STACK F/K FILTER: ± 10 MS/TR
3. TRACE EDIT
4. FIRST ARRIVAL MUTE: SPATIAL
5. DECONVOLUTION:
6. CDP SORT
7. APPLICATION OF DATUM STATICS;
   DATUM= +84.1 FT VEL= 1200 FT/SEC
8. NMO CORRECTION
9. SURFACE CONSISTENT AUTOMATIC RESIDUAL STATICS
10. FINAL NMO CORRECTION
11. TRIM STATICS : ± .5 MS
12. CDP STACK; FOLD: 12
13. POST STACK F/K FILTER: N/A
14. MIGRATION:
15. FREQUENCY FILTER:
16. TRACE SCALING: 160 MS AGC

PRINTER DISPLAY

DATE: 9-95
VERTICAL: 12.5 INCHES/SEC
HORIZONTAL: 25 TR/INCH

STACK

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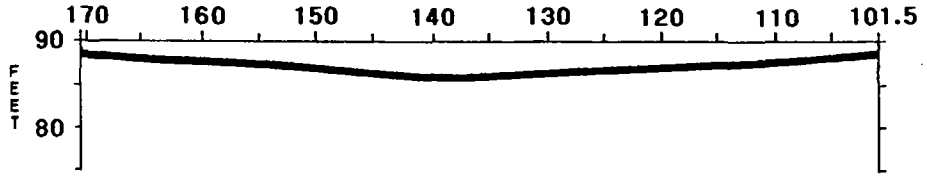
Phone: (215) 782-1863

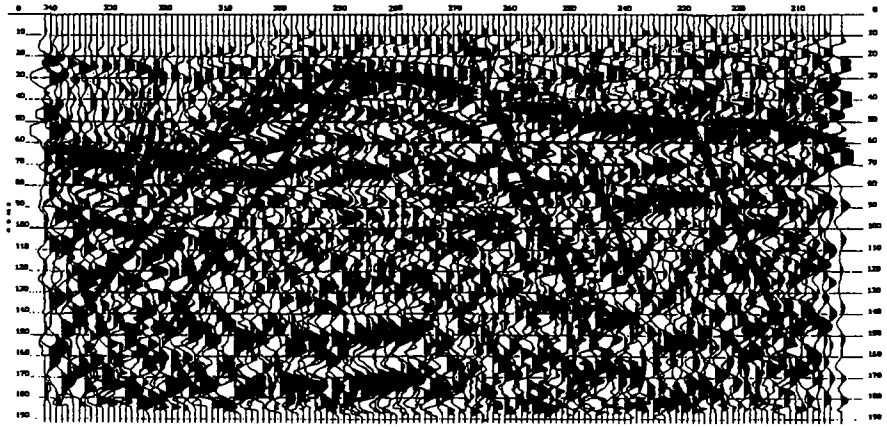
NORTHWEST SOUTHEAST

STATION NUMBER



SURFACE ELEVATIONS

CDP STATION



SCALE: —100'—

- RECENT SEDIMENTS
- PRECAMBRIAN BEDROCK

RAYPATH INCORPORATED

AREA: WETLANDS AREA
LINE: BCM-94-6 DATE: 12-94
LOCATION: WILMINGTON, MA.
CLIENT: BCM ENGINEERS

GEOPHYSICISTS:
STEVEN J. KEENAN BRIAN L. STACHITUS

FIELD PARAMETERS

INSTRUMENTS: BISON
POLARITY: NORMAL
RECORD LENGTH: 192 MS
SAMPLE: .2 MS

SOURCE:

TYPE: SLEDGEHAMMER + PLATE
S.P. OFFSET: VARIABLE
S.P. INTERVAL: 10'

CABLE: LAND

GEOPHONES: 40 HZ AMP
GROUP INTERVAL: 10'
SPREAD LENGTH: 130'

FIELD FILTER:

LOW CUT: 35 HZ
NOTCH: OUT
HI CUT: 1000 HZ

PROCESSING SEQUENCE

1. FREQUENCY FILTER: N/A
2. PRE-STACK F/K FILTER: N/A
3. TRACE EDIT
4. FIRST ARRIVAL MUTE: SPATIAL
5. DECONVOLUTION: N/A
6. CDP SORT
7. APPLICATION OF DATUM STATICS;
   DATUM= +84.1 FT VEL= 1200 FT/SEC
8. NMO CORRECTION
9. SURFACE CONSISTENT AUTOMATIC RESIDUAL STATICS
10. FINAL NMO CORRECTION
11. TRIM STATICS
12. CDP STACK; FOLD: 12
13. POST STACK F/K FILTER: N/A
14. MIGRATION: F/K
15. FREQUENCY FILTER: 110 HZ HC
16. TRACE SCALING: 180 MS AGC

PRINTER DISPLAY

DATE: 12/94
VERTICAL: 12.5 INCHES/SEC
HORIZONTAL: 30 TR/INCH

STACK

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Phone: (215) 782-1863

65

SOUTH NORTH

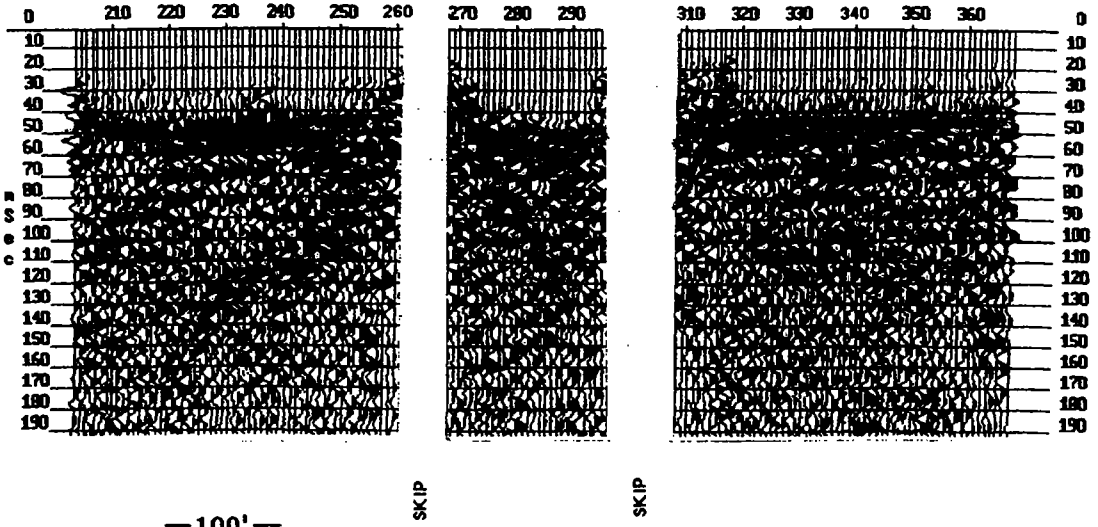
STATION NUMBER

101.5 110 120 130 140 150 160 170 180 184

FEET 90 80

SURFACE ELEVATIONS

CDP STATION



SCALE: —100'—

■ PRECAMBRIAN BEDROCK

RAYPATH INCORPORATED

AREA: EAST BEDROCK VALLEY
LINE: BCM-95-12 **DATE:** 1-95
LOCATION: WILMINGTON, MA.
CLIENT: BCM ENGINEERS

GEOPHYSICISTS:
STEVEN J. KEENAN BRIAN L. STACHITUS

FIELD PARAMETERS

INSTRUMENTS: BISON RECORD LENGTH: 192 MS
POLARITY: NORMAL SAMPLE: .2 MS

SOURCE:
TYPE: SLEDGEHAMMER & PLATE S.P. OFFSET: VARIABLE
S.P. INTERVAL: 10'

CABLE: LAND GEOPHONES: 40 HZ AMP.
GROUP INTERVAL: 10' SPREAD LENGTH: 130'

FIELD FILTER:
LOW CUT: 35 HZ NOTCH: OUT
HI CUT: 1000 HZ

PROCESSING SEQUENCE

1. FREQUENCY FILTER: 75 HZ LC
2. PRE-STACK F/K FILTER: N/A
3. TRACE EDIT
4. FIRST ARRIVAL MUTE: SPATIAL
5. DECONVOLUTION: N/A
6. CDP SORT
7. APPLICATION OF DATUM STATICS;
   DATUM= +84.1 FT VEL= 1200 FT/SEC
8. NMO CORRECTION
9. SURFACE CONSISTENT AUTOMATIC RESIDUAL STATICS
10. FINAL NMO CORRECTION
11. TRIM STATICS
12. CDP STACK; FOLD: 24
13. POST STACK F/K FILTER: N/A
14. MIGRATION: F/K
15. FREQUENCY FILTER:
16. TRACE SCALING: 180 MS AGC

PRINTER DISPLAY

DATE: 2-95
VERTICAL: 12.5 INCHES/SEC
HORIZONTAL: 25 TR/INCH

STACK

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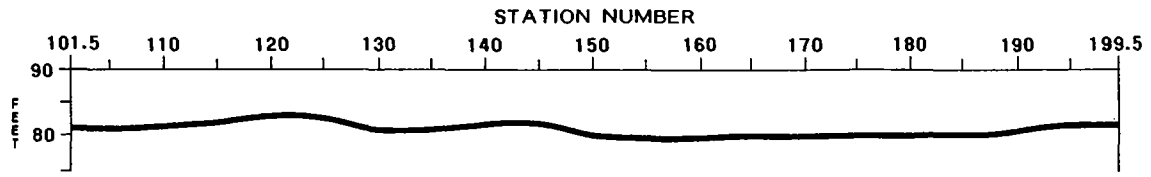
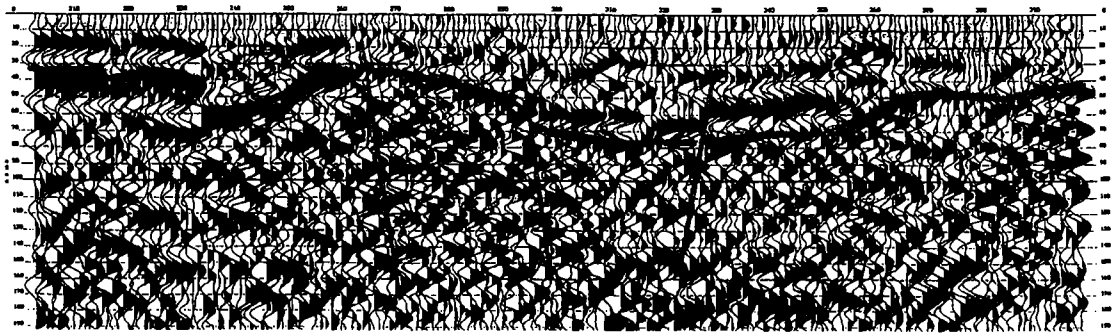
Phone: (215) 782-1863

SOUTHWEST NORTHEAST



SURFACE ELEVATIONS

CDP STATION



SCALE: — 100' —

- RECENT SEDIMENTS
- PRECAMBRIAN BEDROCK

RAYPATH INCORPORATED

AREA: WETLANDS AREA / INFILL
LINE: SE-95-18 DATE: 7-95
LOCATION: WILMINGTON, MA.
CLIENT: SMITH ENVIRONMENTAL

GEOPHYSICISTS:
STEVEN J. KEENAN BRIAN L. STACHITUS

FIELD PARAMETERS

INSTRUMENTS: BISON RECORD LENGTH: 192 MS
POLARITY: NORMAL SAMPLE: .2 MS

SOURCE:
TYPE: SHOTGUN S.P. OFFSET: 10'
S.P. INTERVAL: 10'

CABLE: LAND GEOPHONES: 40 HZ AMP.
GROUP INTERVAL: 10' SPREAD LENGTH: 130'

FIELD FILTER:
LOW CUT: 35 HZ NOTCH: OUT
HI CUT: 1000 HZ

PROCESSING SEQUENCE

1. FREQUENCY FILTER:
2. PRE-STACK F/K FILTER: ± 10 MS/TR
3. TRACE EDIT
4. FIRST ARRIVAL MUTE: SPATIAL
5. DECONVOLUTION:
6. CDP SORT
7. APPLICATION OF DATUM STATICS;
   DATUM= +84.1 FT VEL= 1200 FT/SEC
8. NMO CORRECTION
9. SURFACE CONSISTENT AUTOMATIC RESIDUAL STATICS
10. FINAL NMO CORRECTION
11. TRIM STATICS : ± .5 MS
12. CDP STACK; FOLD: 12
13. POST STACK F/K FILTER: N/A
14. MIGRATION:
15. FREQUENCY FILTER:
16. TRACE SCALING: 180 MS AGC

PRINTER DISPLAY

DATE: 9-95
VERTICAL: 12.5 INCHES/SEC
HORIZONTAL: 25 TR/INCH STACK

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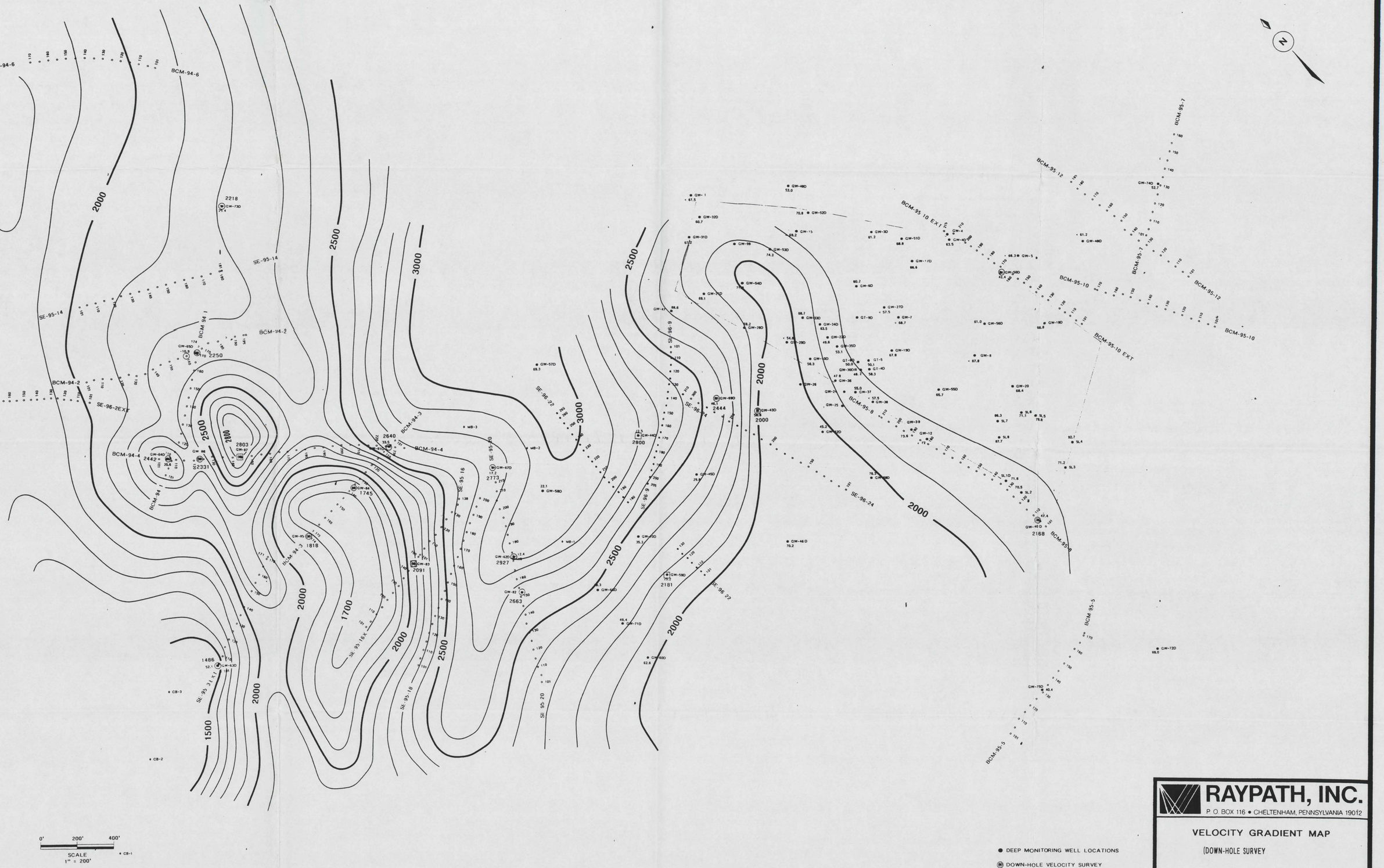
Phone: (215) 782-1863

SECTION C



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VELOCITY GRADIENT MAP

(DOWN-HOLE SURVEY

C.I.: 100 FT/SEC

DATUM: 84.1 FT

GEOPHYSICISTS:
STEVEN J. KEENAN
BRIAN L. STACHITUS

DATE: 12/96

Figure 1

WESTERN BEDROCK VALLEY

UPPER W TERN BEDROCK VALLEY

EASTERN BEDROCK VALLEY

SOUTHWESTERN BEDROCK VALLEY

HIGH

LOW

BCM-94-6

BCM-94-2

BCM-94-4

BCM-94-1

BCM-95-10

BCM-95-10 EXT

BCM-95-12

BCM-95-7

BCM-95-5

SE-95-14

SE-96-2EXT

SE-95-31EXT

SE-96-22

SE-96-24

SE-95-20

SE-95-18

SE-96-9

0' 200' 400'
SCALE
1" = 200'

- DEEP MONITORING WELL LOCATIONS
- DOWN-HOLE VELOCITY SURVEY
- BORING LOCATION
- FACILITY BOUNDARY

Smoothed contours exist away from sensitive data grid; based on widely spaced borings.

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TOP OF PRECAMBRIAN BEDROCK DEPTH STRUCTURE MAP

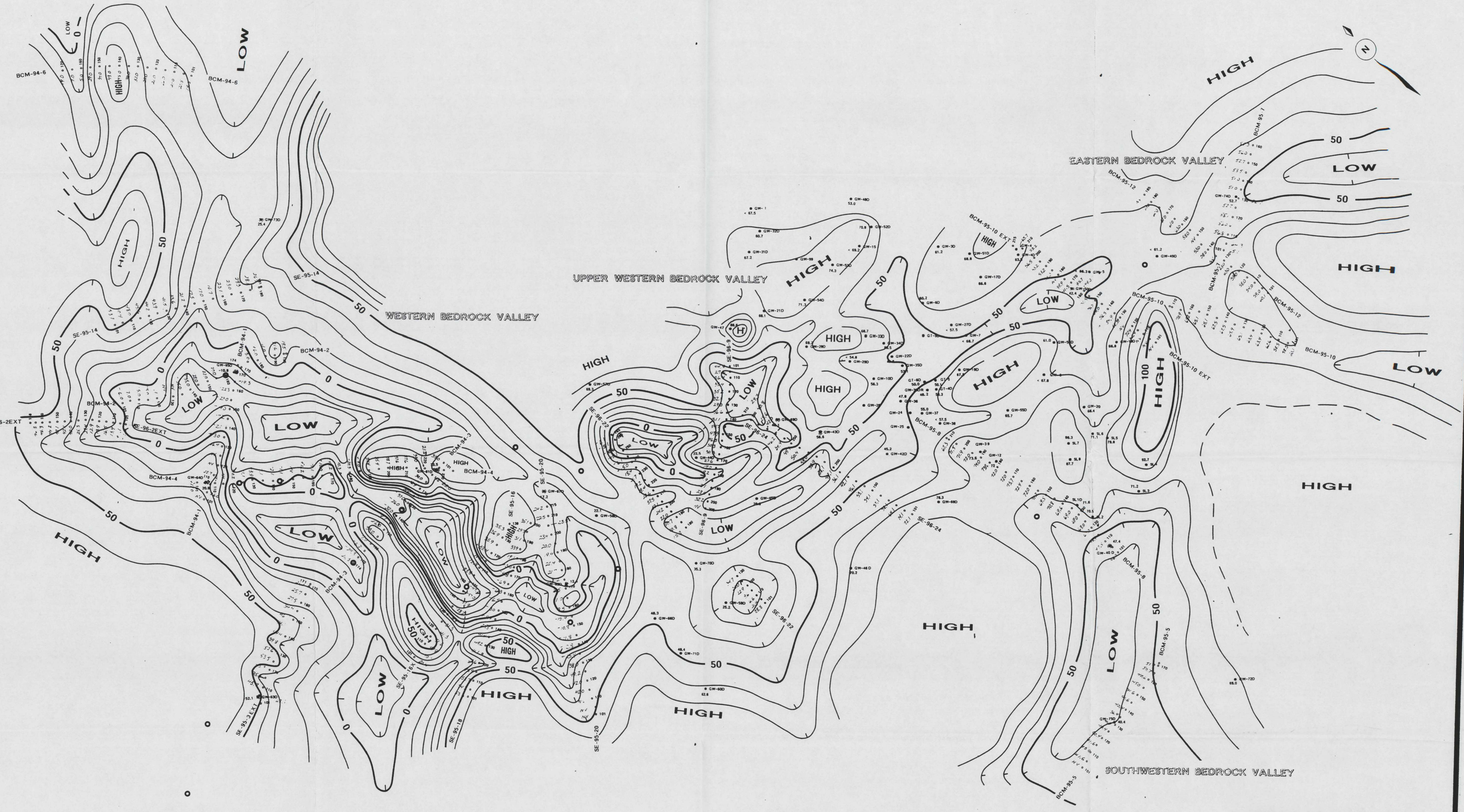
DATUM: SEA LEVEL

C.I.: 10 FEET

GEOPHYSICISTS:
STEVEN J. KEENAN
BRIAN L. STACHITUS

REVISED
DATE: 12/96

Figure 2



RAYPATH, INC.
P. O. BOX 116 • CHELTENHAM, PENNSYLVANIA 19012

TOP OF PRECAMBRIAN BEDROCK DEPTH STRUCTURE MAP

DATUM: SEA LEVEL
C.I.: 10 FEET

GEOPHYSICISTS:
STEVEN J. KEENAN
BRIAN L. STACHITUS

DATE: 4/96

Figure 3

SECTION D

TIME / VELOCITY / DEPTH DATA --CLIN--WILMINGTON, MA				4/3/96	page 1 Of 2
			revised	12/9/96	
SE-96-2ext				SE-96-24			
Station	Time(sec)	Vel(ft./sec)	Depth(msl)	Station	Time(sec)	Vel(ft./sec.)	Depth(msl)
101	0.086	2010	-02.33	101	0.012	2000	72.10
105	0.084	2000	00.10	110	0.005	2000	79.10
110	0.070	1980	14.80	120	0.020	2000	64.10
115	0.066	1950	19.75	130	0.026	2000	58.10
120	0.068	1930	18.48	140	0.027	2000	57.10
125	0.068	1905	19.33	150	0.030	2000	54.10
130	0.054	1900	32.80	160	0.031	2000	53.10
135	0.056	1900	30.90	170	0.038	2000	46.10
140	0.042	1900	44.20	180	0.042	2000	42.10
145	0.040	1900	46.10	190	0.048	2000	36.10
150	0.040	1900	46.10	200	0.035	2000	49.10
155	0.038	1900	48.00	210	0.046	2000	38.10
160	0.036	1900	49.90	220	0.050	2050	32.85
165	0.036	1900	49.90	230	0.028	2150	54.00
170	0.036	1900	49.90	240	0.030	2250	50.35
175	0.038	1900	48.00	250	0.033	2325	45.74
				260	0.041	2400	34.90
				270	0.031	2444	46.22
SE-96-22				280	0.034	2475	42.03
101	0.054	2050	28.75	290	0.044	2525	28.55
105	0.060	2075	21.85	300	0.034	2550	40.75
110	0.064	2110	16.58	310	0.042	2590	29.71
115	0.060	2150	19.60				
120	0.056	2185	22.92				
125	0.058	2210	20.01				
130	0.044	2245	34.71				
Altron Driveway / Eames Ave. Skip							
180	0.052	2650	15.20				
185	0.054	2715	10.80				
190	0.052	2785	11.69				
195	0.044	2825	21.95				
200	0.042	2855	24.15				
205	0.036	2890	32.08				
210	0.032	2915	37.46				
215	0.038	2920	28.62				
220	0.044	2940	19.42				
225	0.044	2950	19.20				
230	0.042	2970	21.73				
235	0.044	2985	18.43				
240	0.046	3005	14.99				
245	0.060	3005	-06.05				
250	0.066	3005	-15.07				
255	0.073	3005	-25.58				
260	0.066	3005	-15.07				
265	0.060	3005	-06.05				

SE-96-9 Olin/Wilmington, MA 04-03-96

Station	Time(sec.)	Vel(ft./sec.)	Deptn(msl)
101	0.032	2450	44.90
105	0.046	2475	27.18
110	0.046	2510	26.37
115	0.04	2535	33.40
120	0.038	2575	35.18
125	0.04	2600	32.10
130	0.042	2625	28.98
135	0.036	2640	36.58
140	0.04	2650	31.10
145	0.022	2670	54.73
150	0.03	2680	43.90
155	0.028	2685	46.51
160	0.04	2690	30.30
165	0.04	2690	30.30
170	0.042	2690	27.61
175	0.05	2685	16.98
180	0.056	2675	09.20
185	0.05	2650	17.85
190	0.054	2630	13.09
195	0.043	2610	27.99
200	0.04	2595	32.20

station #	time(trough	velocity	depth (msl)
SE9514			
101	0.03	2025	53.73
105	0.033	2045	50.36
110	0.035	2065	47.96
115	0.037	2080	45.62
120	0.038	2100	44.20
125	0.038	2115	43.92
130	0.04	2120	41.70
135	0.047	2130	34.05
140	0.058	2135	22.19
145	0.061	2140	18.83
150	0.061	2145	18.68
155	0.061	2150	18.53
160	0.055	2150	24.98
165	0.055	2160	24.70
170	0.049	2170	30.94
175	0.05	2175	29.73
180	0.051	2180	28.51
SE953X			
101	0.048	1500	48.10
105	0.043	1486	52.15
110	0.051	1540	44.83
115	0.061	1610	35.00
120	0.047	1710	43.92
125	0.036	1810	51.52
130	0.036	1890	50.08
135	0.049	1950	36.33
140	0.042	2000	42.10
145	0.041	2050	42.08
150	0.039	2140	42.37
155	0.051	2230	27.24
160	0.056	2230	21.66
165	0.057	2200	21.40
170	0.06	2150	19.60
SE9516X			
101	0.059	1690	34.25
105	0.04	1695	50.20
110	0.028	1700	60.30
115	0.029	1725	59.09
120	0.037	1750	51.73
125	0.045	1790	43.83
130			
135	0.093	1925	-5.41
140	0.1	2010	-16.40
145	0.114	2091	-35.09
150	0.105	2170	-29.83

SE9516			
105	0.09	2250	-17.15
110	0.076	2310	-3.68
115			
120	0.039	2490	35.55
125	0.037	2540	37.11
130	0.036	2590	37.48
135	0.037	2610	35.82
SE9518			
101	0.027	2300	53.05
105	0.026	2290	54.33
110	0.026	2290	54.33
115	0.032	2295	47.38
120	0.05	2300	26.60
125	0.035	2330	43.33
130	0.028	2360	51.06
135	0.034	2400	43.30
140	0.046	2440	27.98
145	0.061	2490	8.16
150	0.067	2510	0.01
155	0.069	2550	-3.88
160	0.072	2600	-9.50
165	0.068	2650	-6.00
170	0.066	2695	-4.84
175	0.06	2705	2.95
180	0.048	2710	19.06
185	0.037	2710	33.97
190	0.039	2715	31.16
195	0.04	2720	29.70
198	0.036	2725	35.05
SE9520			
101			
105			
110			
115	0.03	2420	47.80
120	0.03	2440	47.50
125	0.031	2460	45.97
130	0.032	2500	44.10
135	0.035	2545	39.56
140	0.045	2570	26.28
145	0.05	2610	18.85
150	0.046	2663	22.85
155	0.049	2670	18.69
160	0.051	2725	14.61
165	0.05	2800	14.10
170	0.051	2927	9.46

175	0.045	2927	18.24
180	0.043	2925	21.21
185	0.044	2910	20.08
190	0.045	2890	19.08
195	0.045	2860	19.75
200	0.043	2840	23.04
205	0.043	2805	23.79
210	0.044	2795	22.61
214	0.043	2775	24.44
BCM-94-1			
101			
105	0.051	2442	21.83
110	0.052	2442	20.61
115	0.051	2400	22.90
120			
125			
130	0.059	2320	15.66
135	0.072	2345	-0.32
140	0.077	2350	-6.38
145	0.082	2350	-12.25
150	0.094	2345	-26.12
155	0.098	2325	-29.83
160	0.097	2295	-27.21
165	0.094	2275	-22.83
170	0.085	2250	-11.53
175	0.075	2250	-0.28
BCM-94-2			
101	0.081	2025	2.09
105	0.082	2045	0.25
110	0.08	2060	1.70
115	0.08	2080	0.90
120	0.075	2105	5.16
125			
130			
135	0.103	2190	-28.69
140	0.102	2215	-28.87
145	0.094	2225	-20.48
150	0.093	2240	-20.06
155	0.095	2250	-22.78
160	0.095	2250	-22.78
165	0.085	2250	-11.53
170	0.084	2250	-10.40
175	0.078	2245	-3.46
180	0.069	2255	6.30
185	0.064	2250	12.10
190	0.054	2250	23.35
195	0.056	2245	21.24

BCM-94-3			
101	0.044	2690	24.92
105	0.04	2640	31.30
110	0.051	2550	19.08
115	0.046	2350	30.05
120	0.059	2190	19.50
125			
130	0.112	1895	-22.02
135	0.126	1745	-25.84
140	0.106	1725	-7.33
145	0.066	1680	28.66
150	0.05	1660	42.60
155	0.043	1650	48.63
160	0.068	1660	27.66
165	0.081	1690	15.66
170	0.099	1750	-2.53
172.5	0.096	1818	-3.16
BCM-94-4			
101	0.06	2442	10.84
105	0.052	2442	20.61
110	0.049	2442	24.27
115			
120	0.085	2331	-14.97
125	0.076	2331	-4.48
130	0.071	2490	-4.30
135	0.076	2600	-14.70
140	0.077	2775	-22.74
145	0.076	2803	-22.41
150			
155	0.064	2570	1.86
160	0.076	2490	-10.52
165	0.065	2380	6.75
170	0.063	2300	11.65
175	0.085	2245	-11.31
180	0.095	2195	-20.16
185	0.071	2190	6.36
190	0.042	2200	37.90
195	0.041	2250	37.98
200	0.038	2300	40.40
205	0.039	2400	37.30
210	0.039	2450	36.33
215	0.043	2505	30.24
220	0.054	2590	14.17
225	0.044	2640	26.02
230	0.023	2650	53.63
235	0.042	2675	27.93

BCM-94-6			
101	0.057	2050	25.68
105	0.055	2040	28.00
110	0.052	2020	31.58
115	0.05	2000	34.10
120	0.05	1980	34.60
125	0.047	1975	37.69
130	0.044	1950	41.20
135	0.038	1925	47.53
140	0.032	1915	53.46
145	0.034	1899	51.82
150	0.042	1880	44.62
155	0.047	1870	40.16
160	0.07	1850	19.35
165	0.068	1840	21.54
170	0.061	1830	28.29

SECTION E

GLOSSARY OF GEOPHYSICAL TERMS

Acoustic impedance: seismic velocity multiplied by density. Reflection coefficient depends on change in acoustic impedance.
Amplitude: magnitude of the deflection (*positive-peak or negative-trough)* of a seismic trace measured as a function of the relative velocity and density contrast across a reflecting boundary. Lateral changes in reflection amplitude may indicate changes in the properties of rocks.
Anomaly: difference in appearance of a portion of a seismic profile from the profile in general; Possibly associated with a change in the physical properties or structure of rocks.
Anticline: geological structure generally in the shape of an arch that is convex upwards and its core contains the geologically older rocks; Generally refers to a closed structural high.
Attenuation: a reduction in amplitude or energy.
Attribute: Seismic characteristics indicative of changes in the elastic properties of rocks.
Average velocity: the distance traversed by a seismic wavelet divided by the time required, both often corrected to a reference datum plane.
Bandwidth: the range of frequencies obtained.
Buried glacial valley: subsurface valley carved from bedrock during periods of recent glaciation usually following pre-existing structure subsequently buried by the retreat of glaciers and post glacial deposition.
Buttress: A protruding rock mass on, or a projecting part of, a mountain or hill, resembling the buttress of a building.
Carbonate: of or pertaing to rocks with a high content of calcite generally broken up into limestones and dolomites(dolostones). Limestones are more easily eroded while dolomites are more resistant to weathering due to higher Mg content.
CDP: Common Depth Point; A subsurface point occurring mid way between source and receiver locations. CDP stacking uses the combination of data which have in common the same midpoint (CDP or CMP) between source and receiver. Differentiated from the term CMP in the presence of dip. The CDP spacing controls the horizontal resolution of the data along the profile.
CMP: See CDP above.
Continuity: a qualitative assessment of the interruption or lack of interruption of continuous seismic reflection events.
Dip: the angle made between a plane surface and the horizontal.
Dissolution:the dissolving of a material by a solvent. In the case of carbonate rocks, dissolution is the chemical reaction that occurs between the calcite in the carbonate rock and acidic ground water. The dissolution of material and subsequent removal by the ground water flow sometimes causes voids to develop in the subsurface.
Filtering: That part of a system or processing sequence (mathematical algorithm) that discriminates against some of the information entering. The discrimination is usually performed on the basis of frequency (*frequency filtering*) although other bases such as wavelength or moveout (*F-K filtering*) or coherence may by used. Filter parameters applied during the processing of seismic reflection data are chosen on the basis of iterative testing designed to determine the frequency or move out characteristics of noise.
Fold: refers to the redundancy of seismic data collected using the CDP method; example: if there are 12 offset distances for the same mid-point this is referred to as12 fold data.
Frequency: the number of cycles per second of a seismic wavelet (peak to peak time) measured in Hertz; The frequency content of the recorded seismic data controls the vertical resolution of the data.
Geophone: an instrument used to convert seismic energy to electrical voltage; a receiver.
High: a general term for such features as a crest, culmination, anticline, or dome.
Interpret: to conceive in the light of individual belief, judgement, or circumstance
Interpretation: the act or the result of interpreting.

Interpreter: one who interprets the geological significance of geophysical data.
Interval Velocity: seismic wave velocity measured over a depth interval; usually refers to compressional velocities.
Low: a general term for such features as a structural basin, a syncline, or a sag.
Migration: computerized mathematical process by which dipping reflections are moved to their proper position in the subsurface.
Noise: *any unwanted energy; noise can be coherent (such as ground roll) or incoherent* (randomly generated noise).
Peak: the positive excursion of a seismic wavlet.
Receiver: see "geophone".
Recent sediments: unconsolidated deposits of sediments that have taken place in the recent period of geologic time generally 12,000 b.p. to present.
Record: a recording of the energy for 1 shot received by a spread of geophones.
Reflection: the energy from a seismic source that has been returned (reflected) from a velocity contrast or contrasts in the subsurface. Seismic reflection involves no assumptions about layering or severe constrainsts involving the behavior of the velocity field. The purpose of most reflection work is to measure the travel times of the reflectors, determine their structural attitude and position , observe changes, if any, in seismic attributes such as amplitude and frequency, and subsequently interpret geologic structure and stratigraphy.
Refraction: the energy from a seismic source that has been returned (refracted) from a velocity boundary where an increase in velocity exists. The success of the seismic refraction method is dependent on three assumptions: (1) acoustic velocity increases with depth ("*velocity inversion problem*"), (2) sufficient acoustic velocity contrasts exist to allow differentiation of refracted data between adjacent strata ("*blind zone problem*"), (3) layers have sufficient thickness to permit detection ("*thin bed problem*"). Seismic refraction was used by the petroleum industry in the 1920's through the 1950's to map the subsurface before the advent of the much higher resolution seismic reflection technology.
Saprolite: zone of severely weathered bedrock most often a result of chemical weathering and usually clay-rich.
Seismic: of or pertaining to motions within the earth induced by man or naturally occurring. More appropriately for hydrocarbon exploration work, having to do with elastic waves and their transmission through the earth.
Seismic line: seismic section; continuous subsurface image or cross sectional profile displayed as a function of distance (x axis) and two way travel time or depth (y axis) resulting from the acquistion, processing and interpretation of seismic data. Most often used in conjunction with a grid of lines to produce structure contour maps, identify fault locations and locate changes in stratigraphy.
Seismic profile*: see "seismic line" above.*
Seismograph: instrument used to record (acquire) seismic data in the field.
Shallow: generally less than 500 feet in depth below surface, sometimes referred to as "near surface".
Shotpoint: surface location of the release of energy necessary to generate and transmit seismic waves into the subsurface.
Signal to noise ratio: the energy of all desired seismic events divided by all remaining energy; Often referred to as a measure of data quality.
Sinkhole: surface expression of a collapsed void in the subsurface, usually the result of carbonate dissolution processes.
Source: device used to introduce energy into the subsurface, for shallow work the source is usually either impact (accelerated weight drop or sledghammer) or explosive (shotgun blast).
Stack: combining redundant traces into one trace (summing) thereby decreasing the ambiguity of the final result (stacked trace) and reducing random noise, enhancing the signal to noise ratio.
Station: surface location of source and receivers; A station number is one half the number of the corresponding subsurface (or CDP) point; i.e. station 100 = CDP 200.

Strike: azimuth of a horizontal line in an inclined surface; Horizontal direction perpendicular to dip.
Structure: the general disposition, attitude, arrangement, or relative positions of the rock masses of a region or area.
Structure contour map: a map intended to portray subsurface configuration by means of structure contour lines.
Structural trough: *See syncline.*
Syncline: geologic structure in the shape of a concave upward arch with a core of geologically younger material; Generally refers to a structurally low area.
Synthetic seismogram: An artifical seismic reflection record manufactured from velocity data by convolving the reflectivity function with a waveform which includes the effects of filtering by the earth and recording system. Used to compare with an actual seismogram to aid in identifying events or in predicting how stratigraphic variation might affect a record.
Tie: that point on a seismic line that intersects or crosses the location of a boring / well; generally refers to a point of subsurface control on a seismic profile.
Travel time: The time between time break and the recording of a seismic event.
Two-way time: Recorded time for a reflection event on a seismic profile.
Trough: the negative portion of a seismic wavelet existing between positive consecutive wavelet excursions(peaks).
Velocity gradient: lateral change in the velocity of earth materials; The term is generally used in reference to changes in the average velocity to a specified layer. Factors include depth of burial, *compaction, primary and secondary changes in lithology.*
Velocity survey: measurements usually taken in a well used to determine the average velocity of seismic waves in sediments as a function of depth.
Wavelength: the distance in the line of advance of a wave from any one point to the next point of corresponding phase
Wavelength of structural change: the horizontal distance from a maximum high point to a minimum low point.

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Appendix E

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APPENDIX E

DENSITY CORRECTION

APPENDIX E
DETAILS CONCERNING DENSITY CORRECTION TO GROUNDWATER LEVELS

The first step in correcting hydraulic heads for the density effect was to determine which wells would be affected by variable density groundwater. Table 2-5 of the report shows all wells that penetrate the dense layer, and the location of the fresh water/dense layer interface in the formation around the well. The location of the interface was obtained from the inductance logging performed during the CSA, from specific conductance profiling, or from interpolation between other data points. Of these wells, only those that are screened below the interface have the potential to be affected. For the others, it is likely that there is enough interaction with the fresh groundwater so that the head measured in the well is representative or nearly so and does not need adjustment. These wells are so noted on Table 2-5.

In order to accurately determine the correct hydraulic head in the remaining wells that fully penetrate the dense layer, it is necessary to know the vertical profile of density changes throughout each well. It is not practical to obtain this information in the field: the process of collecting the data disturbs the water column to the point that meaningful data cannot be obtained. Based on our observations in the field, specifically the conductance profiling data, it was assumed that the water column in each well could be divided into fresh water with a density of 1.0 gm/cc, and the dense layer with a fixed specific gravity that was measured in the field.

With this information, it is only necessary to determine the location of the interface between fresh and dense groundwater within the well. This was estimated from conductance profiling data, where available. For wells where there was no information on the exact location, the interface within the well was assumed to be similar to that in the formation.

With this information, the following correction was made:

$$t_d = E_{int} - E_{well}$$

$$t_f = h_{meas} - E_{int}$$

$$t_e = t_d \cdot \rho$$

$$h_{corr} = E_{well} + t_e + t_f$$

where: t_d is the thickness of dense layer in the well,
t_f is the thickness of fresh water in the well,
t_e is the equivalent thickness of fresh water,
E_{int} is the elevation of the interface in the well,
E_{well} is the elevation of the base of the well screen,
ρ is the specific gravity of the dense groundwater, and,
h_{corr} is the corrected head value.

These calculations are only approximate given the uncertainty of the location of the interface within the well at each monitoring event. To evaluate the potential extent of the uncertainties, a maximum possible corrected head for each well was calculated based on the assumption that the well was filled with dense water only.

Appendix F

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APPENDIX F

PUMPING TEST DATA

Specification Summary for Town Park Wells

Olin Corporation
Wilmington, MA Facility

Thickness of Aquifer: 53 feet
Reference: Olin Monitoring Well GW-73-D

Pump Well(s): Well 1 **Pump Rate:** 185 gpm

Observation Well(s): Well 1
Well 1A
Well 1B
Well 2-3
Well 8
Well 9

Well Locations and Geometry

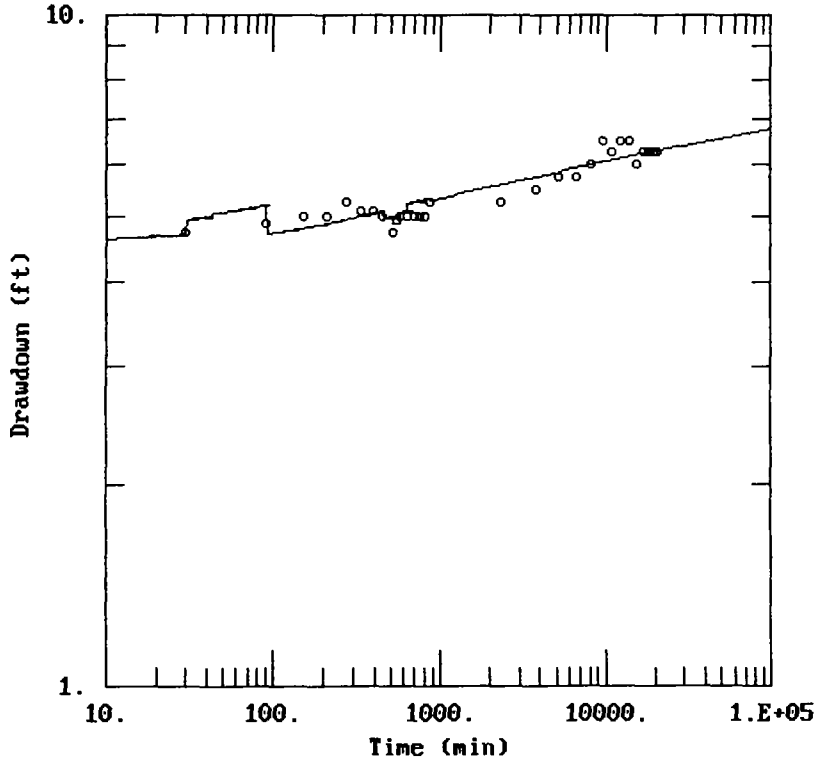
Well Name	Distance From Pump Well (feet)	Well Diameter (feet)	Screened Interval (feet bgs)
Pump Well 1	0	0.2	
Well 1	0.5	0.2	
Well 1A	2	0.2	35-40
Well 1B	2	0.2	35-40
Well 2-3	200	0.2	32-42
Well 8	160	0.2	42-52
Well 9	275	0.2	37-47

TOWN PARK PUMP TEST
FEBRUARY 1962

Date	Time	Elapsed Time	Pump rate (gpm)	Drawdown (feet) 1 Well	1a Well	1b Well	1c Well	2,3&13 Well	8 Well	9 Well
2/5/62	9:30	0	185	4.8	4.3	5.8	0.8	0.5	0.8	0.3
2/5/62	10:00	30	195	5.5	4.8	6.8	1.8	0.6	1.5	0.3
2/5/62	11:00	90	175	5.5	4.9	7.0	2.3	1.0	1.5	0.8
2/5/62	12:00	150	175	5.5	5.0	7.0	2.3	1.0	1.5	0.8
2/5/62	13:00	210	175	5.6	5.0	7.0	2.3	1.0	1.5	0.8
2/5/62	14:00	270	175	5.8	5.3	7.3	2.3	1.0	1.5	1.0
2/5/62	15:00	330	175	5.8	5.1	7.1	2.3	1.0	1.5	1.0
2/5/62	16:00	390	175	5.8	5.1	7.1	2.3	1.0	1.5	1.0
2/5/62	17:00	450	170	5.6	5.0	7.0	2.3	1.0	1.5	0.8
2/5/62	18:00	510	165	5.5	4.8	6.8	2.3	1.1	1.5	0.6
2/5/62	19:00	570	172	5.3	5.0	7.0	2.3	1.1	1.5	0.8
2/5/62	20:00	630	177	5.5	5.0	7.3	2.3	1.1	1.6	0.8
2/5/62	21:00	690	177	5.8	5.0	7.3	2.3	1.1	1.8	0.8
2/5/62	22:00	750	177	5.8	5.0	7.3	2.3	1.1	1.8	0.8
2/5/62	23:00	810	175	5.8	5.0	7.3	2.4	1.1	1.8	0.8
2/6/62	0:00	870	180	6.0	5.3	7.3	2.5	1.1	1.8	0.8
2/7/62	0:00	2310	180	5.8	5.3	7.3	2.5	1.5	1.8	1.0
2/8/62	0:00	3750	180	6.0	5.5	7.5	2.8	1.8	2.0	1.3
2/9/62	0:00	5190	180	6.3	5.8	7.8	3.0	1.9	2.3	1.4
2/10/62	0:00	6630	180	6.8	5.8	7.8	3.1	2.0	2.5	1.5
2/11/62	0:00	8070	180	6.8	6.0	8.5	3.3	2.1	2.8	1.8
2/12/62	0:00	9510	180	6.8	6.5	8.5	3.5	2.3	2.8	1.9
2/13/62	0:00	10950	180	7.0	6.3	8.8	3.5	2.3	3.0	2.0
2/14/62	0:00	12390	180	6.9	6.5	8.8	3.5	2.3	3.0	2.0
2/15/62	0:00	13830	180	6.8	6.5	8.5	3.5	2.3	3.0	2.0
2/16/62	0:00	15270	180	7.0	6.0	8.5	3.5	2.3	3.0	2.0
2/17/62	0:00	16710	180	6.9	6.3	8.8	3.8	2.3	3.0	2.0
2/18/62	0:00	18150	180	6.8	6.3	8.8	3.8	2.3	3.0	2.1
2/19/62	0:00	19590	180	6.8	6.3	8.8	3.8	2.5	3.3	2.0
2/19/62	14:00	20430	0		6.3	8.5		2.6		
2/19/62	15:00	20490	0		2.0	2.8		1.8		
2/19/62	16:00	20550	0		2.0	2.0		2.0		
2/19/62	17:00	20610	0		1.8	1.8		1.8		
2/19/62	18:00	20670	0		1.5	1.5		1.5		
2/19/62	19:00	20730	0		1.5	1.5		1.5		
2/19/62	20:00	20790	0		1.5	1.5		1.5		
2/19/62	21:00	20850	0		1.4	1.4		1.4		
2/19/62	22:00	20910	0		1.3	1.3		1.3		
2/19/62	23:00	20970	0		1.3	1.3		1.3		
2/20/62	0:00	21030	0		1.1	1.1		1.1		
2/20/62	3:00	21210	0		1.1	1.1		1.1		
2/20/62	6:00	21390	0		1.0	1.0		1.0		
2/20/62	9:00	21570	0		1.0	1.0		1.0		
2/20/62	12:00	21750	0		0.9	0.9		0.9		
2/22/62	0:00	23910	0		0.8	0.8		0.8		
2/23/62	0:00	25350	0		0.5	0.5		0.5		
2/24/62	0:00	26790	0		0.4	0.4		0.4		
2/25/62	0:00	28230	0		0.3	0.3		0.3		
2/26/62	0:00	29670	0		0.3	0.3		0.3		
2/27/62	0:00	31110	0		0.3	0.3		0.3		

CLIENT: Olin Corporation	COMPANY: Smith Environmental Tech Corp.
LOCATION: Wilmington, MA	PROJECT: 7074-0102

Town Park Pump Test, Obs Well 1A



DATA SET:
PT1AD.DAT
05/06/96

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Neuman (approx.)

PROJECT DATA:
test date: February 1962
test well: Well 1
obs. well: Well 1A

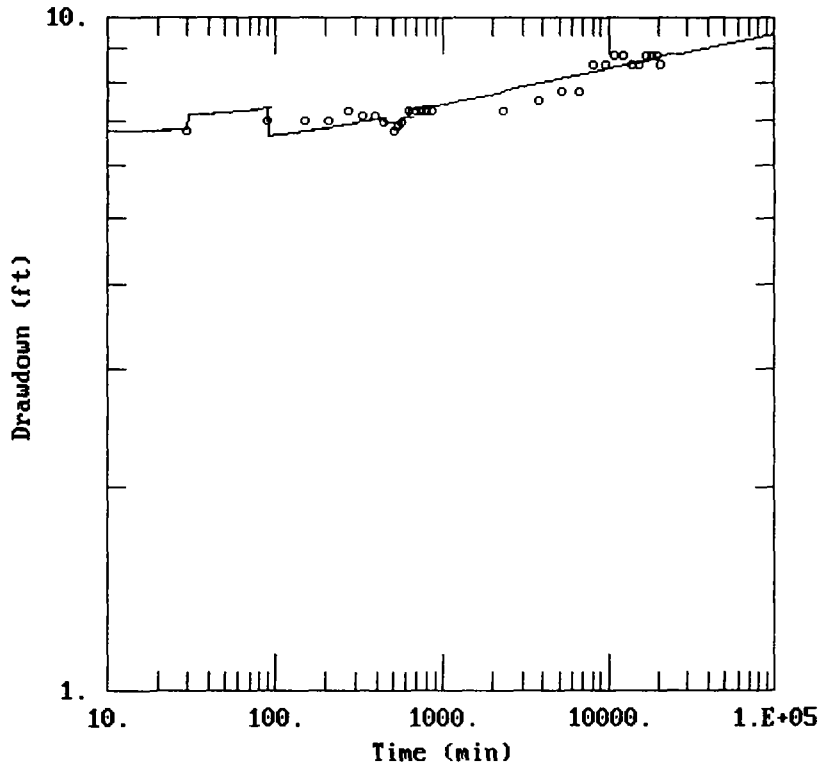
TEST DATA:
Q = 185. gal/min
r = 2. ft
r_c = 0.25 ft
r_w = 0.4 ft
b = 53. ft
Pumping Well Screen Depth:
  top = 35. ft
  bot.= 40. ft
Obs. Well Screen Depth:
  top = 35. ft
  bot.= 40. ft

PARAMETER ESTIMATES:
T = 5.957 ft^2/min
S = 0.000176
Sy = 0.63
ß = 0.004122

AQTESOLV

CLIENT: Olin Corporation	COMPANY: Smith Environmental Tech Corp
LOCATION: Wilmington, MA	PROJECT: 7074-0102

Town Park Pump Test, Obs. Well 1B



DATA SET:
PT1B.DAT
05/06/96

AQUIFER MODEL:
Unconfined
SOLUTION METHOD:
Neuman (approx.)

PROJECT DATA:
test date: February 1962
test well: Well 1
obs. well: Well 1B

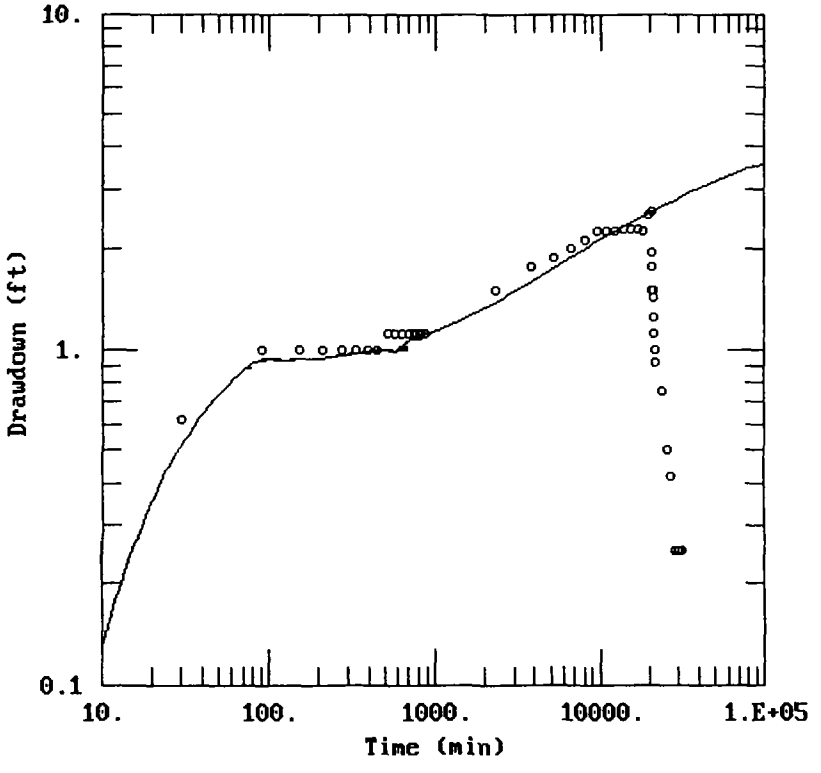
TEST DATA:
Q = 185. gal/min
r = 2. ft
r_c = 0.25 ft
r_w = 0.4 ft
b = 53. ft
Pumping Well Screen Depth:
  top = 35. ft
  bot.= 40. ft
Obs. Well Screen Depth:
  top = 35. ft
  bot.= 40. ft

PARAMETER ESTIMATES:
T = 4.162 ft^2/min
S = 1.45E-05
Sy = 0.8738
ß = 0.004

AQTESOLV

CLIENT: Olin Corporation	COMPANY: Smith Environmental Tech. Corp
LOCATION: Wilmington, MA	PROJECT: 7074-0102

Town Park Pump Test, Well 2-3-13



DATA SET:
PT2.DAT
05/06/96

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Neuman (approx.)

PROJECT DATA:
test date: February 1962
test well: Well 1
obs. well: Well 2-3-13

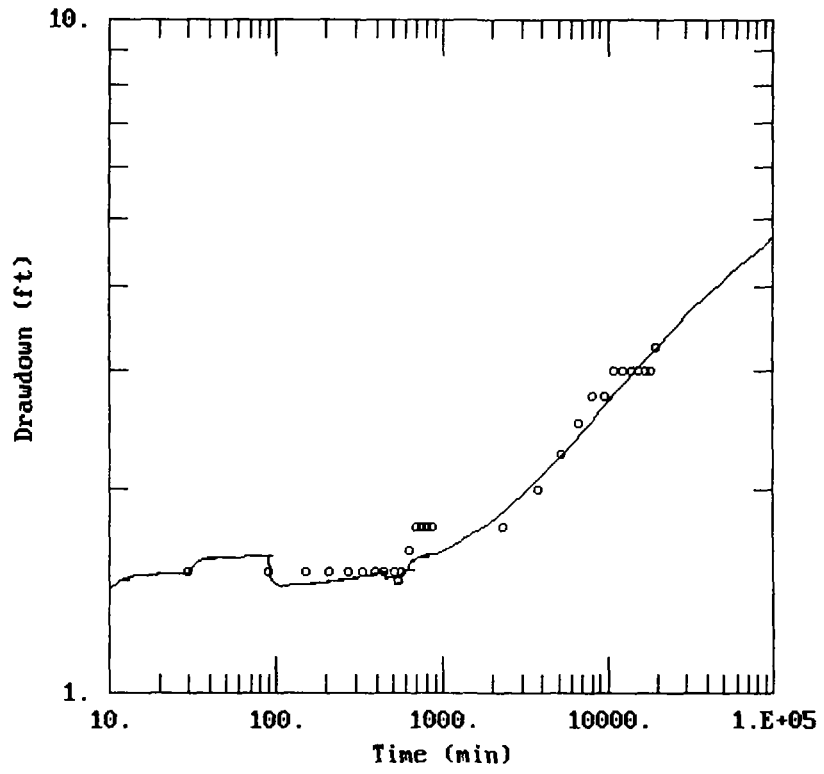
TEST DATA:
Q = 185. gal/min
r = 200. ft
b = 53. ft
Pumping Well Screen Depth:
  top = 35. ft
  bot.= 40. ft
Obs. Well Screen Depth:
  top = 32. ft
  bot.= 37. ft

PARAMETER ESTIMATES:
T = 2.751 ft^2/min
S = 0.0037
Sy = 0.08685
ß = 0.4

AQTESOLV

CLIENT: Olin Corporation	COMPANY: Smith Environmental Tech. Corp
LOCATION: Wilmington, MA	PROJECT: 7074-0102

Town Park Pump Test, Obs Well 8



DATA SET:
PT8.DAT
05/06/96

AQUIFER MODEL:
Unconfined
SOLUTION METHOD:
Neuman (approx.)

PROJECT DATA:
test date: February 1962
test well: Well 1
obs. well: Well 8

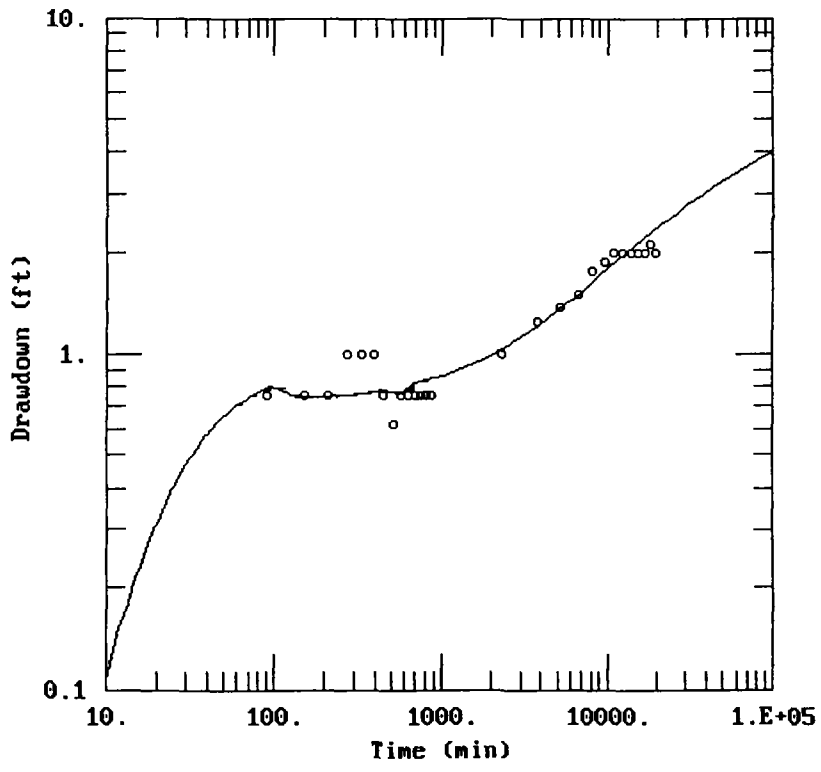
TEST DATA:
Q = 185. gal/min
r = 160. ft
b = 53. ft
Pumping Well Screen Depth:
top = 35. ft
bot.= 40. ft
Obs. Well Screen Depth:
top = 40. ft
bot.= 45. ft

PARAMETER ESTIMATES:
T = 1.933 ft^2/min
S = 0.0003793
Sy = 0.161
ß = 0.4

AQTESOLV

CLIENT: Olin Corporation	COMPANY: Smith Environmental Tech. Corp
LOCATION: Wilmington, MA	PROJECT: 7074-0102

Town Park Pump Test, Obs. Well 9



DATA SET:
PT9.DAT
05/06/96

AQUIFER MODEL:
Unconfined
SOLUTION METHOD:
Neuman (approx.)

PROJECT DATA:
test date: February 1962
test well: Well 1
obs. well: Well 9

TEST DATA:
Q = 185. gal/min
r = 275. ft
b = 53. ft
Pumping Well Screen Depth:
top = 35. ft
bot.= 40. ft
Obs. Well Screen Depth:
top = 26. ft
bot.= 31. ft

PARAMETER ESTIMATES:
T = 1.682 ft^2/min
S = 0.00147
Sy = 0.1403
ß = 0.8

AQTESOLV

AQTESOLV RESULTS

Version 2.01

Developed by Glenn M. Duffield

5/6/96 9:38

==========

TEST DESCRIPTION

Data set..... PT1AD.DAT
Output file..... PT1A.OUT
Data set title..... Town Park Pump Test, Obs Well 1A
Company..... Smith Environmental Tech Corp.
Project..... 7074-0102
Client..... Olin Corporation
Location..... Wilmington, MA
Test date..... February 1962
Test well..... Well 1
Obs. well..... Well 1A

Units of Measurement
Length..... ft
Time..... min
Pumping rate.... gal/min

Pumping Well Data
Well No. 1
Well identification..... WELL 1
X location..... 0
Y location..... 0
Casing radius..... 0.25
Wellbore radius..... 0.4
Depth to top of well screen..... 35
Depth to bottom of well screen... 40
Number of pumping periods..... 10

Period	Pumping Rate
1	185
2	195
3	175
4	175
5	170
6	165
7	172
8	177
9	177
10	175

```
Observation Well/Piezometer Data
  Well identification............. WELL 1A
  X location....................... 2
  Y location....................... 0
  Distance from pumping well #1.... 2
  Depth to top of well screen...... 35
  Depth to bottom of well screen... 40
  No. of observations............. 29

Aquifer Data
  Saturated thickness............. 53

=====================================
              ANALYTICAL METHOD

Neuman (approx.) (Unconfined Aquifer)
Partially Penetrating Well(s)

=====================================
        RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

        Estimate
  T  =  5.9570E+000 ft^2/min
  S  =  1.7600E-004
  Sy =  6.3000E-001
  B  =  4.1220E-003

Derived Parameters
  Kr    = 0.1124      ft/min
  Kz/Kr = 2.895
```

Town Park- Obs. well 1B

AQTESOLV RESULTS

Version 2.01

Developed by Glenn M. Duffield

#####

==========

TEST DESCRIPTION

Data set..... PT1B.DAT
Output file..... PT1B.OUT
Data set title..... Town Park Pump Test, Obs. Well 1B
Company..... Smith Environmental Tech Corp
Project..... 7074-0102
Client..... Olin Corporation
Location..... Wilmington, MA
Test date..... February 1962
Test well..... Well 1
Obs. well..... Well 1B

Units of Measurement
Length..... ft
Time..... min
Pumping rate.... gal/min

Pumping Well Data
Well No. 1
Well identification..... WELL 1
X location..... 0
Y location..... 0
Casing radius..... 0.25
Wellbore radius..... 0.4
Depth to top of well screen..... 35
Depth to bottom of well screen... 40
Number of pumping periods..... 10

Period	Pumping Rate
1	185
2	195
3	175
4	175
5	170
6	165
7	172
8	177
9	177
10	175

Town Park- Obs. well 1B

Observation Well/Piezometer Data
- Well identification..... well 1b
- X location..... 2
- Y location..... 0
- Distance from pumping well #1.... 2
- Depth to top of well screen..... 35
- Depth to bottom of well screen... 40
- No. of observations..... 29

Aquifer Data
- Saturated thickness..... 53

==========

ANALYTICAL METHOD

Neuman (approx.) (Unconfined Aquifer)
Partially Penetrating Well(s)

==========

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

	Estimate
T =	4.1620E+000 ft^2/min
S =	1.4500E-005
Sy =	8.7380E-001
B =	4.0000E-003

Derived Parameters
- Kr = 0.07853 ft/min
- Kz/Kr = 2.809

AQTESOLV RESULTS
Version 2.01
Developed by Glenn M. Duffield

5/6/96 11:04

==========

TEST DESCRIPTION

Data set..... PT2.DAT
Output file..... PT2.OUT
Data set title..... Town Park Pump Test, Well 2-3-13
Company..... Smith Environmental Tech. Corp
Project..... 7074-0102
Client..... Olin Corporation
Location..... Wilmington, MA
Test date..... February 1962
Test well..... Well 1
Obs. well..... Well 2-3-13

Units of Measurement
Length..... ft
Time..... min
Pumping rate.... gal/min

Pumping Well Data
Well No. 1
Well identification..... WELL 1
X location..... 0
Y location..... 0
Depth to top of well screen..... 35
Depth to bottom of well screen... 40
Number of pumping periods..... 10

Period	Pumping Rate
1	185
2	195
3	175
4	175
5	170
6	165
7	172
8	177
9	177
10	175

Town Park- Obs. Well 2

Observation Well/Piezometer Data
Well identification..... WELL 2,3,&13
X location..... 200
Y location..... 0
Distance from pumping well #1.... 200
Depth to top of well screen..... 32
Depth to bottom of well screen... 37
No. of observations..... 49

Aquifer Data
Saturated thickness..... 53

==========

ANALYTICAL METHOD

Neuman (approx.) (Unconfined Aquifer)
Partially Penetrating Well(s)

==========

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

	Estimate
T =	2.7509E+000 ft^2/min
S =	3.7000E-003
Sy =	8.6853E-002
B =	4.0000E-001

Derived Parameters
Kr = 0.0519 ft/min
Kz/Kr = 0.02809

AQTESOLV RESULTS
Version 2.01
Developed by Glenn M. Duffield

#####

==========

TEST DESCRIPTION

Data set..... PT8.DAT
Output file..... PT8.OUT
Data set title..... Town Park Pump Test, Obs Well 8
Company..... Smith Environmental Tech. Corp
Project..... 7074-0102
Client..... Olin Corporation
Location..... Wilmington, MA
Test date..... February 1962
Test well..... Well 1
Obs. well..... Well 8

Units of Measurement
Length..... ft
Time..... min
Pumping rate.... gal/min

Pumping Well Data
Well No. 1
Well identification..... WELL 1
X location..... 0
Y location..... 0
Depth to top of well screen..... 35
Depth to bottom of well screen... 40
Number of pumping periods..... 10

Period	Pumping Rate
1	185
2	195
3	175
4	175
5	170
6	165
7	172
8	177
9	177
10	175

Observation Well/Piezometer Data
Well identification..... WELL 8

Town Park -Obs well 8

X location..... 160
Y location..... 0
Distance from pumping well #1.... 160
Depth to top of well screen..... 40
Depth to bottom of well screen... 45
No. of observations..... 28

Aquifer Data
Saturated thickness..... 53

==========

ANALYTICAL METHOD

Neuman (approx.) (Unconfined Aquifer)
Partially Penetrating Well(s)

==========

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

	Estimate
T =	1.9330E+000 ft^2/min
S =	3.7930E-004
Sy =	1.6100E-001
B =	4.0000E-001

Derived Parameters
Kr = 0.03647 ft/min
Kz/Kr = 0.04389

Table ##

Specification Summary for Butters Row Wells

Olin Corporation
Wilmington, MA Facility

Thickness of Aquifer: 62 feet
Reference: Olin Monitoring Well GW-64-D

Pump Well(s): 2
3

Pump Rate(s): 520 gpm
475 gpm

Observation Well(s): 17
19
19A
19B
19C

Well Locations and Geometry

Well Name	Well Location Coordinates X	Y	Well Diameter (feet)	Screened Interval (feet bgs)
Well 2	650	200	0.67	36-46
Well 3	200	300	0.67	42-52
Well 17	650	302	0.20	28.5-38.5
Well 19	200	298	0.20	39.8-44.8
Well 19A	301	299	0.20	36-46
Well 19B	20	390	0.20	28-38
Well 19C	?	?	0.20	40-50

BUTTERS ROW PUMP TEST

Date	Time	Elapsed Time (min)	Pumping Rate (gpm)		Drawdown (feet)						
			Pump Well 2	Pump Well 3	19B Well	18 & 20 Well	19D,17B, Well	19C Well	17,17A Well	19 Well	19A Well
1/8/64	10:00	0	0	550	0.0	0.0	0.0	0.0	0.0	0.0	0
1/8/64	11:00	60	0	540	0.4	0.4	0.6	0.2	0.0	0.2	0.3
1/8/64	11:30	90	595	540					0.0		
1/8/64	12:00	120	510	520	0.8	0.8	1.4	0.4	0.2	0.7	0.8
1/8/64	13:00	180	510	515	1.2	1.0	1.2	0.9	0.4	1.0	1.8
1/8/64	14:00	240	510	515	1.2	1.5	2.4	1.0	0.6	1.2	1.8
1/8/64	15:00	300	510	515	1.2	1.5	2.6	1.2	0.7	1.4	1.9
1/8/64	16:00	360	510	515	1.3	1.6	2.6	1.2	0.8	1.5	2
1/8/64	17:00	420	515	515	1.4	1.6	2.7	1.2	0.9	1.6	2
1/8/64	18:00	480	520	515	1.4	1.7	2.8	1.2	1.0	1.6	2
1/8/64	19:00	540	520	515	1.5	1.8	2.9	1.3	0.8	1.6	2.1
1/8/64	20:00	600	520	515	1.6	1.9	3.0	1.4	1.2	1.6	2.2
1/8/64	21:00	660	520	515	1.6	2.0	3.0	1.4	1.3	1.7	2.2
1/8/64	22:00	720	520	515	1.6	2.0	3.1	1.4	1.4	1.7	2.2
1/8/64	23:00	780	520	515	1.6	2.0	3.2	1.5	1.5	1.8	2.3
1/9/64	0:00	840	520	515	1.8	2.0	3.3	1.6	1.6	1.8	2.4
1/10/64	0:00	2280	520	510	2.6	3.0	4.0	1.8	2.4	2.6	3.2
1/11/64	0:00	3720	520	480	2.8	3.6	4.6	2.6	3.3	3.0	3.4
1/12/64	0:00	5160	520	475	3.2	3.7	4.8	2.8	3.8	3.2	3.8
1/13/64	0:00	6600	520	475	3.6	3.8	5.0	3.0	4.2	3.3	3.8
1/14/64	0:00	8040	520	475	3.8	4.0	5.4	3.2	4.2	3.4	4.1
1/15/64	0:00	9480	520	475	4.0	4.3	5.4	3.0	4.2	3.3	4.1
1/16/64	0:00	10920	520	475	4.0	4.3	5.4	3.0	4.2	3.4	4.1
1/17/64	0:00	12360	520	475	4.0	4.3	5.4	3.0	4.2	3.4	4.1

Specification Summary for Chestnut Street Wells
Olin Corporation
Wilmington, MA Facility

Thickness of Aquifer: 56 feet
Reference: Chestnut St
Pump Well 1A

Twenty-four Hour Pump Test

Pump Well(s): 1A Pump Rate: 75 gpm

Observation Well(s): 1o, 2, 3, 4, 5

Well Locations and Geometry

Well Name	Distance From Pump Well (feet)	Well Diameter (feet)	Screened Interval (feet bgs)
1A	0	0.67	45-55
1o	3	0.21	25-27
2	75	0.21	31-36
3	125	0.21	14-19
4/C	172	0.21	16.5-21.5
5/B	135	0.21	21.5-26.5

Forty-eight Hour Pump Test

Pump Well(s): Well 1A Pump Rate(s): 503 gpm
Well 1C 200 gpm

Observation Well(s): 1, 1o, 2, 3, 4, 5, C

Well Locations and Geometry

Well Name	Well Location Coordinates		Well Diameter (feet)	Screened Interval (feet bgs)
	X	Y		
1A	144	120	2	45-55
1C	144	20	0.67	40-55
1	144	123	0.21	25-27
1o	144	125	0.21	25-27
2	144	196	0.21	31-36
3	144	248	0.21	14-19
4/C	16	232	0.21	16.6-21.6
5/B	84	0	0.21	21.5-26.5

CHESTNUT STREET 24 HOUR PUMP TEST

Observation Wells: Date	Time	Elapsed Time	Pump Rate (1A)	1o Drawdown	2 Drawdown	3 Drawdown	4/C Drawdown	5/B Drawdown
				0.00	0.00	0.00	0.00	0.00
1/13/91	14:31	0.00	75.00	1.08				
1/13/91	14:32	1.00	75.00	1.08				
1/13/91	14:33	2.00	75.00	1.00				
1/13/91	14:35	4.00	75.00	1.00				
1/13/91	14:40	9.00	75.00	1.04	0.08			
1/13/91	14:45	14.00	75.00	1.08	0.08	0.00	-0.04	0.08
1/13/91	15:00	29.00	75.00	1.08	0.08	0.00	-0.04	0.08
1/13/91	15:15	44.00	75.00	1.08	0.08	0.00	-0.04	0.08
1/13/91	15:30	59.00	75.00	1.08	0.08	0.00	-0.04	0.08
1/13/91	16:30	119.00	75.00	1.08	0.13	0.04	0.00	0.13
1/13/91	17:30	179.00	75.00	1.08	0.13	0.08	0.00	0.13
1/13/91	18:30	239.00	75.00	1.13	0.17	0.08	0.00	0.08
1/13/91	19:30	299.00	75.00	1.17	0.17	0.13	0.04	0.17
1/13/91	20:30	359.00	75.00	1.17	0.17	0.13	0.13	0.19
1/13/91	21:30	419.00	75.00	1.17	0.25	0.21	0.10	0.21
1/13/91	22:30	479.00	75.00	1.17	0.25	0.19	0.11	0.21
1/13/91	23:30	539.00	75.00	1.17	0.25	0.19	0.11	0.21
1/14/91	0:30	599.00	75.00	1.17	0.25	0.19	0.09	0.21
1/14/91	1:30	659.00	75.00	1.17	0.25	0.19	0.08	0.23
1/14/91	2:30	719.00	75.00	1.17	0.25	0.19	0.09	0.23
1/14/91	3:30	779.00	75.00	1.17	0.25	0.19	0.09	0.23
1/14/91	4:30	839.00	75.00	1.17	0.25	0.19	0.09	0.25
1/14/91	5:30	899.00	75.00	1.17	0.25	0.19	0.09	0.25
1/14/91	6:30	959.00	75.00	1.17	0.25	0.19	0.09	0.25
1/14/91	7:30	1019.00	75.00	1.21	0.27	0.25	0.11	0.25
1/14/91	8:30	1079.00	75.00	1.21	0.27	0.21	0.21	0.25
1/14/91	9:30	1139.00	75.00	1.21	0.27	0.21	0.21	0.27
1/14/91	10:30	1199.00	75.00	1.21	0.27	0.19	0.21	0.27
1/14/91	11:30	1259.00	75.00	1.25	0.27	0.21	0.21	0.27
1/14/91	12:30	1319.00	75.00	1.25	0.27	0.21	0.21	0.27
1/14/91	13:30	1379.00	75.00	1.21	0.29	0.21	0.21	0.29
1/14/91	14:30	1439.00	75.00	1.21		0.21	0.21	0.29

CHESTNUT STREET 48 HOUR PUMP TEST

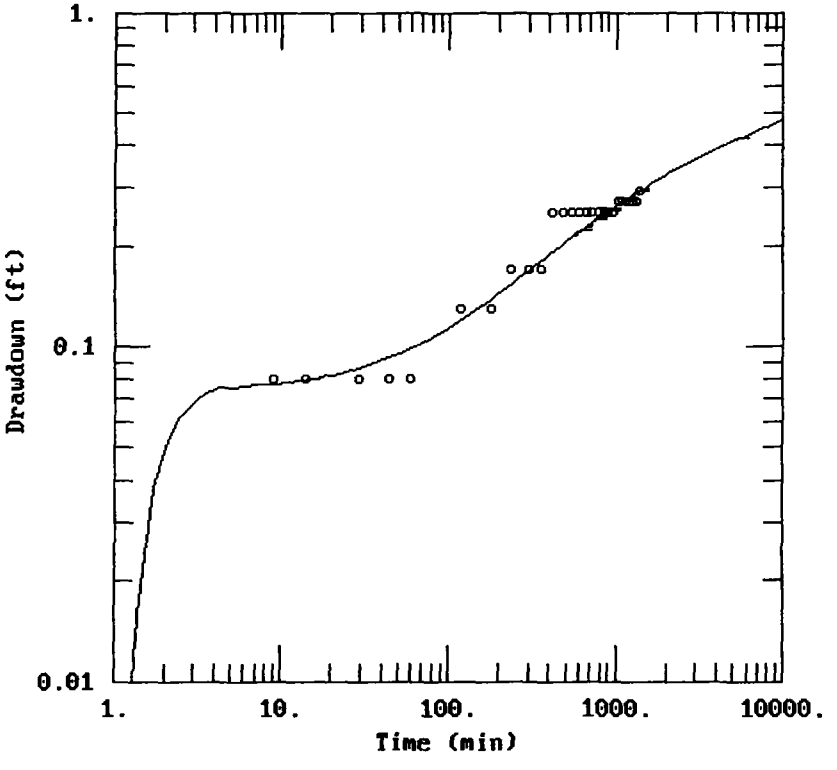
Well 1-A* and Chestnut Street Well 1 (1C)

Date	Time	Elapsed Time (min)	Pumping Rate (gpm)		Drawdown (feet)							
			Pump Well 1C	Pump Well 1A	1C Well	1 Well	1o Well	2 Well	3 Well	4 Well	C Well	5/B Well
8/28/91	9:00	0.00	200.00	0.00								
8/28/91	10:00	60.00	200.00	0.00								
8/28/91	11:00	120.00	200.00	0.00								
8/28/91	11:30	150.00	200.00	503.00								
8/28/91	11:31	151.00	200.00	503.00		4.70						
8/28/91	11:32	152.00	200.00	503.00		4.75						
8/28/91	11:33	153.00	200.00	503.00		4.79						
8/28/91	11:34	154.00	200.00	503.00		4.81						
8/28/91	11:35	155.00	200.00	503.00		4.85	4.72					
8/28/91	11:36	156.00	200.00	503.00		4.85	4.74					
8/28/91	11:37	157.00	200.00	503.00		4.86	4.79					
8/28/91	11:38	158.00	200.00	503.00		4.87	4.79					
8/28/91	11:39	159.00	200.00	503.00		4.89	4.79					
8/28/91	11:40	160.00	200.00	503.00		4.91	4.80					
8/28/91	11:45	165.00	200.00	503.00		4.93	4.86					
8/28/91	11:50	170.00	200.00	503.00		4.87	4.80	0.72	0.31			
8/28/91	11:55	175.00	200.00	503.00		4.77	4.82	0.73	0.32			
8/28/91	12:00	180.00	200.00	503.00		4.96	4.83	0.76	0.34			
8/28/91	12:15	195.00	200.00	503.00		4.97	4.93	0.83	0.38	0.50	0.07	
8/28/91	12:30	210.00	200.00	503.00		4.98	4.93	0.87	0.43	0.54	0.11	
8/28/91	13:00	240.00	200.00	503.00								0.01
8/28/91	14:00	300.00	200.00	503.00	26.43	5.07	4.97	0.92	0.48	0.54	0.15	0.02
8/28/91	16:00	420.00	200.00	503.00	26.46	5.19	5.13	1.04	0.60	0.71	0.26	0.02
8/28/91	18:00	540.00	200.00	503.00	26.48	5.37	5.36	1.25	0.85	0.86	0.45	0.03
8/29/91	6:00	1260.00	200.00	503.00	27.65	5.48	5.44	1.35	0.89	0.99	0.54	0.17
8/29/91	10:00	1500.00	200.00	503.00	26.44	6.02	6.01	1.90	1.43	1.49	1.04	0.2
8/29/91	14:00	1740.00	200.00	503.00	26.49	6.11	6.08	1.99	1.49	1.54	1.1	0.23
8/29/91	16:00	1860.00	200.00	503.00		6.14	6.13	2.07	1.57	1.61	1.21	
8/29/91	18:00	1980.00	200.00	503.00	26.53	6.21	6.18	2.11	1.64	1.67	1.25	0.25
8/30/91	6:00	2700.00	200.00	503.00	27.22	6.40	6.36	2.29	1.80	1.81	1.42	0.34
8/30/91	10:00	2940.00	200.00	503.00	27.00	6.44	6.41	2.35	1.83	1.86	1.45	0.35
8/30/91	12:00	3060.00	200.00	503.00	27.10	6.45	6.52	2.36	1.88	1.89	1.47	0.35

* Well 1-A shown in the original data set as New Well 2

CLIENT: Olin Corporation	COMPANY: Smith Environmental Tech. Corp
LOCATION: Wilmington, MA	PROJECT: 7074-0102

Chestnut St. 24 hr Pump Test, Obs Well 2



DATA SET:
WELL2-1.DAT
01/12/96

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Neuman (approx.)

PROJECT DATA:
test date: March 1991
test well: Well 1-A
obs. well: Well 2

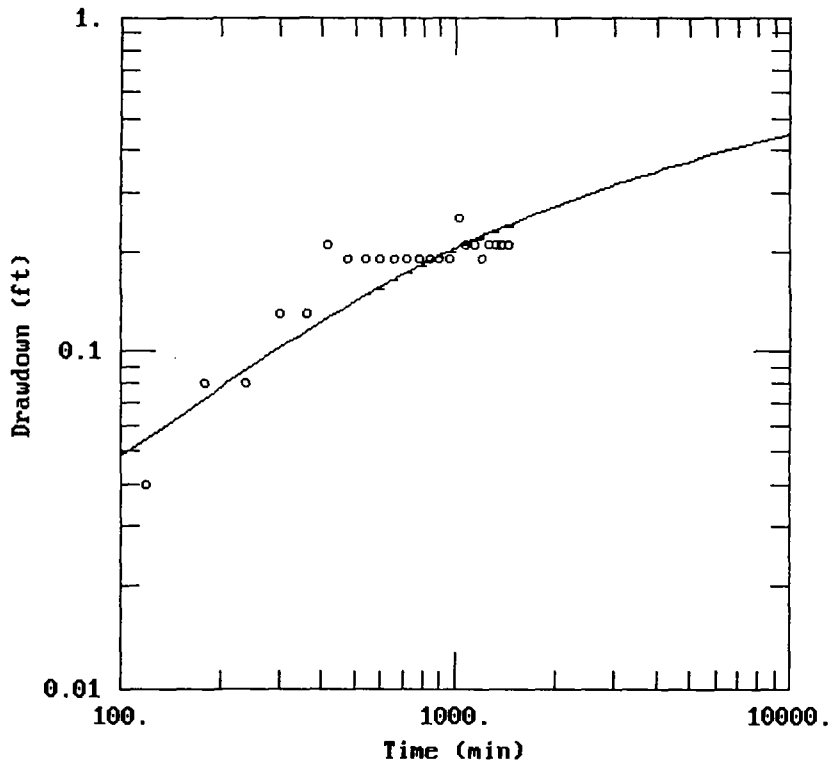
TEST DATA:
Q = 75. gal/min
r = 75. ft
r_c = 0.1 ft
r_w = 0.1 ft
b = 56. ft
Pumping Well Screen Depth:
  top = 45. ft
  bot.= 55. ft
Obs. Well Screen Depth:
  top = 31. ft
  bot.= 36. ft

PARAMETER ESTIMATES:
T = 8.175 ft^2/min
S = 0.003
Sy = 0.2562
ß = 0.8

AQTESOLV

CLIENT: Olin Corporation	COMPANY: Smith Environmental
LOCATION: Wilmington, MA	PROJECT: 7074-0102

Chestnut St 24. hr Pump Test, Obs Well 3



DATA SET:
WELL3-2.DAT
01/12/96

AQUIFER MODEL:
Unconfined
SOLUTION METHOD:
Neuman (approx.)

PROJECT DATA:
test date: March 1991
test well: Well 1-A
obs. well: Well 3

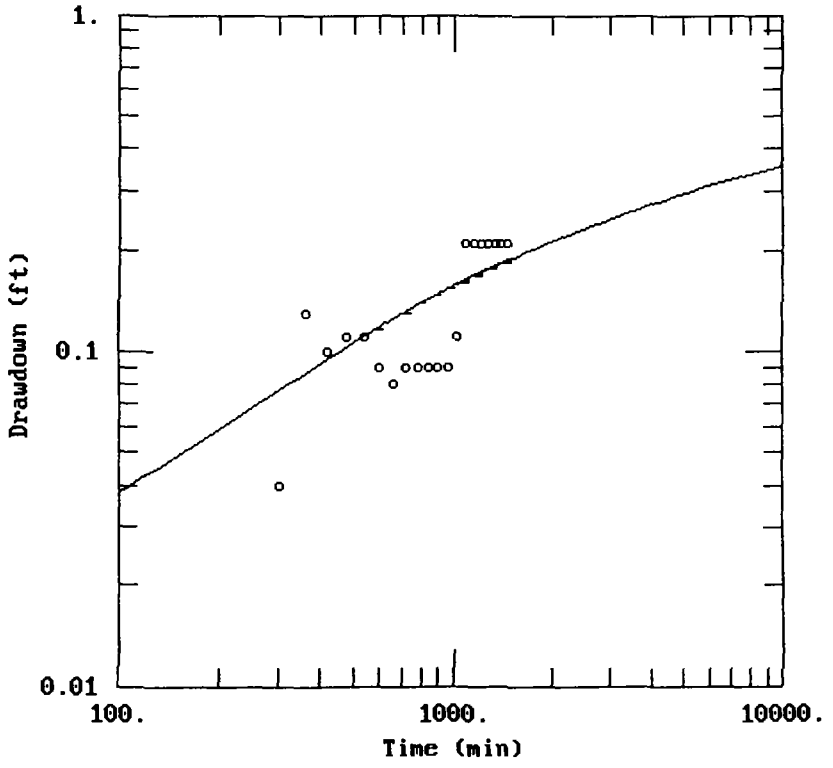
TEST DATA:
Q = 75. gal/min
r = 125. ft
r_c = 0.1 ft
r_w = 0.1 ft
b = 56. ft
Pumping Well Screen Depth:
top = 45. ft
bot.= 55. ft
Obs. Well Screen Depth:
top = 14. ft
bot.= 19. ft

PARAMETER ESTIMATES:
T = 7.247 ft^2/min
S = 0.0031
Sy = 0.1814
ß = 2.

AQTESOLV

CLIENT: Olin Corporation	COMPANY: Smith Environmental Tech. Corp
LOCATION: Wilmington, MA	PROJECT: 7074-0102

Chestnut St 24 hr Pump Test,Obs Well 4/C



DATA SET:
WELL4.DAT
05/07/96

AQUIFER MODEL:
Unconfined
SOLUTION METHOD:
Neuman (approx.)

PROJECT DATA:
test date: March 1991
test well: Well 1-A
obs. well: Well 4/C

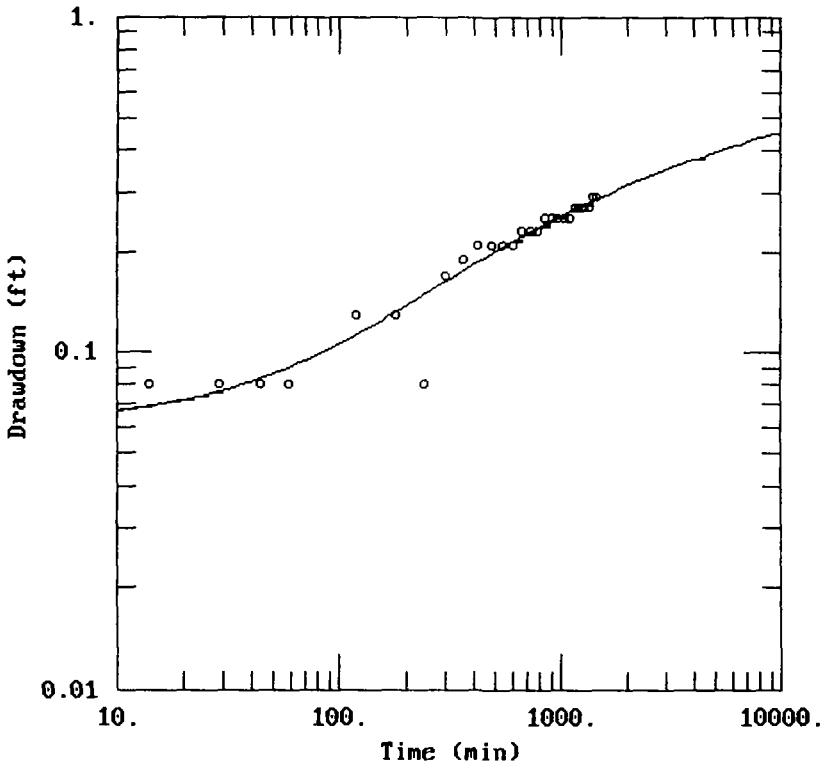
TEST DATA:
Q = 75. gal/min
r = 172. ft
r_c = 0.1 ft
r_w = 0.1 ft
b = 56. ft
Pumping Well Screen Depth:
top = 45. ft
bot.= 55. ft
Obs. Well Screen Depth:
top = 16.5 ft
bot.= 21.5 ft

PARAMETER ESTIMATES:
T = 8.706 ft^2/min
S = 0.003
Sy = 0.1373
β = 2.

AQTESOLV

CLIENT: Olin Corporation	COMPANY: Smith Environmental Tech Corp
LOCATION: Wilmington, MA	PROJECT: 00-70740-0102

Chestnut St 24 hr Pump Test, Obs Well 5



DATA SET:
WELL5.DAT
05/06/96

AQUIFER MODEL:
Unconfined
SOLUTION METHOD:
Neuman (approx.)

PROJECT DATA:
test date: March 1991
test well: Well 1-A
obs. well: Well 5

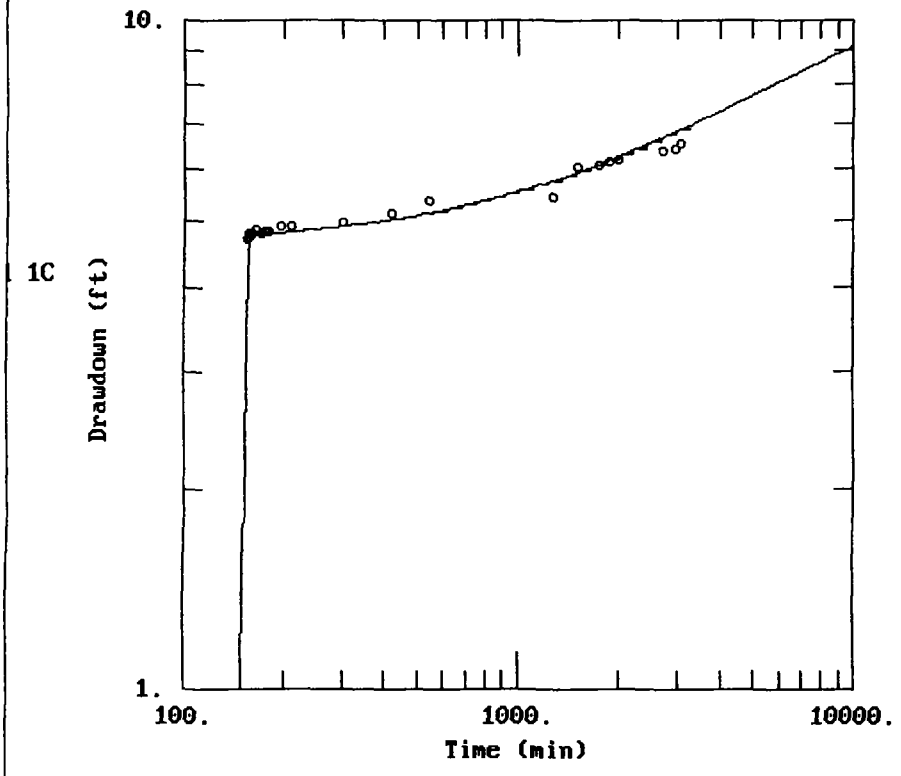
TEST DATA:
Q = 75. gal/min
r = 135. ft
r_c= 0.1 ft
r_w= 0.1 ft
b = 56. ft
Pumping Well Screen Depth:
top = 45. ft
bot.= 55. ft
Obs. Well Screen Depth:
top = 21.5 ft
bot.= 26.5 ft

PARAMETER ESTIMATES:
T = 8.908 ft^2/min
S = 0.0001614
Sy = 0.06387
β = 0.6158

AQTESOLV

CLIENT: Olin Corporation	COMPANY: Smith Environmental Tech Corp
LOCATION: Wilmington, MA	PROJECT: 00-7074-0102

Chestnut St 48 Hr Pump Test, Obs Well 1o



DATA SET:
WELL1-O.DAT
01/12/96

AQUIFER MODEL:
Unconfined
SOLUTION METHOD:
Neuman (approx.)

PROJECT DATA:
test date: August 1991
test well: Chestnut St. Well 1A an
obs. well: Well 1-o

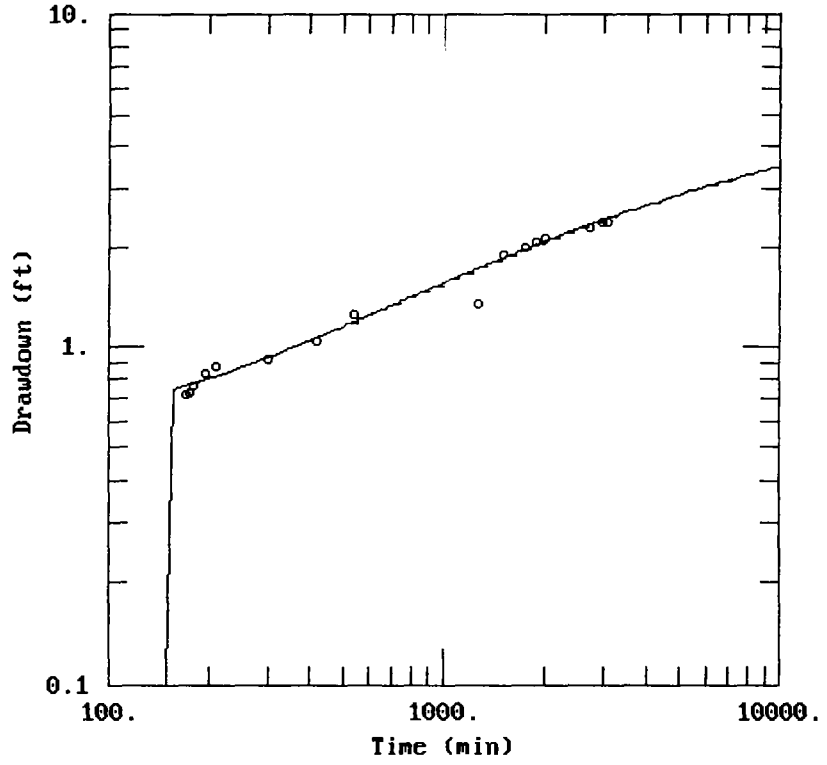
TEST DATA:
Q = 503. gal/min
r = 5. ft
r_c = 1. ft
r_w = 1.5 ft
b = 56. ft
Pumping Well Screen Depth:
top = 45. ft
bot.= 55. ft
Obs. Well Screen Depth:
top = 25. ft
bot.= 27. ft

PARAMETER ESTIMATES:
T = 3.13 ft^2/min
S = 0.00085
Sy = 0.5
β = 0.001

AQTESOLV

CLIENT: Olin Corporation	COMPANY: Smith Environmental Tech Corp
LOCATION: Wilmington, MA	PROJECT: 00-7074-0102

Chestnut St 48 Hr Pump Test, Obs Well 2



DATA SET:
WELL2.DAT
01/12/96

AQUIFER MODEL:
Unconfined
SOLUTION METHOD:
Neuman (approx.)

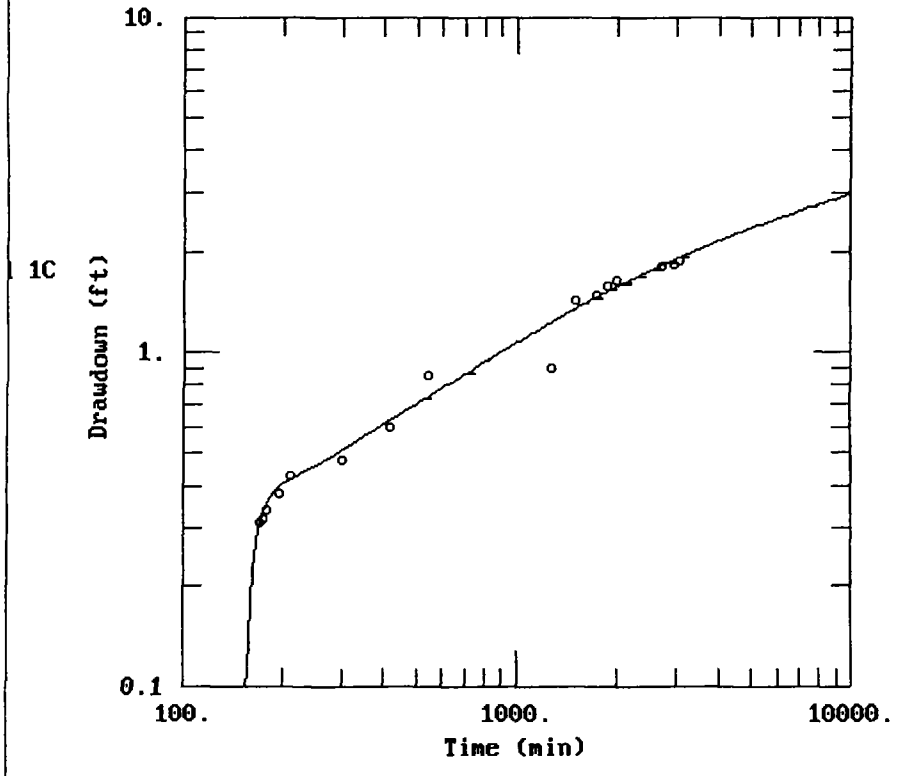
TEST DATA:
Q = 503. gal/min
r = 76. ft
r_c = 1. ft
r_w = 1.5 ft
b = 56. ft
Pumping Well Screen Depth:
  top = 45. ft
  bot.= 55. ft
Obs. Well Screen Depth:
  top = 31. ft
  bot.= 36. ft

PARAMETER ESTIMATES:
T = 8.001 ft^2/min
S = 0.00026
Sy = 0.5
ß = 0.5698

AQTESOLV

CLIENT: Olin Corporation	COMPANY: Smith Environmental Tech Corp
LOCATION: Wilmington, MA	PROJECT: 00-7074-0102

Chestnut St 48 Hr Pump Test, Obs Well 3



1C

DATA SET:
WELL3.DAT
01/12/96

AQUIFER MODEL:
Unconfined
SOLUTION METHOD:
Neuman (approx.)

PROJECT DATA:
test date: August 1991
test well: Chestnut St. Well 1A an
obs. well: Observation Well 3

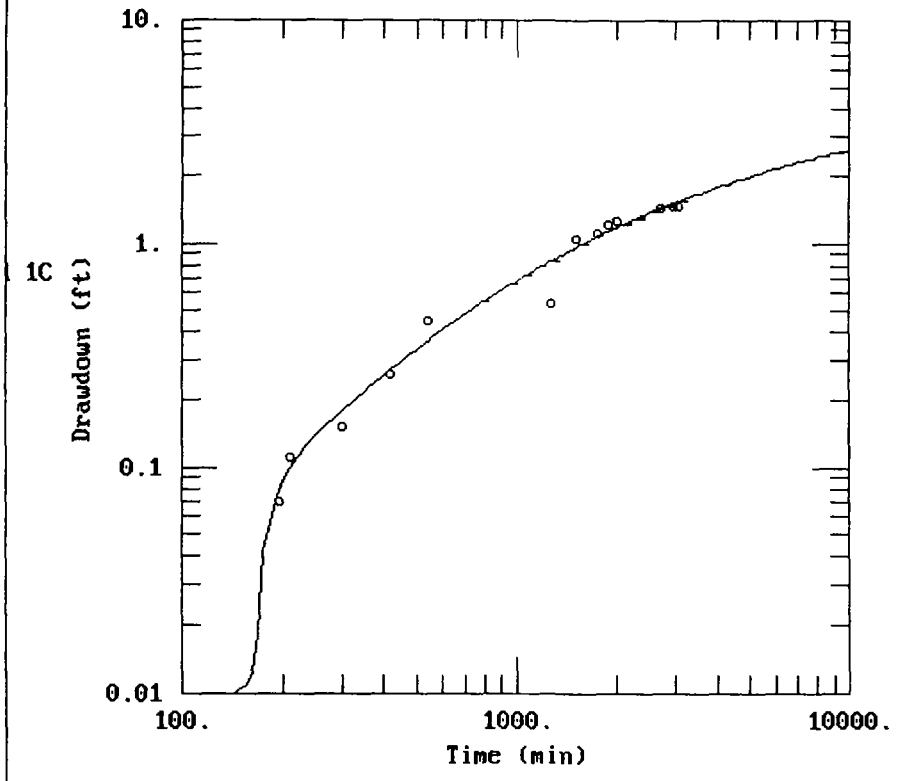
TEST DATA:
Q = 503. gal/min
r = 128. ft
r_c = 1. ft
r_w = 1.5 ft
b = 56. ft
Pumping Well Screen Depth:
top = 45. ft
bot.= 55. ft
Obs. Well Screen Depth:
top = 14. ft
bot.= 19. ft

PARAMETER ESTIMATES:
T = 8.16 ft^2/min
S = 0.014
Sy = 0.3
ß = 0.68

AQTESOLV

CLIENT: Olin Corporation	COMPANY: Smith Environmental Tech Corp
LOCATION: Wilmington, MA	PROJECT: 00-7074-0102

Chestnut St 48 Hr Pump Test,Obs Well 4/C



DATA SET:
WELL4.DAT
05/07/96

AQUIFER MODEL:
Unconfined
SOLUTION METHOD:
Neuman (approx.)

PROJECT DATA:
test date: August 1991
test well: Chestnut St. Well 1A an
obs. well: Well 4/C

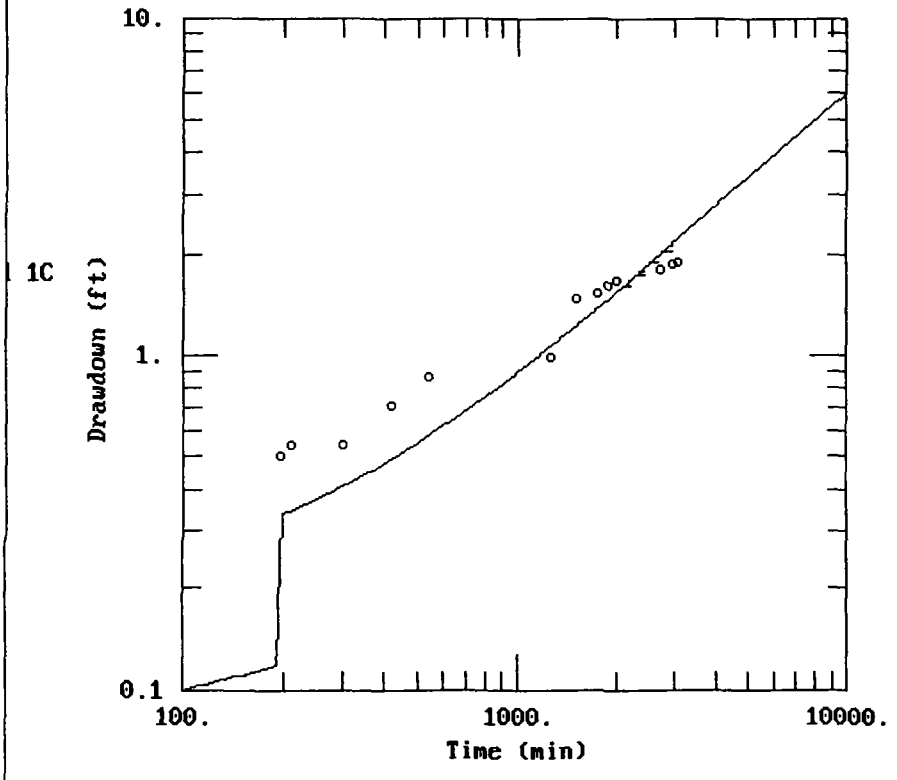
TEST DATA:
Q = 503. gal/min
r = 170.1 ft
r_c = 1. ft
r_w = 1.5 ft
b = 56. ft
Pumping Well Screen Depth:
top = 45. ft
bot.= 55. ft
Obs. Well Screen Depth:
top = 16.5 ft
bot.= 21.5 ft

PARAMETER ESTIMATES:
T = 7.57 ft^2/min
S = 0.056
Sy = 0.33
ß = 3.38

AQTESOLV

CLIENT: Olin Corporation	COMPANY: Smith Environmental Tech Corp
LOCATION: Wilmington, MA	PROJECT: 00-7074-0102

Chestnut St 48 Hr Pump Test, Obs Well 5



DATA SET:
WELL5.DAT
05/06/96

AQUIFER MODEL:
Unconfined
SOLUTION METHOD:
Neuman (approx.)

PROJECT DATA:
test date: August 1991
test well: Chestnut St. Well 1A an
obs. well: Well 5

TEST DATA:
Q = 503. gal/min
r = 134.2 ft
r_c = 1. ft
r_w = 1.5 ft
b = 56. ft
Pumping Well Screen Depth:
top = 45. ft
bot.= 55. ft
Piezometer Depth:
setting = 1. ft

PARAMETER ESTIMATES:
T = 0.9035 ft^2/min
S = 0.02259
Sy = 0.06047
ß = 0.02891

AQTESOLV

AQTESOLV RESULTS
Version 2.01
Developed by Glenn M. Duffield

1/3/96 15:30

==========

TEST DESCRIPTION

Data set..... WELL2-1.DAT
Output file..... WELL2-1.OUT
Data set title..... Chestnut St 24 hr Pump Test, Obs Well 2

Units of Measurement
Length..... ft
Time..... min
Pumping rate.... gal/min

Pumping Well Data
Well No. 1
Well identification..... well 1a
X location..... 0
Y location..... 0
Casing radius..... 0.1
Wellbore radius..... 0.1
Depth to top of well screen..... 45
Depth to bottom of well screen... 55
Number of pumping periods..... 5

Period	Pumping Rate
1	75
2	75
3	75
4	75
5	75

Observation Well/Piezometer Data
Well identification..... well 2
X location..... 75
Y location..... 0
Distance from pumping well #1.... 75
Depth to top of well screen..... 31
Depth to bottom of well screen... 36
No. of observations..... 27

Aquifer Data
Saturated thickness..... 56

Chestnut St- Obs. 2 (24 hr. test)

==========

ANALYTICAL METHOD

Neuman (approx.) (Unconfined Aquifer)
Partially Penetrating Well(s)

==========

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

	Estimate
T =	8.1754E+000 ft^2/min
S =	3.1139E-003
Sy =	2.5619E-001
B =	8.0000E-001

Derived Parameters
Kr = 0.146 ft/min
Kz/Kr = 0.446

<<<<<<<<<<>>>>>>>>>>

AQTESOLV RESULTS

Version 2.01

Developed by Glenn M. Duffield

1/3/96 15:37

==========

TEST DESCRIPTION

Data set..... WELL3-2.DAT
Output file..... WELL3-1.OUT
Data set title..... Chestnut St 24 hr Pump Test, Obs Well 3

Units of Measurement
- Length..... ft
- Time..... min
- Pumping rate.... gal/min

Pumping Well Data
- Well No. 1
- Well identification..... well 1a
- X location..... 0
- Y location..... 0
- Casing radius..... 0.1
- Wellbore radius..... 0.1
- Depth to top of well screen..... 45
- Depth to bottom of well screen... 55
- Number of pumping periods..... 5

Period	Pumping Rate
1	75
2	75
3	75
4	75
5	75

Observation Well/Piezometer Data
- Well identification..... well 3
- X location..... 125
- Y location..... 0
- Distance from pumping well #1.... 125
- Depth to top of well screen..... 14
- Depth to bottom of well screen... 19
- No. of observations..... 23

Aquifer Data
- Saturated thickness..... 56

Chestnut St-Obs Well 3(24 hr. test)

==========

ANALYTICAL METHOD

Neuman (approx.) (Unconfined Aquifer)
Partially Penetrating Well(s)

==========

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

	Estimate
T =	7.2468E+000 ft^2/min
S =	3.1877E-003
Sy =	1.8138E-001
B =	2.0000E+000

Derived Parameters

Kr = 0.1294 ft/min
Kz/Kr = 0.4014

<<<<<<<<<<>>>>>>>>>>

AQTESOLV RESULTS
Version 2.01
Developed by Glenn M. Duffield

1/3/96 15:44

==========

TEST DESCRIPTION

Data set..... WELL4-2.DAT
Output file..... WELL4-2.OUT
Data set title..... Chestnut St 24 hr Pump Test, Obs Well 4

Units of Measurement
Length..... ft
Time..... min
Pumping rate.... gal/min

Pumping Well Data
Well No. 1
Well identification..... well 1a
X location..... 0
Y location..... 0
Casing radius..... 0.1
Wellbore radius..... 0.1
Depth to top of well screen..... 45
Depth to bottom of well screen... 55
Number of pumping periods..... 5

Period	Pumping Rate
1	75
2	75
3	75
4	75
5	75

Observation Well/Piezometer Data
Well identification..... well 4
X location..... 172
Y location..... 0
Distance from pumping well #1.... 172
Depth to top of well screen..... 16.5
Depth to bottom of well screen... 21.5
No. of observations..... 20

Aquifer Data
Saturated thickness..... 56

Chestnut St-Obs Well 4 (24 hr test)

==========

ANALYTICAL METHOD

Neuman (approx.) (Unconfined Aquifer)
Partially Penetrating Well(s)

==========

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

	Estimate
T =	8.7058E+000 ft^2/min
S =	3.0000E-003
Sy =	1.3732E-001
B =	2.0000E+000

Derived Parameters
Kr = 0.1555 ft/min
Kz/Kr = 0.212

AQTESOLV RESULTS
Version 2.01
Developed by Glenn M. Duffield

5/6/96 16:02

TEST DESCRIPTION

Data set..... WELL5.DAT
Output file..... WELL5.OUT
Data set title..... Chestnut St 24 hr Pump Test, Obs Well 5
Company..... Smith Environmental Tech Corp
Project..... 00-70740-0102
Client..... Olin Corporation
Location..... Wilmington, MA
Test date..... March 1991
Test well..... Well 1-A
Obs. well..... Well 5

Units of Measurement
Length..... ft
Time..... min
Pumping rate.... gal/min

Pumping Well Data
Well No. 1
Well identification..... well 1a
X location..... 0
Y location..... 0
Casing radius..... 0.1
Wellbore radius..... 0.1
Depth to top of well screen..... 45
Depth to bottom of well screen... 55
Number of pumping periods..... 5

Period	Pumping Rate
1	75
2	75
3	75
4	75
5	75

Observation Well/Piezometer Data
Well identification..... well 5
X location..... 135
Y location..... 0
Distance from pumping well #1.... 135
Depth to top of well screen..... 21.5
Depth to bottom of well screen... 26.5
No. of observations..... 27

Aquifer Data
Saturated thickness..... 56

==========

ANALYTICAL METHOD

Neuman (approx.) (Unconfined Aquifer)
Partially Penetrating Well(s)

==========

RESULTS FROM STATISTICAL CURVE MATCHING

STATISTICAL MATCH PARAMETER ESTIMATES

	Estimate	Std. Error
T =	8.9084E+000	+/- 1.2421E+000 ft^2/min
S =	1.6143E-004	+/- 1.7254E-002
Sy =	6.3868E-002	+/- 1.7709E-002
B =	6.1579E-001	+/- 1.3330E-001

Derived Parameters
Kr = 0.1591 ft/min
Kz/Kr = 0.106

ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated
weighted residual = residual * weight

Weighted Residual Statistics:
Number of residuals..... 27
Number of estimated parameters.... 4
Degrees of freedom..... 23
Residual mean..... -3.301E-005
Residual standard deviation..... 0.01725
Residual variance..... 0.0002977

Model Residuals:

Time	Observed	Calculated	Residual	Weight
14	0.08	0.068969	0.011031	1
29	0.08	0.076353	0.003647	1
44	0.08	0.083312	-0.00331	1
59	0.08	0.089975	-0.00997	1
119	0.13	0.11324	0.01676	1
179	0.13	0.13246	-0.00246	1
239	0.08	0.14886	-0.06886	1
299	0.17	0.16315	0.006846	1
359	0.19	0.17575	0.014251	1
419	0.21	0.18677	0.023225	1
479	0.21	0.19668	0.013323	1
539	0.21	0.20591	0.004094	1
599	0.21	0.21425	-0.00425	1
659	0.23	0.2218	0.008199	1
719	0.23	0.22865	0.001349	1
779	0.23	0.23489	-0.00489	1
839	0.25	0.24112	0.008882	1
899	0.25	0.24698	0.003016	1
959	0.25	0.25246	-0.00246	1
1019	0.25	0.25756	-0.00756	1
1079	0.25	0.26232	-0.01232	1
1139	0.27	0.26675	0.003253	1
1199	0.27	0.27088	-0.00088	1
1259	0.27	0.27473	-0.00473	1
1319	0.27	0.27843	-0.00843	1
1379	0.29	0.28241	0.007586	1
1439	0.29	0.28624	0.003755	1

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

Estimate

T = 8.9084E+000 ft^2/min
S = 1.6143E-004
Sy = 6.3868E-002
B = 6.1579E-001

Derived Parameters

Kr = 0.1591 ft/min
Kz/Kr = 0.106

AQTESOLV RESULTS
Version 2.01
Developed by Glenn M. Duffield

5/6/96 14:30

==========

TEST DESCRIPTION

Data set..... PT9.DAT
Output file..... PT9.OUT
Data set title..... Town Park Pump Test, Obs. Well 9
Company..... Smith Environmental Tech. Corp
Project..... 7074-0102
Client..... Olin Corporation
Location..... Wilmington, MA
Test date..... February 1962
Test well..... Well 1
Obs. well..... Well 9

Units of Measurement
Length..... ft
Time..... min
Pumping rate.... gal/min

Pumping Well Data
Well No. 1
Well identification..... WELL 1
X location..... 0
Y location..... 0
Depth to top of well screen..... 35
Depth to bottom of well screen... 40
Number of pumping periods..... 10

Period	Pumping Rate
1	185
2	195
3	175
4	175
5	170
6	165
7	172
8	177
9	177
10	175

Town Park- Obs well 9

Observation Well/Piezometer Data
Well identification..... well 9
X location..... 0
Y location..... 275
Distance from pumping well #1.... 275
Depth to top of well screen..... 26
Depth to bottom of well screen... 31
No. of observations..... 27

Aquifer Data
Saturated thickness..... 53

==========

ANALYTICAL METHOD

Neuman (approx.) (Unconfined Aquifer)
Partially Penetrating Well(s)

==========

RESULTS FROM STATISTICAL CURVE MATCHING

STATISTICAL MATCH PARAMETER ESTIMATES

	Estimate	Std. Error	
T =	2.7479E+000	+/- 5.5808E-001	ft^2/min
S =	2.1524E-003	+/- 1.6296E-003	
Sy =	7.1180E-002	+/- 2.9047E-002	
B =	4.4754E-001	+/- 1.0088E-001	

Derived Parameters
Kr = 0.05185 ft/min
Kz/Kr = 0.01662

ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated
weighted residual = residual * weight

Weighted Residual Statistics:
Number of residuals..... 27
Number of estimated parameters.... 4
Degrees of freedom..... 23
Residual mean..... -0.0002907
Residual standard deviation..... 0.1257
Residual variance..... 0.0158

Town Park- Obs well 9

Model Residuals:

Time	Observed	Calculated	Residual	Weight
90	0.75	0.74278	0.007217	1
150	0.75	0.74277	0.007225	1
210	0.75	0.74715	0.002848	1
270	1	0.76126	0.23874	1
330	1	0.77199	0.22801	1
390	1	0.78198	0.21802	1
450	0.75	0.79409	-0.04409	1
510	0.62	0.78891	-0.16891	1
570	0.75	0.77996	-0.02996	1
630	0.75	0.80955	-0.05955	1
690	0.75	0.84055	-0.09055	1
750	0.75	0.85583	-0.10583	1
810	0.75	0.86768	-0.11768	1
870	0.75	0.87211	-0.12211	1
2310	1	1.0973	-0.09729	1
3750	1.25	1.2763	-0.02631	1
5190	1.38	1.4236	-0.04361	1
6630	1.5	1.5455	-0.04553	1
8070	1.75	1.6522	0.097809	1
9510	1.88	1.7449	0.13513	1
10950	2	1.8252	0.17479	1
12390	2	1.898	0.10202	1
13830	2	1.9662	0.033829	1
15270	2	2.0277	-0.02768	1
16710	2	2.0831	-0.08311	1
18150	2.12	2.1331	-0.01308	1
19590	2	2.1782	-0.17819	1

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

Estimate

T = 1.6820E+000 ft^2/min
S = 1.4698E-003
Sy = 1.4032E-001
B = 8.0000E-001

Derived Parameters

Kr = 0.03174 ft/min
Kz/Kr = 0.02972

AQTESOLV RESULTS

Version 2.01
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1/4/96 11:03

==========

TEST DESCRIPTION

Data set..... WELL1-O.DAT
Output file..... WELL1-O.OUT
Data set title..... Chestnut St 48 Hour Pump Test Analysis
Company..... Smith Environmental Tech Corp
Project..... 00-7074-0102
Client..... Olin Corporation
Location..... Wilmington, MA
Test well..... Chestnut St. Well 1A and 1C
Obs. well..... Observation Well 1

Units of Measurement
Length..... ft
Time..... min
Pumping rate.... gal/min

Pumping Well Data
Well No. 1
Well identification..... Well 1A
X location..... 144
Y location..... 120
Casing radius..... 1
Wellbore radius..... 1.5
Depth to top of well screen..... 45
Depth to bottom of well screen... 55
Number of pumping periods..... 5

Period	Pumping Rate
1	503
2	503
3	503
4	503
5	503

Well No. 2
Well identification..... Well 1C
X location..... 144
Y location..... 20
Casing radius..... 0.67
Wellbore radius..... 1
Depth to top of well screen..... 40
Depth to bottom of well screen... 45
Number of pumping periods..... 7

Chestnut Street-Obs. Well 1-0

Period	Pumping Rate
1	200
2	200
3	200
4	200
5	200
6	200
7	200

Observation Well/Piezometer Data
- Well identification..... well1-o
- X location..... 144
- Y location..... 125
- Distance from pumping well #1.... 5
- Depth to top of well screen..... 25
- Depth to bottom of well screen... 27
- No. of observations..... 23

Aquifer Data
- Saturated thickness..... 56

==========

ANALYTICAL METHOD

Neuman (approx.) (Unconfined Aquifer)
Partially Penetrating Well(s)

==========

RESULTS FROM STATISTICAL CURVE MATCHING

STATISTICAL MATCH PARAMETER ESTIMATES

		Estimate	Std. Error	
T	=	3.13E+00 +/-	2.15E-01	ft^2/min
S	=	8.59E-04 +/-	3.46E-04	
Sy	=	5.00E-01 +/-	1.41E-01	
B	=	1.00E-03 +/-	1.42E-06	

Derived Parameters
- Kr = 0.05589 ft/min
- Kz/Kr = 0.1254

ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated
weighted residual = residual * weight

Chestnut Street-Obs. Well 1-0

Weighted Residual Statistics:
Number of residuals..... 23
Number of estimated parameters.... 4
Degrees of freedom..... 19
Residual mean..... -0.009183
Residual standard deviation..... 0.1741
Residual variance..... 0.03033

Model Residuals:

Time	Observed	Calculated	Residual	Weight
155	4.72	4.6239	0.096119	1
156	4.74	4.6819	0.058058	1
157	4.79	4.7167	0.073335	1
158	4.79	4.7381	0.05191	1
159	4.79	4.7517	0.038287	1
160	4.8	4.7606	0.039366	1
165	4.86	4.7784	0.081639	1
170	4.8	4.7853	0.014737	1
175	4.82	4.791	0.028977	1
180	4.83	4.7964	0.033593	1
195	4.93	4.8121	0.11787	1
210	4.93	4.8276	0.10244	1
300	4.97	4.916	0.054035	1
420	5.13	5.03	0.099961	1
540	5.36	5.1428	0.21717	1
1260	5.44	5.7366	-0.29659	1
1500	6.01	5.9129	0.097128	1
1740	6.08	6.0801	-5.15E-05	1
1860	6.13	6.1601	-0.03014	1
1980	6.18	6.2381	-0.05807	1
2700	6.36	6.6664	-0.30643	1
2940	6.41	6.796	-0.38598	1
3060	6.52	6.8586	-0.33857	1

==========

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

		Estimate
T	=	3.13E+00 ft^2/min
S	=	8.59E-04
Sy	=	5.00E-01
B	=	1.00E-03

Derived Parameters
Kr = 0.05589 ft/min
Kz/Kr = 0.1254

AQTESOLV RESULTS
Version 2.01
Developed by Glenn M. Duffield

1/3/96 17:59

==========

TEST DESCRIPTION

Data set..... WELL2.DAT
Output file..... WELL2.OUT
Data set title..... Chestnut St 48 Hour Pump Test Analysis
Company..... Smith Environmental Tech Corp
Project..... 00-7074-0102
Client..... Olin Corporation
Location..... Wilmington, MA
Test well..... Chestnut St. Well 1A and 1C
Obs. well..... Observation Well 2

Units of Measurement
Length..... ft
Time..... min
Pumping rate.... gal/min

Pumping Well Data
Well No. 1
Well identification..... Well 1A
X location..... 144
Y location..... 120
Casing radius..... 1
Wellbore radius..... 1.5
Depth to top of well screen..... 45
Depth to bottom of well screen... 55
Number of pumping periods..... 5

Period	Pumping Rate
1	503
2	503
3	503
4	503
5	503

Well No. 2
Well identification..... Well 1C
X location..... 144
Y location..... 20
Casing radius..... 0.67
Wellbore radius..... 1
Depth to top of well screen..... 40
Depth to bottom of well screen... 45
Number of pumping periods..... 7

Chestnut St-Obs. Well 2

Period	Pumping Rate
1	200
2	200
3	200
4	200
5	200
6	200
7	200

Observation Well/Piezometer Data
- Well identification..... well2
- X location..... 144
- Y location..... 196
- Distance from pumping well #1.... 76
- Depth to top of well screen..... 31
- Depth to bottom of well screen... 36
- No. of observations..... 16

Aquifer Data
- Saturated thickness..... 56

==========

ANALYTICAL METHOD

Neuman (approx.) (Unconfined Aquifer)
Partially Penetrating Well(s)

==========

RESULTS FROM STATISTICAL CURVE MATCHING

STATISTICAL MATCH PARAMETER ESTIMATES

	Estimate		Std. Error	
T	=	8.00E+00	+/-	2.09E+00 ft^2/min
S	=	2.64E-04	+/-	1.19E-01
Sy	=	5.00E-01	+/-	2.08E-01
B	=	5.70E-01	+/-	1.58E-01

Derived Parameters

Kr	=	0.1429 ft/	min
Kz/Kr	=	0.3094	

ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated
weighted residual = residual * weight

Chestnut St-Obs. Well 2

Weighted Residual Statistics:
Number of residuals..... 16
Number of estimated parameters.... 4
Degrees of freedom..... 12
Residual mean..... -0.02464
Residual standard deviation..... 0.1188
Residual variance..... 0.0141

Model Residuals:

Time	Observed	Calculated	Residual	Weight
170	0.72	0.76317	-0.04317	1
175	0.73	0.77006	-0.04006	1
180	0.76	0.77691	-0.01691	1
195	0.83	0.79725	0.032747	1
210	0.87	0.81727	0.052732	1
300	0.92	0.93099	-0.01099	1
420	1.04	1.0675	-0.02755	1
540	1.25	1.1896	0.060408	1
1260	1.35	1.7248	-0.37475	1
1500	1.9	1.8544	0.045577	1
1740	1.99	1.9709	0.019078	1
1860	2.07	2.0239	0.0461	1
1980	2.11	2.0738	0.036187	1
2700	2.29	2.3311	-0.04107	1
2940	2.35	2.4042	-0.05422	1
3060	2.36	2.4384	-0.07841	1

==========

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

	Estimate		
T	=	8.00E+00	ft^2/min
S	=	2.64E-04	
Sy	=	5.00E-01	
B	=	5.70E-01	

Derived Parameters

Kr	=	0.1429	ft/min
Kz/Kr	=	0.3094	

AQTESOLV RESULTS
Version 2.01
Developed by Glenn M. Duffield

1/4/96 11:13

==========

TEST DESCRIPTION

Data set..... WELL3.DAT
Output file..... WELL3.OUT
Data set title..... Chestnut St 48 Hour Pump Test Analysis
Company..... Smith Environmental Tech Corp
Project..... 00-7074-0102
Client..... Olin Corporation
Location..... Wilmington, MA
Test well..... Chestnut St. Well 1A and 1C
Obs. well..... Observation Well 3

Units of Measurement
Length..... ft
Time..... min
Pumping rate.... gal/min

Pumping Well Data
Well No. 1
Well identification..... Well 1A
X location..... 144
Y location..... 120
Casing radius..... 1
Wellbore radius..... 1.5
Depth to top of well screen..... 45
Depth to bottom of well screen... 55
Number of pumping periods..... 5

Period	Pumping Rate
1	503
2	503
3	503
4	503
5	503

Well No. 3
Well identification..... Well 1C
X location..... 144
Y location..... 20
Casing radius..... 0.67
Wellbore radius..... 1
Depth to top of well screen..... 40
Depth to bottom of well screen... 45
Number of pumping periods..... 7

Chestnut St-Obs. Well 3

Period	Pumping Rate
1	200
2	200
3	200
4	200
5	200
6	200
7	200

Observation Well/Piezometer Data
Well identification..... well3
X location..... 144
Y location..... 248
Distance from pumping well #1.... 128
Depth to top of well screen..... 14
Depth to bottom of well screen... 19
No. of observations..... 16

Aquifer Data
Saturated thickness..... 56

==========

ANALYTICAL METHOD

Neuman (approx.) (Unconfined Aquifer)
Partially Penetrating Well(s)

==========

RESULTS FROM STATISTICAL CURVE MATCHING

STATISTICAL MATCH PARAMETER ESTIMATES

	Estimate		Std. Error	
T	=	8.16E+00	+/-	2.46E+00 ft^2/min
S	=	1.46E-02	+/-	1.07E-02
Sy	=	3.07E-01	+/-	1.12E-01
B	=	6.89E-01	+/-	2.09E-01

Derived Parameters
Kr = 0.1457 ft/min
Kz/Kr = 0.1319

ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated
*weighted residual = residual * weight*

Weighted Residual Statistics:
Number of residuals..... 16
Number of estimated parameters.... 4
Degrees of freedom..... 12
Residual mean..... -0.0002677
Residual standard deviation..... 0.111
Residual variance..... 0.01232

Model Residuals:

Time	Observed	Calculated	Residual	Weight
170	0.31	0.29776	0.012237	1
175	0.32	0.32914	-0.00914	1
180	0.34	0.34943	-0.00943	1
195	0.38	0.3941	-0.0141	1
210	0.43	0.41114	0.018861	1
300	0.48	0.50661	-0.02661	1
420	0.6	0.62007	-0.02007	1
540	0.85	0.72505	0.12495	1
1260	0.89	1.2126	-0.32264	1
1500	1.43	1.3365	0.093533	1
1740	1.49	1.4479	0.042078	1
1860	1.57	1.4989	0.071063	1
1980	1.64	1.5471	0.09286	1
2700	1.8	1.7972	0.002795	1
2940	1.83	1.8686	-0.03859	1
3060	1.88	1.9021	-0.02207	1

==========

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

	Estimate		
T	=	8.16E+00	ft^2/min
S	=	1.46E-02	
Sy	=	3.07E-01	
B	=	6.89E-01	

Derived Parameters
Kr = 0.1457 ft/min
Kz/Kr = 0.1319

AQTESOLV RESULTS
Version 2.01
Developed by Glenn M. Duffield

1/4/96 11:13

==========

TEST DESCRIPTION

Data set..... WELL3.DAT
Output file..... WELL3.OUT
Data set title..... Chestnut St 48 Hour Pump Test Analysis
Company..... Smith Environmental Tech Corp
Project..... 00-7074-0102
Client..... Olin Corporation
Location..... Wilmington, MA
Test well..... Chestnut St. Well 1A and 1C
Obs. well..... Observation Well 3

Units of Measurement
Length..... ft
Time..... min
Pumping rate.... gal/min

Pumping Well Data
Well No. 1
Well identification..... Well 1A
X location..... 144
Y location..... 120
Casing radius..... 1
Wellbore radius..... 1.5
Depth to top of well screen..... 45
Depth to bottom of well screen... 55
Number of pumping periods..... 5

Period	Pumping Rate
1	503
2	503
3	503
4	503
5	503

Well No. 3
Well identification..... Well 1C
X location..... 144
Y location..... 20
Casing radius..... 0.67
Wellbore radius..... 1
Depth to top of well screen..... 40
Depth to bottom of well screen... 45
Number of pumping periods..... 7

Chestnut St-Obs. Well 3

Period	Pumping Rate
1	200
2	200
3	200
4	200
5	200
6	200
7	200

Observation Well/Piezometer Data
- Well identification..... well3
- X location..... 144
- Y location..... 248
- Distance from pumping well #1.... 128
- Depth to top of well screen..... 14
- Depth to bottom of well screen... 19
- No. of observations..... 16

Aquifer Data
- Saturated thickness..... 56

==========

ANALYTICAL METHOD

Neuman (approx.) (Unconfined Aquifer)
Partially Penetrating Well(s)

==========

RESULTS FROM STATISTICAL CURVE MATCHING

STATISTICAL MATCH PARAMETER ESTIMATES

	Estimate		Std. Error		
T	=	8.16E+00	+/-	2.46E+00	ft^2/min
S	=	1.46E-02	+/-	1.07E-02	
Sy	=	3.07E-01	+/-	1.12E-01	
B	=	6.89E-01	+/-	2.09E-01	

Derived Parameters
- Kr = 0.1457 ft/min
- Kz/Kr = 0.1319

ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated
weighted residual = residual * weight

Chestnut St-Obs. Well 3

Weighted Residual Statistics:
Number of residuals..... 16
Number of estimated parameters.... 4
Degrees of freedom..... 12
Residual mean..... -0.0002677
Residual standard deviation..... 0.111
Residual variance..... 0.01232

Model Residuals:

Time	Observed	Calculated	Residual	Weight
170	0.31	0.29776	0.012237	1
175	0.32	0.32914	-0.00914	1
180	0.34	0.34943	-0.00943	1
195	0.38	0.3941	-0.0141	1
210	0.43	0.41114	0.018861	1
300	0.48	0.50661	-0.02661	1
420	0.6	0.62007	-0.02007	1
540	0.85	0.72505	0.12495	1
1260	0.89	1.2126	-0.32264	1
1500	1.43	1.3365	0.093533	1
1740	1.49	1.4479	0.042078	1
1860	1.57	1.4989	0.071063	1
1980	1.64	1.5471	0.09286	1
2700	1.8	1.7972	0.002795	1
2940	1.83	1.8686	-0.03859	1
3060	1.88	1.9021	-0.02207	1

==========

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

	Estimate		
T	=	8.16E+00	ft^2/min
S	=	1.46E-02	
Sy	=	3.07E-01	
B	=	6.89E-01	

Derived Parameters
Kr = 0.1457 ft/min
Kz/Kr = 0.1319

AQTESOLV RESULTS
Version 2.01
Developed by Glenn M. Duffield

1/4/96 11:51

==========

TEST DESCRIPTION

Data set..... WELL4.DAT
Output file..... WELL4.OUT
Data set title..... Chestnut St 48 Hour Pump Test Analysis
Company..... Smith Environmental Tech Corp
Project..... 00-7074-0102
Client..... Olin Corporation
Location..... Wilmington, MA
Test well..... Chestnut St. Well 1A and 1C
Obs. well..... Observation Well 4

Units of Measurement
Length..... ft
Time..... min
Pumping rate.... gal/min

Pumping Well Data
Well No. 1
Well identification..... Well 1A
X location..... 144
Y location..... 120
Casing radius..... 1
Wellbore radius..... 1.5
Depth to top of well screen..... 45
Depth to bottom of well screen... 55
Number of pumping periods..... 5

Period	Pumping Rate
1	503
2	503
3	503
4	503
5	503

Well No. 4
Well identification..... Well 1C
X location..... 144
Y location..... 20
Casing radius..... 0.67
Wellbore radius..... 1
Depth to top of well screen..... 40
Depth to bottom of well screen... 45
Number of pumping periods..... 7

Chestnut St-Well 4

Period	Pumping Rate
1	200
2	200
3	200
4	200
5	200
6	200
7	200

Observation Well/Piezometer Data
Well identification..... well4
X location..... 16
Y location..... 232
Distance from pumping well #1.... 170.1
Depth to top of well screen..... 16.5
Depth to bottom of well screen... 21.5
No. of observations..... 13

Aquifer Data
Saturated thickness..... 56

==========

ANALYTICAL METHOD

Neuman (approx.) (Unconfined Aquifer)
Partially Penetrating Well(s)

==========

RESULTS FROM STATISTICAL CURVE MATCHING

STATISTICAL MATCH PARAMETER ESTIMATES

	Estimate	Std. Error	
T =	7.7567E+000	+/- 2.8746E+000	ft^2/min
S =	5.6170E-002	+/- 1.5929E-001	
Sy =	3.3333E-001	+/- 8.2925E-002	
B =	3.3879E+000	+/- 2.8655E+000	

Derived Parameters
Kr = 0.1385 ft/min
Kz/Kr = 0.3673

ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated
weighted residual = residual * weight

Chestnut St-Well 4

Weighted Residual Statistics:
Number of residuals..... 13
Number of estimated parameters.... 4
Degrees of freedom..... 9
Residual mean..... 4.884E-005
Residual standard deviation..... 0.1161
Residual variance..... 0.01348

Model Residuals:

Time	Observed	Calculated	Residual	Weight
195	0.07	0.076984	-0.00698	1
210	0.11	0.096942	0.013058	1
300	0.15	0.17556	-0.02556	1
420	0.26	0.26885	-0.00885	1
540	0.45	0.36138	0.088616	1
1260	0.54	0.82885	-0.28885	1
1500	1.04	0.95213	0.087867	1
1740	1.1	1.0638	0.036158	1
1860	1.21	1.1154	0.094639	1
1980	1.25	1.1642	0.085803	1
2700	1.42	1.4113	0.008712	1
2940	1.45	1.4847	-0.03466	1
3060	1.47	1.5193	-0.04932	1

==========

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

Estimate
T = 7.7567E+000 ft^2/min
S = 5.6170E-002
Sy = 3.3333E-001
B = 3.3879E+000

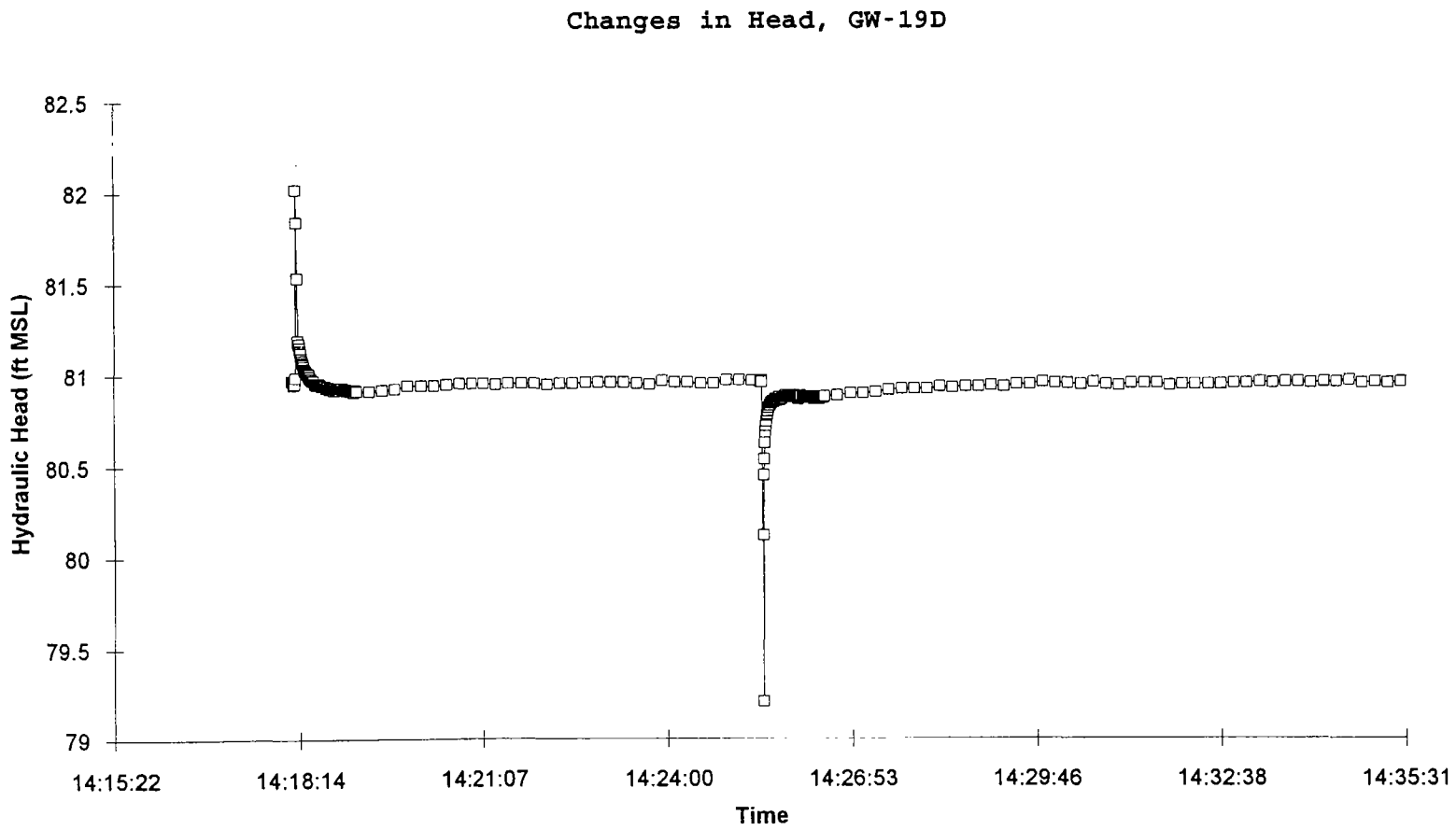
Derived Parameters
Kr = 0.1385 ft/min
Kz/Kr = 0.3673

Appendix G

SMITH

APPENDIX G

SLUG TEST DATA, GRAPHS AND CALCULATIONS



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                A Q T E S O L V   R E S U L T S
                        Version 2.01

                Developed by Glenn M. Duffield
              (c) 1988-1995  Geraghty & Miller, Inc.

                                                   3/12/97 16:11
                    TEST DESCRIPTION

Data set........... 19D_IN.DAT
Output file........ 19DIN.OUT
Data set title..... Positive Displacement Slug Test - GW-19D
Company............ Smith Technology
Project............ 00-7074-0102
Client............. Olin Corporation

Units of Measurement
  Length.......... ft
  Time............ min

Test Well Data
  Initial displacement in well..... 1.053
  Radius of well casing............ 0.0833
  Radius of wellbore............... 0.167
  Aquifer saturated thickness...... 13.28
  Well screen length............... 5
  Static height of water in well... 13.08
  Gravel pack porosity............. 0.3
  Effective well casing radius..... 0.115
  Effective wellbore radius........ 0.167
  Log(Re/Rw)....................... 2.974
  Constants A, B and C............. 2.442 ,  0.397,  0.000
  No. of observations.............. 34

================================================================================
                    ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

================================================================================
                RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

        Estimate
  K  =   7.6383E+001 ft/day
  y0 =   3.5577E-001 ft


<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>
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                  A Q T E S O L V   R E S U L T S
                           Version 2.01

                   Developed by Glenn M. Duffield
                (c) 1988-1995  Geraghty & Miller, Inc.

                                                        3/12/97 17:04
                          TEST DESCRIPTION

Data set........... 19D_OUT.DAT
Output file........ 19DOUT.OUT
Data set title..... Negative Displacement Slug Test - GW-19D
Company............ Smith Technology
Project............ 00-7074-0102
Client............. Olin Corporation

Units of Measurement
  Length.......... ft
  Time............ min

Test Well Data
  Initial displacement in well..... 1.758
  Radius of well casing............ 0.0833
  Radius of wellbore............... 0.167
  Aquifer saturated thickness...... 13.28
  Well screen length............... 5
  Static height of water in well... 13.08
  Gravel pack porosity............. 0.3
  Effective well casing radius..... 0.115
  Effective wellbore radius........ 0.167
  Log(Re/Rw)....................... 2.974
  Constants A, B and C............. 2.442 ,  0.397,  0.000
  No. of observations.............. 121

==========================================================================
                          ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

==========================================================================
                  RESULTS FROM VISUAL CURVE MATCHING

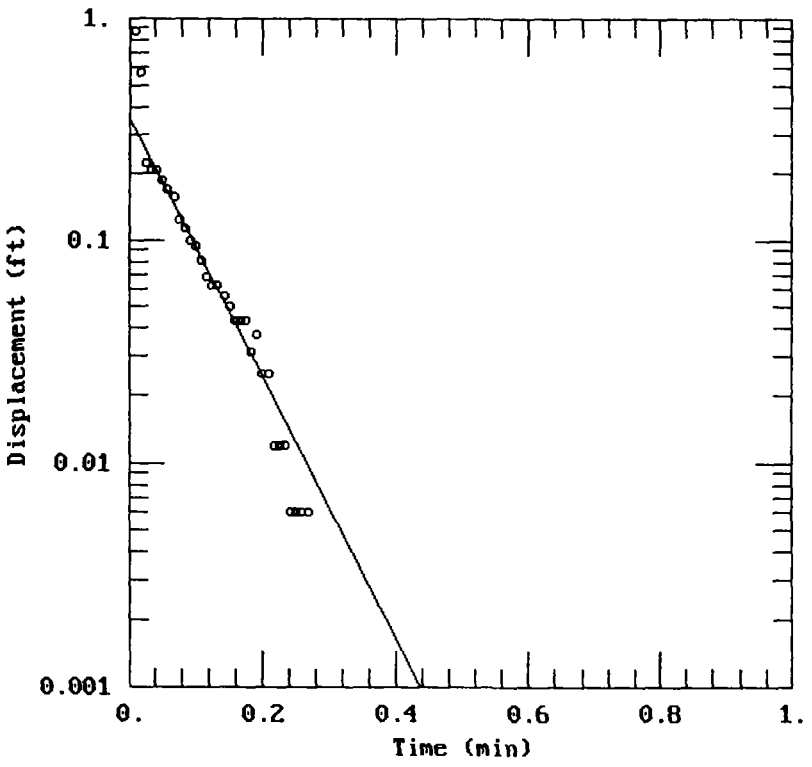

VISUAL MATCH PARAMETER ESTIMATES

        Estimate
  K  =  1.2031E+002 ft/day
  y0 =  7.2965E-001 ft


<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>
```

CLIENT: Olin Corporation	COMPANY: Smith Technology
	PROJECT: 00-7074-0102

Positive Displacement Slug Test - GW-19D



DATA SET:
19D_IN.DAT
03/12/97

AQUIFER MODEL:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

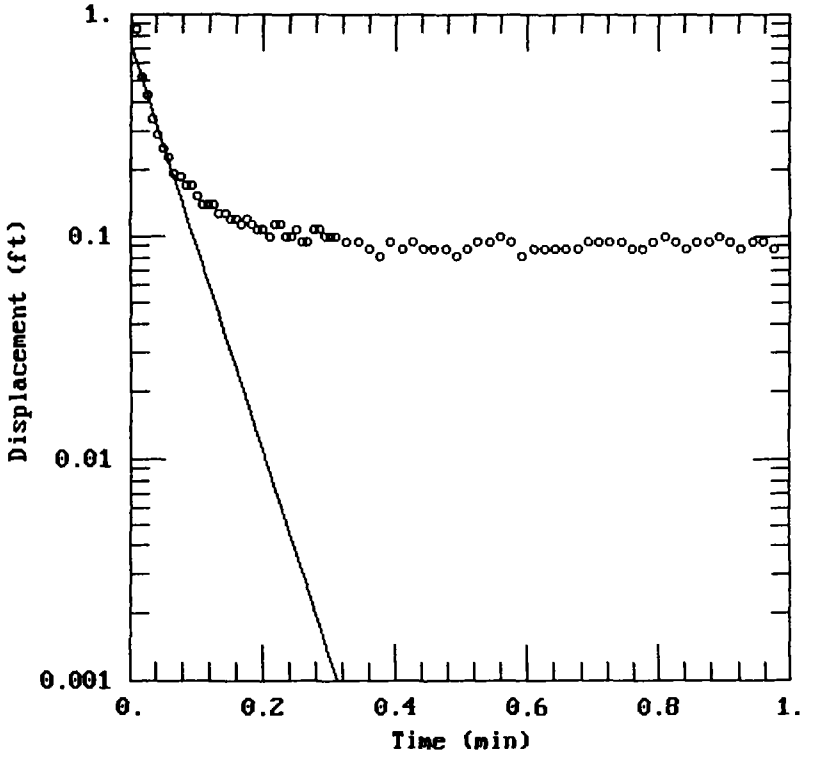
TEST DATA:
H0= 1.053 ft
r_c= 0.0833 ft
r_w= 0.167 ft
L = 5. ft
b = 13.28 ft
H = 13.08 ft

PARAMETER ESTIMATES:
K = 76.38 ft/day
y0 = 0.3558 ft

AQTESOLV

CLIENT: Olin Corporation	COMPANY: Smith Technology
	PROJECT: 00-7074-0102

Negative Displacement Slug Test - GW-19D



DATA SET:
19D_OUT.DAT
03/12/97

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 1.758 ft
r_c= 0.0833 ft
r_w= 0.167 ft
L = 5. ft
b = 13.28 ft
H = 13.08 ft

PARAMETER ESTIMATES:
K = 120.3 ft/day
y0 = 0.7296 ft

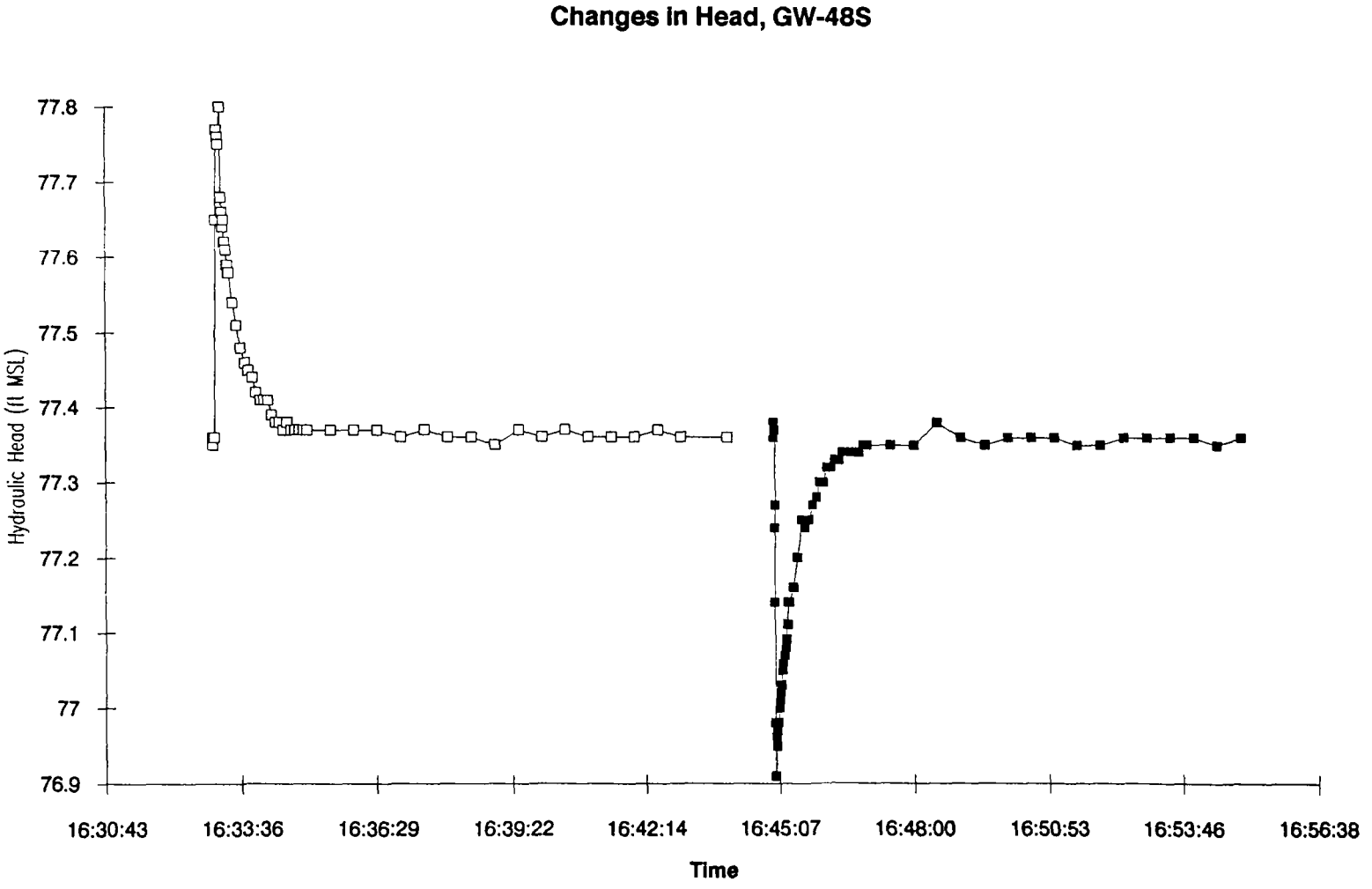
AQTESOLV

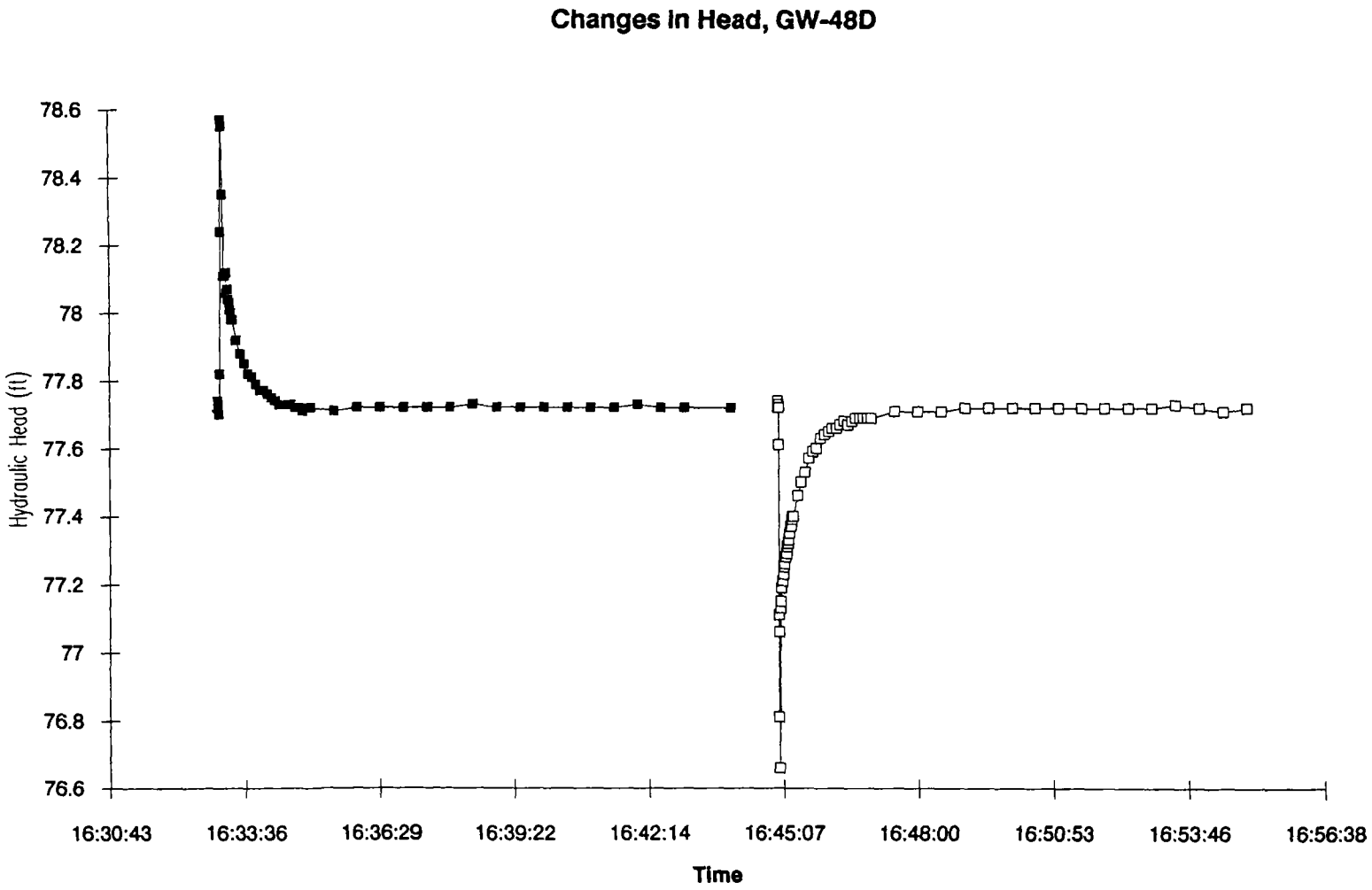
	Elapsed		GW					
Time	Time	Head	Elevation					
	Elapsed		GW					
Time	Time	Head	Elevation					
14:18:08	0	-8.818	80.962			SE2000		
14:18:08	0.0083	-8.818	80.962			Environmental Logger		
14:18:09	0.0166	-8.818	80.962			02/19 06:03		
14:18:09	0.025	-8.837	80.943					
14:18:10	0.0333	-8.818	80.962			Unit# 2K-125 Test 0		
14:18:10	0.0416	-8.831	80.949					
14:18:11	0.05	-8.8	80.98			Setups: INPUT 1		
14:18:11	0.0583	-7.765	82.015			---------- --------		
14:18:12	0.0666	-7.945	81.835			Type Level (F)		
14:18:12	0.075	-8.251	81.529			Mode Surface		
14:18:13	0.0833	-8.594	81.186			I.D. 19D		
14:18:13	0.0916	-8.612	81.168					
14:18:14	0.1	-8.612	81.168			Reference -8.800		
14:18:14	0.1083	-8.631	81.149			PSI at Ref. 4.759		
14:18:15	0.1166	-8.65	81.13			SG 1.000		
14:18:15	0.125	-8.662	81.118			Linearity 0.000		
14:18:16	0.1333	-8.694	81.086			Scale factor 19.754		
14:18:16	0.1416	-8.706	81.074			Offset -0.046		
14:18:17	0.15	-8.718	81.062			Delay mSEC 50.000		
14:18:17	0.1583	-8.725	81.055					14:18:08
14:18:18	0.1666	-8.737	81.043			Step 0	18-Feb	
14:18:18	0.175	-8.75	81.03					
14:18:19	0.1833	-8.756	81.024					
14:18:19	0.1916	-8.756	81.024					
14:18:20	0.2	-8.762	81.018					
14:18:20	0.2083	-8.768	81.012					
14:18:21	0.2166	-8.775	81.005					
14:18:21	0.225	-8.775	81.005					
14:18:22	0.2333	-8.775	81.005					
14:18:22	0.2416	-8.787	80.993					
14:18:23	0.25	-8.781	80.999					
14:18:23	0.2583	-8.793	80.987					
14:18:24	0.2666	-8.793	80.987					
14:18:24	0.275	-8.806	80.974					
14:18:25	0.2833	-8.806	80.974					
14:18:25	0.2916	-8.806	80.974					
14:18:26	0.3	-8.812	80.968					
14:18:26	0.3083	-8.812	80.968					
14:18:27	0.3166	-8.812	80.968					
14:18:27	0.325	-8.812	80.968					
14:18:28	0.3333	-8.818	80.962					
14:18:29	0.35	-8.831	80.949					
14:18:30	0.3666	-8.837	80.943					
14:18:31	0.3833	-8.837	80.943					
14:18:32	0.4	-8.837	80.943					
14:18:33	0.4166	-8.831	80.949					
14:18:34	0.4333	-8.837	80.943					
14:18:35	0.45	-8.843	80.937					
14:18:36	0.4666	-8.843	80.937					
14:18:37	0.4833	-8.843	80.937					
14:18:38	0.5	-8.843	80.937					
14:18:39	0.5166	-8.843	80.937					
14:18:40	0.5333	-8.856	80.924					
14:18:41	0.55	-8.849	80.931					
14:18:42	0.5666	-8.849	80.931					
14:18:43	0.5833	-8.862	80.918					
14:18:44	0.6	-8.856	80.924					
14:18:45	0.6166	-8.856	80.924					
14:18:46	0.6333	-8.862	80.918					
14:18:47	0.65	-8.868	80.912					
14:18:48	0.6666	-8.856	80.924					
14:18:49	0.6833	-8.868	80.912					

Time	Elapsed Time	Head	GW Elevation
14:18:50	0.7	-8.862	80.918
14:18:51	0.7166	-8.868	80.912
14:18:52	0.7333	-8.868	80.912
14:18:53	0.75	-8.856	80.924
14:18:54	0.7666	-8.856	80.924
14:18:55	0.7833	-8.856	80.924
14:18:56	0.8	-8.868	80.912
14:18:57	0.8166	-8.862	80.918
14:18:58	0.8333	-8.862	80.918
14:18:59	0.85	-8.868	80.912
14:19:00	0.8666	-8.868	80.912
14:19:01	0.8833	-8.868	80.912
14:19:02	0.9	-8.874	80.906
14:19:03	0.9166	-8.874	80.906
14:19:04	0.9333	-8.874	80.906
14:19:05	0.95	-8.881	80.899
14:19:06	0.9666	-8.868	80.912
14:19:07	0.9833	-8.868	80.912
14:19:08	1	-8.874	80.906
14:19:20	1.2	-8.874	80.906
14:19:32	1.4	-8.868	80.912
14:19:44	1.6	-8.862	80.918
14:19:56	1.8	-8.843	80.937
14:20:08	2	-8.843	80.937
14:20:20	2.2	-8.843	80.937
14:20:32	2.4	-8.837	80.943
14:20:44	2.6	-8.831	80.949
14:20:56	2.8	-8.831	80.949
14:21:08	3	-8.831	80.949
14:21:20	3.2	-8.837	80.943
14:21:32	3.4	-8.831	80.949
14:21:44	3.6	-8.831	80.949
14:21:56	3.8	-8.831	80.949
14:22:08	4	-8.837	80.943
14:22:20	4.2	-8.831	80.949
14:22:32	4.4	-8.831	80.949
14:22:44	4.6	-8.824	80.956
14:22:56	4.8	-8.824	80.956
14:23:08	5	-8.824	80.956
14:23:20	5.2	-8.824	80.956
14:23:32	5.4	-8.831	80.949
14:23:44	5.6	-8.837	80.943
14:23:56	5.8	-8.818	80.962
14:24:08	6	-8.824	80.956
14:24:20	6.2	-8.824	80.956
14:24:32	6.4	-8.831	80.949
14:24:44	6.6	-8.831	80.949
14:24:56	6.8	-8.812	80.968
14:25:08	7	-8.812	80.968
14:25:20	7.2	-8.818	80.962

Time	Elapsed Time	Head	GW Elevation				
14:25:28	0	-8.824	80.956		SE2000		
14:25:28	0.0083	-8.818	80.962		Environmental Logger		
14:25:29	0.0166	-8.824	80.956		02/19 06:05		
14:25:29	0.025	-10.576	79.204				
14:25:30	0.0333	-9.666	80.114		Unit# 2K-125 Test 0		
14:25:30	0.0416	-9.336	80.444				
14:25:31	0.05	-9.248	80.532		Setups: INPUT 1		
14:25:31	0.0583	-9.161	80.619		--------- -------		
14:25:32	0.0666	-9.105	80.675		Type Level (F)		
14:25:32	0.075	-9.068	80.712		Mode Surface		
14:25:33	0.0833	-9.043	80.737		I.D. 19D		
14:25:33	0.0916	-9.011	80.769				
14:25:34	0.1	-9.005	80.775		Reference -8.800		
14:25:34	0.1083	-8.987	80.793		PSI at Ref. 4.759		
14:25:35	0.1166	-8.987	80.793		SG 1.000		
14:25:35	0.125	-8.968	80.812		Linearity 0.000		
14:25:36	0.1333	-8.955	80.825		Scale factor 19.754		
14:25:36	0.1416	-8.955	80.825		Offset -0.046		
14:25:37	0.15	-8.955	80.825		Delay mSEC 50.000		
14:25:37	0.1583	-8.943	80.837				
14:25:38	0.1666	-8.943	80.837		Step 1		
14:25:38	0.175	-8.937	80.843			18-Feb	14:25:28
14:25:39	0.1833	-8.937	80.843		Elapsed Time INPUT 1		
14:25:39	0.1916	-8.93	80.85				
14:25:40	0.2	-8.937	80.843				
14:25:40	0.2083	-8.93	80.85				
14:25:41	0.2166	-8.924	80.856				
14:25:41	0.225	-8.924	80.856				
14:25:42	0.2333	-8.918	80.862				
14:25:42	0.2416	-8.93	80.85				
14:25:43	0.25	-8.93	80.85				
14:25:43	0.2583	-8.918	80.862				
14:25:44	0.2666	-8.918	80.862				
14:25:44	0.275	-8.924	80.856				
14:25:45	0.2833	-8.912	80.868				
14:25:45	0.2916	-8.912	80.868				
14:25:46	0.3	-8.924	80.856				
14:25:46	0.3083	-8.924	80.856				
14:25:47	0.3166	-8.918	80.862				
14:25:47	0.325	-8.918	80.862				
14:25:48	0.3333	-8.918	80.862				
14:25:49	0.35	-8.912	80.868				
14:25:50	0.3666	-8.912	80.868				
14:25:51	0.3833	-8.905	80.875				
14:25:52	0.4	-8.899	80.881				
14:25:53	0.4166	-8.912	80.868				
14:25:54	0.4333	-8.905	80.875				
14:25:55	0.45	-8.912	80.868				
14:25:56	0.4666	-8.905	80.875				
14:25:57	0.4833	-8.905	80.875				
14:25:58	0.5	-8.905	80.875				
14:25:59	0.5166	-8.899	80.881				
14:26:00	0.5333	-8.905	80.875				
14:26:01	0.55	-8.912	80.868				
14:26:02	0.5666	-8.912	80.868				
14:26:03	0.5833	-8.918	80.862				
14:26:04	0.6	-8.912	80.868				
14:26:05	0.6166	-8.899	80.881				
14:26:06	0.6333	-8.905	80.875				
14:26:07	0.65	-8.905	80.875				
14:26:08	0.6666	-8.905	80.875				
14:26:09	0.6833	-8.905	80.875				
14:26:10	0.7	-8.905	80.875				
14:26:11	0.7166	-8.912	80.868				

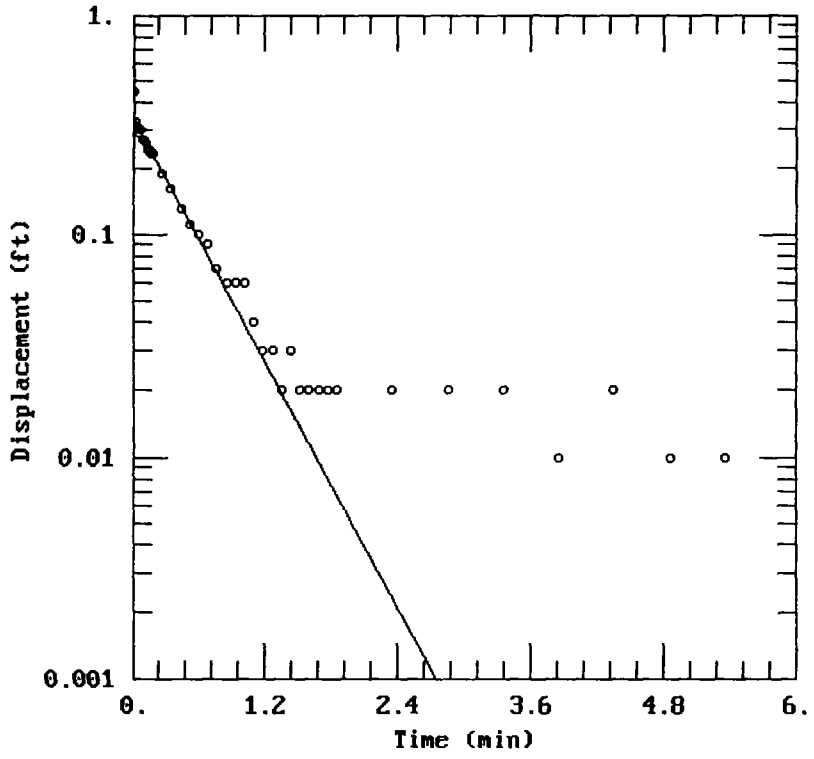
Time	Elapsed Time	Head	GW Elevation
14:26:12	0.7333	-8.912	80.868
14:26:13	0.75	-8.912	80.868
14:26:14	0.7666	-8.912	80.868
14:26:15	0.7833	-8.905	80.875
14:26:16	0.8	-8.905	80.875
14:26:17	0.8166	-8.912	80.868
14:26:18	0.8333	-8.918	80.862
14:26:19	0.85	-8.912	80.868
14:26:20	0.8666	-8.905	80.875
14:26:21	0.8833	-8.912	80.868
14:26:22	0.9	-8.912	80.868
14:26:23	0.9166	-8.918	80.862
14:26:24	0.9333	-8.912	80.868
14:26:25	0.95	-8.905	80.875
14:26:26	0.9666	-8.912	80.868
14:26:27	0.9833	-8.912	80.868
14:26:28	1	-8.905	80.875
14:26:40	1.2	-8.899	80.881
14:26:52	1.4	-8.887	80.893
14:27:04	1.6	-8.887	80.893
14:27:16	1.8	-8.881	80.899
14:27:28	2	-8.868	80.912
14:27:40	2.2	-8.862	80.918
14:27:52	2.4	-8.862	80.918
14:28:04	2.6	-8.862	80.918
14:28:16	2.8	-8.849	80.931
14:28:28	3	-8.856	80.924
14:28:40	3.2	-8.849	80.931
14:28:52	3.4	-8.849	80.931
14:29:04	3.6	-8.843	80.937
14:29:16	3.8	-8.849	80.931
14:29:28	4	-8.837	80.943
14:29:40	4.2	-8.837	80.943
14:29:52	4.4	-8.824	80.956
14:30:04	4.6	-8.831	80.949
14:30:16	4.8	-8.831	80.949
14:30:28	5	-8.837	80.943
14:30:40	5.2	-8.824	80.956
14:30:52	5.4	-8.837	80.943
14:31:04	5.6	-8.843	80.937
14:31:16	5.8	-8.831	80.949
14:31:28	6	-8.831	80.949
14:31:40	6.2	-8.831	80.949
14:31:52	6.4	-8.843	80.937
14:32:04	6.6	-8.837	80.943
14:32:16	6.8	-8.837	80.943
14:32:28	7	-8.837	80.943
14:32:40	7.2	-8.837	80.943
14:32:52	7.4	-8.831	80.949
14:33:04	7.6	-8.831	80.949
14:33:16	7.8	-8.824	80.956
14:33:28	8	-8.831	80.949
14:33:40	8.2	-8.824	80.956
14:33:52	8.4	-8.824	80.956
14:34:04	8.6	-8.831	80.949
14:34:16	8.8	-8.824	80.956
14:34:28	9	-8.824	80.956
14:34:40	9.2	-8.818	80.962
14:34:52	9.4	-8.831	80.949
14:35:04	9.6	-8.824	80.956
14:35:16	9.8	-8.831	80.949
14:35:28	10	-8.824	80.956





CLIENT: Olin, Wilmington, MA	COMPANY: BCM/SMITH
	PROJECT: 00-7074-0102

OLIN SLUG TESTS, GW48S TEST 1



DATA SET:
GW48S-1.DAT
01/13/96

AQUIFER MODEL:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 0.45 ft
r_c= 0.083 ft
r_w= 0.33 ft
L = 10. ft
b = 24.4 ft
H = 10.5 ft

PARAMETER ESTIMATES:
K = 0.008861 ft/min
y0 = 0.3362 ft

AQTESOLV

```
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

                      A Q T E S O L V   R E S U L T S
                               Version 2.01

                       Developed by Glenn M. Duffield
                   (c) 1988-1995  Geraghty & Miller, Inc.

09/01/95                                                                15:09:18

================================================================================
                              TEST DESCRIPTION

Data set........... GW48S-1.DAT
Output file........ GW48S-1.OUT
Data set title..... OLIN SLUG TESTS, GW48S TEST 1
Company............ BCM/SMITH
Project............ 00-7074-0102
Client............. Olin, Wilmington, MA
Test date.......... August 1995
Obs. well.......... GW-48-S

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 0.45
   Radius of well casing............ 0.083
   Radius of wellbore............... 0.33
   Aquifer saturated thickness...... 24.4
   Well screen length............... 10
   Static height of water in well... 10.5
   Gravel pack porosity............. 0.3
   Effective well casing radius..... 0.1936
   Effective wellbore radius........ 0.33
   Log(Re/Rw)....................... 2.231
   Constants A, B and C............. 2.453 ,   0.399,   0.000
   No. of observations.............. 38

================================================================================
                              ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

================================================================================
                     RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

           Estimate
   K  =   8.8607E-003 ft/min
   y0 =   3.3617E-001 ft

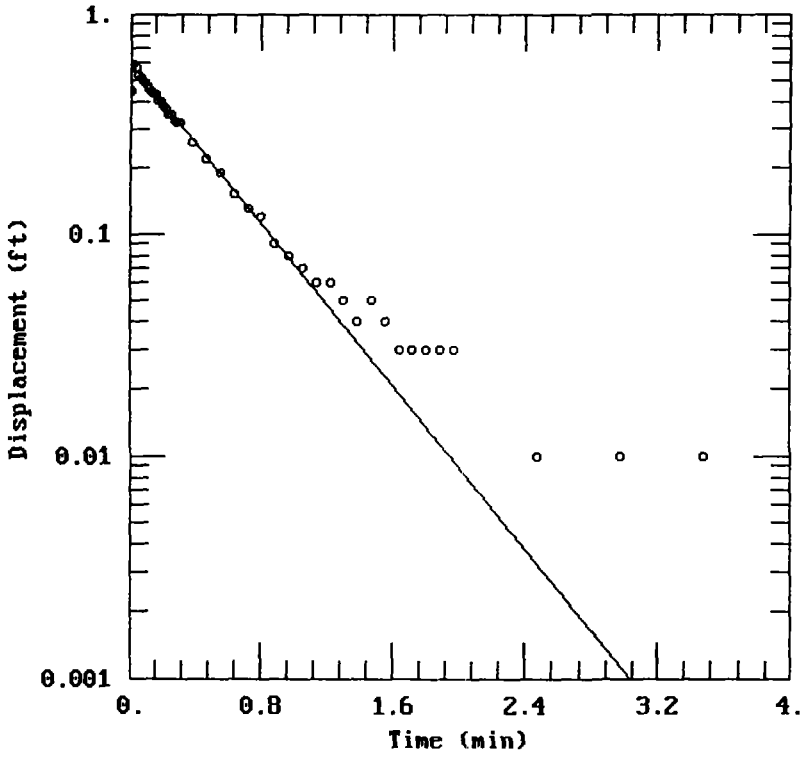

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>
```

CLIENT: Olin, Wilmington, MA

COMPANY: BCM/SMITH

PROJECT: 00-7074-0102

OLIN SLUG TESTS, GW48S TEST 2



DATA SET:
GW48S-2.DAT
01/13/96

AQUIFER MODEL:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 0.45 ft
r_c= 0.083 ft
r_w= 0.33 ft
L = 10. ft
b = 24.4 ft
H = 10.5 ft

PARAMETER ESTIMATES:
K = 0.008813 ft/min
y0 = 0.5925 ft

AQTESOLV

```
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

                    A Q T E S O L V   R E S U L T S
                               Version 2.01

                       Developed by Glenn M. Duffield
                   (c) 1988-1995  Geraghty & Miller, Inc.

09/01/95                                                              15:11:23

================================================================================
                               TEST DESCRIPTION

Data set........... GW48S-2.DAT
Output file........ GW48S-2.OUT
Data set title..... OLIN SLUG TESTS, GW48S TEST 2
Company............ BCM/SMITH
Project............ 00-7074-0102
Client............. Olin, Wilmington, MA
Test date.......... August 1995
Obs. well.......... GW-48-S

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 0.45
   Radius of well casing............ 0.083
   Radius of wellbore............... 0.33
   Aquifer saturated thickness...... 24.4
   Well screen length............... 10
   Static height of water in well... 10.5
   Gravel pack porosity............. 0.3
   Effective well casing radius..... 0.1936
   Effective wellbore radius........ 0.33
   Log(Re/Rw)....................... 2.231
   Constants A, B and C............. 2.453 ,   0.399,   0.000
   No. of observations.............. 41

================================================================================
                               ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

================================================================================
                      RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

           Estimate
   K  =   8.8128E-003 ft/min
   y0 =   5.9246E-001 ft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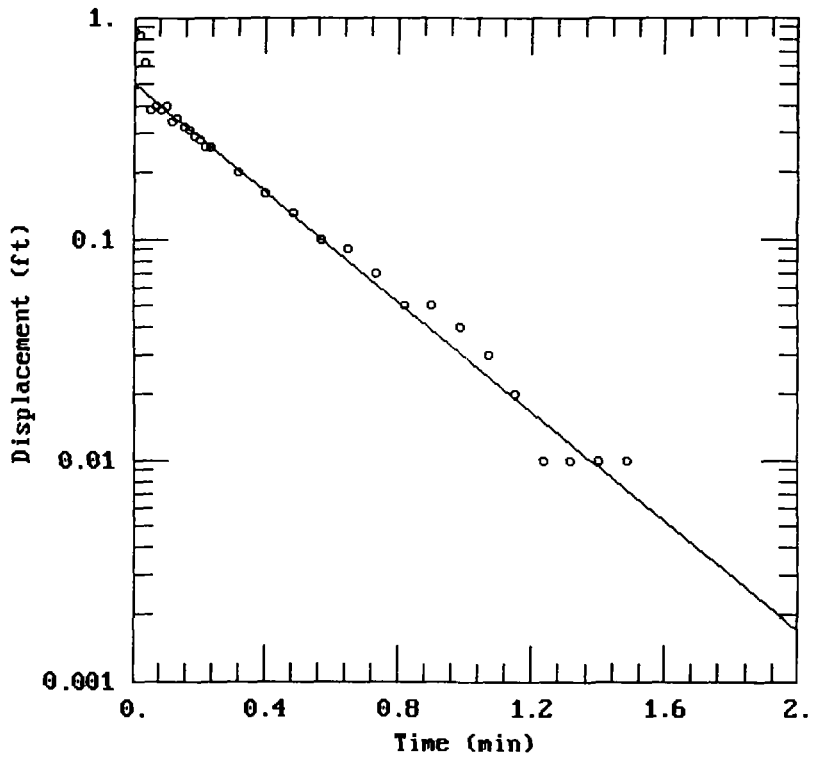
```

CLIENT: Olin, Wilmington, MA

COMPANY: BCM/SMITH

PROJECT: 00-7074-0102

OLIN SLUG TESTS, GW48D TEST 1



DATA SET:
GW48D-1.DAT
01/13/96

AQUIFER MODEL:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 0.85 ft
r_c= 0.083 ft
r_w= 0.33 ft
L = 5. ft
b = 24.4 ft
H = 24.4 ft

PARAMETER ESTIMATES:
K = 0.03 ft/min
y0 = 0.498 ft

AQTESOLV

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A Q T E S O L V R E S U L T S
Version 2.01

Developed by Glenn M. Duffield
(c) 1988-1995 Geraghty & Miller, Inc.

09/01/95 15:16:44

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TEST DESCRIPTION

Data set..... GW48D-1.DAT
Output file..... GW48D-1.OUT
Data set title..... OLIN SLUG TESTS, GW48D TEST 1
Company..... BCM/SMITH
Project..... 00-7074-0102
Client..... Olin, Wilmington, MA
Test date..... August 1995
Obs. well..... GW-48-D

Units of Measurement
Length..... ft
Time..... min

Test Well Data
Initial displacement in well..... 0.85
Radius of well casing..... 0.083
Radius of wellbore..... 0.33
Aquifer saturated thickness..... 24.4
Well screen length..... 5
Static height of water in well... 24.4
Gravel pack porosity..... 0.3
Effective well casing radius..... 0.1936
Effective wellbore radius..... 0.33
Log(Re/Rw)..... 2.818
Constants A, B and C..... 0.000 , 0.000, 1.504
No. of observations..... 29

==========

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

==========

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

	Estimate
K =	3.0000E-002 ft/min
y0 =	4.9800E-001 ft

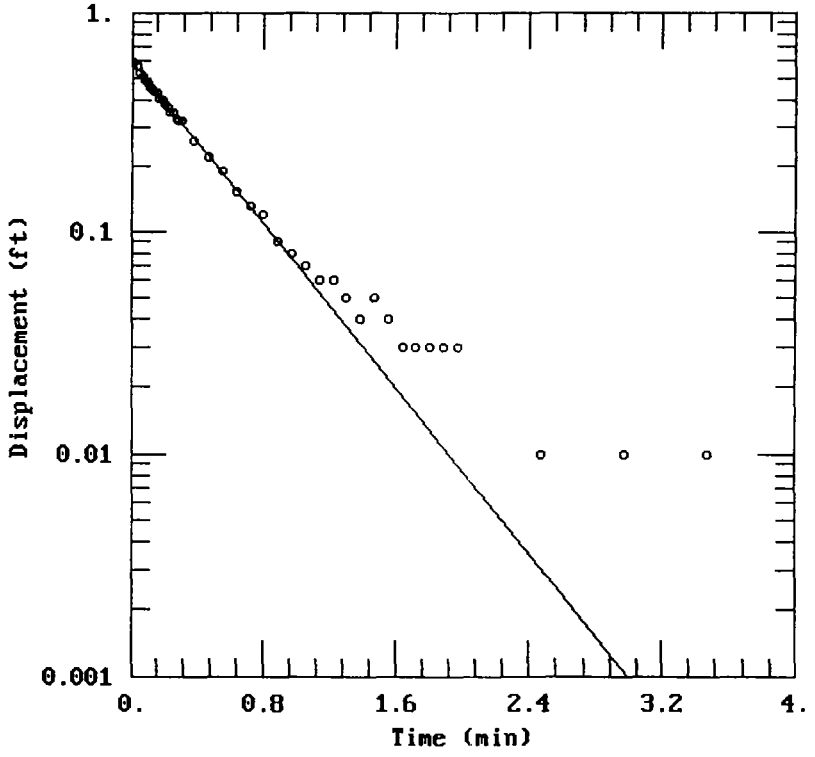
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<

CLIENT: Olin, Wilmington, MA

COMPANY: BCM/SMITH

PROJECT: 00-7074-0102

OLIN SLUG TESTS, GW48D TEST 2



DATA SET:
GW48D-2.DAT
01/13/96

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 1.06 ft
r_c= 0.083 ft
r_w= 0.33 ft
L = 5. ft
b = 24.4 ft
H = 24.4 ft

PARAMETER ESTIMATES:
K = 0.02254 ft/min
y0 = 0.5872 ft

AQTESOLV

```
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

                      A Q T E S O L V   R E S U L T S
                               Version 2.01

                      Developed by Glenn M. Duffield
                   (c) 1988-1995  Geraghty & Miller, Inc.

09/01/95                                                                15:29:28

================================================================================
                              TEST DESCRIPTION

Data set........... GW48D-2.DAT
Output file........ GW48D-2.OUT
Data set title..... OLIN SLUG TESTS, GW48D TEST 2
Company............ BCM/SMITH
Project............ 00-7074-0102
Client............. Olin, Wilmington, MA
Test date.......... August 1995
Obs. well.......... GW-48-D

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 1.06
   Radius of well casing............ 0.083
   Radius of wellbore............... 0.33
   Aquifer saturated thickness...... 24.4
   Well screen length............... 5
   Static height of water in well... 24.4
   Gravel pack porosity............. 0.3
   Effective well casing radius..... 0.1936
   Effective wellbore radius........ 0.33
   Log(Re/Rw)....................... 2.818
   Constants A, B and C............. 0.000 ,  0.000,  1.504
   No. of observations.............. 41

================================================================================
                             ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

================================================================================
                     RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

           Estimate
   K  =   2.2542E-002 ft/min
   y0 =   5.8721E-001 ft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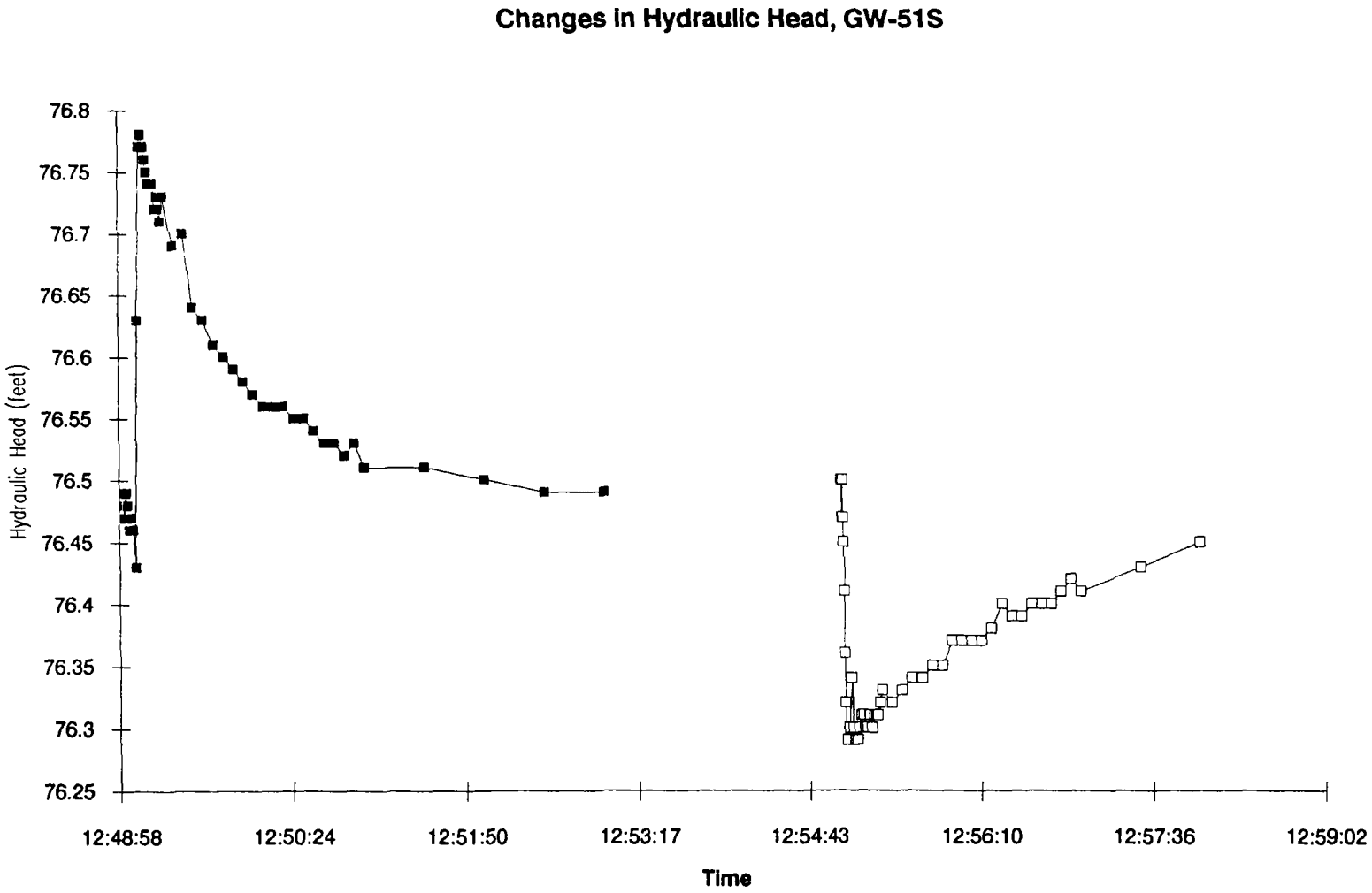
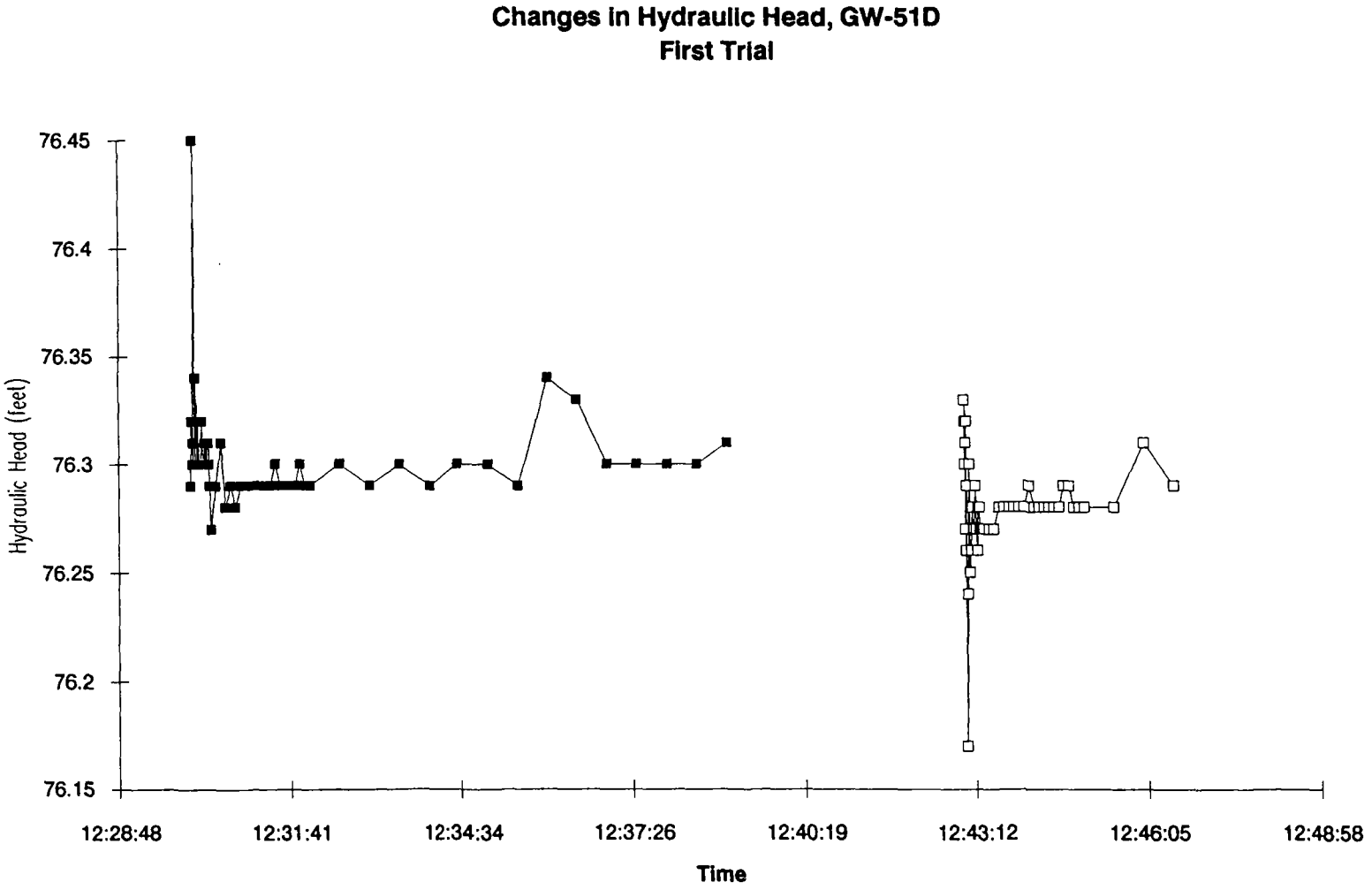
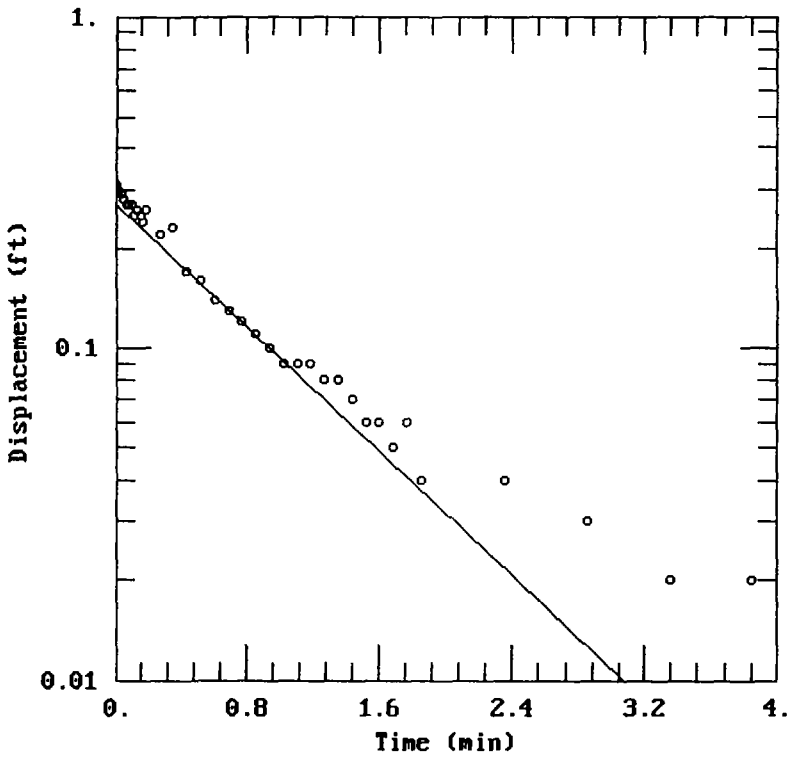
```





CLIENT: Olin, Wilmington, MA	COMPANY: BCM/SMITH
	PROJECT: 00-7074-0102

OLIN SLUG TESTS, GW51S TEST 1



DATA SET:
GW51S-1.DAT
01/13/96

AQUIFER MODEL:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 0.31 ft
r_c= 0.083 ft
r_w= 0.33 ft
L = 1.6 ft
b = 7.7 ft
H = 1.6 ft

PARAMETER ESTIMATES:
K = 0.01047 ft/min
y0 = 0.2716 ft

AQTESOLV

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                        A Q T E S O L V    R E S U L T S
                                Version 2.01

                          Developed by Glenn M. Duffield
                      (c) 1988-1995  Geraghty & Miller, Inc.

09/01/95                                                                15:33:53

================================================================================
                                TEST DESCRIPTION

Data set........... GW51S-1.DAT
Output file........ GW51S-1.OUT
Data set title..... OLIN SLUG TESTS, GW51S TEST 1
Company............ BCM/SMITH
Project............ 00-7074-0102
Client............. Olin, Wilmington, MA
Test date.......... August 1995
Obs. well.......... GW-51-S

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 0.31
   Radius of well casing............ 0.083
   Radius of wellbore............... 0.33
   Aquifer saturated thickness...... 7.7
   Well screen length............... 1.6
   Static height of water in well... 1.6
   Gravel pack porosity............. 0.3
   Effective well casing radius..... 0.1936
   Effective wellbore radius........ 0.33
   Log(Re/Rw)....................... 0.8327
   Constants A, B and C............. 1.728 ,  0.245,  0.000
   No. of observations.............. 35

================================================================================
                                ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

================================================================================
                         RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

           Estimate
   K  =   1.0465E-002 ft/min
   y0 =   2.7161E-001 ft


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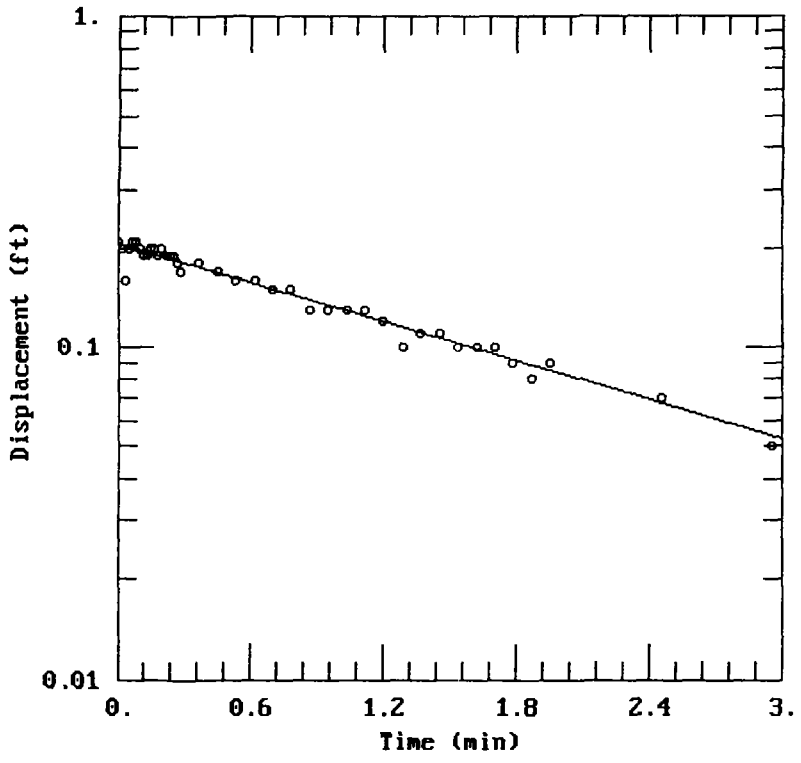
```

CLIENT: Olin, Wilmington, MA	COMPANY: BCM/SMITH
	PROJECT: 00-7074-0102

OLIN SLUG TESTS, GW51S TEST 2



DATA SET:
GW51S-2.DAT
01/13/96

AQUIFER MODEL:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 0.21 ft
r_c= 0.083 ft
r_w= 0.33 ft
L = 1.6 ft
b = 7.7 ft
H = 1.6 ft

PARAMETER ESTIMATES:
K = 0.004439 ft/min
y0 = 0.2059 ft

AQTESOLV

```
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                        A Q T E S O L V    R E S U L T S
                                  Version 2.01

                          Developed by Glenn M. Duffield
                      (c) 1988-1995  Geraghty & Miller, Inc.

09/01/95                                                                 16:29:1

================================================================================
                                TEST DESCRIPTION

Data set........... GW51S-2.DAT
Output file........ GW51S-2.OUT
Data set title..... OLIN SLUG TESTS, GW51S TEST 2
Company............ BCM/SMITH
Project............ 00-7074-0102
Client............. Olin, Wilmington, MA
Test date.......... August 1995
Obs. well.......... GW-51-S

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 0.21
   Radius of well casing............ 0.083
   Radius of wellbore............... 0.33
   Aquifer saturated thickness...... 7.7
   Well screen length............... 1.6
   Static height of water in well... 1.6
   Gravel pack porosity............. 0.3
   Effective well casing radius..... 0.1936
   Effective wellbore radius........ 0.33
   Log(Re/Rw)....................... 0.8327
   Constants A, B and C............. 1.728 ,  0.245,  0.000
   No. of observations.............. 39

================================================================================
                                ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

================================================================================
                     RESULTS FROM STATISTICAL CURVE MATCHING


STATISTICAL MATCH PARAMETER ESTIMATES

           Estimate          Std. Error
   K  =   4.4385E-003 +/-   1.8359E-004 ft/min
   y0 =   2.0585E-001 +/-   2.5908E-003 ft


ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated
```

weighted residual = residual * weight

Weighted Residual Statistics:

Number of residuals	39
Number of estimated parameters	2
Degrees of freedom	37
Residual mean	-3.844E-005
Residual standard deviation	0.00936
Residual variance	8.761E-005

Model Residuals:

Time	Observed	Calculated	Residual	Weight
0.0166	0.2	0.2043	-0.0043037	1
0.0333	0.16	0.20276	-0.042757	1
0.05	0.2	0.20122	-0.0012229	1
0.0666	0.21	0.19971	0.010291	1
0.0833	0.21	0.1982	0.011802	1
0.1	0.2	0.1967	0.0033025	1
0.1166	0.19	0.19522	-0.0052177	1
0.1333	0.19	0.19374	-0.0037402	1
0.15	0.2	0.19227	0.0077261	1
0.1666	0.2	0.19083	0.0091726	1
0.1833	0.19	0.18938	0.00061687	1
0.2	0.2	0.18795	0.01205	1
0.2166	0.19	0.18654	0.0034642	1
0.2333	0.19	0.18512	0.004876	1
0.25	0.19	0.18372	0.0062771	1
0.2666	0.18	0.18234	-0.0023407	1
0.2833	0.17	0.18096	-0.010961	1
0.3667	0.18	0.17422	0.0057764	1
0.45	0.17	0.16774	0.0022551	1
0.5333	0.16	0.16151	-0.0015071	1
0.6167	0.16	0.15549	0.0045057	1
0.7	0.15	0.14971	0.00028795	1
0.7833	0.15	0.14414	0.0058551	1
0.8667	0.13	0.13878	-0.0087784	1
0.95	0.13	0.13362	-0.0036178	1
1.0333	0.13	0.12865	0.0013509	1
1.1167	0.13	0.12386	0.0061405	1
1.2	0.12	0.11925	0.00074635	1
1.2833	0.1	0.11482	-0.014819	1
1.3666	0.11	0.11055	-0.00054942	1
1.45	0.11	0.10643	0.0035663	1
1.5333	0.1	0.10248	-0.0024758	1
1.6167	0.1	0.098661	0.0013393	1
1.7	0.1	0.094992	0.0050081	1
1.7833	0.09	0.09146	-0.0014595	1
1.8667	0.08	0.088055	-0.0080545	1
1.95	0.09	0.08478	0.0052199	1
2.45	0.07	0.067532	0.0024681	1
2.95	0.05	0.053793	-0.0037928	1

==========

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

```
              Estimate
   K   =    4.4385E-003 ft/min
   y0 =    2.0585E-001 ft


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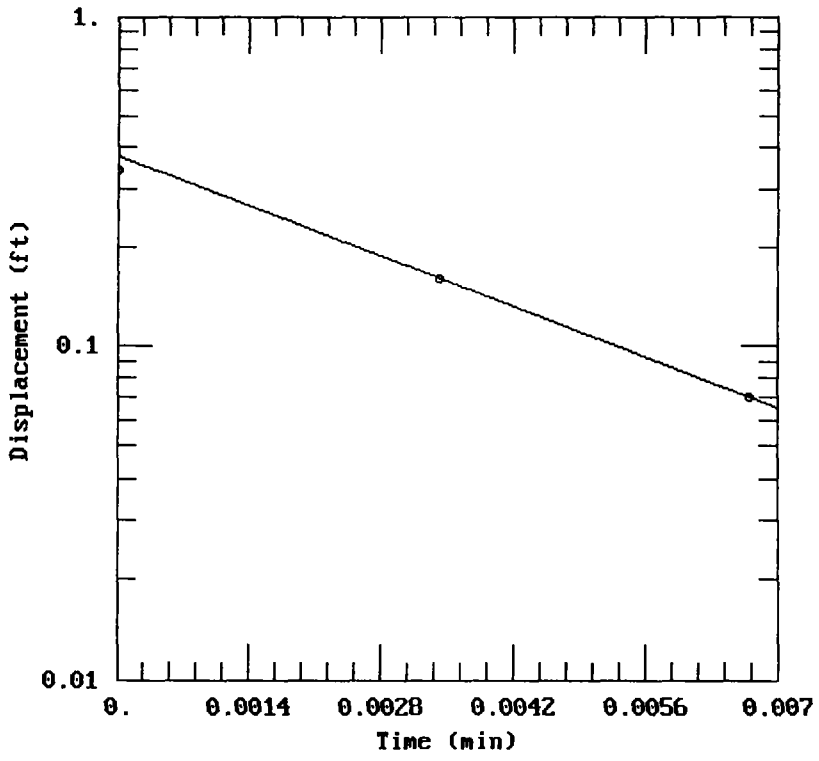
```

CLIENT: Olin, Wilmington, MA	COMPANY: BCM/SMITH
	PROJECT: 00-7074-0102

OLIN SLUG TESTS, GW51D TEST 1



DATA SET:
GW51D-1.DAT
01/13/96

AQUIFER MODEL:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 0.34 ft
r_c= 0.083 ft
r_w= 0.33 ft
L = 3. ft
b = 7.7 ft
H = 7.5 ft

PARAMETER ESTIMATES:
K = 2.875 ft/min
y0 = 0.375 ft

AQTESOLV

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                         A Q T E S O L V    R E S U L T S
                                   Version 2.01

                           Developed by Glenn M. Duffield
                       (c) 1988-1995  Geraghty & Miller, Inc.

09/01/95                                                                16:40:31

================================================================================
                                 TEST DESCRIPTION

Data set........... GW51D-1.DAT
Output file........ GW51D-1.OUT
Data set title..... OLIN SLUG TESTS, GW51D TEST 1
Company............ BCM/SMITH
Project............ 00-7074-0102
Client............. Olin, Wilmington, MA
Test date.......... August 1995
Obs. well.......... GW-51-D

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 0.34
   Radius of well casing............ 0.083
   Radius of wellbore............... 0.33
   Aquifer saturated thickness...... 7.7
   Well screen length............... 3
   Static height of water in well... 7.5
   Gravel pack porosity............. 0.3
   Effective well casing radius..... 0.1936
   Effective wellbore radius........ 0.33
   Log(Re/Rw)....................... 1.837
   Constants A, B and C............. 1.876 ,   0.257,   0.000
   No. of observations.............. 2

================================================================================
                                 ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

================================================================================
                          RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

           Estimate
   K  =   2.8752E+000 ft/min
   y0 =   3.7499E-001 ft


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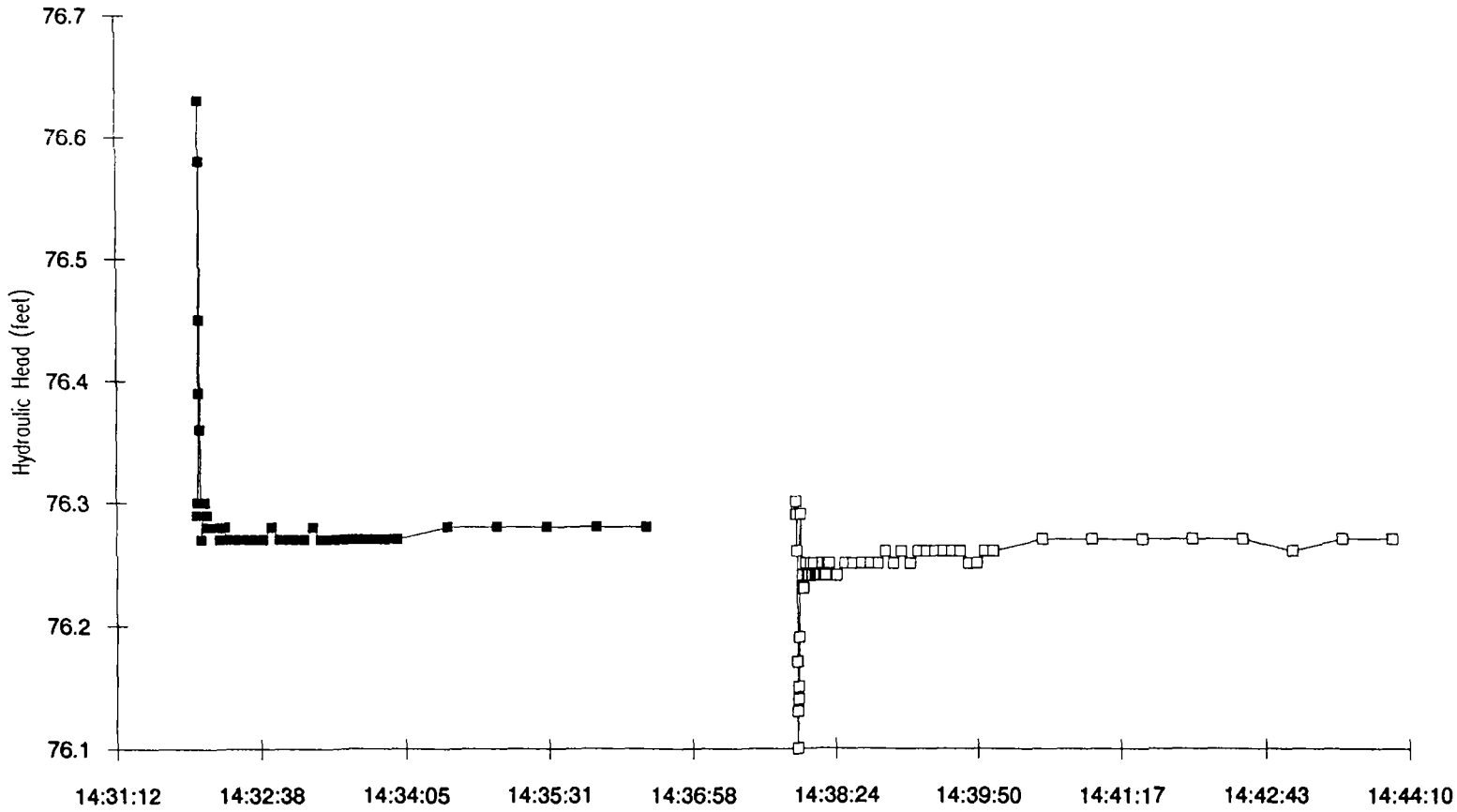
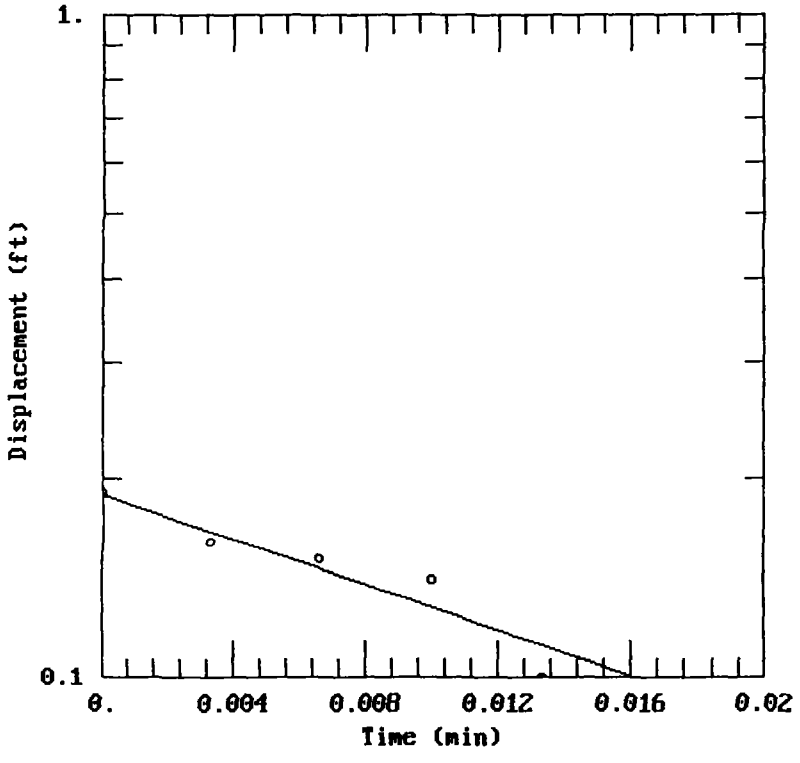
```

Changes in Hydraulic Head, GW-51D
Second Trial



CLIENT: Olin, Wilmington, MA	COMPANY: BCM/SMITH
	PROJECT: 00-7074-0102

OLIN SLUG TESTS, GW51D TEST 2



DATA SET:
GW51D-2.DAT
01/13/96

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 0.19 ft
r_c= 0.083 ft
r_w= 0.33 ft
L = 3. ft
b = 7.7 ft
H = 7.5 ft

PARAMETER ESTIMATES:
K = 0.454 ft/min
y0 = 0.189 ft

AQTESOLV

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                      A Q T E S O L V    R E S U L T S
                                Version 2.01

                        Developed by Glenn M. Duffield
                    (c) 1988-1995  Geraghty & Miller, Inc.

09/01/95                                                                16:43:4

===============================================================================
                               TEST DESCRIPTION

Data set........... GW51D-2.DAT
Output file........ GW51D-2.OUT
Data set title..... OLIN SLUG TESTS, GW51D TEST 2
Company............ BCM/SMITH
Project............ 00-7074-0102
Client............. Olin, Wilmington, MA
Test date.......... August 1995
Obs. well.......... GW-51-D

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 0.19
   Radius of well casing............ 0.083
   Radius of wellbore............... 0.33
   Aquifer saturated thickness...... 7.7
   Well screen length............... 3
   Static height of water in well... 7.5
   Gravel pack porosity............. 0.3
   Effective well casing radius..... 0.1936
   Effective wellbore radius........ 0.33
   Log(Re/Rw)....................... 1.837
   Constants A, B and C............. 1.876 ,  0.257,  0.000
   No. of observations.............. 4

===============================================================================
                               ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

===============================================================================
                    RESULTS FROM STATISTICAL CURVE MATCHING


STATISTICAL MATCH PARAMETER ESTIMATES

           Estimate          Std. Error
   K  =   4.5401E-001 +/-   1.5169E-001 ft/min
   y0 =   1.8897E-001 +/-   2.0132E-002 ft


ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated
```

```
weighted residual = residual * weight

Weighted Residual Statistics:
   Number of residuals............... 4
   Number of estimated parameters.... 2
   Degrees of freedom................ 2
   Residual mean..................... -7.41E-005
   Residual standard deviation....... 0.01329
   Residual variance................. 0.0001765


Model Residuals:

     Time          Observed       Calculated       Residual         Weight
 -------------  -------------  -------------  -------------  -------------
       0.0033           0.16        0.16585     -0.0058471              1
       0.0066           0.15        0.14555       0.004449              1
         0.01           0.14        0.12723       0.012766              1
       0.0133            0.1        0.11166      -0.011664              1

================================================================================
                       RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

          Estimate
   K  =   4.5401E-001 ft/min
   y0 =   1.8897E-001 ft


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```

Olin, Wilmington, MA
Slug Test Data

GW-51D

SE1000B
Environmental Logger
08/22 14:08

Unit# 00000 Test# 0

INPUT 2: Level (M)

Reference 76.30
Scale factor 19.75
Offset 0.00

Step# 0 08/22 12:30

Elapsed Time	Value
0	76.29
0.0033	76.32
0.0066	76.31
0.0099	76.31
0.0133	76.32
0.0166	76.31
0.02	76.31
0.0233	76.31
0.0266	76.31
0.03	76.31
0.0333	76.3
0.05	76.45
0.0666	76.3
0.0833	76.34
0.1	76.3
0.1166	76.32
0.1333	76.3
0.15	76.3
0.1666	76.3
0.1833	76.32
0.2	76.3
0.2166	76.3
0.2333	76.31
0.25	76.3
0.2666	76.31
0.2833	76.31

GW-51S

SE1000B
Environmental Logger
08/22 14:13

Unit# 00000 Test# 2

INPUT 1: Level (M)

Reference 76.49
Scale factor 19.94
Offset 0.00

Step# 0 08/22 12:49

Elapsed Time	Value
0	76.47
0.0033	76.48
0.0066	76.47
0.0099	76.48
0.0133	76.49
0.0166	76.48
0.02	76.49
0.0233	76.48
0.0266	76.48
0.03	76.48
0.0333	76.48
0.05	76.46
0.0666	76.47
0.0833	76.46
0.1	76.43
0.1166	76.63
0.1333	76.77
0.15	76.78
0.1666	76.77
0.1833	76.76
0.2	76.75
0.2166	76.74
0.2333	76.74
0.25	76.74
0.2666	76.72
0.2833	76.73

GW-51D		GW-51S	
0.3	76.3	0.3	76.72
0.3166	76.29	0.3166	76.71
0.3333	76.27	0.3333	76.73
0.4167	76.29	0.4167	76.69
0.5	76.31	0.5	76.7
0.5833	76.28	0.5833	76.64
0.6667	76.29	0.6667	76.63
0.75	76.28	0.75	76.61
0.8333	76.29	0.8333	76.6
0.9167	76.29	0.9167	76.59
1	76.29	1	76.58
1.0833	76.29	1.0833	76.57
1.1667	76.29	1.1667	76.56
1.25	76.29	1.25	76.56
1.3333	76.29	1.3333	76.56
1.4166	76.3	1.4166	76.55
1.5	76.29	1.5	76.55
1.5833	76.29	1.5833	76.54
1.6667	76.29	1.6667	76.53
1.75	76.29	1.75	76.53
1.8333	76.3	1.8333	76.52
1.9167	76.29	1.9167	76.53
2	76.29	2	76.51
2.5	76.3	2.5	76.51
3	76.29	3	76.5
3.5	76.3	3.5	76.49
4	76.29	4	76.49
4.5	76.3	END	
5	76.3		
5.5	76.29		
6	76.34		
6.5	76.33		
7	76.3		
7.5	76.3		
8	76.3		
8.5	76.3		
9	76.31		
END			

Olin, Wilmington, MA
Slug Test Data

GW-51D

SE1000B
Environmental Logger
08/22 14:11

Unit# 00000 Test# 1

INPUT 2: Level (M)

Reference 76.30
Scale factor 19.75
Offset 0.00

Step# 0 08/22 12:43

Elapsed Time	Value
0	76.3
0.0033	76.32
0.0066	76.33
0.0099	76.32
0.0133	76.32
0.0166	76.31
0.02	76.27
0.0233	76.31
0.0266	76.32
0.03	76.26
0.0333	76.29
0.05	76.17
0.0666	76.24
0.0833	76.3
0.1	76.25
0.1166	76.26
0.1333	76.28
0.15	76.27
0.1666	76.27
0.1833	76.29
0.2	76.27
0.2166	76.26
0.2333	76.28
0.25	76.28
0.2666	76.27
0.2833	76.27

GW-51S

SE1000B
Environmental Logger
08/22 14:15

Unit# 00000 Test# 3

INPUT 1: Level (M)

Reference 76.49
Scale factor 19.94
Offset 0.00

Step# 0 08/22 12:55

Elapsed Time	Value
0	76.5
0.0033	76.5
0.0066	76.5
0.0099	76.47
0.0133	76.47
0.0166	76.5
0.02	76.47
0.0233	76.45
0.0266	76.41
0.03	76.36
0.0333	76.32
0.05	76.29
0.0666	76.3
0.0833	76.34
0.1	76.3
0.1166	76.29
0.1333	76.29
0.15	76.3
0.1666	76.31
0.1833	76.31
0.2	76.3
0.2166	76.3
0.2333	76.31
0.25	76.3
0.2666	76.31
0.2833	76.31

GW-51D		GW-51S	
0.3	76.27	0.3	76.31
0.3166	76.27	0.3166	76.32
0.3333	76.27	0.3333	76.33
0.4167	76.27	0.4167	76.32
0.5	76.27	0.5	76.33
0.5833	76.28	0.5833	76.34
0.6667	76.28	0.6667	76.34
0.75	76.28	0.75	76.35
0.8333	76.28	0.8333	76.35
0.9167	76.28	0.9167	76.37
1	76.28	1	76.37
1.0833	76.29	1.0833	76.37
1.1667	76.28	1.1667	76.37
1.25	76.28	1.25	76.38
1.3333	76.28	1.3333	76.4
1.4166	76.28	1.4166	76.39
1.5	76.28	1.5	76.39
1.5833	76.28	1.5833	76.4
1.6667	76.29	1.6667	76.4
1.75	76.29	1.75	76.4
1.8333	76.28	1.8333	76.41
1.9167	76.28	1.9167	76.42
2	76.28	2	76.41
2.5	76.28	2.5	76.43
3	76.31	3	76.45
3.5	76.29	END	
END			

Olin, Wilmington, MA
Slug Test Data

GW-51D GW-51S

SE1000B
Environmental Logger
08/23 17:03

Unit# 00000 Test# 0

INPUT 2: Level (M)

Reference 68.07
Scale factor 19.75
Offset 0.00

Step# 0 08/23 14:32

Elapsed Time	Value
0	68.07
0.0033	68.07
0.0066	68.08
0.0099	68.08
0.0133	68.07
0.0166	68.08
0.02	68.17
0.0233	68.36
0.0266	68.41
0.03	68.23
0.0333	68.14
0.05	68.05
0.0666	68.07
0.0833	68.08
0.1	68.07
0.1166	68.06
0.1333	68.06
0.15	68.06
0.1666	68.06
0.1833	68.06
0.2	68.06
0.2166	68.06
0.2333	68.05
0.25	68.06
0.2666	68.05
0.2833	68.06

GW-51D GW-51S

0.3	68.05	14:32:18
0.3166	68.05	14:32:19
0.3333	68.05	14:32:20
0.4167	68.05	14:32:25
0.5	68.05	14:32:30
0.5833	68.05	14:32:35
0.6667	68.05	14:32:40
0.75	68.06	14:32:45
0.8333	68.05	14:32:50
0.9167	68.05	14:32:55
1	68.05	14:33:00
1.0833	68.05	14:33:05
1.1667	68.06	14:33:10
1.25	68.05	14:33:15
1.3333	68.05	14:33:20
1.4166	68.05	14:33:25
1.5	68.05	14:33:30
1.5833	68.05	14:33:35
1.6667	68.05	14:33:40
1.75	68.05	14:33:45
1.8333	68.05	14:33:50
1.9167	68.05	14:33:55
2	68.05	14:34:00
2.5	68.06	14:34:30
3	68.06	14:35:00
3.5	68.06	14:35:30
4	68.06	14:36:00
4.5	68.06	14:36:30

END

Olin, Wilmington, MA
Slug Test Data

GW-51D GW-51S

SE1000B
Environmental Logger
08/23 17:04

Unit# 00000 Test# 1

INPUT 2: Level (M)

Reference 68.07
Scale factor 19.75
Offset 0.00

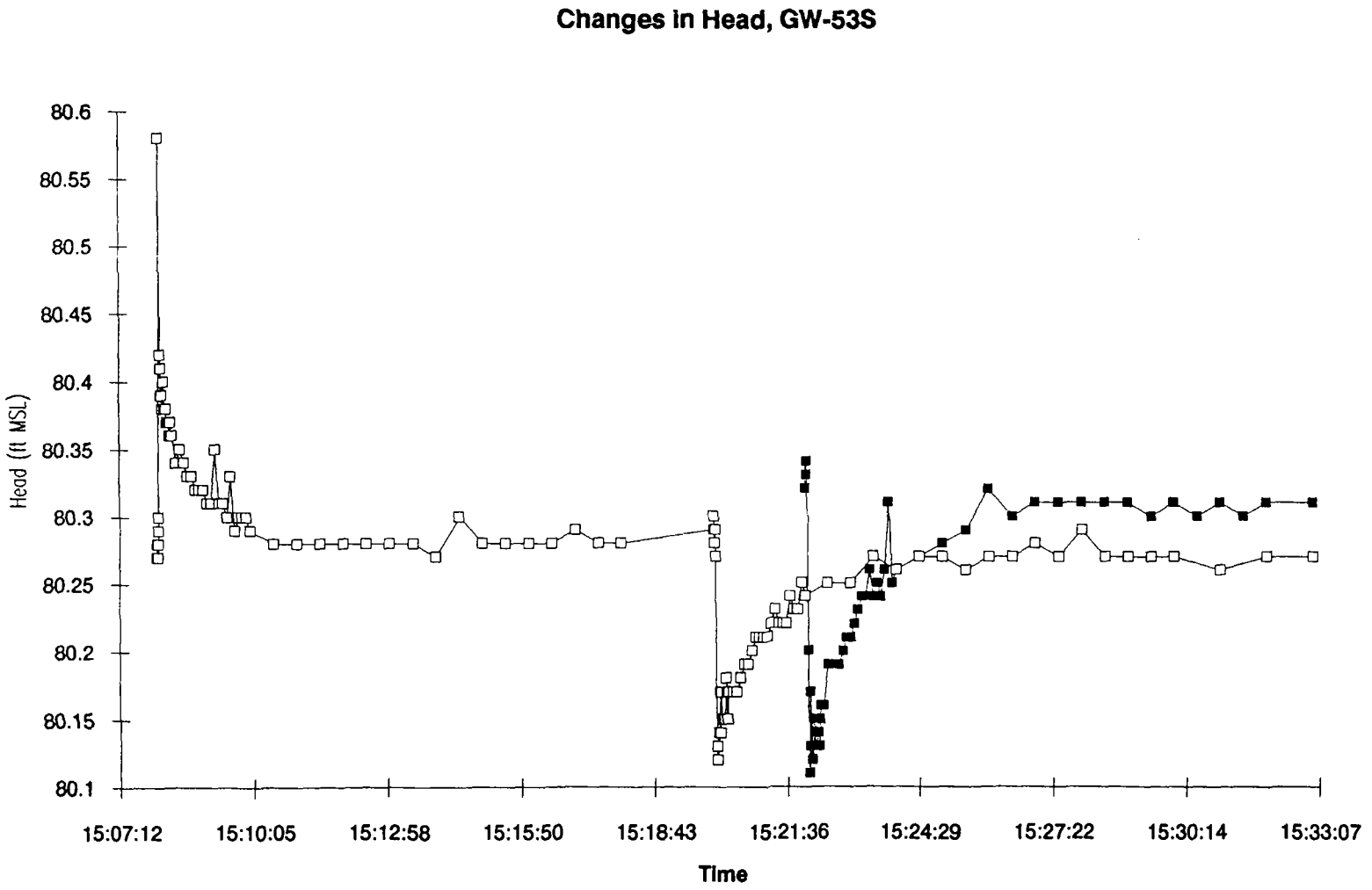
Step# 0 08/23 14:38

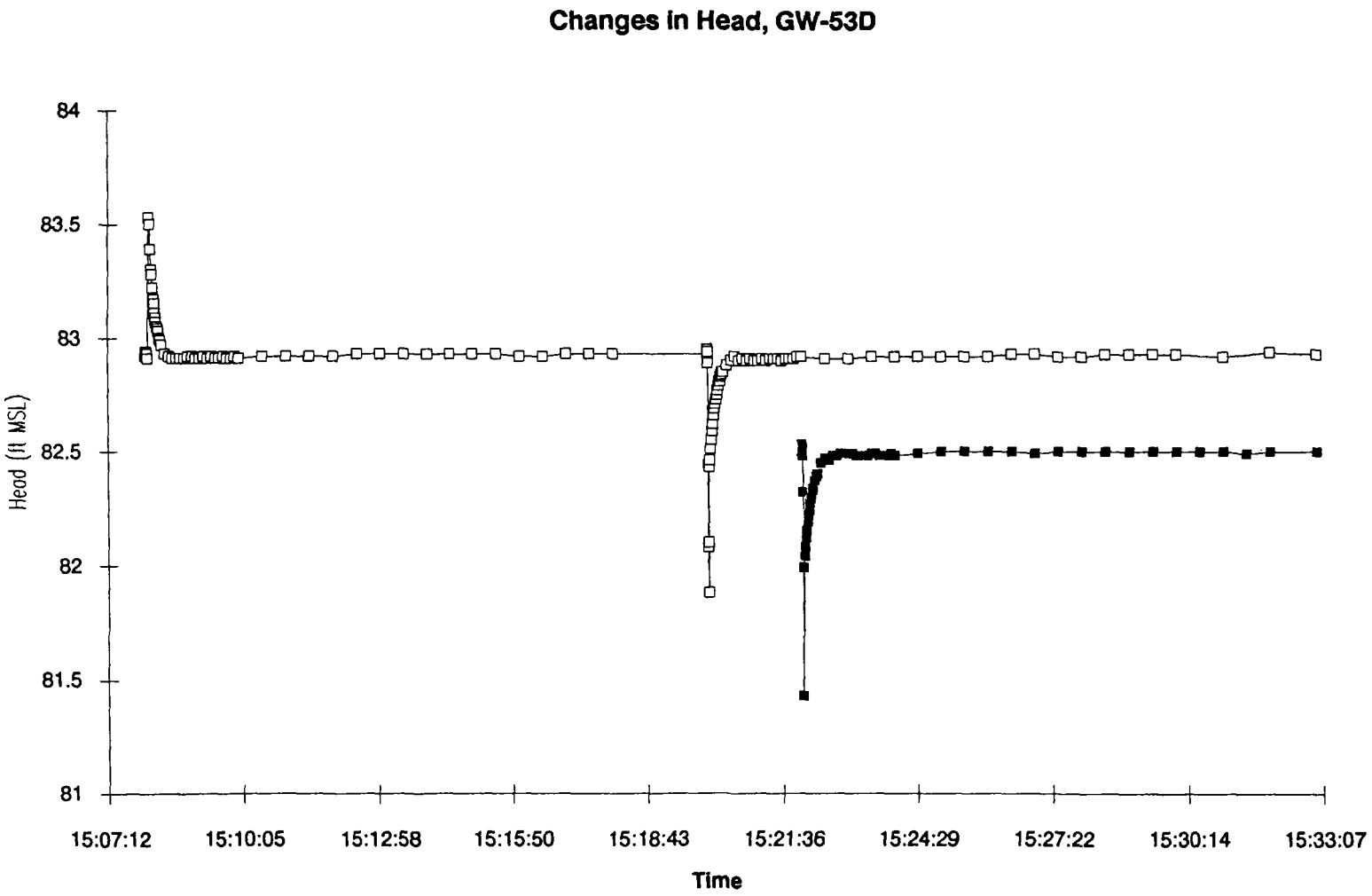
Elapsed Time	Value
0	68.07
0.0033	68.07
0.0066	68.08
0.0099	68.07
0.0133	68.04
0.0166	67.95
0.02	67.88
0.0233	67.91
0.0266	67.92
0.03	67.93
0.0333	67.97
0.05	68.07
0.0666	68.02
0.0833	68.01
0.1	68.03
0.1166	68.02
0.1333	68.02
0.15	68.03
0.1666	68.02
0.1833	68.03
0.2	68.02
0.2166	68.02
0.2333	68.02
0.25	68.02
0.2666	68.03
0.2833	68.02

GW-51D GW-51S

0.3	68.02	14:38:18
0.3166	68.03	14:38:19
0.3333	68.03	14:38:20
0.4167	68.02	14:38:25
0.5	68.03	14:38:30
0.5833	68.03	14:38:35
0.6667	68.03	14:38:40
0.75	68.03	14:38:45
0.8333	68.03	14:38:50
0.9167	68.04	14:38:55
1	68.03	14:39:00
1.0833	68.04	14:39:05
1.1667	68.03	14:39:10
1.25	68.04	14:39:15
1.3333	68.04	14:39:20
1.4166	68.04	14:39:25
1.5	68.04	14:39:30
1.5833	68.04	14:39:35
1.6667	68.04	14:39:40
1.75	68.03	14:39:45
1.8333	68.03	14:39:50
1.9167	68.04	14:39:55
2	68.04	14:40:00
2.5	68.05	14:40:30
3	68.05	14:41:00
3.5	68.05	14:41:30
4	68.05	14:42:00
4.5	68.05	14:42:30
5	68.04	14:43:00
5.5	68.05	14:43:30
6	68.05	14:44:00

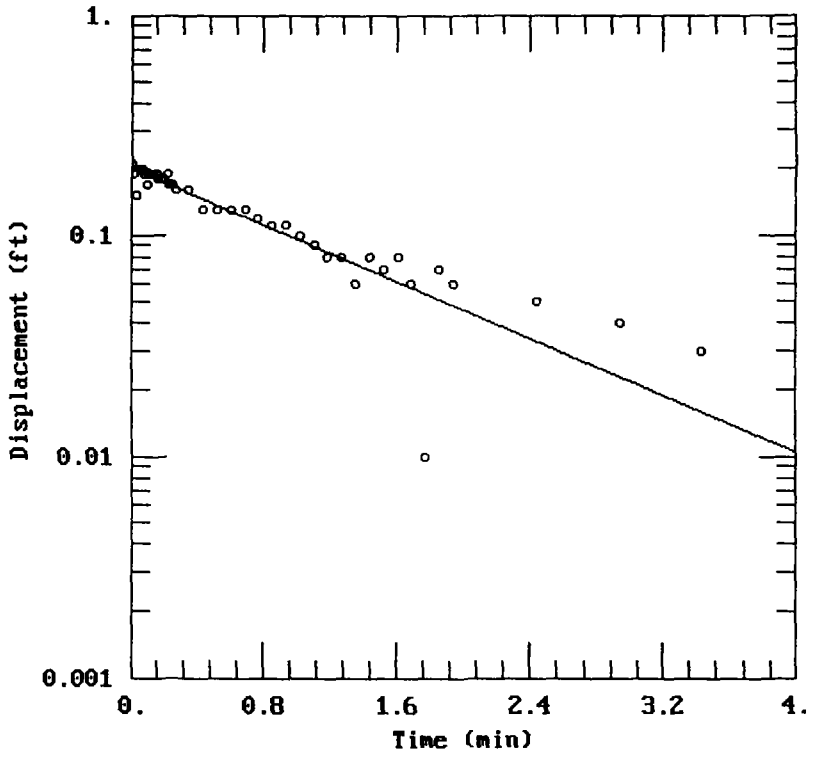
END





CLIENT: Olin, Wilmington, MA	COMPANY: BCM/SMITH
	PROJECT: 00-7074-0102

OLIN SLUG TESTS, GW53S TEST 1



DATA SET:
GW53S-1.DAT
01/13/96

AQUIFER MODEL:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 0.21 ft
r_c= 0.083 ft
r_w= 0.33 ft
L = 1.8 ft
b = 6. ft
H = 1.8 ft

PARAMETER ESTIMATES:
K = 0.0013 ft/min
y0 = 0.2 ft

AQTESOLV

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                    A Q T E S O L V    R E S U L T S
                               Version 2.01

                       Developed by Glenn M. Duffield
                    (c) 1988-1995  Geraghty & Miller, Inc.

08/31/95                                                                 09:54:4

================================================================================
                               TEST DESCRIPTION

Data set........... GW53S-1.DAT
Output file........ GW53S-1.OUT
Data set title..... OLIN SLUG TESTS, GW53S TEST 1
Company............ BCM/SMITH
Project............ 00-7074-0102
Client............. Olin, Wilmington, MA
Test date.......... August 1995
Obs. well.......... GW-53-S

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 0.21
   Radius of well casing............ 0.083
   Radius of wellbore............... 0.33
   Aquifer saturated thickness...... 6
   Well screen length............... 1.8
   Static height of water in well... 1.8
   Gravel pack porosity............. 0
   Effective well casing radius..... 0.083
   Effective wellbore radius........ 0.33
   Log(Re/Rw)....................... 0.9225
   Constants A, B and C............. 1.755 ,   0.244,   0.000
   No. of observations.............. 39

================================================================================
                               ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

================================================================================
                       RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

           Estimate
   K  =    1.3000E-003 ft/min
   y0 =    2.0000E-001 ft


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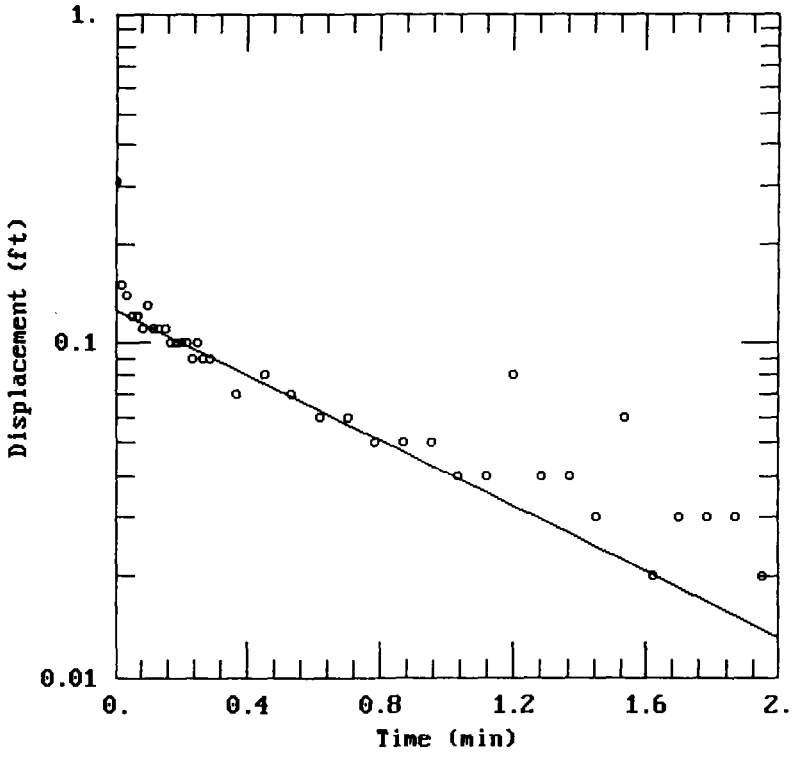
```

CLIENT: Olin, Wilmington, MA	COMPANY: BCM/SMITH
	PROJECT: 00-7074-0102

OLIN SLUG TESTS, GW53S TEST 2



DATA SET:
GW53S-2.DAT
01/13/96

AQUIFER MODEL:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 0.31 ft
r_c= 0.083 ft
r_w= 0.33 ft
L = 1.8 ft
b = 6. ft
H = 1.8 ft

PARAMETER ESTIMATES:
K = 0.001987 ft/min
y0 = 0.1253 ft

AQTESOLV

```
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                     A Q T E S O L V   R E S U L T S
                              Version 2.01

                      Developed by Glenn M. Duffield
                   (c) 1988-1995  Geraghty & Miller, Inc.

08/31/95                                                                09:47:03

================================================================================
                             TEST DESCRIPTION

Data set........... GW53S-2.DAT
Output file........ GW53S-2.OUT
Data set title..... OLIN SLUG TESTS, GW53S TEST 2
Company............ BCM/SMITH
Project............ 00-7074-0102
Client............. Olin, Wilmington, MA
Test date.......... August 1995
Obs. well.......... GW-53-S

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 0.31
   Radius of well casing............ 0.083
   Radius of wellbore............... 0.33
   Aquifer saturated thickness...... 6
   Well screen length............... 1.8
   Static height of water in well... 1.8
   Gravel pack porosity............. 0
   Effective well casing radius..... 0.083
   Effective wellbore radius........ 0.33
   Log(Re/Rw)....................... 0.9225
   Constants A, B and C............. 1.755 ,  0.244,  0.000
   No. of observations.............. 37

================================================================================
                            ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

================================================================================
                   RESULTS FROM STATISTICAL CURVE MATCHING


STATISTICAL MATCH PARAMETER ESTIMATES

           Estimate          Std.  Error
   K  =   1.6428E-003 +/-   1.3054E-004 ft/min
   y0 =   1.2533E-001 +/-   3.8882E-003 ft


ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated
```

weighted residual = residual * weight

Weighted Residual Statistics:

Number of residuals	37
Number of estimated parameters	2
Degrees of freedom	35
Residual mean	0.0005577
Residual standard deviation	0.01205
Residual variance	0.0001452

Model Residuals:

Time	Observed	Calculated	Residual	Weight
0.0166	0.15	0.12341	0.02659	1
0.0333	0.14	0.12151	0.018493	1
0.05	0.12	0.11963	0.0003663	1
0.0666	0.12	0.1178	0.0022001	1
0.0833	0.11	0.11598	-0.0059834	1
0.1	0.13	0.11419	0.015805	1
0.1166	0.11	0.11244	-0.0024444	1
0.1333	0.11	0.11071	-0.00071048	1
0.15	0.11	0.109	0.00099671	1
0.1666	0.1	0.10733	-0.0073324	1
0.1833	0.1	0.10568	-0.0056773	1
0.2	0.1	0.10405	-0.0040477	1
0.2166	0.1	0.10245	-0.0024528	1
0.2333	0.09	0.10087	-0.010873	1
0.25	0.1	0.099317	0.00068252	1
0.2666	0.09	0.097795	-0.0077951	1
0.2833	0.09	0.096287	-0.006287	1
0.3667	0.07	0.089097	-0.019097	1
0.45	0.08	0.082451	-0.0024514	1
0.5333	0.07	0.076301	-0.0063015	1
0.6167	0.06	0.070604	-0.010604	1
0.7	0.06	0.065338	-0.0053376	1
0.7833	0.05	0.060464	-0.010464	1
0.8667	0.05	0.055949	-0.0059491	1
0.95	0.05	0.051776	-0.001776	1
1.0333	0.04	0.047914	-0.0079141	1
1.1167	0.04	0.044336	-0.0043362	1
1.2	0.08	0.041029	0.038971	1
1.2833	0.04	0.037969	0.0020311	1
1.3666	0.04	0.035137	0.0048631	1
1.45	0.03	0.032513	-0.0025131	1
1.5333	0.06	0.030088	0.029912	1
1.6167	0.02	0.027841	-0.0078412	1
1.7	0.03	0.025765	0.0042354	1
1.7833	0.03	0.023843	0.0061571	1
1.8667	0.03	0.022062	0.0079376	1
1.95	0.02	0.020417	-0.00041686	1

==========

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

Estimate

```
   K  =   1.9873E-003 ft/min
   y0 =   1.2534E-001 ft


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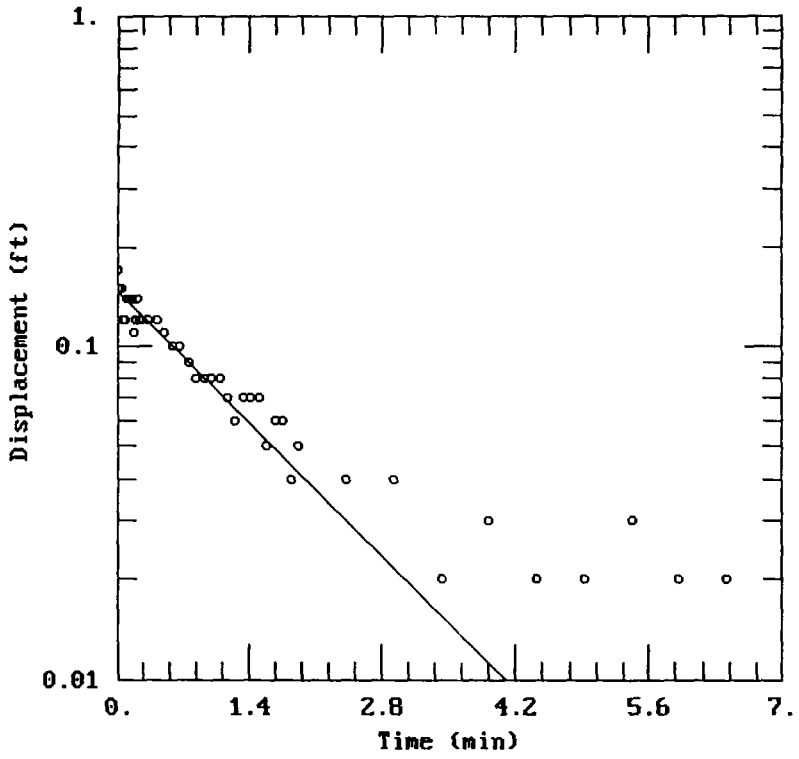
CLIENT: Olin, Wilmington, MA	COMPANY: BCM/SMITH
	PROJECT: 00-7074-0102

OLIN SLUG TESTS, GW53S TEST 3



DATA SET:
GW53S-3.DAT
01/13/96

AQUIFER MODEL:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 0.17 ft
r_c= 0.083 ft
r_w= 0.33 ft
L = 1.8 ft
b = 6. ft
H = 1.8 ft

PARAMETER ESTIMATES:
K = 0.001155 ft/min
y0 = 0.1462 ft

AQTESOLV

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                          A Q T E S O L V    R E S U L T S
                                   Version 2.01

                            Developed by Glenn M. Duffield
                        (c) 1988-1995  Geraghty & Miller, Inc.

08/31/95                                                                  09:50:13

================================================================================
                                  TEST DESCRIPTION

Data set........... GW53S-3.DAT
Output file........ GW53S-3.OUT
Data set title..... OLIN SLUG TESTS, GW53S TEST 3
Company............ BCM/SMITH
Project............ 00-7074-0102
Client............. Olin, Wilmington, MA
Test date.......... August 1995
Obs. well.......... GW-53-S

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 0.17
   Radius of well casing............ 0.083
   Radius of wellbore............... 0.33
   Aquifer saturated thickness...... 6
   Well screen length............... 1.8
   Static height of water in well... 1.8
   Gravel pack porosity............. 0
   Effective well casing radius..... 0.083
   Effective wellbore radius........ 0.33
   Log(Re/Rw)....................... 0.9225
   Constants A, B and C............. 1.755 ,   0.244,   0.000
   No. of observations.............. 44

================================================================================
                                  ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

================================================================================
                           RESULTS FROM VISUAL CURVE MATCHING

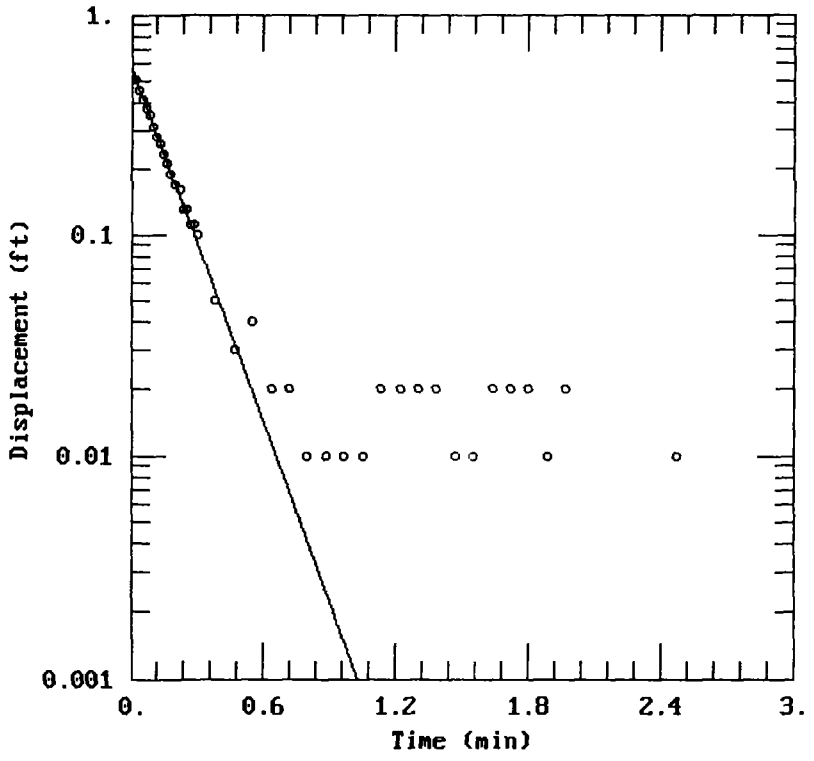

VISUAL MATCH PARAMETER ESTIMATES

           Estimate
   K  =    1.1550E-003 ft/min
   y0 =    1.4617E-001 ft


<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>
```

CLIENT: Olin, Wilmington, MA	COMPANY: BCM/SMITH
	PROJECT: 00-7074-0102

OLIN SLUG TESTS, GW53D TEST 1



DATA SET:
GW53D-1.DAT
01/13/96

AQUIFER MODEL:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 1.07 ft
r_c= 0.083 ft
r_w= 0.33 ft
L = 3.5 ft
b = 6. ft
H = 6. ft

PARAMETER ESTIMATES:
K = 0.0656 ft/min
y0 = 0.571 ft

AQTESOLV

```
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

                         A Q T E S O L V   R E S U L T S
                                   Version 2.01

                           Developed by Glenn M. Duffield
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08/31/95                                                                 10:13:39

==================================================================================
                                 TEST DESCRIPTION

Data set........... GW53D-1.DAT
Output file........ GW53D-1.OUT
Data set title..... OLIN SLUG TESTS, GW53D TEST 1
Company............ BCM/SMITH
Project............ 00-7074-0102
Client............. Olin, Wilmington, MA
Test date.......... August 1995
Obs. well.......... GW-53-D

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 1.07
   Radius of well casing............ 0.083
   Radius of wellbore............... 0.33
   Aquifer saturated thickness...... 6
   Well screen length............... 3.5
   Static height of water in well... 6
   Gravel pack porosity............. 0.3
   Effective well casing radius..... 0.1936
   Effective wellbore radius........ 0.33
   Log(Re/Rw)....................... 1.987
   Constants A, B and C............. 0.000 ,  0.000,  1.315
   No. of observations.............. 39

==================================================================================
                                 ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

==================================================================================
                          RESULTS FROM VISUAL CURVE MATCHING

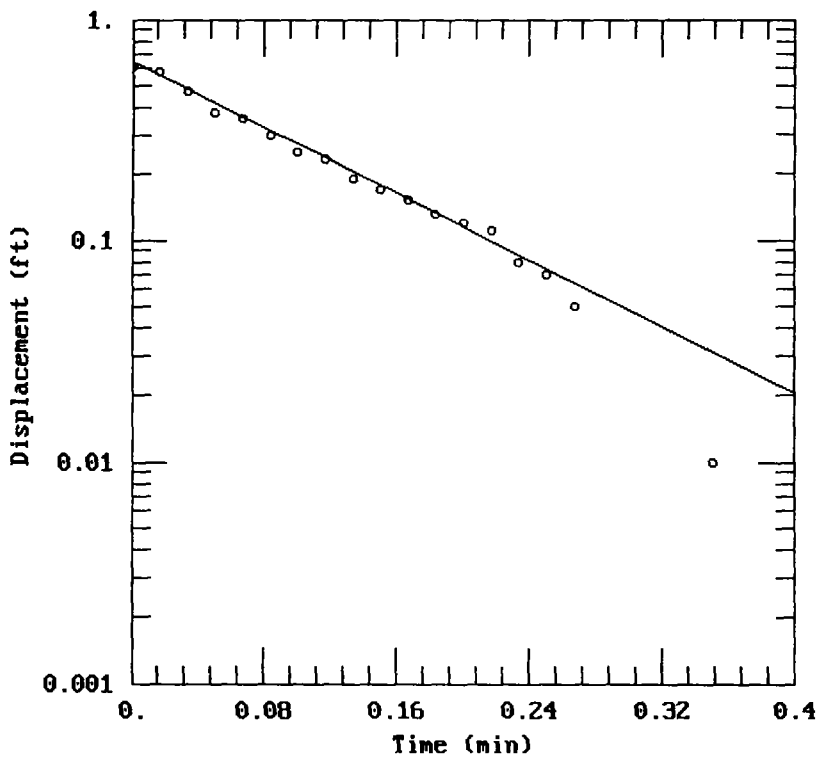

VISUAL MATCH PARAMETER ESTIMATES

           Estimate
   K  =   6.5600E-002 ft/min
   y0 =   5.7100E-001 ft


<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>
```

CLIENT: Olin, Wilmington, MA	COMPANY: BCM/SMITH
	PROJECT: 00-7074-0102

OLIN SLUG TESTS, GW53D TEST 2



DATA SET:
GW53D-2.DAT
01/13/96

AQUIFER MODEL:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 0.61 ft
r_c= 0.083 ft
r_w= 0.33 ft
L = 3.5 ft
b = 6. ft
H = 6. ft

PARAMETER ESTIMATES:
K = 0.092 ft/min
y0 = 0.65 ft

AQTESOLV

```
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

                      A Q T E S O L V   R E S U L T S
                               Version 2.01

                      Developed by Glenn M. Duffield
                  (c) 1988-1995  Geraghty & Miller, Inc.

08/31/95                                                                10:22:19

================================================================================
                              TEST DESCRIPTION

Data set........... GW53D-2.DAT
Output file........ GW53D-2.OUT
Data set title..... OLIN SLUG TESTS, GW53D TEST 2
Company............ BCM/SMITH
Project............ 00-7074-0102
Client............. Olin, Wilmington, MA
Test date.......... August 1995
Obs. well.......... GW-53-D

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 0.61
   Radius of well casing............ 0.083
   Radius of wellbore............... 0.33
   Aquifer saturated thickness...... 6
   Well screen length............... 3.5
   Static height of water in well... 6
   Gravel pack porosity............. 0.3
   Effective well casing radius..... 0.1936
   Effective wellbore radius........ 0.33
   Log(Re/Rw)....................... 1.987
   Constants A, B and C............. 0.000 ,  0.000,   1.315
   No. of observations.............. 17

================================================================================
                             ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

================================================================================
                      RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

           Estimate
   K  =   9.2000E-002 ft/min
   y0 =   6.5000E-001 ft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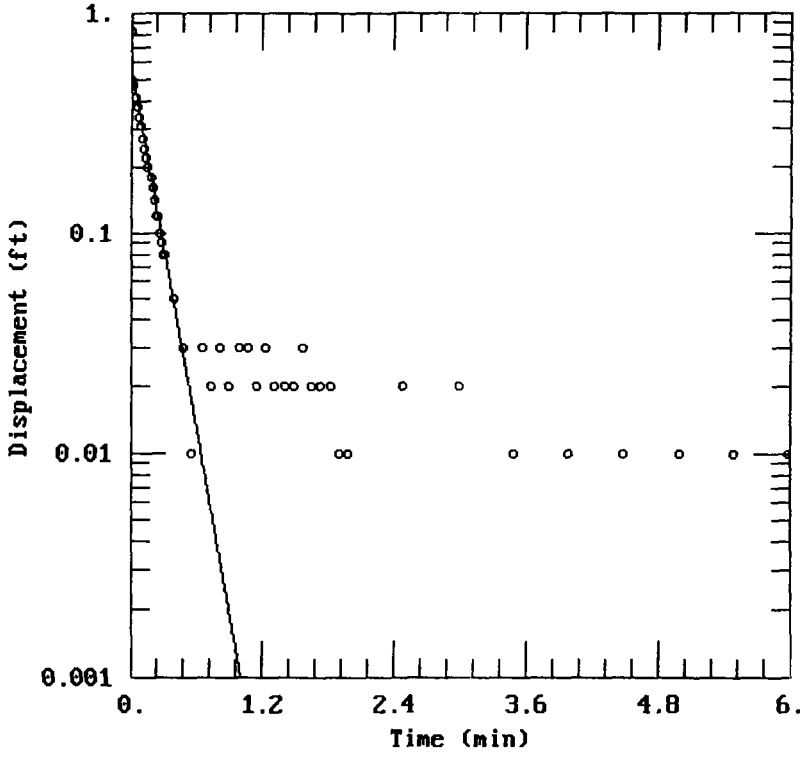
CLIENT: Olin, Wilmington, MA	COMPANY: BCM/SMITH
	PROJECT: 00-7074-0102

OLIN SLUG TESTS, GW53D TEST 3



DATA SET:
GW53D-3.DAT
01/13/96

AQUIFER MODEL:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 1.05 ft
r_c= 0.083 ft
r_w= 0.33 ft
L = 3.5 ft
b = 6. ft
H = 6. ft

PARAMETER ESTIMATES:
K = 0.067 ft/min
y0 = 0.55 ft

AQTESOLV

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                       A Q T E S O L V   R E S U L T S
                                 Version 2.01

                        Developed by Glenn M. Duffield
                    (c) 1988-1995  Geraghty & Miller, Inc.

08/31/95                                                                10:27:41

================================================================================
                                TEST DESCRIPTION

Data set........... GW53D-3.DAT
Output file........ GW53D-3.OUT
Data set title..... OLIN SLUG TESTS, GW53D TEST 3
Company............ BCM/SMITH
Project............ 00-7074-0102
Client............. Olin, Wilmington, MA
Test date.......... August 1995
Obs. well.......... GW-53-D

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 1.05
   Radius of well casing............ 0.083
   Radius of wellbore............... 0.33
   Aquifer saturated thickness...... 6
   Well screen length............... 3.5
   Static height of water in well... 6
   Gravel pack porosity............. 0.3
   Effective well casing radius..... 0.1936
   Effective wellbore radius........ 0.33
   Log(Re/Rw)....................... 1.987
   Constants A, B and C............. 0.000 ,   0.000,   1.315
   No. of observations.............. 49

================================================================================
                                ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

================================================================================
                       RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

           Estimate
   K  =   6.7000E-002 ft/min
   y0 =   5.5000E-001 ft


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```

Olin, Wilmington, MA
Slug Test Data

GW-53D		GW-53S	
SE1000B		SE1000B	
Environmental Logger		Environmental Logger	
08/22 17:21		08/22 17:20	
Unit# 00000 Test# 0		Unit# 00000 Test# 0	
INPUT 2: Level (M)		INPUT 1: Level (M)	
Reference	82.46	Reference	80.31
Scale factor	19.75	Scale factor	19.94
Offset	0.00	Offset	0.00
Step# 0 08/22 15:22		Step# 0 08/22 15:22	
Elapsed Time	Value	Elapsed Time	Value
0	82.5	0	80.32
0.0033	82.52	0.0033	80.34
0.0066	82.53	0.0066	80.34
0.0099	82.51	0.0099	80.34
0.0133	82.52	0.0133	80.33
0.0166	82.51	0.0166	80.33
0.02	82.51	0.02	80.34
0.0233	82.51	0.0233	80.33
0.0266	82.48	0.0266	80.34
0.03	82.32	0.03	80.34
0.0333	81.43	0.0333	80.34
0.05	81.99	0.05	80.2
0.0666	82.04	0.0666	80.11
0.0833	82.08	0.0833	80.13
0.1	82.12	0.1	80.17
0.1166	82.15	0.1166	80.12
0.1333	82.19	0.1333	80.12
0.15	82.22	0.15	80.13
0.1666	82.24	0.1666	80.15
0.1833	82.27	0.1833	80.13
0.2	82.29	0.2	80.13
0.2166	82.31	0.2166	80.13
0.2333	82.33	0.2333	80.14
0.25	82.34	0.25	80.14
0.2666	82.37	0.2666	80.14
0.2833	82.37	0.2833	80.13
0.3	82.39	0.3	80.15
0.3166	82.39	0.3166	80.15
0.3333	82.4	0.3333	80.16
0.4167	82.45	0.4167	80.16
0.5	82.47	0.5	80.19
0.5833	82.46	0.5833	80.19
0.6667	82.48	0.6667	80.19
0.75	82.48	0.75	80.19
0.8333	82.49	0.8333	80.2
0.9167	82.49	0.9167	80.21
1	82.49	1	80.21
1.0833	82.49	1.0833	80.22
1.1667	82.48	1.1667	80.23
1.25	82.48	1.25	80.24
1.3333	82.48	1.3333	80.24
1.4166	82.48	1.4166	80.26
1.5	82.49	1.5	80.24
1.5833	82.49	1.5833	80.25
1.6667	82.48	1.6667	80.24
1.75	82.48	1.75	80.26
1.8333	82.48	1.8333	80.31
1.9167	82.49	1.9167	80.25
2	82.48	2	80.26
2.5	82.49	2.5	80.27
3	82.5	3	80.28
3.5	82.5	3.5	80.29
4	82.5	4	80.32
4.5	82.5	4.5	80.3
5	82.49	5	80.31
5.5	82.5	5.5	80.31
6	82.5	6	80.31
6.5	82.5	6.5	80.31
7	82.5	7	80.31
7.5	82.5	7.5	80.3
8	82.5	8	80.31
8.5	82.5	8.5	80.3
9	82.5	9	80.31
9.5	82.49	9.5	80.3
10	82.5	10	80.31
11	82.5	11	80.31
END		END	

Olin, Wilmington, MA
Slug Test Data

GW-53D

SE1000B
Environmental Logger
08/23 17:08

Unit# 00000 Test# 2

INPUT 2: Level (M)

Reference 82.93
Scale factor 19.75
Offset 0.00

Step# 0 08/23 15:08

Elapsed Time	Value
0	82.92
0.0033	82.94
0.0066	82.94
0.0099	82.94
0.0133	82.94
0.0166	82.94
0.02	82.94
0.0233	82.93
0.0266	82.93
0.03	82.93
0.0333	82.93
0.05	82.91
0.0666	83.53
0.0833	83.5
0.1	83.39
0.1166	83.3
0.1333	83.28
0.15	83.22
0.1666	83.17
0.1833	83.15
0.2	83.11
0.2166	83.09
0.2333	83.07
0.25	83.05
0.2666	83.04
0.2833	83.03
0.3	83
0.3166	82.99

GW-53S

SE1000B
Environmental Logger
08/23 17:07

Unit# 00000 Test# 2

INPUT 1: Level (M)

Reference 80.27
Scale factor 19.94
Offset 0.00

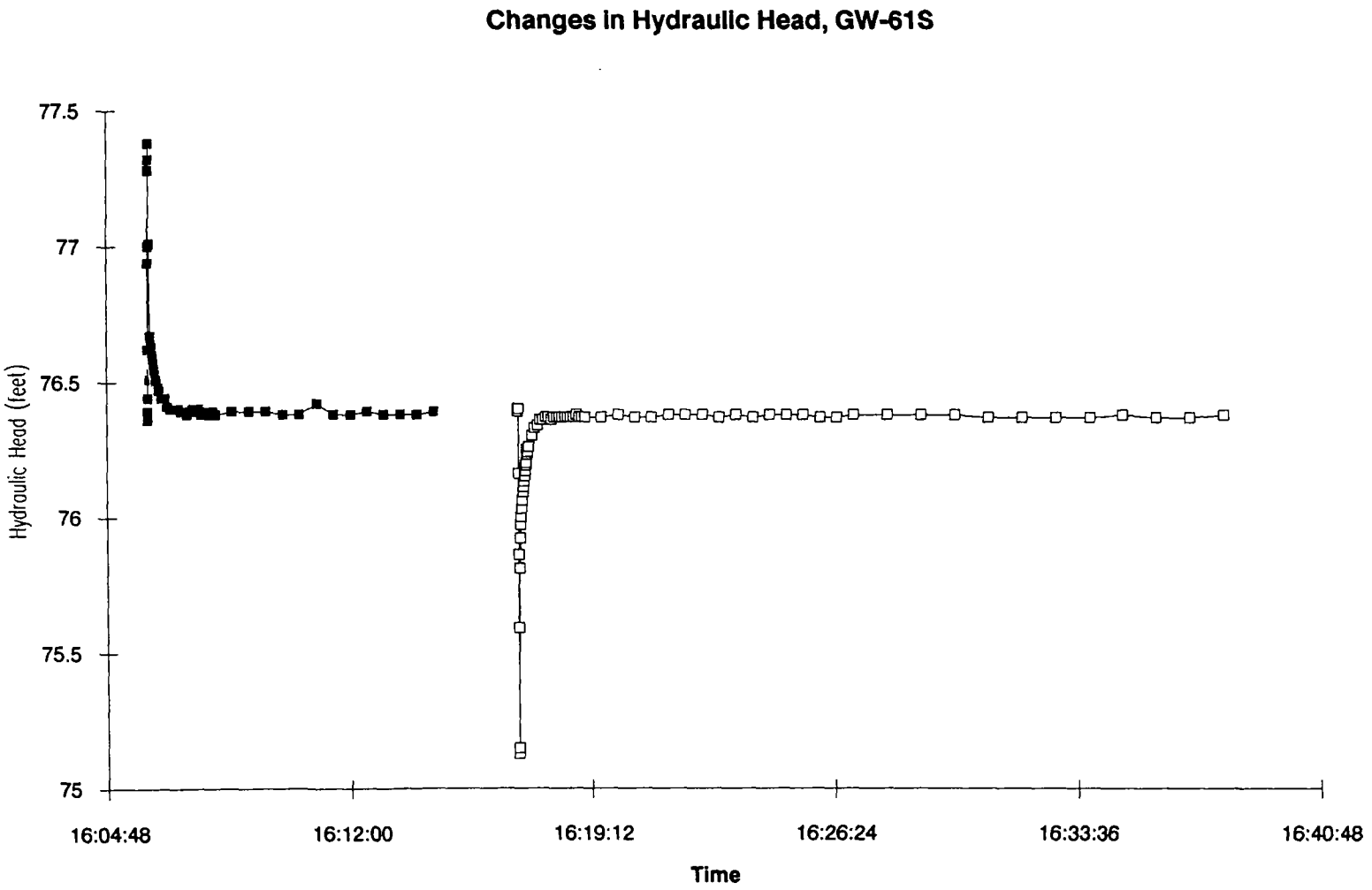
Step# 0 08/23 15:08

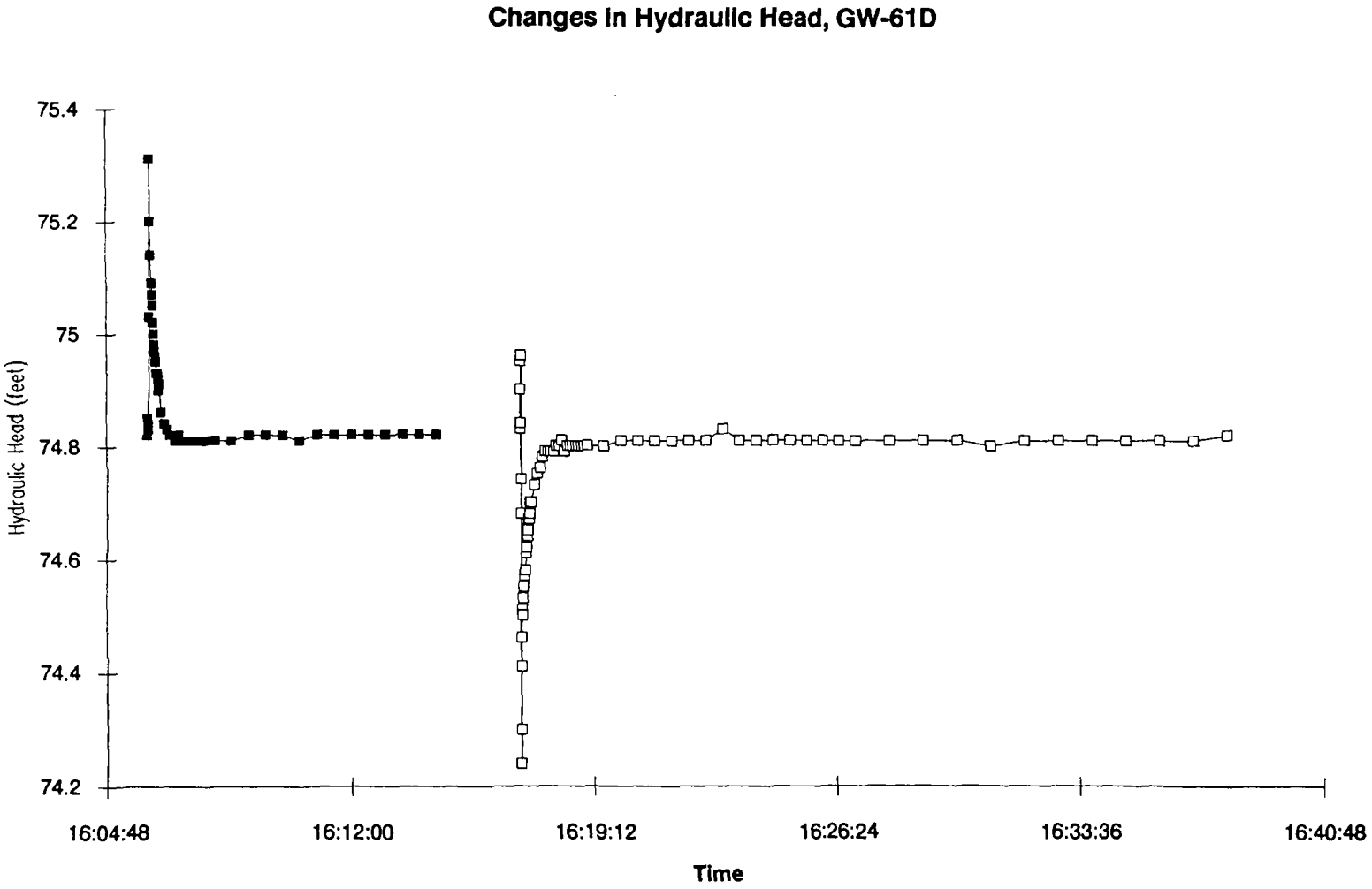
Elapsed Time	Value
0	80.27
0.0033	80.27
0.0066	80.28
0.0099	80.27
0.0133	80.27
0.0166	80.27
0.02	80.28
0.0233	80.27
0.0266	80.29
0.03	80.28
0.0333	80.3
0.05	80.58
0.0666	80.42
0.0833	80.41
0.1	80.39
0.1166	80.39
0.1333	80.38
0.15	80.4
0.1666	80.38
0.1833	80.38
0.2	80.38
0.2166	80.37
0.2333	80.37
0.25	80.37
0.2666	80.37
0.2833	80.36
0.3	80.37
0.3166	80.36

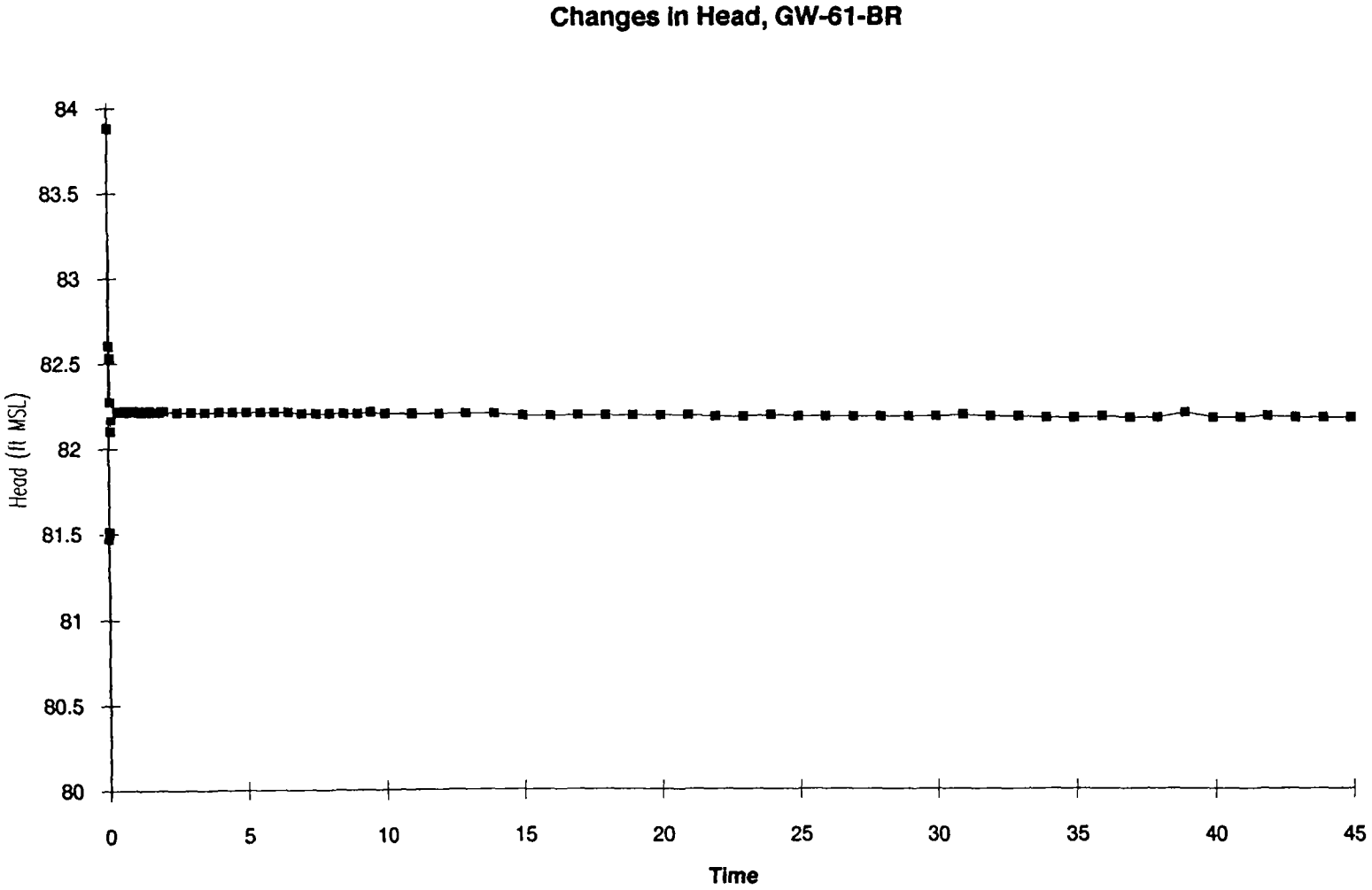
GW-53D		GW-53S	
0.3333	82.97	0.3333	80.36
0.4167	82.93	0.4167	80.34
0.5	82.92	0.5	80.35
0.5833	82.91	0.5833	80.34
0.6667	82.91	0.6667	80.33
0.75	82.91	0.75	80.33
0.8333	82.91	0.8333	80.32
0.9167	82.92	0.9167	80.32
1	82.92	1	80.32
1.0833	82.91	1.0833	80.31
1.1667	82.91	1.1667	80.31
1.25	82.92	1.25	80.35
1.3333	82.91	1.3333	80.31
1.4166	82.92	1.4166	80.31
1.5	82.91	1.5	80.3
1.5833	82.91	1.5833	80.33
1.6667	82.92	1.6667	80.29
1.75	82.91	1.75	80.3
1.8333	82.91	1.8333	80.3
1.9167	82.92	1.9167	80.3
2	82.91	2	80.29
2.5	82.92	2.5	80.28
3	82.92	3	80.28
3.5	82.92	3.5	80.28
4	82.92	4	80.28
4.5	82.93	4.5	80.28
5	82.93	5	80.28
5.5	82.93	5.5	80.28
6	82.93	6	80.27
6.5	82.93	6.5	80.3
7	82.93	7	80.28
7.5	82.93	7.5	80.28
8	82.92	8	80.28
8.5	82.92	8.5	80.28
9	82.93	9	80.29
9.5	82.93	9.5	80.28
10	82.93	10	80.28
END		END	

Olin, Wilmington, MA
Slug Test Data

GW-53D		GW-53S	
SE1000B Environmental Logger		SE1000B Environmental Logger	
08/23 17:11		08/23 17:10	
Unit# 00000 Test# 3		Unit# 00000 Test# 3	
INPUT 2: Level (M)		INPUT 1: Level (M)	
Reference	82.93	Reference	80.27
Scale factor	19.75	Scale factor	19.94
Offset	0.00	Offset	0.00
Step# 0 08/23 15:20		Step# 0 08/23 15:20	
Elapsed Time	Value	Elapsed Time	Value
0	82.93	0	80.29
0.0033	82.94	0.0033	80.29
0.0066	82.95	0.0066	80.3
0.0099	82.94	0.0099	80.28
0.0133	82.94	0.0133	80.29
0.0166	82.89	0.0166	80.29
0.02	82.08	0.02	80.28
0.0233	81.88	0.0233	80.29
0.0266	82.1	0.0266	80.29
0.03	82.44	0.03	80.29
0.0333	82.43	0.0333	80.29
0.05	82.46	0.05	80.27
0.0666	82.51	0.0666	80.13
0.0833	82.55	0.0833	80.12
0.1	82.59	0.1	80.14
0.1166	82.62	0.1166	80.14
0.1333	82.66	0.1333	80.14
0.15	82.69	0.15	80.17
0.1666	82.71	0.1666	80.17
0.1833	82.73	0.1833	80.15
0.2	82.75	0.2	80.15
0.2166	82.77	0.2166	80.15
0.2333	82.79	0.2333	80.15
0.25	82.81	0.25	80.15
0.2666	82.81	0.2666	80.18
0.2833	82.83	0.2833	80.17
0.3	82.84	0.3	80.15
0.3166	82.85	0.3166	80.17
0.3333	82.85	0.3333	80.17
0.4167	82.88	0.4167	80.17
0.5	82.9	0.5	80.17
0.5833	82.92	0.5833	80.18
0.6667	82.9	0.6667	80.19
0.75	82.91	0.75	80.19
0.8333	82.9	0.8333	80.2
0.9167	82.91	0.9167	80.21
1	82.9	1	80.21
1.0833	82.9	1.0833	80.21
1.1667	82.91	1.1667	80.21
1.25	82.9	1.25	80.22
1.3333	82.91	1.3333	80.23
1.4166	82.91	1.4166	80.22
1.5	82.91	1.5	80.22
1.5833	82.9	1.5833	80.22
1.6667	82.91	1.6667	80.24
1.75	82.91	1.75	80.23
1.8333	82.91	1.8333	80.23
1.9167	82.92	1.9167	80.25
2	82.92	2	80.24
2.5	82.91	2.5	80.25
3	82.91	3	80.25
3.5	82.92	3.5	80.27
4	82.92	4	80.26
4.5	82.92	4.5	80.27
5	82.92	5	80.27
5.5	82.92	5.5	80.26
6	82.92	6	80.27
6.5	82.93	6.5	80.27
7	82.93	7	80.28
7.5	82.92	7.5	80.27
8	82.92	8	80.29
8.5	82.93	8.5	80.27
9	82.93	9	80.27
9.5	82.93	9.5	80.27
10	82.93	10	80.27
11	82.92	11	80.26
12	82.94	12	80.27
13	82.93	13	80.27
END		END	

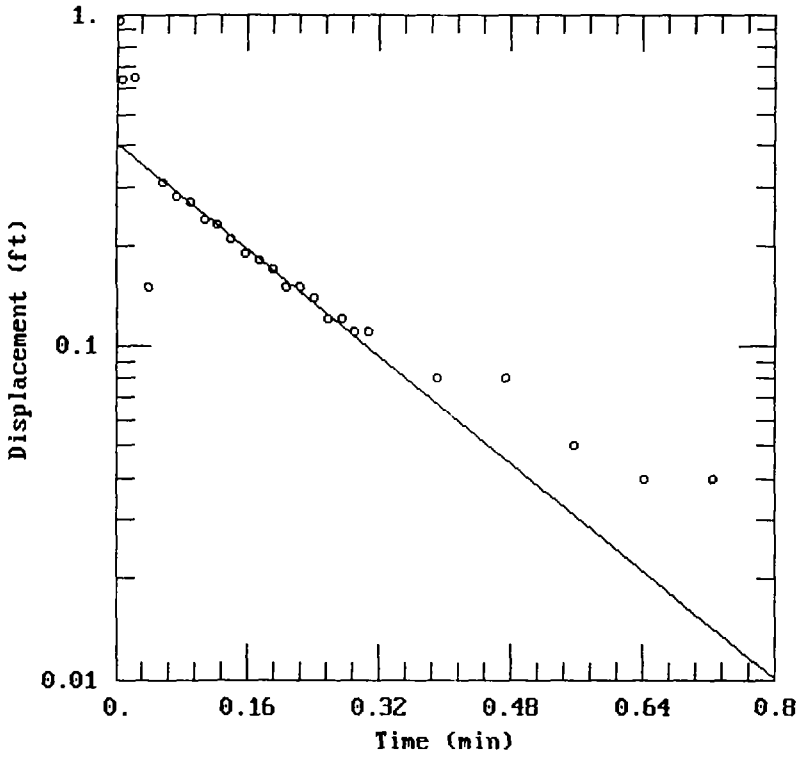






CLIENT: Olin, Wilmington, MA	COMPANY: BCM/SMITH
	PROJECT: 00-7074-0102

OLIN SLUG TESTS, GW61S TEST 1



DATA SET:
GW61S-1.DAT
01/19/96

AQUIFER MODEL:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 1.02 ft
r_c= 0.083 ft
r_w= 0.33 ft
L = 10. ft
b = 42.9 ft
H = 14.7 ft

PARAMETER ESTIMATES:
K = 0.02022 ft/min
y0 = 0.4065 ft

AQTESOLV

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A Q T E S O L V R E S U L T S
Version 2.01

Developed by Glenn M. Duffield
(c) 1988-1995 Geraghty & Miller, Inc.

09/01/95 17:13:43

==========

TEST DESCRIPTION

Data set..... GW61S-1.DAT
Output file..... GW61S-1.OUT
Data set title..... OLIN SLUG TESTS, GW61S TEST 1
Company..... BCM/SMITH
Project..... 00-7074-0102
Client..... Olin, Wilmington, MA
Test date..... August 1995
Obs. well..... GW-61-S

Units of Measurement
Length..... ft
Time..... min

Test Well Data
Initial displacement in well..... 1.02
Radius of well casing..... 0.083
Radius of wellbore..... 0.33
Aquifer saturated thickness..... 42.9
Well screen length..... 10
Static height of water in well... 14.7
Gravel pack porosity..... 0.3
Effective well casing radius..... 0.1936
Effective wellbore radius..... 0.33
Log(Re/Rw)..... 2.33
Constants A, B and C..... 2.453 , 0.399, 0.000
No. of observations..... 25

==========

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

==========

RESULTS FROM VISUAL CURVE MATCHING

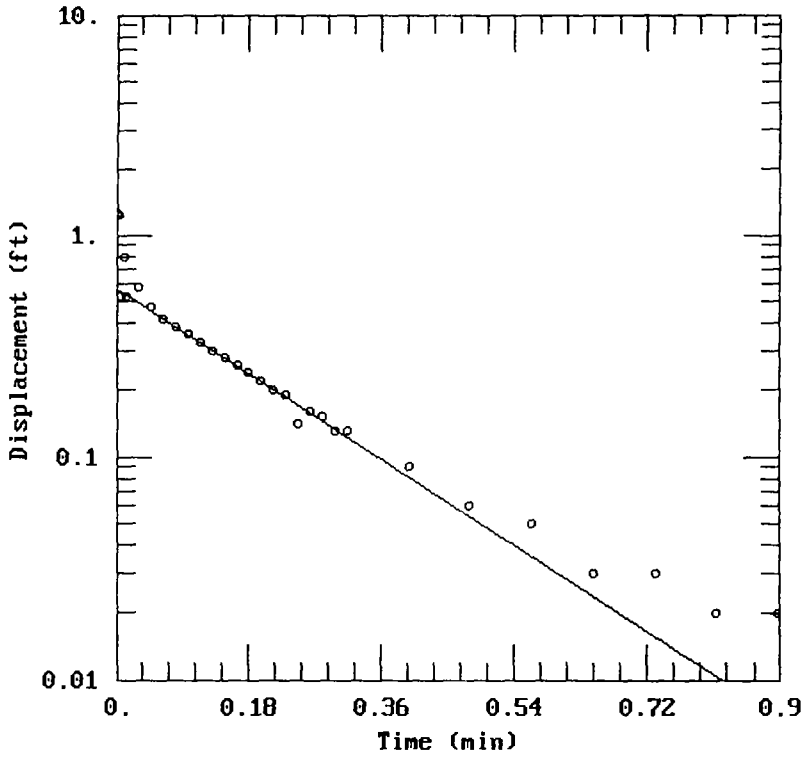
VISUAL MATCH PARAMETER ESTIMATES

	Estimate
K =	2.0221E-002 ft/min
y0 =	4.0646E-001 ft

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<

CLIENT: Olin, Wilmington, MA	COMPANY: BCM/SMITH
	PROJECT: 00-7074-0102

OLIN SLUG TESTS, GW61S TEST 2



DATA SET:
GW61S-2.DAT
01/19/96

AQUIFER MODEL:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 1.26 ft
r_c= 0.083 ft
r_w= 0.33 ft
L = 10. ft
b = 42.9 ft
H = 14.7 ft

PARAMETER ESTIMATES:
K = 0.0215 ft/min
y0 = 0.57 ft

AQTESOLV

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                      A Q T E S O L V    R E S U L T S
                                Version 2.01

                      Developed by Glenn M. Duffield
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09/01/95                                                              17:18:14

================================================================================
                              TEST DESCRIPTION

Data set........... GW61S-2.DAT
Output file........ GW61S-2.OUT
Data set title..... OLIN SLUG TESTS, GW61S TEST 2
Company............ BCM/SMITH
Project............ 00-7074-0102
Client............. Olin, Wilmington, MA
Test date.......... August 1995
Obs. well.......... GW-61-S

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 1.26
   Radius of well casing............ 0.083
   Radius of wellbore............... 0.33
   Aquifer saturated thickness...... 42.9
   Well screen length............... 10
   Static height of water in well... 14.7
   Gravel pack porosity............. 0.3
   Effective well casing radius..... 0.1936
   Effective wellbore radius........ 0.33
   Log(Re/Rw)....................... 2.33
   Constants A, B and C............. 2.453 ,   0.399,   0.000
   No. of observations.............. 29

================================================================================
                              ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

================================================================================
                       RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

           Estimate
   K  =   2.1500E-002 ft/min
   y0 =   5.7000E-001 ft


<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>
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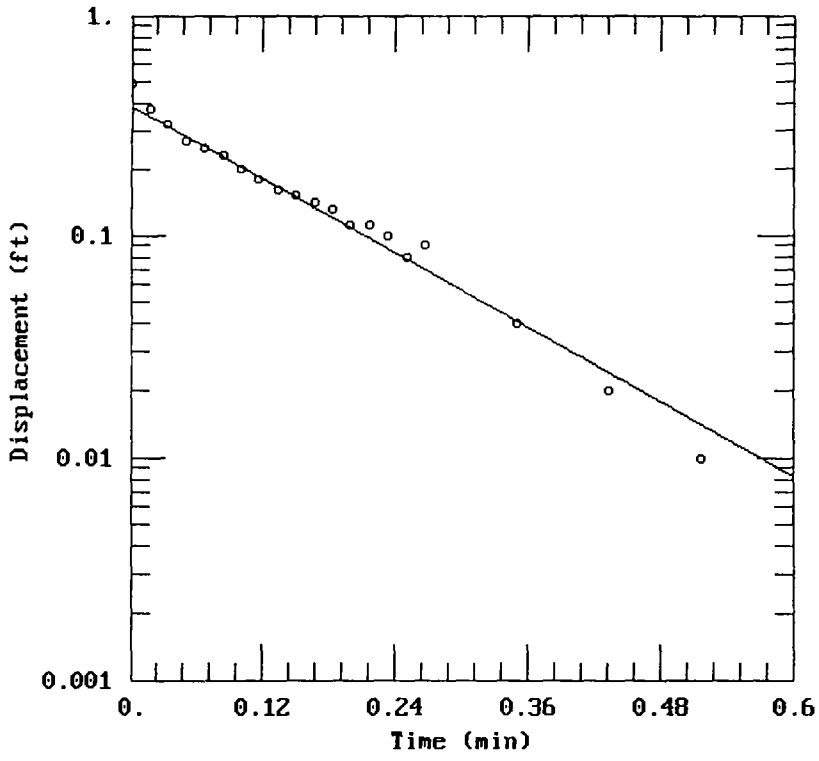
CLIENT: Olin, Wilmington, MA	COMPANY: BCM/SMITH
	PROJECT: 00-7074-0102

OLIN SLUG TESTS, GW61D TEST 1



DATA SET:
GW61D-1.DAT
01/19/96

AQUIFER MODEL:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 0.49 ft
r_c= 0.083 ft
r_w= 0.33 ft
L = 7. ft
b = 42.9 ft
H = 41.3 ft

PARAMETER ESTIMATES:
K = 0.04818 ft/min
y0 = 0.3857 ft

AQTESOLV

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<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

                       A Q T E S O L V    R E S U L T S
                                 Version 2.01

                         Developed by Glenn M. Duffield
                      (c) 1988-1995  Geraghty & Miller, Inc.

09/05/95                                                                16:40:36

================================================================================
                                TEST DESCRIPTION

Data set........... GW61D-1.DAT
Output file........ GW61D-1.OUT
Data set title..... OLIN SLUG TESTS, GW61D TEST 1
Company............ BCM/SMITH
Project............ 00-7074-0102
Client............. Olin, Wilmington, MA
Test date.......... August 1995
Obs. well.......... GW-61-D

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 0.49
   Radius of well casing............ 0.083
   Radius of wellbore............... 0.33
   Aquifer saturated thickness...... 42.9
   Well screen length............... 7
   Static height of water in well... 41.3
   Gravel pack porosity............. 0.3
   Effective well casing radius..... 0.1936
   Effective wellbore radius........ 0.33
   Log(Re/Rw)....................... 2.806
   Constants A, B and C............. 2.183 ,  0.345,   0.000
   No. of observations.............. 19

================================================================================
                                ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

================================================================================
                        RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

            Estimate
   K  =   4.8181E-002 ft/min
   y0 =   3.8568E-001 ft


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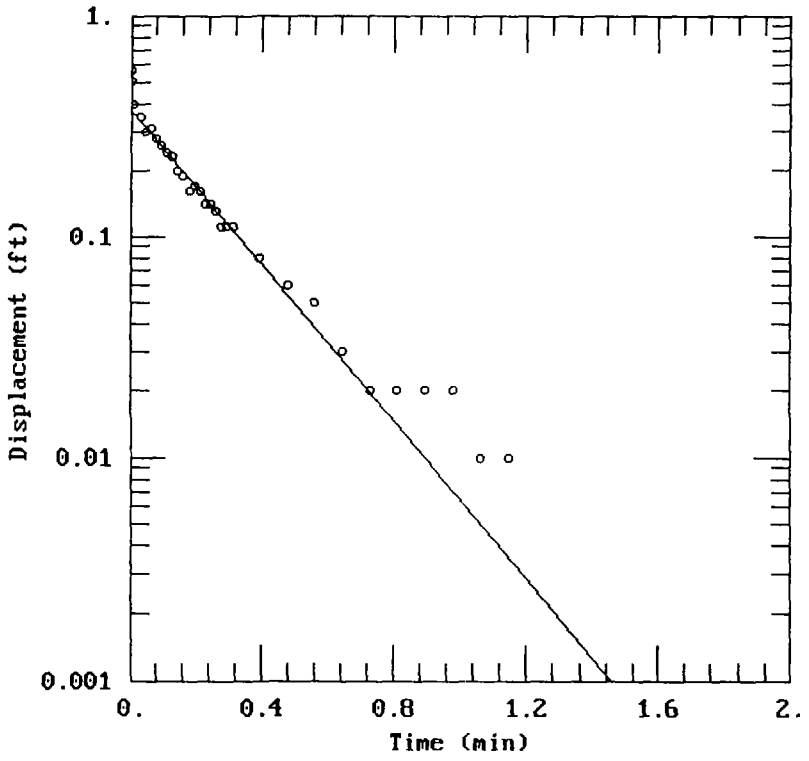
```

CLIENT: Olin, Wilmington, MA	COMPANY: BCM/SMITH
	PROJECT: 00-7074-0102

OLIN SLUG TESTS, GW61D TEST 2



DATA SET:
GW61D-2.DAT
01/19/96

AQUIFER MODEL:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 0.57 ft
r_c= 0.083 ft
r_w= 0.33 ft
L = 7. ft
b = 42.9 ft
H = 41.3 ft

PARAMETER ESTIMATES:
K = 0.03056 ft/min
y0 = 0.3746 ft

AQTESOLV

```
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                        A Q T E S O L V    R E S U L T S
                                   Version 2.01

                            Developed by Glenn M. Duffield
                         (c) 1988-1995  Geraghty & Miller, Inc.

09/05/95                                                                   16:43:1

================================================================================
                                 TEST DESCRIPTION

Data set........... GW61D-2.DAT
Output file........ GW61D-2.OUT
Data set title..... OLIN SLUG TESTS, GW61D TEST 2
Company............ BCM/SMITH
Project............ 00-7074-0102
Client............. Olin, Wilmington, MA
Test date.......... August 1995
Obs. well.......... GW-61-D

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 0.57
   Radius of well casing............ 0.083
   Radius of wellbore............... 0.33
   Aquifer saturated thickness...... 42.9
   Well screen length............... 7
   Static height of water in well... 41.3
   Gravel pack porosity............. 0.3
   Effective well casing radius..... 0.1936
   Effective wellbore radius........ 0.33
   Log(Re/Rw)....................... 2.806
   Constants A, B and C............. 2.183 ,   0.345,   0.000
   No. of observations.............. 30

================================================================================
                                 ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

================================================================================
                          RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

           Estimate
   K  =   3.0560E-002 ft/min
   y0 =   3.7458E-001 ft


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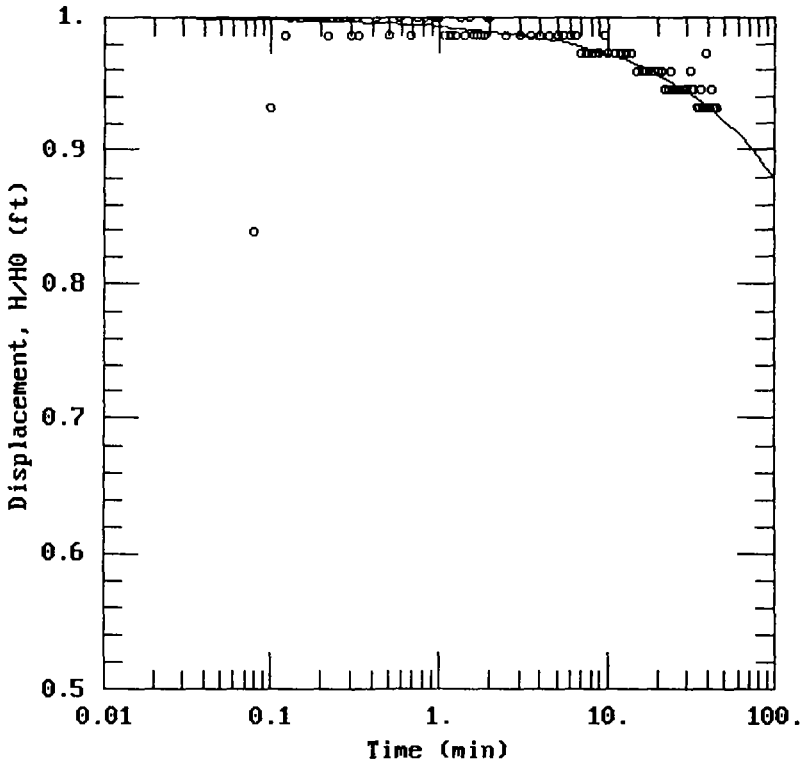
```

CLIENT: Olin, Wilmington, MA	COMPANY: BCM/SMITH
	PROJECT: 00-7074-0102

OLIN SLUG TESTS, GW61BR TEST 1



DATA SET:
GW61BR.DAT
01/19/96

AQUIFER MODEL:
Confined
SOLUTION METHOD:
Cooper et al.

TEST DATA:
H0= 0.75 ft
r_c= 0.167 ft
r_w= 0.167 ft

PARAMETER ESTIMATES:
T = 2.397E-05 ft^2/min
S = 0.01

AQTESOLV

```
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                         A Q T E S O L V   R E S U L T S
                                  Version 2.01

                        Developed by Glenn M. Duffield
                     (c) 1988-1995  Geraghty & Miller, Inc.

01/19/96                                                                 13:17:2

================================================================================
                                TEST DESCRIPTION

Data set........... GW61BR.DAT
Output file........ GW61BR.OUT
Data set title..... OLIN SLUG TESTS, GW61BR TEST 1
Company............ BCM/SMITH
Project............ 00-7074-0102
Client............. Olin, Wilmington, MA
Test date.......... August 1995
Obs. well.......... GW-61-BR

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 0.75
   Radius of well casing............ 0.167
   Radius of wellbore............... 0.167
   Aquifer saturated thickness...... 87
   Well screen length............... 20
   Static height of water in well... 87
   Gravel pack porosity............. 1
   Effective well casing radius..... 0.167
   Effective wellbore radius........ 0.167
   Log(Re/Rw)....................... 4.609
   Constants A, B and C............. 0.000 ,   0.000,   4.927
   No. of observations.............. 89

================================================================================
                               ANALYTICAL METHOD

Cooper et al. (Confined Aquifer Slug Test)

================================================================================
                         RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

          Estimate
   T  =   2.3966E-005 ft^2/min
   S  =   1.0000E-002

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>
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Olin, Wilmington, MA
Slug Test Data

GW-61S	GW-61D	GW-61BR
SE1000B Environmental Logger 08/23 17:12	SE1000B Environmental Logger 08/23 17:13	SE1000B Environmental Logger 08/24 17:44
Unit# 00000 Test# 4	Unit# 00000 Test# 4	Unit# 00000 Test# 3
INPUT 1: Level (M)	INPUT 2: Level (M)	INPUT 1: Level (M)
Reference 76.38	Reference 74.81	Reference 76.17
Scale factor 19.94	Scale factor 19.75	Scale factor 19.94
Offset 0.00	Offset 0.00	Offset 0.00
Step# 0 08/23 16:06	Step# 0 08/23 16:06	Step# 0 08/24 15:08

Elapsed Time	Value	Elapsed Time	Value	Elapsed Time	Value
0	76.36	0	74.82	0	81.47
0.0033	76.38	0.0033	74.84	0.0033	81.48
0.0066	76.37	0.0066	74.84	0.0066	81.47
0.0099	76.39	0.0099	74.85	0.0099	81.48
0.0133	76.44	0.0133	74.84	0.0133	81.48
0.0166	76.62	0.0166	74.83	0.0166	81.49
0.02	76.94	0.02	74.83	0.02	81.51
0.0233	77.28	0.0233	74.83	0.0233	89.98
0.0266	77.38	0.0266	74.84	0.0266	79.46
0.03	77.32	0.03	74.84	0.03	82.6
0.0333	77	0.0333	74.84	0.0333	83.88
0.05	77.01	0.05	75.03	0.05	82.53
0.0666	76.51	0.0666	75.31	0.0666	82.27
0.0833	76.67	0.0833	75.2	0.0833	82.1
0.1	76.64	0.1	75.14	0.1	82.17
0.1166	76.63	0.1166	75.09	0.1166	82.21
0.1333	76.6	0.1333	75.07	0.1333	82.22
0.15	76.59	0.15	75.05	0.15	82.22
0.1666	76.57	0.1666	75.02	0.1666	82.22
0.1833	76.55	0.1833	75	0.1833	82.22
0.2	76.54	0.2	74.98	0.2	82.22
0.2166	76.53	0.2166	74.97	0.2166	82.21
0.2333	76.51	0.2333	74.96	0.2333	82.22
0.25	76.51	0.25	74.95	0.25	82.22
0.2666	76.5	0.2666	74.93	0.2666	82.22
0.2833	76.48	0.2833	74.93	0.2833	82.22

Olin, Wilmington, MA
Slug Test Data

GW-61S		GW-61D		GW-61BR	
0.3	76.48	0.3	74.92	0.3	82.21
0.3166	76.47	0.3166	74.9	0.3166	82.22
0.3333	76.47	0.3333	74.91	0.3333	82.21
0.4167	76.44	0.4167	74.86	0.4167	82.22
0.5	76.44	0.5	74.84	0.5	82.21
0.5833	76.41	0.5833	74.83	0.5833	82.22
0.6667	76.4	0.6667	74.82	0.6667	82.21
0.75	76.4	0.75	74.82	0.75	82.22
0.8333	76.4	0.8333	74.81	0.8333	82.22
0.9167	76.4	0.9167	74.82	0.9167	82.22
1	76.39	1	74.81	1	82.22
1.0833	76.39	1.0833	74.81	1.0833	82.21
1.1667	76.38	1.1667	74.81	1.1667	82.21
1.25	76.39	1.25	74.81	1.25	82.21
1.3333	76.4	1.3333	74.81	1.3333	82.22
1.4166	76.39	1.4166	74.81	1.4166	82.21
1.5	76.4	1.5	74.81	1.5	82.22
1.5833	76.38	1.5833	74.81	1.5833	82.21
1.6667	76.39	1.6667	74.81	1.6667	82.21
1.75	76.39	1.75	74.81	1.75	82.21
1.8333	76.38	1.8333	74.81	1.8333	82.21
1.9167	76.39	1.9167	74.81	1.9167	82.22
2	76.38	2	74.81	2	82.22
2.5	76.39	2.5	74.81	2.5	82.21
3	76.39	3	74.82	3	82.21
3.5	76.39	3.5	74.82	3.5	82.21
4	76.38	4	74.82	4	82.21
4.5	76.38	4.5	74.81	4.5	82.21
5	76.42	5	74.82	5	82.21
5.5	76.38	5.5	74.82	5.5	82.21
6	76.38	6	74.82	6	82.21
6.5	76.39	6.5	74.82	6.5	82.21
7	76.38	7	74.82	7	82.2
7.5	76.38	7.5	74.82	7.5	82.2
8	76.38	8	74.82	8	82.2
8.5	76.39	8.5	74.82	8.5	82.2
END		END		9	82.2
				9.5	82.21
				10	82.2
				11	82.2
				12	82.2
				13	82.2

Olin, Wilmington, MA
Slug Test Data

GW-61S

SE1000B
Environmental Logger
08/23 17:15

Unit# 00000 Test# 5
INPUT 1: Level (M)
Reference 76.38
Scale factor 19.94
Offset 0.00
Step# 0 08/23 16:17

Elapsed Time	Value
0	76.39
0.0033	76.4
0.0066	76.39
0.0099	76.4
0.0133	76.4
0.0166	76.16
0.02	75.13
0.0233	75.15
0.0266	75.86
0.03	75.59
0.0333	75.86
0.05	75.81
0.0666	75.92
0.0833	75.97
0.1	76
0.1166	76.03
0.1333	76.06
0.15	76.09
0.1666	76.11
0.1833	76.13
0.2	76.15
0.2166	76.17
0.2333	76.19
0.25	76.2
0.2666	76.25
0.2833	76.23
0.3	76.24
0.3166	76.26
0.3333	76.26

GW-61D

SE1000B
Environmental Logger
08/23 17:16

Unit# 00000 Test# 5
INPUT 2: Level (M)
Reference 74.81
Scale factor 19.75
Offset 0.00
Step# 0 08/23 16:17

Elapsed Time	Value
0	74.95
0.0033	74.84
0.0066	74.9
0.0099	74.83
0.0133	74.74
0.0166	74.84
0.02	74.68
0.0233	74.24
0.0266	74.3
0.03	74.96
0.0333	74.41
0.05	74.46
0.0666	74.51
0.0833	74.5
0.1	74.53
0.1166	74.55
0.1333	74.57
0.15	74.58
0.1666	74.61
0.1833	74.62
0.2	74.65
0.2166	74.64
0.2333	74.65
0.25	74.67
0.2666	74.67
0.2833	74.68
0.3	74.7
0.3166	74.7
0.3333	74.7

GW-61BR

14	82.2
15	82.19
16	82.19
17	82.19
18	82.19
19	82.19
20	82.19
21	82.19
22	82.18
23	82.18
24	82.19
25	82.18
26	82.18
27	82.18
28	82.18
29	82.18
30	82.18
31	82.19
32	82.18
33	82.18
34	82.17
35	82.17
36	82.18
37	82.17
38	82.17
39	82.2
40	82.17
41	82.17
42	82.18
43	82.17
44	82.17
45	82.17

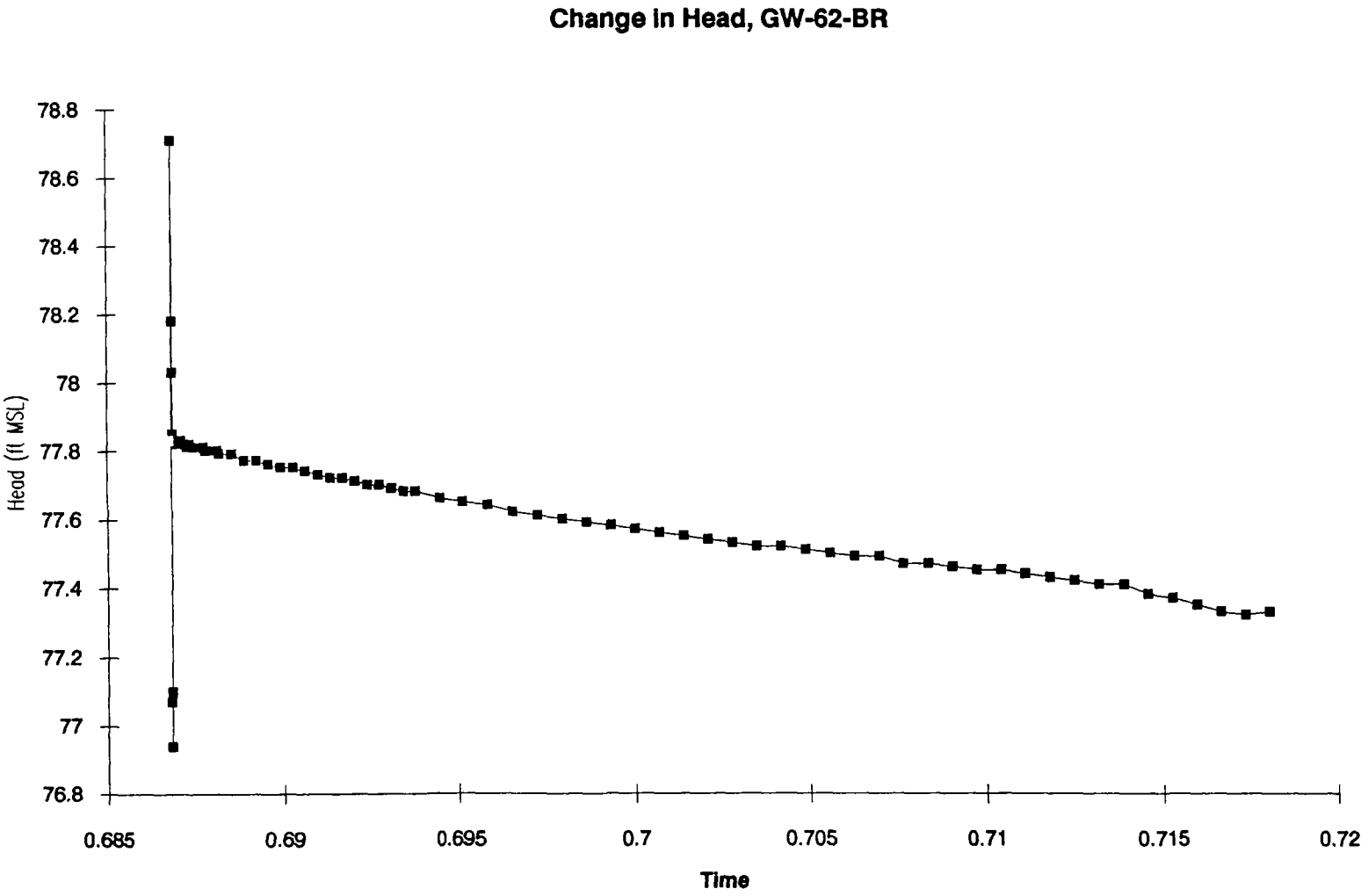
END

Olin, Wilmington, MA
Slug Test Data

GW-61S		GW-61D		GW-61BR
0.4167	76.3	0.4167	74.73	
0.5	76.33	0.5	74.75	
0.5833	76.34	0.5833	74.76	
0.6667	76.36	0.6667	74.78	
0.75	76.36	0.75	74.79	
0.8333	76.37	0.8333	74.79	
0.9167	76.37	0.9167	74.79	
1	76.36	1	74.79	
1.0833	76.37	1.0833	74.8	
1.1667	76.37	1.1667	74.8	
1.25	76.37	1.25	74.81	
1.3333	76.37	1.3333	74.79	
1.4166	76.37	1.4166	74.8	
1.5	76.37	1.5	74.8	
1.5833	76.37	1.5833	74.8	
1.6667	76.37	1.6667	74.8	
1.75	76.38	1.75	74.8	
1.8333	76.37	1.8333	74.8	
1.9167	76.37	1.9167	74.8	
2	76.37	2	74.8	
2.5	76.37	2.5	74.8	
3	76.38	3	74.81	
3.5	76.37	3.5	74.81	
4	76.37	4	74.81	
4.5	76.38	4.5	74.81	
5	76.38	5	74.81	
5.5	76.38	5.5	74.81	
6	76.37	6	74.83	
6.5	76.38	6.5	74.81	
7	76.37	7	74.81	
7.5	76.38	7.5	74.81	
8	76.38	8	74.81	
8.5	76.38	8.5	74.81	
9	76.37	9	74.81	
9.5	76.37	9.5	74.81	
10	76.38	10	74.81	
11	76.38	11	74.81	
12	76.38	12	74.81	
13	76.38	13	74.81	
14	76.37	14	74.8	
15	76.37	15	74.81	
16	76.37	16	74.81	

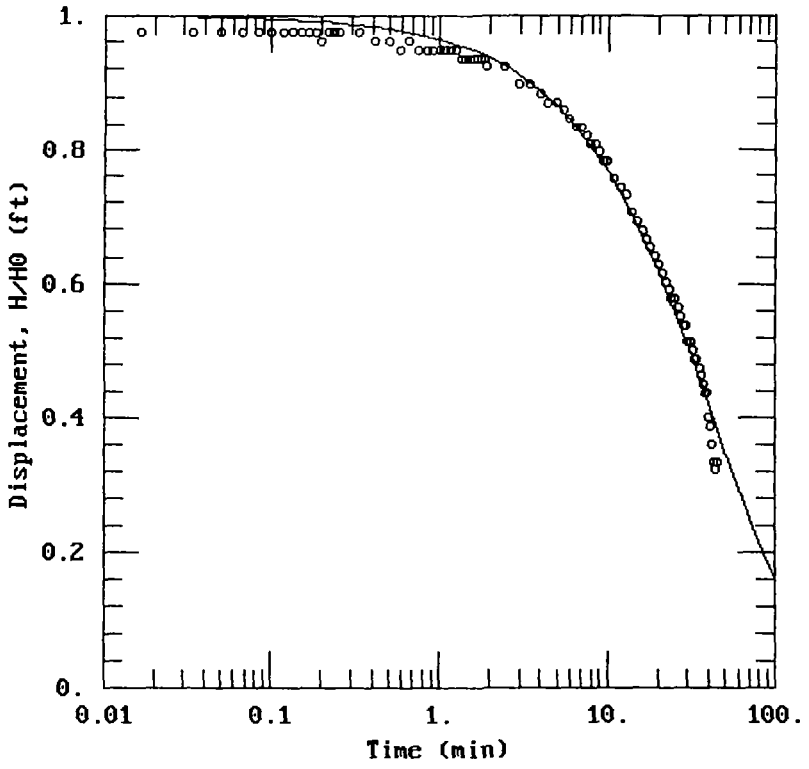
Olin, Wilmington, MA
Slug Test Data

GW-61S		GW-61D		GW-61BR
17	76.37	17	74.81	
18	76.38	18	74.81	
19	76.37	19	74.81	
20	76.37	20	74.81	
21	76.38	21	74.82	
END		END		



CLIENT: Olin, Wilmington, MA	COMPANY: BCM/SMITH
	PROJECT: 00-7074-0102

OLIN SLUG TESTS, GW62BR TEST 1



DATA SET:
GW62BR.DAT
01/19/96

AQUIFER MODEL:
Confined
SOLUTION METHOD:
Cooper et al.

TEST DATA:
H0= 0.78 ft
r_c= 0.167 ft
r_w= 0.167 ft

PARAMETER ESTIMATES:
T = 0.001557 ft^2/min
S = 0.0001277

AQTESOLV

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<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

                        A Q T E S O L V    R E S U L T S
                                  Version 2.01

                         Developed by Glenn M. Duffield
                      (c) 1988-1995  Geraghty & Miller, Inc.

09/05/95                                                                17:19:0

================================================================================
                                TEST DESCRIPTION

Data set........... GW62BR.DAT
Output file........ GW62BR.OUT
Data set title..... OLIN SLUG TESTS, GW62BR TEST 1
Company............ BCM/SMITH
Project............ 00-7074-0102
Client............. Olin, Wilmington, MA
Test date.......... August 1995
Obs. well.......... GW-62-BR

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 0.78
   Radius of well casing............ 0.167
   Radius of wellbore............... 0.167
   Aquifer saturated thickness...... 101
   Well screen length............... 21.8
   Static height of water in well... 100.5
   Gravel pack porosity............. 1
   Effective well casing radius..... 0.167
   Effective wellbore radius........ 0.167
   Log(Re/Rw)....................... 4.592
   Constants A, B and C............. 5.053 ,   0.856,   0.000
   No. of observations.............. 86

================================================================================
                                ANALYTICAL METHOD

Cooper et al. (Confined Aquifer Slug Test)

================================================================================
                     RESULTS FROM STATISTICAL CURVE MATCHING


STATISTICAL MATCH PARAMETER ESTIMATES

           Estimate         Std.  Error
   T  =   1.5573E-003 +/-   1.7001E-004 ft^2/min
   S  =   1.2768E-004 +/-   1.1990E-004


ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated
```

weighted residual = residual * weight

Weighted Residual Statistics:
   Number of residuals..... 86
   Number of estimated parameters.... 2
   Degrees of freedom..... 84
   Residual mean..... -0.004612
   Residual standard deviation..... 0.01462
   Residual variance..... 0.0002139

Model Residuals:

Time	Observed	Calculated	Residual	Weight
0.016667	0.76	0.77883	-0.018825	1
0.033333	0.76	0.77806	-0.018063	1
0.05	0.76	0.77738	-0.017382	1
0.066667	0.76	0.77675	-0.016746	1
0.083333	0.76	0.77614	-0.016141	1
0.1	0.76	0.77556	-0.015558	1
0.11667	0.76	0.77499	-0.014994	1
0.13333	0.76	0.77444	-0.014443	1
0.15	0.76	0.77391	-0.013905	1
0.16667	0.76	0.77338	-0.013378	1
0.18333	0.76	0.77286	-0.012859	1
0.2	0.75	0.77235	-0.022349	1
0.21667	0.76	0.77185	-0.011846	1
0.23333	0.76	0.77135	-0.011349	1
0.25	0.76	0.77086	-0.010859	1
0.33333	0.76	0.76848	-0.0084815	1
0.41667	0.75	0.7662	-0.016202	1
0.5	0.75	0.764	-0.013997	1
0.58333	0.74	0.76185	-0.021852	1
0.66667	0.75	0.75976	-0.0097571	1
0.75	0.74	0.7577	-0.017705	1
0.83333	0.74	0.75569	-0.01569	1
0.91667	0.74	0.75371	-0.013708	1
1	0.74	0.75176	-0.011756	1
1.0833	0.74	0.74983	-0.0098319	1
1.1667	0.74	0.74793	-0.0079322	1
1.25	0.74	0.74606	-0.0060556	1
1.3333	0.73	0.7442	-0.0142	1
1.4167	0.73	0.74237	-0.012365	1
1.5	0.73	0.74055	-0.010549	1
1.5833	0.73	0.73875	-0.0087504	1
1.6667	0.73	0.73697	-0.0069685	1
1.75	0.73	0.7352	-0.0052027	1
1.8333	0.73	0.73345	-0.003452	1
1.9167	0.72	0.73172	-0.011716	1
2.4167	0.72	0.72157	-0.0015725	1
2.9167	0.7	0.71183	-0.011833	1
3.4167	0.7	0.70243	-0.002433	1
3.9167	0.69	0.69333	-0.0033274	1
4.4167	0.68	0.68448	-0.0044835	1
4.9167	0.68	0.67588	0.0041239	1
5.4167	0.67	0.66749	0.0025147	1
5.9167	0.66	0.65929	0.00070542	1
6.4167	0.65	0.65129	-0.0012904	1
6.9167	0.65	0.64346	0.0065389	1

```
     7.4167          0.64          0.6358      0.0042033           1
     7.9167          0.63         0.62829      0.0017114           1
     8.4167          0.63         0.62093      0.0090711           1
     8.9167          0.62         0.61371       0.006289           1
     9.4167          0.61         0.60663      0.0033714           1
     9.9167          0.61         0.59968       0.010324           1
     10.917          0.59         0.58614      0.0038589           1
     11.917          0.58         0.57307      0.0069296           1
     12.917          0.57         0.56043      0.0095666           1
     13.917          0.55          0.5482      0.0017964           1
     14.917          0.54         0.53636      0.0036424           1
     15.917          0.53         0.52487      0.0051251           1
     16.917          0.52         0.51374      0.0062631           1
     17.917          0.51         0.50293      0.0070734           1
     18.917           0.5         0.49243      0.0075712           1
     19.917          0.49         0.48223      0.0077705           1
     20.917          0.48         0.47232      0.0076842           1
     21.917          0.47         0.46268      0.0073244           1
     22.917          0.46          0.4533      0.0067021           1
     23.917          0.45         0.44417      0.0058276           1
     24.917          0.45         0.43529       0.014711           1
     25.917          0.44         0.42664        0.01336           1
     26.917          0.43         0.41821       0.011785           1
     27.917          0.42         0.41001      0.0099934           1
     28.917          0.42         0.40201       0.017992           1
     29.917           0.4         0.39421      0.0057895           1
     30.917           0.4         0.38661       0.013391           1
     31.917          0.39          0.3792       0.010805           1
     32.917          0.38         0.37196      0.0080356           1
     33.917          0.38         0.36491        0.01509           1
     34.917          0.37         0.35803       0.011973           1
     35.917          0.36         0.35131      0.0086908           1
     36.917          0.35         0.34475       0.005248           1
     37.917          0.34         0.33835      0.0016497           1
     38.917          0.34          0.3321      0.0079004           1
     39.917          0.31           0.326      -0.015995           1
     40.917           0.3         0.32003      -0.020033           1
     41.917          0.28         0.31421      -0.034209           1
     42.917          0.26         0.30852      -0.048518           1
     43.917          0.25         0.30296      -0.052958           1
     44.917          0.26         0.29752      -0.037524           1

=====================================================================================
                        RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

             Estimate
   T   =    1.5573E-003 ft^2/min
   S   =    1.2768E-004


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```

Olin, Wilmington, MA
Slug Test Data

GW-62BR

SE1000B
Environmental Logger
08/24 17:46

Unit# 00000 Test# 4

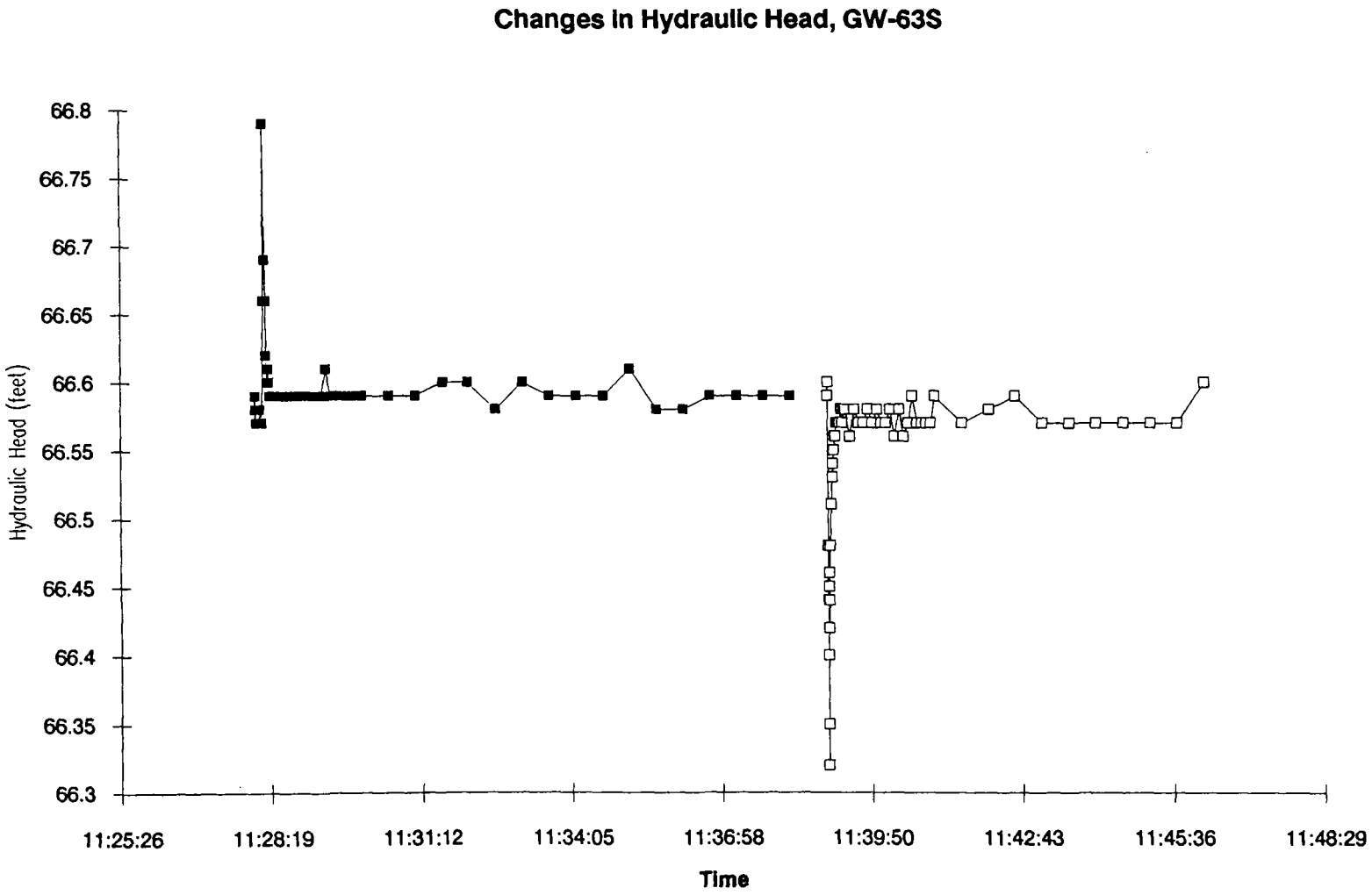
INPUT 1: Level (M)

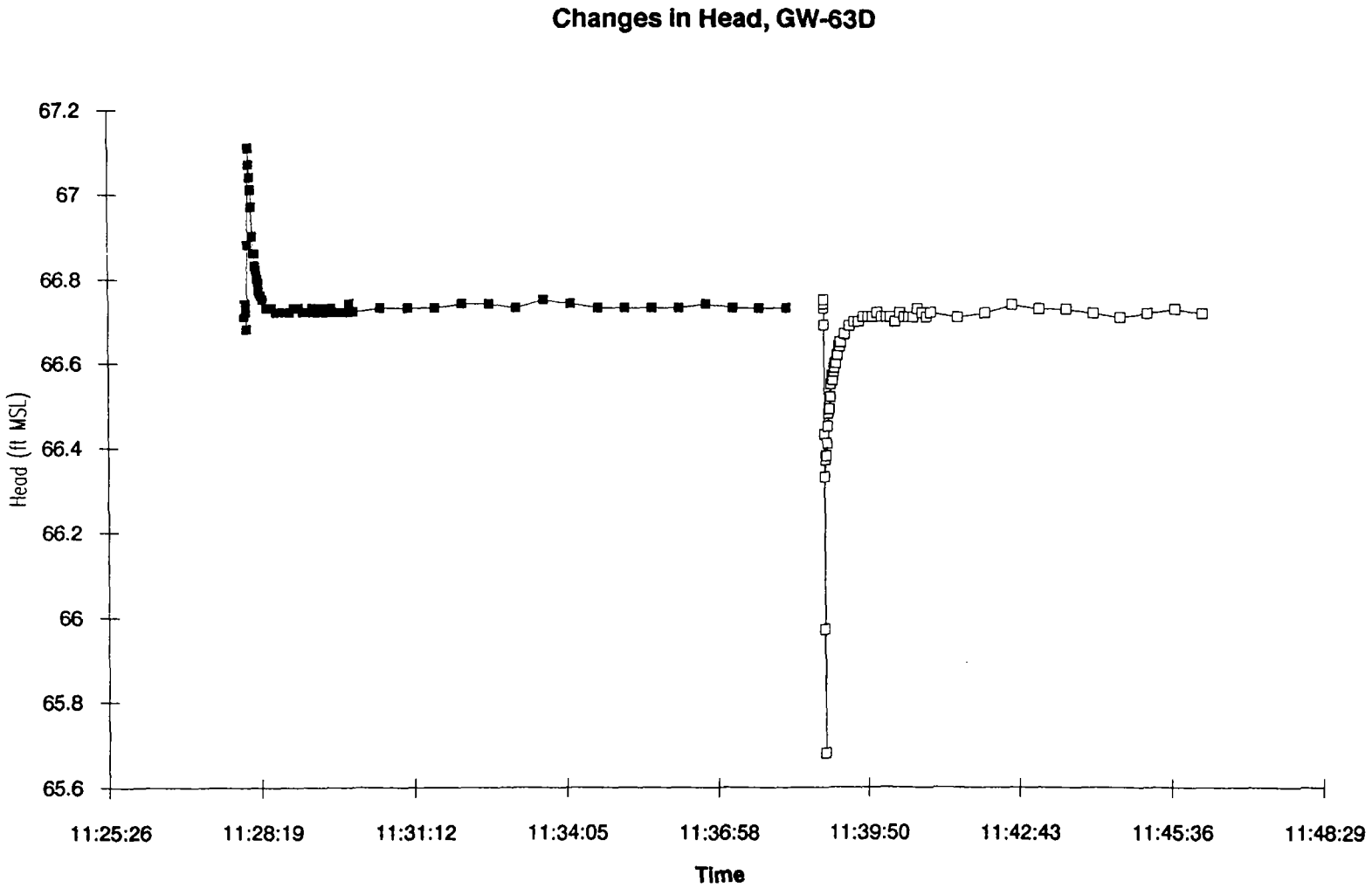
Reference 77.09
Scale factor 19.94
Offset 0.00

Step# 0 08/24 16:29

Elapsed Time	Value
0	77.07
0.0033	77.07
0.0066	77.07
0.0099	77.07
0.0133	77.08
0.0166	77.07
0.02	77.08
0.0233	77.09
0.0266	77.1
0.03	76.94
0.0333	78.71
0.05	78.18
0.0666	78.03
0.0833	77.85
0.1	77.83
0.1166	77.83
0.1333	77.83
0.15	77.83
0.1666	77.83
0.1833	77.83
0.2	77.83
0.2166	77.83
0.2333	77.83
0.25	77.83
0.2666	77.83
0.2833	77.82
0.3	77.83
0.3166	77.83
0.3333	77.83
0.4167	77.83
0.5	77.82
0.5833	77.82
0.6667	77.81
0.75	77.82
0.8333	77.81
0.9167	77.81
1	77.81
1.0833	77.81
1.1667	77.81
1.25	77.81
1.3333	77.81
1.4166	77.8
1.5	77.8
1.5833	77.8
1.6667	77.8
1.75	77.8
1.8333	77.8
1.9167	77.8
2	77.79
2.5	77.79
3	77.77
3.5	77.77
4	77.76
4.5	77.75
5	77.75
5.5	77.74
6	77.73
6.5	77.72
7	77.72
7.5	77.71
8	77.7
8.5	77.7
9	77.69
9.5	77.68
10	77.68
11	77.66
12	77.65
13	77.64
14	77.62
15	77.61
16	77.6
17	77.59
18	77.58
24	77.52
25	77.52
26	77.51
27	77.5
28	77.49
29	77.49
30	77.47
31	77.47
32	77.46
33	77.45
34	77.45
35	77.44
36	77.43
37	77.42
38	77.41
39	77.41
40	77.38
41	77.37
42	77.35
43	77.33
44	77.32
45	77.33

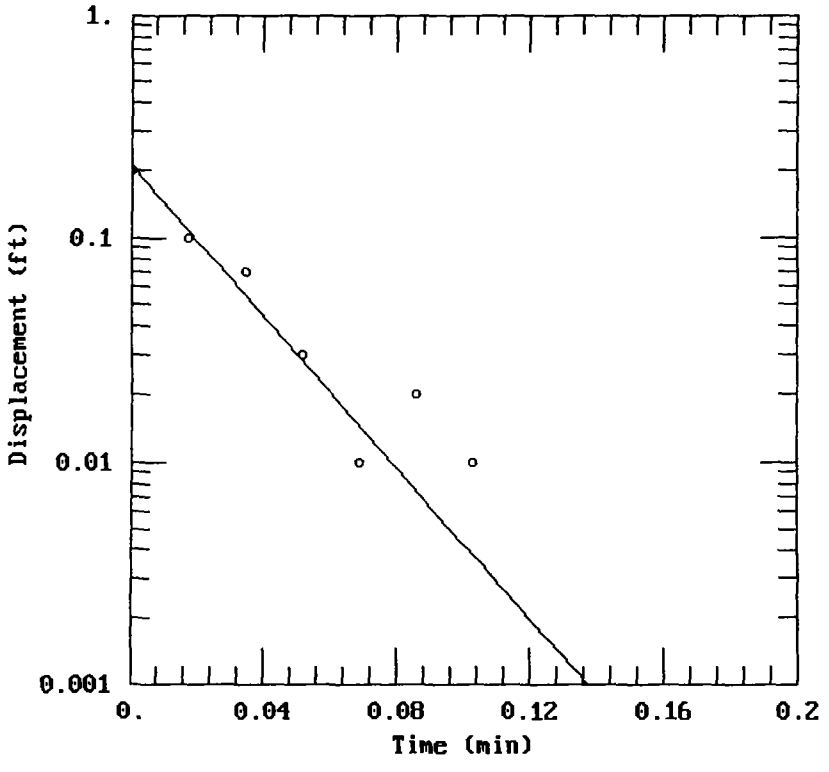
END





CLIENT: Olin, Wilmington, MA	COMPANY: BCM/SMITH
	PROJECT: 00-7074-0102

OLIN SLUG TESTS, GW63S TEST 1



DATA SET:
GW63S-1.DAT
01/19/96

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 0.2 ft
r_c= 0.083 ft
r_w= 0.33 ft
L = 3.5 ft
b = 14.5 ft
H = 3.5 ft

PARAMETER ESTIMATES:
K = 0.2833 ft/min
y0 = 0.2057 ft

AQTESOLV

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                      A Q T E S O L V   R E S U L T S
                               Version 2.01

                       Developed by Glenn M. Duffield
                   (c) 1988-1995  Geraghty & Miller, Inc.

08/31/95                                                               12:03:23

================================================================================
                               TEST DESCRIPTION

Data set........... GW63S-1.DAT
Output file........ GW63S-1.OUT
Data set title..... OLIN SLUG TESTS, GW63S TEST 1
Company............ BCM/SMITH
Project............ 00-7074-0102
Client............. Olin, Wilmington, MA
Test date.......... August 1995
Obs. well.......... GW-63-S

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 0.2
   Radius of well casing............ 0.083
   Radius of wellbore............... 0.33
   Aquifer saturated thickness...... 14.5
   Well screen length............... 3.5
   Static height of water in well... 3.5
   Gravel pack porosity............. 0.3
   Effective well casing radius..... 0.1936
   Effective wellbore radius........ 0.33
   Log(Re/Rw)....................... 1.361
   Constants A, B and C............. 1.915 ,   0.267,   0.000
   No. of observations.............. 6

================================================================================
                               ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

================================================================================
                      RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

           Estimate
   K  =   2.8330E-001 ft/min
   y0 =   2.0572E-001 ft

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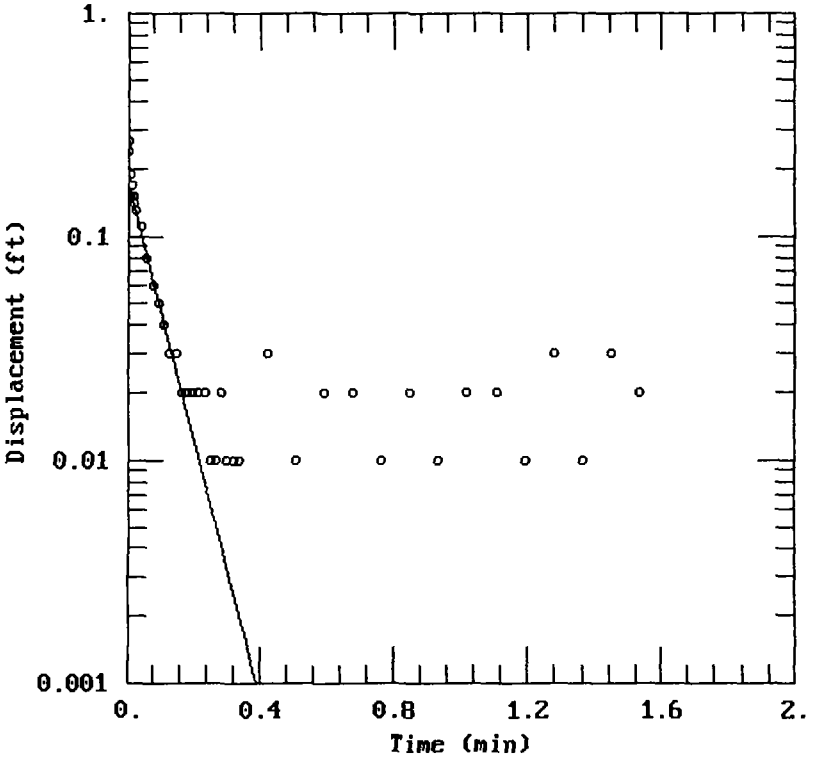
```

CLIENT: Olin, Wilmington, MA

COMPANY: BCM/SMITH

PROJECT: 00-7074-0102

OLIN SLUG TESTS, GW63S TEST 2



DATA SET:
GW63S-2.DAT
01/19/96

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 0.27 ft
r_c= 0.083 ft
r_w= 0.33 ft
L = 3.5 ft
b = 14.5 ft
H = 3.5 ft

PARAMETER ESTIMATES:
K = 0.097 ft/min
y0 = 0.17 ft

AQTESOLV

```
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                        A Q T E S O L V   R E S U L T S
                                 Version 2.01

                        Developed by Glenn M. Duffield
                     (c) 1988-1995  Geraghty & Miller, Inc.

08/31/95                                                              12:11:27

================================================================================
                               TEST DESCRIPTION

Data set........... GW63S-2.DAT
Output file........ GW63S-2.OUT
Data set title..... OLIN SLUG TESTS, GW63S TEST 2
Company............ BCM/SMITH
Project............ 00-7074-0102
Client............. Olin, Wilmington, MA
Test date.......... August 1995
Obs. well.......... GW-63-S

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 0.27
   Radius of well casing............ 0.083
   Radius of wellbore............... 0.33
   Aquifer saturated thickness...... 14.5
   Well screen length............... 3.5
   Static height of water in well... 3.5
   Gravel pack porosity............. 0.3
   Effective well casing radius..... 0.1936
   Effective wellbore radius........ 0.33
   Log(Re/Rw)....................... 1.361
   Constants A, B and C............. 1.915 ,   0.267,   0.000
   No. of observations.............. 39

================================================================================
                               ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

================================================================================
                       RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

           Estimate
   K  =   9.7000E-002 ft/min
   y0 =   1.7000E-001 ft


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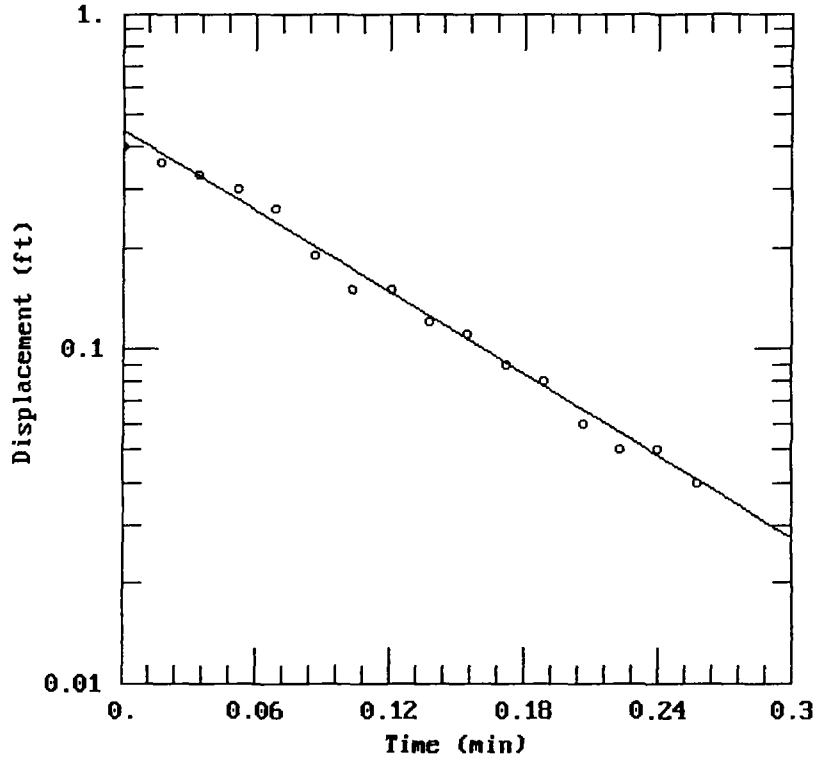
```

CLIENT: Olin, Wilmington, MA	COMPANY: BCM/SMITH
	PROJECT: 00-7074-0102

OLIN SLUG TESTS, GW63D TEST 1



DATA SET:
GW63D-1.DAT
01/19/96

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 0.4 ft
r_c= 0.083 ft
r_w= 0.33 ft
L = 5. ft
b = 14.5 ft
H = 14.5 ft

PARAMETER ESTIMATES:
K = 0.08931 ft/min
y0 = 0.4461 ft

AQTESOLV

```
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                      A Q T E S O L V   R E S U L T S
                               Version 2.01

                       Developed by Glenn M. Duffield
                   (c) 1988-1995  Geraghty & Miller, Inc.

08/31/95                                                                12:18:19

================================================================================
                              TEST DESCRIPTION

Data set........... GW63D-1.DAT
Output file........ GW63D-1.OUT
Data set title..... OLIN SLUG TESTS, GW63D TEST 1
Company............ BCM/SMITH
Project............ 00-7074-0102
Client............. Olin, Wilmington, MA
Test date.......... August 1995
Obs. well.......... GW-63-D

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 0.4
   Radius of well casing............ 0.083
   Radius of wellbore............... 0.33
   Aquifer saturated thickness...... 14.5
   Well screen length............... 5
   Static height of water in well... 14.5
   Gravel pack porosity............. 0.3
   Effective well casing radius..... 0.1936
   Effective wellbore radius........ 0.33
   Log(Re/Rw)....................... 2.564
   Constants A, B and C............. 0.000 ,  0.000,  1.504
   No. of observations.............. 15

================================================================================
                             ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

================================================================================
                    RESULTS FROM STATISTICAL CURVE MATCHING


STATISTICAL MATCH PARAMETER ESTIMATES

           Estimate          Std. Error
   K  =   8.9308E-002 +/-   3.7037E-003 ft/min
   y0 =   4.4614E-001 +/-   1.3217E-002 ft


ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated
```

```
weighted residual = residual * weight

Weighted Residual Statistics:
   Number of residuals............... 15
   Number of estimated parameters.... 2
   Degrees of freedom................ 13
   Residual mean..................... -0.0004634
   Residual standard deviation....... 0.0133
   Residual variance................. 0.0001769


Model Residuals:

     Time          Observed      Calculated      Residual         Weight
 -------------  -------------  -------------  -------------  -------------
     0.017177          0.36        0.38033       -0.02033              1
     0.034251          0.33        0.32454      0.0054598              1
     0.051429           0.3        0.27667       0.023333              1
     0.068606          0.26        0.23586       0.024143              1
      0.08568          0.19        0.20126       -0.01126              1
      0.10286          0.15        0.17157      -0.021573              1
      0.12003          0.15        0.14627      0.0037349              1
      0.13711          0.12        0.12481     -0.0048085              1
      0.15429          0.11         0.1064      0.0036013              1
      0.17146          0.09       0.090704    -0.00070444              1
      0.18854          0.08       0.077399      0.0026008              1
      0.20571          0.06       0.065982     -0.0059824              1
      0.22289          0.05        0.05625     -0.0062497              1
      0.23997          0.05       0.047998      0.0020019              1
      0.25714          0.04       0.040918    -0.00091817              1

================================================================================
                       RESULTS FROM VISUAL CURVE MATCHING

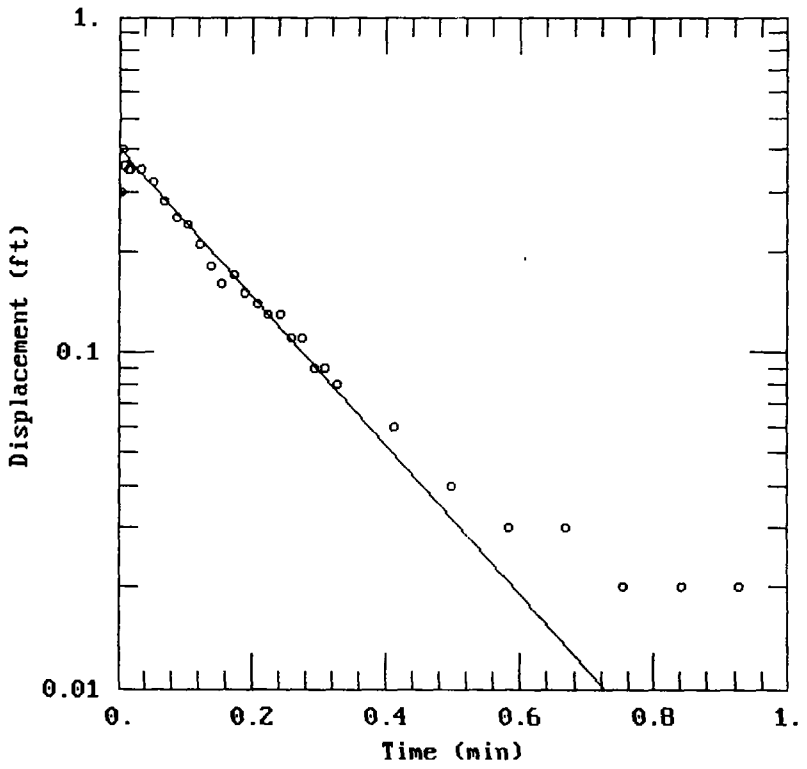

VISUAL MATCH PARAMETER ESTIMATES

           Estimate
   K  =   8.9308E-002 ft/min
   y0 =   4.4614E-001 ft


<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>
```

CLIENT: Olin, Wilmington, MA	COMPANY: BCM/SMITH
	PROJECT: 00-7074-0102

OLIN SLUG TESTS, GW63D TEST 2



DATA SET:
GW63D-2.DAT
01/19/96

AQUIFER MODEL:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 1.05 ft
r_c= 0.083 ft
r_w= 0.33 ft
L = 5. ft
b = 14.5 ft
H = 14.5 ft

PARAMETER ESTIMATES:
K = 0.04885 ft/min
y0 = 0.4003 ft

AQTESOLV

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                       A Q T E S O L V   R E S U L T S
                                 Version 2.01

                       Developed by Glenn M. Duffield
                   (c) 1988-1995  Geraghty & Miller, Inc.

08/31/95                                                                12:23:5

================================================================================
                              TEST DESCRIPTION

Data set........... GW63D-2.DAT
Output file........ GW63D-2.OUT
Data set title..... OLIN SLUG TESTS, GW63D TEST 2
Company............ BCM/SMITH
Project............ 00-7074-0102
Client............. Olin, Wilmington, MA
Test date.......... August 1995
Obs. well.......... GW-63-D

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 1.05
   Radius of well casing............ 0.083
   Radius of wellbore............... 0.33
   Aquifer saturated thickness...... 14.5
   Well screen length............... 5
   Static height of water in well... 14.5
   Gravel pack porosity............. 0.3
   Effective well casing radius..... 0.1936
   Effective wellbore radius........ 0.33
   Log(Re/Rw)....................... 2.564
   Constants A, B and C............. 0.000 ,   0.000,   1.504
   No. of observations.............. 30

================================================================================
                              ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

================================================================================
                     RESULTS FROM STATISTICAL CURVE MATCHING


STATISTICAL MATCH PARAMETER ESTIMATES

           Estimate          Std. Error
   K  =   4.4706E-002 +/-   1.9781E-003 ft/min
   y0 =   3.7520E-001 +/-   7.8652E-003 ft


ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated
```

weighted residual = residual * weight

Weighted Residual Statistics:

Number of residuals	30
Number of estimated parameters	2
Degrees of freedom	28
Residual mean	0.001451
Residual standard deviation	0.01847
Residual variance	0.0003412

Model Residuals:

Time	Observed	Calculated	Residual	Weight
0.003497	0.3	0.36914	-0.069143	1
0.006891	0.4	0.36336	0.036638	1
0.010286	0.36	0.35767	0.0023304	1
0.013783	0.35	0.3519	-0.0018996	1
0.017177	0.35	0.34639	0.0036114	1
0.034354	0.35	0.31979	0.030207	1
0.051429	0.32	0.29538	0.02462	1
0.068606	0.28	0.2727	0.007299	1
0.085783	0.25	0.25176	-0.0017633	1
0.10286	0.24	0.23254	0.0074554	1
0.12003	0.21	0.21469	-0.0046901	1
0.13721	0.18	0.19821	-0.018206	1
0.15429	0.16	0.18308	-0.023075	1
0.17146	0.17	0.16902	0.00098116	1
0.18864	0.15	0.15604	-0.0060418	1
0.20571	0.14	0.14413	-0.0041301	1
0.22289	0.13	0.13306	-0.0030639	1
0.24007	0.13	0.12285	0.0071531	1
0.25714	0.11	0.11347	-0.0034691	1
0.27432	0.11	0.10476	0.0052429	1
0.2915	0.09	0.096714	-0.006714	1
0.30857	0.09	0.089331	0.00066883	1
0.32575	0.08	0.082472	-0.002472	1
0.41153	0.06	0.055341	0.0046595	1
0.49721	0.04	0.037152	0.0028477	1
0.58289	0.03	0.024942	0.0050581	1
0.66867	0.03	0.016736	0.013264	1
0.75435	0.02	0.011236	0.0087641	1
0.84003	0.02	0.0075431	0.012457	1
0.92582	0.02	0.0050615	0.014938	1

==========

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

	Estimate	
K =	5.7394E-002	ft/min
y0 =	4.3742E-001	ft

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                         A Q T E S O L V   R E S U L T S
                                  Version 2.01

                          Developed by Glenn M. Duffield
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01/19/96                                                                14:06:57

================================================================================
                                TEST DESCRIPTION

Data set........... GW63D-2.DAT
Output file........ GW63D-2.OUT
Data set title..... OLIN SLUG TESTS, GW63D TEST 2
Company............ BCM/SMITH
Project............ 00-7074-0102
Client............. Olin, Wilmington, MA
Test date.......... August 1995
Obs. well.......... GW-63-D

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 1.05
   Radius of well casing............ 0.083
   Radius of wellbore............... 0.33
   Aquifer saturated thickness...... 14.5
   Well screen length............... 5
   Static height of water in well... 14.5
   Gravel pack porosity............. 0.3
   Effective well casing radius..... 0.1936
   Effective wellbore radius........ 0.33
   Log(Re/Rw)....................... 2.564
   Constants A, B and C............. 0.000 ,   0.000,   1.504
   No. of observations.............. 30

================================================================================
                                ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

================================================================================
                        RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

          Estimate
   K  =   4.8847E-002 ft/min
   y0 =   4.0026E-001 ft

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```

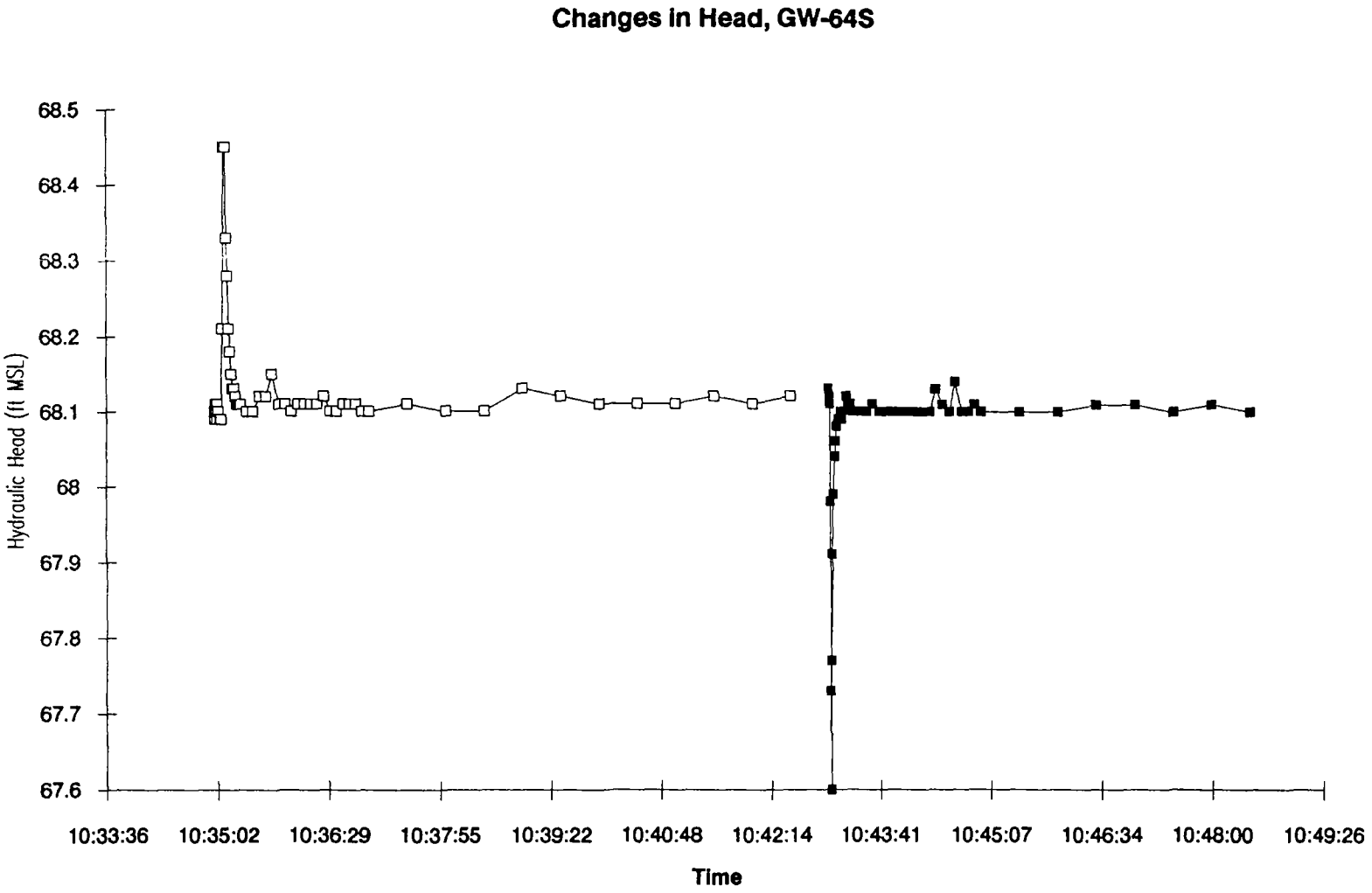
Olin, Wilmington, MA
Slug Test Data

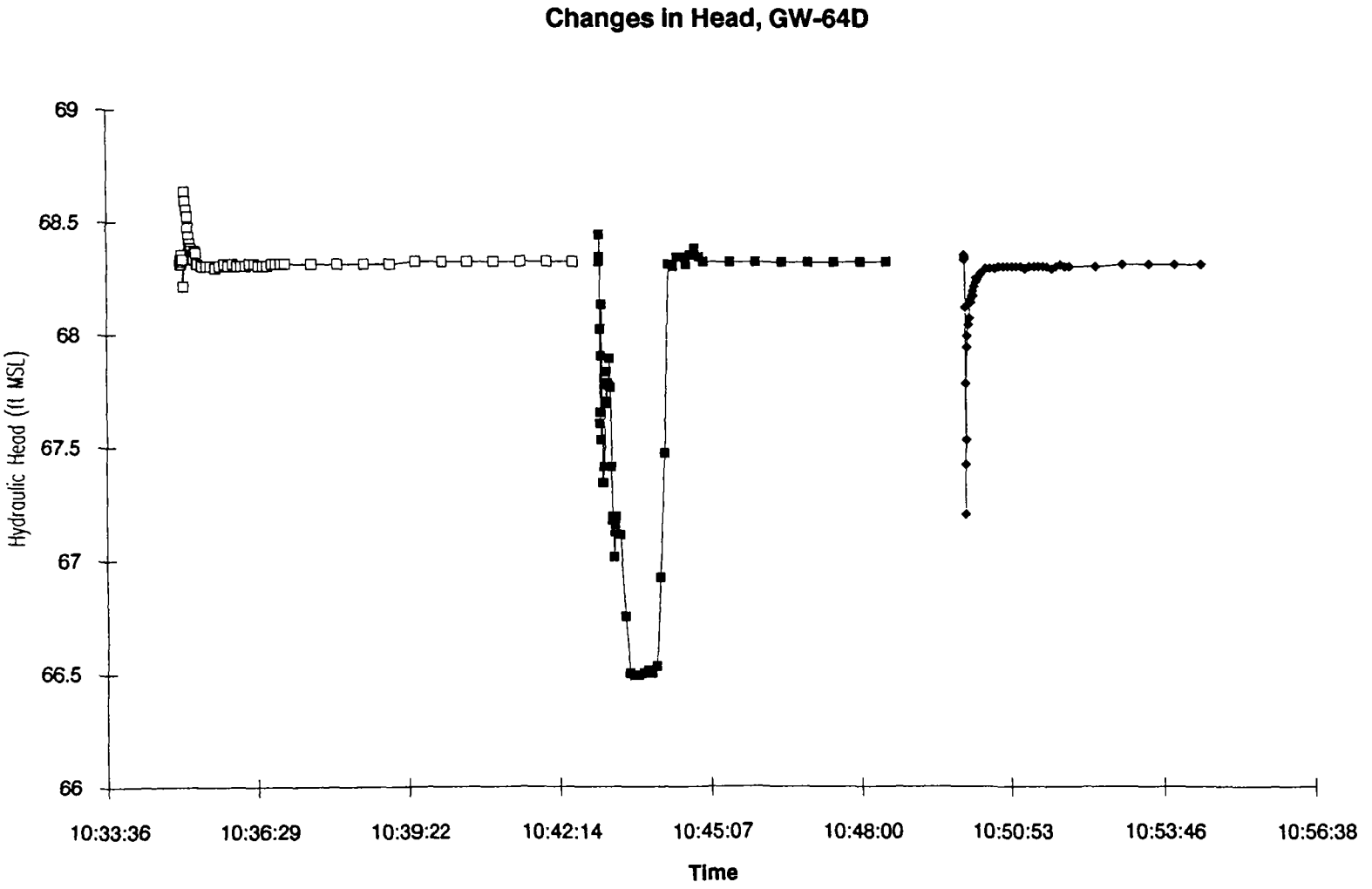
GW-63D	GW-63S
SE1000B	SE1000B
Environmental Logger	Environmental Logger
08/23 13:51	08/23 13:49
Unit# 00000 Test# 3	Unit# 00000 Test# 3
INPUT 2: Level (M)	INPUT 1: Level (M)
Reference 66.72	Reference 66.57
Scale factor 19.75	Scale factor 19.94
Offset 0.00	Offset 0.00
Step# 0 08/23 11:28	Step# 0 08/23 11:28

Elapsed Time	Value	Elapsed Time	Value
0	66.71	0	66.59
0.0033	66.74	0.0033	66.59
0.0066	66.73	0.0066	66.58
0.0099	66.73	0.0099	66.58
0.0133	66.73	0.0133	66.58
0.0166	66.74	0.0166	66.58
0.02	66.73	0.02	66.59
0.0233	66.73	0.0233	66.57
0.0266	66.72	0.0266	66.58
0.03	66.73	0.03	66.59
0.0333	66.73	0.0333	66.57
0.05	66.68	0.05	66.57
0.0666	66.88	0.0666	66.57
0.0833	67.11	0.0833	66.57
0.1	67.07	0.1	66.57
0.1166	67.04	0.1166	66.58
0.1333	67.01	0.1333	66.57
0.15	66.97	0.15	66.57
0.1666	66.9	0.1666	66.66
0.1833	66.86	0.1833	66.79
0.2	66.86	0.2	66.69
0.2166	66.83	0.2166	66.66
0.2333	66.82	0.2333	66.62
0.25	66.8	0.25	66.6
0.2666	66.79	0.2666	66.61
0.2833	66.77	0.2833	66.6
0.3	66.76	0.3	66.59
0.3166	66.76	0.3166	66.59
0.3333	66.75	0.3333	66.59
0.4167	66.73	0.4167	66.59
0.5	66.73	0.5	66.59
0.5833	66.72	0.5833	66.59
0.6667	66.72	0.6667	66.59
0.75	66.72	0.75	66.59
0.8333	66.72	0.8333	66.59
0.9167	66.73	0.9167	66.59
1	66.73	1	66.59
1.0833	66.72	1.0833	66.59
1.1667	66.72	1.1667	66.59
1.25	66.73	1.25	66.59
1.3333	66.72	1.3333	66.61
1.4166	66.73	1.4166	66.59
1.5	66.72	1.5	66.59
1.5833	66.73	1.5833	66.59
1.6667	66.72	1.6667	66.59
1.75	66.72	1.75	66.59
1.8333	66.72	1.8333	66.59
1.9167	66.74	1.9167	66.59
2	66.72	2	66.59
2.5	66.73	2.5	66.59
3	66.73	3	66.59
3.5	66.73	3.5	66.6
4	66.74	4	66.6
4.5	66.74	4.5	66.58
5	66.73	5	66.6
5.5	66.75	5.5	66.59
6	66.74	6	66.59
6.5	66.73	6.5	66.59
7	66.73	7	66.61
7.5	66.73	7.5	66.58
8	66.73	8	66.58
8.5	66.74	8.5	66.59
9	66.73	9	66.59
9.5	66.73	9.5	66.59
10	66.73	10	66.59
END		END	

Olin, Wilmington, MA
Slug Test Data

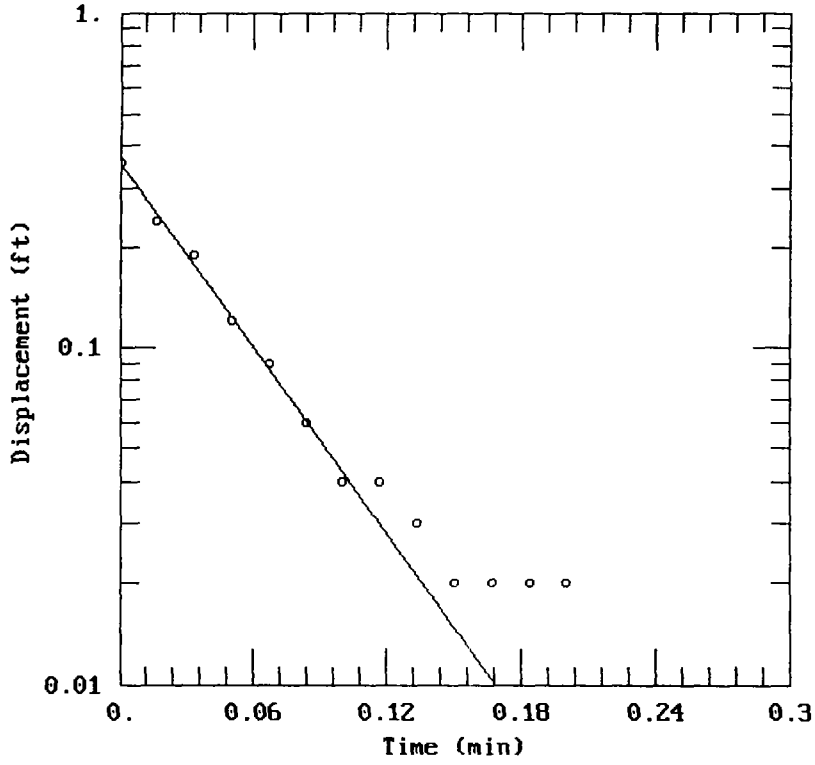
GW-63D		GW-63S	
SE1000B		SE1000B	
Environmental Logger		Environmental Logger	
08/23 13:54		08/23 13:52	
Unit# 00000 Test# 4		Unit# 00000 Test# 4	
INPUT 2: Level (M)		INPUT 1: Level (M)	
Reference	66.72	Reference	66.57
Scale factor	19.75	Scale factor	19.94
Offset	0.00	Offset	0.00
Step# 0 08/23 11:39		Step# 0 08/23 11:39	
Elapsed Time	Value	Elapsed Time	Value
0	66.73	0	66.59
0.0033	66.74	0.0033	66.6
0.0066	66.75	0.0066	66.48
0.0099	66.69	0.0099	66.32
0.0133	65.97	0.0133	66.35
0.0166	65.68	0.0166	66.4
0.02	66.43	0.02	66.44
0.0233	66.33	0.0233	66.42
0.0266	66.37	0.0266	66.44
0.03	66.38	0.03	66.45
0.0333	66.38	0.0333	66.46
0.05	66.38	0.05	66.48
0.0666	66.41	0.0666	66.51
0.0833	66.45	0.0833	66.53
0.1	66.48	0.1	66.54
0.1166	66.49	0.1166	66.55
0.1333	66.52	0.1333	66.56
0.15	66.55	0.15	66.56
0.1666	66.57	0.1666	66.57
0.1833	66.56	0.1833	66.57
0.2	66.58	0.2	66.57
0.2166	66.59	0.2166	66.57
0.2333	66.6	0.2333	66.57
0.25	66.6	0.25	66.58
0.2666	66.62	0.2666	66.58
0.2833	66.62	0.2833	66.57
0.3	66.64	0.3	66.58
0.3166	66.64	0.3166	66.58
0.3333	66.65	0.3333	66.58
0.4167	66.67	0.4167	66.56
0.5	66.69	0.5	66.58
0.5833	66.7	0.5833	66.57
0.6667	66.7	0.6667	66.57
0.75	66.71	0.75	66.58
0.8333	66.71	0.8333	66.57
0.9167	66.71	0.9167	66.58
1	66.72	1	66.57
1.0833	66.71	1.0833	66.57
1.1667	66.71	1.1667	66.58
1.25	66.71	1.25	66.56
1.3333	66.7	1.3333	66.58
1.4166	66.72	1.4166	66.56
1.5	66.71	1.5	66.57
1.5833	66.71	1.5833	66.59
1.6667	66.71	1.6667	66.57
1.75	66.73	1.75	66.57
1.8333	66.72	1.8333	66.57
1.9167	66.71	1.9167	66.57
2	66.72	2	66.59
2.5	66.71	2.5	66.57
3	66.72	3	66.58
3.5	66.74	3.5	66.59
4	66.73	4	66.57
4.5	66.73	4.5	66.57
5	66.72	5	66.57
5.5	66.71	5.5	66.57
6	66.72	6	66.57
6.5	66.73	6.5	66.57
7	66.72	7	66.6
END		END	





CLIENT: Olin, Wilmington, MA	COMPANY: BCM/SMITH
	PROJECT: 00-7074-0102

OLIN SLUG TESTS, GW64S TEST 1



DATA SET:
GW64S-1.DAT
01/19/96

AQUIFER MODEL:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 0.36 ft
r_c= 0.083 ft
r_w= 0.33 ft
L = 4. ft
b = 47.5 ft
H = 4. ft

PARAMETER ESTIMATES:
K = 0.1393 ft/min
y0 = 0.3558 ft

AQTESOLV

```
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                       A Q T E S O L V   R E S U L T S
                                 Version 2.01

                         Developed by Glenn M. Duffield
                    (c) 1988-1995  Geraghty & Miller, Inc.

08/31/95                                                                  12:29:3

==================================================================================
                                TEST DESCRIPTION

Data set........... GW64S-1.DAT
Output file........ GW64S-1.OUT
Data set title..... OLIN SLUG TESTS, GW64S TEST 1
Company............ BCM/SMITH
Project............ 00-7074-0102
Client............. Olin, Wilmington, MA
Test date.......... August 1995
Obs. well.......... GW-64-S

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 0.36
   Radius of well casing............ 0.083
   Radius of wellbore............... 0.33
   Aquifer saturated thickness...... 47.5
   Well screen length............... 4
   Static height of water in well... 4
   Gravel pack porosity............. 0.3
   Effective well casing radius..... 0.1936
   Effective wellbore radius........ 0.33
   Log(Re/Rw)....................... 1.4
   Constants A, B and C............. 1.952 ,   0.279,   0.000
   No. of observations.............. 12

==================================================================================
                                ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

==================================================================================
                       RESULTS FROM VISUAL CURVE MATCHING

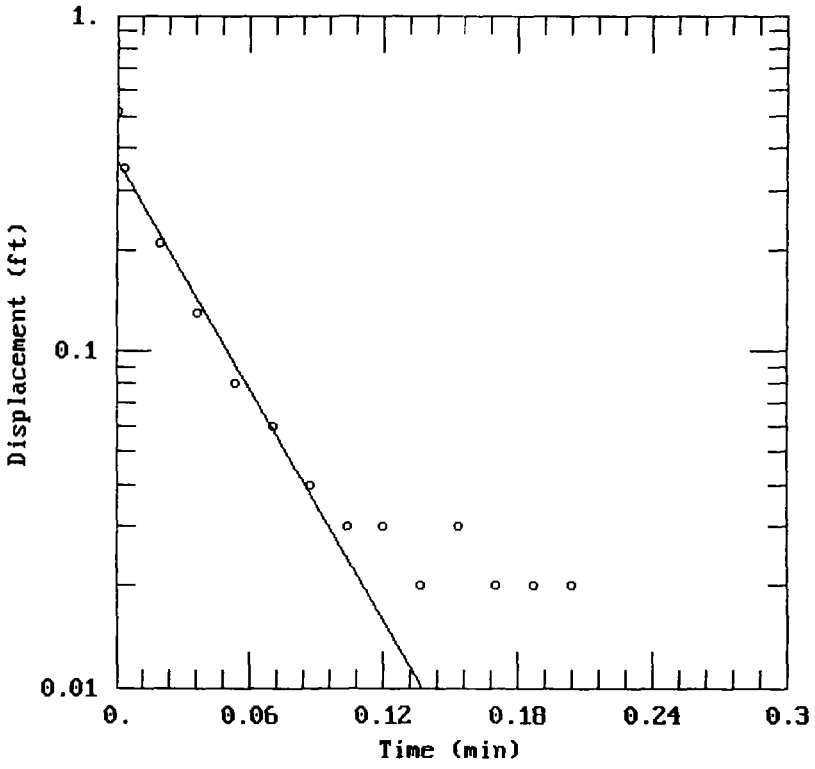

VISUAL MATCH PARAMETER ESTIMATES

           Estimate
   K  =   1.3928E-001 ft/min
   y0 =   3.5577E-001 ft


<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>
```

CLIENT: Olin, Wilmington, MA	COMPANY: BCM/SMITH
	PROJECT: 00-7074-0102

OLIN SLUG TESTS, GW64S TEST 2



DATA SET:
GW64S-2.DAT
01/19/96

AQUIFER MODEL:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 0.52 ft
r_c= 0.083 ft
r_w= 0.33 ft
L = 4. ft
b = 47.5 ft
H = 4. ft

PARAMETER ESTIMATES:
K = 0.1723 ft/min
y0 = 0.3695 ft

AQTESOLV

```
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>:

                     A Q T E S O L V    R E S U L T S
                              Version 2.01

                      Developed by Glenn M. Duffield
                  (c) 1988-1995  Geraghty & Miller, Inc.

08/31/95                                                               15:48:2(

===============================================================================
                             TEST DESCRIPTION

Data set........... GW64S-2.DAT
Output file........ GW64S-2.OUT
Data set title..... OLIN SLUG TESTS, GW64S TEST 2
Company............ BCM/SMITH
Project............ 00-7074-0102
Client............. Olin, Wilmington, MA
Test date.......... August 1995
Obs. well.......... GW-64-S

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 0.52
   Radius of well casing............ 0.083
   Radius of wellbore............... 0.33
   Aquifer saturated thickness...... 47.5
   Well screen length............... 4
   Static height of water in well... 4
   Gravel pack porosity............. 0.3
   Effective well casing radius..... 0.1936
   Effective wellbore radius........ 0.33
   Log(Re/Rw)....................... 1.4
   Constants A, B and C............. 1.952 ,   0.279,   0.000
   No. of observations.............. 13

===============================================================================
                             ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

===============================================================================
                   RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

           Estimate
   K  =   1.7226E-001 ft/min
   y0 =   3.6947E-001 ft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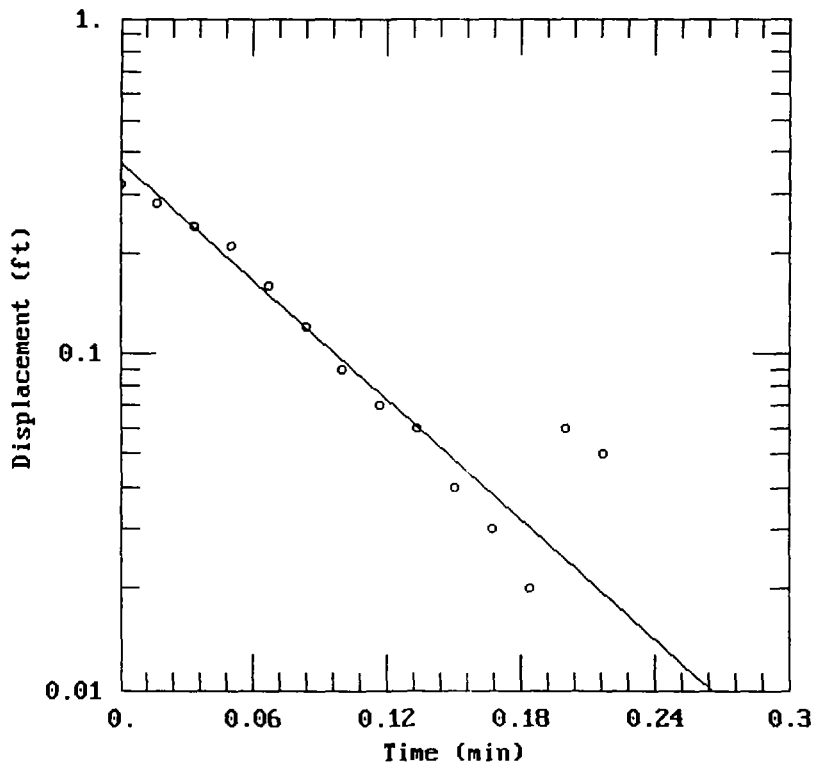
```

CLIENT: Olin, Wilmington, MA	COMPANY: BCM/SMITH
	PROJECT: 00-7074-0102

OLIN SLUG TESTS, GW64D TEST 1



DATA SET:
GW64D-1.DAT
01/19/96

AQUIFER MODEL:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 0.32 ft
r_c= 0.083 ft
r_w= 0.33 ft
L = 7.5 ft
b = 47.5 ft
H = 47.5 ft

PARAMETER ESTIMATES:
K = 0.1144 ft/min
y0 = 0.3718 ft

AQTESOLV

```
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                        A Q T E S O L V   R E S U L T S
                                  Version 2.01

                          Developed by Glenn M. Duffield
                      (c) 1988-1995  Geraghty & Miller, Inc.

09/05/95                                                                 16:50:1

================================================================================
                                TEST DESCRIPTION

Data set........... GW64D-1.DAT
Output file........ GW64D-1.OUT
Data set title..... OLIN SLUG TESTS, GW64D TEST 1
Company............ BCM/SMITH
Project............ 00-7074-0102
Client............. Olin, Wilmington, MA
Test date.......... August 1995
Obs. well.......... GW-64-D

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 0.32
   Radius of well casing............ 0.083
   Radius of wellbore............... 0.33
   Aquifer saturated thickness...... 47.5
   Well screen length............... 7.5
   Static height of water in well... 47.5
   Gravel pack porosity............. 0.3
   Effective well casing radius..... 0.1936
   Effective wellbore radius........ 0.33
   Log(Re/Rw)....................... 3.355
   Constants A, B and C............. 0.000 ,  0.000,  1.744
   No. of observations.............. 13

================================================================================
                               ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

================================================================================
                      RESULTS FROM STATISTICAL CURVE MATCHING


STATISTICAL MATCH PARAMETER ESTIMATES

           Estimate          Std.  Error
   K  =   1.1438E-001 +/-   5.9755E-003 ft/min
   y0 =   3.7178E-001 +/-   1.4565E-002 ft


ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated
```

```
weighted residual = residual * weight

Weighted Residual Statistics:
   Number of residuals............... 11
   Number of estimated parameters.... 2
   Degrees of freedom................ 9
   Residual mean..................... -0.001537
   Residual standard deviation....... 0.01138
   Residual variance................. 0.0001296


Model Residuals:

     Time          Observed       Calculated       Residual        Weight
 -------------   -------------   -------------   -------------   -------------
       0.0167            0.28         0.29604       -0.016041               1
       0.0333            0.24         0.23605        0.003948               1
         0.05            0.21         0.18796        0.022037               1
       0.0667            0.16         0.14967         0.01033               1
       0.0833            0.12         0.11934      0.00065834               1
          0.1            0.09        0.095029       -0.005029               1
       0.1167            0.07        0.075669      -0.0056693               1
       0.1333            0.06        0.060336     -0.00033598               1
         0.15            0.04        0.048044      -0.0080441               1
       0.1667            0.03        0.038256      -0.0082564               1
       0.1833            0.02        0.030504       -0.010504               1

==================================================================================
                       RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

            Estimate
   K  =   1.1438E-001 ft/min
   y0 =   3.7178E-001 ft

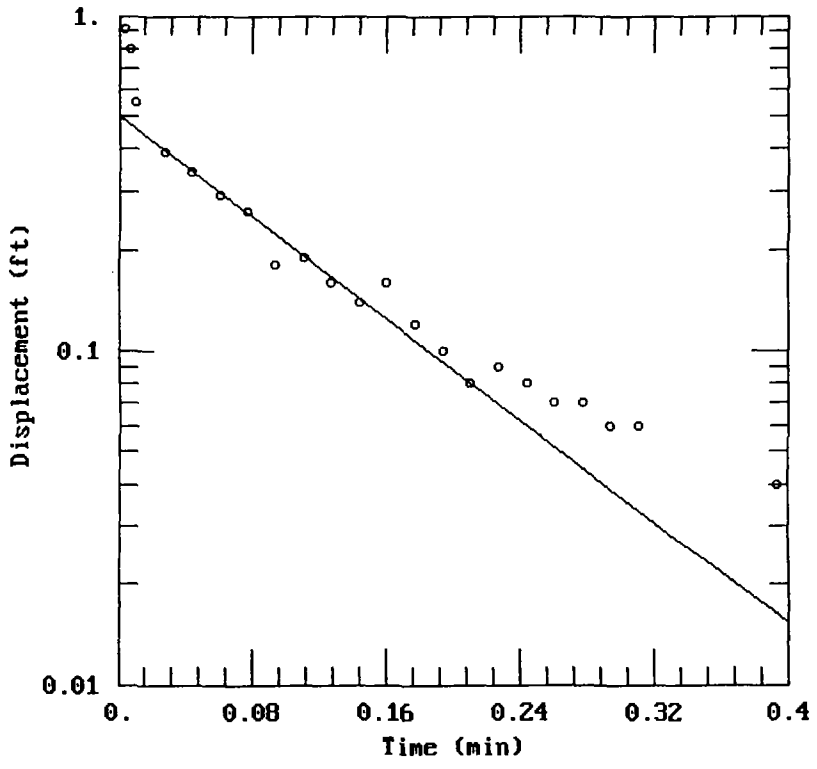

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>
```

CLIENT: Olin, Wilmington, MA

COMPANY: BCM/SMITH

PROJECT: 00-7074-0102

OLIN SLUG TESTS, GW64D TEST 2



DATA SET:
GW64D-2.DAT
01/19/96

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 1.13 ft
r_c= 0.083 ft
r_w= 0.33 ft
L = 7.5 ft
b = 47.5 ft
H = 47.5 ft

PARAMETER ESTIMATES:
K = 0.073 ft/min
y0 = 0.497 ft

AQTESOLV

```
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                        A Q T E S O L V    R E S U L T S
                                  Version 2.01

                          Developed by Glenn M. Duffield
                    (c) 1988-1995  Geraghty & Miller, Inc.

09/05/95                                                                  16:53:33

=================================================================================
                                TEST DESCRIPTION

Data set........... GW64D-2.DAT
Output file........ GW64D-2.OUT
Data set title..... OLIN SLUG TESTS, GW64D TEST 2
Company............ BCM/SMITH
Project............ 00-7074-0102
Client............. Olin, Wilmington, MA
Test date.......... August 1995
Obs. well.......... GW-64-D

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 1.13
   Radius of well casing............ 0.083
   Radius of wellbore............... 0.33
   Aquifer saturated thickness...... 47.5
   Well screen length............... 7.5
   Static height of water in well... 47.5
   Gravel pack porosity............. 0.3
   Effective well casing radius..... 0.1936
   Effective wellbore radius........ 0.33
   Log(Re/Rw)....................... 3.355
   Constants A, B and C............. 0.000 ,  0.000,  1.744
   No. of observations.............. 22

=================================================================================
                               ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

=================================================================================
                        RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

           Estimate
   K  =   7.3000E-002 ft/min
   y0 =   4.9700E-001 ft

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```

Olin, Wilmington, MA
Slug Test Data

GW-64D		GW-64S	
SE1000B		SE1000B	
Environmental Logger		Environmental Logger	
08/23 13:44		08/23 13:43	
Unit# 00000 Test# 0		Unit# 00000 Test# 0	
INPUT 2: Level (M)		INPUT 1: Level (M)	
Reference	68.31	Reference	68.09
Scale factor	19.75	Scale factor	19.94
Offset	0.00	Offset	0.00
Step# 0 08/23 10:35		Step# 0 08/23 10:35	
Elapsed Time	Value	Elapsed Time	Value
0	68.31	0	68.09
0.0033	68.33	0.0033	68.1
0.0066	68.32	0.0066	68.11
0.0099	68.31	0.0099	68.11
0.0133	68.32	0.0133	68.1
0.0166	68.33	0.0166	68.1
0.02	68.31	0.02	68.1
0.0233	68.35	0.0233	68.11
0.0266	68.32	0.0266	68.09
0.03	68.32	0.03	68.11
0.0333	68.33	0.0333	68.11
0.05	68.33	0.05	68.1
0.0666	68.21	0.0666	68.09
0.0833	68.63	0.0833	68.09
0.1	68.59	0.1	68.21
0.1166	68.55	0.1166	68.45
0.1333	68.52	0.1333	68.45
0.15	68.47	0.15	68.33
0.1666	68.43	0.1666	68.28
0.1833	68.4	0.1833	68.21
0.2	68.38	0.2	68.18
0.2166	68.37	0.2166	68.15
0.2333	68.35	0.2333	68.13
0.25	68.34	0.25	68.13
0.2666	68.33	0.2666	68.12
0.2833	68.37	0.2833	68.11
0.3	68.36	0.3	68.11
0.3166	68.31	0.3166	68.11
0.3333	68.31	0.3333	68.11
0.4167	68.3	0.4167	68.1
0.5	68.3	0.5	68.1
0.5833	68.3	0.5833	68.12
0.6667	68.29	0.6667	68.12
0.75	68.3	0.75	68.15
0.8333	68.31	0.8333	68.11
0.9167	68.3	0.9167	68.11
1	68.31	1	68.1
1.0833	68.3	1.0833	68.11
1.1667	68.3	1.1667	68.11
1.25	68.3	1.25	68.11
1.3333	68.31	1.3333	68.11
1.4166	68.31	1.4166	68.12
1.5	68.3	1.5	68.1
1.5833	68.3	1.5833	68.1
1.6667	68.3	1.6667	68.11
1.75	68.31	1.75	68.11
1.8333	68.31	1.8333	68.11
1.9167	68.31	1.9167	68.1
2	68.31	2	68.1
2.5	68.31	2.5	68.11
3	68.31	3	68.1
3.5	68.31	3.5	68.1
4	68.31	4	68.13
4.5	68.32	4.5	68.12
5	68.32	5	68.11
5.5	68.32	5.5	68.11
6	68.32	6	68.11
6.5	68.32	6.5	68.12
7	68.32	7	68.11
7.5	68.32	7.5	68.12
END		END	

Olin, Wilmington, MA
Slug Test Data

GW-64D		GW-64S	
SE1000B		SE1000B	
Environmental Logger		Environmental Logger	
08/23 13:47		08/23 13:46	
Unit# 00000 Test# 1		Unit# 00000 Test# 1	
INPUT 2: Level (M)		INPUT 1: Level (M)	
Reference	68.31	Reference	68.09
Scale factor	19.75	Scale factor	19.94
Offset	0.00	Offset	0.00
Step# 0 08/23 10:43		Step# 0 08/23 10:43	
Elapsed Time	Value	Elapsed Time	Value
0	68.32	0	68.12
0.0033	68.34	0.0033	68.13
0.0066	68.34	0.0066	68.12
0.0099	68.33	0.0099	68.12
0.0133	68.34	0.0133	68.12
0.0166	68.44	0.0166	68.12
0.02	67.6	0.02	68.11
0.0233	67.65	0.0233	67.98
0.0266	67.53	0.0266	67.73
0.03	68.02	0.03	67.6
0.0333	67.9	0.0333	67.77
0.05	68.13	0.05	67.91
0.0666	67.34	0.0666	67.99
0.0833	67.34	0.0833	68.04
0.1	67.41	0.1	68.06
0.1166	67.69	0.1166	68.08
0.1333	67.83	0.1333	68.09
0.15	67.7	0.15	68.09
0.1666	67.78	0.1666	68.1
0.1833	67.77	0.1833	68.09
0.2	67.89	0.2	68.1
0.2166	67.76	0.2166	68.1
0.2333	67.41	0.2333	68.1
0.25	67.17	0.25	68.12
0.2666	67.19	0.2666	68.11
0.2833	67.01	0.2833	68.11
0.3	67.12	0.3	68.11
0.3166	67.15	0.3166	68.1
0.3333	67.19	0.3333	68.1
0.4167	67.11	0.4167	68.1
0.5	66.75	0.5	68.1
0.5833	66.5	0.5833	68.11
0.6667	66.49	0.6667	68.1
0.75	66.49	0.75	68.1
0.8333	66.5	0.8333	68.1
0.9167	66.51	0.9167	68.1
1	66.5	1	68.1
1.0833	66.53	1.0833	68.1
1.1667	66.92	1.1667	68.1
1.25	67.47	1.25	68.1
1.3333	68.31	1.3333	68.1
1.4166	68.3	1.4166	68.13
1.5	68.34	1.5	68.11
1.5833	68.34	1.5833	68.1
1.6667	68.31	1.6667	68.14
1.75	68.35	1.75	68.1
1.8333	68.38	1.8333	68.1
1.9167	68.34	1.9167	68.11
2	68.32	2	68.1
2.5	68.32	2.5	68.1
3	68.32	3	68.1
3.5	68.32	3.5	68.11
4	68.32	4	68.11
4.5	68.32	4.5	68.1
5	68.32	5	68.11
5.5	68.32	5.5	68.1
END		END	

Olin, Wilmington, MA
Slug Test Data

GW-64D GW-64S

SE1000B
Environmental Logger
08/23 13:48

Unit# 00000 Test# 2

INPUT 2: Level (M)

Reference 68.31
Scale factor 19.75
Offset 0.00

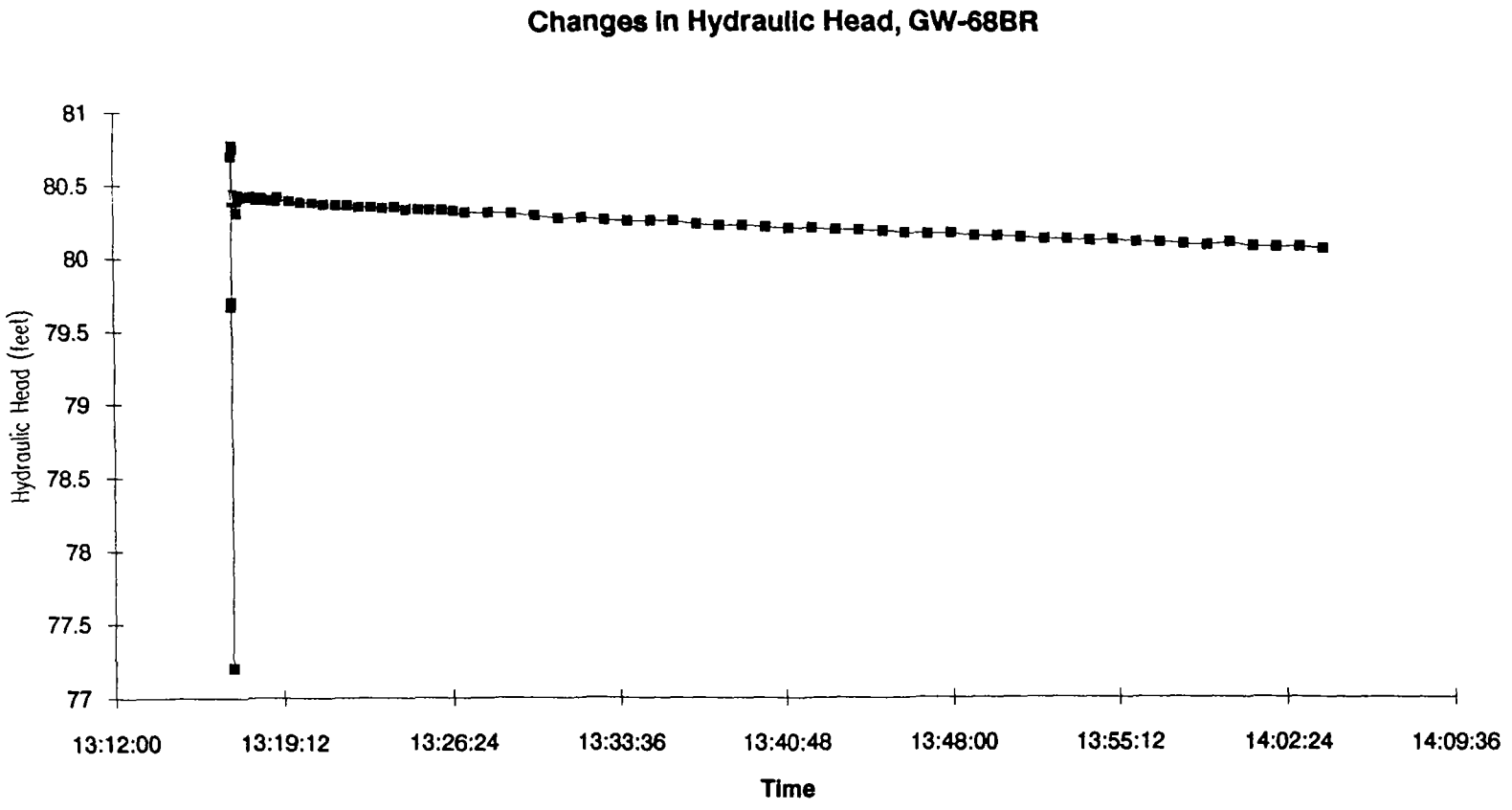
Step# 0 08/23 10:50

Elapsed Time	Value
0	68.33
0.0033	68.35
0.0066	68.34
0.0099	68.34
0.0133	68.34
0.0166	68.34
0.02	68.12
0.0233	67.2
0.0266	67.42
0.03	67.53
0.0333	67.78
0.05	67.94
0.0666	67.99
0.0833	68.04
0.1	68.07
0.1166	68.15
0.1333	68.14
0.15	68.17
0.1666	68.19
0.1833	68.17
0.2	68.21
0.2166	68.23
0.2333	68.25
0.25	68.24
0.2666	68.25
0.2833	68.26
0.3	68.26
0.3166	68.27

GW-64D GW-64S

0.3333	68.27
0.4167	68.29
0.5	68.29
0.5833	68.29
0.6667	68.3
0.75	68.3
0.8333	68.3
0.9167	68.3
1	68.3
1.0833	68.3
1.1667	68.29
1.25	68.3
1.3333	68.3
1.4166	68.3
1.5	68.3
1.5833	68.3
1.6667	68.29
1.75	68.3
1.8333	68.31
1.9167	68.3
2	68.3
2.5	68.3
3	68.31
3.5	68.31
4	68.31
4.5	68.31

END

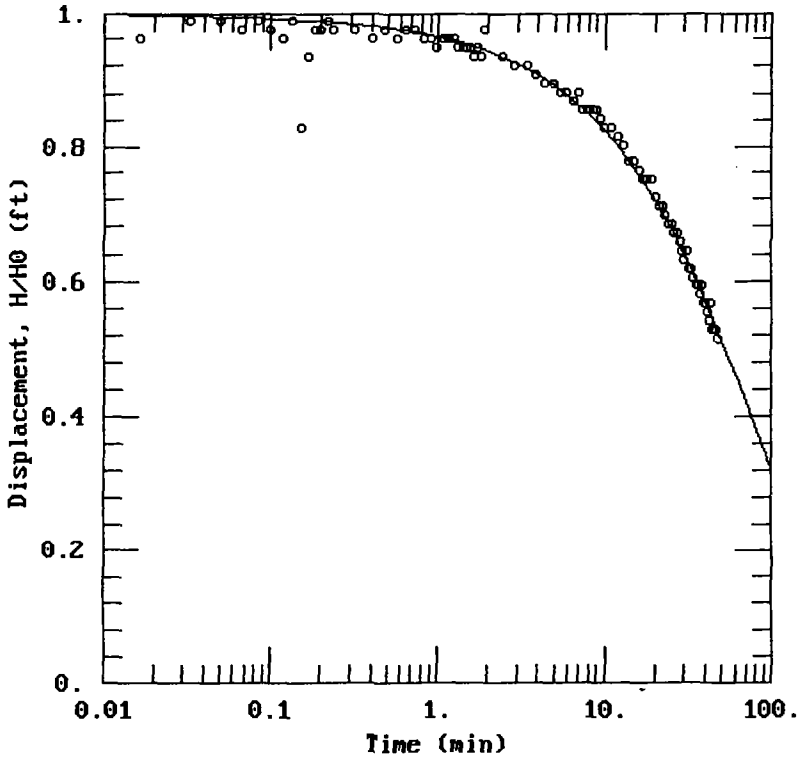


CLIENT: Olin, Wilmington, MA

COMPANY: BCM/SMITH

PROJECT: 00-7074-0102

OLIN SLUG TESTS, GW68BR TEST 1



DATA SET:
GW68BR.DAT
01/19/96

AQUIFER MODEL:
Confined

SOLUTION METHOD:
Cooper et al.

TEST DATA:
H0= 0.76 ft
r_c= 0.167 ft
r_w= 0.167 ft

PARAMETER ESTIMATES:
T = 0.0005354 ft^2/min
S = 0.004693

AQTESOLV

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<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

                       A Q T E S O L V   R E S U L T S
                                 Version 2.01

                        Developed by Glenn M. Duffield
                    (c) 1988-1995  Geraghty & Miller, Inc.

09/05/95                                                                17:37:42

================================================================================
                                TEST DESCRIPTION

Data set........... GW68BR.DAT
Output file........ GW68BR.OUT
Data set title..... OLIN SLUG TESTS, GW68BR TEST 1
Company............ BCM/SMITH
Project............ 00-7074-0102
Client............. Olin, Wilmington, MA
Test date.......... August 1995
Obs. well.......... GW-68-BR

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 0.76
   Radius of well casing............ 0.167
   Radius of wellbore............... 0.167
   Aquifer saturated thickness...... 65.5
   Well screen length............... 45
   Static height of water in well... 65.5
   Gravel pack porosity............. 1
   Effective well casing radius..... 0.167
   Effective wellbore radius........ 0.167
   Log(Re/Rw)....................... 4.663
   Constants A, B and C............. 0.000 ,  0.000,  8.156
   No. of observations.............. 87

================================================================================
                                ANALYTICAL METHOD

Cooper et al. (Confined Aquifer Slug Test)

================================================================================
                    RESULTS FROM STATISTICAL CURVE MATCHING


STATISTICAL MATCH PARAMETER ESTIMATES

           Estimate          Std. Error
   T  =   5.3537E-004 +/-   5.6528E-005 ft^2/min
   S  =   4.6930E-003 +/-   2.1328E-003


ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated
```

weighted residual = residual * weight

Weighted Residual Statistics:

Number of residuals	87
Number of estimated parameters	2
Degrees of freedom	85
Residual mean	-0.003371
Residual standard deviation	0.01643
Residual variance	0.0002698

Model Residuals:

Time	Observed	Calculated	Residual	Weight
0.0166	0.73	0.75768	-0.027676	1
0.0333	0.75	0.75658	-0.0065825	1
0.05	0.75	0.75571	-0.0057054	1
0.0666	0.74	0.75493	-0.014933	1
0.0833	0.75	0.75422	-0.0042181	1
0.1	0.74	0.75356	-0.013561	1
0.1166	0.73	0.75295	-0.022946	1
0.1333	0.75	0.75236	-0.0023571	1
0.15	0.63	0.75179	-0.12179	1
0.1666	0.71	0.75126	-0.041258	1
0.1833	0.74	0.75073	-0.010732	1
0.2	0.74	0.75021	-0.010213	1
0.2166	0.75	0.7497	0.00029699	1
0.2333	0.74	0.74924	-0.0092404	1
0.3167	0.74	0.74686	-0.0068577	1
0.4	0.73	0.74479	-0.014786	1
0.4833	0.74	0.74296	-0.0029572	1
0.5667	0.73	0.74111	-0.011114	1
0.65	0.74	0.73935	0.00065302	1
0.7333	0.74	0.73765	0.0023541	1
0.8167	0.73	0.736	-0.0059986	1
0.9	0.73	0.7344	-0.0044013	1
0.9833	0.72	0.73285	-0.012846	1
1.0667	0.73	0.73133	-0.0013267	1
1.15	0.73	0.72984	0.00015755	1
1.2333	0.73	0.72839	0.0016115	1
1.3166	0.72	0.72696	-0.0069623	1
1.4	0.72	0.72556	-0.0055597	1
1.4833	0.72	0.72418	-0.0041821	1
1.5667	0.72	0.72282	-0.0028246	1
1.65	0.71	0.72149	-0.011489	1
1.7333	0.72	0.72017	-0.00017218	1
1.8167	0.71	0.71887	-0.0088716	1
1.9	0.74	0.71759	0.022411	1
2.4	0.71	0.7102	-0.00019608	1
2.9	0.7	0.70323	-0.0032301	1
3.4	0.7	0.6966	0.0033988	1
3.9	0.69	0.69025	-0.00024992	1
4.4	0.68	0.68413	-0.0041341	1
4.9	0.68	0.67822	0.0017772	1
5.4	0.67	0.67249	-0.0024919	1
5.9	0.67	0.66692	0.0030775	1
6.4	0.66	0.6615	-0.0014993	1
6.9	0.67	0.65621	0.01379	1
7.4	0.65	0.65104	-0.0010431	1

```
       7.9          0.65        0.64599     0.0040096          1
       8.4          0.65        0.64104     0.0089562          1
       8.9          0.65         0.6362      0.013803          1
       9.4          0.64        0.63144     0.0085572          1
       9.9          0.63        0.62678     0.0032228          1
      10.9          0.63        0.61769      0.012308          1
      11.9          0.62        0.60891       0.01109          1
      12.9          0.61         0.6004     0.0095958          1
      13.9          0.59        0.59215    -0.0021525          1
      14.9          0.59        0.58414     0.0058636          1
      15.9          0.58        0.57634     0.0036602          1
      16.9          0.57        0.56875     0.0012512          1
      17.9          0.57        0.56135      0.008649          1
      18.9          0.57        0.55414      0.015864          1
      19.9          0.55        0.54709     0.0029071          1
      20.9          0.54        0.54021   -0.00021399          1
      21.9          0.54        0.53349     0.0065089          1
      22.9          0.53        0.52692      0.003083          1
      23.9          0.52        0.52049   -0.00048507          1
      24.9          0.52        0.51419     0.0058107          1
      25.9          0.51        0.50802     0.0019759          1
      26.9          0.51        0.50198     0.0080156          1
      27.9           0.5        0.49607     0.0039346          1
      28.9          0.49        0.49026   -0.00026251          1
      29.9          0.48        0.48457    -0.0045717          1
      30.9          0.49        0.47899      0.011011          1
      31.9          0.47        0.47351     -0.003511          1
      32.9          0.47        0.46813      0.001866          1
      33.9          0.46        0.46285    -0.0028548          1
      34.9          0.45        0.45767    -0.0076705          1
      35.9          0.45        0.45258    -0.0025781          1
      36.9          0.44        0.44757    -0.0075748          1
      37.9          0.45        0.44266     0.0073419          1
      38.9          0.43        0.43783    -0.0078256          1
      39.9          0.43        0.43307    -0.0030747          1
      40.9          0.42         0.4284    -0.0084034          1
      41.9          0.41        0.42381     -0.013809          1
      42.9          0.43        0.41929      0.010709          1
      43.9           0.4        0.41485     -0.014846          1
      44.9           0.4        0.41047     -0.010472          1
      45.9           0.4        0.40617    -0.0061679          1
      46.9          0.39        0.40193     -0.011932          1

================================================================================
                       RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

           Estimate
  T  =   5.3537E-004 ft^2/min
  S  =   4.6930E-003


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```

Olin, Wilmington, MA
Slug Test Data

GW-68BR

SE1000B
Environmental Logger
08/24 17:42

Unit# 00000 Test# 0

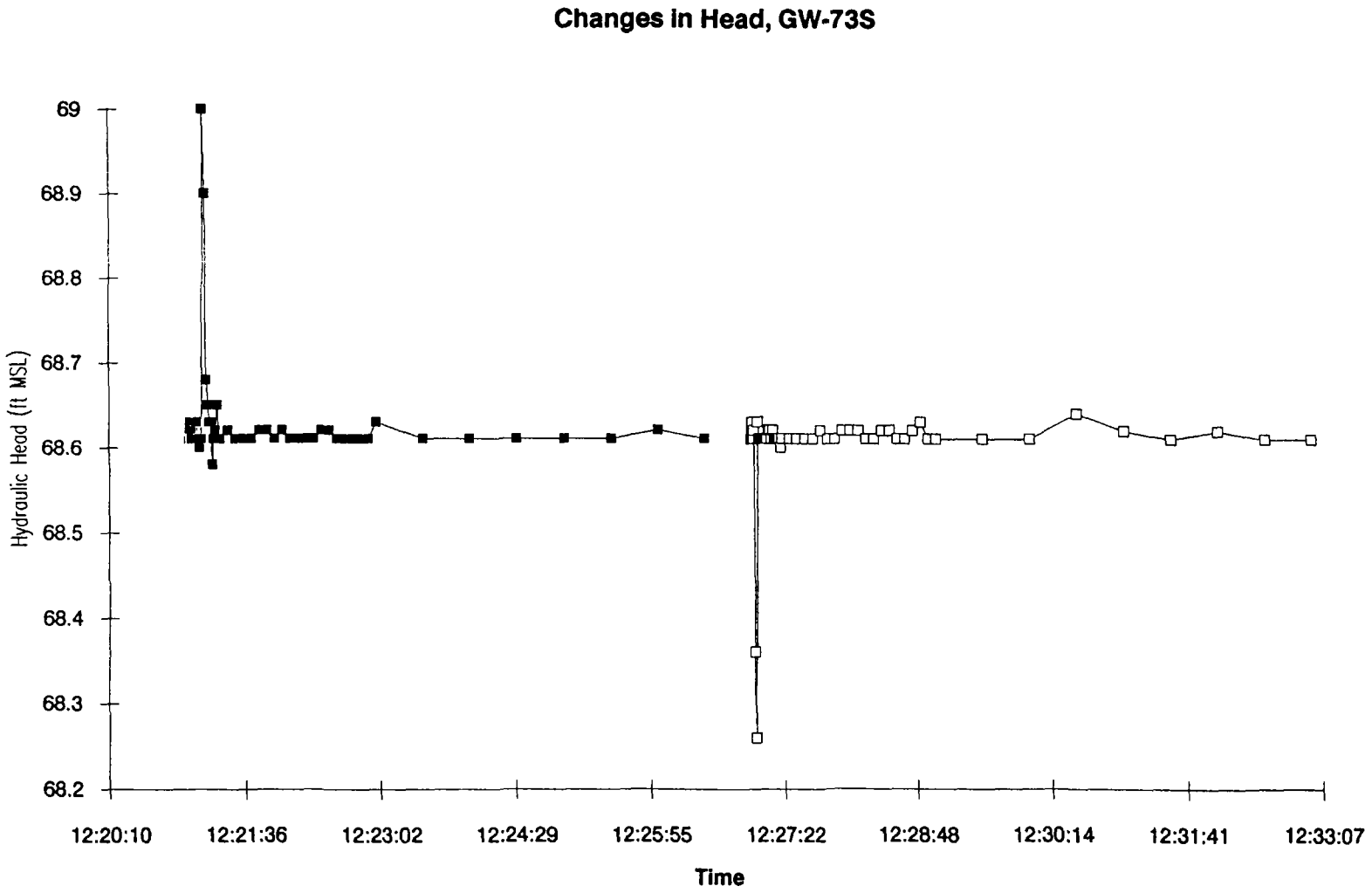
INPUT 1: Level (M)

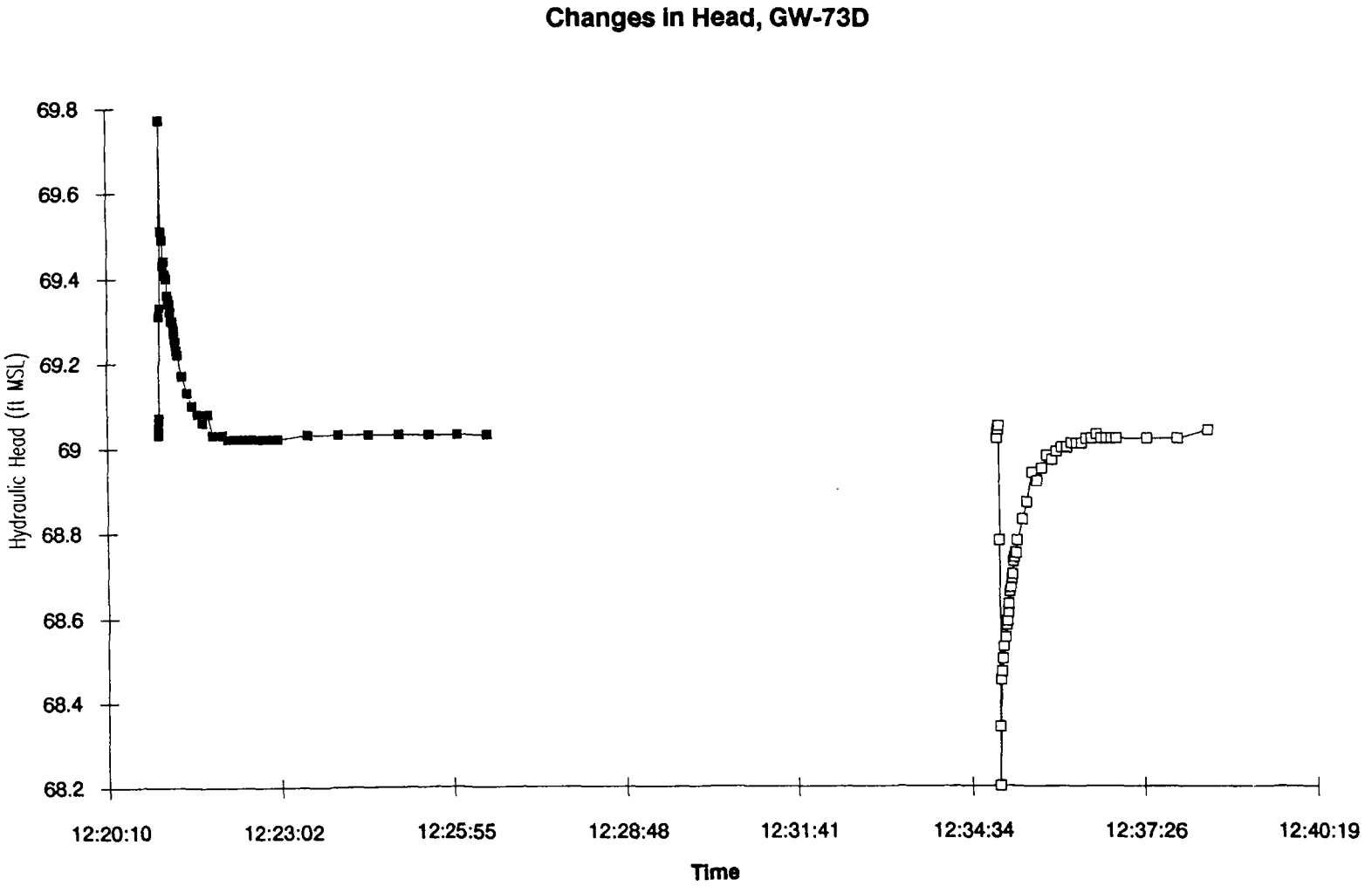
Reference 79.73
Scale factor 19.94
Offset 0.00

Step# 0 08/24 13:17

Elapsed Time	Value
0	79.68
0.0033	79.68
0.0066	79.67
0.0099	79.67
0.0133	79.67
0.0166	79.69
0.02	79.69
0.0233	79.69
0.0266	79.7
0.03	77.2
0.0333	80.7
0.05	80.77
0.0666	80.75
0.0833	80.39
0.1	80.44
0.1166	80.41
0.1333	80.43
0.15	80.43
0.1666	80.42
0.1833	80.43
0.2	80.42
0.2166	80.41
0.2333	80.43
0.25	80.31
0.2666	80.39
0.2833	80.42
0.3	80.42
0.3166	80.43
0.3333	80.42
0.4167	80.42
0.5	80.41
0.5833	80.42
0.6667	80.41
0.75	80.42
0.8333	80.42
0.9167	80.41
1	80.41
1.0833	80.4
1.1667	80.41
1.25	80.41
1.3333	80.41
1.4166	80.4
1.5	80.4
1.5833	80.4
1.6667	80.4
1.75	80.39
1.8333	80.4
1.9167	80.39
2	80.42
2.5	80.39
3	80.38
3.5	80.38
4	80.37
4.5	80.36
5	80.36
5.5	80.35
6	80.35
6.5	80.34
7	80.35
7.5	80.33
8	80.33
8.5	80.33
9	80.33
9.5	80.32
10	80.31
11	80.31
12	80.3
13	80.29
14	80.27
15	80.27
16	80.26
17	80.25
18	80.25
19	80.25
20	80.23
21	80.22
22	80.22
23	80.21
24	80.2
25	80.2
26	80.19
27	80.19
28	80.18
29	80.17
30	80.16
31	80.17
32	80.15
33	80.15
34	80.14
35	80.13
36	80.13
37	80.12
38	80.13
39	80.11
40	80.11
41	80.1
42	80.09
43	80.11
44	80.08
45	80.08
46	80.08
47	80.07

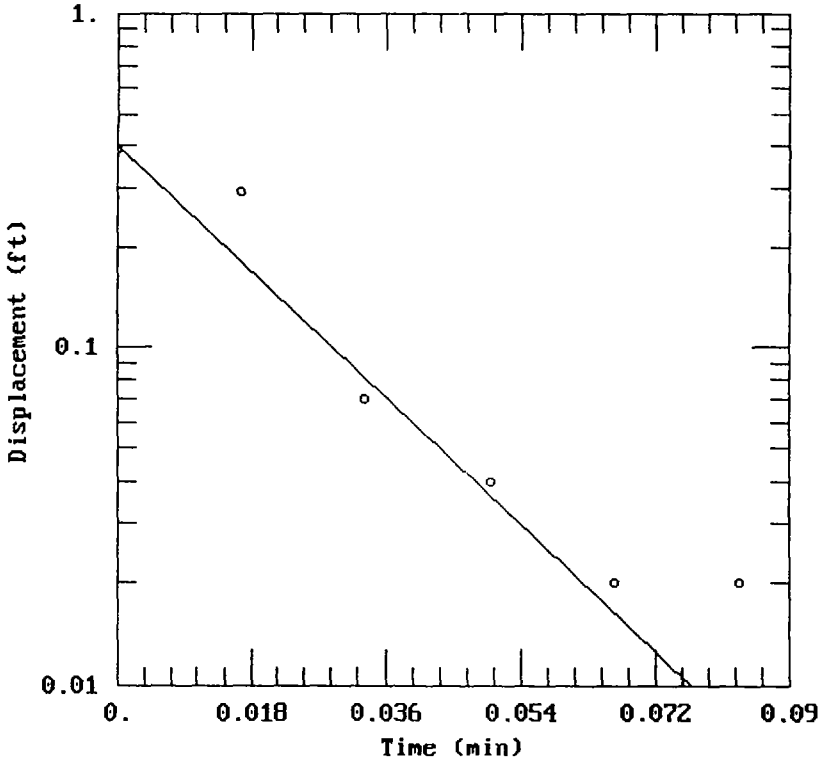
END





CLIENT: Olin, Wilmington, MA	COMPANY: BCM/SMITH
	PROJECT: 00-7074-0102

OLIN SLUG TESTS, GW73S TEST 1



DATA SET:
GW73S-1.DAT
01/19/96

AQUIFER MODEL:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 0.39 ft
r_c= 0.083 ft
r_w= 0.33 ft
L = 10. ft
b = 42.8 ft
H = 10.2 ft

PARAMETER ESTIMATES:
K = 0.1946 ft/min
y0 = 0.4003 ft

AQTESOLV

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                     A Q T E S O L V   R E S U L T S
                              Version 2.01

                      Developed by Glenn M. Duffield
                   (c) 1988-1995  Geraghty & Miller, Inc.

09/01/95                                                                14:57:5

================================================================================
                             TEST DESCRIPTION

Data set........... GW73S-1.DAT
Output file........ GW73S-1.OUT
Data set title..... OLIN SLUG TESTS, GW73S TEST 1
Company............ BCM/SMITH
Project............ 00-7074-0102
Client............. Olin, Wilmington, MA
Test date.......... August 1995
Obs. well.......... GW-73-S

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 0.39
   Radius of well casing............ 0.083
   Radius of wellbore............... 0.33
   Aquifer saturated thickness...... 42.8
   Well screen length............... 10
   Static height of water in well... 10.2
   Gravel pack porosity............. 0.3
   Effective well casing radius..... 0.1936
   Effective wellbore radius........ 0.33
   Log(Re/Rw)....................... 2.164
   Constants A, B and C............. 2.453 ,   0.399,   0.000
   No. of observations.............. 5

================================================================================
                            ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

================================================================================
                    RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

           Estimate
   K  =   1.9456E-001 ft/min
   y0 =   4.0026E-001 ft

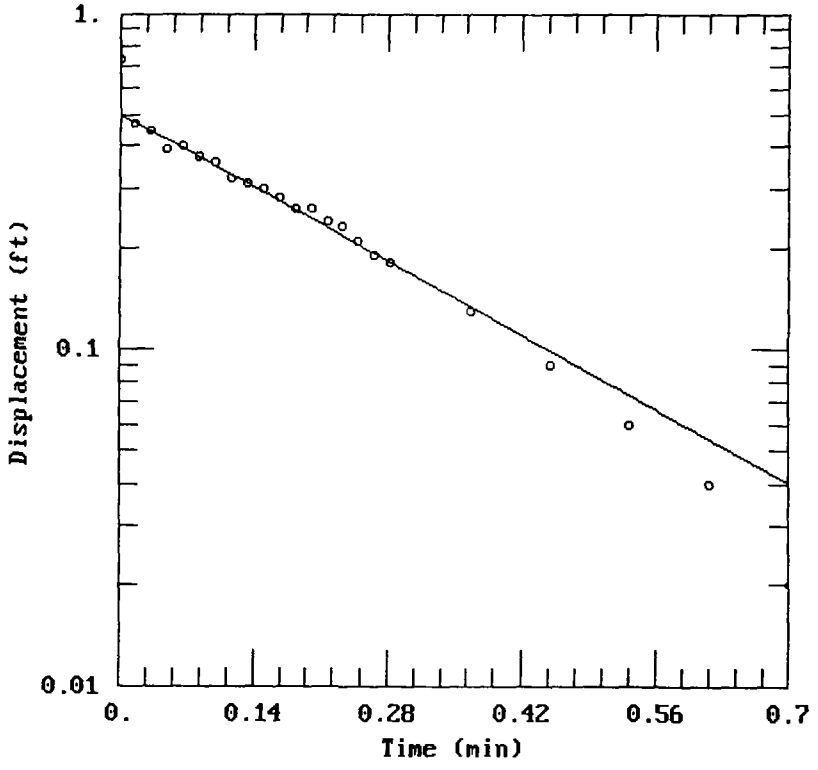

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>
```

CLIENT: Olin, Wilmington, MA

COMPANY: BCM/SMITH

PROJECT: 00-7074-0102

OLIN SLUG TESTS, GW73D TEST 1



DATA SET:
GW73D-1.DAT
01/19/96

AQUIFER MODEL:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 0.73 ft
r_c= 0.083 ft
r_w= 0.33 ft
L = 3.5 ft
b = 42.8 ft
H = 42.8 ft

PARAMETER ESTIMATES:
K = 0.05508 ft/min
y0 = 0.5016 ft

AQTESOLV

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<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

                         A Q T E S O L V    R E S U L T S
                                  Version 2.01

                          Developed by Glenn M. Duffield
                       (c) 1988-1995  Geraghty & Miller, Inc.

09/01/95                                                                15:00:45

================================================================================
                                TEST DESCRIPTION

Data set........... GW73D-1.DAT
Output file........ GW73D-1.OUT
Data set title..... OLIN SLUG TESTS, GW73D TEST 1
Company............ BCM/SMITH
Project............ 00-7074-0102
Client............. Olin, Wilmington, MA
Test date.......... August 1995
Obs. well.......... GW-73-D

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 0.73
   Radius of well casing............ 0.083
   Radius of wellbore............... 0.33
   Aquifer saturated thickness...... 42.8
   Well screen length............... 3.5
   Static height of water in well... 42.8
   Gravel pack porosity............. 0.3
   Effective well casing radius..... 0.1936
   Effective wellbore radius........ 0.33
   Log(Re/Rw)....................... 2.857
   Constants A, B and C............. 0.000 ,   0.000,   1.315
   No. of observations.............. 22

================================================================================
                               ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

================================================================================
                      RESULTS FROM STATISTICAL CURVE MATCHING


STATISTICAL MATCH PARAMETER ESTIMATES

           Estimate         Std. Error
   K  =   5.5083E-002 +/-   1.4985E-003 ft/min
   y0 =   5.0162E-001 +/-   7.0239E-003 ft


ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated
```

```
weighted residual = residual * weight

Weighted Residual Statistics:
   Number of residuals............... 22
   Number of estimated parameters.... 2
   Degrees of freedom................ 20
   Residual mean..................... -0.001321
   Residual standard deviation....... 0.01153
   Residual variance................. 0.000133


Model Residuals:

     Time          Observed       Calculated       Residual         Weight
 -------------  -------------  -------------  -------------  -------------
       0.0166           0.47        0.47252     -0.0025166              1
       0.0333           0.45        0.44495      0.0050547              1
         0.05           0.39        0.41898      -0.028983              1
       0.0666            0.4        0.39468      0.0053228              1
       0.0833           0.37        0.37165     -0.0016478              1
          0.1           0.36        0.34996       0.010038              1
       0.1166           0.32        0.32966     -0.0096606              1
       0.1333           0.31        0.31042    -0.00042496              1
         0.15            0.3        0.29231      0.0076883              1
       0.1666           0.28        0.27535      0.0046455              1
       0.1833           0.26        0.25929     0.00071245              1
          0.2           0.26        0.24416       0.015842              1
       0.2166           0.24        0.22999       0.010006              1
       0.2333           0.23        0.21657       0.013426              1
         0.25           0.21        0.20394      0.0060629              1
       0.2666           0.19        0.19211     -0.0021065              1
       0.2833           0.18         0.1809    -0.00089714              1
       0.3667           0.13        0.13398     -0.0039787              1
         0.45           0.09       0.099265      -0.009265              1
       0.5333           0.06       0.073546      -0.013546              1
       0.6167           0.04        0.05447       -0.01447              1
          0.7           0.02       0.040357      -0.020357              1

================================================================================
                       RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

          Estimate
   K  =   5.5083E-002 ft/min
   y0 =   5.0162E-001 ft

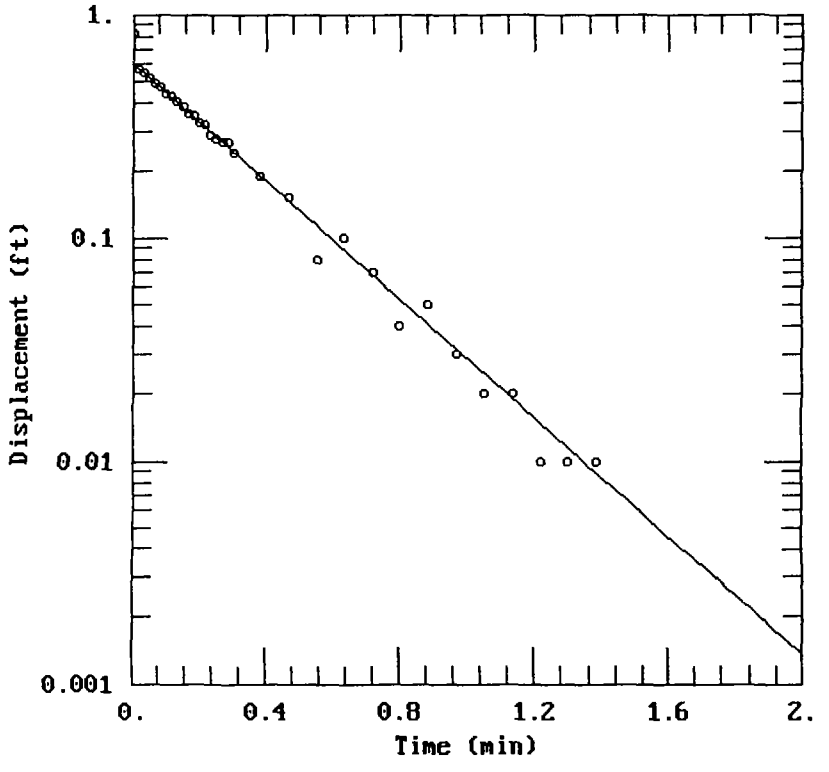

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>
```

CLIENT: Olin, Wilmington, MA

COMPANY: BCM/SMITH

PROJECT: 00-7074-0102

OLIN SLUG TESTS, GW73D TEST 2



DATA SET:
GW73D-2.DAT
01/19/96

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 0.82 ft
r_c= 0.083 ft
r_w= 0.33 ft
L = 3.5 ft
b = 42.8 ft
H = 42.8 ft

PARAMETER ESTIMATES:
K = 0.04673 ft/min
y0 = 0.6064 ft

AQTESOLV

```
<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>

                         A Q T E S O L V   R E S U L T S
                                  Version 2.01

                          Developed by Glenn M. Duffield
                      (c) 1988-1995  Geraghty & Miller, Inc.

09/01/95                                                                15:02:27

================================================================================
                                TEST DESCRIPTION

Data set........... GW73D-2.DAT
Output file........ GW73D-2.OUT
Data set title..... OLIN SLUG TESTS, GW73D TEST 2
Company............ BCM/SMITH
Project............ 00-7074-0102
Client............. Olin, Wilmington, MA
Test date.......... August 1995
Obs. well.......... GW-73-D

Units of Measurement
   Length.......... ft
   Time............ min

Test Well Data
   Initial displacement in well..... 0.82
   Radius of well casing............ 0.083
   Radius of wellbore............... 0.33
   Aquifer saturated thickness...... 42.8
   Well screen length............... 3.5
   Static height of water in well... 42.8
   Gravel pack porosity............. 0.3
   Effective well casing radius..... 0.1936
   Effective wellbore radius........ 0.33
   Log(Re/Rw)....................... 2.857
   Constants A, B and C............. 0.000 ,  0.000,  1.315
   No. of observations.............. 31

================================================================================
                               ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

================================================================================
                     RESULTS FROM STATISTICAL CURVE MATCHING


STATISTICAL MATCH PARAMETER ESTIMATES

           Estimate         Std. Error
   K  =   4.6731E-002 +/-   7.2443E-004 ft/min
   y0 =   6.0640E-001 +/-   4.7307E-003 ft


ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated
```

```
weighted residual = residual * weight

Weighted Residual Statistics:
   Number of residuals............... 31
   Number of estimated parameters.... 2
   Degrees of freedom................ 29
   Residual mean..................... -0.0004277
   Residual standard deviation....... 0.008634
   Residual variance................. 7.454E-005


Model Residuals:

     Time          Observed      Calculated      Residual        Weight
 -------------  -------------  -------------  -------------  -------------
       0.0167           0.57        0.57625     -0.0062457              1
       0.0333           0.55        0.54776      0.0022422              1
         0.05           0.52        0.52052    -0.00051938              1
       0.0667           0.49        0.49464     -0.0046354              1
       0.0833           0.47        0.47018    -0.00018215              1
          0.1           0.44         0.4468     -0.0068013              1
       0.1167           0.43        0.42458      0.0054169              1
       0.1333           0.41        0.40359       0.006407              1
         0.15           0.39        0.38352      0.0064765              1
       0.1667           0.36        0.36445     -0.0044519              1
       0.1833           0.35        0.34643      0.0035655              1
          0.2           0.33        0.32921     0.00079268              1
       0.2167           0.32        0.31284      0.0071632              1
       0.2333           0.29        0.29737     -0.0073711              1
         0.25           0.28        0.28258     -0.0025836              1
       0.2667           0.27        0.26853      0.0014685              1
       0.2833           0.27        0.25526       0.014744              1
          0.3           0.24        0.24256      -0.002563              1
       0.3834           0.19        0.18802      0.0019823              1
       0.4667           0.15        0.14578      0.0042175              1
         0.55           0.08        0.11303      -0.033035              1
       0.6334            0.1       0.087617       0.012383              1
       0.7167           0.07       0.067935      0.0020651              1
          0.8           0.04       0.052674      -0.012674              1
       0.8834           0.05       0.040829      0.0091705              1
       0.9667           0.03       0.031658     -0.0016578              1
         1.05           0.02       0.024546     -0.0045464              1
       1.1334           0.02       0.019027     0.00097338              1
       1.2167           0.01       0.014753     -0.0047526              1
          1.3           0.01       0.011439     -0.0014387              1
       1.3833           0.01      0.0088691      0.0011309              1

===============================================================================
                       RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

          Estimate
   K  =   4.6731E-002 ft/min
   y0 =   6.0640E-001 ft


<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>
```

Olin, Wilmington, MA
Slug Test Data

GW-73D		GW-73S	
SE1000B		SE1000B	
Environmental Logger		Environmental Logger	
08/23 13:57		08/23 13:56	
Unit# 00000 Test# 5		Unit# 00000 Test# 5	
INPUT 2: Level (M)		INPUT 1: Level (M)	
Reference	69.02	Reference	68.63
Scale factor	19.75	Scale factor	19.94
Offset	0.00	Offset	0.00
Step# 0 08/23 12:21		Step# 0 08/23 12:21	
Elapsed Time	Value	Elapsed Time	Value
0	69.04	0	68.61
0.0033	69.05	0.0033	68.61
0.0066	69.04	0.0066	68.61
0.0099	69.04	0.0099	68.63
0.0133	69.05	0.0133	68.62
0.0166	69.05	0.0166	68.61
0.02	69.04	0.02	68.61
0.0233	69.03	0.0233	68.61
0.0266	69.07	0.0266	68.62
0.03	69.31	0.03	68.61
0.0333	69.33	0.0333	68.61
0.05	69.77	0.05	68.61
0.0666	69.51	0.0666	68.61
0.0833	69.49	0.0833	68.63
0.1	69.43	0.1	68.61
0.1166	69.44	0.1166	68.6
0.1333	69.41	0.1333	68.61
0.15	69.4	0.15	69
0.1666	69.36	0.1666	68.9
0.1833	69.35	0.1833	68.68
0.2	69.34	0.2	68.65
0.2166	69.32	0.2166	68.63
0.2333	69.3	0.2333	68.63
0.25	69.3	0.25	68.58
0.2666	69.28	0.2666	68.61
0.2833	69.27	0.2833	68.62
0.3	69.25	0.3	68.65
0.3166	69.23	0.3166	68.61
0.3333	69.22	0.3333	68.61
0.4167	69.17	0.4167	68.62
0.5	69.13	0.5	68.61
0.5833	69.1	0.5833	68.61
0.6667	69.08	0.6667	68.61
0.75	69.06	0.75	68.62
0.8333	69.08	0.8333	68.62
0.9167	69.03	0.9167	68.61
1	69.03	1	68.62
1.0833	69.03	1.0833	68.61
1.1667	69.02	1.1667	68.61
1.25	69.02	1.25	68.61
1.3333	69.02	1.3333	68.61
1.4166	69.02	1.4166	68.62
1.5	69.02	1.5	68.62
1.5833	69.02	1.5833	68.61
1.6667	69.02	1.6667	68.61
1.75	69.02	1.75	68.61
1.8333	69.02	1.8333	68.61
1.9167	69.02	1.9167	68.61
2	69.02	2	68.63
2.5	69.03	2.5	68.61
3	69.03	3	68.61
3.5	69.03	3.5	68.61
4	69.03	4	68.61
4.5	69.03	4.5	68.61
5	69.03	5	68.62
5.5	69.03	5.5	68.61
END		END	

Olin, Wilmington, MA
Slug Test Data

GW-73D

SE1000B
Environmental Logger
08/23 14:00

Unit# 00000 Test# 7

INPUT 2: Level (M)

Reference 69.02
Scale factor 19.75
Offset 0.00

Step# 0 08/23 12:35

Elapsed Time	Value
0	69.02
0.0033	69.04
0.0066	69.04
0.0099	69.05
0.0133	69.04
0.0166	69.05
0.02	69.05
0.0233	69.05
0.0266	68.78
0.03	68.34
0.0333	68.2
0.05	68.45
0.0666	68.47
0.0833	68.5
0.1	68.53
0.1166	68.55
0.1333	68.58
0.15	68.59
0.1666	68.61
0.1833	68.63
0.2	68.66
0.2166	68.67
0.2333	68.69
0.25	68.7
0.2666	68.73
0.2833	68.74

GW-73S

SE1000B
Environmental Logger
08/23 13:58

Unit# 00000 Test# 6

INPUT 1: Level (M)

Reference 68.63
Scale factor 19.94
Offset 0.00

Step# 0 08/23 12:27

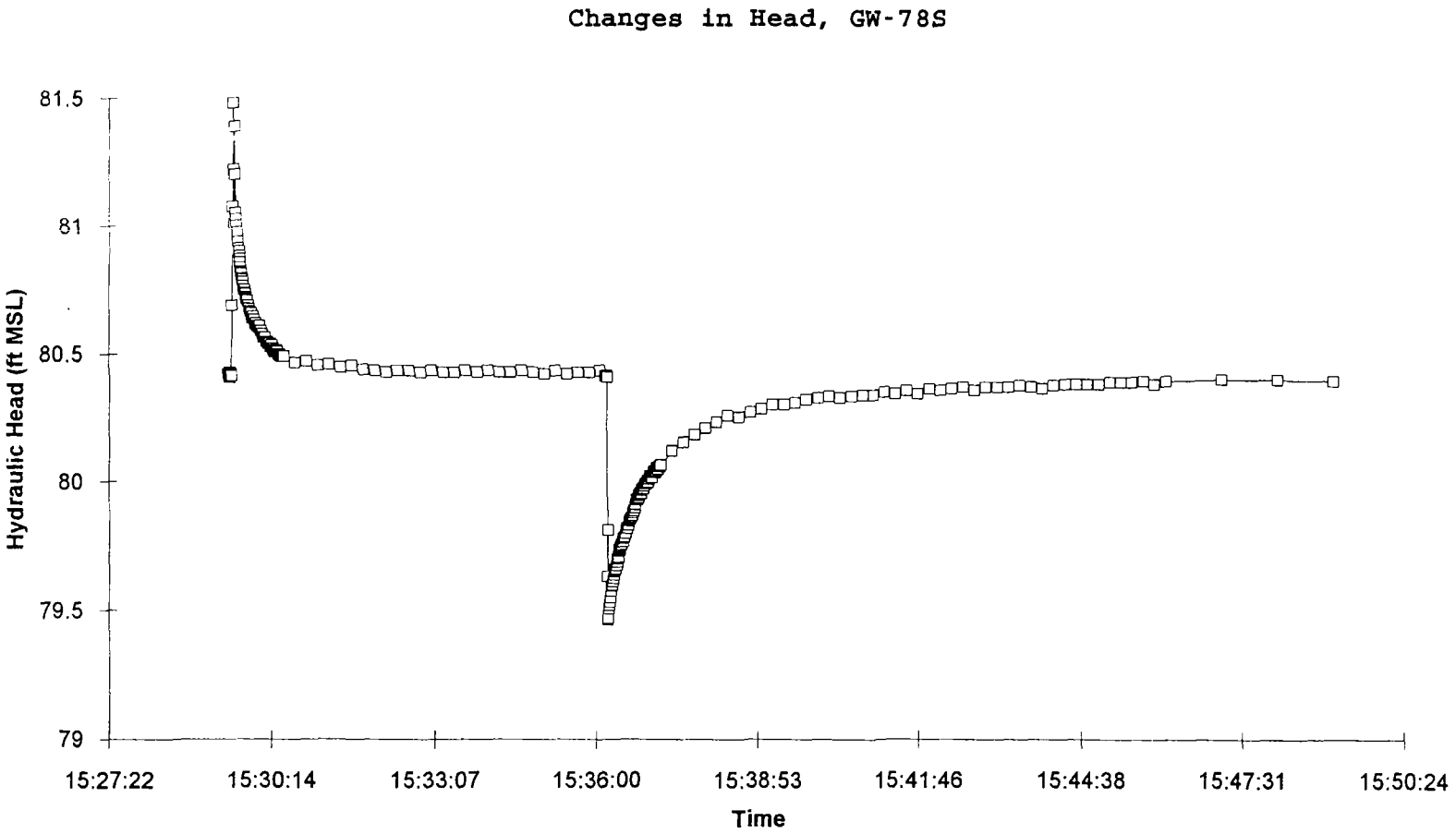
Elapsed Time	Value
0	68.61
0.0033	68.63
0.0066	68.62
0.0099	68.62
0.0133	68.63
0.0166	68.61
0.02	68.62
0.0233	68.61
0.0266	68.62
0.03	68.62
0.0333	68.36
0.05	68.26
0.0666	68.63
0.0833	68.61
0.1	68.61
0.1166	68.61
0.1333	68.61
0.15	68.61
0.1666	68.61
0.1833	68.62
0.2	68.62
0.2166	68.61
0.2333	68.62
0.25	68.61
0.2666	68.61
0.2833	68.61

GW-73D

0.3	68.75	
0.3166	68.75	
0.3333	68.78	
0.4167	68.83	
0.5	68.87	
0.5833	68.94	
0.6667	68.92	
0.75	68.95	
0.8333	68.98	
0.9167	68.97	
1	68.99	
1.0833	69	
1.1667	69	
1.25	69.01	
1.3333	69.01	
1.4166	69.01	
1.5	69.02	
1.5833	69.02	
1.6667	69.03	
1.75	69.02	
1.8333	69.02	
1.9167	69.02	
2	69.02	
2.5	69.02	
3	69.02	
3.5	69.04	
END		

GW-73S

0.3	68.61
0.3166	68.6
0.3333	68.61
0.4167	68.61
0.5	68.61
0.5833	68.61
0.6667	68.61
0.75	68.62
0.8333	68.61
0.9167	68.61
1	68.62
1.0833	68.62
1.1667	68.62
1.25	68.61
1.3333	68.61
1.4166	68.62
1.5	68.62
1.5833	68.61
1.6667	68.61
1.75	68.62
1.8333	68.63
1.9167	68.61
2	68.61
2.5	68.61
3	68.61
3.5	68.64
4	68.62
4.5	68.61
5	68.62
5.5	68.61
6	68.61
END	



Time	Elapsed Time	Head	GW Elevation					
Time	Elapsed Time	Head	GW Elevation					
						SE2000		
15:29:28	0	-4.448	80.422			Environmental Logger		
15:29:28	0.0083	-4.448	80.422			02/19 06:12		
15:29:29	0.0166	-4.454	80.416					
15:29:30	0.025	-4.448	80.422			Unit# 2K-125	Test 2	
15:29:30	0.0333	-4.461	80.409					
15:29:30	0.0416	-4.442	80.428			Setups:	INPUT 1	
15:29:31	0.05	-4.448	80.422					
15:29:31	0.0583	-4.448	80.422			Type	Level (F)	
15:29:32	0.0666	-4.454	80.416			Mode	Surface	
15:29:32	0.075	-4.18	80.69			I.D.	79S	
15:29:33	0.0833	-3.794	81.076					
15:29:33	0.0916	-3.388	81.482			Reference	-4.430	
15:29:34	0.1	-3.65	81.22			PSI at Ref.	2.345	
15:29:34	0.1083	-3.862	81.008			SG	1.000	
15:29:35	0.1166	-3.482	81.388			Linearity	0.000	
15:29:35	0.125	-3.669	81.201			Scale factor	19.754	
15:29:36	0.1333	-3.819	81.051			Offset	-0.046	
15:29:36	0.1416	-3.843	81.027			Delay mSEC	50.000	
15:29:37	0.15	-3.868	81.002					
15:29:37	0.1583	-3.893	80.977			Step 0	18-Feb	15:29:28
15:29:38	0.1666	-3.906	80.964					
15:29:38	0.175	-3.931	80.939					
15:29:39	0.1833	-3.956	80.914					
15:29:39	0.1916	-3.968	80.902					
15:29:40	0.2	-3.987	80.883					
15:29:40	0.2083	-3.999	80.871					
15:29:41	0.2166	-4.012	80.858					
15:29:42	0.225	-4.031	80.839					
15:29:42	0.2333	-4.049	80.821					
15:29:42	0.2416	-4.055	80.815					
15:29:43	0.25	-4.074	80.796					
15:29:43	0.2583	-4.08	80.79					
15:29:44	0.2666	-4.087	80.783					
15:29:45	0.275	-4.105	80.765					
15:29:45	0.2833	-4.118	80.752					
15:29:45	0.2916	-4.118	80.752					
15:29:46	0.3	-4.118	80.752					
15:29:46	0.3083	-4.13	80.74					
15:29:47	0.3166	-4.136	80.734					
15:29:47	0.325	-4.149	80.721					
15:29:48	0.3333	-4.155	80.715					
15:29:49	0.35	-4.161	80.709					
15:29:50	0.3666	-4.18	80.69					
15:29:51	0.3833	-4.193	80.677					
15:29:52	0.4	-4.205	80.665					
15:29:53	0.4166	-4.211	80.659					
15:29:54	0.4333	-4.23	80.64					
15:29:55	0.45	-4.224	80.646					
15:29:56	0.4666	-4.236	80.634					
15:29:57	0.4833	-4.255	80.615					
15:29:58	0.5	-4.249	80.621					
15:29:59	0.5166	-4.261	80.609					
15:30:00	0.5333	-4.261	80.609					
15:30:01	0.55	-4.267	80.603					
15:30:02	0.5666	-4.261	80.609					
15:30:03	0.5833	-4.28	80.59					
15:30:04	0.6	-4.28	80.59					
15:30:05	0.6166	-4.292	80.578					
15:30:06	0.6333	-4.305	80.565					
15:30:07	0.65	-4.305	80.565					
15:30:08	0.6666	-4.305	80.565					
15:30:09	0.6833	-4.324	80.546					

	Elapsed		GW
Time	Time	Head	Elevation
15:30:10	0.7	-4.324	80.546
15:30:11	0.7166	-4.33	80.54
15:30:12	0.7333	-4.33	80.54
15:30:13	0.75	-4.33	80.54
15:30:14	0.7666	-4.342	80.528
15:30:15	0.7833	-4.336	80.534
15:30:16	0.8	-4.348	80.522
15:30:17	0.8166	-4.355	80.515
15:30:18	0.8333	-4.361	80.509
15:30:19	0.85	-4.355	80.515
15:30:20	0.8666	-4.355	80.515
15:30:21	0.8833	-4.361	80.509
15:30:22	0.9	-4.373	80.497
15:30:23	0.9166	-4.373	80.497
15:30:24	0.9333	-4.38	80.49
15:30:25	0.95	-4.38	80.49
15:30:26	0.9666	-4.38	80.49
15:30:27	0.9833	-4.38	80.49
15:30:28	1	-4.38	80.49
15:30:40	1.2	-4.405	80.465
15:30:52	1.4	-4.398	80.472
15:31:04	1.6	-4.417	80.453
15:31:16	1.8	-4.411	80.459
15:31:28	2	-4.423	80.447
15:31:40	2.2	-4.417	80.453
15:31:52	2.4	-4.43	80.44
15:32:04	2.6	-4.436	80.434
15:32:16	2.8	-4.442	80.428
15:32:28	3	-4.436	80.434
15:32:40	3.2	-4.436	80.434
15:32:52	3.4	-4.442	80.428
15:33:04	3.6	-4.436	80.434
15:33:16	3.8	-4.442	80.428
15:33:28	4	-4.442	80.428
15:33:40	4.2	-4.436	80.434
15:33:52	4.4	-4.442	80.428
15:34:04	4.6	-4.436	80.434
15:34:16	4.8	-4.442	80.428
15:34:28	5	-4.442	80.428
15:34:40	5.2	-4.436	80.434
15:34:52	5.4	-4.442	80.428
15:35:04	5.6	-4.448	80.422
15:35:16	5.8	-4.436	80.434
15:35:28	6	-4.448	80.422
15:35:40	6.2	-4.442	80.428
15:35:52	6.4	-4.442	80.428
15:36:04	6.6	-4.436	80.434

Time	Elapsed Time	Head	GW Elevation				
15:36:09	0	-4.454	80.416		SE2000		
15:36:09	0.0083	-4.454	80.416		Environmental Logger		
15:36:10	0.0166	-4.454	80.416		02/19 06:13		
15:36:10	0.025	-4.454	80.416				
15:36:11	0.0333	-4.461	80.409		Unit# 2K-125 Test 2		
15:36:11	0.0416	-5.24	79.63				
15:36:12	0.05	-5.059	79.811		Setups: INPUT 1		
15:36:12	0.0583	-5.408	79.462		--- ---		
15:36:13	0.0666	-5.402	79.468		Type Level (F)		
15:36:14	0.075	-5.365	79.505		Mode Surface		
15:36:14	0.0833	-5.352	79.518		I.D. 79S		
15:36:14	0.0916	-5.34	79.53				
15:36:15	0.1	-5.321	79.549		Reference -4.430		
15:36:15	0.1083	-5.296	79.574		PSI at Ref. 2.345		
15:36:16	0.1166	-5.277	79.593		SG 1.000		
15:36:16	0.125	-5.277	79.593		Linearity 0.000		
15:36:17	0.1333	-5.271	79.599		Scale factor 19.754		
15:36:17	0.1416	-5.259	79.611		Offset -0.046		
15:36:18	0.15	-5.246	79.624		Delay mSEC 50.000		
15:36:18	0.1583	-5.234	79.636				
15:36:19	0.1666	-5.215	79.655		Step 1	35479	0.65010417
15:36:19	0.175	-5.221	79.649				
15:36:20	0.1833	-5.215	79.655		Elapsed Time INPUT 1		
15:36:20	0.1916	-5.209	79.661		--- ---		
15:36:21	0.2	-5.196	79.674				
15:36:21	0.2083	-5.196	79.674				
15:36:22	0.2166	-5.184	79.686				
15:36:22	0.225	-5.171	79.699				
15:36:23	0.2333	-5.171	79.699				
15:36:23	0.2416	-5.165	79.705				
15:36:24	0.25	-5.134	79.736				
15:36:24	0.2583	-5.14	79.73				
15:36:25	0.2666	-5.134	79.736				
15:36:25	0.275	-5.128	79.742				
15:36:26	0.2833	-5.121	79.749				
15:36:26	0.2916	-5.115	79.755				
15:36:27	0.3	-5.115	79.755				
15:36:27	0.3083	-5.103	79.767				
15:36:28	0.3166	-5.09	79.78				
15:36:28	0.325	-5.103	79.767				
15:36:29	0.3333	-5.09	79.78				
15:36:30	0.35	-5.084	79.786				
15:36:31	0.3666	-5.072	79.798				
15:36:32	0.3833	-5.053	79.817				
15:36:33	0.4	-5.053	79.817				
15:36:34	0.4166	-5.04	79.83				
15:36:35	0.4333	-5.022	79.848				
15:36:36	0.45	-5.016	79.854				
15:36:37	0.4666	-5.009	79.861				
15:36:38	0.4833	-5.003	79.867				
15:36:39	0.5	-4.991	79.879				
15:36:40	0.5166	-4.984	79.886				
15:36:41	0.5333	-4.972	79.898				
15:36:42	0.55	-4.959	79.911				
15:36:43	0.5666	-4.941	79.929				
15:36:44	0.5833	-4.941	79.929				
15:36:45	0.6	-4.934	79.936				
15:36:46	0.6166	-4.922	79.948				
15:36:47	0.6333	-4.916	79.954				
15:36:48	0.65	-4.916	79.954				
15:36:49	0.6666	-4.903	79.967				
15:36:50	0.6833	-4.897	79.973				
15:36:51	0.7	-4.897	79.973				
15:36:52	0.7166	-4.885	79.985				
15:36:53	0.7333	-4.878	79.992				

	Elapsed		GW					
Time	Time	Head	Elevation					
15:36:54	0.75	-4.978	79.992					
15:36:55	0.7666	-4.866	80.004					
15:36:56	0.7833	-4.872	79.998					
15:36:57	0.8	-4.86	80.01					
15:36:58	0.8166	-4.847	80.023					
15:36:59	0.8333	-4.853	80.017					
15:37:00	0.85	-4.853	80.017					
15:37:01	0.8666	-4.835	80.035					
15:37:02	0.8833	-4.828	80.042					
15:37:03	0.9	-4.835	80.035					
15:37:04	0.9166	-4.828	80.042					
15:37:05	0.9333	-4.816	80.054					
15:37:06	0.95	-4.822	80.048					
15:37:07	0.9666	-4.81	80.06					
15:37:08	0.9833	-4.81	80.06					
15:37:09	1	-4.904	80.066					
15:37:21	1.2	-4.747	80.123					
15:37:33	1.4	-4.716	80.154					
15:37:45	1.6	-4.685	80.185					
15:37:57	1.8	-4.66	80.21					
15:38:09	2	-4.635	80.235					
15:38:21	2.2	-4.61	80.26					
15:38:33	2.4	-4.617	80.253					
15:38:45	2.6	-4.598	80.272					
15:38:57	2.8	-4.585	80.285					
15:39:09	3	-4.567	80.303					
15:39:21	3.2	-4.567	80.303					
15:39:33	3.4	-4.56	80.31					
15:39:45	3.6	-4.548	80.322					
15:39:57	3.8	-4.542	80.328					
15:40:09	4	-4.535	80.335					
15:40:21	4.2	-4.542	80.328					
15:40:33	4.4	-4.535	80.335					
15:40:45	4.6	-4.529	80.341					
15:40:57	4.8	-4.529	80.341					
15:41:09	5	-4.517	80.353					
15:41:21	5.2	-4.523	80.347					
15:41:33	5.4	-4.511	80.359					
15:41:45	5.6	-4.523	80.347					
15:41:57	5.8	-4.504	80.366					
15:42:09	6	-4.511	80.359					
15:42:21	6.2	-4.504	80.366					
15:42:33	6.4	-4.498	80.372					
15:42:45	6.6	-4.511	80.359					
15:42:57	6.8	-4.498	80.372					
15:43:09	7	-4.498	80.372					
15:43:21	7.2	-4.498	80.372					
15:43:33	7.4	-4.492	80.378					
15:43:45	7.6	-4.498	80.372					
15:43:57	7.8	-4.504	80.366					
15:44:09	8	-4.492	80.378					
15:44:21	8.2	-4.486	80.384					
15:44:33	8.4	-4.486	80.384					
15:44:45	8.6	-4.486	80.384					
15:44:57	8.8	-4.486	80.384					
15:45:09	9	-4.479	80.391					
15:45:21	9.2	-4.479	80.391					
15:45:33	9.4	-4.479	80.391					
15:45:45	9.6	-4.473	80.397					
15:45:57	9.8	-4.486	80.384					
15:46:09	10	-4.473	80.397					
15:47:09	11	-4.467	80.403					
15:48:09	12	-4.467	80.403					
15:49:09	13	-4.473	80.397					

AQTESOLV RESULTS
Version 2.01

Developed by Glenn M. Duffield
(c) 1988-1995 Geraghty & Miller, Inc.

3/12/97 12:11

TEST DESCRIPTION

Data set..... 78S_IN.DAT
Output file..... 78SIN.OUT
Data set title..... Positive Displacement Slug Test - GW-78S
Company..... Smith Technology
Project..... 00-7074-0102
Client..... Olin Corporation

Units of Measurement
Length..... ft
Time..... min

Test Well Data
Initial displacement in well..... 0.98
Radius of well casing..... 0.0833
Radius of wellbore..... 0.167
Aquifer saturated thickness..... 9
Well screen length..... 9
Static height of water in well... 9
Gravel pack porosity..... 0.3
Effective well casing radius..... 0.115
Effective wellbore radius..... 0.167
Log(Re/Rw)..... 3.054
Constants A, B and C..... 0.000 , 0.000, 2.776
No. of observations..... 95

==========

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

==========

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

	Estimate
K =	1.2900E+001 ft/day
y0 =	7.1461E-001 ft

AQTESOLV RESULTS
Version 2.01

Developed by Glenn M. Duffield
(c) 1988-1995 Geraghty & Miller, Inc.

3/12/97 13:28

TEST DESCRIPTION

Data set..... 78S_OUT.DAT
Output file..... 78SOUT.OUT
Data set title..... Negative Displacement Slug Test - GW-78S
Company..... Smith Technology
Project..... 00-7074-0102
Client..... Olin Corporation

Units of Measurement
Length..... ft
Time..... min

Test Well Data
Initial displacement in well.. .. 1.06
Radius of well casing..... 0.0833
Radius of wellbore..... 0.167
Aquifer saturated thickness..... 9
Well screen length..... 9
Static height of water in well... 9
Gravel pack porosity..... 0.3
Effective well casing radius.... 0.115
Effective wellbore radius..... 0.167
Log(Re/Rw)..... 3.054
Constants A, B and C..... 0.000 , 0.000, 2.776
No. of observations..... 121

==========

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

==========

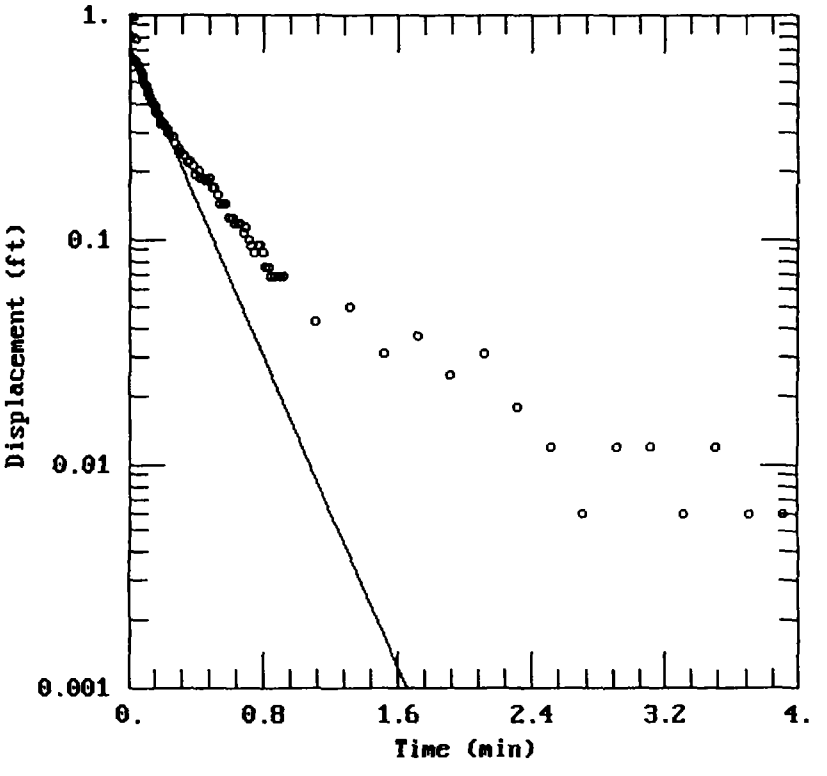
RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

	Estimate
K =	4.0138E+000 ft/day
y0 =	8.9268E-001 ft

CLIENT: Olin Corporation	COMPANY: Smith Technology
	PROJECT: 00-7074-0102

Positive Displacement Slug Test - GW-78S



DATA SET:
78S_IN.DAT
03/12/97

AQUIFER MODEL:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

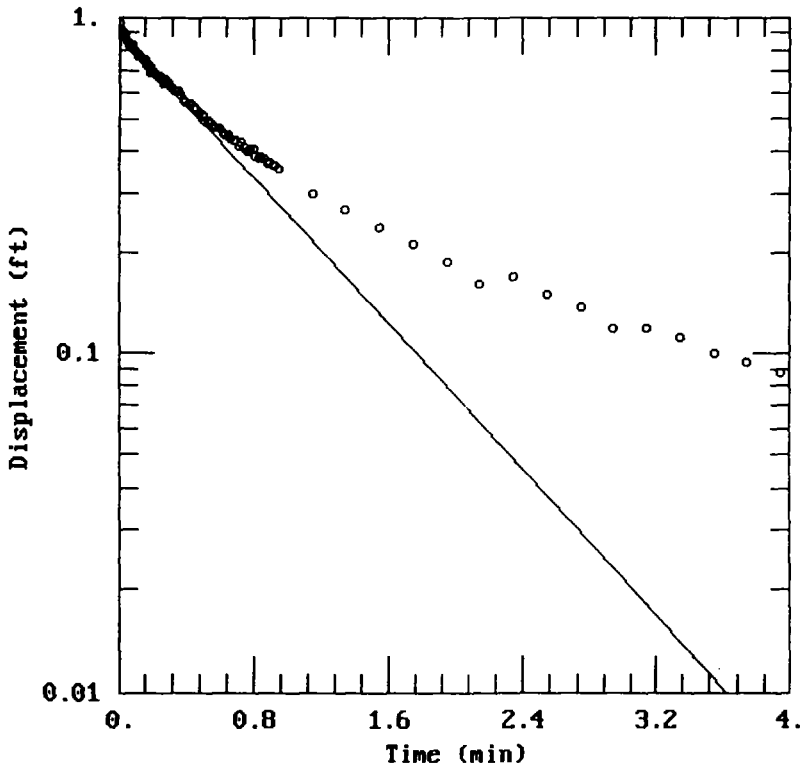
TEST DATA:
H0= 0.98 ft
r_c= 0.0833 ft
r_w= 0.167 ft
L = 9. ft
b = 9. ft
H = 9. ft

PARAMETER ESTIMATES:
K = 12.9 ft/day
y0 = 0.7146 ft

AQTESOLV

CLIENT: Olin Corporation	COMPANY: Smith Technology
	PROJECT: 00-7074-0102

Negative Displacement Slug Test - GW-78S



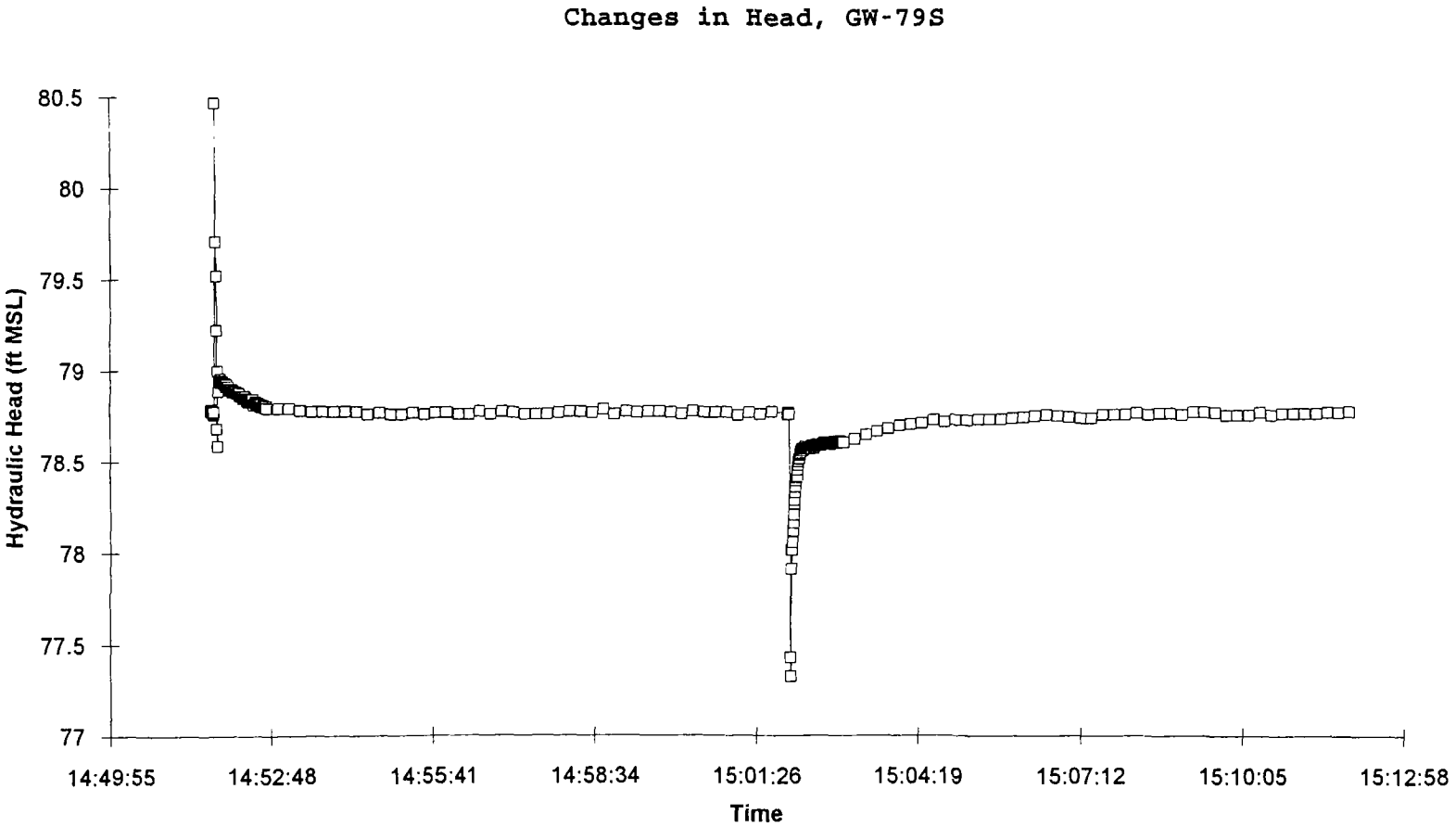
DATA SET:
78S_OUT.DAT
03/12/97

AQUIFER MODEL:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 1.06 ft
r_c= 0.0833 ft
r_w= 0.167 ft
L = 9. ft
b = 9. ft
H = 9. ft

PARAMETER ESTIMATES:
K = 4.014 ft/day
y0 = 0.8927 ft

AQTESOLV



SLUG79S.XLS

Time	Elapsed Time	Head	GW Elevation				
14:51:44	0	-2.612	78.778				
14:51:44	0.0083	-2.606	78.784			SE2000	
14:51:45	0.0166	-2.612	78.778			Environmental Logger	
14:51:45	0.025	-2.618	78.772			02/19 06:07	
14:51:46	0.0333	-2.618	78.772				
14:51:46	0.0416	-2.618	78.772			Unit# 2K-125	Test 1
14:51:47	0.05	-2.631	78.759				
14:51:47	0.0583	-2.624	78.766			Setups:	INPUT 1
14:51:48	0.0666	-2.618	78.772				
14:51:48	0.075	-0.923	80.467			Type	Level (F)
14:51:49	0.0833	-1.683	79.707			Mode	Surface
14:51:49	0.0916	-1.87	79.52			I.D.	79S
14:51:50	0.1	-2.169	79.221				
14:51:50	0.1083	-2.712	78.678			Reference	-2.600
14:51:51	0.1166	-2.805	78.585			PSI at Ref.	3.561
14:51:52	0.125	-2.394	78.996			SG	1.000
14:51:52	0.1333	-2.506	78.884			Linearity	0.000
14:51:52	0.1416	-2.444	78.946			Scale factor	19.754
14:51:53	0.15	-2.444	78.946			Offset	-0.046
14:51:53	0.1583	-2.45	78.94			Delay mSEC	50.000
14:51:54	0.1666	-2.456	78.934				
14:51:54	0.175	-2.437	78.953			Step 0	18-Feb
14:51:55	0.1833	-2.444	78.946				
14:51:55	0.1916	-2.45	78.94				
14:51:56	0.2	-2.45	78.94				
14:51:56	0.2083	-2.45	78.94				
14:51:57	0.2166	-2.456	78.934				
14:51:57	0.225	-2.462	78.928				
14:51:58	0.2333	-2.462	78.928				
14:51:58	0.2416	-2.462	78.928				
14:51:59	0.25	-2.469	78.921				
14:51:59	0.2583	-2.462	78.928				
14:52:00	0.2666	-2.481	78.909				
14:52:00	0.275	-2.469	78.921				
14:52:01	0.2833	-2.469	78.921				
14:52:01	0.2916	-2.481	78.909				
14:52:02	0.3	-2.481	78.909				
14:52:02	0.3083	-2.481	78.909				
14:52:03	0.3166	-2.494	78.896				
14:52:04	0.325	-2.5	78.89				
14:52:04	0.3333	-2.494	78.896				
14:52:05	0.35	-2.5	78.89				
14:52:06	0.3666	-2.494	78.896				
14:52:07	0.3833	-2.512	78.878				
14:52:08	0.4	-2.5	78.89				
14:52:09	0.4166	-2.506	78.884				
14:52:10	0.4333	-2.512	78.878				
14:52:11	0.45	-2.506	78.884				
14:52:12	0.4666	-2.518	78.872				
14:52:13	0.4833	-2.512	78.878				
14:52:14	0.5	-2.518	78.872				
14:52:15	0.5166	-2.531	78.859				
14:52:16	0.5333	-2.531	78.859				
14:52:17	0.55	-2.537	78.853				
14:52:18	0.5666	-2.531	78.859				
14:52:19	0.5833	-2.543	78.847				
14:52:20	0.6	-2.531	78.859				
14:52:21	0.6166	-2.543	78.847				
14:52:22	0.6333	-2.543	78.847				
14:52:23	0.65	-2.55	78.84				
14:52:24	0.6666	-2.556	78.834				
14:52:25	0.6833	-2.562	78.828				
14:52:26	0.7	-2.556	78.834				
14:52:27	0.7166	-2.556	78.834				

Time	Elapsed Time	Head	GW Elevation
14:52:28	0.7333	-2.562	78.828
14:52:29	0.75	-2.55	78.84
14:52:30	0.7666	-2.575	78.815
14:52:31	0.7833	-2.581	78.809
14:52:32	0.8	-2.562	78.828
14:52:33	0.8166	-2.568	78.822
14:52:34	0.8333	-2.581	78.809
14:52:35	0.85	-2.568	78.822
14:52:36	0.8666	-2.575	78.815
14:52:37	0.8833	-2.587	78.803
14:52:38	0.9	-2.575	78.815
14:52:39	0.9166	-2.593	78.797
14:52:40	0.9333	-2.581	78.809
14:52:41	0.95	-2.587	78.803
14:52:42	0.9666	-2.593	78.797
14:52:43	0.9833	-2.587	78.803
14:52:44	1	-2.6	78.79
14:52:56	1.2	-2.6	78.79
14:53:08	1.4	-2.6	78.79
14:53:20	1.6	-2.612	78.778
14:53:32	1.8	-2.618	78.772
14:53:44	2	-2.618	78.772
14:53:56	2.2	-2.618	78.772
14:54:08	2.4	-2.618	78.772
14:54:20	2.6	-2.618	78.772
14:54:32	2.8	-2.631	78.759
14:54:44	3	-2.624	78.766
14:54:56	3.2	-2.631	78.759
14:55:08	3.4	-2.631	78.759
14:55:20	3.6	-2.624	78.766
14:55:32	3.8	-2.631	78.759
14:55:44	4	-2.624	78.766
14:55:56	4.2	-2.624	78.766
14:56:08	4.4	-2.631	78.759
14:56:20	4.6	-2.631	78.759
14:56:32	4.8	-2.618	78.772
14:56:44	5	-2.631	78.759
14:56:56	5.2	-2.618	78.772
14:57:08	5.4	-2.624	78.766
14:57:20	5.6	-2.631	78.759
14:57:32	5.8	-2.631	78.759
14:57:44	6	-2.631	78.759
14:57:56	6.2	-2.624	78.766
14:58:08	6.4	-2.618	78.772
14:58:20	6.6	-2.618	78.772
14:58:32	6.8	-2.624	78.766
14:58:44	7	-2.606	78.784
14:58:56	7.2	-2.631	78.759
14:59:08	7.4	-2.618	78.772
14:59:20	7.6	-2.624	78.766
14:59:32	7.8	-2.618	78.772
14:59:44	8	-2.618	78.772
14:59:56	8.2	-2.624	78.766
15:00:08	8.4	-2.631	78.759
15:00:20	8.6	-2.618	78.772
15:00:32	8.8	-2.624	78.766
15:00:44	9	-2.624	78.766
15:00:56	9.2	-2.624	78.766
15:01:08	9.4	-2.637	78.753
15:01:20	9.6	-2.624	78.766
15:01:32	9.8	-2.631	78.759
15:01:44	10	-2.618	78.772

SLUG79S.XLS

Time	Elapsed Time	Head	GW Elevation				
15:02:01	0	-2.624	78.766				
15:02:01	0.0083	-2.631	78.759		SE2000		
15:02:02	0.0166	-2.624	78.766		Environmental Logger		
15:02:03	0.025	-2.631	78.759		02/19 06:09		
15:02:03	0.0333	-3.965	77.425				
15:02:03	0.0416	-4.065	77.325		Unit# 2K-125	Test 1	
15:02:04	0.05	-3.379	78.011				
15:02:04	0.0583	-3.479	77.911		Setups:	INPUT 1	
15:02:05	0.0666	-3.379	78.011		--------	------	
15:02:06	0.075	-3.335	78.055		Type	Level (F)	
15:02:06	0.0833	-3.273	78.117		Mode	Surface	
15:02:06	0.0916	-3.229	78.161		I.D.	79S	
15:02:07	0.1	-3.186	78.204				
15:02:07	0.1083	-3.123	78.267		Reference	-2.600	
15:02:08	0.1166	-3.104	78.286		PSI at Ref.	3.561	
15:02:08	0.125	-3.061	78.329		SG	1.000	
15:02:09	0.1333	-3.03	78.36		Linearity	0.000	
15:02:09	0.1416	-2.998	78.392		Scale factor	19.754	
15:02:10	0.15	-2.98	78.41		Offset	-0.046	
15:02:10	0.1583	-2.974	78.416		Delay mSEC	50.000	
15:02:11	0.1666	-2.936	78.454				
15:02:12	0.175	-2.911	78.479		Step 1	18-Feb	15:02:01
15:02:12	0.1833	-2.893	78.497				
15:02:12	0.1916	-2.88	78.51		Elapsed Time	INPUT 1	
15:02:13	0.2	-2.874	78.516		--------	------	
15:02:13	0.2083	-2.855	78.535				
15:02:14	0.2166	-2.849	78.541				
15:02:15	0.225	-2.843	78.547				
15:02:15	0.2333	-2.83	78.56				
15:02:15	0.2416	-2.83	78.56				
15:02:16	0.25	-2.824	78.566				
15:02:16	0.2583	-2.83	78.56				
15:02:17	0.2666	-2.824	78.566				
15:02:18	0.275	-2.818	78.572				
15:02:18	0.2833	-2.824	78.566				
15:02:18	0.2916	-2.818	78.572				
15:02:19	0.3	-2.824	78.566				
15:02:19	0.3083	-2.811	78.579				
15:02:20	0.3166	-2.818	78.572				
15:02:20	0.325	-2.818	78.572				
15:02:21	0.3333	-2.818	78.572				
15:02:22	0.35	-2.818	78.572				
15:02:23	0.3666	-2.818	78.572				
15:02:24	0.3833	-2.811	78.579				
15:02:25	0.4	-2.811	78.579				
15:02:26	0.4166	-2.818	78.572				
15:02:27	0.4333	-2.805	78.585				
15:02:28	0.45	-2.805	78.585				
15:02:29	0.4666	-2.818	78.572				
15:02:30	0.4833	-2.811	78.579				
15:02:31	0.5	-2.799	78.591				
15:02:32	0.5166	-2.805	78.585				
15:02:33	0.5333	-2.799	78.591				
15:02:34	0.55	-2.805	78.585				
15:02:35	0.5666	-2.805	78.585				
15:02:36	0.5833	-2.805	78.585				
15:02:37	0.6	-2.799	78.591				
15:02:38	0.6166	-2.799	78.591				
15:02:39	0.6333	-2.793	78.597				
15:02:40	0.65	-2.787	78.603				
15:02:41	0.6666	-2.787	78.603				
15:02:42	0.6833	-2.793	78.597				
15:02:43	0.7	-2.799	78.591				
15:02:44	0.7166	-2.793	78.597				
15:02:45	0.7333	-2.793	78.597				

Time	Elapsed Time	Head	GW Elevation
15:02:46	0.75	-2.793	78.597
15:02:47	0.7666	-2.799	78.591
15:02:48	0.7833	-2.793	78.597
15:02:49	0.8	-2.787	78.603
15:02:50	0.8166	-2.793	78.597
15:02:51	0.8333	-2.787	78.603
15:02:52	0.85	-2.78	78.61
15:02:53	0.8666	-2.787	78.603
15:02:54	0.8833	-2.793	78.597
15:02:55	0.9	-2.787	78.603
15:02:56	0.9166	-2.787	78.603
15:02:57	0.9333	-2.78	78.61
15:02:58	0.95	-2.787	78.603
15:02:59	0.9666	-2.787	78.603
15:03:00	0.9833	-2.787	78.603
15:03:01	1	-2.787	78.603
15:03:13	1.2	-2.768	78.622
15:03:25	1.4	-2.743	78.647
15:03:37	1.6	-2.724	78.666
15:03:49	1.8	-2.712	78.678
15:04:01	2	-2.693	78.697
15:04:13	2.2	-2.687	78.703
15:04:25	2.4	-2.681	78.709
15:04:37	2.6	-2.662	78.728
15:04:49	2.8	-2.674	78.716
15:05:01	3	-2.662	78.728
15:05:13	3.2	-2.662	78.728
15:05:25	3.4	-2.656	78.734
15:05:37	3.6	-2.656	78.734
15:05:49	3.8	-2.656	78.734
15:06:01	4	-2.649	78.741
15:06:13	4.2	-2.643	78.747
15:06:25	4.4	-2.637	78.753
15:06:37	4.6	-2.631	78.759
15:06:49	4.8	-2.637	78.753
15:07:01	5	-2.643	78.747
15:07:13	5.2	-2.649	78.741
15:07:25	5.4	-2.649	78.741
15:07:37	5.6	-2.631	78.759
15:07:49	5.8	-2.631	78.759
15:08:01	6	-2.631	78.759
15:08:13	6.2	-2.624	78.766
15:08:25	6.4	-2.631	78.759
15:08:37	6.6	-2.624	78.766
15:08:49	6.8	-2.624	78.766
15:09:01	7	-2.631	78.759
15:09:13	7.2	-2.618	78.772
15:09:25	7.4	-2.618	78.772
15:09:37	7.6	-2.618	78.772
15:09:49	7.8	-2.631	78.759
15:10:01	8	-2.631	78.759
15:10:13	8.2	-2.631	78.759
15:10:25	8.4	-2.618	78.772
15:10:37	8.6	-2.631	78.759
15:10:49	8.8	-2.624	78.766
15:11:01	9	-2.624	78.766
15:11:13	9.2	-2.624	78.766
15:11:25	9.4	-2.624	78.766
15:11:37	9.6	-2.618	78.772
15:11:49	9.8	-2.618	78.772
15:12:01	10	-2.612	78.778
	END		

AQTESOLV RESULTS
Version 2.01

Developed by Glenn M. Duffield
(c) 1988-1995 Geraghty & Miller, Inc.

3/12/97 13:35

TEST DESCRIPTION

Data set..... 79S_IN.DAT
Output file..... 79SIN.OUT
Data set title..... Positive Displacement Slug Test - GW-79S
Company..... Smith Technology
Project..... 00-7074-0102
Client..... Olin Corporation

Units of Measurement
Length..... ft
Time..... min

Test Well Data
Initial displacement in well..... 1.689
Radius of well casing..... 0.0833
Radius of wellbore..... 0.167
Aquifer saturated thickness..... 10
Well screen length..... 10
Static height of water in well... 10
Gravel pack porosity..... 0.3
Effective well casing radius..... 0.115
Effective wellbore radius..... 0.167
Log(Re/Rw)..... 3.138
Constants A, B and C..... 0.000 , 0.000, 2.985
No. of observations..... 72

==========

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

==========

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

Estimate
K = 6.6468E+000 ft/day
y0 = 2.1788E-001 ft

AQTESOLV RESULTS

Version 2.01

Developed by Glenn M. Duffield

3/13/97 8:48

TEST DESCRIPTION

Data set..... 79S_OUT.DAT
Output file..... 79S0UT.OUT
Data set title..... Negative Displacement Slug Test - GW-79S
Company..... Smith Technology
Project..... 00-7074-0102
Client..... Olin Corporation

Units of Measurement
Length..... ft
Time..... min

Test Well Data
Initial displacement in well..... 1.453
Radius of well casing..... 0.0833
Radius of wellbore..... 0.167
Aquifer saturated thickness..... 10
Well screen length..... 10
Static height of water in well... 10
Gravel pack porosity..... 0.3
Effective well casing radius..... 0.115
Effective wellbore radius..... 0.167
Log(Re/Rw)..... 3.138
Constants A, B and C..... 0.000 , 0.000, 2.985
No. of observations..... 120

==========

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

==========

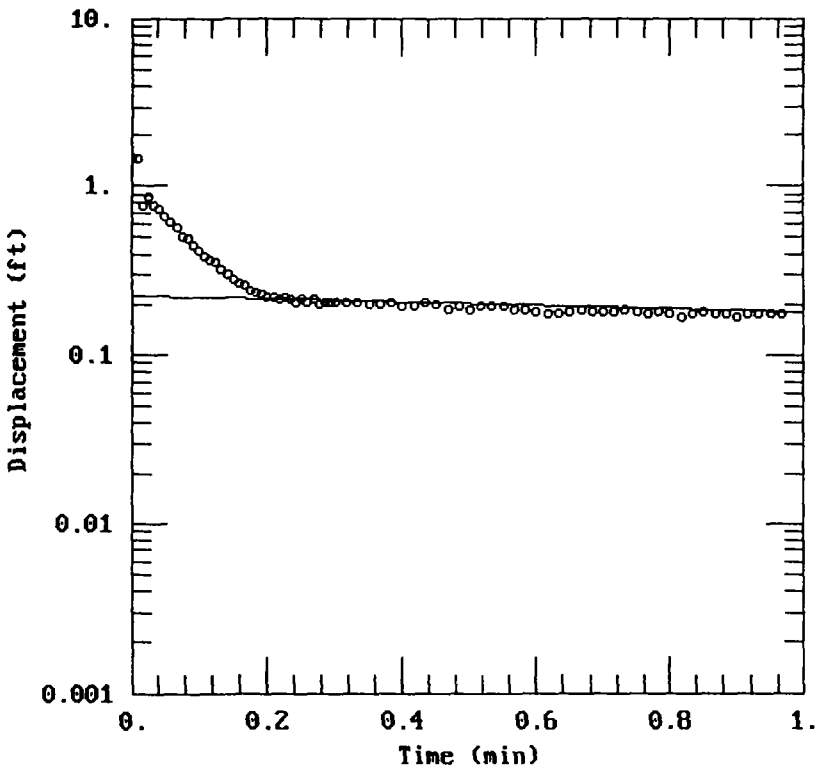
RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

Estimate
K = 6.4844E-001 ft/day
y0 = 2.2312E-001 ft

CLIENT: Olin Corporation	COMPANY: Smith Technology
	PROJECT: 00-7074-0102

Negative Displacement Slug Test - GW-79S



DATA SET:
79S_OUT.DAT
03/12/97

AQUIFER MODEL:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

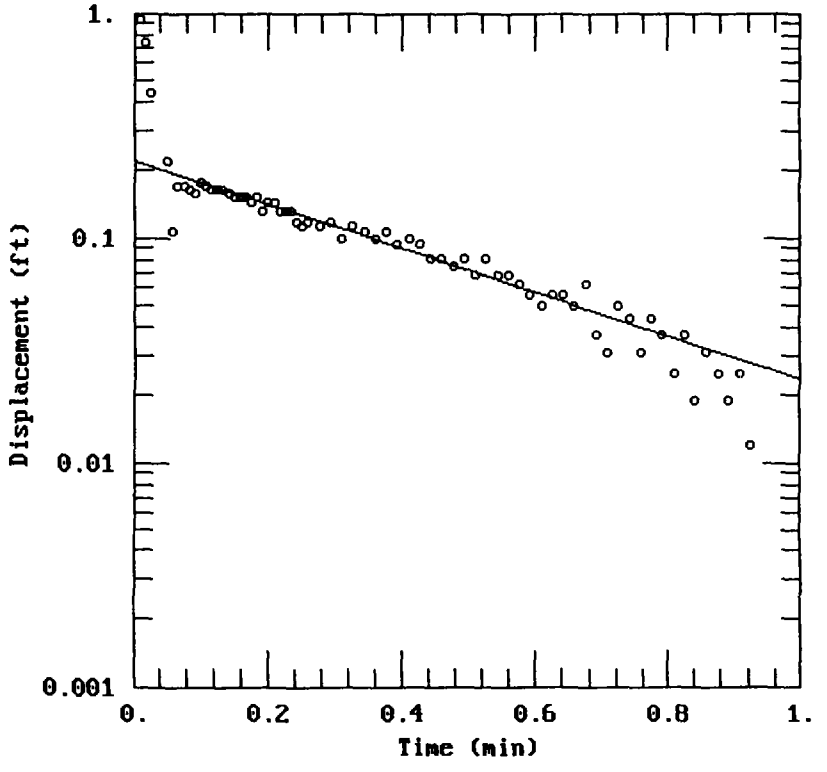
TEST DATA:
H0= 1.453 ft
r_c= 0.0833 ft
r_w= 0.167 ft
L = 10. ft
b = 10. ft
H = 10. ft

PARAMETER ESTIMATES:
K = 0.6484 ft/day
y0 = 0.2231 ft

AQTESOLV

CLIENT: Olin Corporation	COMPANY: Smith Technology
	PROJECT: 00-7074-0102

Positive Displacement Slug Test - GW-79S



DATA SET:
79S_IN.DAT
03/12/97

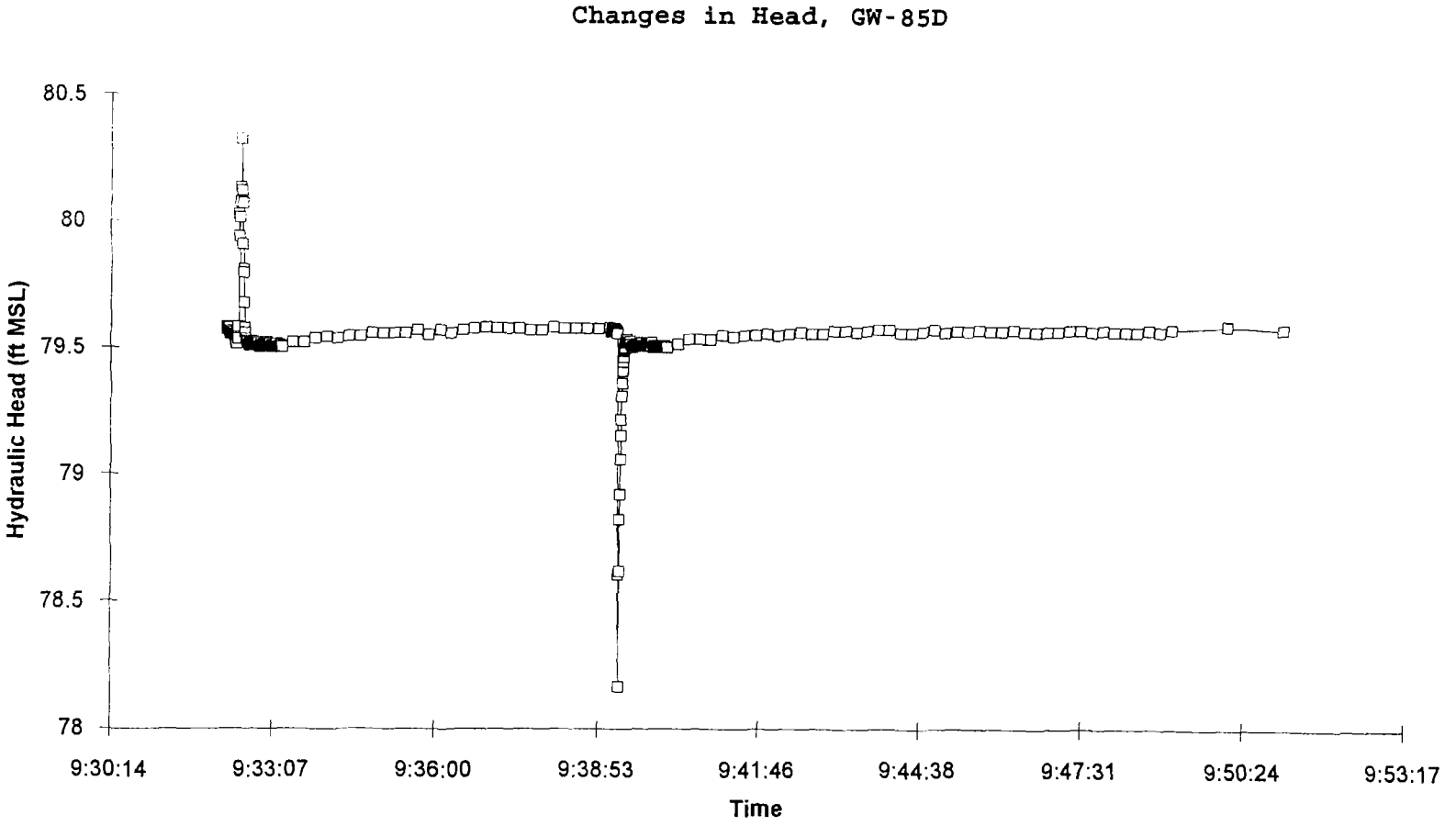
AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 1.689 ft
r_c= 0.0833 ft
r_w= 0.167 ft
L = 10. ft
b = 10. ft
H = 10. ft

PARAMETER ESTIMATES:
K = 6.647 ft/day
y0 = 0.2179 ft

AQTESOLV



SLUG85D.XLS

Time	Elapsed Time	Head	GW Elevation					
Time	Elapsed Time	Head	GW Elevation					
9:32:18	0	-7.66	79.58			SE2000		
9:32:18	0.0083	-7.66	79.58			Environmental Logger		
9:32:19	0.0166	-7.666	79.574			02/19 11:05		
9:32:19	0.025	-7.672	79.568					
9:32:20	0.0333	-7.666	79.574			Unit# 2K-125 Test 3		
9:32:20	0.0416	-7.666	79.574					
9:32:21	0.05	-7.666	79.574			Setups: INPUT 1		
9:32:21	0.0583	-7.678	79.562					
9:32:22	0.0666	-7.678	79.562			Type Level (F)		
9:32:22	0.075	-7.684	79.556			Mode Surface		
9:32:23	0.0833	-7.691	79.549			I.D. 85		
9:32:23	0.0916	-7.684	79.556					
9:32:24	0.1	-7.684	79.556			Reference -7.660		
9:32:24	0.1083	-7.691	79.549			PSI at Ref. 10.850		
9:32:25	0.1166	-7.691	79.549			SG 1.000		
9:32:26	0.125	-7.684	79.556			Linearity 0.000		
9:32:26	0.1333	-7.691	79.549			Scale factor 19.754		
9:32:26	0.1416	-7.691	79.549			Offset -0.046		
9:32:27	0.15	-7.691	79.549			Delay mSEC 50.000		
9:32:27	0.1583	-7.697	79.543					
9:32:28	0.1666	-7.697	79.543			Step 0	19-Feb	9:32:18
9:32:29	0.175	-7.728	79.512					
9:32:29	0.1833	-7.703	79.537					
9:32:29	0.1916	-7.728	79.512					
9:32:30	0.2	-7.691	79.549					
9:32:30	0.2083	-7.66	79.58					
9:32:31	0.2166	-7.709	79.531					
9:32:31	0.225	-7.217	80.023					
9:32:32	0.2333	-7.304	79.936					
9:32:32	0.2416	-7.229	80.011					
9:32:33	0.25	-7.167	80.073					
9:32:33	0.2583	-7.111	80.129					
9:32:34	0.2666	-6.918	80.322					
9:32:34	0.275	-7.123	80.117					
9:32:35	0.2833	-7.335	79.905					
9:32:35	0.2916	-7.173	80.067					
9:32:36	0.3	-7.435	79.805					
9:32:36	0.3083	-7.448	79.792					
9:32:37	0.3166	-7.566	79.674					
9:32:37	0.325	-7.666	79.574					
9:32:38	0.3333	-7.684	79.556					
9:32:39	0.35	-7.709	79.531					
9:32:40	0.3666	-7.716	79.524					
9:32:41	0.3833	-7.722	79.518					
9:32:42	0.4	-7.734	79.506					
9:32:43	0.4166	-7.728	79.512					
9:32:44	0.4333	-7.722	79.518					
9:32:45	0.45	-7.728	79.512					
9:32:46	0.4666	-7.716	79.524					
9:32:47	0.4833	-7.722	79.518					
9:32:48	0.5	-7.722	79.518					
9:32:49	0.5166	-7.722	79.518					
9:32:50	0.5333	-7.728	79.512					
9:32:51	0.55	-7.722	79.518					
9:32:52	0.5666	-7.728	79.512					
9:32:53	0.5833	-7.728	79.512					
9:32:54	0.6	-7.741	79.499					
9:32:55	0.6166	-7.734	79.506					
9:32:56	0.6333	-7.734	79.506					
9:32:57	0.65	-7.734	79.506					
9:32:58	0.6666	-7.734	79.506					
9:32:59	0.6833	-7.728	79.512					
9:33:00	0.7	-7.734	79.506					

Time	Elapsed Time	Head	GW Elevation
9:33:01	0.7166	-7.728	79.512
9:33:02	0.7333	-7.722	79.518
9:33:03	0.75	-7.728	79.512
9:33:04	0.7666	-7.728	79.512
9:33:05	0.7833	-7.734	79.506
9:33:06	0.8	-7.728	79.512
9:33:07	0.8166	-7.741	79.499
9:33:08	0.8333	-7.734	79.506
9:33:09	0.85	-7.741	79.499
9:33:10	0.8666	-7.741	79.499
9:33:11	0.8833	-7.734	79.506
9:33:12	0.9	-7.734	79.506
9:33:13	0.9166	-7.728	79.512
9:33:14	0.9333	-7.741	79.499
9:33:15	0.95	-7.741	79.499
9:33:16	0.9666	-7.734	79.506
9:33:17	0.9833	-7.741	79.499
9:33:18	1	-7.741	79.499
9:33:30	1.2	-7.722	79.518
9:33:42	1.4	-7.722	79.518
9:33:54	1.6	-7.703	79.537
9:34:06	1.8	-7.697	79.543
9:34:18	2	-7.703	79.537
9:34:30	2.2	-7.697	79.543
9:34:42	2.4	-7.697	79.543
9:34:54	2.6	-7.684	79.556
9:35:06	2.8	-7.684	79.556
9:35:18	3	-7.684	79.556
9:35:30	3.2	-7.684	79.556
9:35:42	3.4	-7.672	79.568
9:35:54	3.6	-7.691	79.549
9:36:06	3.8	-7.672	79.568
9:36:18	4	-7.684	79.556
9:36:30	4.2	-7.672	79.568
9:36:42	4.4	-7.666	79.574
9:36:54	4.6	-7.66	79.58
9:37:06	4.8	-7.666	79.574
9:37:18	5	-7.666	79.574
9:37:30	5.2	-7.666	79.574
9:37:42	5.4	-7.672	79.568
9:37:54	5.6	-7.672	79.568
9:38:06	5.8	-7.66	79.58
9:38:18	6	-7.666	79.574
9:38:30	6.2	-7.666	79.574
9:38:42	6.4	-7.666	79.574
9:38:54	6.6	-7.666	79.574
9:39:06	6.8	-7.66	79.58

SLUG85D.XLS

Time	Elapsed Time	Head	GW Elevation					
9:39:08	0	-7.678	79.562					
9:39:08	0.0083	-7.666	79.574		SE2000			
9:39:09	0.0166	-7.672	79.568		Environmental Logger			
9:39:10	0.025	-7.666	79.574		02/19 11:06			
9:39:10	0.0333	-7.666	79.574					
9:39:10	0.0416	-7.666	79.574		Unit# 2K-125 Test 3			
9:39:11	0.05	-7.666	79.574					
9:39:11	0.0583	-7.672	79.568		Setups: INPUT 1			
9:39:12	0.0666	-7.672	79.568		--- ---			
9:39:13	0.075	-7.678	79.562		Type Level (F)			
9:39:13	0.0833	-7.672	79.568		Mode Surface			
9:39:13	0.0916	-7.678	79.562		I.D. 85			
9:39:14	0.1	-7.678	79.562					
9:39:14	0.1083	-7.684	79.556		Reference -7.660			
9:39:15	0.1166	-8.638	78.602		PSI at Ref. 10.850			
9:39:15	0.125	-9.075	78.165		SG 1.000			
9:39:16	0.1333	-8.626	78.614		Linearity 0.000			
9:39:16	0.1416	-8.42	78.82		Scale factor 19.754			
9:39:17	0.15	-8.32	78.92		Offset -0.046			
9:39:17	0.1583	-8.183	79.057		Delay mSEC 50.000			
9:39:18	0.1666	-8.09	79.15					
9:39:19	0.175	-8.027	79.213		Step 1	19-Feb	9:39:08	
9:39:19	0.1833	-7.934	79.306					
9:39:19	0.1916	-7.884	79.356		Elapsed Time INPUT 1			
9:39:20	0.2	-7.834	79.406		--- ---			
9:39:20	0.2083	-7.797	79.443					
9:39:21	0.2166	-7.778	79.462					
9:39:22	0.225	-7.753	79.487					
9:39:22	0.2333	-7.747	79.493					
9:39:22	0.2416	-7.741	79.499					
9:39:23	0.25	-7.722	79.518					
9:39:23	0.2583	-7.722	79.518					
9:39:24	0.2666	-7.709	79.531					
9:39:24	0.275	-7.709	79.531					
9:39:25	0.2833	-7.722	79.518					
9:39:25	0.2916	-7.716	79.524					
9:39:26	0.3	-7.716	79.524					
9:39:26	0.3083	-7.722	79.518					
9:39:27	0.3166	-7.722	79.518					
9:39:27	0.325	-7.722	79.518					
9:39:28	0.3333	-7.716	79.524					
9:39:29	0.35	-7.728	79.512					
9:39:30	0.3666	-7.741	79.499					
9:39:31	0.3833	-7.734	79.506					
9:39:32	0.4	-7.734	79.506					
9:39:33	0.4166	-7.734	79.506					
9:39:34	0.4333	-7.728	79.512					
9:39:35	0.45	-7.728	79.512					
9:39:36	0.4666	-7.728	79.512					
9:39:37	0.4833	-7.728	79.512					
9:39:38	0.5	-7.728	79.512					
9:39:39	0.5166	-7.734	79.506					
9:39:40	0.5333	-7.728	79.512					
9:39:41	0.55	-7.722	79.518					
9:39:42	0.5666	-7.734	79.506					
9:39:43	0.5833	-7.734	79.506					
9:39:44	0.6	-7.734	79.506					
9:39:45	0.6166	-7.734	79.506					
9:39:46	0.6333	-7.728	79.512					
9:39:47	0.65	-7.734	79.506					
9:39:48	0.6666	-7.728	79.512					
9:39:49	0.6833	-7.728	79.512					
9:39:50	0.7	-7.734	79.506					
9:39:51	0.7166	-7.722	79.518					
9:39:52	0.7333	-7.722	79.518					
9:39:53	0.75	-7.741	79.499					

Time	Elapsed Time	Head	GW Elevation
9:39:54	0.7666	-7.734	79.506
9:39:55	0.7833	-7.734	79.506
9:39:56	0.8	-7.734	79.506
9:39:57	0.8166	-7.741	79.499
9:39:58	0.8333	-7.734	79.506
9:39:59	0.85	-7.734	79.506
9:40:00	0.8666	-7.734	79.506
9:40:01	0.8833	-7.741	79.499
9:40:02	0.9	-7.734	79.506
9:40:03	0.9166	-7.734	79.506
9:40:04	0.9333	-7.734	79.506
9:40:05	0.95	-7.734	79.506
9:40:06	0.9666	-7.734	79.506
9:40:07	0.9833	-7.741	79.499
9:40:08	1	-7.741	79.499
9:40:20	1.2	-7.728	79.512
9:40:32	1.4	-7.709	79.531
9:40:44	1.6	-7.709	79.531
9:40:56	1.8	-7.709	79.531
9:41:08	2	-7.691	79.549
9:41:20	2.2	-7.697	79.543
9:41:32	2.4	-7.691	79.549
9:41:44	2.6	-7.691	79.549
9:41:56	2.8	-7.684	79.556
9:42:08	3	-7.691	79.549
9:42:20	3.2	-7.684	79.556
9:42:32	3.4	-7.678	79.562
9:42:44	3.6	-7.684	79.556
9:42:56	3.8	-7.684	79.556
9:43:08	4	-7.672	79.568
9:43:20	4.2	-7.672	79.568
9:43:32	4.4	-7.678	79.562
9:43:44	4.6	-7.672	79.568
9:43:56	4.8	-7.666	79.574
9:44:08	5	-7.666	79.574
9:44:20	5.2	-7.678	79.562
9:44:32	5.4	-7.678	79.562
9:44:44	5.6	-7.672	79.568
9:44:56	5.8	-7.666	79.574
9:45:08	6	-7.678	79.562
9:45:20	6.2	-7.672	79.568
9:45:32	6.4	-7.672	79.568
9:45:44	6.6	-7.666	79.574
9:45:56	6.8	-7.672	79.568
9:46:08	7	-7.672	79.568
9:46:20	7.2	-7.666	79.574
9:46:32	7.4	-7.672	79.568
9:46:44	7.6	-7.672	79.568
9:46:56	7.8	-7.672	79.568
9:47:08	8	-7.672	79.568
9:47:20	8.2	-7.666	79.574
9:47:32	8.4	-7.666	79.574
9:47:44	8.6	-7.672	79.568
9:47:56	8.8	-7.666	79.574
9:48:08	9	-7.672	79.568
9:48:20	9.2	-7.672	79.568
9:48:32	9.4	-7.672	79.568
9:48:44	9.6	-7.666	79.574
9:48:56	9.8	-7.672	79.568
9:49:08	10	-7.66	79.58
9:50:08	11	-7.647	79.593
9:51:08	12	-7.66	79.58
	END		

AQTESOLV RESULTS
Version 2.01

Developed by Glenn M. Duffield
(c) 1988-1995 Geraghty & Miller, Inc.

3/13/97 10:03

TEST DESCRIPTION

Data set..... 85D_IN.DAT
Output file..... 85DIN.OUT
Data set title..... Positive Displacement Slug Test - GW-85D
Company..... Smith Technology
Project..... 00-7074-0102
Client..... Olin Corporation

Units of Measurement
Length..... ft
Time..... min

Test Well Data
Initial displacement in well..... 0.81
Radius of well casing..... 0.0833
Radius of wellbore..... 0.167
Aquifer saturated thickness..... 85.48
Well screen length..... 10
Static height of water in well... 85.48
Gravel pack porosity..... 0.3
Effective well casing radius..... 0.115
Effective wellbore radius..... .. 0.167
Log(Re/Rw)..... 4.421
Constants A, B and C..... 0.000 , 0.000, 2.985
No. of observations..... 47

==========

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

==========

RESULTS FROM STATISTICAL CURVE MATCHING

STATISTICAL MATCH PARAMETER ESTIMATES

	Estimate	Std. Error	
K =	1.3097E+002	+/- 1.6726E+001	ft/day
y0 =	8.1699E-001	+/- 7.9498E-002	ft

```
ANALYSIS OF MODEL RESIDUALS

residual = observed - calculated
weighted residual = residual * weight

Weighted Residual Statistics:
  Number of residuals............... 20
  Number of estimated parameters.... 2
  Degrees of freedom................ 18
  Residual mean..................... -0.002326
  Residual standard deviation....... 0.05589
  Residual variance................. 0.003123


Model Residuals:

    Time        Observed     Calculated     Residual       Weight
 ------------ ------------ ------------ ------------ ------------
    0.0084       0.605        0.62909     -0.024092          1
    0.0167       0.393        0.48592     -0.092915          1
    0.025        0.555        0.37532      0.17968           1
    0.0334       0.293        0.289        0.0039968         1
    0.0417       0.28         0.22323      0.056772          1
    0.05         0.162        0.17242     -0.010423          1
    0.0584       0.062        0.13277     -0.070767          1
    0.0667       0.044        0.10255     -0.058551          1
    0.0834       0.019        0.060993    -0.041993          1
    0.1          0.012        0.036389    -0.024389          1
    0.1167       0.006        0.021643    -0.015643          1
    0.1667       0.006        0.0045677    0.0014323         1
    0.2          0.012        0.0016208    0.010379          1
    0.2167       0.006        0.00096399   0.005036          1
    0.2334       0.006        0.00057334   0.0054267         1
    0.25         0.006        0.00034206   0.0056579         1
    0.2834       0.006        0.000121     0.005879          1
    0.4667       0.006        4.0361E-007  0.0059996         1
    0.9334       0.006        1.9939E-013  0.006             1
    1.1334       0.006        3.9556E-016  0.006             1

==========================================================================
                  RESULTS FROM VISUAL CURVE MATCHING


VISUAL MATCH PARAMETER ESTIMATES

        Estimate
  K  =  1.7500E+002 ft/day
  y0 =  8.1699E-001 ft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AQTESOLV RESULTS
Version 2.01

Developed by Glenn M. Duffield
(c) 1988-1995 Geraghty & Miller, Inc.

3/12/97 14:01

TEST DESCRIPTION

Data set..... *85D_OUT.DAT*
Output file..... 85SOUT.OUT
Data set title..... Negative Displacement Slug Test - GW-85D
Company..... Smith Technology
Project..... 00-7074-0102
Client..... Olin Corporation

Units of Measurement
Length..... ft
Time..... min

Test Well Data
Initial displacement in well..... 0.966
Radius of well casing..... 0.0833
Radius of wellbore..... 0.167
Aquifer saturated thickness..... 85.48
Well screen length..... 10
Static height of water in well... 85.48
Gravel pack porosity..... 0.3
Effective well casing radius..... 0.115
Effective wellbore radius..... 0.167
Log(Re/Rw)..... 4.421
Constants A, B and C..... 0.000 , 0.000, 2.985
No. of observations..... 109

==========

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

==========

RESULTS FROM VISUAL CURVE MATCHING

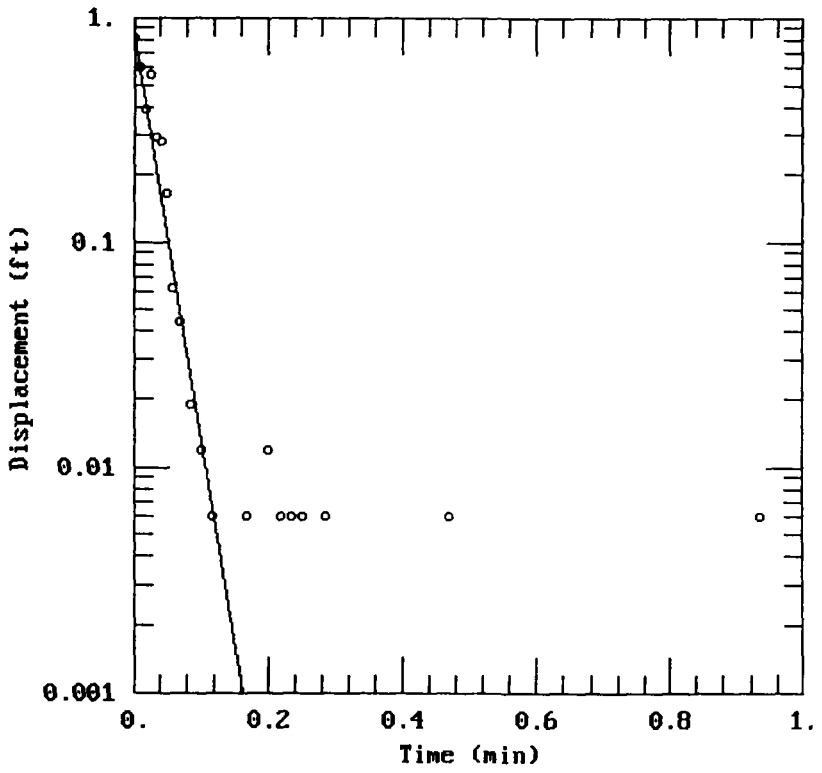
VISUAL MATCH PARAMETER ESTIMATES

	Estimate
K =	1.0380E+002 ft/day
y0 =	1.1648E+000 ft

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<

CLIENT: Olin Corporation	COMPANY: Smith Technology
	PROJECT: 00-7074-0102

Positive Displacement Slug Test - GW-85D



DATA SET:
85D_IN.DAT
03/13/97

AQUIFER MODEL:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

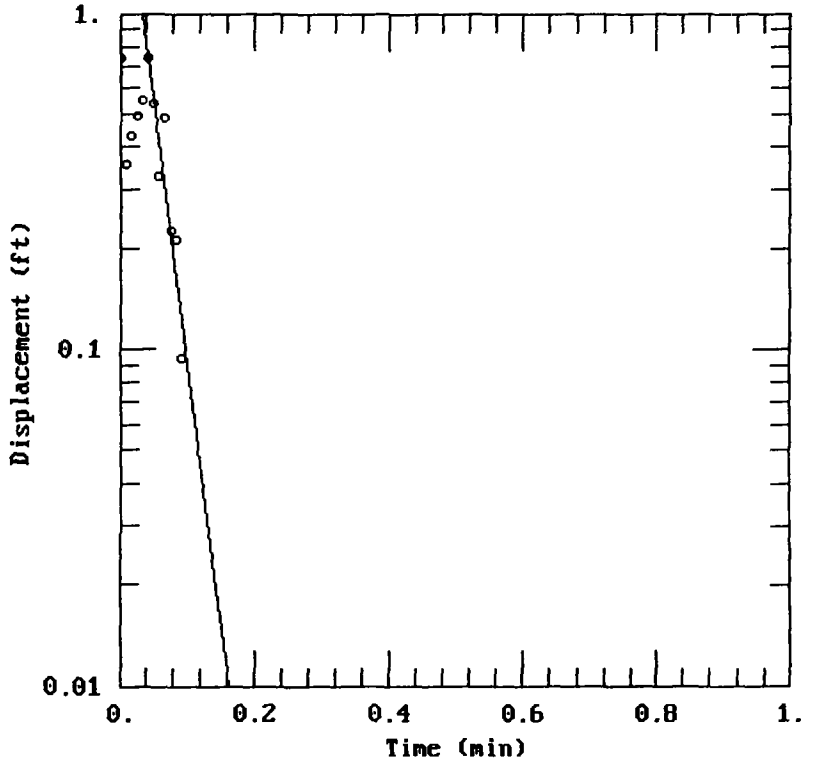
TEST DATA:
H0= 0.81 ft
r_c= 0.0833 ft
r_w= 0.167 ft
L = 10. ft
b = 85.48 ft
H = 85.48 ft

PARAMETER ESTIMATES:
K = 175. ft/day
y0 = 0.817 ft

AQTESOLV

CLIENT: Olin Corporation	COMPANY: Smith Technology
	PROJECT: 00-7074-0102

Positive Displacement Slug Test - GW-85D



DATA SET:
85D_IN.DAT
03/12/97

AQUIFER MODEL:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

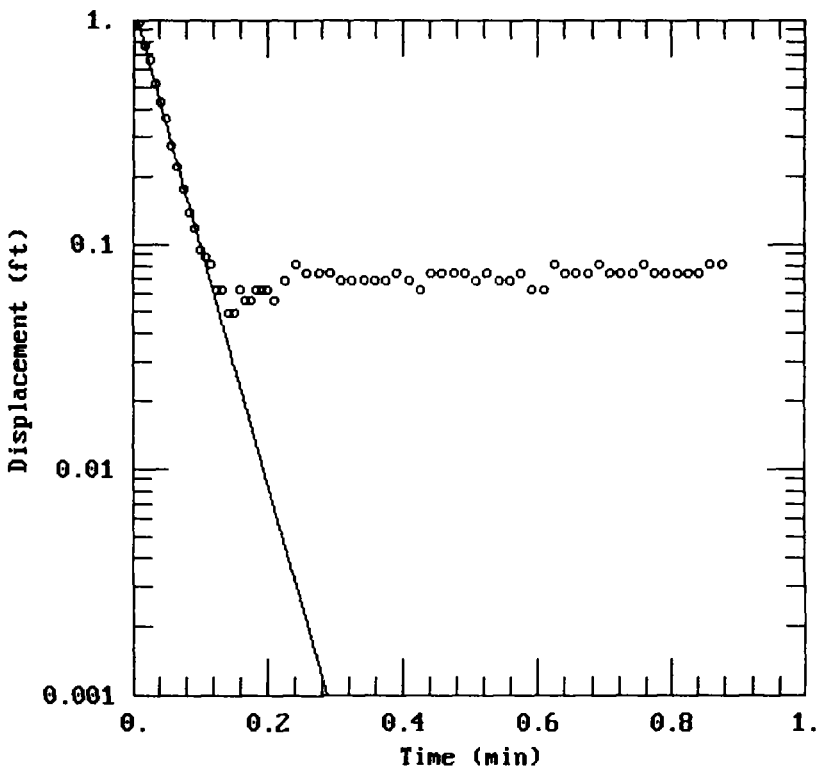
TEST DATA:
H0= 0.742 ft
r_c= 0.0833 ft
r_w= 0.167 ft
L = 10. ft
b = 85.48 ft
H = 85.48 ft

PARAMETER ESTIMATES:
K = 152. ft/day
y0 = 3.452 ft

AQTESOLV

CLIENT: Olin Corporation	COMPANY: Smith Technology
	PROJECT: 00-7074-0102

Negative Displacement Slug Test - GW-85D



DATA SET:
85D_OUT.DAT
03/12/97

AQUIFER MODEL:
Unconfined
SOLUTION METHOD:
Bouwer-Rice

TEST DATA:
H0= 0.966 ft
r_c= 0.0833 ft
r_w= 0.167 ft
L = 10. ft
b = 85.48 ft
H = 85.48 ft

PARAMETER ESTIMATES:
K = 103.8 ft/day
y0 = 1.165 ft

AQTESOLV

Appendix H

SMITH

SMITH

APPENDIX H

BOREHOLE VELOCITY REPORT

Appendix H
Groundwater Flow Monitoring Report

The following are corrections to the attached report prepared by KV Associates, Inc. These changes have been incorporated into the data and analysis presented in the Supplemental Phase II Investigation Report.

- Page 12, states that the monitored intervals are referenced as depths measured from the top of casing of each well. Although this is correct for GW-27S, the reference for all the rest of the wells is the ground surface.

- Table 1, "Depth below TOC" should be "Depth below ground surface" for all wells except GW-27S.

- Table 1 and Groundwater Flow Worksheet, the vector resolution performed for GW-27S at a depth of 17.5 feet was performed incorrectly; the corrected direction of flow is 194°.

- Table 1, omits a duplicate measurement from GW-27D at a depth of 28 feet. The duplicate reading is a direction of 310° at a rate of 0.36 feet/day.

- Table 2, "Depth" should be "Depth below ground surface" for all wells except GW-62BR which was referenced to the top of casing.

- Table 2, units of "Peak Time" not shown should be listed as "Sec" (seconds).

- Table 2, flow values for GW-62BR at a depth of 80.5 feet, for "Peak Time" 49.5 and 46.8 seconds should be omitted due to displacement effects caused by the packer system.

- Table 2, "Calibration Curve Direction" for GW-62BR at a depth of 100 feet for "Peak Time" 57.8 seconds should be "Down" to reflect the negative (-26) "Peak Temperature".

- Table 2, "Peak Temperature" value for GW-68BR at a depth of 55 feet for "Peak Time" 1.5 minutes should be negative (-2).

GROUNDWATER FLOW EVALUATION
OLIN CORPORATION SITE
58 EAMES STREET
WILMINGTON, MASSACHUSETTS

PREPARED FOR:

SMITH ENVIRONMENTAL
TECHNOLOGIES CORPORATION
ONE PLYMOUTH MEETING
PLYMOUTH MEETING, PENNSYLVANIA 19462

PREPARED BY:

K-V ASSOCIATES, INC.
281 MAIN STREET
FALMOUTH, MASSACHUSETTS 02540

DECEMBER 16, 1995

K-V ASSOCIATES, INC.
PROJECT NUMBER 1100

K-V ASSOCIATES, INC.
GROUNDWATER, SOIL-GAS AND SOIL SPECIALISTS

281 MAIN STREET • P.O. BOX 574 • FALMOUTH, MASSACHUSETTS 02541 • (508) 540-0561 • FAX: (508) 457-9053

December 16, 1995

Ms. A. Elizabeth Perry, PG
Smith Environmental Technologies Corp.
One Plymouth Meeting
Plymouth Meeting, PA 19462

RE: Report - Groundwater Flow Evaluation
Olin Corp, 58 Eames Street, Wilmington, MA
Smith Project Number 00-7074-0102

Dear Ms. Perry:

Please find included with this letter the above referenced report and a final invoice for this project. Also included is the site base map with plotted groundwater flow vectors.

If you have any questions or comments regarding this report please do not hesitate to call.

Sincerely,

William B. Kerfoot

WIlliam B. Kerfoot, PhD, LSP
K-V Associates, Inc.

encl: report/base map

TABLE OF CONTENTS PAGE

FIGURES

TABLES

APPENDICES

1.00 INTRODUCTION

K-V Associates, Inc. (K-V) has completed this report at the request of Smith Environmental Technologies Corporation (Smith) of Plymouth Meeting, PA (Smith Project Number 00-7074-0102), and pursuant to the contract signed by Smith and K-V dated on November 6, 1995.

Field work for this project was completed on November 8, 9, 10, 12, 13, 14 and 15 of 1995 at the Olin Corporation facilities located at 51 Eames Street in Wilmington, MA. This location shall hereafter be referred to as the Site.

This work consisted of evaluating horizontal flow direction and horizontal velocity for groundwater in twenty-one (21) groundwater monitoring wells at and in the vicinity of the Site and at various depths. Additionally, four (4) open borehole groundwater monitoring wells were evaluated for vertical velocities at various depths.

2.00 HEAT PULSE TECHNOLOGY - GENERAL THEORY

Electronic groundwater flow measurement is based upon thermal transmission within a porous solid under the influence of interstitial liquid flow. The controlling factors are: 1) the thermal conductance of the solid and liquid phases; 2) the surface area of the solid phase; 3) the thermal transfer coefficient of the liquid phase, and, 4) the rate of movement of the liquid phase.

For example, with a porous solid phase of glass beads with distilled water, the thermal conductivity of the glass is about 0.023 cal/(s) (cm) (C/cm) while that of the water is 0.0014 cal/(s) (cm) (C/cm). The principal heat transfer occurs between the zones of contact of the glass beads, which are small points surrounded by a thin interface of water. The slightest movement of the liquid during the period of heat transfer can profoundly influence the conductance.

The GeoFlo flowmeter creates a heat pulse which is transmitted through the porous matrix. Any net movement of the interstitial water mass creates a thermal conductance bias which is linearly proportional to the rate of flow (Kerfoot, 1988). To expand the dynamic range of the flowmeter, calibration has been modified to include time-of-travel with heat magnitude. The resulting dynamic flow measurement range expands over 10^6 units.

The Geoflometer probe's heat source is surrounded by eight thermistors. Each thermistor is linked to another directionally opposing thermistor making four pairs. The instruments operate by emitting a transient, short duration, point source of heat. The heat pulse is carried

preferentially in one direction by the movement of soil pore water, thus causing a temperature differential between the pairs of thermistors around the circumference of the probe.

By using the rotary channel selector switch, relative thermal difference between any pair of thermistors can be measured and displayed by channel on the control box. Each channel measures the relative thermal difference between a given pair. The sign, plus or minus (+ or -), of the displayed value indicates which of the two thermistors is reading the higher temperature.

For example, if thermistor +1 is sensing more heat than its pair, thermistor -6, the display will be a positive value indicating flow (heat) in the direction of thermistor +1. Conversely, should thermistor -9 sense more heat than thermistor +4 then, the display will be a negative value indicating flow towards thermistor -9.

In a no-flow condition the center of the expanding heat ring remains stationary and all thermistors see the same temperature rise with time. There is no net difference between pairs. In a flow condition the center of propagation is displaced in the direction of flow. Refer to Figure 1.

The propagation of the heat wave is much faster than that of the water - it's rise and decay short lived also. The effect of even a very slow flow rate is magnified greatly. A quantitative value varying linearly with the flow may be acquired after a specific time interval. The optimum time interval for a given heater output and thermistor radius is based on the heat conductivity of the glass bead packing. Refer to Appendix A for Technical Publication Material.

3.00 THE K-V GEOFLOW METERS

The Geo Flowmeters, manufactured by K-V Associates, Inc. of Falmouth, Massachusetts, are a portable field instrument utilizing heat pulse technology to determine ground water flow direction and velocity. It can be used in saturated soils or open boreholes and within a variety of diameters.

The instruments used during this investigation were a Model 40 GEOFLOW Groundwater Flowmeter for horizontal flow direction and velocity evaluation and a Model 90 GEOFLOW Groundwater Flowmeter for the evaluation vertical flow velocities. The Model 40 instrument consists of a control box linked by a cable to a probe. The Model 90 consists of computer controller linked to an interface module linked by a cable to the probe. Refer to Figure 2 and Figure 3.

The units may be powered by re-chargeable gelcell batteries. The field probe for the Model 90 is only 1.75 inches in

In the NO FLOW condition (i.e. there is no water head potential), Fig. a , the center of the expanding heat ring remains stationary. All thermistors see the same temperature rise with time and there is no net difference between opposed pairs of thermistors.

In the FLOW condition, Fig. b , the center of propagation is displaced in the direction of flow, at the flow rate of the water. The propagation rate of the heat wave is much faster than the water; its rise and decay short lived also. The effect of even a very slow flow rate is thus magnified greatly.

NO FLOW

FLOW

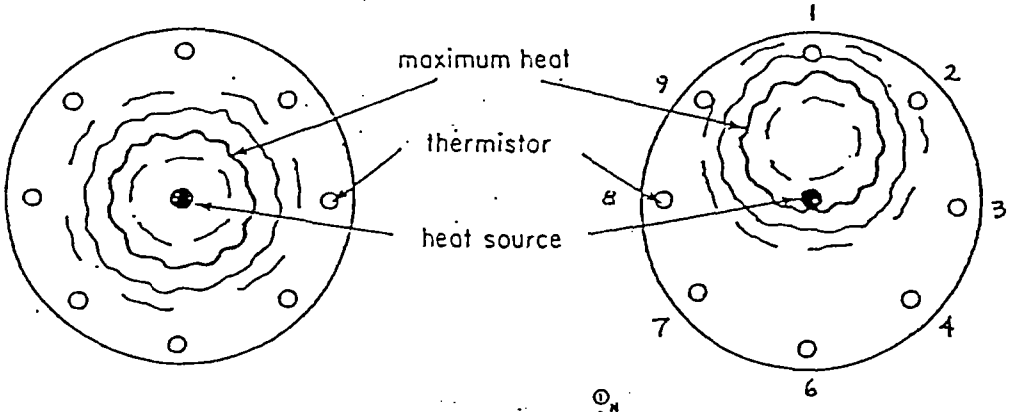
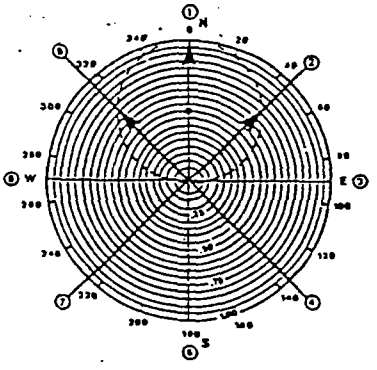


Figure a.



Vectors

Figure b.

FIGURE 1 Schematic Illustrating FLOW / NO FLOW Conditions

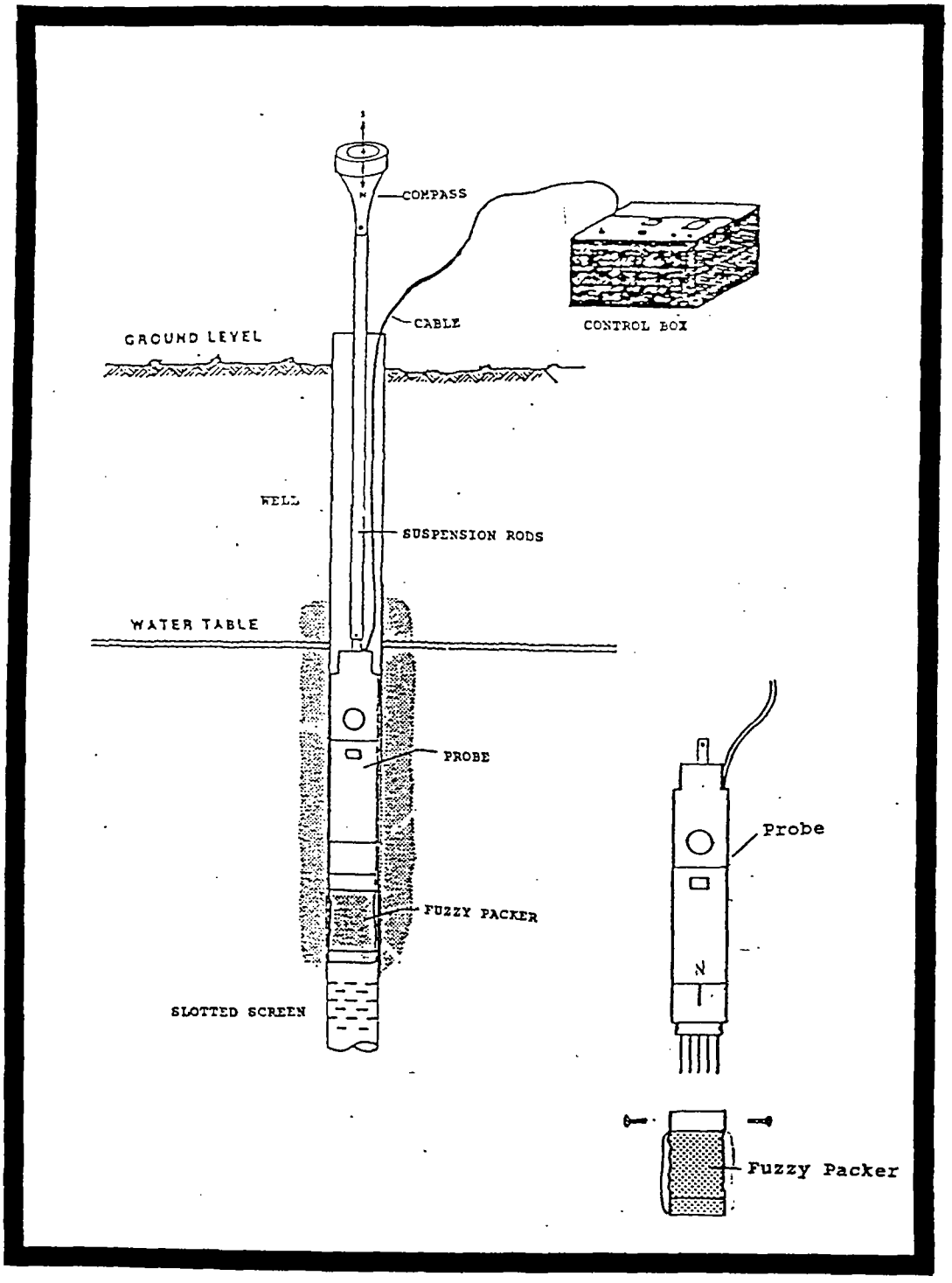


FIGURE 2 Schematic of the Model 40 Components

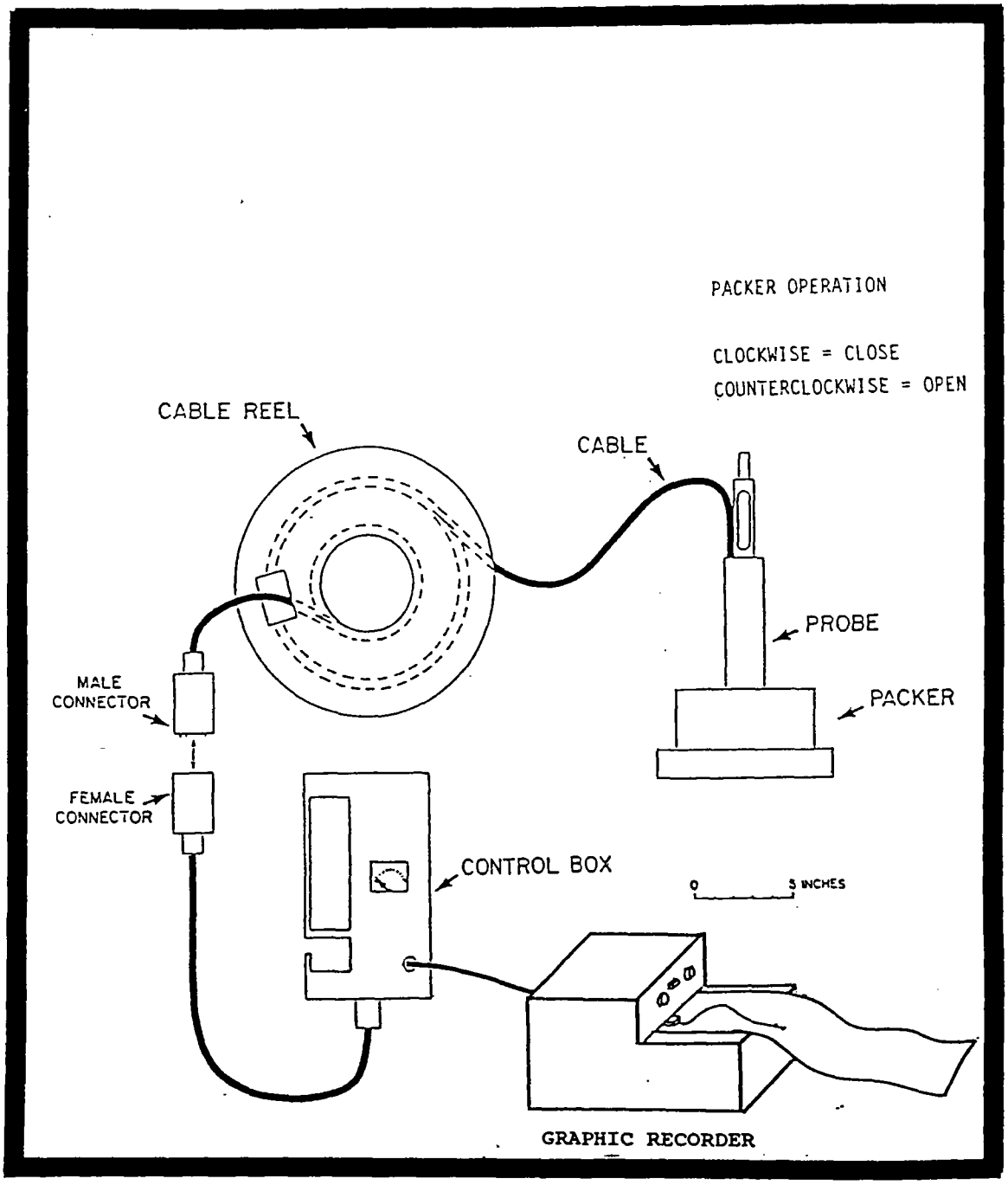


FIGURE 3 Schematic of the Model 90 Components

diameter, ideally suitable for three (3) inch through nine (9) inch diameter open boreholes. The Model 40 probe is suitable for two (2) inch through nine (9) inch boreholes. Available pneumatic packers used to isolate vertical flow inflate to a maximum of 10 inches.

4.00 METHODS AND PROCEDURES

4.10 FLOWMETER CALIBRATION

In order to calibrate the Model 40, the appropriate probe-packer combination is placed inside a one-foot length of slotted, PVC well screen, a Timco .010 slot in this case, intended to match the screen type used at the Site.

The PVC screen with the probe and packer was then placed in a 10 inch diameter flow chamber. The chamber was filled with a fine to medium sand intended to match the aquifer formation material expected in the glacial till and outwash deposits observed in the subsurface at the Site.

A known flow regime is stabilized within the flow chamber and the instrument's relative machine readings (RMR) are plotted versus the known velocity within the chamber. Usually, this is done for a minimum of three varying flow rates in order to establish a calibration curve to convert RMR to field flow (in ft/d) over a range of flow velocities. Refer to Figure 4 for a calibration chamber schematic for the Model 40, and Figure 5 for a sample calibration curve.

By duplicating the well installation found in the field within the flow chamber, the calibration procedure corrects for hydraulic conductivity differences between the sand pack (k_o), the packer contact (k_p), and the glass bead packing (k_1). The resistance to flow unique to the slot width (.010 inch) and configuration was automatically compensated for (Kerfoot, 1986; ASTM 963). Refer to Appendix B for the calibration curve for the Model 40.

For calibration of the Model 90 Geoflo Meter, the unit is placed in a .1 meter (4 inch) ID diameter PVC tube with through flow circulated by a peristaltic pump. Recordings are performed under no flow (i.e. less than .1 cc/min) and rates ranging up to 2.0 liters/minute.

For use in open boreholes, a one-dimensional array of heater and temperature sensors is placed in a .3m (1 ft.) long small diameter (2.54 or 1.0 inch diameter) tube. The tube is then fitted with a base for the 4 or 6 (uninflated) diameter pneumatic packer.

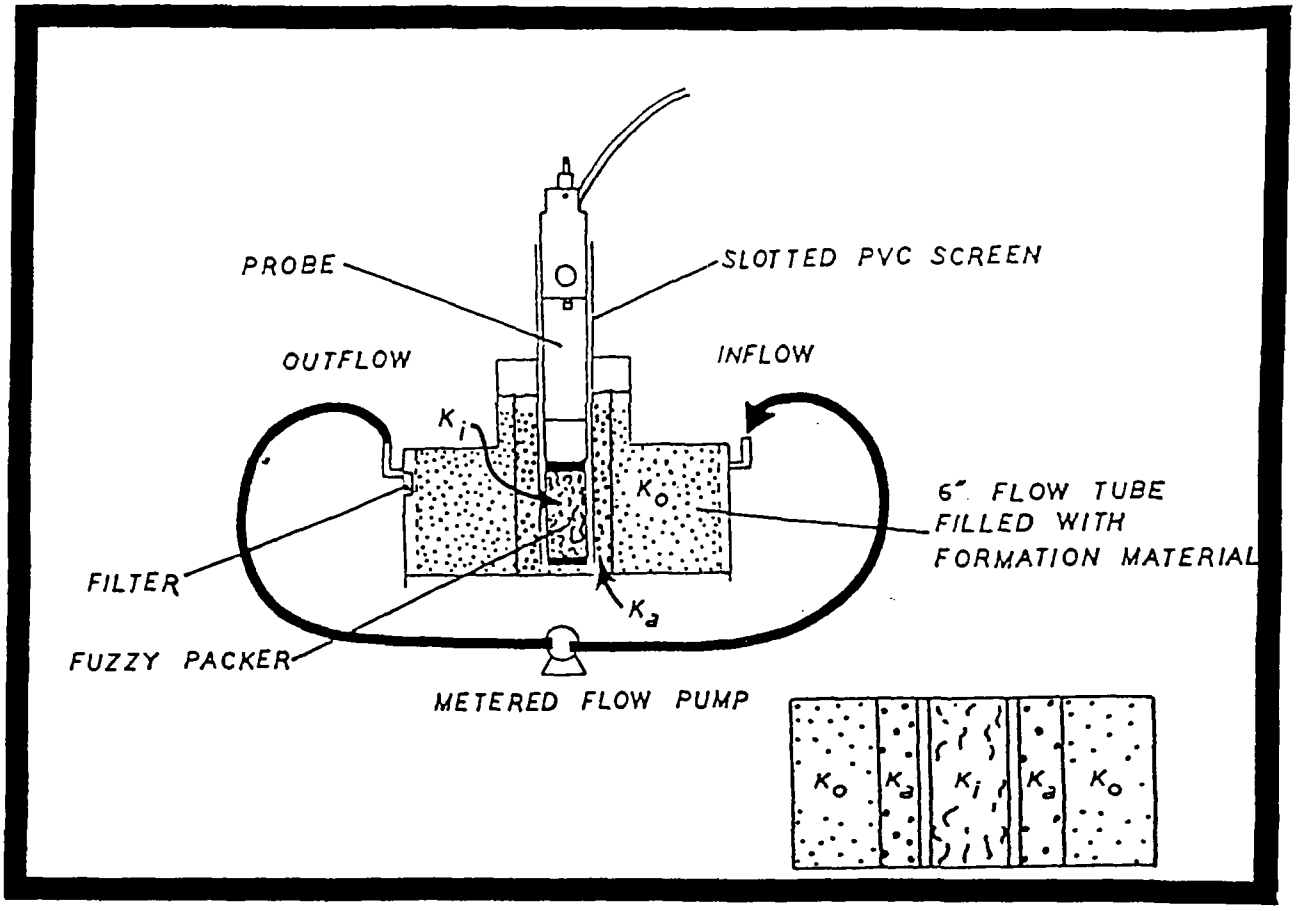


FIGURE 4 Calibration Chamber Schematic For the Model 40

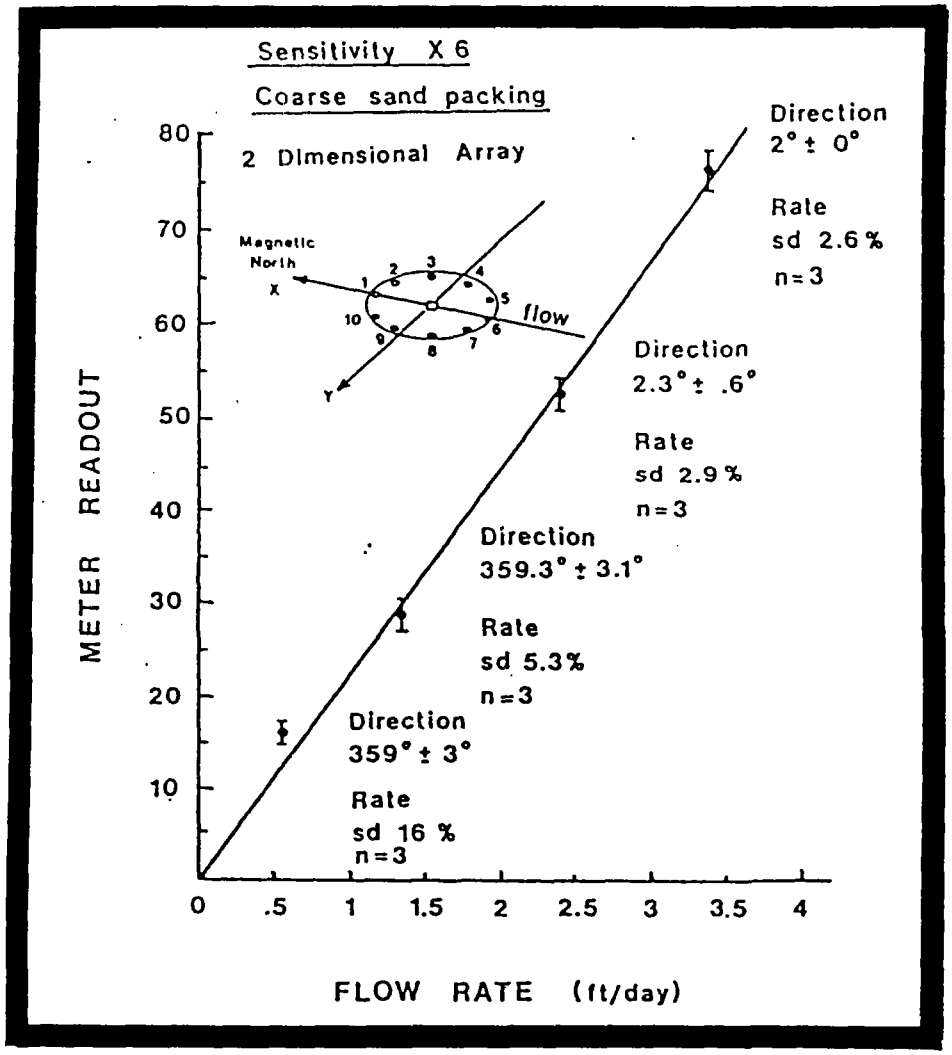


FIGURE 5 Sample Calibration Curve

Flow results are given in units of volume (cc/min) which can be converted to vertical velocity by dividing by the cross sectional area of the borehole. Refer to Appendix C for the calibration curve for the Model 90.

4.20 EQUIPMENT SET-UP

The probe for the Model 40 is inserted into a "fuzzy packer" (packer) which is filled with glass beads. The packer is of a diameter which matches the inside diameter of the borehole being examined and attaches to the probe with two set screws. The glass beads are of a diameter which approximates in size the natural aquifer formation material. This set up provides a porous medium which facilitates communication between pore water movement within the formation and the probe's thermistors.

The probe/packer is lowered into the well by five (5) or ten (10) foot aluminum rods which join together by snap buttons. Care must be taken to insure that the probe is situated within the slotted portion of the screen. It is necessary to know the well construction details before heading to the field. A grip wrench is used to hold the aluminum rods at the desired depth.

Once the probe is set at the proper depth, it must be oriented. To facilitate this, a compass is attached to the snap button of the top most rod. The compass is then oriented north-south. The snap buttons along the rods ensure that the pair of thermistors numbers plus one (+1) and minus six (-6) on the probe are also lined up north-south. The probe is now ready for use.

4.30 EQUIPMENT OPERATION

Prior to initiating the heat pulse, readings for each channel should be monitored at short intervals until a stable display is observed. Values should be within +10, however, they may be larger with a grater sensitivity setting. Initial values for the four channels are recorded on a Ground Water Flow Worksheet in Column A. Subsequent to this the START button is pushed to initiate the heat pulse. The ampere meter on the control box will monitor the electrical output to the heater. The LCD panel will flash to indicate that a measurement cycle is in progress.

The rotary switch on the control box selects which channel (or pair of thermistors) is being read and displayed. The flow direction is indicated by sign (plus or minus) and flow rate is indicated as relative numerical differences on the LCD (liquid crystal display) as the rotary switch is moved from channel to channel.

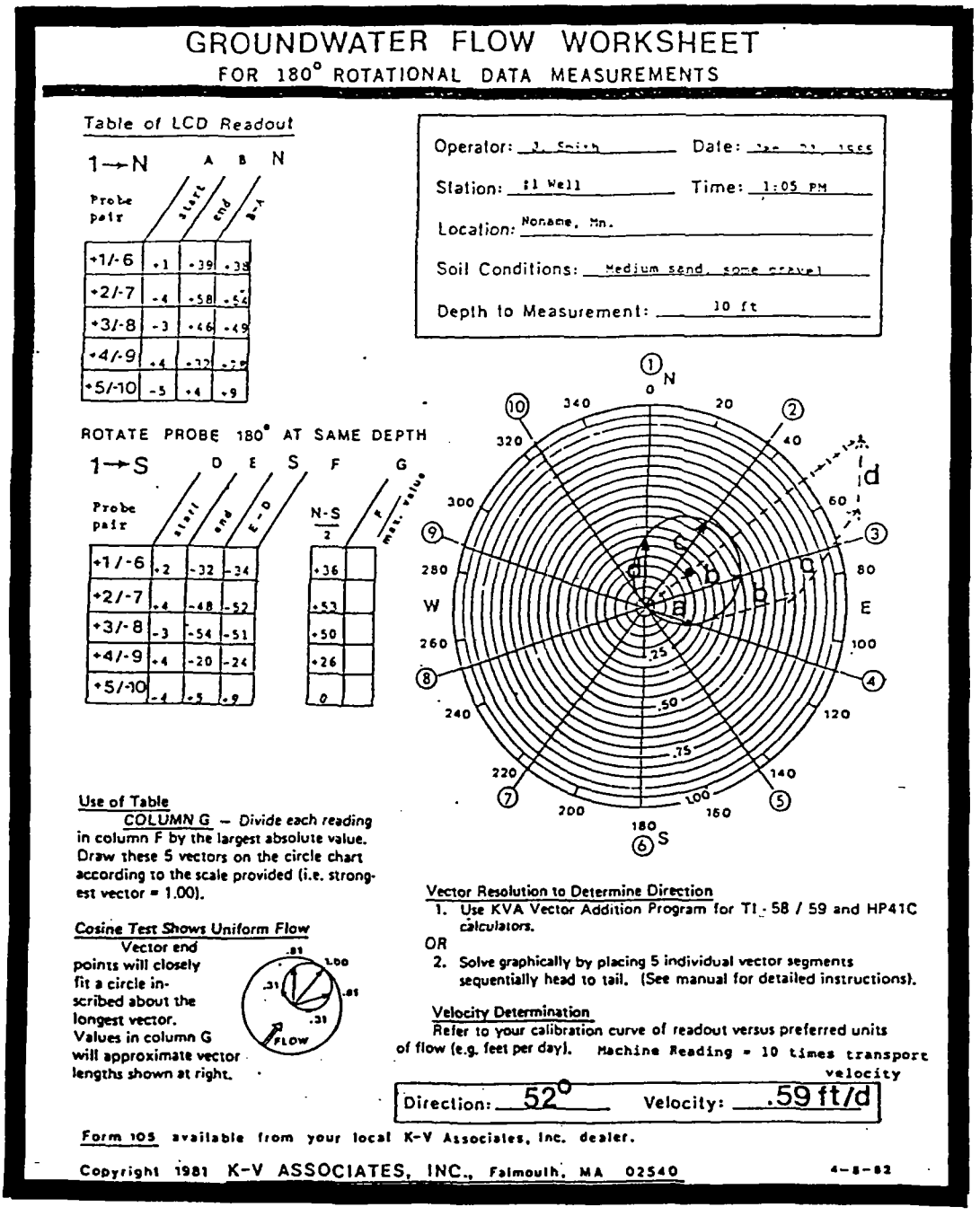
When the beeper sounds, approximately one minute and forty seconds after the heat pulse, values from respective channels are immediately recorded in the "end" column B. The RESET button can be pressed to silence the beeper.

Next, the probe must be rotated one hundred and eighty degrees (180^{0}) and oriented to the south direction. The probe must be left to stabilize for at least fifteen minutes before continuing to allow the heat to dissipate and groundwater flow to re-establish. It is suggested that the fuzzy packer be raised and lowered several times in order to help the heat dissipate.

After fifteen minutes the cycle is repeated and the readings are recorded in the second set of columns on the Groundwater Flow Worksheet. For each channel or thermistor pair, Column B is subtracted from Column A and the result is placed in Column C from the first set of readings. Column E is subtracted from Column D and the result is placed in Column S from the second set of readings. Then Column S is subtracted from Column N and divided by 2. This result is recorded in Column F. Each reading in Column F is then divided by the largest absolute value from this column and the result placed n Column G.

Number in Column G can be drawn as vectors on the circular diagram on the right side of the worksheet - the largest value being 1. Starting at the end of the largest vector, connect the vectors head to tail, maintaining their respective lengths and directions. A line drawn from the center through the head of the last vector will intersect the outermost circle of the paper at a degree reading representing the principal direction of flow. Refer to Figure 6 for a completed, sample of the Groundwater Flow Worksheet.

When the instrument is used in open core borings. No packer is used and the prongs of the probe are inserted directly into the soil and readings taken as before. If the bottom of the hole consists of clay, placement of the probe may be difficult since the rods may bend. When the probe is rotated to the south, it is suggested that the probe first be pulled completely from the hole, sediment removed from between the prongs of the probe, the probe rotated and then placed back down the hole.



GROUNDWATER FLOW WORKSHEET

FOR 180° ROTATIONAL DATA MEASUREMENTS

Table of LCD Readout

1→N

Probe pair	A start	B end	N B-A
+1/-6	+1	+39	+38
+2/-7	-4	+58	+62
+3/-8	-3	+46	+49
+4/-9	+4	+72	+68
+5/-10	-5	+4	+9

ROTATE PROBE 180° AT SAME DEPTH

1→S

Probe pair	D start	E end	S E-D	F N-S/2	G F / max. value
+1/-6	+2	-32	-34	+36	
+2/-7	+4	-48	-52	+53	
+3/-8	-3	-54	-51	+50	
+4/-9	+4	-20	-24	+26	
+5/-10	-4	+5	+9	0	

Operator: J. Smith Date: Dec 22, 1985

Station: #1 Well Time: 1:05 PM

Location: Noname, Mn.

Soil Conditions: Medium sand, some gravel

Depth to Measurement: 10 ft

Use of Table

COLUMN G — *Divide each reading* in column F by the largest absolute value. Draw these 5 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.

Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program for TI-58 / 59 and HP41C calculators.

OR

2. Solve graphically by placing 5 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). Machine Reading = 10 times transport velocity

Direction: 52° Velocity: .59 ft/d

Form 105 available from your local K-V Associates, Inc. dealer.

 4-8-82

FIGURE 6 Sample Groundwater Flow Worksheet

The velocity of the groundwater can also be computed as follows:

$$Nc \times F_L = \text{feet/day through } (V_G) \text{ glass beads}$$

Where: Nc = Calibration number

F_L = Largest value in the Column F (worksheet)

Then, using the ratio:

$$\frac{.30}{V_G} \quad \frac{P_S}{V_S}$$

Where: .30 = the void space of the glass beads

V_G = feet/day through glass beads

V_S = feet/day through the soil

P_S = porosity of soil calculated by filling a graduated cylinder with 25 ml of water and then dumping soil into the water until the soil height reaches 25 ml. Then dividing the difference by the old measurement (25 ml) to compute void space.

5.00 PROJECT FIELD RESULTS

Groundwater flow measurements were conducted at, and in the vicinity of, the Olin Site in Wilmington, Massachusetts. A series of 21 monitoring wells, in 11 different areas spanning over a one-half mile region, were evaluated. The Model 40 Groundwater Flow Meter was used in shallow and deep, slotted, PVC screened, monitoring wells. Two separate probes were used with the Model 40 in order to expedite the work. The Model 90 Borehole Flowmeter was used in four open rock boreholes.

Table 1 and Table 2 present a summary of results. The accompanying site map includes groundwater flow direction and rate plotted as vectors. The number included with each vector indicates the depth below Top of Casing. Refer to Section 5.10 for a discussion of the results. Refer to Appendix D for a copy of the groundwater flow worksheets.

TABLE 1

Well #	Depth ft.BTOC	°MN / Direction	Rate ft./d	Comments
GW27S	15	263° W	1.8	x8 sensitivity
	12.5	358° N	1.0	Unstable
	12.5	141° SE	2.15	Duplicate
	17.5	200° SW	1.34	
GW27D	23	230° SW	.6	
	26	255° SW	.54	
	28	275° W	1.36	
GW62S	13	335° NW	.84	
	13	351° N	.80	Duplicate
	7	359° N	.44	
	7	348° N	.31	
GW62M	37	221° SW	1.78	
	37	220° SW	1.42	Duplicate
	33	229° SW	13.8	Duplicate
	33	214° SW	18.0	
GW62D	68	96° E	.45	
	68	89° E	.69	Duplicate
	64	93° E	.62	
	64	85° E	.47	Duplicate
GW44S	5.5	41° NE	.07	In casing
	13	356° N	.22	
	13	7° N	.17	Duplicate
	17	46° NE	.35	
	17	38° NE	.27	Duplicate
GW44D	58	87° E	1.02	First reading
	58	81° E	.10	Duplicate
	63	205° SW	2.8	First reading
	63	250° SW	.47	Duplicate
GW43S	1	315° NW	3.45	
	1	323° NW	3.41	Duplicate
	15	330° WNW	2.40	
	15	296° NNW	2.95	Duplicate
GW43D	27	78° ENE	1.4	
	27	118° ESE	1.1	Duplicate
	32	75° ENE	4.2	
	32	80° ENE	3.2	Duplicate
GW45S	15	223° SW	2.83	
	15	220° SW	3.10	Duplicate
	19	200° SSW	2.02	
	19	220° SW	2.64	Duplicate

Table 1 Continued

Well #	Depth ft.BTO C	°MN / Direction	Rate ft./d	Comments
GW45D	55	278° WNW	.60	
	55	280° WN	1.1	Duplicate
	60	320° NW	.57	
	60	321° NW	.59	Duplicate
GW42S	16	205° SW	.97	
	16	195° SSW	.70	Duplicate
	12	236° SW	.62	
	12	192° SSW	.85	Duplicate
GW42D	41.5	36° NE	.60	
	41.5	35° NE	.60	Duplicate
	36.5	18° NNE	.40	
	36.5	93° E	.40	Duplicate
	36.5	230° NW	.40	Duplicate
GW58D	77	318° NW	.60	
	77	324° NNW	.61	Duplicate
	72	236° SW	.40	
	72	311° NW	.50	Duplicate
GW58S	25	248° WSW	2.17	
	25	248° WSW	2.05	Duplicate
	21	286° WNW	1.47	
	21	289° NW	1.55	Duplicate
GW50D	37.5	337° NNW	.60	
	37	332° NNW	.60	
	32.5	332° NW	.30	
	32.5	331° NW	.60	Duplicate
GW50S	8	235° SW	1.28	
	8	149° SE	3.06	Duplicate
	12	190° SSW	7.98	
	12	168° SSE	3.52	Duplicate
GW30DR	37	308° NW	1.6	
	37	288° WNW	1.6	Duplicate
	33	81° E	45.	Off scale
	33	58° NE	6.75	Duplicate
GT6S	7	2° N	1.82	
	7	325° NW	2.79	Duplicate
GT6D	25	198° SSW	.93	
	25	140° SE	.70	Duplicate
	29	308° NW	.38	
	29	237° SW	.23	Duplicate

Table 1 Cotinued

Well #	Depth ft.BTO C	°MN / Direction	Rate ft./d	Comments
GW36	30	56° NE	3.5	
	30	304° NW	1.8	Duplicate
	34	274° W	2.6	
	34	257° W	1.0	Duplicate

TABLE 2

Well / Depth	Peak Time	Peak Temp	Flow cc/Min	Calibration Curve Direction
WELL 80BR				
35	86	11.4	.1	Up
40	17.9	-16.1	.2	Down
	104.6	11.7	.1	Up
	92.2	10.1	.1	Up
45	57.2	-12.3	.1	Down
	33.9	-14.2	.2	Down
	32.5	-14.5	.2	Down
	54.2	12.2	.1	Up
	40.5	-12	.1	Down
50	55.4	-17.1	.2	Down
	27.8	-10.5	.1	Down
50	15.2	-13.9	.1	Down
55	32.7	-10.6	.1	Down
	59.4	-10.7	.1	Down
	22.7	56.3	.6	Up
60	65.5	10.4	.1	Up
	54.4	13.3	.1	Up
	137.4	10.9	.1	Up
Note: Train passes <100 ft. away				
WELL GW68 BR				
45	5 Min	-9.9	.1	Down
	130 Sec	-6	.05	Down
	73 Sec	-9	.1	Down
55	80 Sec	-18	.2	Down
	136.8 Sec	-11	.15	Down

Table 2 Continued

Well / Depth	Peak Time	Peak Temp	Flow cc/Min	Calibration Curve Direction
WELL GW68 BR				
55	1.5 Min 90 Sec	02	0	Down
65	2 Min	-14	.2	Down
	1 Min	-11	.15	Down
75	3 Min	-24	.3	Down
	4 Min	-20	.2	Down
	2 Min	-29	.3	Down
WELL GW62 BRD				
118.5	44.4	-30.3	.35	Down
	59.1	-30.4	.35	Down
129	52.2	-28.2	.3	Down
	17.4	-21.5	.3	Down
	46.3	-26.9	.3	Down
	31.4	-22.3	.3	Down
139	10.7	-25.1	.3	Down
	31.3	-27.3	.3	Down
	49.3	30	.35	Up
	33.6	-45.6	.45	Down
139	54	25.1	.3	Up
	58.6	-26.6	.3	Down
WELL GW62 BR				
80.5	49.5	319.1	29.9	Up
	46.8	439	32.4	Up
	33.4	-20.4	.3	Down
	51.2	-32.4	.35	Down
	35.5	-22.9	.3	Down
90	4.0	-22.2	.2	Down
	.4	20	.2	Up
	19.2	26	.2	Up
100	46.2	24.2	.2	Up
	38.8	-28.0	.1	Down
	57.8	-26	.2	Up

5.10 DISCUSSION

Measurements were made at several depths within the wells - usually at five foot intervals. Often they revealed a shallow flow direction differing from the deeper flow regime. In the easternmost region, shallow flow occurred in a south easterly direction while deep flow moved down a bedrock valley dipping towards the west.

A series of vector plots of flow rate, direction and depths is presented on a site map. Velocities commonly ranged ten-fold .17 to over 3.10 ft/day across the site. At monitoring well GW62M velocities over 10 ft/d were encountered in shallow (33-37 ft) zones. This well may be influenced by a municipal pumping well situated near the wetlands.

There appeared to be evidence of a shallow (0-15 ft below static water) groundwater divide near monitoring wells GW27 located south of the Olin Plant. East from this location, shallow groundwater flowed in a southeasterly direction as indicated by GW50S. From GW27, shallow groundwater flowed in a north westerly direction down a buried valley contour, branching laterally as it reached the vicinity of Main Street.

A recovery well or some other withdrawal or recharge event may be occurring near GW30DR, shown by an anomalous northeasterly flow at 33 ft depth.

With the exception of GW43D, deeper flow progressed down the sunken valley at a much lower velocity (0.2 ft/d - 3.0 ft/d) than the shallow flow. Individual flows, or their vector sums, greater than 30 ft below grade headed downward towards the central axis of the northwestern tilted valley floor.

APPENDIX A

TECHNICAL PUBLICATION BACKUP MATERIAL

KVA ANALYTICAL SYSTEMS

TECHNICAL PUBLICATION

#72

GROUND WATER CONTAMINATION:

FIELD METHODS

HEAT PULSE GROUNDWATER FLOWMETER

ASTM SPECIAL TECHNICAL PUBLICATION 963

KVA ANALYTICAL SYSTEMS
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Ground-Water Contamination: Field Methods

A symposium sponsored by
ASTM Committees D-19 on Water
and D-18 on Soil and Rock
Cocoa Beach, FL, 2–7 Feb. 1986

ASTM SPECIAL TECHNICAL PUBLICATION 963

A. G. Collins, National Institute for
Petroleum and Energy Research, and
A. I. Johnson, A. Ivan Johnson, Inc.,
editors

ASTM Publication Code Number (PCN)
04-963000-38

1916 Race Street, Philadelphia, PA 19103

William B. Kerfoot[1]

Monitoring Well Construction, and Recommended Procedures for Direct Ground-Water Flow Measurements Using a Heat-Pulsing Flowmeter

REFERENCE: Kerfoot, W. B., "Monitoring Well Construction, and Recommended Procedures for Direct Ground-Water Flow Measurements Using a Heat-Pulsing Flowmeter," *Ground-Water Contamination: Field Methods, ASTM STP 963*, A. G. Collins and A. I. Johnson, Eds., American Society for Testing and Materials, Philadelphia, 1988, pp. 146–161.

ABSTRACT: Direct flow measurements using heat-pulsing techniques provide an accurate and economic method of determining direction of ground-water flow. The use of this method requires that care be taken in choice of well screen, methods of installation, measurement procedure, and method of data handling. The influence of well slot number, slot size, and screen configuration is explained. Drilling without using drilling fluid additives is recommended for installation. The use of coarse sand instead of gravel packing for the annular region also improves readings. Hydraulic conductivity and field porosity variation in annular packing versus the natural stratum is dealt with by a new calibration procedure. The use of vector analysis for this data handling is recommended. A procedure involving convergence of down-gradient direction and mean vector sum for direct flow measurement is offered to provide answers to the old question of whether enough wells have been installed for understanding flow in the natural stratum.

KEY WORDS: ground water, flowmeters, monitoring well, screen design, measurement, field procedures

Direct flow measurement offers the convenience of rapid simultaneous determination of ground-water flow direction and rate for subsurface engineering applications. A heat pulse is transmitted through a porous glass medium in the probe. Interstitial water modifies the heat distribution between paired thermal sensors, yielding a linear response to increase in flow rate. A more detailed discussion of the theory of the heat-pulsing technique can be found in Melville, et al. [*1*].

The ability of the heat-pulsing technique to detect and measure flow rates below 0.35×10^{-7} m/s (0.1 ft/day) has been verified in a number of test conditions [*1–3*]. However, the accuracy of determination of the flow in the water-bearing strata depends greatly on the nature of the penetration into the strata. The choice of well screen, consistency of material placed between the well and the natural strata (annular packing), method of drilling, and centralizing of the screen play a large role in obtaining appropriate readings. The well and its surroundings become a crucial interface in channeling the natural flow across the well orifice in such a way as to be easily interpretable. The following text briefly describes preferred well conditions, flowmeter calibration, and field procedures found during five years of survey applications, principally in glacial till and outwash deposits.

The complete procedure for successful well installation and measurement can be reduced to six steps (Fig. 1):

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Well screens have previously been chosen from a practical standpoint by the well driller from what was closest at hand or from the most convenient distributor in the locale with the greatest discount. For direct flow measurement, far more care must be exercised in well screen selection to avoid distortion of field flow and to assure adequate flow rates across the screened area. The type of well screen can have considerable influence on the accuracy of the ground-water flow measurements performed inside the screen [*4*]. Installation of sections of pipe consisting of random hand-drilled rows of holes or intermittent horizontal hacksawing creates distortions of flow over 40 deg and potential 100-fold rate variations, depending upon whether the thermal sensor is opposite a hole or a blank space.

A variety of commercial smooth interior wire-wound, continuous slot plastic [polyvinyl chloride (PVC)] screens and stainless steel wire-wrapped screens has been found satisfactory for sensitive measurements (Fig. 2). The preferred diameters have been 5-cm (2 in.) and 10-cm (4 in.) internal diameter screens. Although probes and well screens exist for 3.8-cm (1.5 in.) PVC, the reduction in intercepted cross section is considered undesirable for flow direction determinations.

The commonly used 5-cm (2 in.) internal diameter schedule 40 ASTM plastic screens (PVC) should possess the following characteristics:

1. Continuous slot.
2. Slot orientation: perpendicular to axis of casing.
3. Slot distance: 0.6 cm (0.25 in.) or less.
4. Slot rows: greater than 3 or continuous slot.
5. Flush jointing.

See Table 1 for some common commercial 5-cm (2 in.) PVC screens which fit these criteria.

The number of rows of slots in 5-cm (2 in.) internal diameter PVC monitoring wells has a significant influence on the accuracy of the ground-water flow direction, inferred from the interscreen direction [*4*]. Figure 3 plots the accuracy of flow direction determinations inside the well relative to the true flow outside the well against the number of rows of slots. As the number of rows of slots increases, the accuracy of measurement increases markedly.

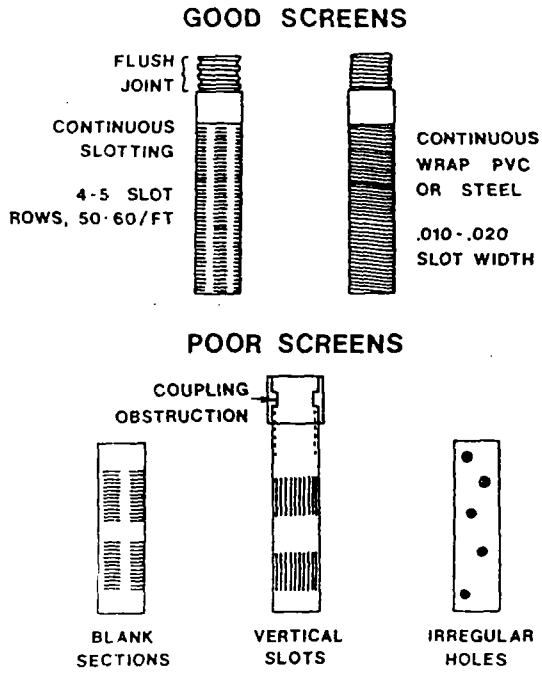

FIG. 2—*Preferred and problem screen types for direct ground-water flow measurement.*

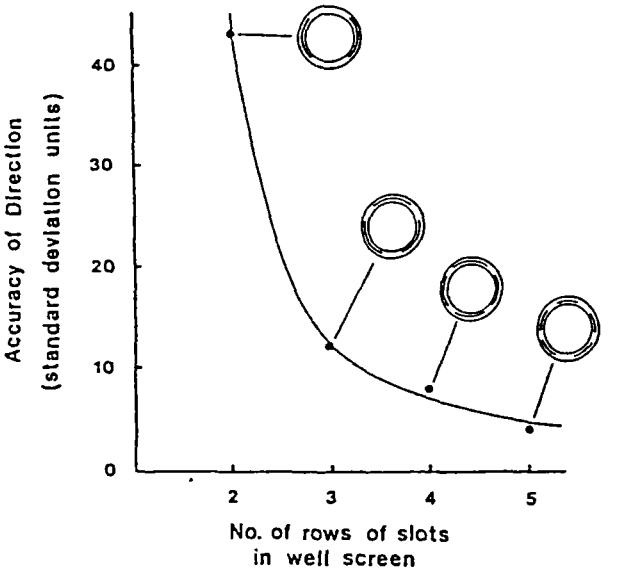

FIG. 3—*Accuracy of flow direction measured in well screen compared to actual external flow direction.*

slot width results in about a 50% increase in internal flow compared to its 5-cm (2 in.) internal diameter four-slot row counterpart.

Emplacements in hydrocarbon products should have their screens checked beforehand for swelling or dissolution if PVC is planned for use. A 5-cm (2 in.) section should be placed in a glass container with the product for 24 h, visually inspected, and poked with a pointed object to test for softness. Complete closing of 0.25-mm (0.010 in.) slots has been encountered with one

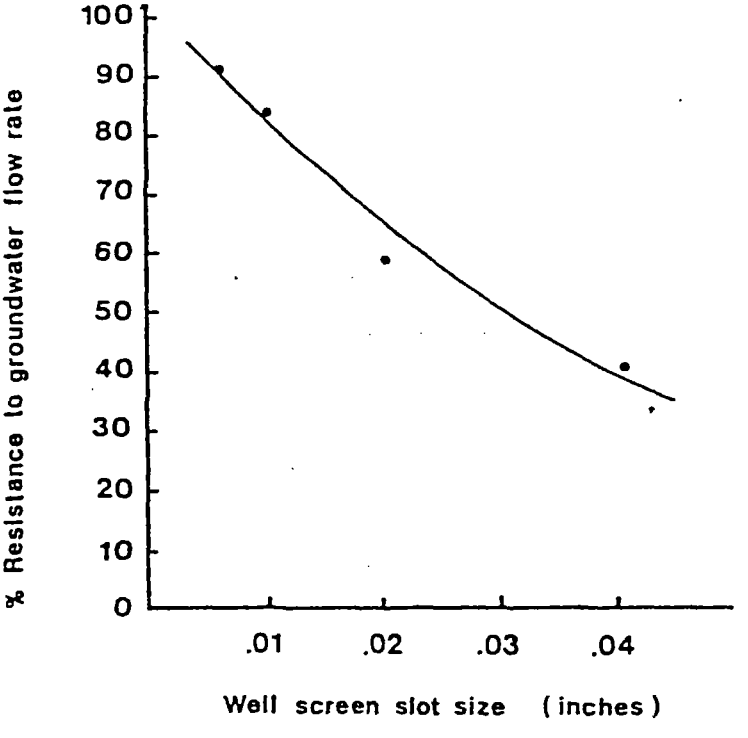

FIG. 4—*Well slot size and resistance to flow.*

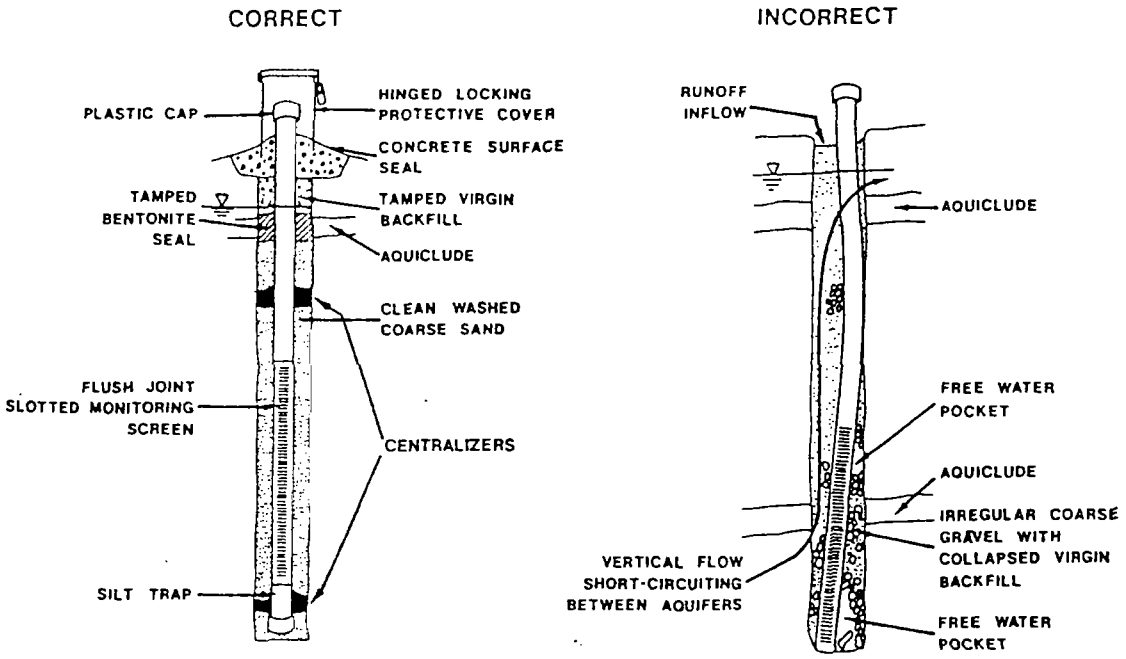

FIG. 5—*Ideal and poor well installations for direct flow measurement.*

It is also important to centralize the casing. If the casing bends and positions the screen against the wall, it can shield the immediate region from the annular packing (Fig. 5). Several commercial centralizers are available, both solvent welded and metal. Avoiding channelization around the slotted casing is extremely important. Small channels along a section of the screened area can invalidate the instrument response.

The best strategy for confined aquifers has been similar to recommended methods for emplacement of piezometers: (*a*) Use limited screen length [1.5 to 3.0 m (5 to 10 ft) at maximum] between confining layers; (*b*) seal with bentonite at penetration points of casing through any confining layers; and (*c*) use clusters of individual screens rather than multiple screens on a single casing to avoid inducing vertical movement of water up casing between confining layers under different head pressures.

Calibration of the Meter

Ground-water flowmeters are equipped with a control box and field probe. The unit is powered by rechargeable gel-cell batteries. The field probe of the Model 30 GeoFlo meter is 4.44 cm (1.75 in.) in diameter, suitable for 5-cm (2 in.) slotted PVC monitoring wells.

Electronic ground-water flow measurement is based upon thermal transmission within a porous solid under the influence of interstitial liquid flow. The controlling factors are thermal conductance of the solid and liquid phases, surface area of the solid phase, thermal transfer coefficient of the liquid phase, and rate of movement of the liquid phase.

For example, with a porous solid phase of glass beads with distilled water, the thermal conductivity of the glass is about 0.023 cal/(s)(cm^2)(°C/cm) while that of the water is 0.0015 cal/(s)(cm^2)(°C/cm). The principal heat transfer occurs between the zones of contact of the glass beads, a small point surrounded by a thin interface of water. The slightest movement of the liquid during the period of heat transfer can profoundly influence the conductance. The GeoFlo flowmeter creates a heat pulse which is transmitted through the porous matrix. Any net movement of the interstitial water mass creates a thermal conductance bias which is linearly proportional to the rate of flow (Fig. 6).

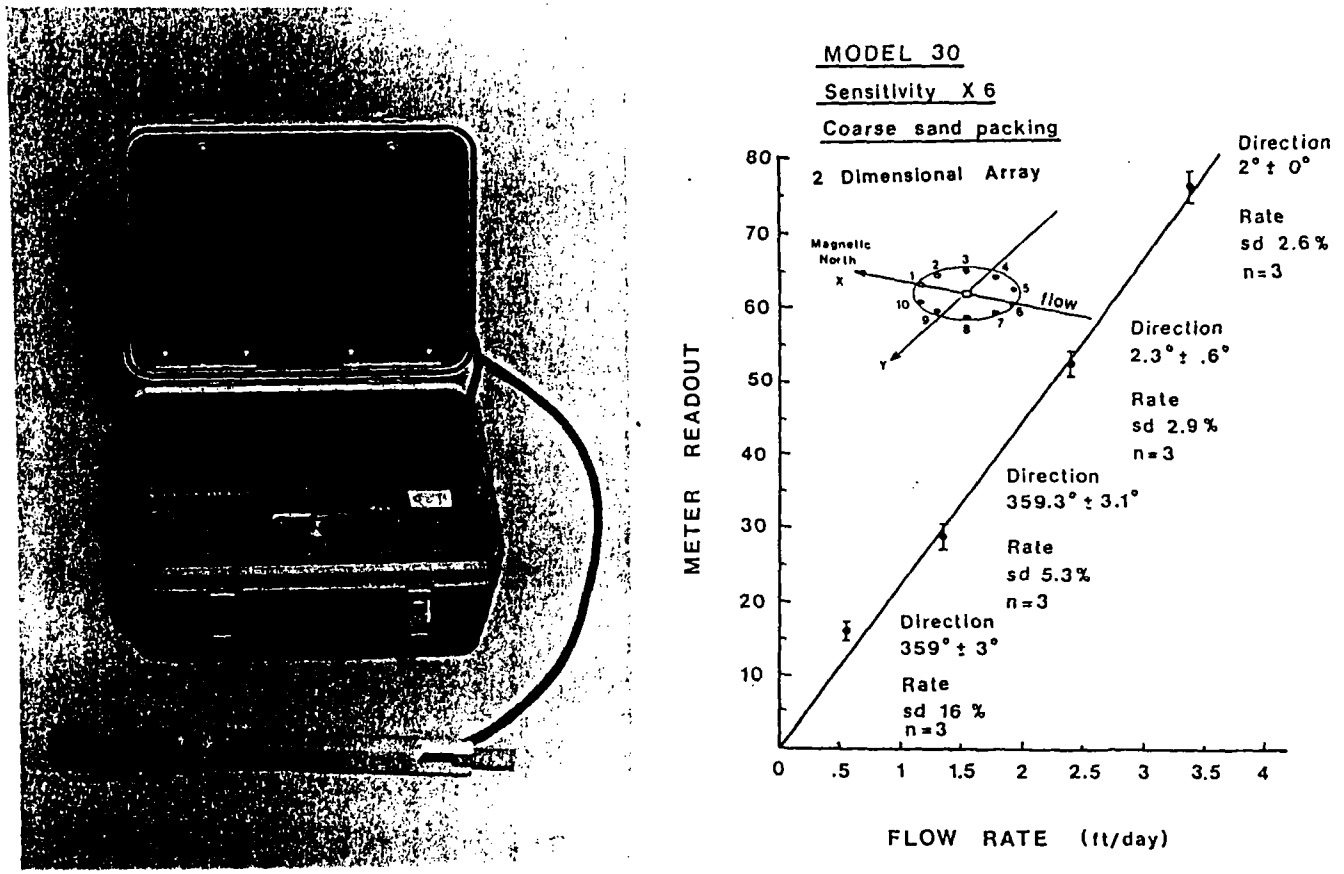

FIG. 6—*GeoFlo® Model 30 ground-water flowmeter showing calibration curve and arrangement of thermal sensors [2,6]. Probe is inserted into porous fiber packer.*

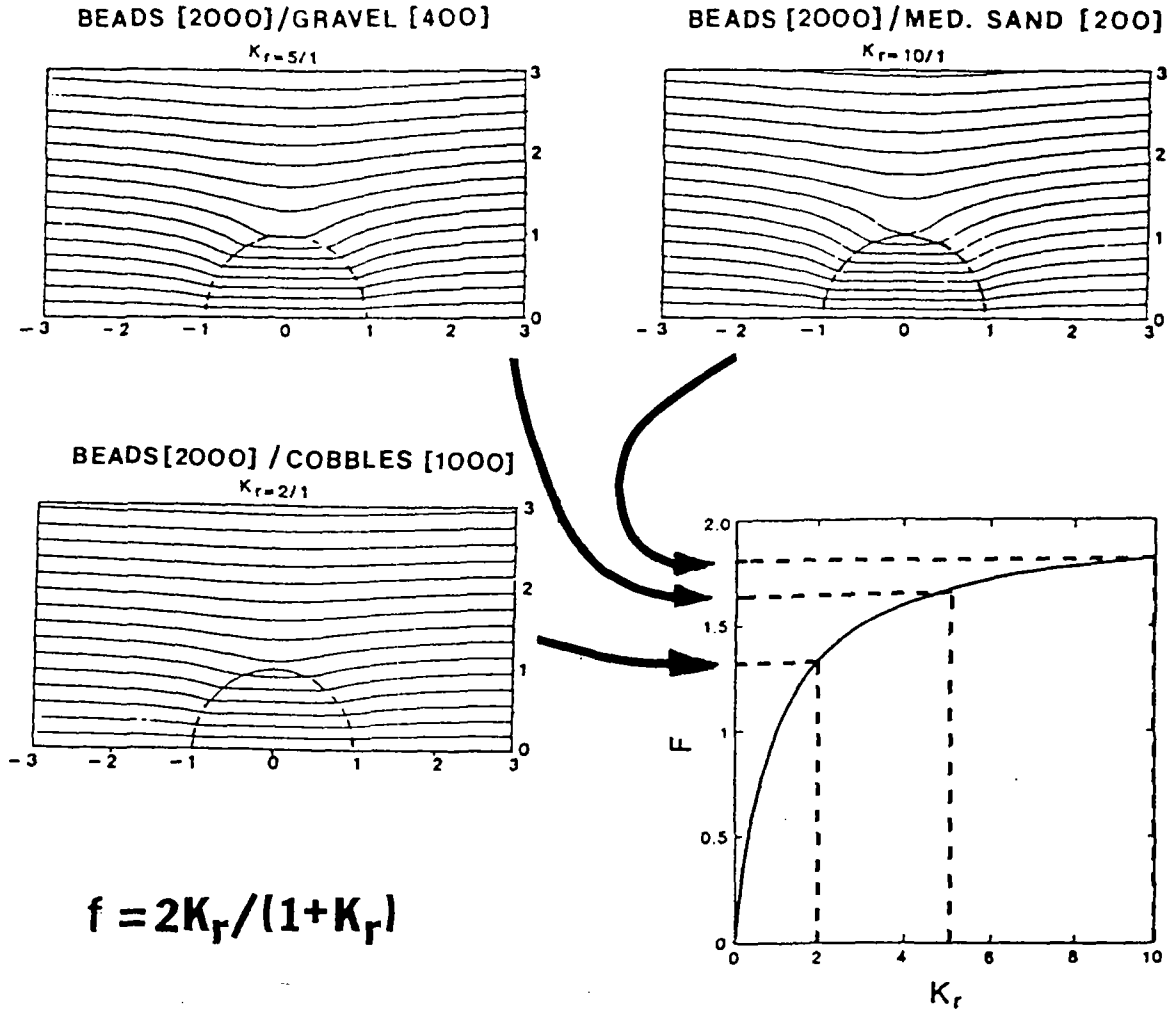

FIG. 8—*Correction factor (f) for hydraulic conductivity contrasts between internal glass bead packing [7 × 10⁻³ m/s (2000 ft/day)] and common geologic units.*

Vector Resolution

The probe is inserted and its orientation controlled by snap-connect hollow aluminum rods when taking flow measurements down the well. The porous fibers of the packer surrounding the probe maintain contact with the sides of the screen. The cable should be secured to the rods by PVC tape as sections are lowered. When the desired depth is reached, the top section is secured by a

TABLE 3—*Hydraulic conductivities.*

	Hydraulic Conductivity	
Geologic Unit	m/day	(ft/day)
Fine sand	15	(50)
Medium sand	46	(150)
Coarse sand	91	(300)
Gravel	137	(450)
Cobblestones	182	(600)

degrees of angle around the edge of the polar graph paper, or (*b*) adding the component vectors head to tail and drawing a line from the origin to the point of the final vector. For rate by both methods, in the first (*a*) circular array procedure, the diameter of the circle is directly proportional to flow. In the second method, the length of the line is divided by 2.7. This geometric constant results from dividing a circle into 36-deg arcs from a single point on its circumference, adding the straight-line segments retaining their original angle (vector addition), and dividing the resultant distance (sum of vectors) from the single point to the end of the segments by the diameter of the circle.

The length of the diameter of the circle is then compared with the original calibration curve to translate the proportional machine response to the rate of flow in the formation at the measured depth in the well.

The newer flow worksheets include the use of 180-deg rotation of probe to offset any bias which may have occurred due to position of the sensor pair to the heater tip. Continual use of the probe and its movement through irregularly shaped sections of well casing may move one of a pair of thermal sensors farther away from the heat source than the distance of the second pair. The rotation procedure completely compensates for any position bias. The use of porous fiber packers, which provide additional protection for the probe, also reduces bias interference.

Common Measurement Problems

When the probe is inserted below the static water level in the well, water is displaced upward, creating a displaced slug of water which recharges along the length of the well screen. The invading water flows into the most permeable formation, regardless of the regional flow pattern. The most pronounced impact usually occurs at the top of the screen. This phenomenon is most apparent in tighter soils, like silty sands, which have long periods of decay for the displaced water head. There are two procedures which make the user aware of the "slug effect" and how to compensate for it. First, take replicate measurements. The second measurement should duplicate in direction and rate the original measurement if no interference is present. Second, the user can start taking measurements near the bottom of the well screen and come up, rather than the reverse.

The probe should not be put on the bottom in any silty deposit. The compaction of silt will squeeze interstitial water outwards, causing another type of interference: compression flow. This phenomenon is also evidenced when the user is standing near a probe emplacement with 10 cm (4 in.) or less of unsaturated soil above static water. The weight of compaction will induce a local flow bearing no relationship to flow in the region.

In reviewing cases of flowmeter field use, a number of instances were found where the probe was placed down the well and rested on the bottom. This was due either to forgetting a clamp or naivete. The movement of water during measurement time (3 min with a Model 30 GeoFlo meter), if the natural transport velocity is 1.7×10^{-6} m/s (0.5 ft/day), is only 0.13 cm (0.05 in.), below the usual capacity of the eye to perceive motion. Securing the probe to the top of the well with vinyl or rubber tape is not satisfactory since the weight of the rod and probe assembly will slowly stretch the tape, hardly visible to the eye, but significant to the probe.

In layered glacial deposits or any highly permeable deposits [hydraulic conductivity (K) greater than 30 m/day (100 ft/day)], the most common error during field operations comes from not taking enough measurements at different intervals along the well screen. It is not unusual to encounter a ten-fold variation in flow from one horizon to the next. Using a coarse sand annular pack can help to average the flow, but usually a minimum of three measurements are taken in 1.5 to 3 m (5 to 10 ft) well screens.

The individual measurements must be treated as vectors to determine the mean flow and direction across the intercepted cross section of the well screen, not as arithmetic numbers which are added and divided by the number of observations. In other words, the observation (*a*) should be taken

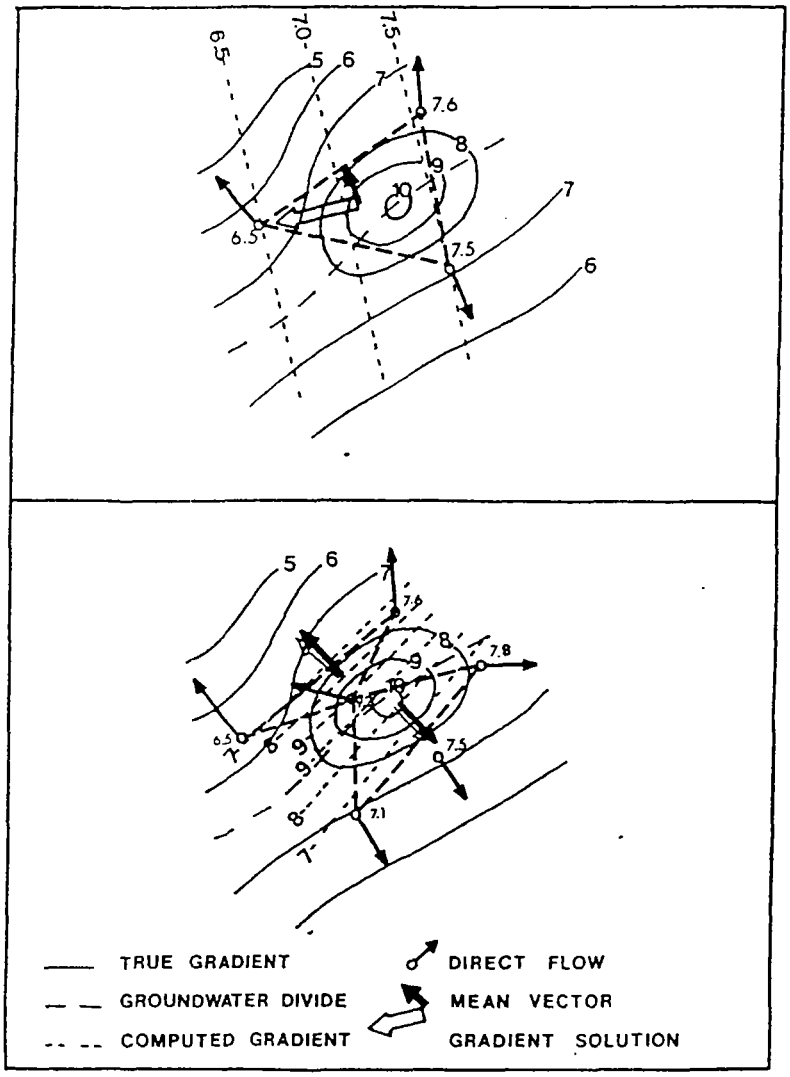

FIG. 11—*Convergence method for determining adequacy of measurement points.*

in the choice of well screens, means of installation, measurement procedure, and choice of data handling. In summary, five years' experience with direct flow measurement has produced the following helpful guidelines:

1. Optimal PVC well screens have four or greater rows of slots or continuous slotting.
2. It is better to use coarse sand annular packing to reduce silt infiltration into the screen, rather than change to a smaller slot size in the screen which would decrease internal flow.
3. Dry drilling rather than wet drilling techniques are necessary to avoid aquifer occlusion.
4. It is necessary to maintain porous flow conditions across the entire well screen. Pockets of free water interfere with measurement.
5. Hydraulic conductivity contrasts can be corrected by careful calibration.
6. Vertical currents in the well should be avoided by bentonite sealing of the annular area.
7. Flow measurements should be treated as vectors, not as arithmetic quantities.
8. Vector and static water elevations can be used to test adequacy of number of holes by convergence of downgradient and mean vector sum.

KVA ANALYTICAL SYSTEMS

TECHNICAL PUBLICATION

#67

DIRECT READING BOREHOLE FLOWMETER RESULTS IN FIELD APPLICATIONS

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Presented at the Fifth National Outdoor Action Conference
on Aquifer Restoration, Ground Water
Monitoring and Geophysical Methods,
May 13 - 16, 1991
Las Vegas, Nevada

DIRECT-READING BOREHOLE FLOWMETER RESULTS IN FIELD APPLICATIONS

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ABSTRACT

A direct-reading heat-pulse flowmeter has been used in a variety of bore holes to measure natural vertical flow or small volume pumped flow. The heat pulse flowmeter uses a flexible packer to fill the annular region; the meter can be rotated to open apertures for movement up and down the borehole. The flow cell has been designed to measure flows over an exceptionally broad range from .1 to 10,000 ml/min. Aluminum rods interconnect to provide positive control over depth and aperture selection.

Fractured rock yields flow at discrete locations along the borehole. High inflow zones cause abrupt changes in direction, or under pumping, result in an abrupt change in volume. By plotting the differential of flow rate, the location can be shown and the inflow or outflow determined. A computer program has been devised to depict borehole flow characteristics. The procedure is compared to previous methodologies of depiction of flow found in the literature.

Fairly commonly, flow at the point of entry of the fracture or bedding plane is not found to be constant but oscillates. The regularity of the frequency may be related to piped flow. An example of simple pipe flow which may induce oscillations is presented.

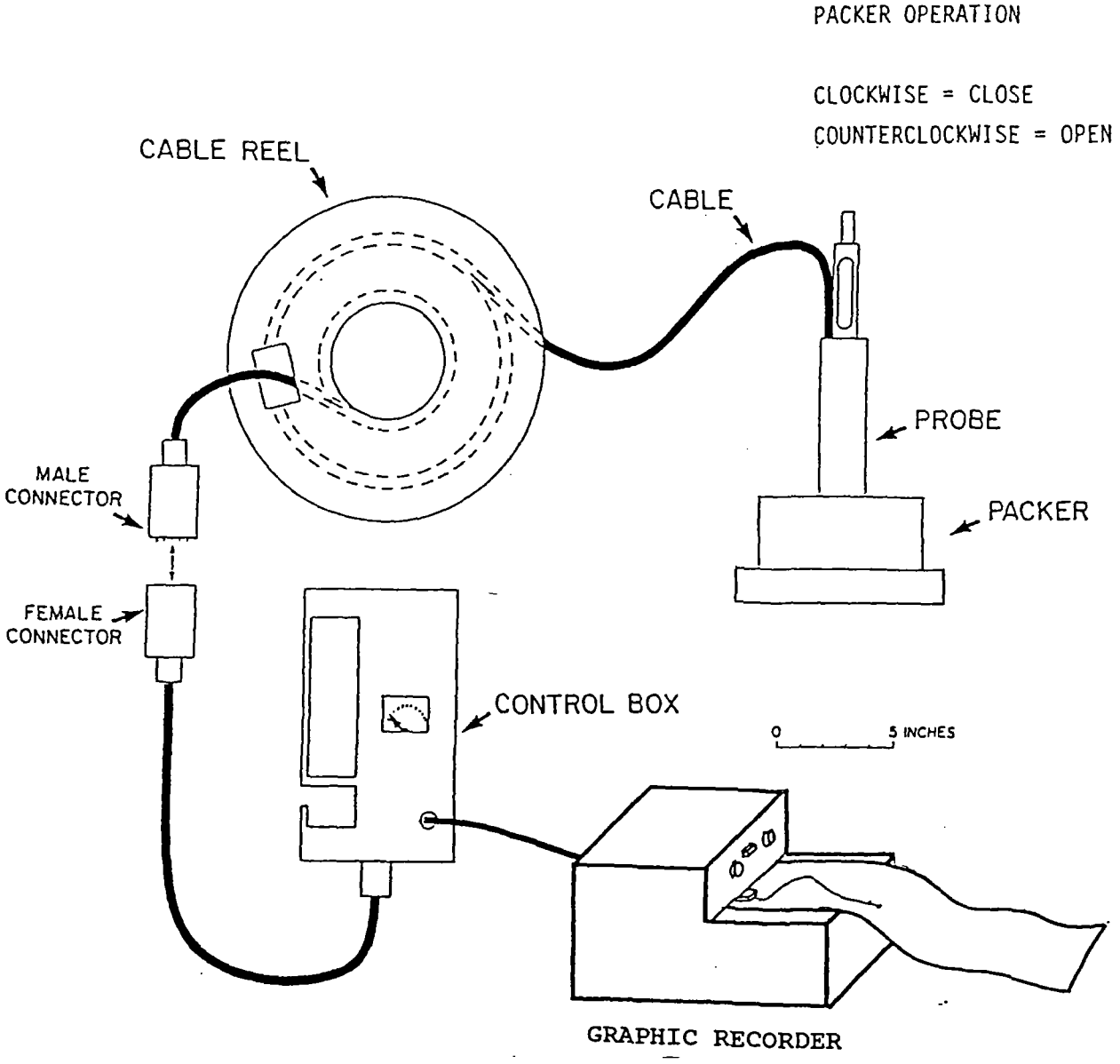

Figure 1. Schematic diagram of the Model 80 Borehole Flowmeter

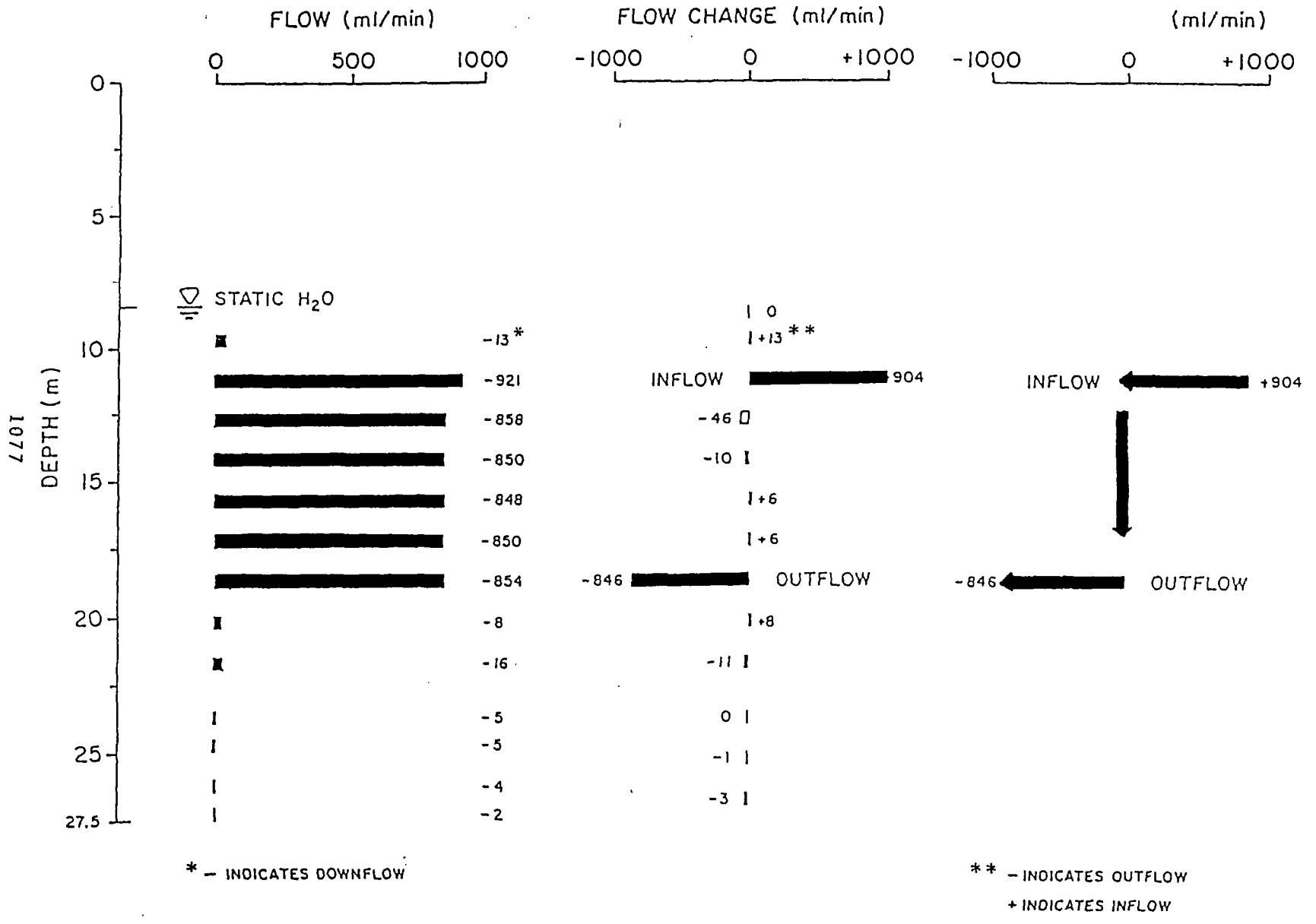

Figure 2 Flowmeter recordings at test borehole.

The second column in Figure 2 shows the differential (or difference) of flow as a histogram. Only two fractures were responsible for the majority of water flow in the open borehole. The induced vertical flow reached a maximum of 921 ml/min., about 96m (321 ft.) per day downwards. Daily, this would transport 345 gallons vertically. The two regions (inflow and outflow) plot in opposite directions.

A third column is added to produce a mass flow diagram using the second column differences. Here the differences are treated as vectors (arrows added to the magnitude of difference) and, importantly, the direction of flow indicated down the borehole. The result is a diagrammatic representation of water movement into, through, and out of the borehole. In this particular case, the upper source of flow was perched water in weathered material above a relatively impermeable limestone deposit. The borehole connected the upper zone to a highly permeable bedding plane and transmissive zone located at about 18m beneath top of casing.

Complex Vertical Flows

Flow in boreholes can become complex to analyze and depict graphically. The two boreholes (A and B) shown in Figure 3 are such examples.

Borehole A was an active hole for flow. Static water level occurs in the upper cased section. The bottom half of the hole is dominated by upflow which enters in two regions, about 320 ft. and about 285 ft. below TOC (38 ml/min and about 100 ml/min). The flow continues upwards until about 135 ft. below TOC where about 100 ml/min exits. A small flow (about 12 ml/min) continues upwards until 75 and 40 ft. below TOC. Where the remainder of upwards flow exists. A small flow (5 ml/min) occurs downwards from the base of casing at 25 ft. below TOC until near 40 ft. where it also exits. The combined outflow would be about 12 ml/min. Since the location is near a dammed river, the elevated river head probably is responsible for the initial downflow which then reverses to discharge upwards to the river bottom. (Points of inflow and discharge are mean locations between measurements unless fracture noted by sensing.)

Borehole B is the most active borehole in terms of flow. A small volume (98 ml/min) flows down from the base of the casing. This then combines with a substantial downward inflow (390 m/min) at about 48 ft. below TOC. The flow doubles again at 75 - 79 ft. below TOC (inflow 410 ml/min). The combined flow continues almost the entire length of the borehole with minor losses at 295 and 315 ft. This may also indicate poor packing rather than any water transfer.

However, at about 342 ft. below TOC, a widening occurs with exiting of all vertical downwards flow (probably 800 ml/min) This outflow is also combined with upflow (182 ml/min) from the bottom of the hole, resulting in a total discharge of abut 1 liter per minute.

To graphically depict the flows, the depths of entry and exit are placed below or at the base of the vectors. Here the borehole is darkened and vertical flows offset with a right-angle tail from the point of entry or exit. In the case of B, the flow magnitude was too great to depict, so the vector was shortened.

Oscillations of Flow

As opposed to relatively uniformly moving flow measured by direct-reading flowmeters in unconsolidated sediments like sand and gravels, the observed flow in fractured rock commonly exhibits oscillations. This poses the question of what causes the oscillations. Sandy substrate offers a uniform resistance to advancing flow, whereas fractured rock channels have low resistance to flow but highly fragmented pathways, quite analogous to interconnected piping systems. The frequency of oscillations is often observed seconds or minutes during a 10 minute measurement. The oscillation becomes more distinct as the borehole flowmeter is placed immediately adjacent to the cavity or fracture yielding the water inflow.

Very often rocky fractures are dipped, particularly when bedding planes have been subject to metamorphic pressures. Cracks between the beds are at right angles or similar to perpendicular to the tilted strata. Rainwater recharge to the tilted fracture patterns create zig-zag pathways which water enters from surface topsoil and weathered bedrock, depending upon the last precipitation event. The upper portions of the cavities are likely to be partially air-filled. Water trickling down the sides of the cavities partially fills reservoirs before spilling over into sections completely filled with water.

The nature of the upper cracks could be likened to a simple reservoir model, one familiar to anyone who has encountered a leaking toilet bowl. The larger reservoir (A) receives a continuous flow of water from recharge (R). The outlet from the reservoir has a gooseneck discharge, analogous to a right angle small diameter pipe (D). The inflowing water rises to a height above the top of D (head pressure) sufficient to overcome the resistance to flow in D. Then rapid flow occurs, the depth of the water in the central reservoir dipping to level B, governed by the siphon end of the gooseneck K. Water flow attenuates as it approaches B

because of the reduced driving head height. Once B is reached, water discharge slows and the level of water in the reservoir rises again. The discharge subsequently exhibits a continual oscillation despite the constant rate of inflow of the water.

The simple gooseneck oscillation mechanism could explain why flows from fractures commonly exhibit oscillations. The peaks and valleys or flow would not have to be indicative of earth tremors or other exotic phenomena. Interconnections from wide bedding planes through rock strata are often small narrow fractures which appear to duplicate the large reservoir - small right angle discharge analogy. The observed phenomenon is also quite consistent with piping networks and flow theory.

Conclusions

A direct-reading heat-pulse borehole flow meter has been constructed and tested in open boreholes to 120m (360 ft.) depths. The constructed unit appears capable of identifying horizontally-situated solution channels, faults, and bedding planes as it is moved vertically. The presence of the water-bearing zone is shown by an abrupt change in velocity. By taking the difference in mass flow, the location of inflow and outflow zones can be mapped as vector systems.

The use of a polyurethane packer allows the user to feel the resistance of the side of the borehole. Locations of fractures or bedding planes can be noted on the borehole log.

Frequently, the measured signal exhibits oscillations as different harmonics on the heat-pulse signal. The borehole flow clearly is not darcian but fits closer to piped flow. A simple gooseneck system, similar the zig-zag fault pathways can serve as a simple generator of oscillations.

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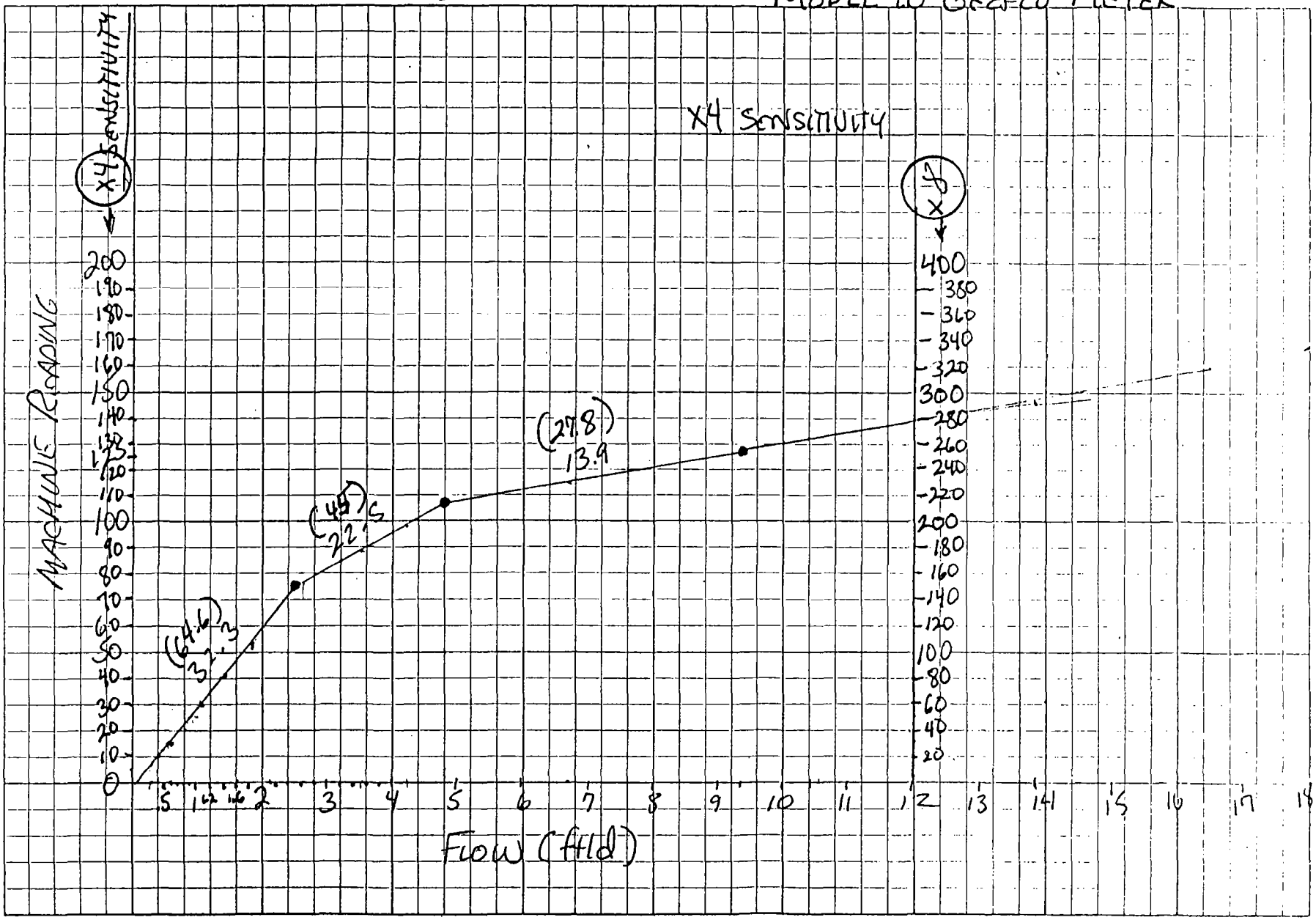
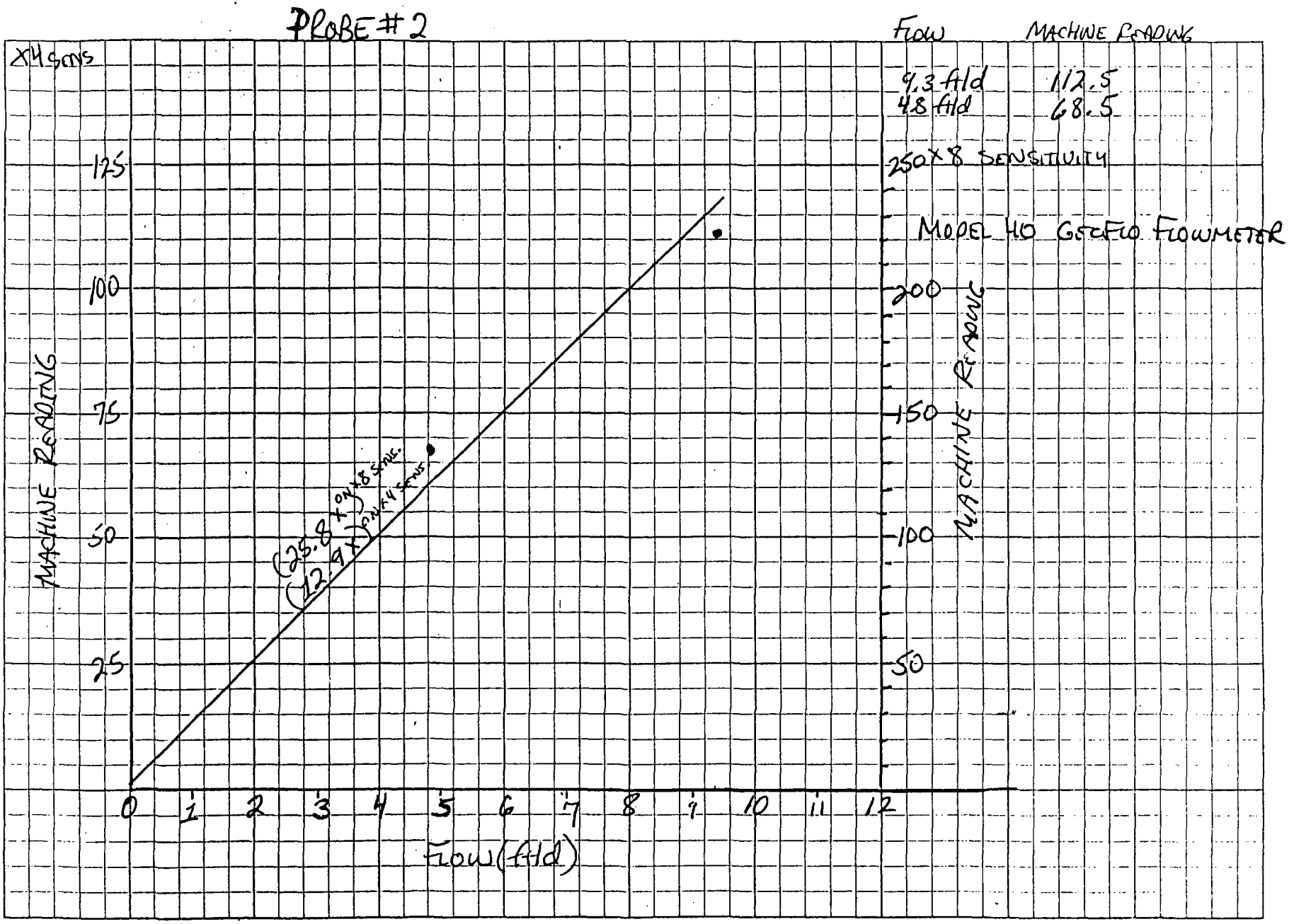
APPENDIX B

CALIBRATION CURVE FOR MODEL 40

PROBE #1

MODEL 40 GEOFLO METER





GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, **4 channel probe**

Model-4C Probe # 1

Operator: Lina Yang Date: 11/17/95

Station: Calibration Time:

Location: 10 Slot

Soil Conditions: F - M Sand

Depth to Measurement:

Table of LCD Readout

1→N

Probe pair	A (start)	B (end)	C (B-A)
+1/-6	-7	+135	+128
+2/-7	-20	+100	-80
+3/-8	+6	-71	-75
+4/-9	+1	-167	-168

10:45 Am

ROTATE PROBE 180° AT SAME DEPTH

1→S

Probe pair	D (start)	E (end)	S (E-D)	F (N-S / 2)	G (F / max. value)
+1/-6	-8	-139	-131	+129.5	
+2/-7	+10	-109	-119	-99.5	
+3/-8	+0	-87	-87	-5.5	
+4/-9	+12	+75	+63	-85.3	

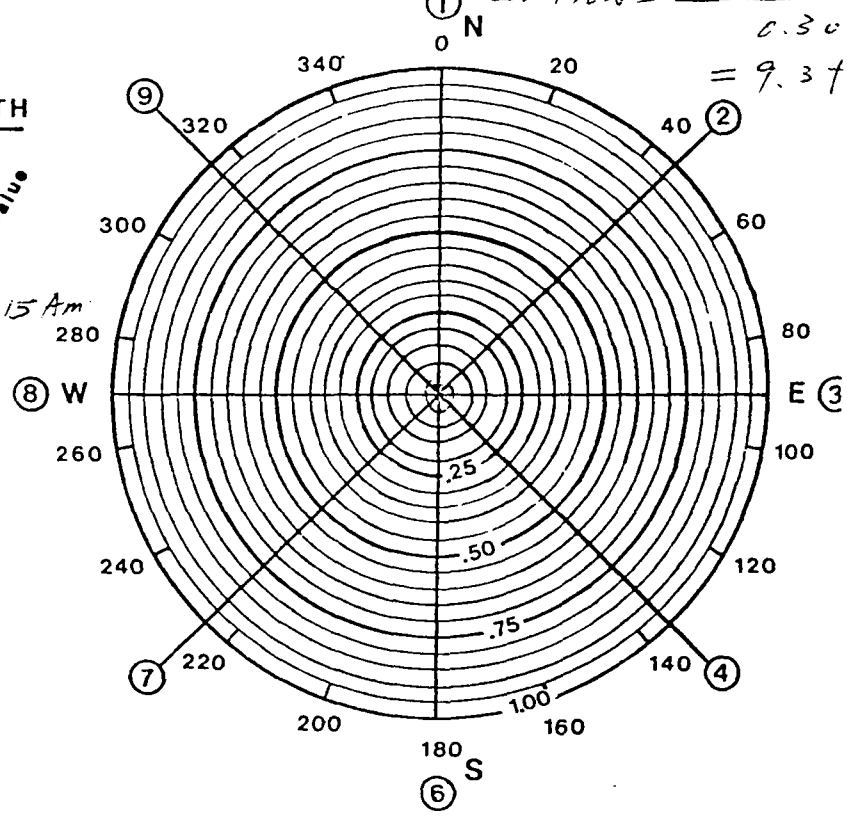
10:15 Am

129.5/9.3 = 13.9

Flow = 0.146 × 19c

0.3c

= 9.3 f

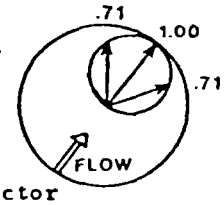


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator:

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day).

Direction: _____ Velocity: _____

Form 104 available from your local K-V Associates, Inc. dealer.

9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, **4 channel probe**

PROBE #1

Operator: Lisa Date: 11/17/95

Station: Calibration Time: _____

Location: 10 slots

Soil Conditions: M-F Sand 10 slots

Depth to Measurement: M+CF Sand 12"

Table of LCD Readout

1→N

Probe pair	A start	B end	C B-A
+1/-6	-3	+105	
+2/-7	-24	+99	
+3/-8	+6	-99	
+4/-9	+4	-96	

0-30 Amp

ROTATE PROBE 180° AT SAME DEPTH

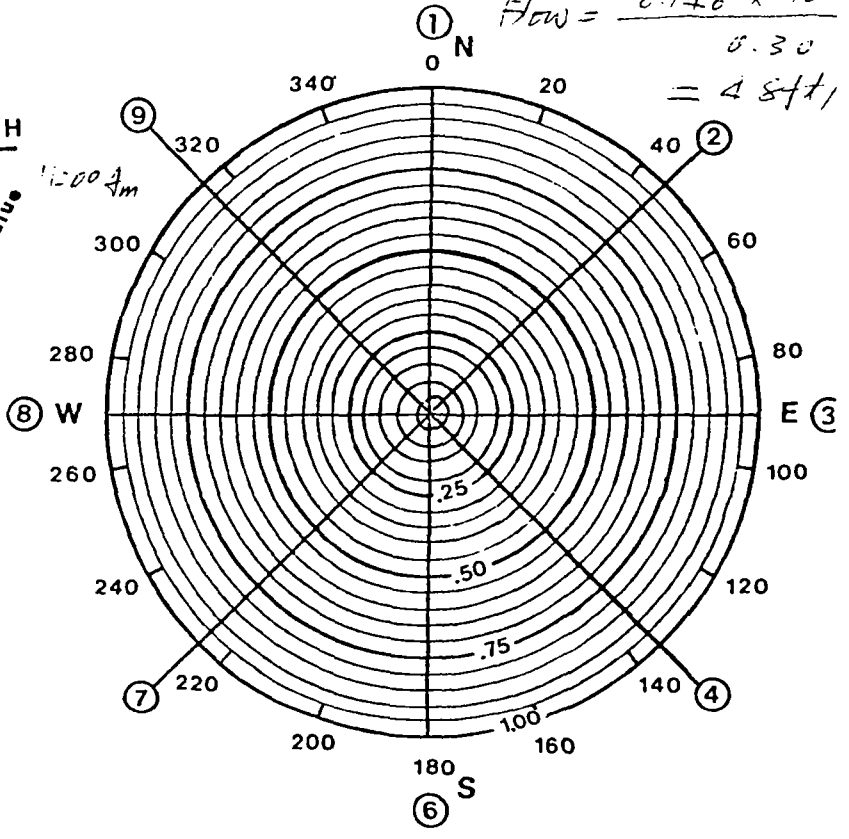
1→S

Probe pair	D start	E end	S E-D	F N-S/2	G F/max. value
+1/-6	+0	-111	-111	+108	
+2/-7	+14	-67	-81	+90	
+3/-8	+3	-116	-119	+10	
+4/-9	+8	+48	+40	-65	

108/4.8 = 22.5

Flow = 0.146 * 100 / 0.30 = 48 ft/d

1000 gpm

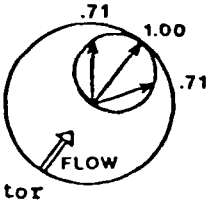


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator:

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day).

Direction: _____ Velocity: _____

Form 104 available from your local K-V Associates, Inc. dealer.

9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, **4 channel probe**

PROBE #1

Table of LCD Readout

1→N Probe pair	A start	B end	C B−A
+1/-6	+4	+112	
+2/-7	+18	+79	
+3/-8	+0	-155	
+4/-9	+2	-111	

11:30 Am

Operator: Lina Date: 11/17

Station: Calibration Time:

Location: 10 Slot

Soil Conditions: Mi-F Sand

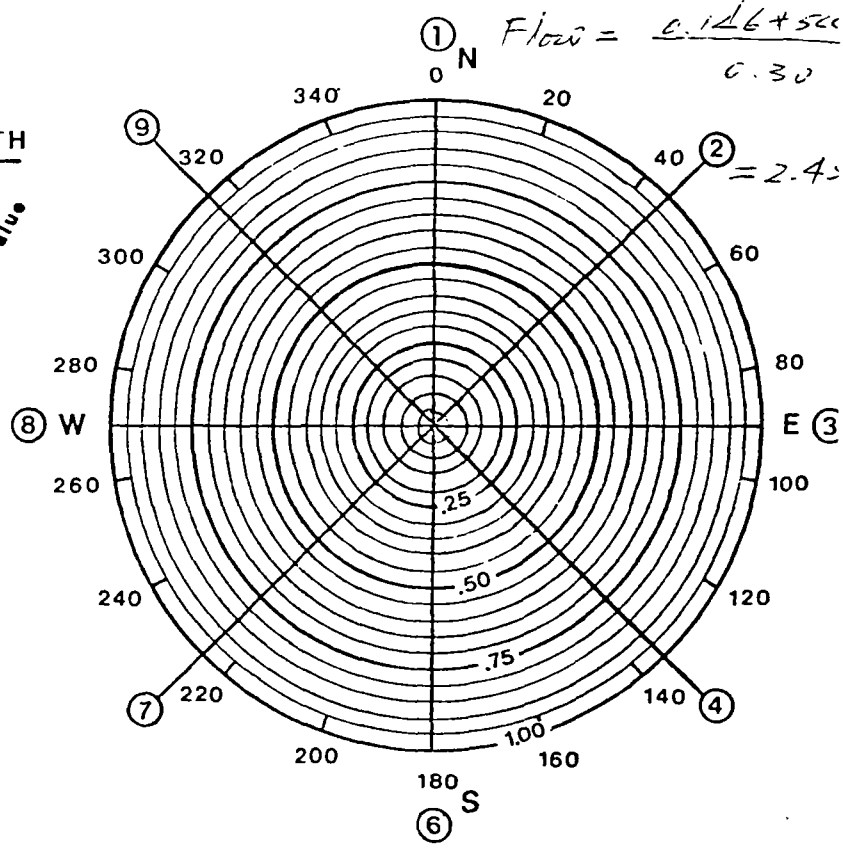
Depth to Measurement: 12"

Flow = 0.126+sec / 0.30

ROTATE PROBE 180° AT SAME DEPTH

1→S Probe pair	D start	E end	S E−D	F N−S / 2	G F / max. value
+1/-6	+4	-45	-49	-78.5	
+2/-7	+9	-23	-41	-5.	
+3/-8	+2	-126	-128	-16.5	
+4/-9	+3	-20	-17	-65	

78.5/2.23 = 35.3

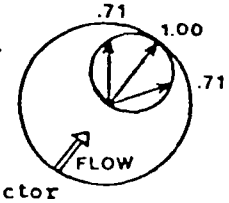


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator:

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day).

Direction: _____ Velocity: _____

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, **4 channel probe**

X1 Model-4 Probe No 2

Table of LCD Readout

1→N

Probe pair	A start	B end	C B-A
+1/-6	+32	+120	-96
+2/-7	+17	+68	+51
+3/-8	-5	-70	-65
+4/-9	+10	-68	-78

2:30pm

Operator: Lina Date: 11/6/95

Station: Calibration Time: _____

Location: 10 sht

Soil Conditions: F - M Sand

Depth to Measurement: 12"

ROTATE PROBE 180° AT SAME DEPTH

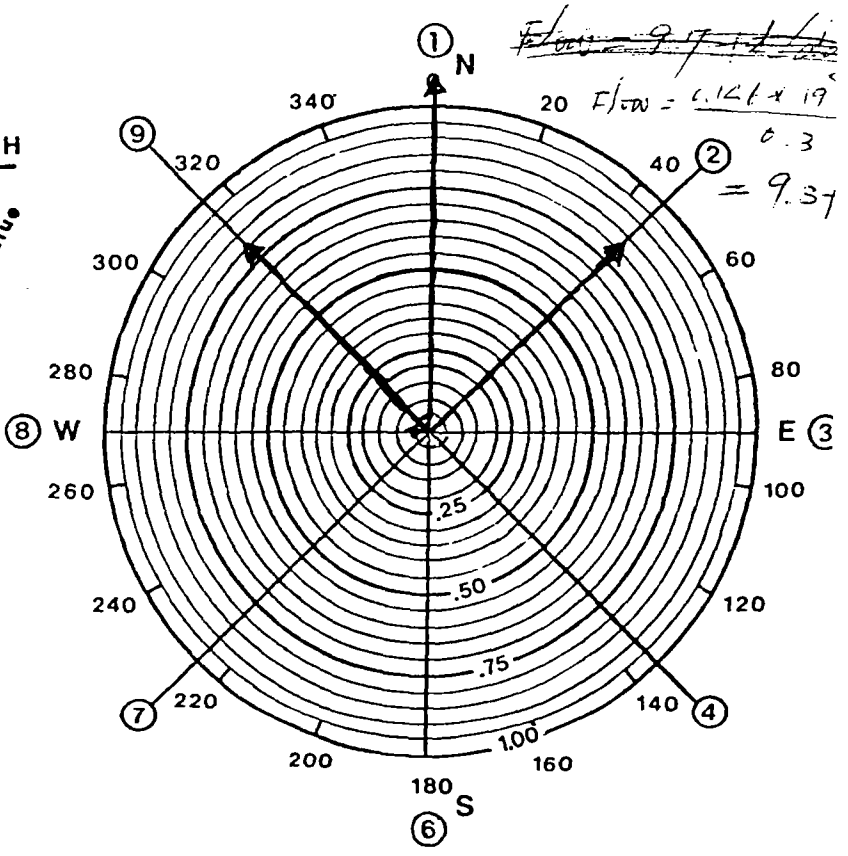
1→S

Probe pair	D start	E end	S E-D	F N-S/2	G F max. value
+1/-6	+77	-22	-129	+112.5	
+2/-7	+6	-115	-115	+83	
+3/-8	-6	-56	-50	-75	
+4/-9	+29	+115	+86	-82	

$$9.7\sqrt{112.5}\ 11.6\times$$

Flow = 9.7 + 1.4

Flow = 0.14 × 19 × 0.3 = 9.37

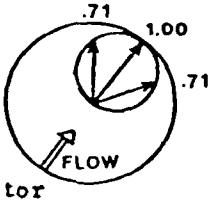


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator:

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day).

Direction: 0° Velocity: 9.37fpd

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

+4

Table of LCD Readout

1→N

Probe pair	A start	B end	C B-A
+1/-6	+14	+73	+59
+2/-7	+4	+48	+44
+3/-8	+0	-63	-63
+4/-9	+24	-48	-72

3:00pm

Operator: Lina Date: 11/16/95

Station: Calibration Time:

Location: 10 S/ft

Soil Conditions: F - M Sand

Depth to Measurement: 12"

Flow = 0.146 x 10 cc/
0.30
= 4.8 ft/

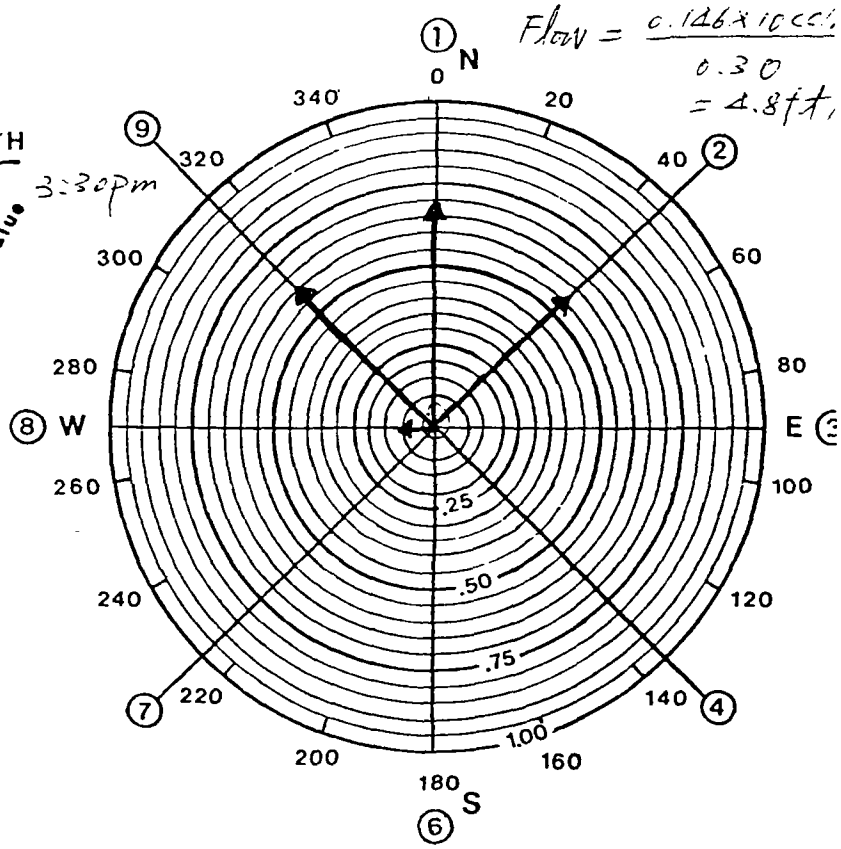
ROTATE PROBE 180° AT SAME DEPTH

1→S

Probe pair	D start	E end	S E-D	F N-S / 2	G F / max. value
+1/-6	+6	-72	-78	+68.5	
+2/-7	+2	-69	-71	+57.5	
+3/-8	+1	-29	-30	-16.5	
+4/-9	+32	+87	+55	-63.5	

3:30pm

68.5 / 4.8 = 14.27

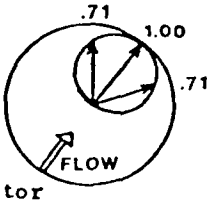


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator;
OR
2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day).

Direction: 358° Velocity: 4.8 ft/d

Form 104 available from your local K-V Associates, Inc. dealer.

9/82

APPENDIX C

CALIBRATION CURVE FOR MODEL 90

Date: 1/6/10 Time: [illegible] Job: [illegible]

Water Temp: 19C Screen Type: _____ Others : Lina

wRate & irection	RefTemp	PeakTime (U/D)	PeakTemp (U/D)	PeakTime (N/S)	PeakTime (E/W)	PeakTemp (N/S)	PeakTemp (E/W)	Temp120 (N/S)	Temp120 (E/W)	Readout
0	8.5	297.7	10							Less than 0.1 ml/min
50cc/min up	-5.5	42.5	265.6							45cc/min & up
30 ~~cc~~/min up	-29.3	47.8	300.7							30.4cc/min & up
30cc/min down	-12	46.9	-404							32.2cc/min & down

APPENDIX D

GROUNDWATER FLOW WORKSHEETS

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

×8 2 AMPS

Table of LCD Readout

1→N

Probe pair	A start	B end	C B-A		
+1/-6	+13	-182	-195	+12	+13
+2/-7	+38	-312	-350	+37	+38
+3/-8	-17	-520	-503	-21	-17
+4/-9	+2	-27	-29	+2	+2

Operator: BK Date: 11/8/95

Station: GW27S Time: 10:35 am

Location: TIMCO HIGH FLOW - 2 INCH

Soil Conditions:

Depth to Measurement: WATER 8.5' TOC Probe @ 15' TOC

ROTATE PROBE 180° AT SAME DEPTH

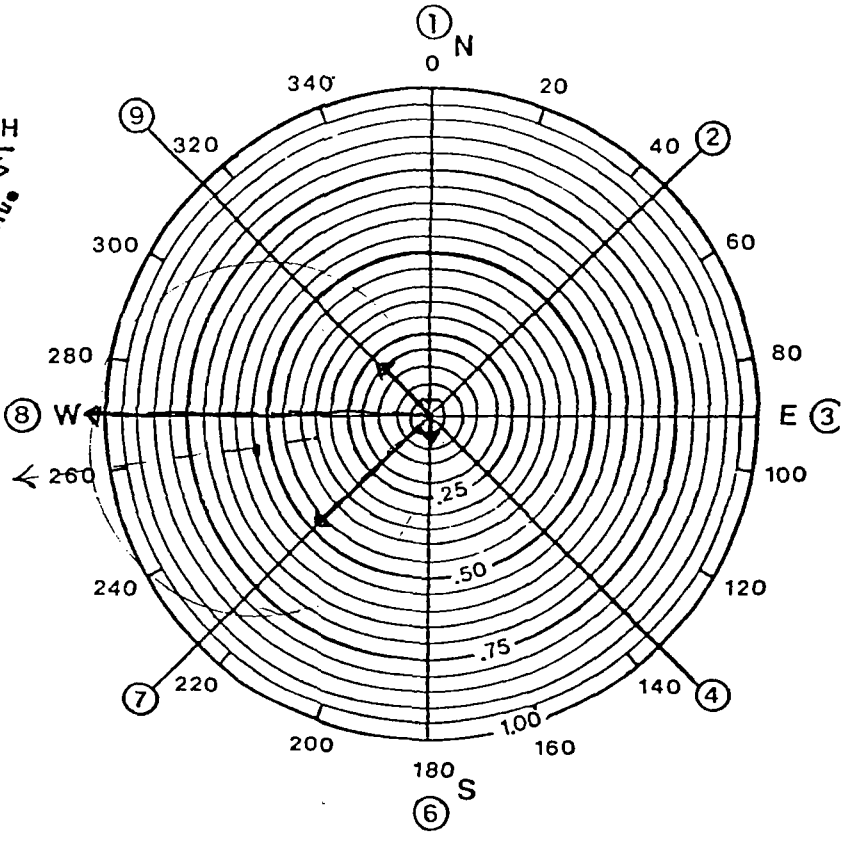
1→S ×8 F 2 amps

Probe pair	D start	E end	S E-D	F max. value
+1/-6	+11	-170	-181	-7
+2/-7	+33	-224	-257	-49
+3/-8	-24	+313	+289	+107
+4/-9	+0	+17	+17	+23

N-S / 2: -195+181 / 2; -350+257 / 2; -503+289 / 2; -29-17 / 2

3.6 ft/d

30 ⟌ 107

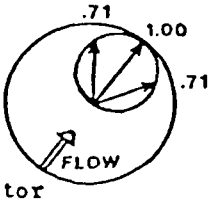


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculators

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). 1.8 ft/d

Direction: 263° W Velocity: 3.6

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

2.0 amps X8

Table of LCD Readout

1→N

Probe pair	A start	B end	ε/N D-A
+1/-6	+3	-91	-99
+2/-7	+34	-156	-190
+3/-8	11	-327	-316
+4/-9	+2	+1	-1

Operator: BK/SM Date: 11/8/95

Station: GW275 Time: ~~12:45~~ 11:45

Location: Olin/Wilmington

Soil Conditions: _____

Depth to Measurement: 17½' BTOC

2:51 Rotate Probe

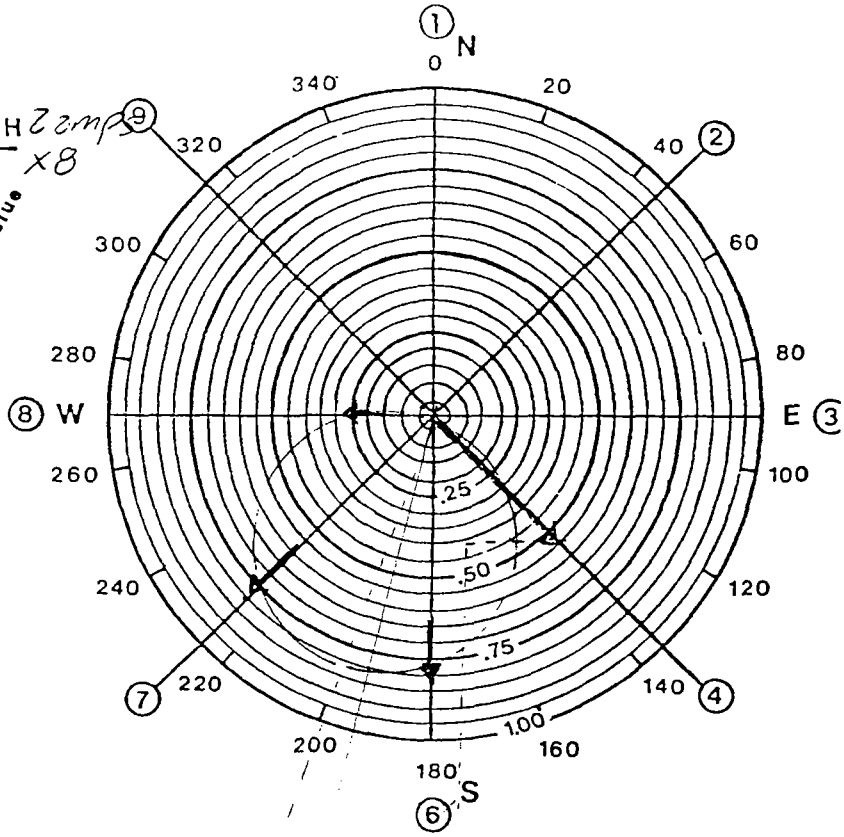
ROTATE PROBE 180° AT SAME DEPTH 2 amps X8

1→S

Probe pair	D start	E end	S E-D	F N-S / 2	G F / max. value
+1/-6	+18	-80	+62	-80.5	
+2/-7	+40	+7	-33	-78.5	
+3/-8	-28	-291	~~-263~~ -263	-26.5	
+4/-9	+0	-111	-111	+55	

2.68 ft/d

30 | 80.5

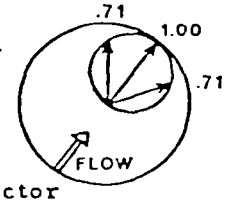


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculators

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). 1.34 ft/d

Direction: 200° MSW Velocity: ~~2.68~~

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Table of LCD Readout ×8 2 temps

1→N

Probe pair	A start	B end	B-A
+1/-6	+11	+196	+185
+2/-7	+38	+88	+50
+3/-8	+0	-287	-287
+4/-9	+0	-341	-341

Operator: BK/SM Date: 11/8/95

Station: GW275 Time: 12 14

Location: Olin/Wilmington

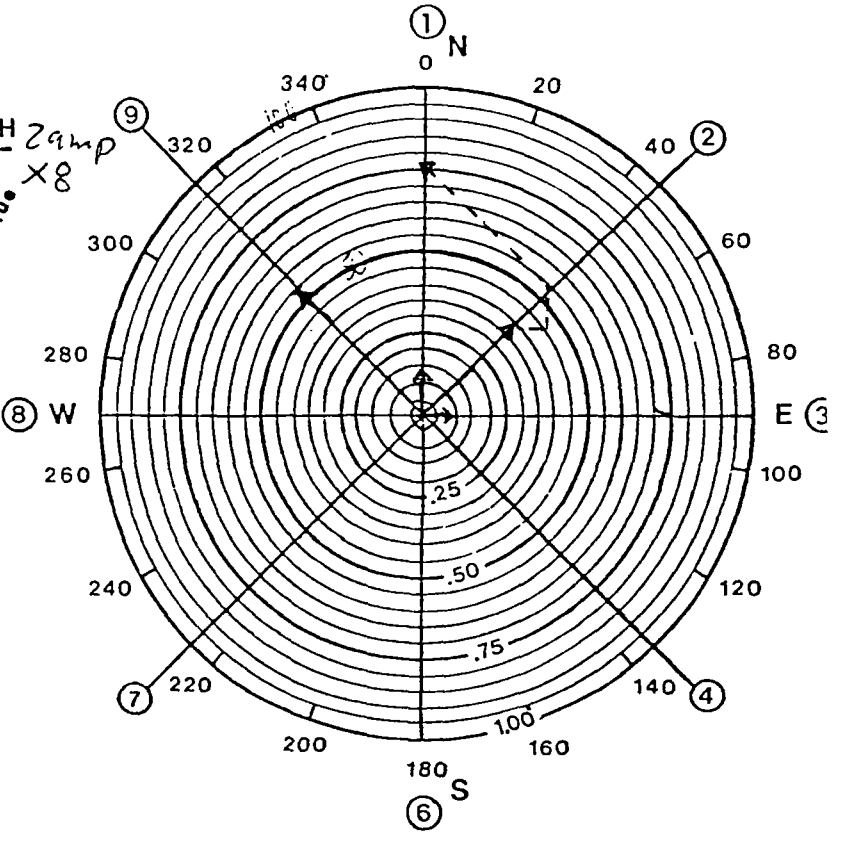
Soil Conditions:

Depth to Measurement: 12½' BTOC

ROTATE PROBE 180° AT SAME DEPTH 2 temp ×8

1→S

Probe pair	D start	E end	E-D	N-S / 2	F max. value	G
+1/-6	+11	+164	+153	+14.5	+29	
+2/-7	+40	+70	-30	+40	+80	
+3/-8	+0	-302	-302	-7.5	+15	
+4/-9	+11	-223	-234	-535	+107	

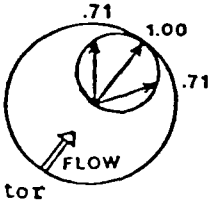


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator.

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). 1.0 ft/d

Direction: 358° Velocity: 1.78

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Table of LCD Readout

1→N

2 amp x8

Probe pair	A start	B end	C B-A
+1/-6	+21	-84	-105
+2/-7	+50	+93	+113
+3/-8	-27	-169	-142
+4/-9	-12	+4	+16

Operator: BKJ SM Date: 11/8/95

Station: GW27S Time: 12 55 pm

Location: Olin / Wilmington

Soil Conditions:

Depth to Measurement: 12.5 BTOC Dry

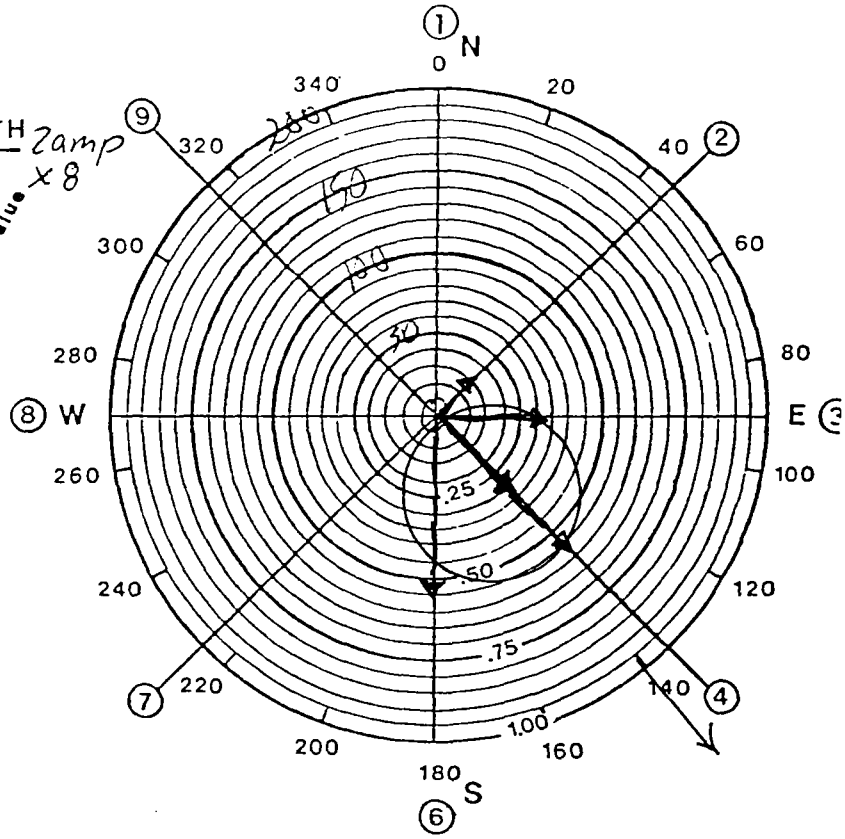
ROTATE PROBE 180° AT SAME DEPTH

1→S

2 amp x8

Probe pair	D start	E end	S E-D	F N-S / 2	G F / max. value
+1/-6	+10	+158	-148	-126.5	
+2/-7	+40	+17	-23	+33	
+3/-8	+0	-275	-275	+66.5	
+4/-9	+12	-201	-213	+114.5	

South 1ST

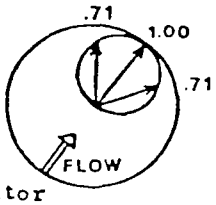


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). 2.15 ft/d

Direction: 141° SE Velocity: 4

Form 104 available from your local K-V Associates, Inc. dealer.

9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Table of LCD Readout

1→N

Probe pair	A start	B end	C B-A	Ramp ×8
+1/-6	+13	+43	+30	
+2/-7	+40	+5	-35	
+3/-8	+0	-244	-244	
+4/-9	+0	-119	-119	

Operator: SM Date: 11/8/95

Station: GW27D Time: 1240

Location: Olin

Soil Conditions:

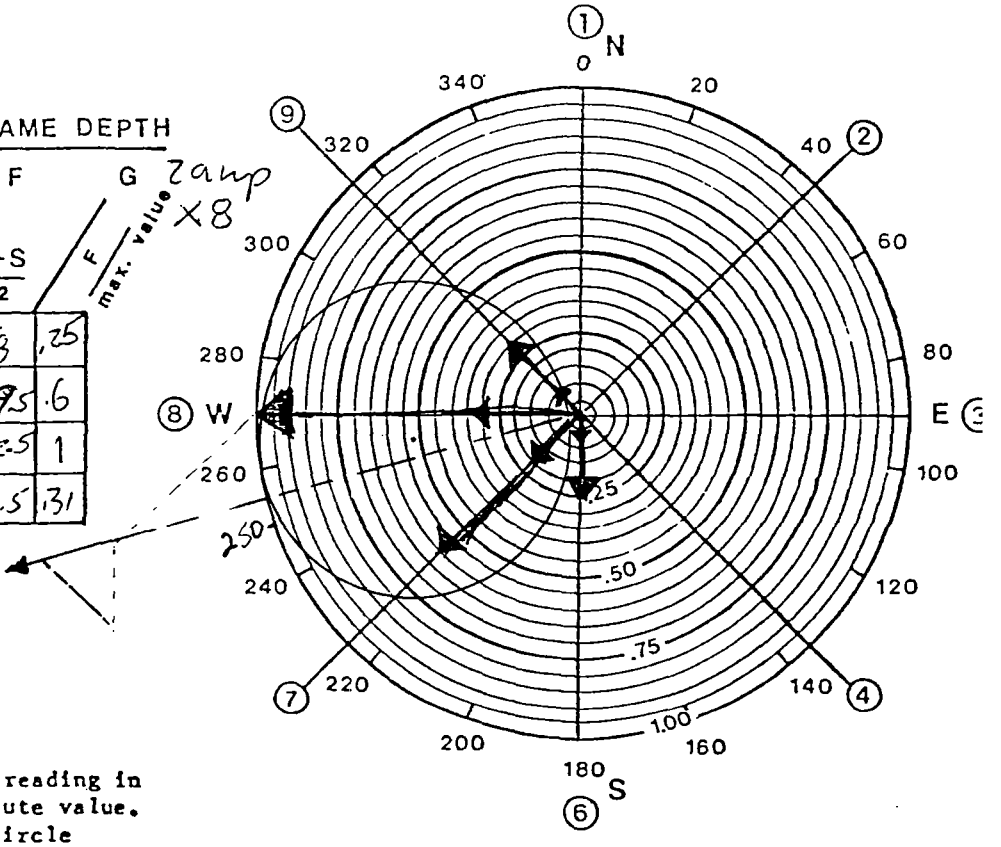
Depth to Measurement: 26' BGrade

ROTATE PROBE 180° AT SAME DEPTH

1→S

Probe pair	D start	E end	S E-D	+30 -46 / 2	N-S / 2	F max. value	G
+1/-6	+14	+60	+46		-8	.25	
+2/-7	+11	+15	+4		-195	.6	
+3/-8	-16	-195	-179		-32.5	1	
+4/-9	+0	-98	-98		-6.5	.131	

Ramp ×8

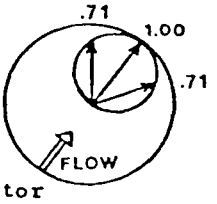


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). .54 ft/d

Direction: 255° SW Velocity: 1.08

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Table of LCD Readout 2 Zimp x8

1→N

Probe pair	A start	B end	C B-A
+1/-6	+11	+33	+22
+2/-7	+38	-35	-73
+3/-8	-12	-321	-309
+4/-9	+0	-120	-120

Operator: SM Date: 11/8/95

Station: GW27D Time: 2 20p

Location: Olin/Wilmington

Soil Conditions:

Depth to Measurement: 28' 13"

ROTATE PROBE 180° AT SAME DEPTH

1→S

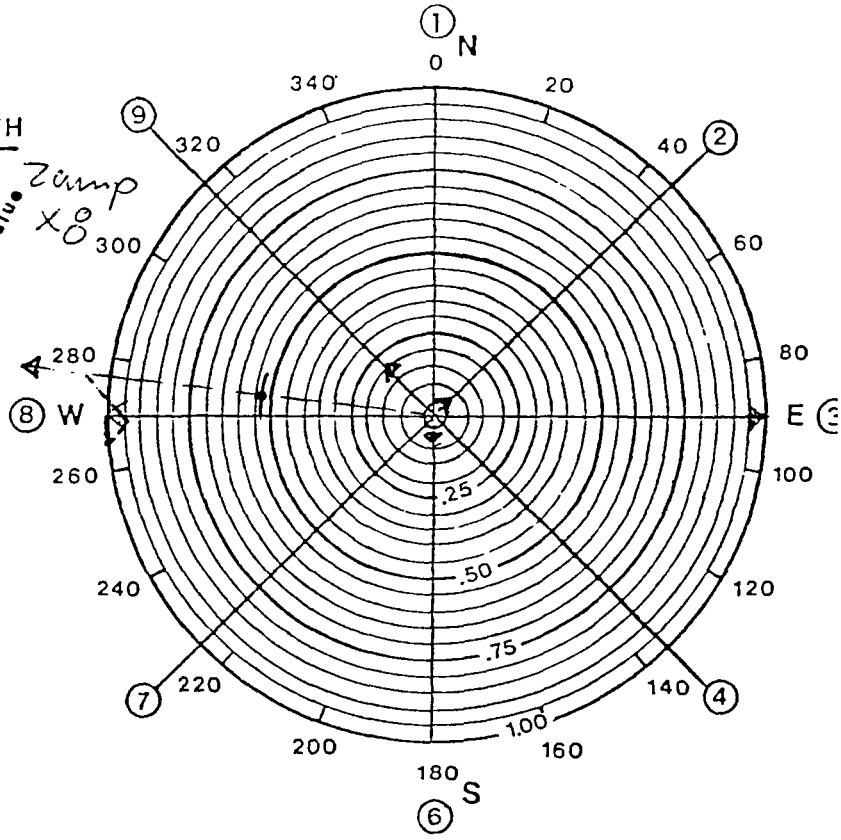
Probe pair	D start	E end	S E-D	F N-S/2	G F/max. value
+1/-6	+12	+30	+18	+12	.01
+2/-7	+49	+27	-21	-26	.18
+3/-8	+0	-21	-24	-142.5	1
+4/-9	+7	-57	-64	-28	.20

+22-18 / 2 = +2

-309+24 / 2 = -142.5

2 Zimp x8

√78.37

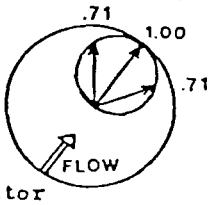


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). 1.36 ftd

Direction: 275° W Velocity: 4.75

Form 104 available from your local K-V Associates, Inc. dealer.

9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Table of LCD Readout Tamp ×8

1→N

Probe pair	A start	B end	C B-A
+1/-6	+80	+37	+29
+2/-7	+38	+25	-13
+3/-8	-0	-205	-205
+4/-9	+2	-95	-97

Operator: SM Date: 9/11/95

Station: GW77D Time: 3:13p

Location: Olin/Wilmington

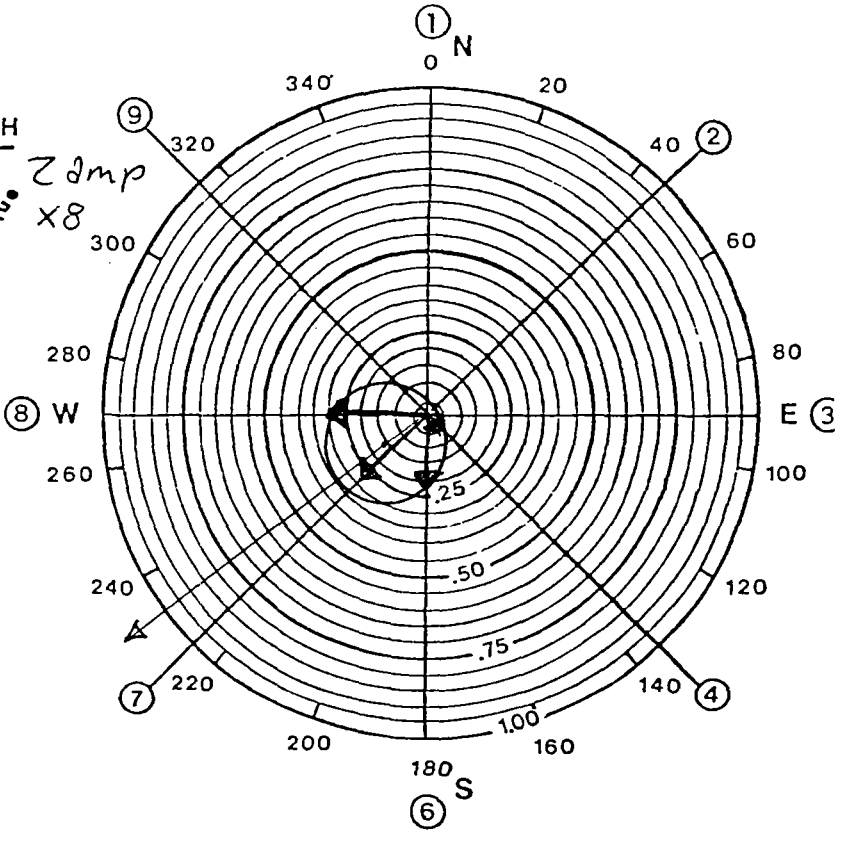
Soil Conditions:

Depth to Measurement: 23'13G

ROTATE PROBE 180° AT SAME DEPTH

1→S Tamp ×8

Probe pair	D start	E end	S E-D	F N-S/2	G F max. value
+1/-6	+78	+90	+72	-21.5	
+2/-7	+48	+89	+41	-27	
+3/-8	+0	-144	-144	-305	
+4/-9	+0	-106	-106	+41.5	

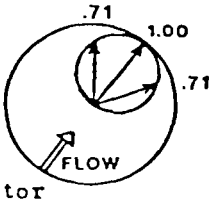


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator:

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). .6 ftd

Direction: 230° SW Velocity: X.0

Form 104 available from your local K-V Associates, Inc. dealer.

9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Operator: SM Date: 11/8/95

Station: GW27D Time: 3 5 T O

Location: Olin

Soil Conditions:

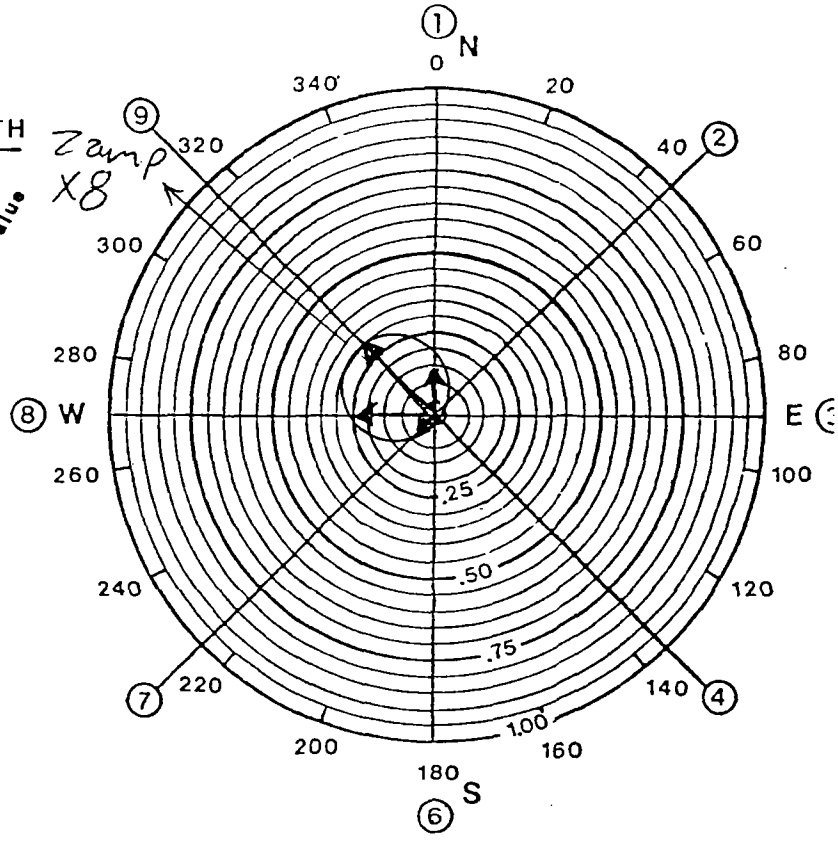
Depth to Measurement: 28 36

Table of LCD Readout

2 amps x8

1→N

Probe pair	A start	B end	C B-A
+1/-6	-7	+75	-68
+2/-7	+34	-10	-44
+3/-8	-13	-288	-275
+4/-9	0	-190	-190



ROTATE PROBE 180° AT SAME DEPTH

1→S

Probe pair	D start	E end	S E-D	F N-S / 2	G F / max. value
+1/-6	+18	+59	+41	+13.5	
+2/-7	+19	+18	-31	-6.5	
+3/-8	+0	-278	-278	-23.5	
+4/-9	+0	-128	-128	-31	

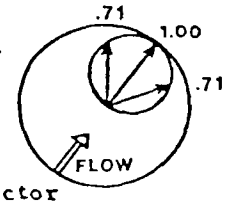
64.1 | 23.5

Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day).

Direction: 310° NW Velocity: .28 .36

Form 104 available from your local K-V Associates, Inc. dealer.

9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

2 amps

Table of LCD Readout ×8

1→N

Probe pair	A start	B end	B-A
+1/-6	+8	+100	+92
+2/-7	+42	-14	-56
+3/-8	+10	-284	-294
+4/-9	+5	-183	-188

Operator: SM Date: 11/9/95

Station: GW62S Time: 10:27

Location: Olin/Wilmington

Soil Conditions:

Depth to Measurement: 13' BG

ROTATE PROBE 180° AT SAME DEPTH

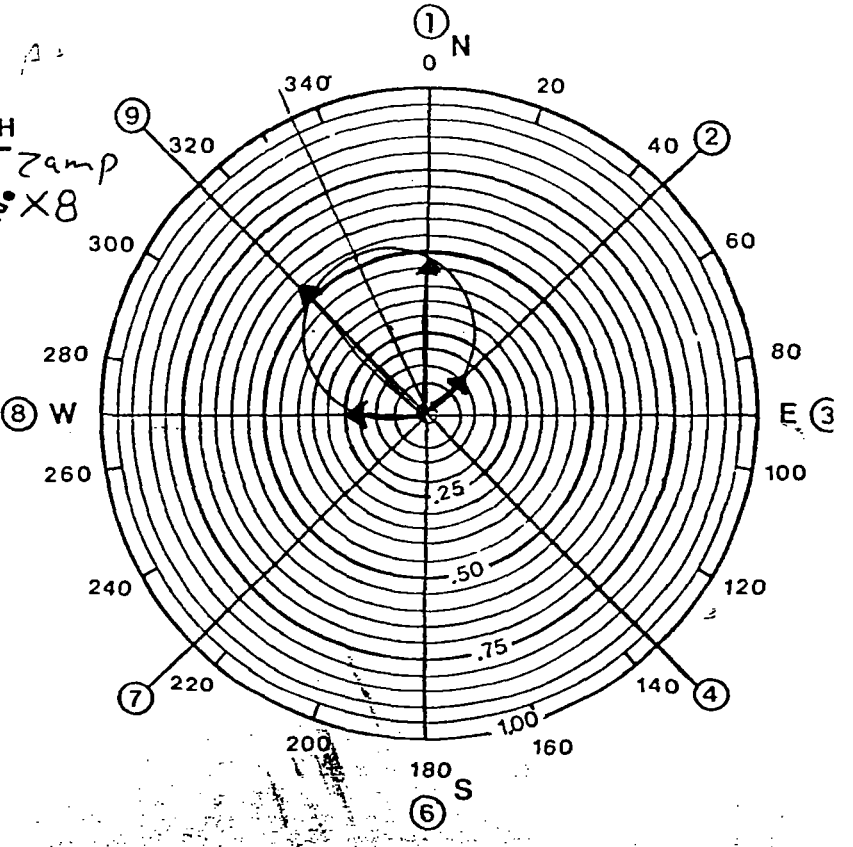
1→S

2 amp ×8

Probe pair	D start	E end	S E-D	F N-S /2	G F max. value
+1/-6	+0	+0	+0	+46	
+2/-7	+35	-53	-88	+76	
+3/-8	+0	-245	-245	-274.5	
+4/-9	+13	-66	-79	-54.5	

.84 ftld

64.6 | 54.5

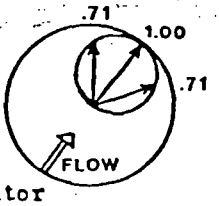


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator:

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). .84

Direction: 335° NW Velocity: 1.8 ftld

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Table of LCD Readout

1→N

Probe pair	A start	B end	C B-A
+1/-6	+29	+14	-65
+2/-7	+52	+14	-38
+3/-8	-14	-229	-26
+4/-9	-12	-165	-153

Zamp ×8

Operator: SM/EP Date: 11/9/95

Station: GW 62S Time: ~11:20 Du

Location: Olin / Wilmington

Soil Conditions: /

Depth to Measurement: 13'13G

South First To

ROTATE PROBE 180° AT SAME DEPTH

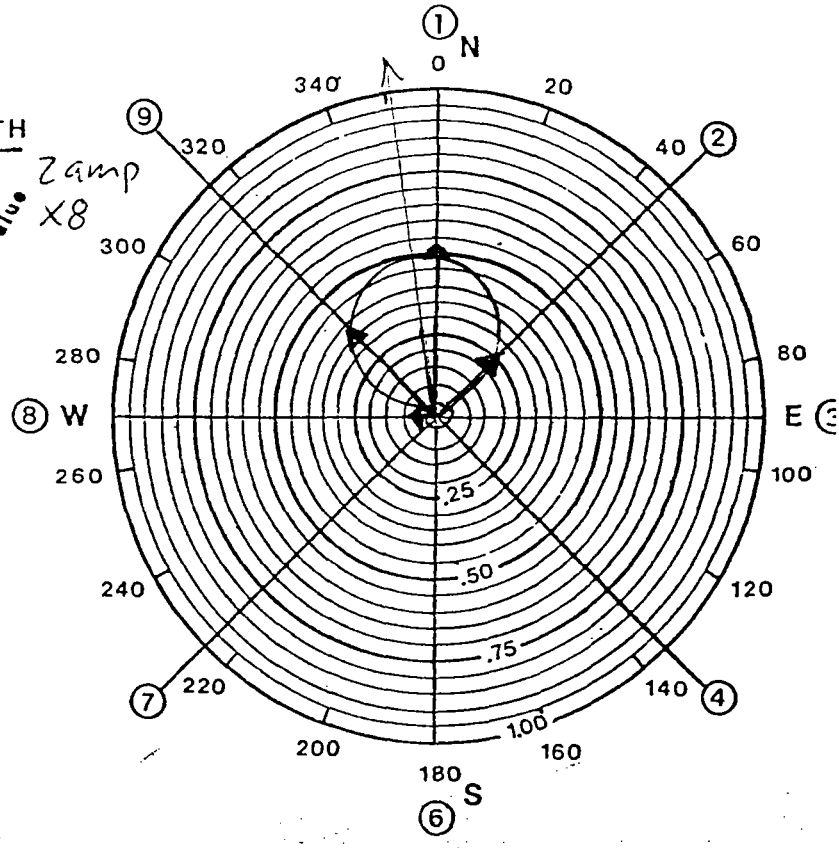
1→S

Probe pair	D start	E end	S E-D	N-S / 2	F	G F max. value
+1/-6	+20	-19	-19	+52	+104	
+2/-7	+33	-56	-89	+26	+51	
+3/-8	+0	-246	-246	-7.5	-15	
+4/-9	+20	-59	-79	-37	-74	

Zamp ×8

64.6 104

64.6 52

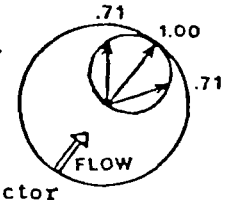


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test–Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). ~~-80~~ -80 f

Direction: 351 N Velocity: ~~+73~~

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Table of LCD Readout

1→N

Probe pair	A start	B end	C B-A
+1/-6	+14	+44	+30
+2/-7	+42	+2	-40
+3/-8	+0	-167	-167
+4/-9	+0	-107	-107

ramp ×8

Operator: SM Date: 11/9/95

Station GW62S Time: 11:50

Location: Olin/Wilmington

Soil Conditions:

Depth to Measurement: 7 BG

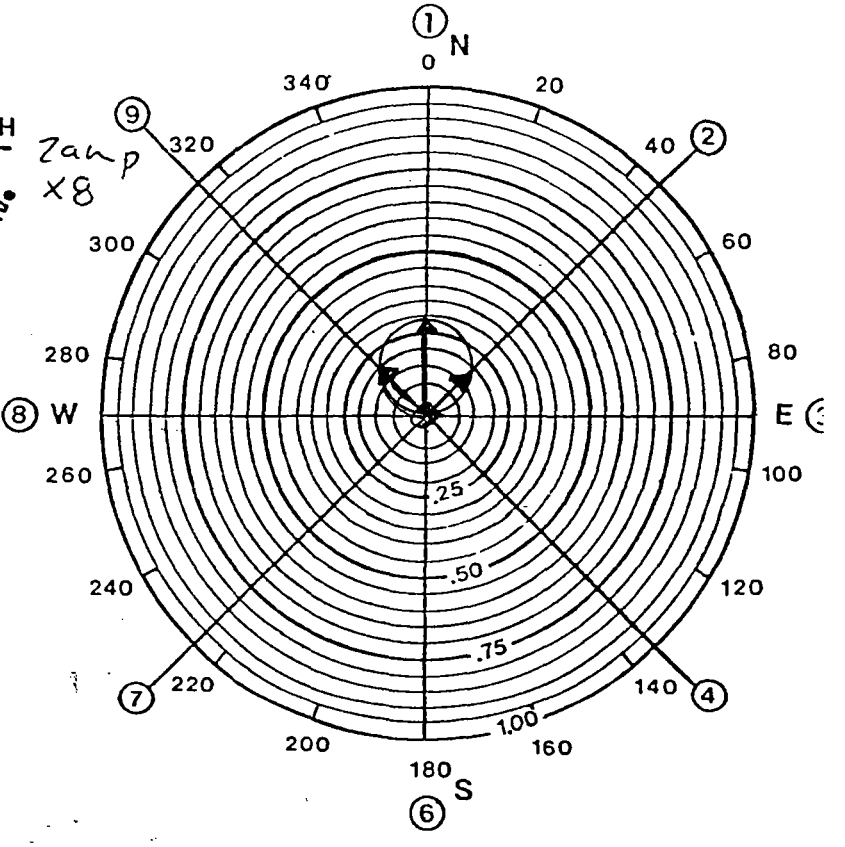
ROTATE PROBE 180° AT SAME DEPTH

1→S

Probe pair	D start	E end	S E-D	F N-S/2	G F/max. value
+1/-6	+0	-27	-27	-28.5	
+2/-7	+36	-40	-76	+18	
+3/-8	+6	-167	-172	+2.5	
+4/-9	+5	-56	-71	-18	

64.6 | 28.5

ramp ×8

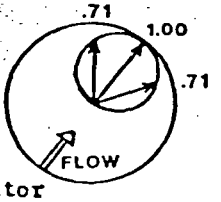


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). .44 ft/d

Direction: 359 N Velocity: .85

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Table of LCD Readout 7amp ×8

1→N

Probe pair	A start	B end	C B-A
+1/-6	+10	-37	-27
+2/-7	+6	-15	-61
+3/-8	+5	-193	-208
+4/-9	+6	-108	-114

Operator: SM Date: 11/9/95

Station: GW625 Time: 1250

Location: Olin/Wilmington Dc

Soil Conditions:

Depth to Measurement: 73G

South First (12:32)

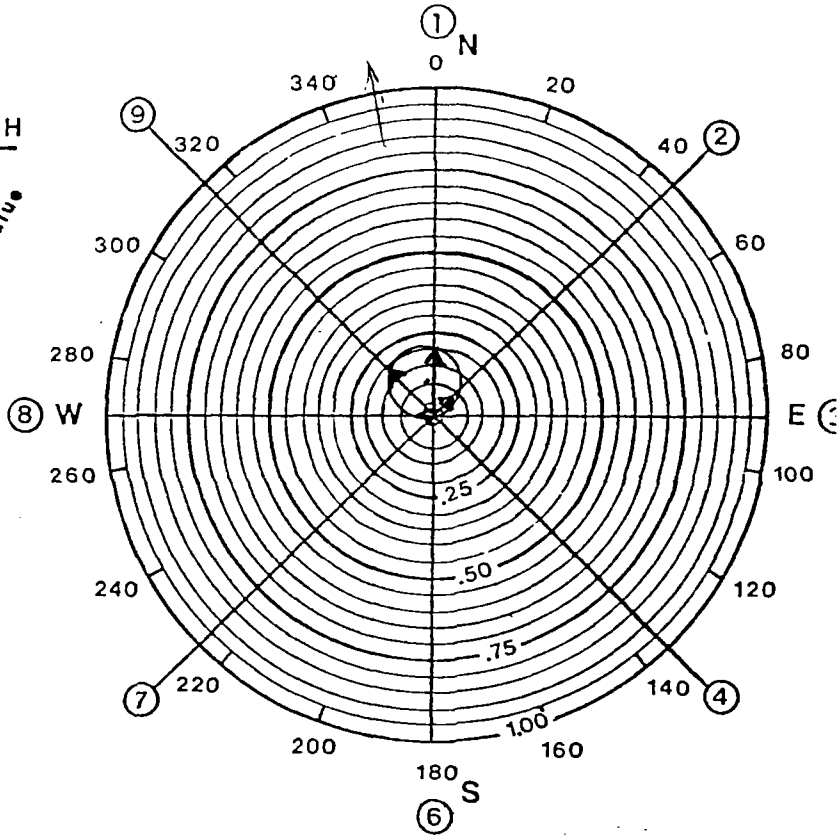
ROTATE PROBE 180° AT SAME DEPTH

1→S

Probe pair	D start	E end	S E-D	F N-S/2	G F/max. value
+1/-6	0	-13	13	+ 20	
+2/-7	+47	-31	-78	+ 8.5	
+3/-8	+28	-175	-203	- 25	
+4/-9	+24	-54	-78	- 10.	

.309

64.6|20

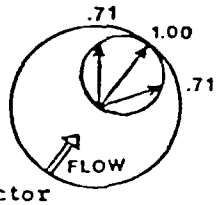


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). .309 ft/d

Direction: 348° N Velocity: .66

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Table of LCD Readout

1→N

Probe pair	A start	B end	C B-A
+1/-6	+2	-69	-71
+2/-7	+28	-170	-198
+3/-8	-10	-360	-350
+4/-9	+3	-131	-134

Zamp ×8

Operator: SM Date: 11/9/95

Station: GW62M Time: 107

Location: Olin / Wilmington

Soil Conditions: ✓

Depth to Measurement: 37.36

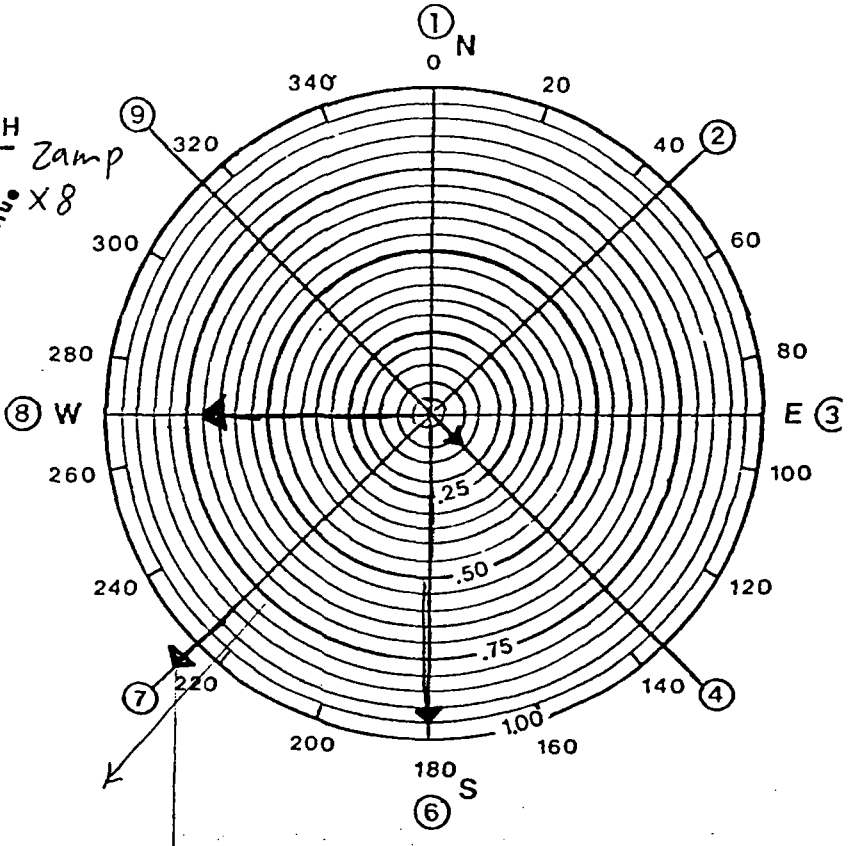
ROTATE PROBE 180° AT SAME DEPTH

1→S

Probe pair	D start	E end	S E-D	F N-S/2	G F max. value
+1/-6	+26	+145	+119	-95	
+2/-7	+44	+76	+32	-115	
+3/-8	-20	-230	-210	-70	
+4/-9	-19	-178	-159	+12.5	

Zamp ×8

64.6 / 115

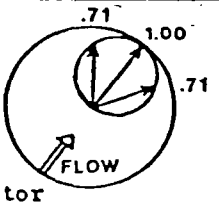


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator:

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). 1.78

Direction: 221 SW Velocity: 3.8

Form 104 available from your local K-V Associates, Inc. dealer.

9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Table of LCD Readout 2amp x8

1→N

Probe pair	A start	B end	C B-A
+1/-6	+20	-20	-40
+2/-7	+40	-129	-169
+3/-8	-32	-379	-347
+4/-9	-15	-148	-127

Operator: SM Date: 11/9/95

Station: GWG2M Time: _____

Location: Olin/Wilmington

Soil Conditions: _____

Depth to Measurement: 37' BG DU

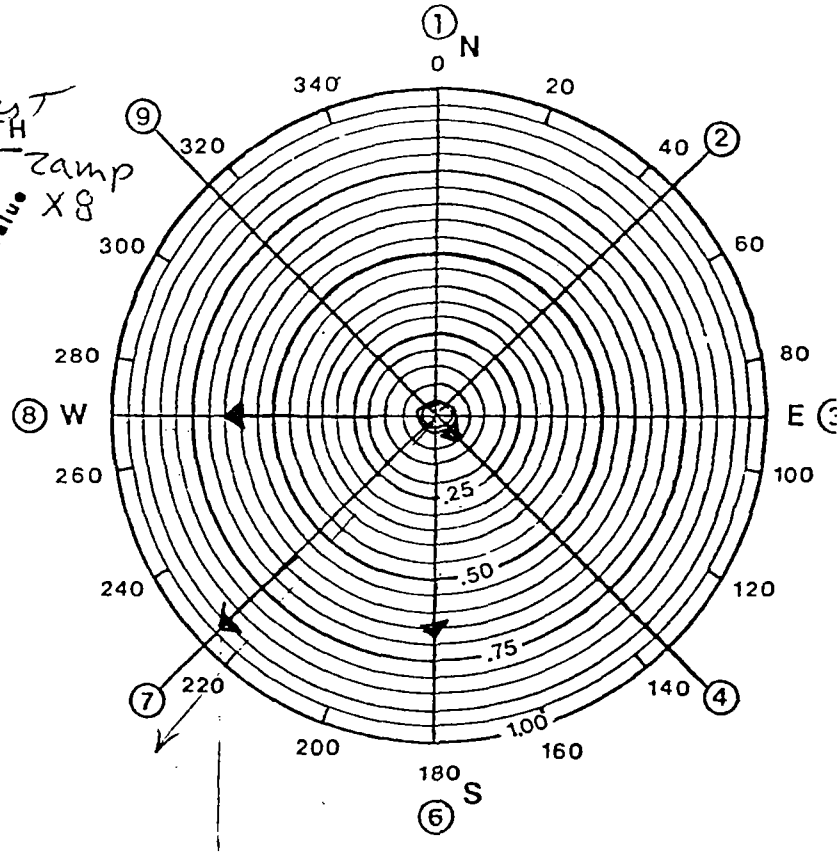
ROTATE PROBE 180° AT SAME DEPTH southfirst

1→S

Probe pair	D start	E end	S E-D	F N-S / 2	G F / max. value
+1/-6	+19	+114	+95	-67.5	
+2/-7	+48	+62	+14	-91.5	
+3/-8	-10	-226	-216	-65.5	
+4/-9	0	-147	-147	+10	

2amp x8

646 91.5

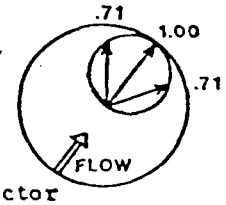


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). 1.42 ft/d

Direction: 220° SW Velocity: 3.05

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Operator: SR Date: 11/9/95

Station: GW62M Time: ~230

Location: Qin/Wilmington

Soil Conditions:

Depth to Measurement: 33' BG

Table of LCD Readout

1→N

Probe pair	A start	B end	C B-A
+1/-6	+19	+0	-70
+2/-7	+39	-308	-347
+3/-8	-13	-685	-672
+4/-9	+0	-248	-248

Camp x8

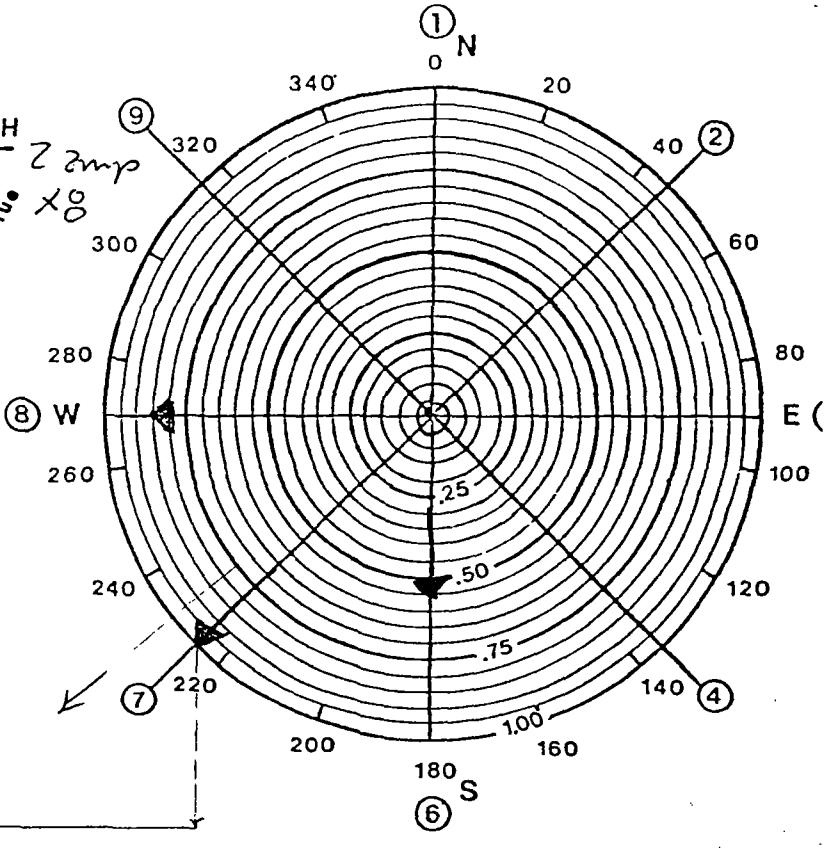
ROTATE PROBE 180° AT SAME DEPTH

1→S

Probe pair	D start	E end	S E-D	F N-S/2	G F max. value
+1/-6	+41	+365	-324	-167	.56
+2/-7	+61	+308	-247	-297	1
+3/-8	-35	-197	-162	-255	.85
+4/-9	-16	-235	-219	-145	.04

2 Camp x8

297

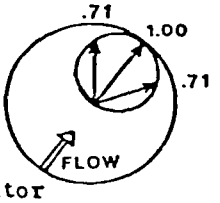


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculato

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

13.8 fild

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). ~~14 fild~~

Direction: 229 Velocity: ~~9.8~~

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Table of LCD Readout Camp X8

1→N

Probe pair	A start	B end	C B-A
+1/-6	+10	+118	-88
+2/-7	+30	-371	-401
+3/-8	-14	-215	-171
+4/-9	+0	-192	-192

Operator: SM Date: 11/9/95

Station: BW62M Time: ~3:15

Location: Olin/Wilmington

Soil Conditions:

Depth to Measurement: 33' 136

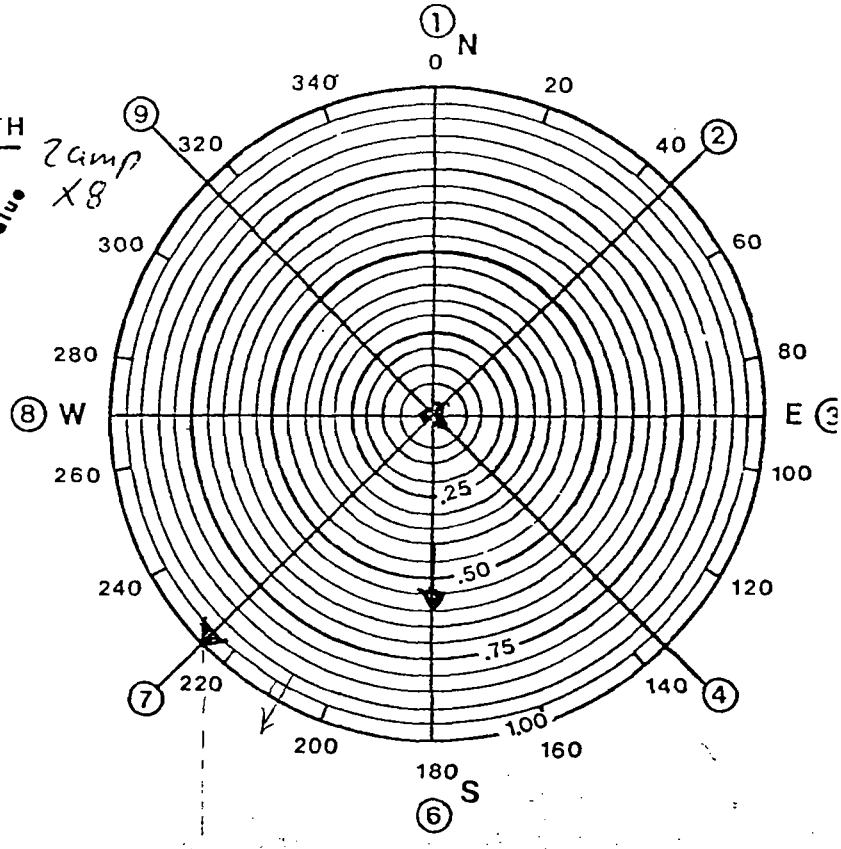
Du

ROTATE PROBE 180° AT SAME DEPTH South 1st

1→S Camp X8

Probe pair	D start	E end	S E-D	F N-S/2	G F max. value
+1/-6	+42	+395	+311	-199.5	.59
+2/-7	+72	+341	+269	-335	1
+3/-8	-15	-177	-162	-4.5	.01
+4/-9	-11	-240	-229	+18.5	.05

√335

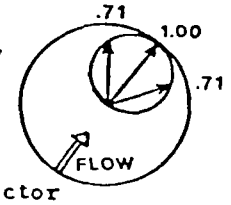


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day).

Direction: 214° SW Velocity: 11.16

Form 104 available from your local K-V Associates, Inc. dealer.

9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Operator: S.M Date: 11/9/95

Station: GW62D Time: ~1430

Location: Olin / Wilmington

Soil Conditions: /

Depth to Measurement: 68 BG

Table of LCD Readout

1→N

Zamp ×8

Probe pair	A start	B end	C B-A
+1/-6	+8	+32	+32
+2/-7	+38	+14	-24
+3/-8	+0	-203	-203
+4/-9	+0	-77	-77

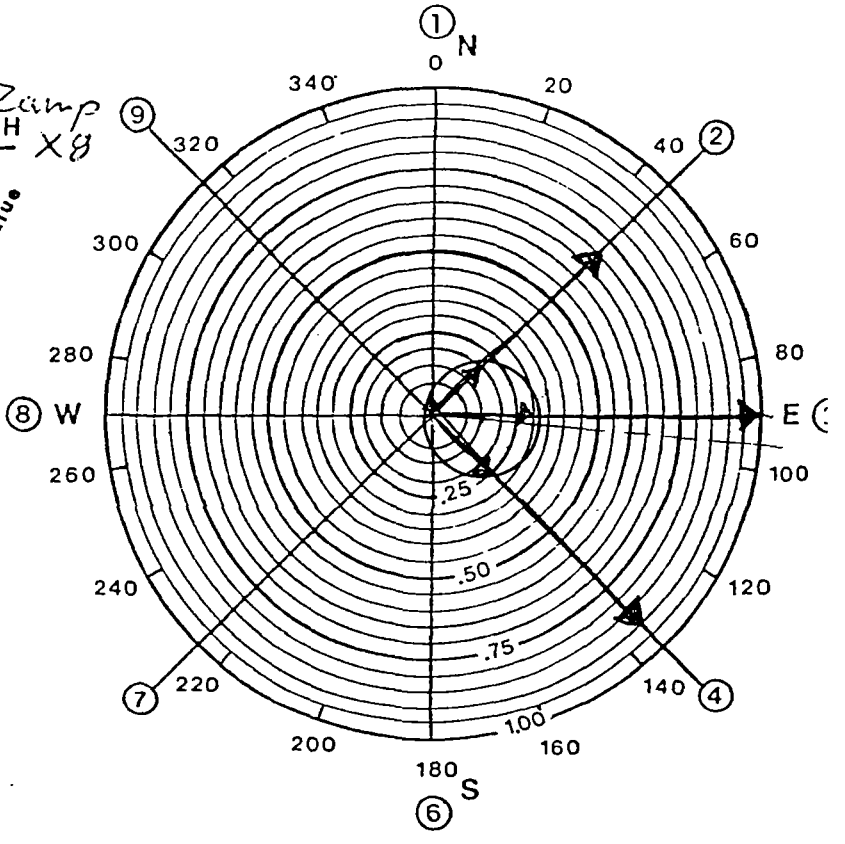
ROTATE PROBE 180° AT SAME DEPTH

Zamp ×8

1→S

Probe pair	D start	E end	S E-D	F N-S/2	G F/max. value
+1/-6	+8	+37	+29	+15	.05
+2/-7	+32	-33	-65	+20.5	.70
+3/-8	-28	-290	-262	-29.5	1
+4/-9	0	-130	-130	+26.5	.90

.45
646 | 29.5

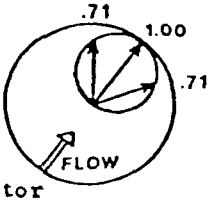


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). .45

Direction: 96° Velocity: .98

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Table of LCD Readout 2amp x8

1→N

Probe pair	A start	B end	C B-A
+1/-6	+11	+18	+37
+2/-7	+33	+24	-9
+3/-8	-28	-211	-183
+4/-9	+0	-84	-84

Operator: SM Date: 11/10/95

Station: GW62D Time: ~9 00

Location: Olin / Wilmington De

Soil Conditions: —

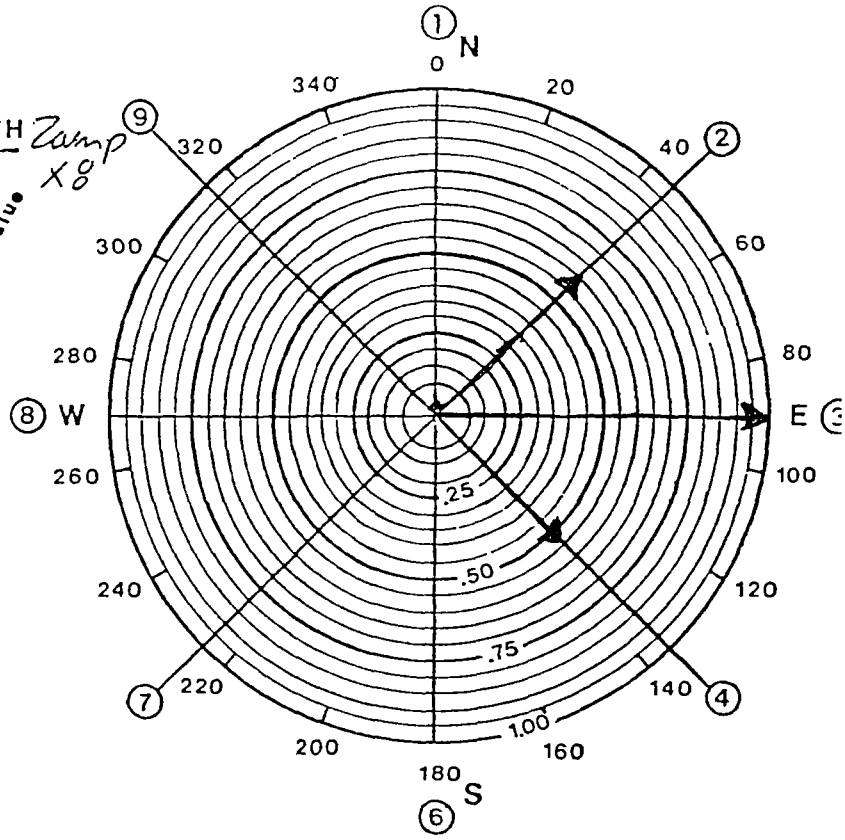
Depth to Measurement: 68' 36

ROTATE PROBE 180° AT SAME DEPTH 2amp x8

1→S

Probe pair	D start	E end	S E-D	N-S/2	F max. value
+1/-6	+10	+46	+36	-.5	.101
+2/-7	+12	-21	-63	+.27	.60
+3/-8	+0	-273	-273	+.45	1
+4/-9	+11	-128	-132	+.24	.53

64.6/45

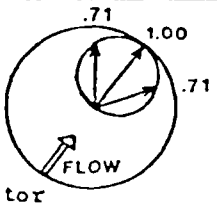


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). .69

Direction: 89° E Velocity: 1.5

Form 104 available from your local K-V Associates, Inc. dealer.

9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Table of LCD Readout

Zamp x8

1→N

Probe pair	A start	B end	C B-A
+1/-6	+8	+41	-33
+2/-7	+42	+30	-12
+3/-8	+0	+186	-186
+4/-9	+5	-77	-82

Operator: SM Date: 11/10/95

Station: GW62D Time: ~945

Location: Main/Wilmington

Soil Conditions: /

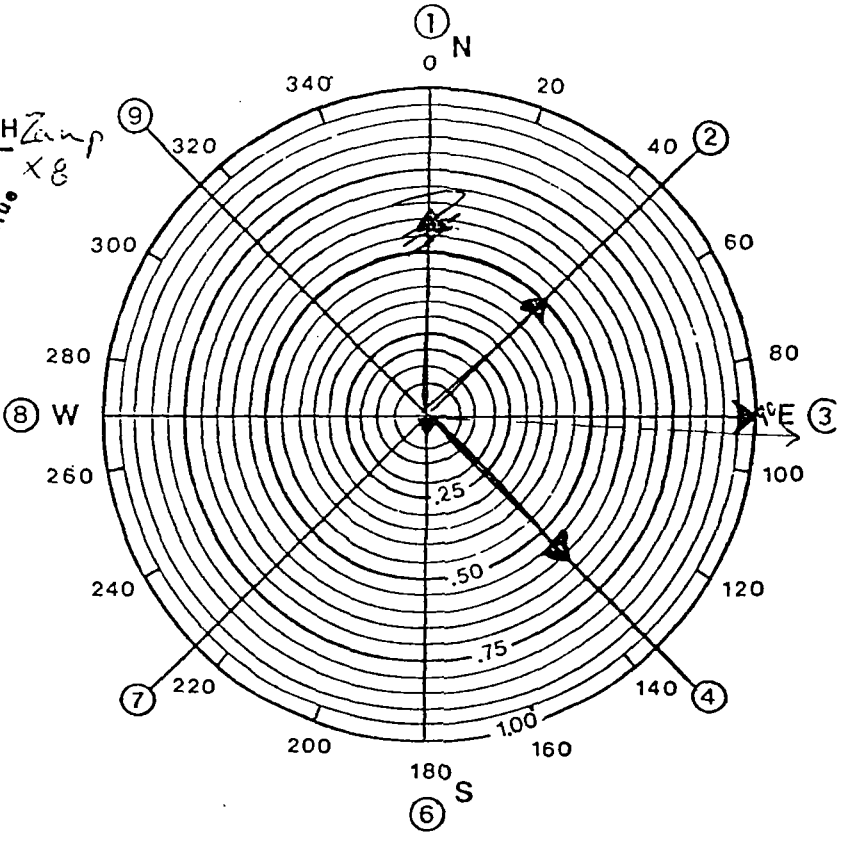
Depth to Measurement: 64 BG

ROTATE PROBE 180° AT SAME DEPTH Zamp x8

1→S

Probe pair	D start	E end	S E-D	N-S / 2	F max. value
+1/-6	+6	+49	+43	-5	12
+2/-7	+39	-13	-52	+ 20	50
+3/-8	+0	-267	-267	+ 40.5	1
+4/-9	+4	-129	-133	+ 25.5	.62

64.6 | 40.5

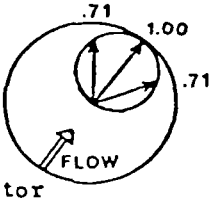


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculators

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). .62 ft/d

Direction: 93° E Velocity: .13 ft

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

[illegible] FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Table of LCD Readout

2 amps ×8

1→N

Probe pair	A start	B end	B-A
+1/-6	+11	+55	+44
+2/-7	+37	+25	-12
+3/-8	-20	-212	-192
+4/-9	0	-100	-100

Operator: SN Date: 11/10/95

Station: GW62D Time: ~10 30

Location: Glin / Wilmington

Soil Conditions: /

Depth to Measurement: 64 13G Dr

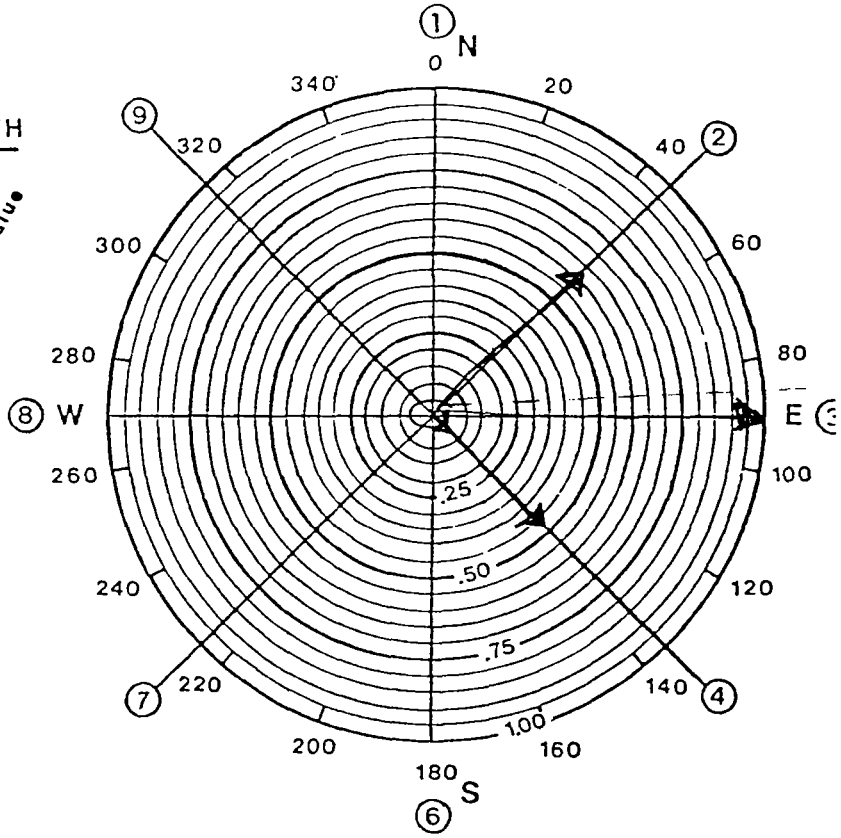
ROTATE PROBE 180° AT SAME DEPTH

South 1st

1→S

Probe pair	D start	E end	E-D	F N-S/2	G F/max. value
+1/-6	+4	+48	+41	0	0
+2/-7	+31	-19	-50	+19	.62
+3/-8	-20	-278	-258	+30.5	1
+4/-9	+0	-129	-129	+14.5	.47

64.6 √30.5

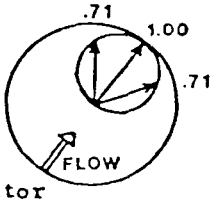


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). .47

Direction: 85° E Velocity: 1.02 / 1.01

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Table of LCD Readout 2amp x8

1→N

Probe pair	A start	B end	C B-A
+1/-6	0	+52	+52
+2/-7	+30	-31	-61
+3/-8	+20	-251	-271
+4/-9	+13	-132	-145

Operator: SM Date: 11/10/95

Station: GW445 Time: ~11.50

Location: Olin/Wilmington

Soil Conditions: /

Depth to Measurement: 12' 36

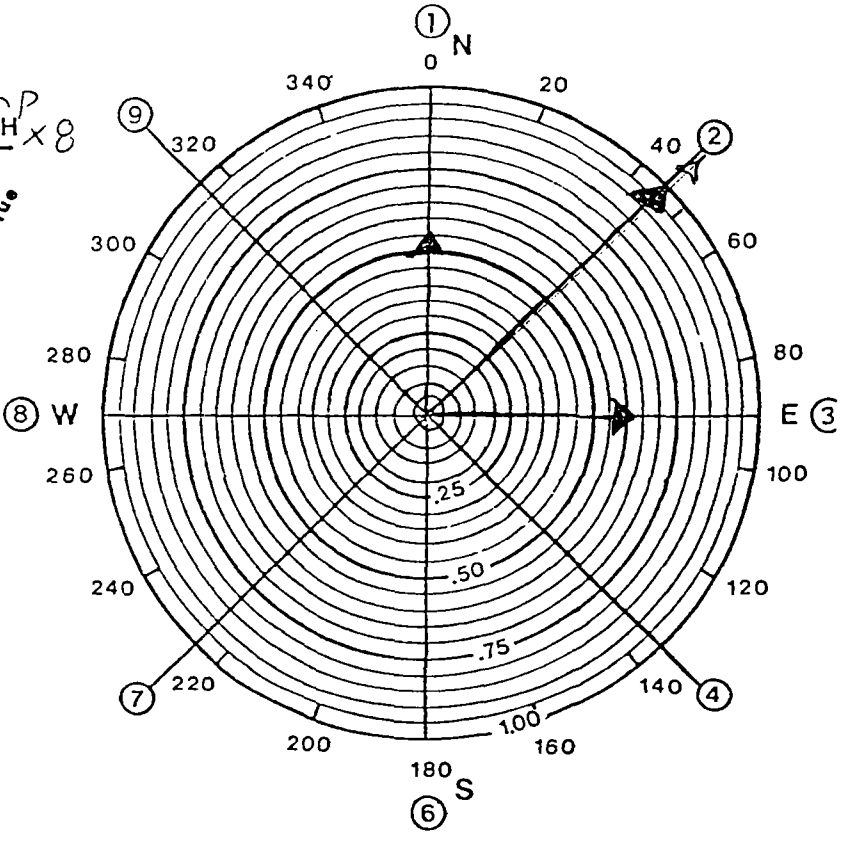
ROTATE PROBE 180° AT SAME DEPTH 2amp x8

1→S

Probe pair	D start	E end	S E-D	F N-S/2	G F max. value
+1/-6	+14	+42	+28	+ 12	.53
+2/-7	+40	-66	-106	+ 22.5	1
+3/-8	-15	-314	-299	+ 14	.62
+4/-9	0	-145	-145	+ 0	0

348

64.6 | 22.5

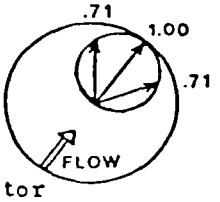


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculators
OR
2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). .35 .75

Direction: 46° NE Velocity: .75

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Table of LCD Readout 2amp x8

1→N

Probe pair	A start	B end	C B-A
+1/-6	+12	+74	+62
+2/-7	+42	-22	-64
+3/-8	-76	-282	-206
+4/-9	+4	-138	-142

Operator: [illegible] Date: 11/10/95

Station: GW245 Time: ~1230

Location: Olin/Wilmington

Soil Conditions: /

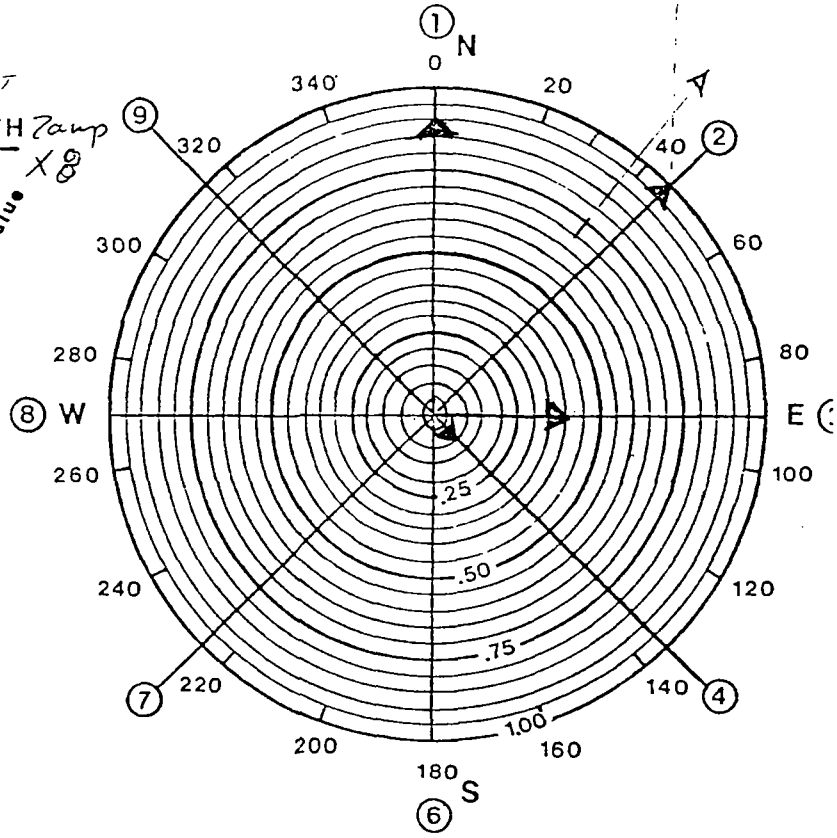
Depth to Measurement: 17 BG DJ

ROTATE PROBE 180° AT SAME DEPTH South 1st 2amp x8

1→S

Probe pair	D start	E end	S E-D	F N-S/2	G F/max. value
+1/-6	+12	+41	+29	-16.5	.9
+2/-7	+32	-68	-100	+18	1
+3/-8	-34	-315	-281	+13.5	.4
+4/-9	0	-138	-138	-2	.1

64.6/18

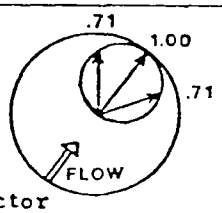


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). .278

Direction: 38° NE Velocity: .60

Form 104 available from your local K-V Associates, Inc. dealer.

9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Table of LCD Readout 2 amps ×8

1→N

Probe pair	A start	B end	C B-A
+1/-6	+12	+82	+70
+2/-7	+50	-31	-81
+3/-8	+7	-285	-293
+4/-9	+11	-166	-177

Operator: SR Date: 11/10/95

Station: GW44 S Time: 1.09 p

Location: Olin / Wilmington

Soil Conditions: /

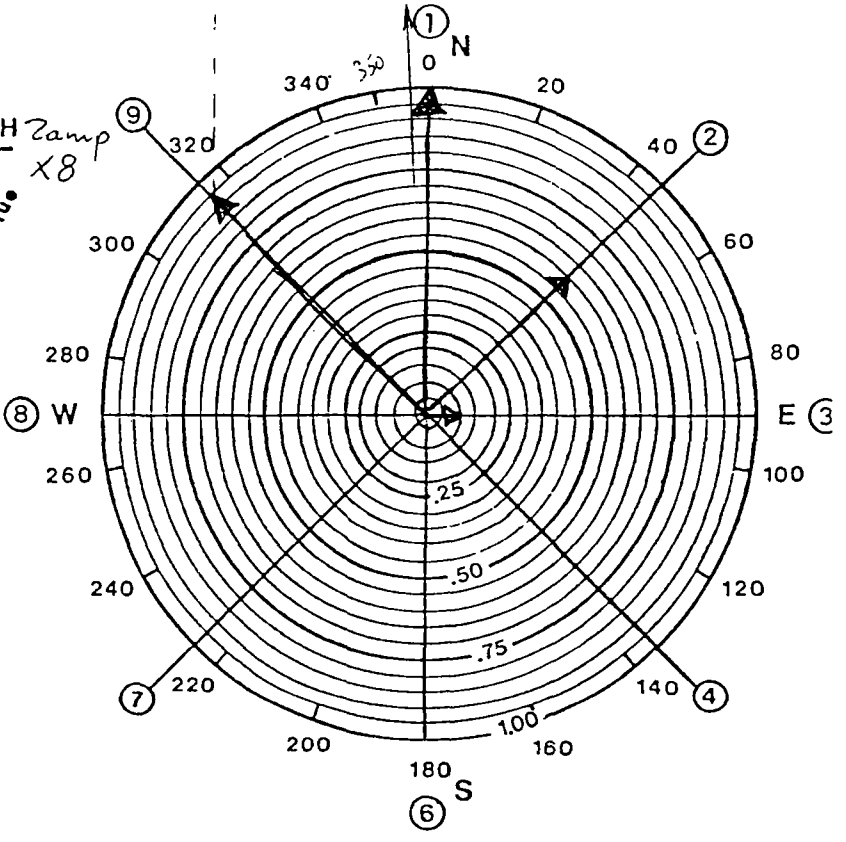
Depth to Measurement: 13 BG

ROTATE PROBE 180° AT SAME DEPTH 2amp ×8

1→S

Probe pair	D start	E end	S E-D	F N-S/2	G F/max. value
+1/-6	+12	+54	+42	+ 14	1
+2/-7	+43	-55	-98	+ 8.5	.6
+3/-8	0	-295	-295	+ 1.5	.1
+4/-9	+4	-146	-150	- 13.5	.96

64.6/14

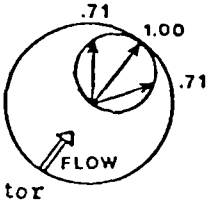


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator;
OR
2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). .22 FHD

Direction: 356° N Velocity: 46

Form 104 available from your local K-V Associates, Inc. dealer.

9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Zamp

Table of LCD Readout ×8

1→N

Probe pair	A start	B end	C B-A
+1/-6	+15	-100	-65
+2/-7	+44	-34	-78
+3/-8	-10	-295	-285
+4/-9	0	-165	-165

Operator: SM Date: 11/10/95

Station: GW 445 Time: 1345

Location: Olin/Wilmington

Soil Conditions: —

Depth to Measurement: 13 13 G Dup

South 1ST

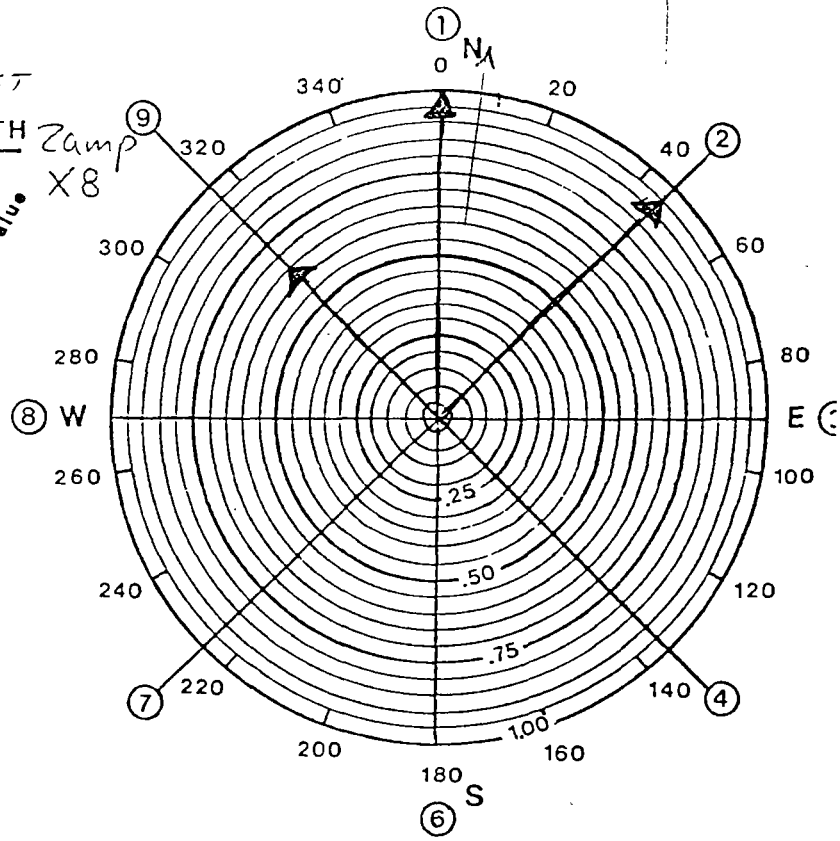
ROTATE PROBE 180° AT SAME DEPTH

Zamp ×8

1→S

Probe pair	D start	E end	S E-D	F N-S/2	G F max. value
+1/-6	+9	-51	-42	+ 11.5	1
+2/-7	+43	-57	-100	+ 11.0	.95
+3/-8	-8	-293	-285	0	0
+4/-9	+8	-142	-150	- 11.5	-.65

64.6 | 11.5

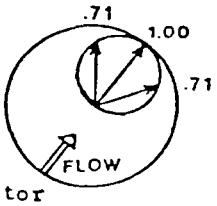


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day).

Direction: 7° N Velocity: .17 ft/d

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Operator: SM Date: 11/10/95

Station: GW-45 Time: ~1230

Location: Main/Wilmington

Soil Conditions: /

Depth to Measurement: 5'5" BG in casing/no flow

Table of LCD Readout 2amp x8

1→N

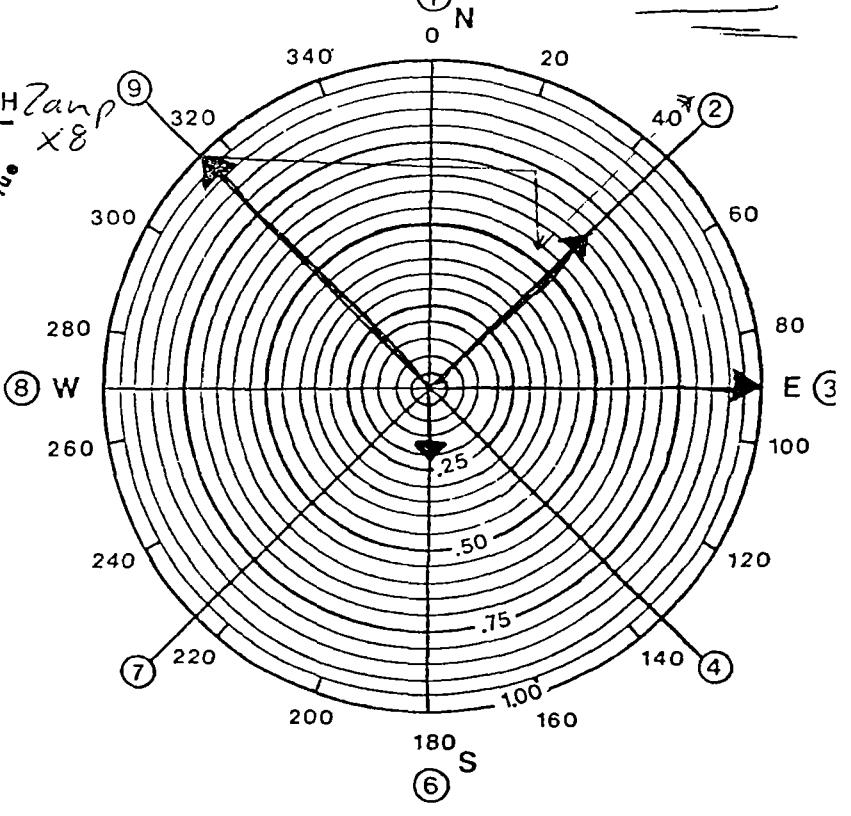
Probe pair	A start	B end	C B-A
+1/-6	+72	+78	+16
+2/-7	+43	-12	-55
+3/-8	+3	-228	-231
+4/-9	0	-78	-78

ROTATE PROBE 180° AT SAME DEPTH 2amp x8

1→S

Probe pair	D start	E end	S E-D		F N-S/2	G F max. value
+1/-6	+8	+26	+18	-	1	.22
+2/-7	+40	-21	-61	+	3	.66
+3/-8	0	-240	-240	+	4.5	1
+4/-9	+3	-84	-87	+	4.5	1

64.6 ↑ 4.5

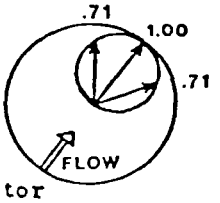


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator:

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). .07

Direction: 41° NE Velocity: .45

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Table of LCD Readout

1→5

Probe pair	A start	B end	C B-A
+1/-6	+7	-376	-243
+2/-7	+40	-303	-343
+3/-8	-2	-394	-396
+4/-9	+41	+30	-26

5 samples ×8

Operator: SM Date: 11/10/95

Station: GW44D Time: 3 25

Location: Olin / Wilmington

Soil Conditions: /

Depth to Measurement: 63 36

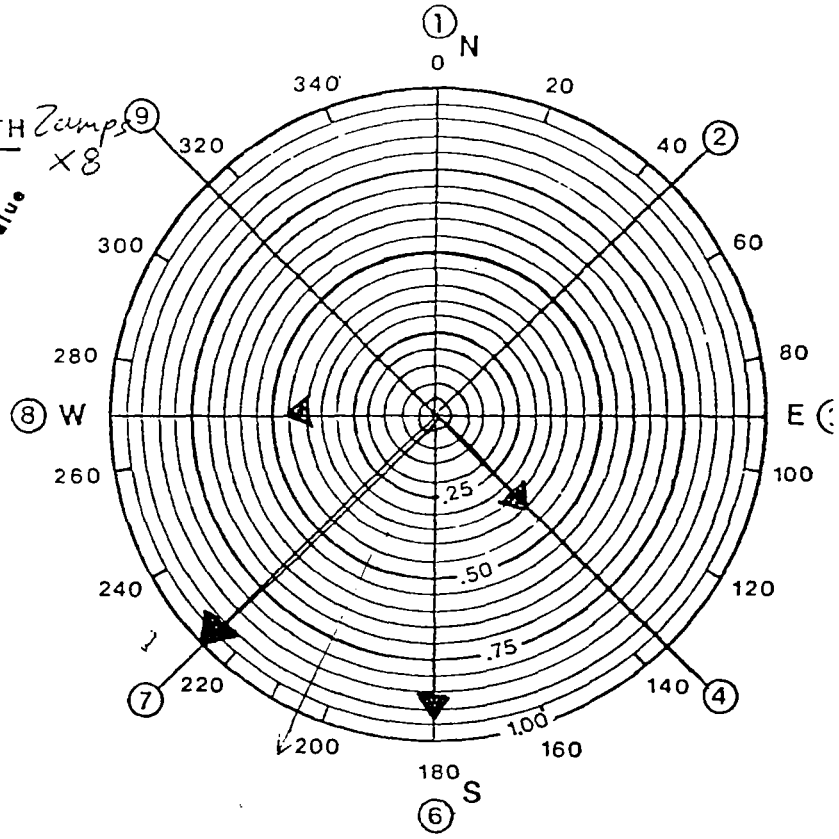
ROTATE PROBE 180° AT SAME DEPTH

1→8

Probe pair	D start	E end	S E-D	F N-S / 2	G F / max. value
+1/-6	+8	+52	+44	-143.5	.93
+2/-7	+37	0	-37	-153	1
+3/-8	-28	-285	-257	-69.5	.45
+4/-9	+1	-100	-101	+63.5	.41

5 samples ×8

153

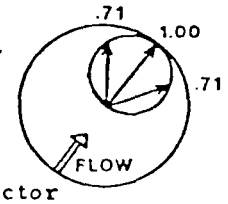


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). 2.8

Direction: 205° SW Velocity: 5.4

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Table of LCD Readout 2 Amp ×8

1→N

Probe pair	A start	B end	C B-A
+1/-6	+16	+34	+18
+2/-7	+35	-66	-101
+3/-8	-40	-351	-317
+4/-9	0	-130	-130

Operator: SM Date: 11/10/95

Station: GW44D Time: _____

Location: Olin/Whittington

Soil Conditions: /

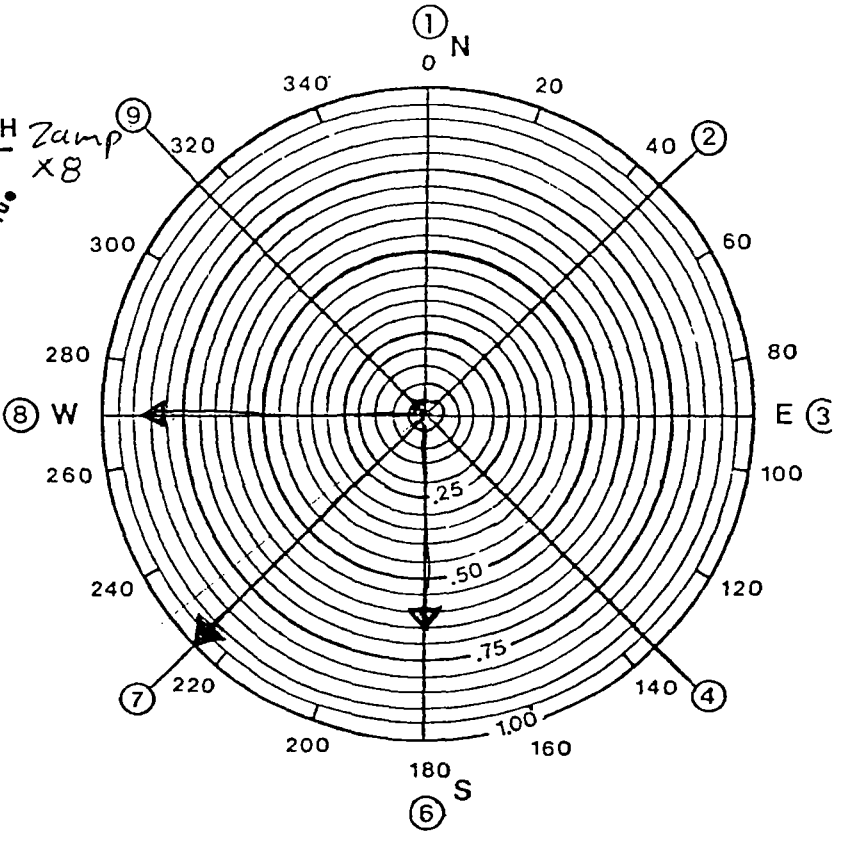
Depth to Measurement: 63 BG Dup

ROTATE PROBE 180° AT SAME DEPTH South 1st 2amp ×8

1→S

Probe pair	D start	E end	S E-D	F N-S/2	G F max. value
+1/-6	+21	+80	+59	-20.5	.62
+2/-7	+50	+10	-40	-30.5	1
+3/-8	-17	-281	-264	-26.5	.80
+4/-9	0	-128	-128	-1	.103

646 | 30.5

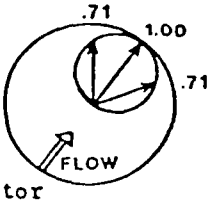


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculators

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). .47 ftd

Direction: 250° SW Velocity: 1.0

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Table of LCD Readout 7amps x8

1→N

Probe pair	A start	B end	C B-A
+1/-6	+7	+60	+53
+2/-7	-53	+67	+14
+3/-8	-13	-180	-193
+4/-9	+18	-27	-45

Operator: SM Date: 11/10/95

Station: GW44D Time: ~600

Location: Olin / Wilmington

Soil Conditions: /

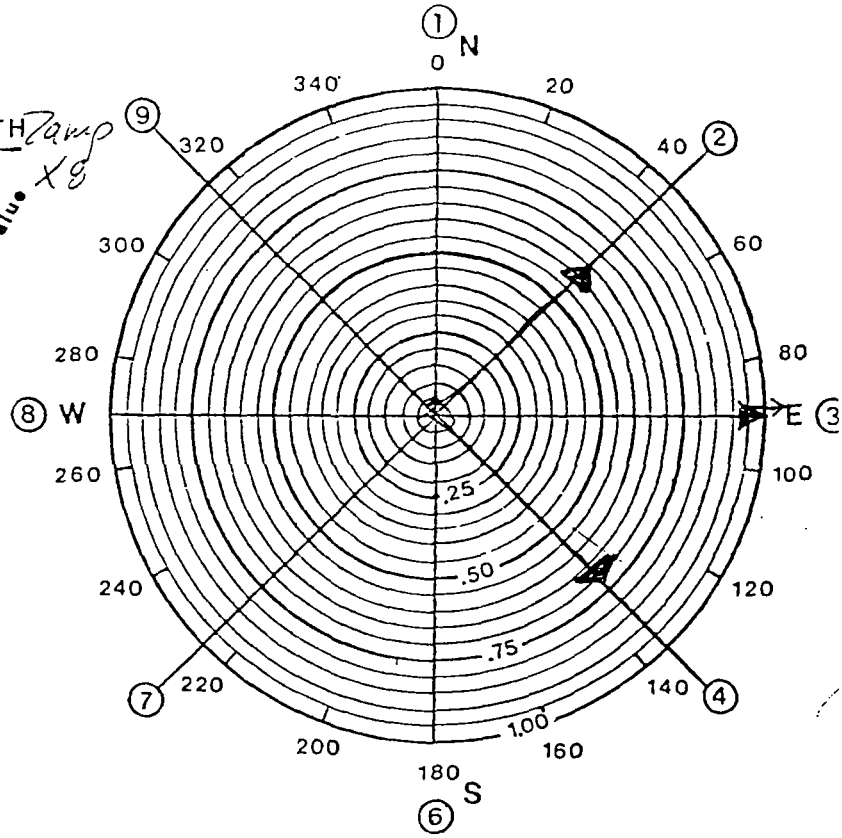
Depth to Measurement: 58

ROTATE PROBE 180° AT SAME DEPTH 7amp x8

1→S

Probe pair	D start	E end	S E-D	F N-S/2	G F max. value
+1/-6	+74	+57	+13	+ 5	.07
+2/-7	+52	-23	-75	+ 44.5	.62
+3/-8	0	-325	-325	- 66	1
+4/-9	+11	-130	-141	+ 48	.72

64.6 166

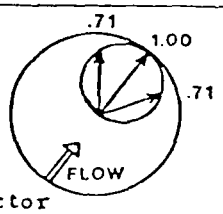


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator:

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). 1.02 ft/d

Direction: 87° E Velocity: 2.2

Form 104 available from your local K-V Associates, Inc. dealer.

9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Table of LCD Readout

1→N

Probe pair	A start	B end	C B-A
+1/-6	+14	+59	+45
+2/-7	+41	-38	-79
+3/-8	-73	-351	-332
+4/-9	0	-136	0 -136

Operator: SM Date: 11/10/95

Station: GW44D Time: ~ 6:30

Location: Olin/Wilmington

Soil Conditions:

Depth to Measurement: 58 BG

ROTATE PROBE 180° AT SAME DEPTH

South 1ST

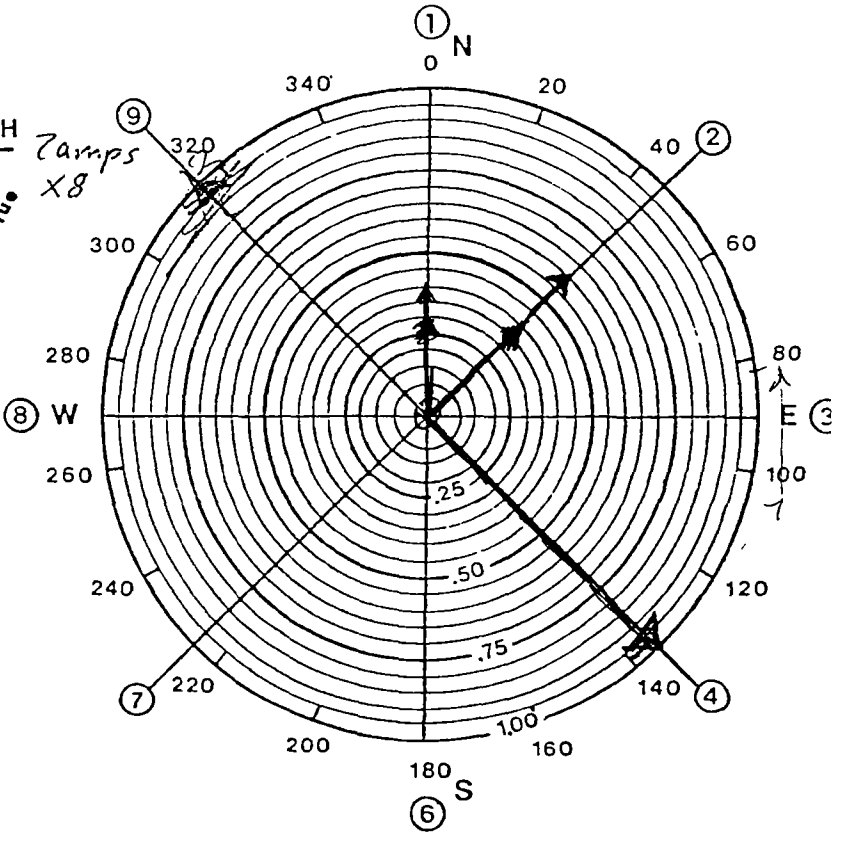
7 amps x8

1→S

Probe pair	D start	E end	S E-D	F N-S / 2	G F max. value
+1/-6	+75	-55	+40	+45-40 / 2 = + 2.5	.03
+2/-7	+40	-46	-86	- 3.5	.04
+3/-8	-23	-355	-332	+ 0	0
+4/-9	0	-150	-150	+ 7.0	1

-136+150 / 2 = .11

64.6 | 7.0

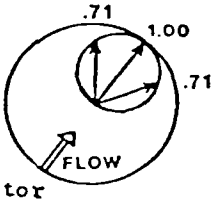


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator:

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). .11

Direction: 310° Velocity: 2.5

Form 104 available from your local K-V Associates, Inc. dealer.

9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Table of LCD Readout Ramp ×8

1→N

Probe pair	A start	B end	C B-A
+1/-6	+9	+80	+71
+2/-7	+40	+210	+170
+3/-8	+1	-39	-40
+4/-9	+1	+20	-19

Operator: SM/AEP Date: 11/12/95

Station: GW43D Time: _____

Location: Olin / Wilmington

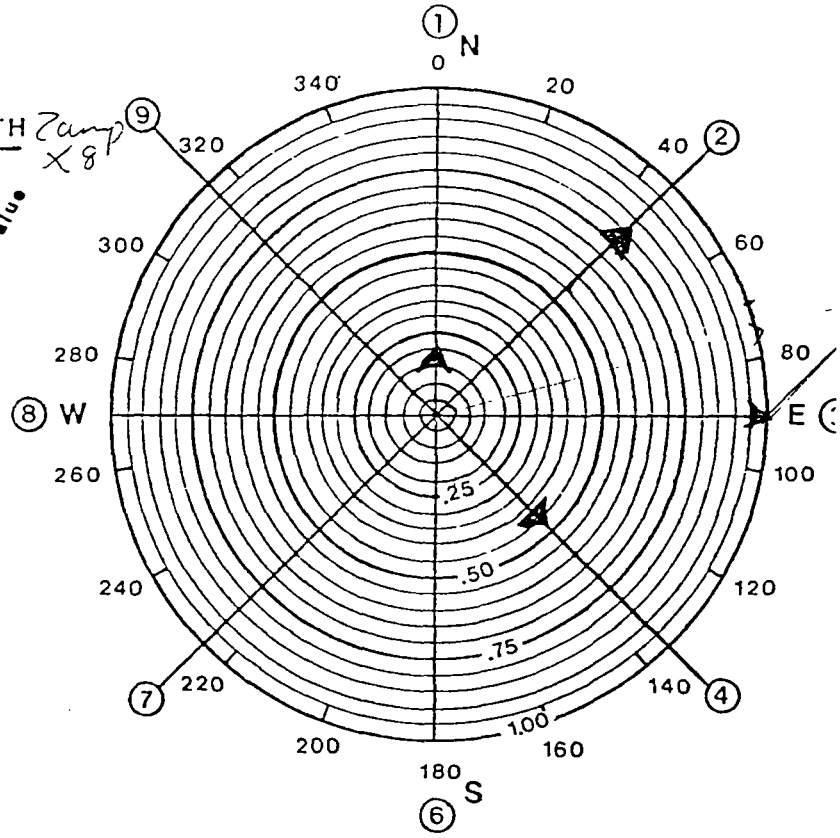
Soil Conditions: /

Depth to Measurement: 32 BG

ROTATE PROBE 180° AT SAME DEPTH Ramp ×8

1→S

Probe pair	D start	E end	S E-D	F N-S / 2	G F / max. value
+1/-6	+8	0	-8	+39.5	.20
+2/-7	+34	-120	-154	+162	.82
+3/-8	-23	-455	-432	+196	1
+4/-9	0	-162	-162	+90.5	.46

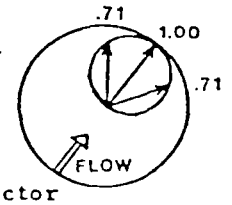


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day).

4/12

Direction: 75° Velocity: 5.7

Form 104 available from your local K-V Associates, Inc. dealer.

9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Table of LCD Readout Zeroes ×8

1→N

Probe pair	A start	B end	C B-A
+1/-6	±15	±44	+29
+2/-7	±50	±172	+122
+3/-8	0	-74	-74
+4/-9	±6	±40	+34

Operator: SM/REP Date: 11/12/95

Station: GW430 Time: _____

Location: Elm / Wilmington Dr

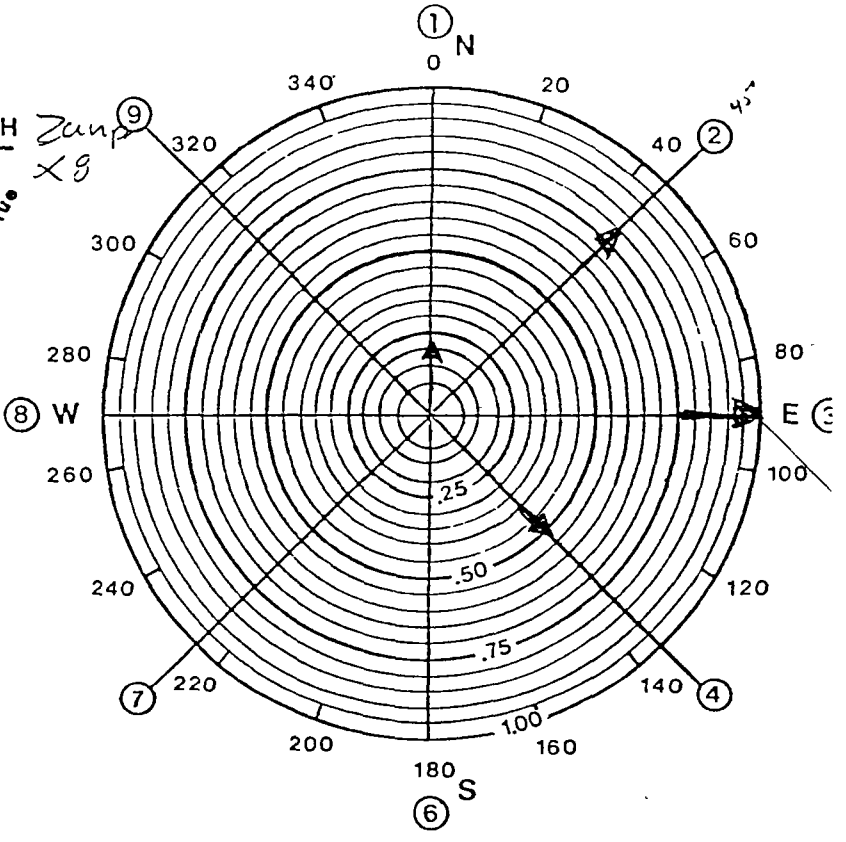
Soil Conditions: _____

Depth to Measurement: 32' 13G

ROTATE PROBE 180° AT SOUTH AT SAME DEPTH Zeroes ×8

1→S

Probe pair	D start	E end	S E-D	F N-S / 2	G F / max. value
+1/-6	±5	-25	-30	+29.5	0.17
+2/-7	±25	-188	+163	+137.5	0.80
+3/-8	-32	-490	-458	+172	1
+4/-9	0	-150	-150	+92	0.55

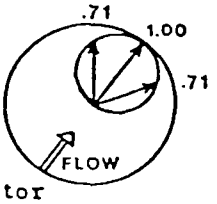


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day).

3.2

Direction: 80 ENE Velocity: 5.1

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Table of LCD Readout 2 amps ×8

1→N

Probe pair	A start	B end	C B−A
+1/-6	+14	+158	−144
+2/-7	+39	+205	−166
+3/-8	0	+145	−145
+4/-9	0	+158	−156

Operator: SM/BEP Date: 11/22/95

Station: GW43D Time: _____

Location: Olin / Wilmington

Soil Conditions: _____

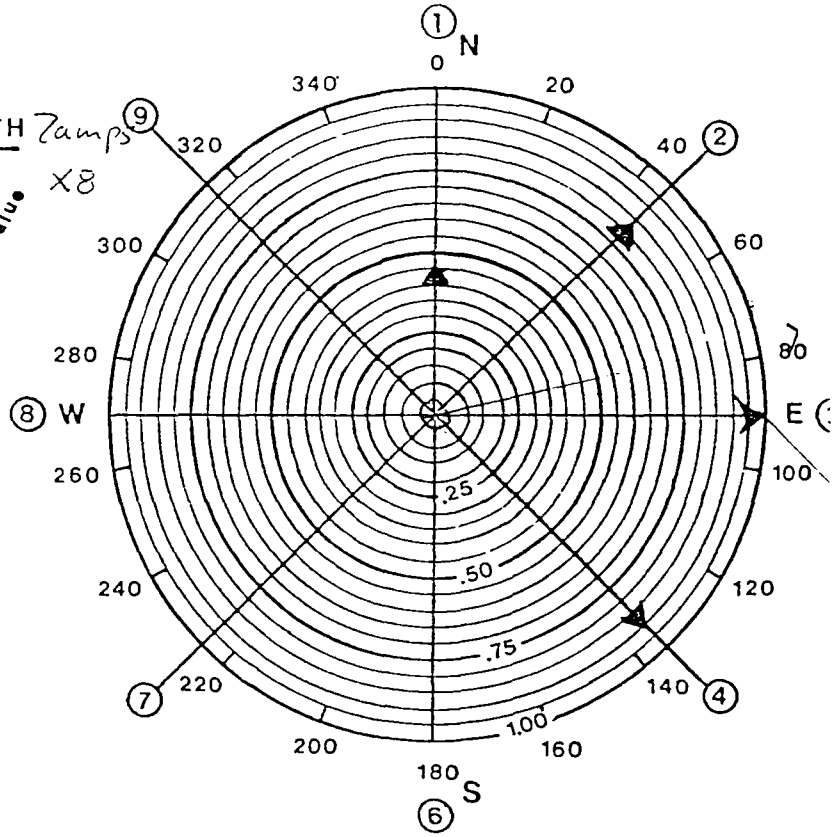
Depth to Measurement: 27' BG

2 amps

ROTATE PROBE 180° AT SAME DEPTH 2 amps ×8

1→S

Probe pair	D start	E end	S E−D	F N−S/2	G F/max. value
+1/-6	+11	+84	+73	+35.5	.44
+2/-7	+46	+79	+33	+66.5	.83
+3/-8	0	−305	−305	+80	1
+4/-9	+2	−300	−302	+73	.91

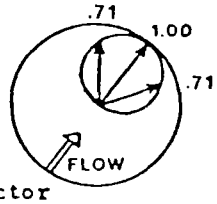


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). 1.4

Direction: 78° Velocity: 2.6

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Operator: SM/MP Date: 11/17/95

Station: GW43D Time:

Location: Olin/Wilmington

Soil Conditions:

Depth to Measurement: 27'36

Table of LCD Readout

1→N

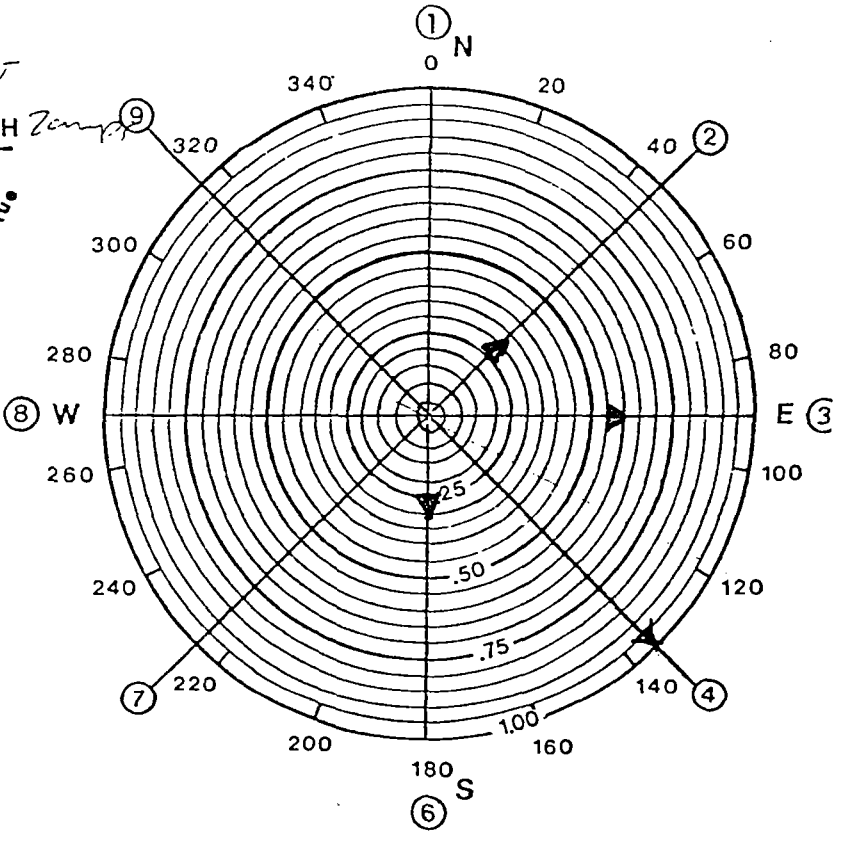
Probe pair	A start	B end	C B-A
+1/-6	+11	+22	-11
+2/-7	+114	+119	+75
+3/-8	+1	-211	-212
+4/-9	+2	-125	-127

ROTATE PROBE 180° AT SAME DEPTH

South 1ST Sample

1→S

Probe pair	D start	E end	S E-D	F N-S/2	G F max. value
+1/-6	+9	+81	+72	- 30.5	.32
+2/-7	+42	+57	+15	+ 30	.32
+3/-8	0	-322	-322	+ 55	.60
+4/-9	0	-312	-312	+ 92.5	1

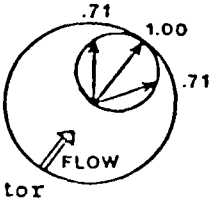


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculators

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day).

111

Direction: 118 Velocity: 308

Form 104 available from your local K-V Associates, Inc. dealer.

9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Table of LCD Readout 2amp x8

1→N

Probe pair	A start	B end	C B-A
+1/-6	+11	+24	+13
+2/-7	+42	+12	-30
+3/-8	+0	-241	-241
+4/-9	+4	-53	-57

Operator: SM Date: 11/12/95

Station: GW45D Time: ~8:30

Location: Orin / Wilmington

Soil Conditions:

Depth to Measurement: 60.13G

ROTATE PROBE 180° AT SAME DEPTH 2amp x8

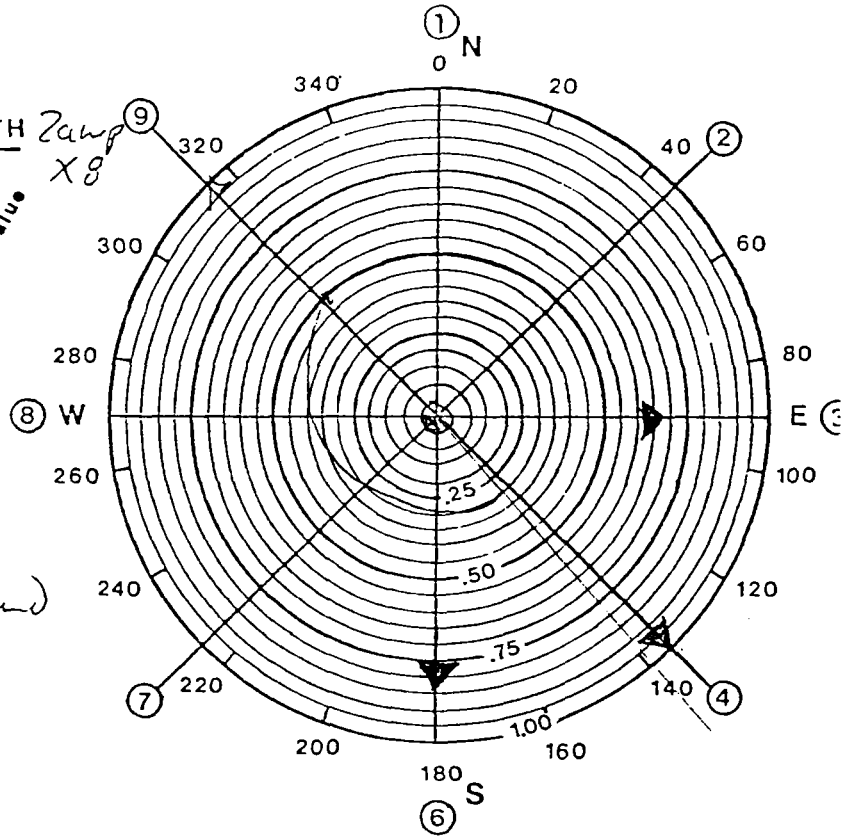
1→S

Probe pair	D start	E end	S E-D	F N-S/2	G F max. value
+1/-6	+11	+86	+75	+31	.83
+2/-7	+37	+10	-27	+1.5	.04
+3/-8	-8	-309	-291	-25	.67
+4/-9	+1	-130	-131	-32	1

+75-13/2 = +31; -27+30/2 = +1.5; -291+241/2 = -25; -131+69/2 = -32

N.B. South done on North and North on South

64.6 | 37

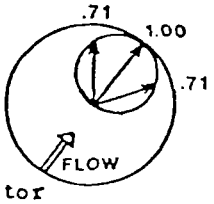


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). .57 ft/d

Direction: 140°SE 180 320° Velocity: 1.2

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Table of LCD Readout

Zamp X8

1→N

Probe pair	A start	B end	C B-A
+1/-6	±13	±85	±72
+2/-7	±37	+5	-32
+3/-8	-26	-315	-289
+4/-9	0	-134	-134

Operator: SM Date: 11/12/95

Station: GW45D Time: _____

Location: Olin / Wilmington Du

Soil Conditions: _____

Depth to Measurement: 60.36

ROTATE PROBE 180° AT SAME DEPTH Zamp X8

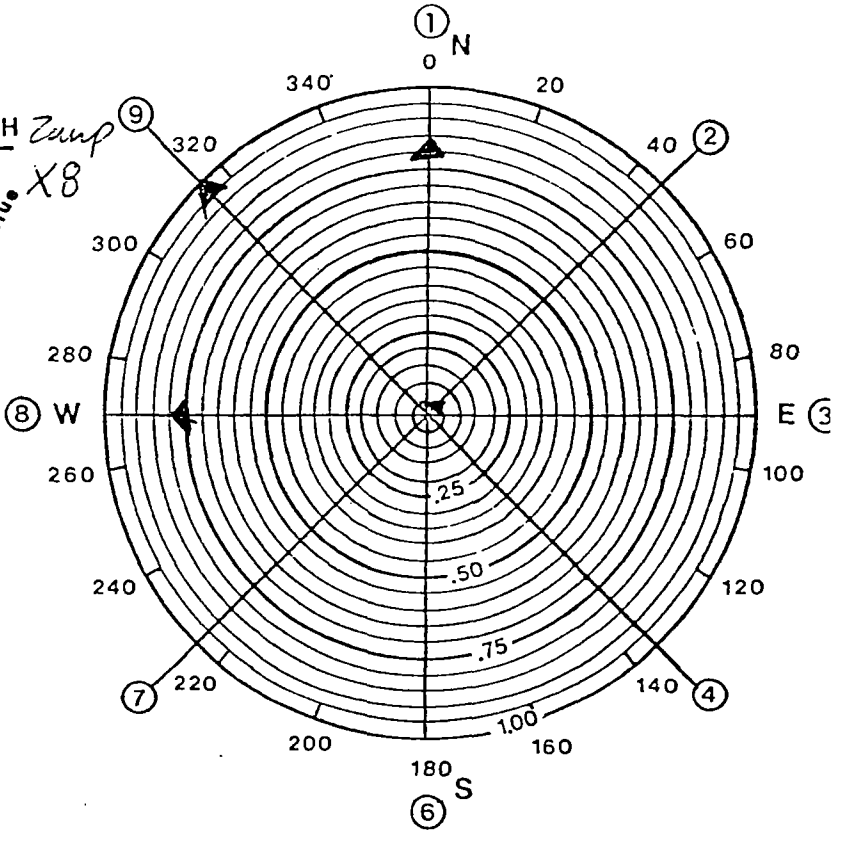
1→S

Probe pair	D start	E end	S E-D	F N-S / 2	G F max. value
+1/-6	±17	±24	7	-32.5	.84
+2/-7	±40	+6	-34	-41	.02
+3/-8	-27	-256	-229	-150	.77
+4/-9	0	-37	-37	-38.5	1

+72 -7 / 2 = -32

+34 / 2 + -32 = -289 + 22 / 2 = -134 + 57 / 2 = -38.5

64.6 | 38.5

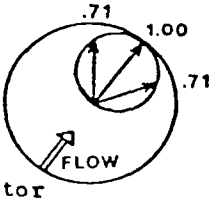


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator:

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). .59

Direction: 321° NW Velocity: ~~1.28~~

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Table of LCD Readout Ramp x8

1→N

Probe pair	A start	B end	C B-A
+1/-6	+7	+14	-7
+2/-7	+43	+18	-25
+3/-8	+1	-223	-224
+4/-9	+8	-53	-61

Operator: GM Date: 11/12/85

Station: GW45D Time: ~10:10

Location: Olin / Wilmington

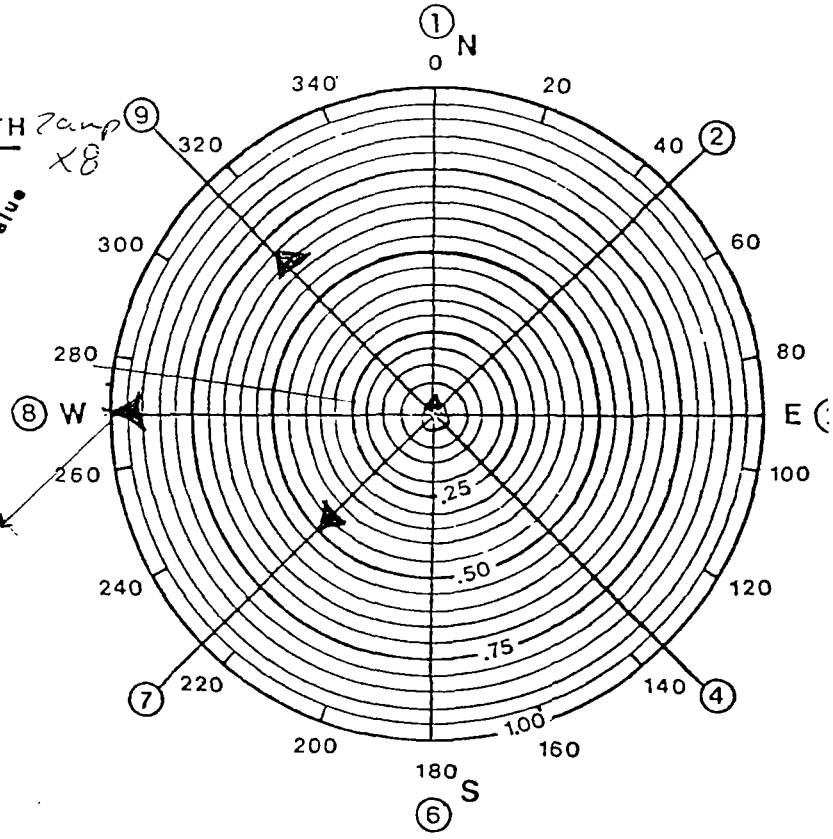
Soil Conditions: /

Depth to Measurement: 55 BG

ROTATE PROBE 180° AT SAME DEPTH Ramp x8

1→S

Probe pair	D start	E end	S E-D	F N-S/2	G F max. value
+1/-6	+20	+14	-4	+ 11.5	.03
+2/-7	+46	+48	+2	- 13.5	.49
+3/-8	0	-169	-169	- 27.5	1
+4/-9	+9	-13	-22	- 19.5	.17

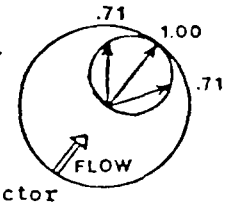


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day).

Direction: 278 Velocity: .60 .91

Form 104 available from your local K-V Associates, Inc. dealer.

9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Table of LCD Readout 2 amp X8

1→N

Probe pair	A start	B end	C D-A
+1/-6	+14	+79	+64
+2/-7	+37	+18	-55
+3/-8	+29	-332	-309
+4/-9	0	-150	-150

Operator: SM Date: 11/12/95

Station: GW45D Time: ~11:00 am

Location: Olin / Wilmington

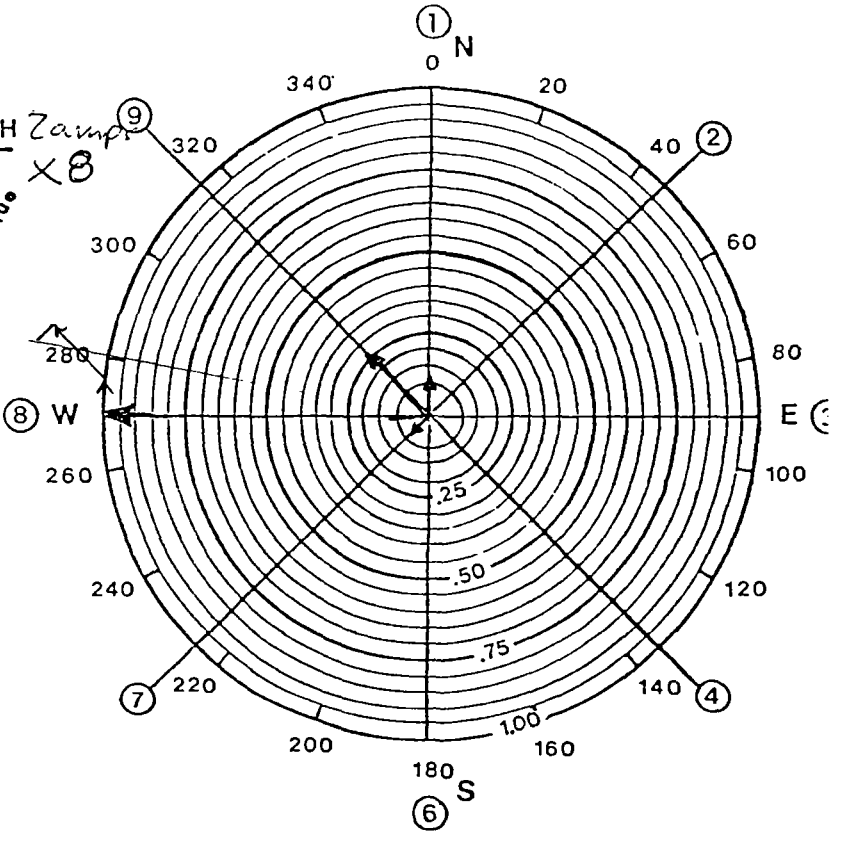
Soil Conditions: Di

Depth to Measurement: 55 BG

ROTATE PROBE 180° AT SAME DEPTH 2 amps X8 South 1st

1→S

Probe pair	D start	E end	S E-D	N-S/2 F	G F/max. value
+1/-6	+12	+16	+4	+30	.48
+2/-7	+43	+27	-16	-19.5	.31
+3/-8	-18	-203	-221	-185	1
+4/-9	+7	-32	-39	-55.9	.189

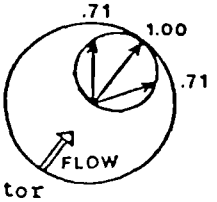


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day).

Direction: 280° Velocity: 1.1

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Table of LCD Readout

1→N

Probe pair	A start	B end	C B-A
+1/-6	+16 +352	+110	+94
+2/-7	+24 +19	-54	-88
+3/-8	-25 ?	-356	-361
+4/-9	-12 +358	-246	-234

20 wps 5x

Operator: SM/ACP Date: 11/15/95

Station: GW-36 Time: 12:00

Location: Rte Wilmington MA

Soil Conditions:

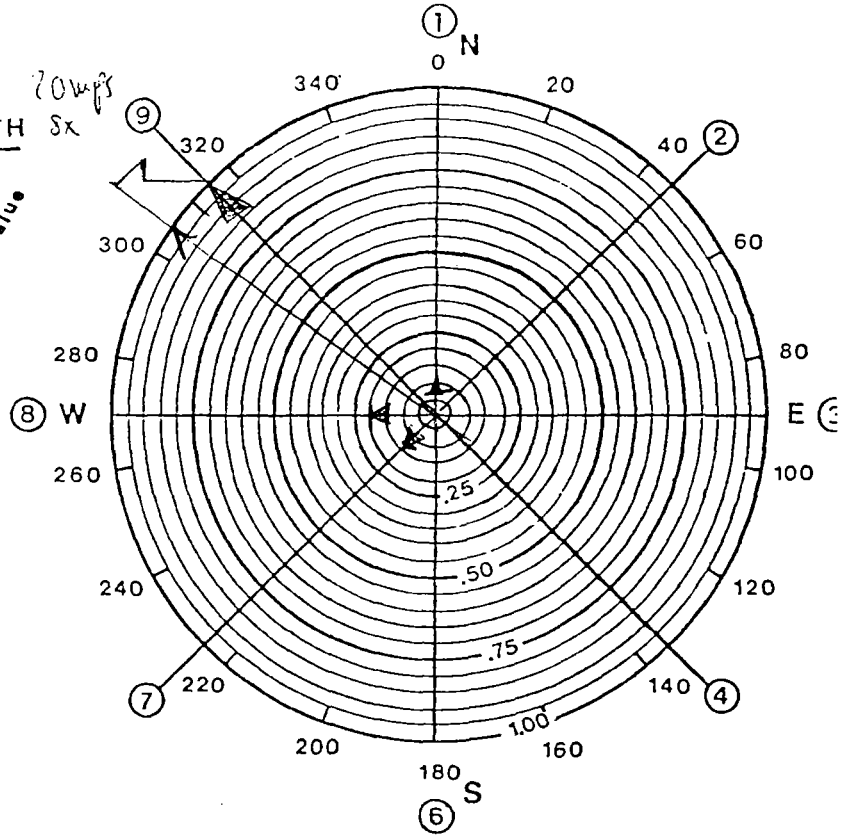
Depth to Measurement: 30 bg (dup)

South 1st 20 wps 5x

ROTATE PROBE 180° AT SAME DEPTH

1→S

Probe pair	D start	E end	S E-D	F N-S / 2	G F / max. value
+1/-6	+14	+94	+80	+7	0.21
+2/-7	+37	-20	-57	+15.5	0.19
+3/-8	-23	-340	-317	-22	0.20
+4/-9	0	-12	-12	-111	1

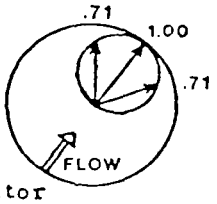


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day).

Direction: 304 NW Velocity: ~~3.1~~ 1.8

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Table of LCD Readout

1→N

Probe pair	A start	B end	C B-A
+1/-6	+12	+343	+351
+2/-7	+43	+390	+342
+3/-8	-6	+52	+46
+4/-9	-8	-54	-46

20 mps 8X

Operator: SM/AEP Date: 11/15/95

Station: GW36 Time: 11:00

Location: Olin Wilmington MA

Soil Conditions:

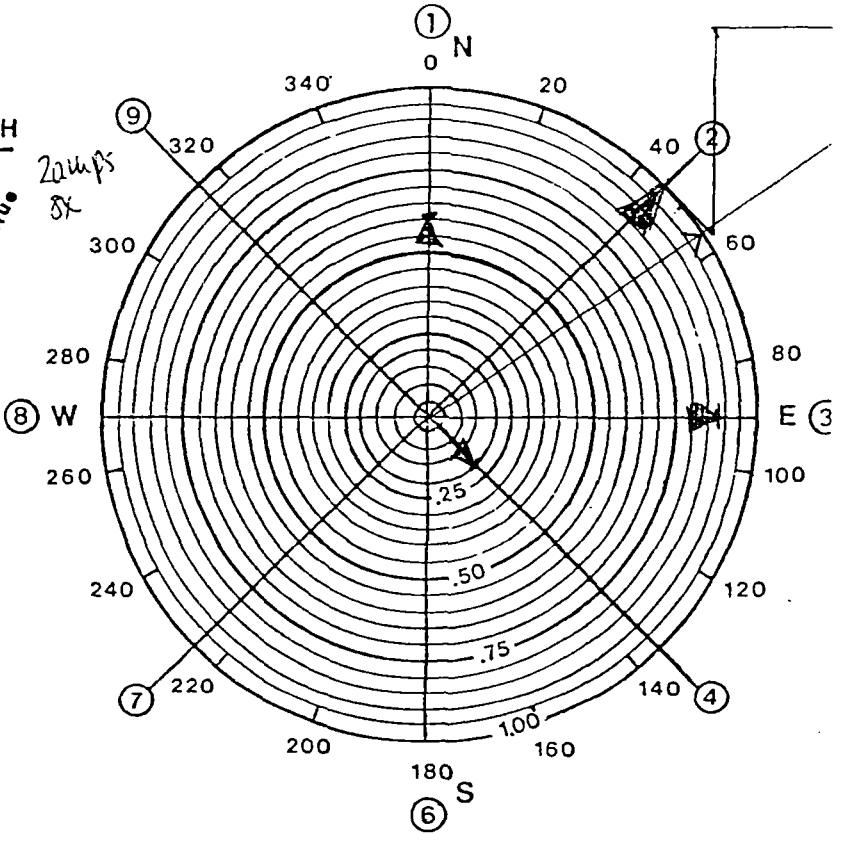
Depth to Measurement: 30' bgs

ROTATE PROBE 180° AT SAME DEPTH

1→S

Probe pair	D start	E end	S E-D	F N-S / 2	G F / max. value
+1/-6	+28	+145	+117	+107	0.61
+2/-7	+62	+54	-8	+175	1
+3/-8	+8	-251	-259	+152.5	0.87
+4/-9	+1	-114	-115	+34.5	0.20

20 mps 8X

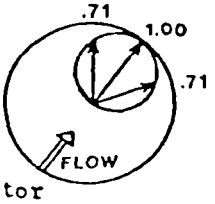


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator:

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day).

3.5

Direction: 56 NE Velocity: 5.8

Form 104 available from your local K-V Associates, Inc. dealer.

9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Table of LCD Readout

1→N

Probe pair	A start	B end	C B-A
+1/-6	+45	+89	+44
+2/-7	+20	-32	-52
+3/-8	-82	-381	-299
+4/-9	-66	-194	-128

20 amps 5x

Operator: AEP/SM Date: 11/15/95

Station: GW 36 Time: 10:30

Location: Olin Wilmington MA

Soil Conditions:

Depth to Measurement: 34' bg (40)

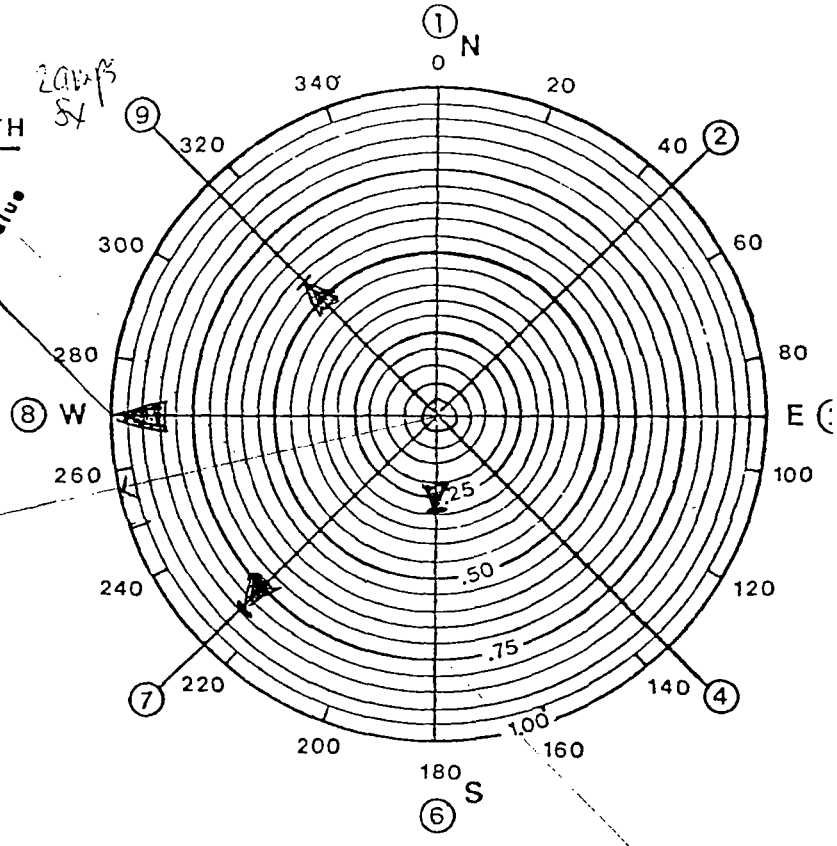
South 1st

20 amps 5x

ROTATE PROBE 180° AT SAME DEPTH

1→S

Probe pair	D start	E end	S E-D	F N-S/2	G F max. value
+1/-6	+6	+84	+78	-11	0.24
+2/-7	+58	+103	+45	-48.5	0.58
+3/-8	+13	-170	-183	-58	1
+4/-9	+30	-32	-62	-33	0.57

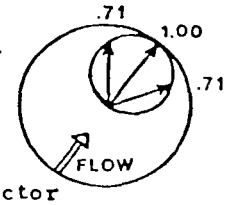


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day).

1.0

Direction: 257 Velocity: 1.4

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Table of LCD Readout

1→N

Probe pair	A start	B end	B-A
+1/-6	+12	+90	78
+2/-7	+44	-66	110
+3/-8	0	-442	442
+4/-9	+2	-225	227

2 amps 8x

Operator: ACP/GM Date: 11/15/85

Station: GW2 Time: 1000

Location: Elm Wilmington MA

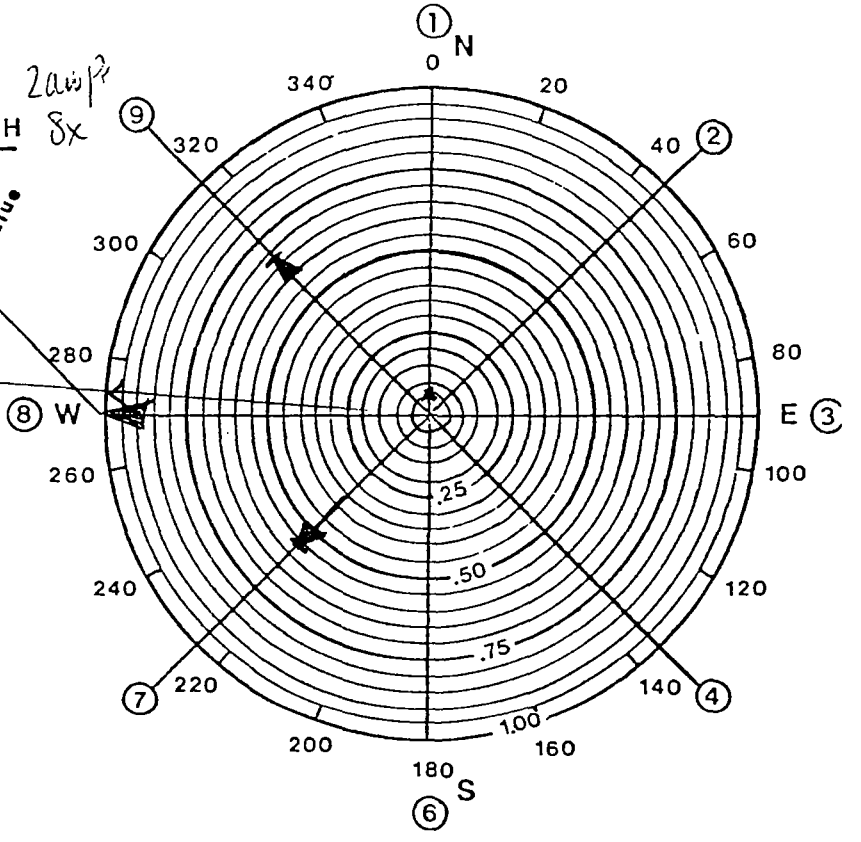
Soil Conditions:

Depth to Measurement: 34' bg

ROTATE PROBE 180° AT SAME DEPTH

1→S

Probe pair	D start	E end	S E-D	F N-S/2	G F max. value
+1/-6	+6	+65	+59	+10	0.07
+2/-7	+47	+109	+62	-86	0.56
+3/-8	0	-136	-136	-153	1
+4/-9	+22	+3	-19	-104	0.68



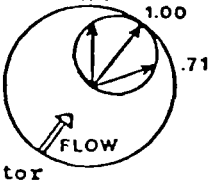
2 amps 8x

Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculators

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day).

2.6

Direction: 274 W Velocity: 5.1

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Operator: SM/AEP Date: 11/14/95

Station: GW30DR Time: ~1,30

Location: Olin/Wilmington

Soil Conditions:

Depth to Measurement: 37'13"

Table of LCD Readout

2 pumps X4

1→N

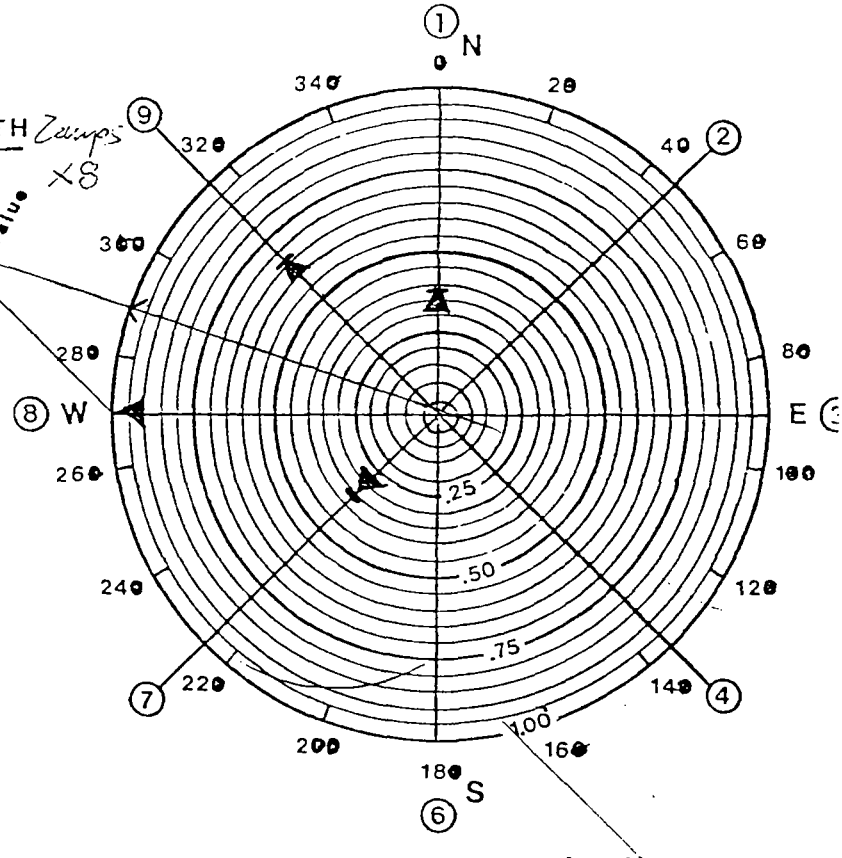
Probe pair	A start	B end	C B-A
+1/-6	-1	+99	-98
+2/-7	-39	0	-39
+3/-8	+6	-328	-334
+4/-9	+74	-163	-177

ROTATE PROBE 180° AT SAME DEPTH

2 pumps X8

1→S

Probe pair	D start	E end	S E-D	F N-S / 2	G F / max. value
+1/-6	+21	+51	+30	+ 34	.30
+2/-7	+46	+73	+27	- 33	.32
+3/-8	0	-156	-156	- 89	1
+4/-9	0	-59	-59	- 59	.66

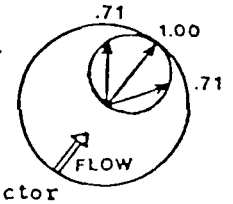


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day).

1.6

Direction: 288 WNW Velocity: 2.9

Form 104 available from your local K-V Associates, Inc. dealer.

9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Operator: SAM/AAP Date: 11/14/95

Station: GW30DR Time:

Location: Olin/Wilmington

Soil Conditions:

Depth to Measurement: 37.86 Dz

Table of LCD Readout 2 samples x 2

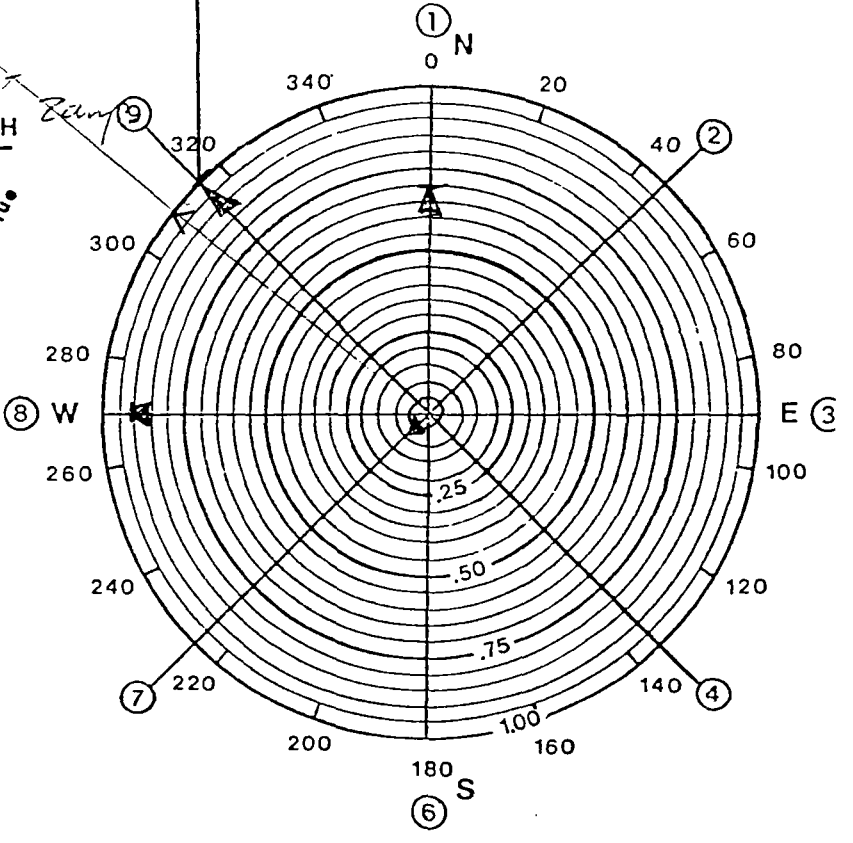
1→N

Probe pair	A start	B end	C B-A
+1/-6	+20	-131	+111
+2/-7	+38	-37	-1
+3/-8	-31	-340	-309
+4/-9	-13	-176	-163

ROTATE PROBE 180° AT SAME DEPTH — South 1st Zero

1→S

Probe pair	D start	E end	S E-D	F N-S/2	G F max. value
+1/-6	+35	-18	-17	+64	0.70
+2/-7	-55	+69	+14	-75	0.83
+3/-8	-19	-162	-143	-83	0.91
+4/-9	-17	+2	+19	-91	1

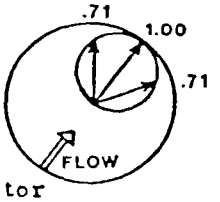


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculators

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day).

1.6

Direction: 308 Velocity: 3.0

Form 104 available from your local K-V Associates, Inc. dealer.

9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Table of LCD Readout

1→N

Probe pair	A start	B end	C B-A
+1/-6	+12	-152	-434
+2/-7	+15	-111	+96
+3/-8	-55	-174	-119
+4/-9	-30	-119	-89

Operator: REJSM Date: 11/14/95

Station: GW30DR Time: _____

Location: Olin/Wilmington

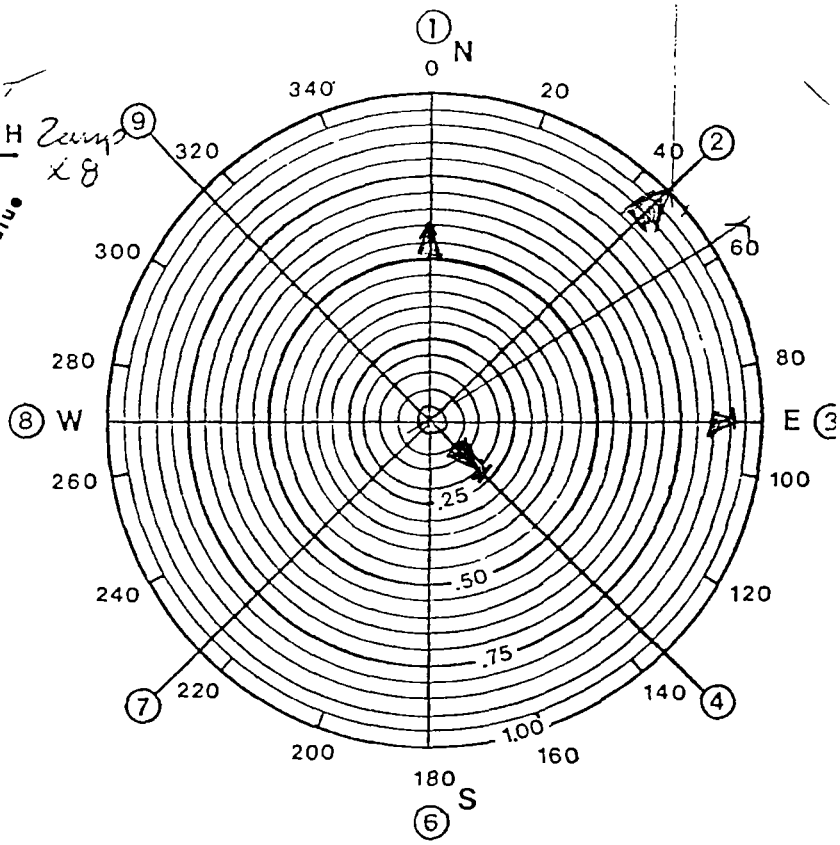
Soil Conditions: /

Depth to Measurement: 33 BG

ROTATE PROBE 180° AT SAME DEPTH

1→S

Probe pair	D start	E end	S E-D	F N-S / 2	G F / max. value
+1/-6	-75	-128	-113	-143 + 140.5	0.62
+2/-7	-64	-397	-333	+ 234.5	1
+3/-8	-107	-651	-765	-544 + 242.5	0.41
+4/-9	-66	-266	-200	+ 55.5	0.24

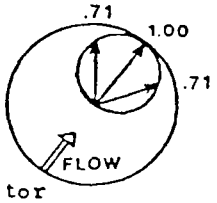


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator:

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day).

Direction: 58 Velocity: 6.75

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Operator: SM/REP Date: 11/14/85

Station: G430 DIR Time: _____

Location: Elm / Wilmington

Soil Conditions: _____

Depth to Measurement: 33' 13G

Table of LCD Readout

Temp x8

1→N

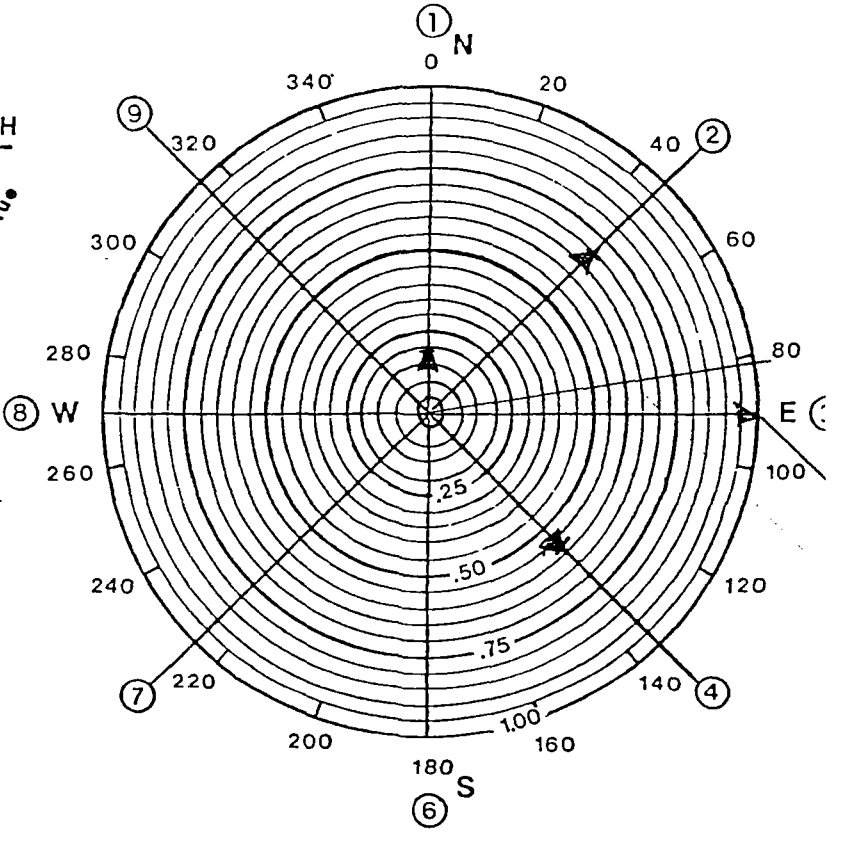
Probe pair	A start	B end	C B-A
+1/-6	+76	+294	+218
+2/-7	+59	+216	+157
+3/-8	+78	+324	+246
+4/-9	+76	+435	+359

ROTATE PROBE 180° AT SAME DEPTH

1→S

Probe pair	D start	E end	F E-D	G N-S / 2	H F max. value
+1/-6	+29	+66	+37	+120.5	.18
+2/-7	+54	+185	+239	+448.5	.70
+3/-8	+20	+586	+566	+636	1
+4/-9	+12	+336	+324	+371.5	.58

B.9 N636

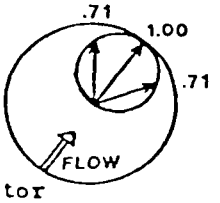


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day).

45 f:d

Direction: 81 Velocity: 2.2

Form 104 available from your local K-V Associates, Inc. dealer.

9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Operator: AEP/SM Date: 11/14/95

Station: GW50D Time: 1:00

Location: Olin/Wilmington

Soil Conditions:

Depth to Measurement: 32.5 BG

Table of LCD Readout

1→N

Probe pair	A start	B end	C B-A
+1/-6	+11	+80	+69
+2/-7	+38	+67	+29
+3/-8	-23	-200	+177
+4/-9	0	-96	-96

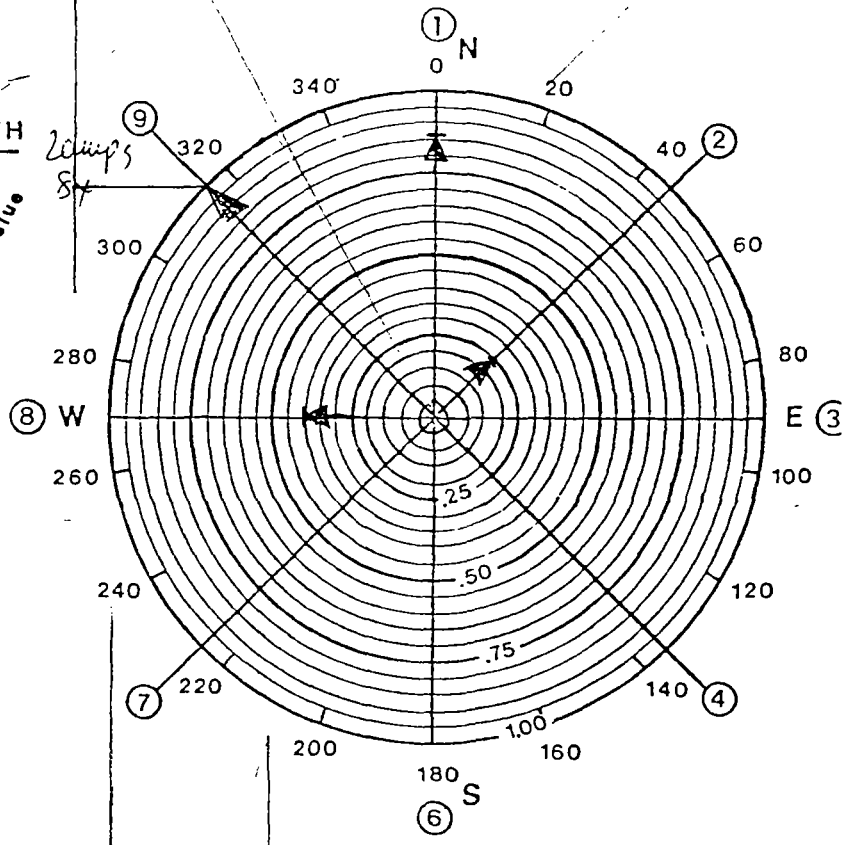
2 temps 8x

ROTATE PROBE 180° AT SAME DEPTH

1→S

Probe pair	D start	E end	S E-D	F N-S/2	G F/max. value
+1/-6	+12	+31	+19	+ 50	0.36
+2/-7	+44	+59	+15	+ 7	0.24
+3/-8	0	-154	+154	- 11.5	0.40
+4/-9	+2	-36	-38	- 29	1

2 temps 8x

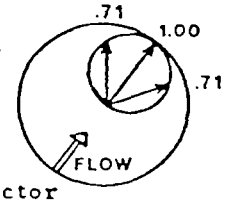


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculators

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day).

Direction: 331 NNW Velocity: .60 .097

Form 104 available from your local K-V Associates, Inc. dealer.

9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Table of LCD Readout

1→N

Probe pair	A start	B end	C B-A
+1/-6	+9	+41	+32
+2/-7	+42	+52	+10
+3/-8	0	-162	-162
+4/-9	+5	-62	-67

2 amps SV

Operator: AEP/SM Date: 11/14/95

Station: QW50D Time: 12:00

Location: Elm Williamsburg MA

Soil Conditions: /

Depth to Measurement: 32.5 bg

ROTATE PROBE 180° AT SAME DEPTH

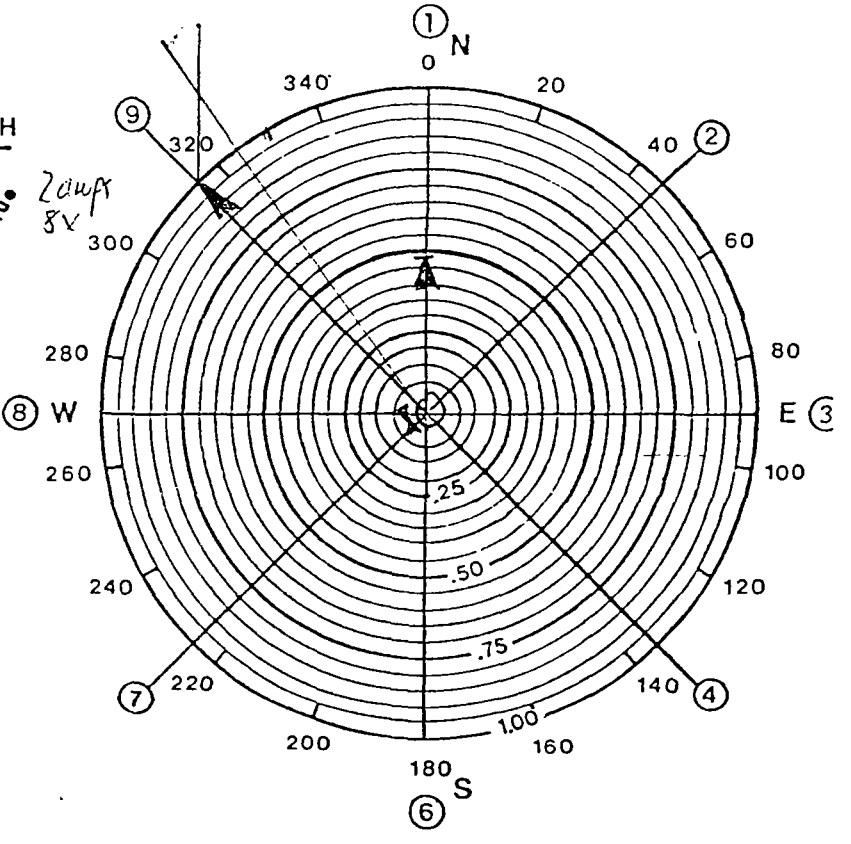
1→S

Probe pair	D start	E end	S E-D	F N-S/2	G F max. value
+1/-6	+2	+29	+17	7.5	0.47
+2/-7	+45	+57	+12	1	0.04
+3/-8	0	-160	-160	1	1.00
+4/-9	+3	-33	-36	16.5	1

-16

12:30 start - 1 min before this

2 amps SV

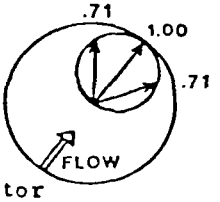


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator:

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day).

Direction: 322' Velocity: 0.30

Form 104 available from your local K-V Associates, Inc. dealer.

9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Operator: MP/SM Date: 11/14/95

Station: GW50D Time: 11:30

Location: Glen Wilmington

Soil Conditions:

Depth to Measurement: 37' bg

Table of LCD Readout

1→N

Probe pair	A start	B end	C B-A
+1/-6	+13	+99	+86
+2/-7	142	+70	+28
+3/-8	-15	-220	-205
+4/-9	+2	+15	+17

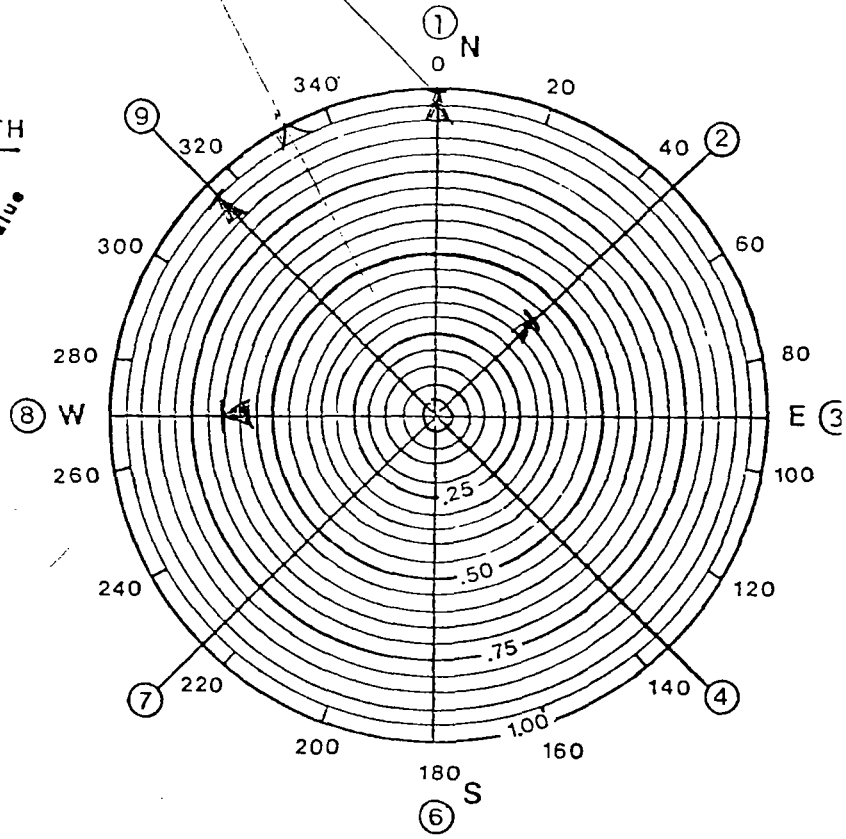
20 deg Sec

ROTATE PROBE 180° AT SAME DEPTH

1→S

Probe pair	D start	E end	S E-D	F N-S/2		G F/max. value
+1/-6	+14	+40	+26	+	30	1
+2/-7	+36	+39	+3	+	12.5	.42
+3/-8	-41	-204	-163	-	19.5	.65
+4/-9	0	-60	-60	-	28.5	-.95

(Drain 1 min before test)

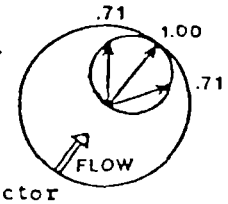


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator:

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day).

,160

Direction: 332 Velocity: 1 ft/day

Form 104 available from your local K-V Associates, Inc. dealer.

9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Table of LCD Readout

1→N Probe pair	A start	B end	C B-A
+1/-6	-9	-91	-55
+2/-7	-41	+63	+27
+3/-8	+3	-196	-199
+4/-9	+5	-107	-112

20 cfs 8X

Operator: SM/AEP Date: 11/14/95

Station: GW50D Time: 11 am

Location: Otis/Wilmington

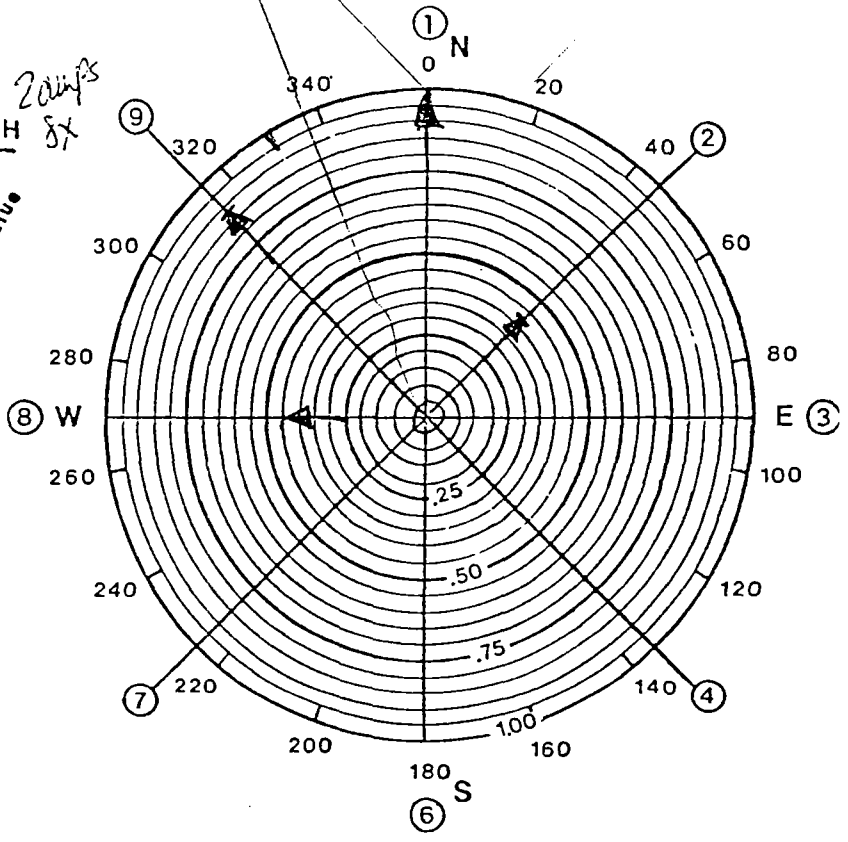
Soil Conditions:

Depth to Measurement: 37.5 BG

ROTATE PROBE 180° AT SAME DEPTH

1→S Probe pair	D start	E end	S E-D	F N-S / 2	G F / max. value
+1/-6	+11	+36	+25	+ 29	1
+2/-7	+40	+42	+2	+ 12.5	0.43
+3/-8	-15	-188	-173	- 13	0.45
+4/-9	+3	-58	-61	- 25.5	0.88

20 cfs 8X

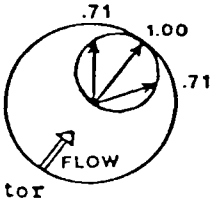


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculators

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day).

Direction: 337 Velocity: 0.97 .60

Form 104 available from your local K-V Associates, Inc. dealer.

9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Table of LCD Readout 2 amps x 8

1→N

Probe pair	A start	B end	C B-A
+1/-6	+12	+146	+134
+2/-7	+42	+91	+49
+3/-8	0	-345	-345
+4/-9	-2	-133	-135

Operator: SMITH Date: 1/15/85

Station: GW42D Time: _____

Location: Olin / Wilmington

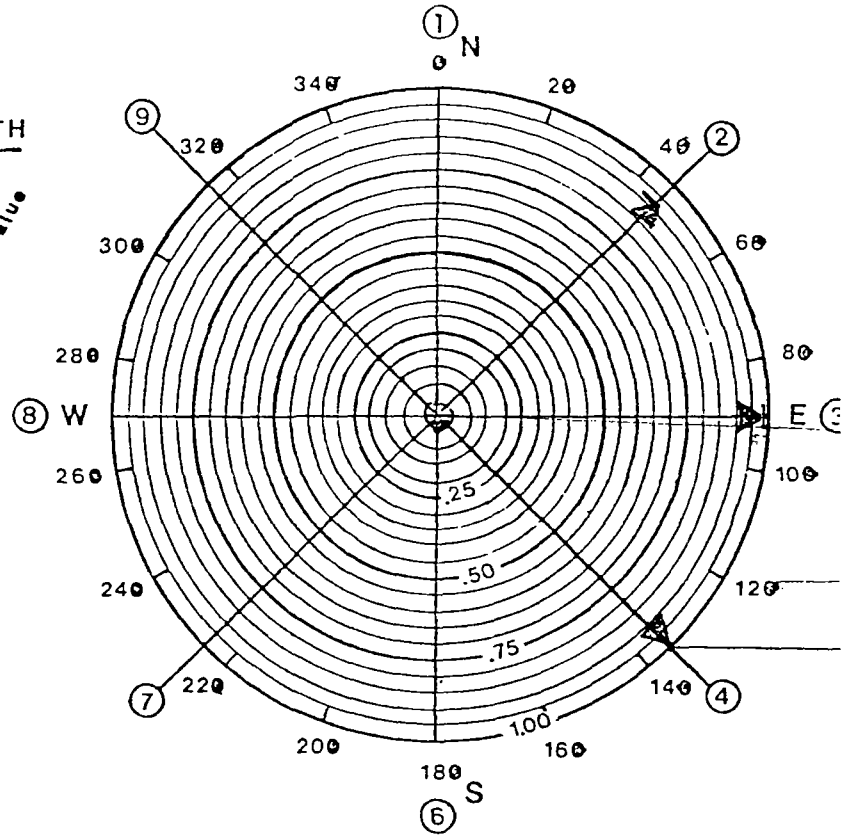
Soil Conditions: _____

Depth to Measurement: 36.5' BG

ROTATE PROBE 180° AT SAME DEPTH

1→S

Probe pair	D start	E end	S E-D	F N-S / 2	G F / max. value
+1/-6	+15	+150	+135	-5	-.02
+2/-7	+44	+57	+13	+18	.92
+3/-8	-13	-396	-383	+19	.97
+4/-9	-6	-168	-174	+19.51	1

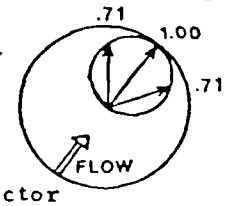


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). 1.0

Direction: 93 E Velocity: .65

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Table of LCD Readout

1→N

Probe pair	A start	B end	C B-A
+1/-6	±21	+174	149
+2/-7	±42	±46	+4
+3/-8	-19	-439	-420
+4/-9	0	-204	-204

Operator: AE/SM Date: 11/13/95

Station: GW42D Time: ~3 50

Location: Olin / Wilmington

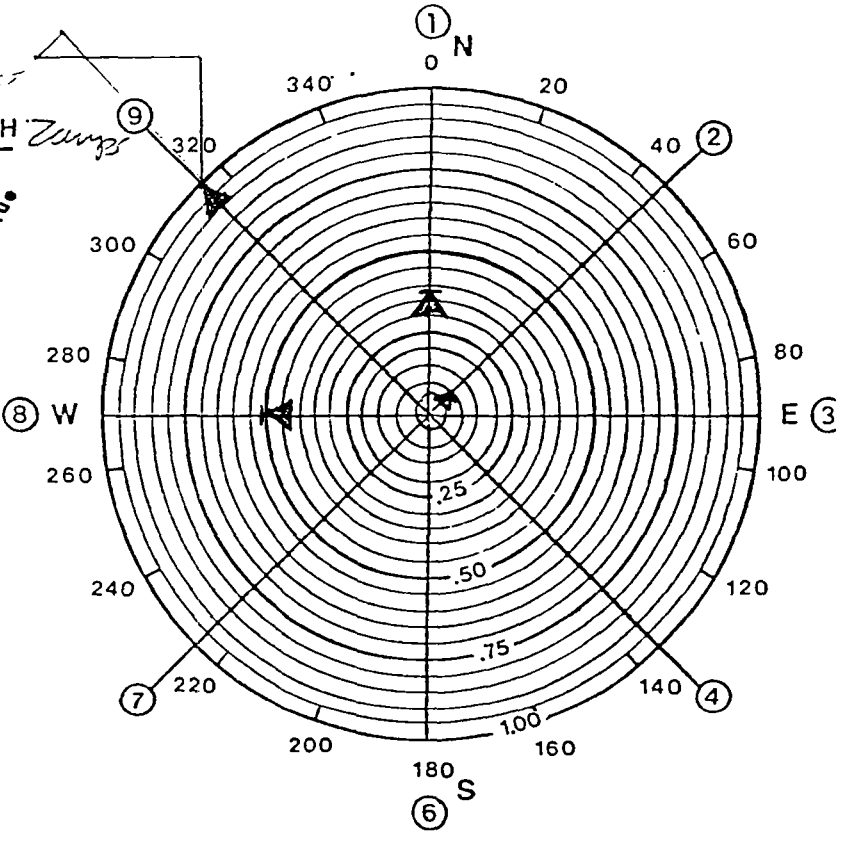
Soil Conditions: Dr

Depth to Measurement: 36.5

ROTATE PROBE 180° AT SAME DEPTH South 1st Turn

1→S

Probe pair	D start	E end	S E-D	F N-S/2	G F max. value
+1/-6	+15	+146	+137	+ 6	-38
+2/-7	+49	+50	+1	+ 1.5	.04
+3/-8	0	-404	-404	- 8	1.5
+4/-9	±8	-165	-173	- 15.5	1

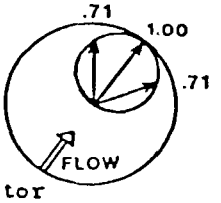


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculators
OR
2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). .40

Direction: 320 NW Velocity: .54

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Table of LCD Readout Temp

1→N

Probe pair	A start	B end	C T B-A
+1/-6	+21	+170	149
+2/-7	+42	+54	+12
+3/-8	+20	+125	+105
+4/-9	0	-202	-202

Operator: RGism Date: 11/13/95

Station: GW421 Time: 4:36

Location: Olin/Wilmington

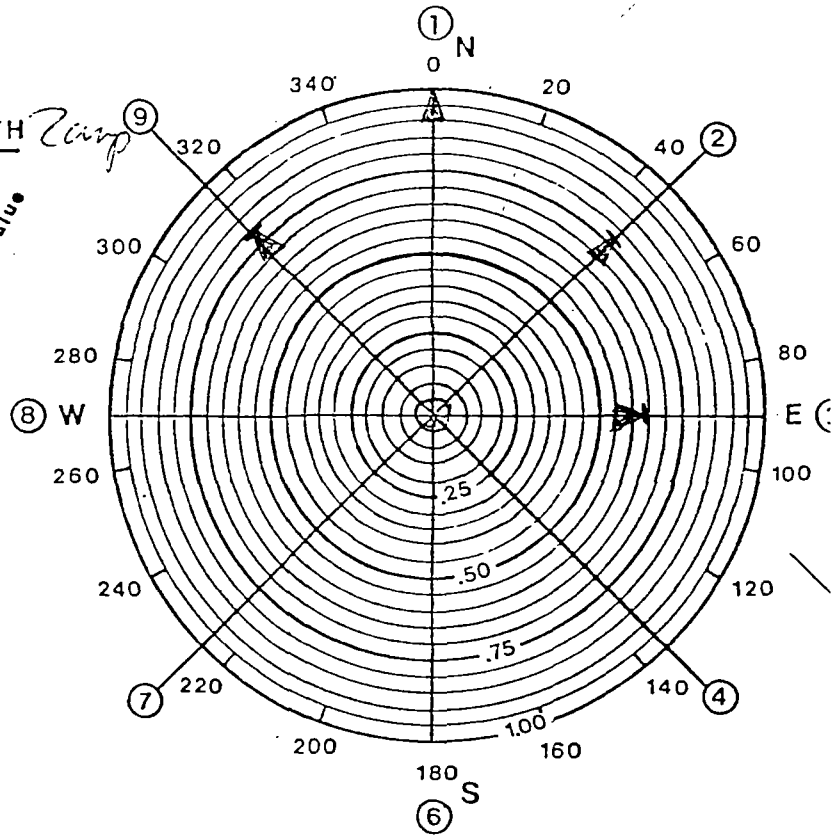
Soil Conditions:

Depth to Measurement: 36.5 BG Dry

ROTATE PROBE 180° AT SAME DEPTH Temp

1→S

Probe pair	D start	E end	S E-D	F N-S / 2	G F / max. value
+1/-6	+15	+125	+110	+ 19.5	1
+2/-7	+44	+22	-22	+ 15	0.77
+3/-8	+35	+43	+8	+ 12.5	0.64
+4/-9	+35	+166	+131	- 19.5	1.00

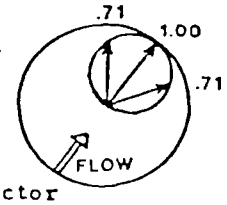


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). .40

Direction: 18° Velocity: 0.65

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

[illegible] WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Table of LCD Readout 2 amps ×8

1→N

Probe pair	A start	B end	C B-A
+1/-6	+11	+121	+110
+2/-7	+45	+87	+42
+3/-8	0	-215	-215
+4/-9	+7	-129	-136

Operator: AEP/SM Date: 11/13/95

Station: GW42D Time: ~2:10

Location: Olin/Wilmington

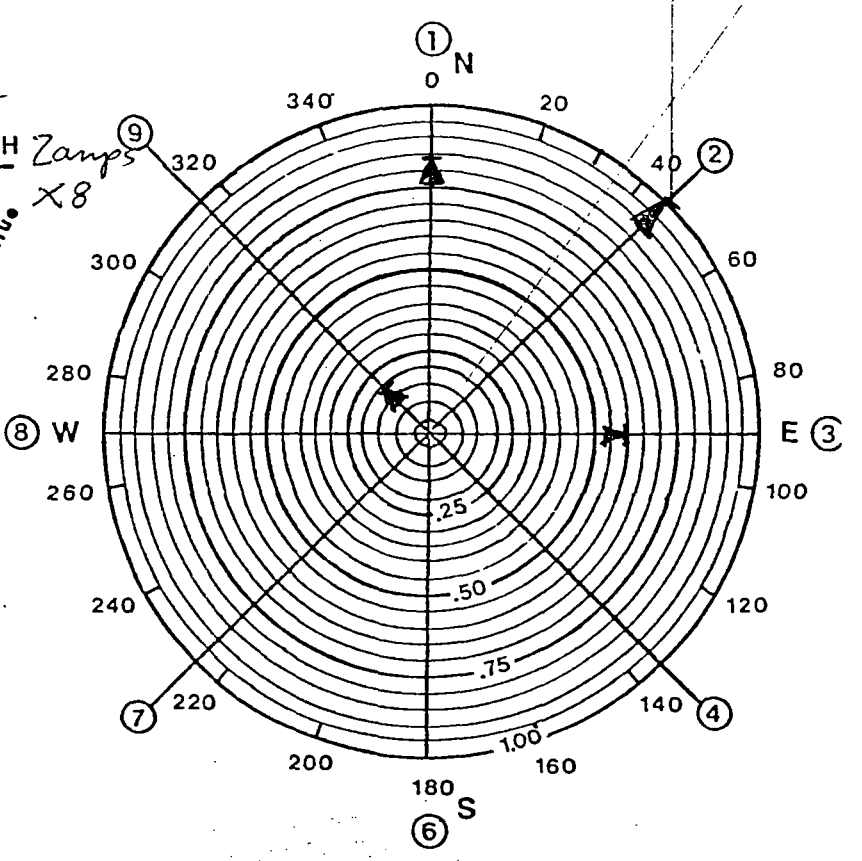
Soil Conditions: —

Depth to Measurement: 4/-5 Dry

ROTATE PROBE 180° AT SAME DEPTH South 1st 2 amps ×8

1→S

Probe pair	D start	E end	S E-D	F N-S / 2	G F max. value
+1/-6	+13	+65	+52	+ 29	0.84
+2/-7	+36	+9	-27	+ 34.5	1
+3/-8	-28	-283	-255	+ 20	0.58
+4/-9	0	-123	-123	- 6.5	0.19

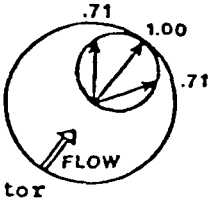


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculators

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). ,60

Direction: 35° NE Velocity: +.2

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Table of LCD Readout Zamp ×8

1→N

Probe pair	A start	B end	C B-A
+1/-6	+9	+102	93
+2/-7	+41	+62	+21
+3/-8	+1	-228	-229
+4/-9	+1	-127	-128

Operator: AEP/SM Date: 11/13/95

Station: GW421 Time: ~1300

Location: Olin/Wilmington

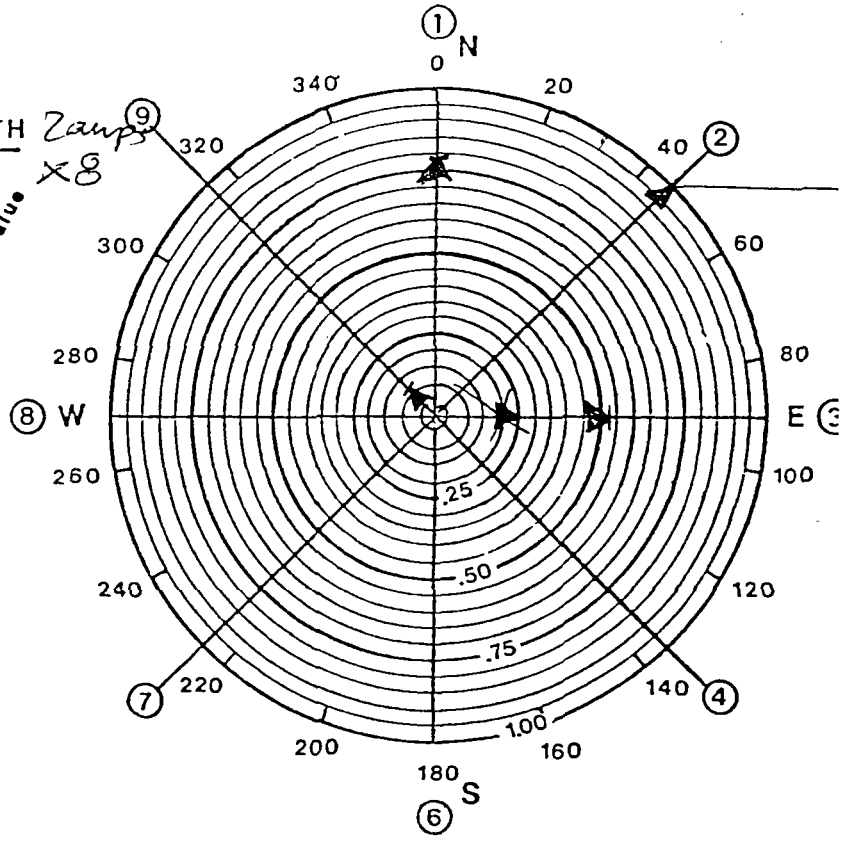
Soil Conditions:

Depth to Measurement: 41.5 BG

ROTATE PROBE 180° AT SAME DEPTH Zamps ×8

1→S

Probe pair	D start	E end	S E-D	F N-S/2	G F / max. value
+1/-6	+11	+64	+53	+ 20	,78
+2/-7	+37	+7	-30	+ 25,5	1
+3/-8	-17	-273	-256	+ 13,5	,52
+4/-9	0	-122	-122	- 3	,11

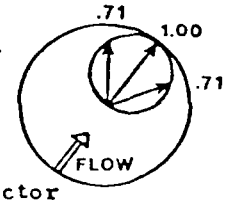


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). ,60

Direction: 36° Velocity: ~~,85~~

Form 104 available from your local K-V Associates, Inc. dealer.

9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Operator: [illegible] Date: 11/13/95

Station: GW58D Time: ~ noon

Location: Olin / Wilmington

Soil Conditions: —

Depth to Measurement: 22 136 DC

Table of LCD Readout

2 amps x8

1→N

Probe pair	A start	B end	C B-A
+1/-6	+11	+72	61
+2/-7	-32	+8	-29
+3/-8	-29	-219	-790
+4/-9	+2	-118	-120

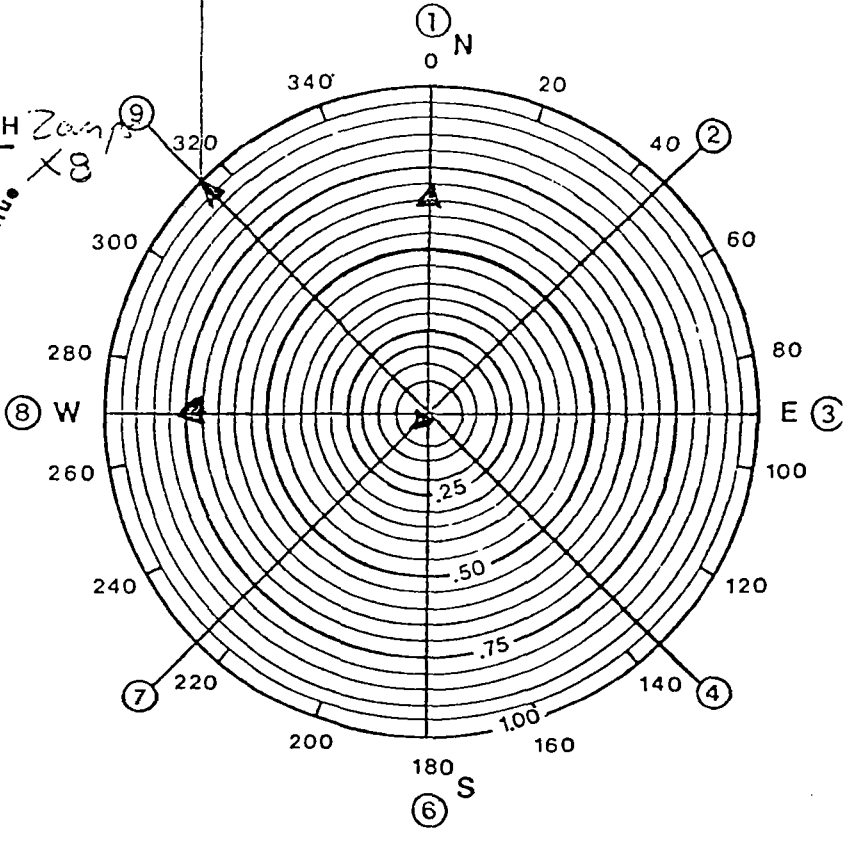
ROTATE PROBE 180° AT SAME DEPTH

South 1st

2 amps x8

1→S

Probe pair	D start	E end	S E-D	N-S / 2	F max. value
+1/-6	+8	+24	+16	+ 22.5	.68
+2/-7	-38	+13	-25	- 2	.06
+3/-8	-29	-268	-239	- 25.5	.77
+4/-9	+11	-43	-54	- 33	1

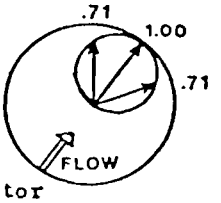


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculators

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day).

Direction: 311 NW Velocity: ~1.50

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Table of LCD Readout 2 amps x8

1→N

Probe pair	A start	B end	C B-A
+1/-6	+5	-2	-3
+2/-7	+42	0	-42
+3/-8	+2	-229	-227
+4/-9	+12	-36	-48

Operator: Carlson Date: 11/13/85

Station: GW58D Time: ~11:30

Location: Olin/Wilmington

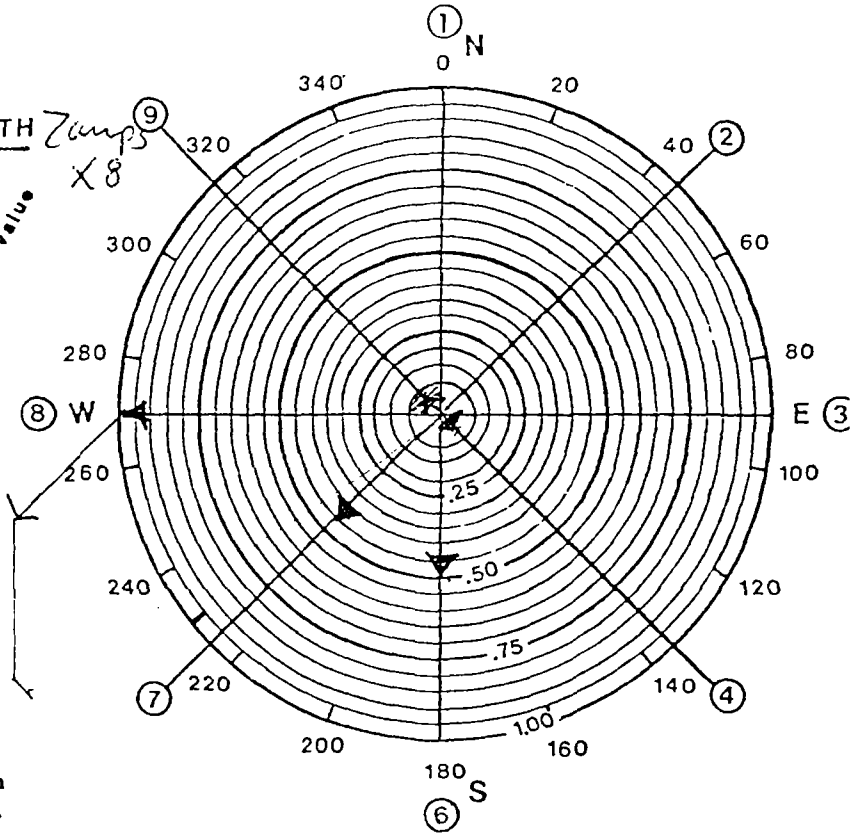
Soil Conditions: /

Depth to Measurement: 72 B6

ROTATE PROBE 180° AT SAME DEPTH 2 amps x8

1→S

Probe pair	D start	E end	S E-D	F N-S/2	G F max. value
+1/-6	+4	+19	+15	-9	.50
+2/-7	+35	+9	-26	-8	.44
+3/-8	-26	-267	-241	-18	1
+4/-9	+14	-36	-50	+1	.05

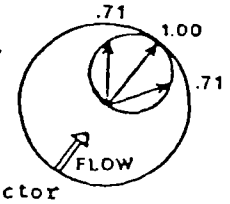


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculators

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day).

Direction: 236 SW Velocity: 0.4

Form 104 available from your local K-V Associates, Inc. dealer.

9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Operator: JEP/SM Date: 11/13/85

Station: GW58D Time: 10:45

Location: Olin/Lexington

Soil Conditions: _____

Depth to Measurement: 77 BG

Du

Table of LCD Readout

2 samps x8

1→N

Probe pair	A start	B end	C B-A
+1/-6	+11	+78	+67
+2/-7	+38	+32	-6
+3/-8	+20	+270	-250
+4/-9	+3	+125	-121

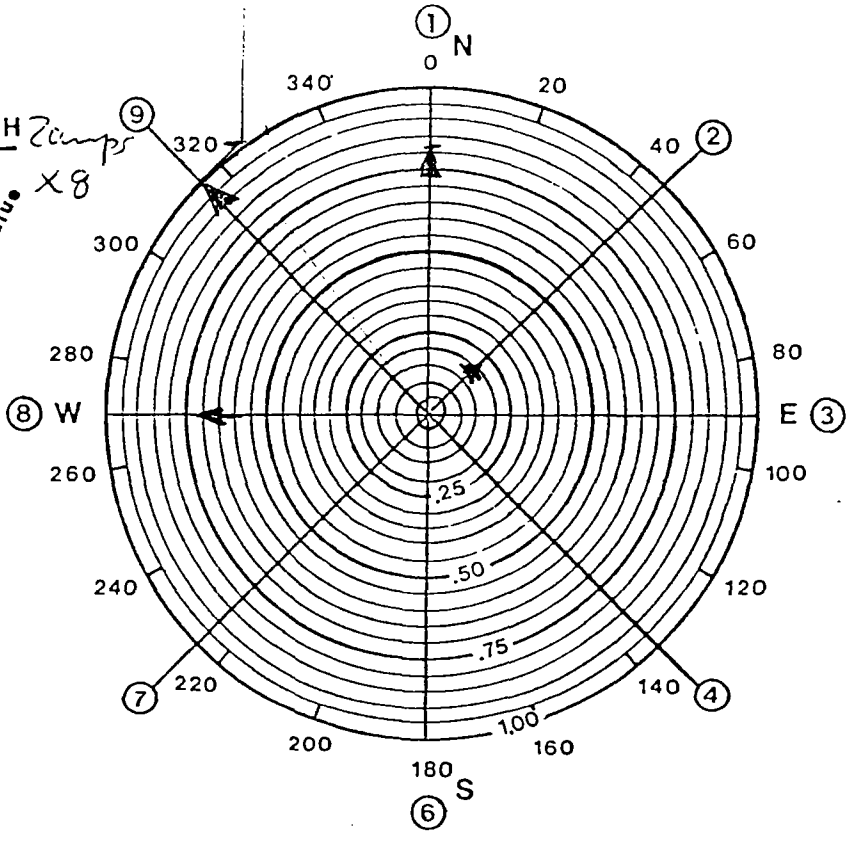
ROTATE PROBE 180° AT SAME DEPTH

Sample 1st

2 samps x8

1→S

Probe pair	D start	E end	S E-D	F N-S / 2	G F / max. value
+1/-6	+12	+33	+21	+ 23	0.82
+2/-7	+42	+26	-16	+ 5	0.18
+3/-8	-14	-224	-210	- 20	0.71
+4/-9	+3	-62	-65	- 28	1

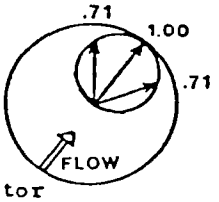


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculators

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). .61

Direction: 324 Velocity: 043

Form 104 available from your local K-V Associates, Inc. dealer.

9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Table of LCD Readout Zamp x9

1→N

Probe pair	A start	B end	C B-A
+1/-6	9	82	73
+2/-7	42	31	11
+3/-8	7	258	259
+4/-9	2	126	128

Operator: SM/KEP Date: 11/13/95

Station: GW58D Time: ~ 9 :-0

Location: Olin/Wilmington

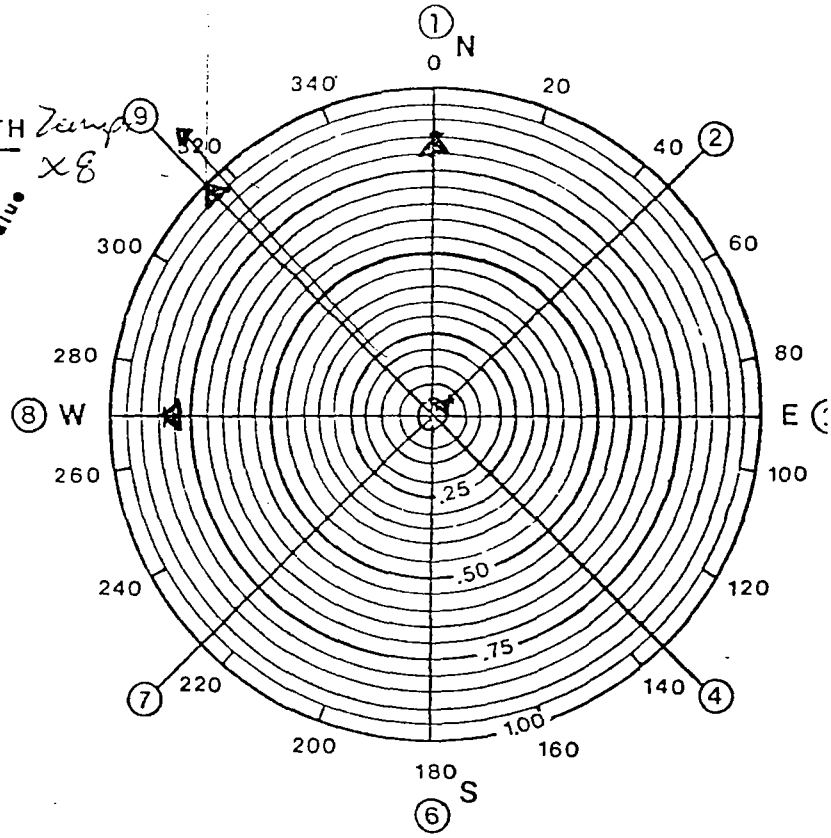
Soil Conditions:

Depth to Measurement: 27.13 G

ROTATE PROBE 180° AT SAME DEPTH Zamp x8

1→S

Probe pair	D start	E end	S E-D	F N-S / 2	G F / max. value
+1/-6	15	40	25	+ 24	.95
+2/-7	40	27	266 13	+ 1	.03
+3/-8	19	231	212	- 23.5	.93
+4/-9	0	72	72	- 28.1	1

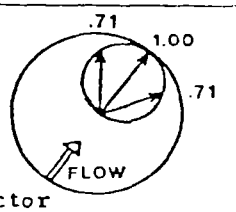


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day).

Direction: 318° Velocity: .9 .6

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

PROBE 2

Table of LCD Readout 2amps x8

1→N

Probe pair	A start	B end	C B-A
+1/-6	+45	-32	-77
+2/-7	-16	-76	-92
+3/-8	-20	-52	-192
+4/-9	-44	+9	-35

Operator: EPISM Date: 11/13/95

Station: EW58S Time: 10:20

Location: Olin / Wilmington

Soil Conditions: /

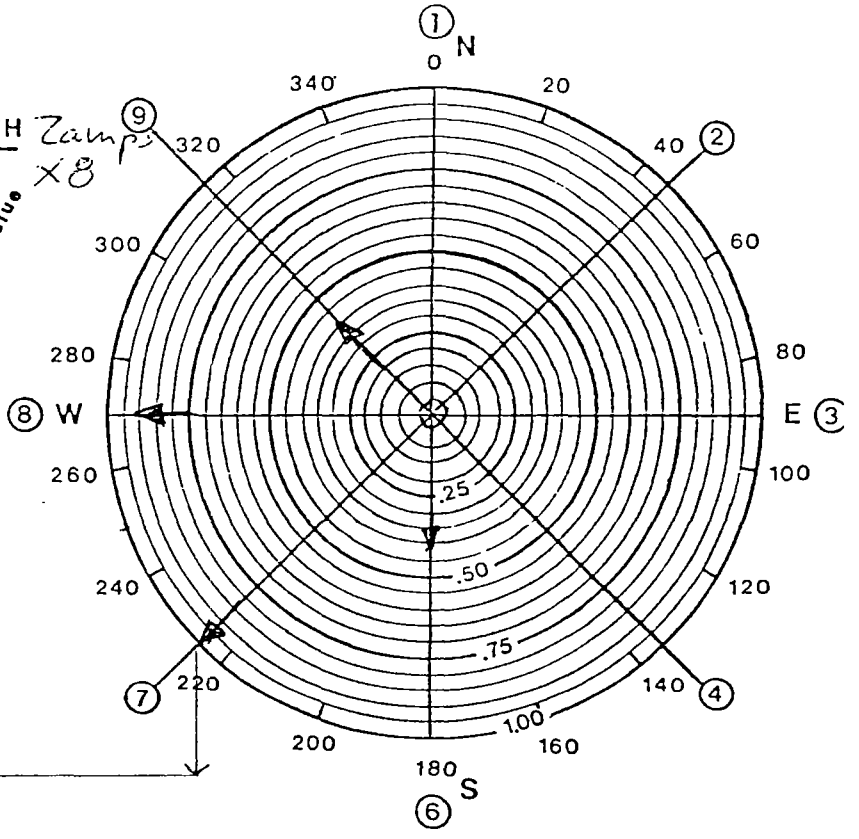
Depth to Measurement: 25'13C DO

ROTATE PROBE 180° AT SAME DEPTH South 1st 2amps x8

1→S

Probe pair	D start	E end	F E-D	G N-S/2	H F max. value
+1/-6	+35	0	-35	-21	0.41
+2/-7	+24	+34	+10	-51	1
+3/-8	+6	-92	-98	-47	0.92
+4/-9	+20	+27	+7	-21	0.41

2.05 / 25.3 | 53

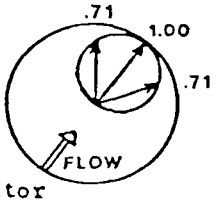


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculators

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). 53 2.05 fld

Direction: 248 Velocity: 1.7

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

PROBE 2

Table of LCD Readout Ramp ×8

1→N

Probe pair	A start	B end	C B-A
+1/-6	+39	-38	-77
+2/-7	+18	-75	-93
+3/-8	-5	-216	-211
+4/-9	+44	+7	-37

Operator: SM/AEP Date: 11/13/95

Station GW58S Time: 940

Location: Olin / Wilmington

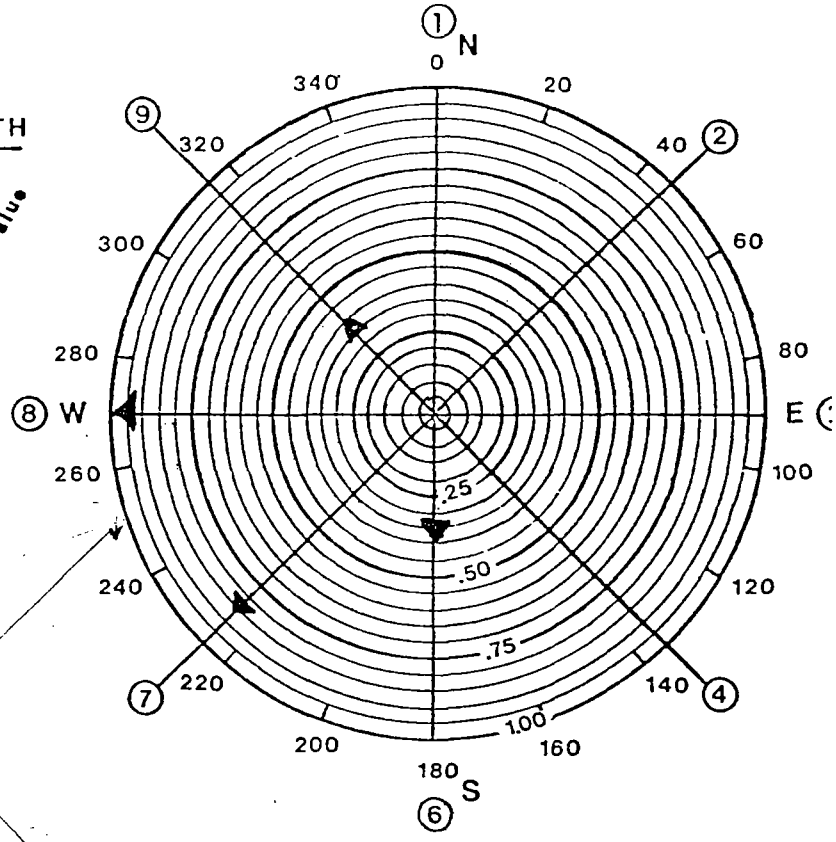
Soil Conditions: /

Depth to Measurement: 25' 86

ROTATE PROBE 180° AT SAME DEPTH

1→S

Probe pair	D start	E end	S E-D	F N-S / 2	G F / max. value
+1/-6	+31	0	-31	-23.	+38
+2/-7	+19	+30	+11	-52.	.86
+3/-8	+1	-90	-91	-60.	1
+4/-9	+63	+76	+13	-25	-41



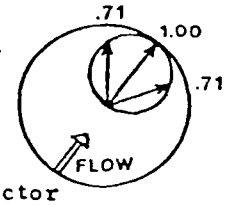
2.17 / 56 = .248

Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). 2.17 / 56 ft

Direction: 250° Velocity: 2.0

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

PROBE 2

Operator: SM/AEP Date: 11/12/95

Station: GW435 Time: _____

Location: Olin/Wilmington D

Soil Conditions: /

Depth to Measurement: 11 13 G-

Table of LCD Readout 2 amps x8

1→N

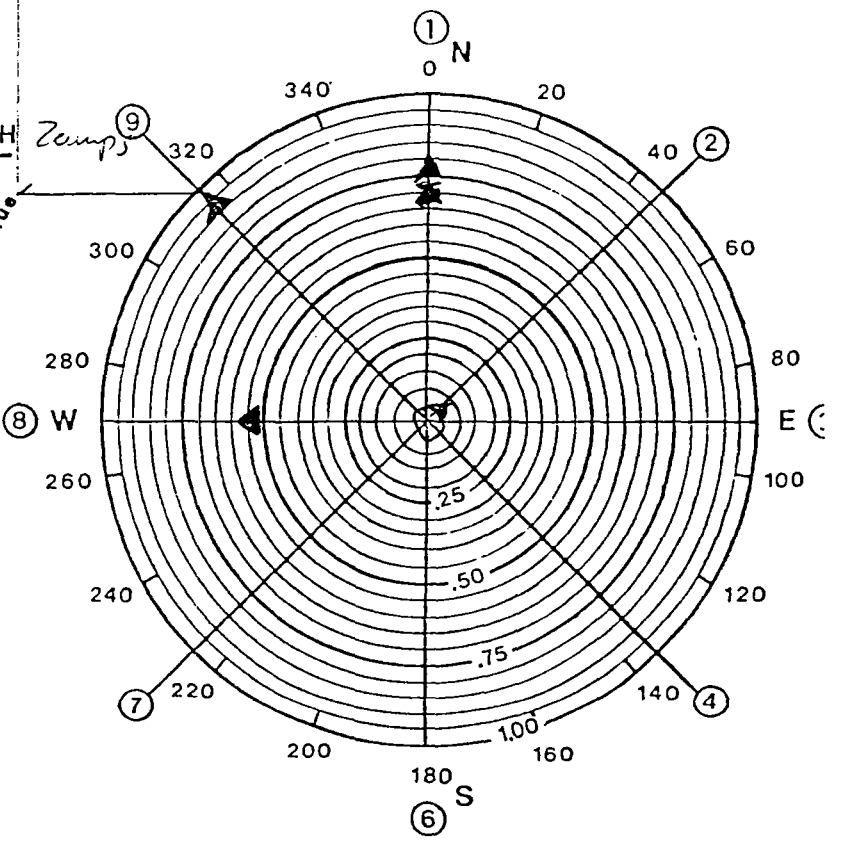
Probe pair	A start	B end	C B-A
+1/-6	-81	+36	-53
+2/-7	+30	+5	-45
+3/-8	-29	-130	-101
+4/-9	+7	+28	21

ROTATE PROBE 180° AT SAME DEPTH Earth 1st 2 amps

1→S

Probe pair	D start	E end	S E-D	F N-S / 2	G F / max. value
+1/-6	+25	-172	-197	+72	.28
+2/-7	+26	-37	-63	+9	.10
+3/-8	+20	+20	0	-50.5	.57
+4/-9	+82	+280	+198	-88.5	1

3.41
25.8 | 88

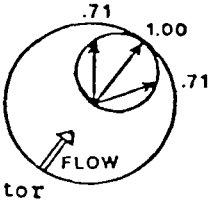


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). 3.41 ft/d

Direction: 323 320 Velocity: 3.45

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

PROBE 2

Operator: SM/AEP Date: 11/12/85

Station: GW43S Time: ~1:40

Location: Olin / Wilmington

Soil Conditions: /

Depth to Measurement: 11' 5G

Table of LCD Readout

Zamp x8

1→N

Probe pair	A start	B end	C B-A
+1/-6	+56	-19	-75
+2/-7	+21	-32	-53
+3/-8	-20	-136	-116
+4/-9	-25	+51	+76

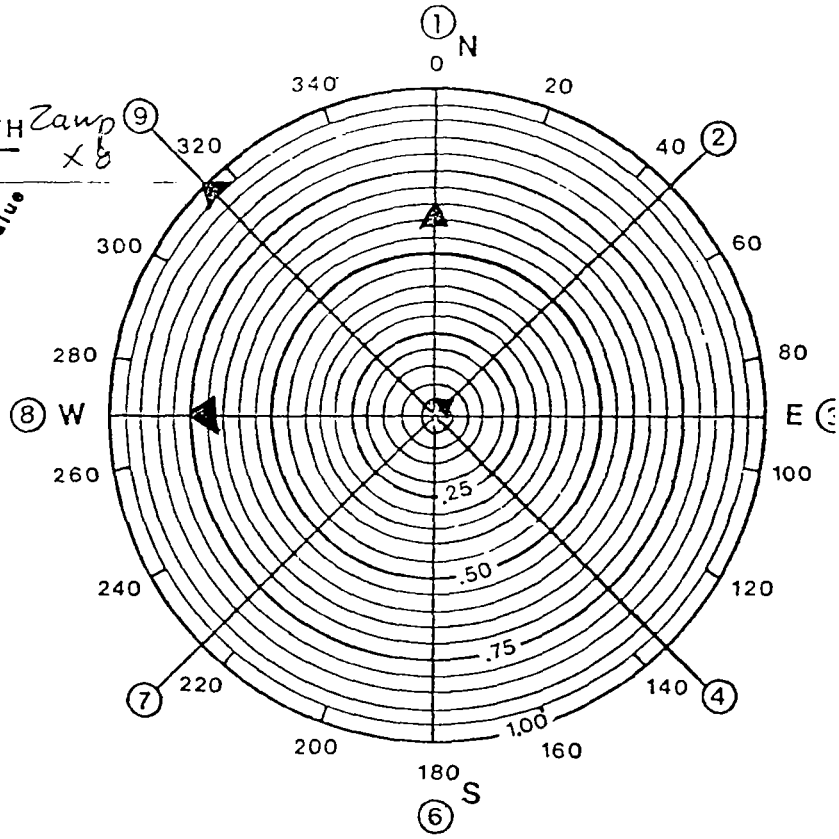
ROTATE PROBE 180° AT SAME DEPTH

Zamp x8

1→S

Probe pair	D start	E end	S E-D	F N-S / 2	G F max. value
+1/-6	+30	-175	-205	-65	.75
+2/-7	+27	-32	59	-3	.03
+3/-8	+16	+29	+13	-54.5	.74
+4/-9	+76	+275	+199	-86.5	1

3.45 / 25-5189

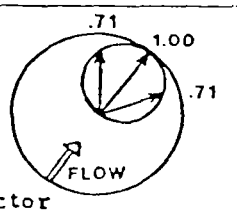


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). 3.45 ft/d 3.79

Direction: 315° Velocity: 2.8

Form 104 available from your local K-V Associates, Inc. dealer.

9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

PROBE 2

Operator: SM/ACP Date: 11/12/85

Station: 4W43S Time: 12:05

Location: Olin/Wilmington

Soil Conditions:

Depth to Measurement: 15' BG

Table of LCD Readout (Ramp x 8)

1→N

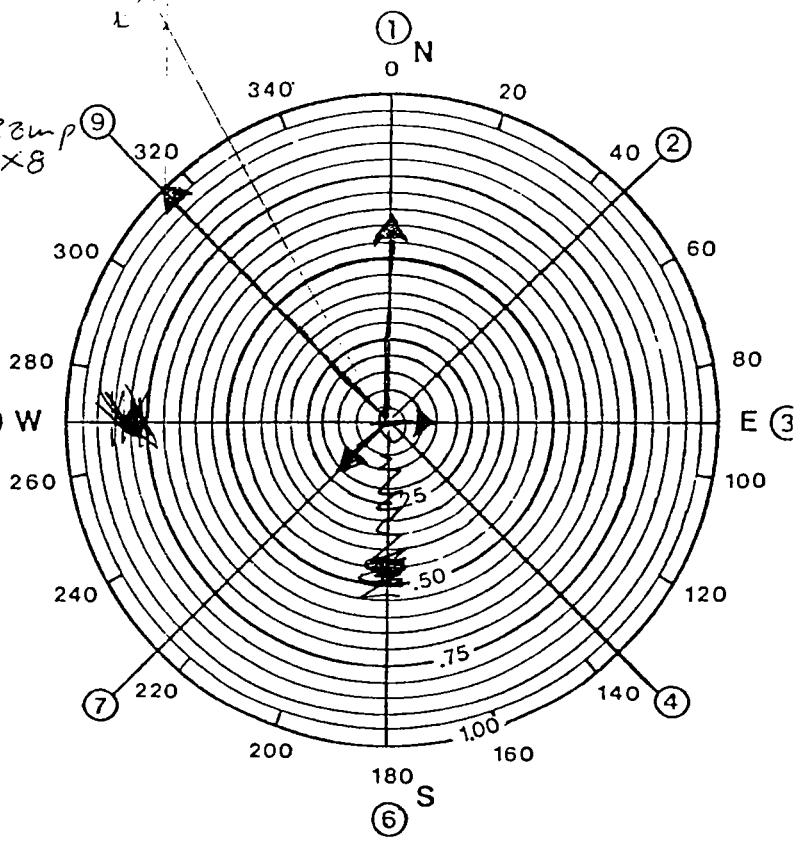
Probe pair	A start	B end	C B-A
+1/-6	±13	+10	-7
+2/-7	±12	-23	-35
+3/-8	+16	±32	~~-53~~ ±71
+4/-9	±78	±77	-1

ROTATE PROBE 180° AT SAME DEPTH (Ramp x 8)

1→S

Probe pair	D start	E end	S E-D		F N-S/2	G F max. value	
+1/-6	±32	±73	-105	±56	~~-99~~	.54	.62+
+2/-7	±20	±20	0	+ -	125	.19	.19-
+3/-8	+6	±50	±44	13.5	~~-35~~	~~-82~~	.15-
+4/-9	±62	±210	±178	-	89.5	1	1-

2.40 / .62 = 2.58

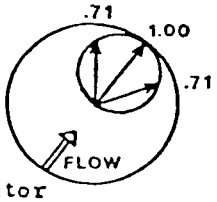


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator:

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day).

÷2 2.40 ft/d

Direction: 330 NNW Velocity: 2.9

Form 104 available from your local K-V Associates, Inc. dealer.

9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

PROBE 2

Operator: SH/REP Date: 11/12/95

Station: GW43S Time:

Location: Olin / Wilmington

Soil Conditions:

Depth to Measurement: 15 30

Table of LCD Readout 2 amps x8

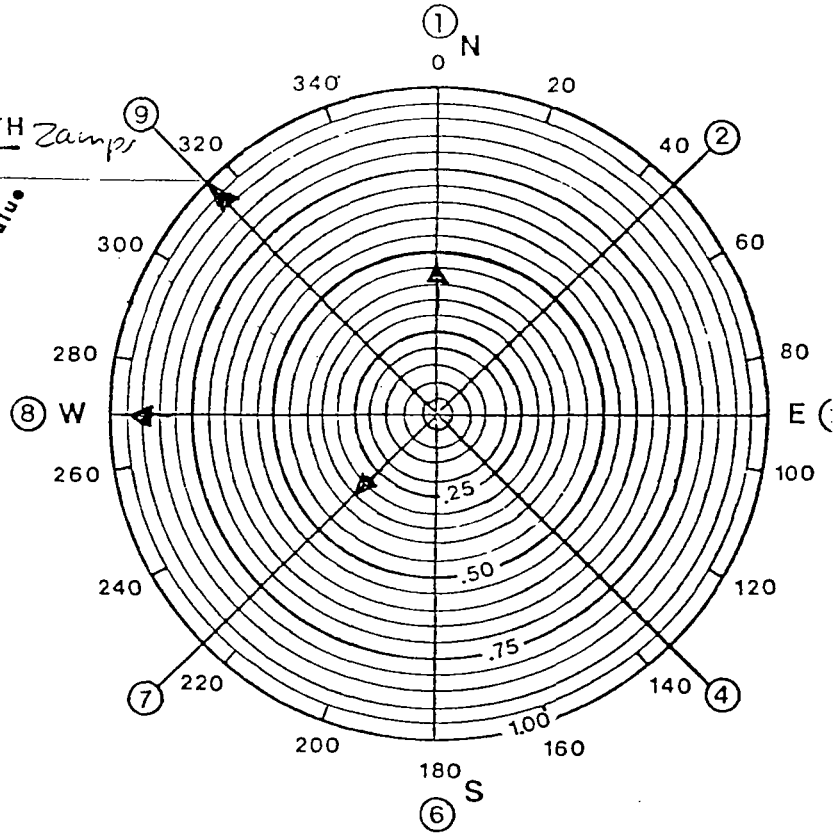
1→N

Probe pair	A start	B end	C B-A
+1/-6	+72	+29	-50
+2/-7	+29	-31	-60
+3/-8	-24	-128	-104
+4/-9	+18	+39	+21

ROTATE PROBE 180° AT SAME DEPTH South 1st 2 amps

1→S

Probe pair	D start	E end	S E-D	F N-S / 2	G F max. value
+1/-6	+27	-89	-116	+33	0.45
+2/-7	+27	+7	-10	-25	0.35
+3/-8	+23	+55	+32	+68	0.94
+4/-9	-185	+200	+165	-72	1



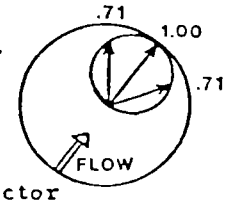
25.8 | 2.95 / 76.0

Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). 2.95 (1) 76

Direction: 296 Velocity: 2.4

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

PROBE 2

Table of LCD Readout 2 amp x8

1→N

Probe pair	A start	B end	C B-A
+1/-6	+39	+100	+61
+2/-7	-19	-70	+51
+3/-8	0	-110	-110
+4/-9	+56	0	-56

Operator: SM Date: 11/2/95

Station: _____ Time: _____

Location: GW455 Olin/Wilmington DE

Soil Conditions: —

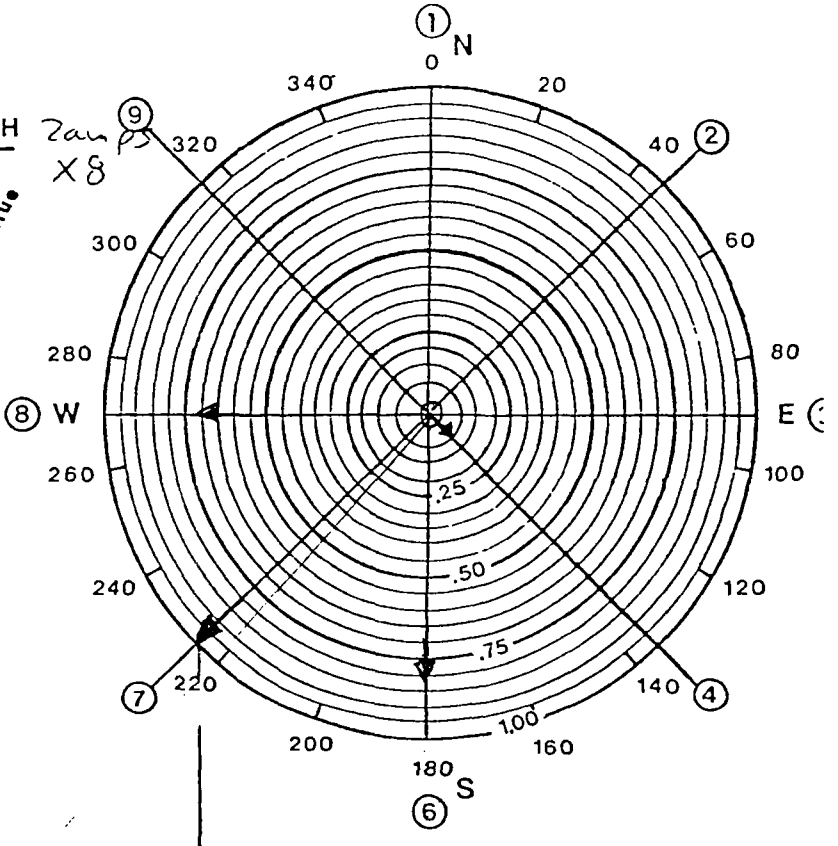
Depth to Measurement: 15'

ROTATE PROBE 180° AT SAME DEPTH South 15'

2 amp x8

1→S

Probe pair	D start	E end	S E-D	F N-S/2	G F/max. value
+1/-6	+37	+222	+185	-62	0.81
+2/-7	+20	224 +204		-76.5	1
+3/-8	0	0	0	~~-55~~	0.72
+4/-9	+55	-16	-71	+7.5	0.10



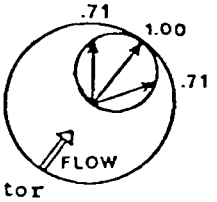
3.10
258 | 80

Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

OR
1. Use K-V Vector Addition Program (TI-58/59-HP41C) calculator
2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). 3.1 ft

3.10 ÷ 80 = 2.6

Direction: 220 Velocity: 2.6

Form 104 available from your local K-V Associates, Inc. dealer.

9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

PROBE 2

Table of LCD Readout

2 Gaps 8x

1→N

Probe pair	A start	B end	C B-A
+1/-6	+37	-113	+51
+2/-7	123	-81	+58
+3/-8	+2	-111	-113
+4/-9	+53	-18	-71

Operator: JM/EP Date: 11/12/95

Station: GW45S Time: 10:05

Location: Clin / Wilmington

Soil Conditions:

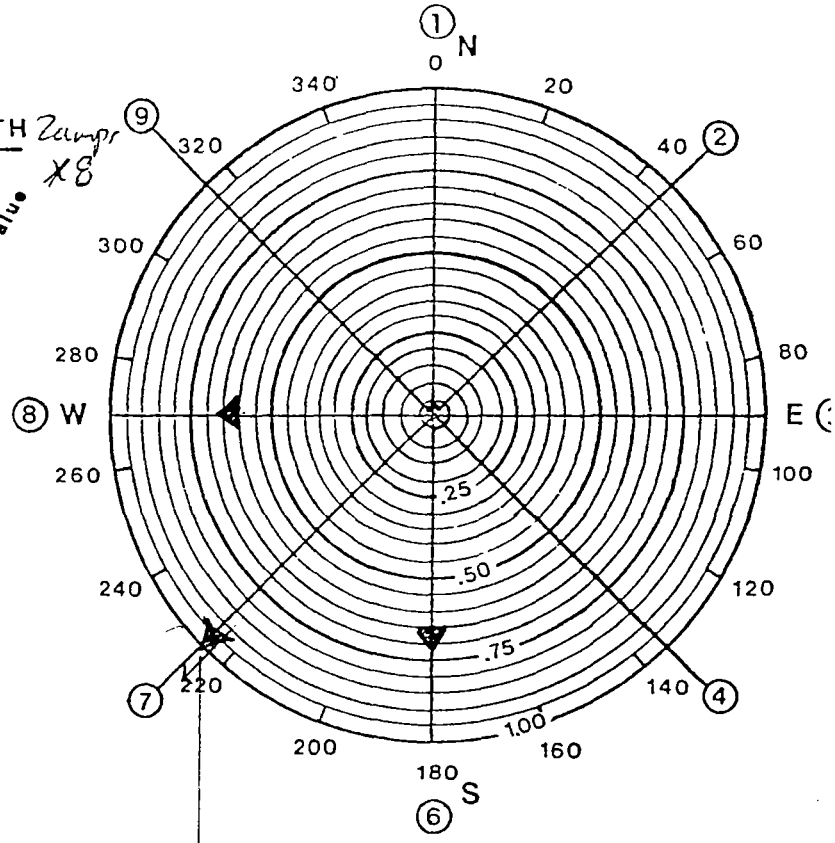
Depth to Measurement: 15' bg

ROTATE PROBE 180° AT SAME DEPTH 2 amps x8

1→S

Probe pair	D start	E end	S E-D	F N-S / 2	G F / max. value
+1/-6	+36	+225	+189	-54	.72
+2/-7	+6	+222	+206	-74	1
+3/-8	0	-5	-15	-49	.66
+4/-9	+52	-20	-72	-15	.00

2.83 / 75.8 | 73

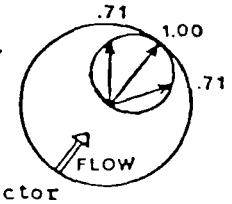


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day).

2.83 ft/d

73

Direction: 223° Velocity: 2.4

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

PROBE 2

Operator: SM Date: 11/12/95

Station: GW455 Time: ~9:45

Location: Olin / Wilmington DL

Soil Conditions:

Depth to Measurement: 19.36

Table of LCD Readout

2 amps x8

1→N

Probe pair	A start	B end	C B-A
+1/-6	±64	+178	+114
+2/-7	±41	107	+66
+3/-8	±1	108	+109
+4/-9	±40	56	-96

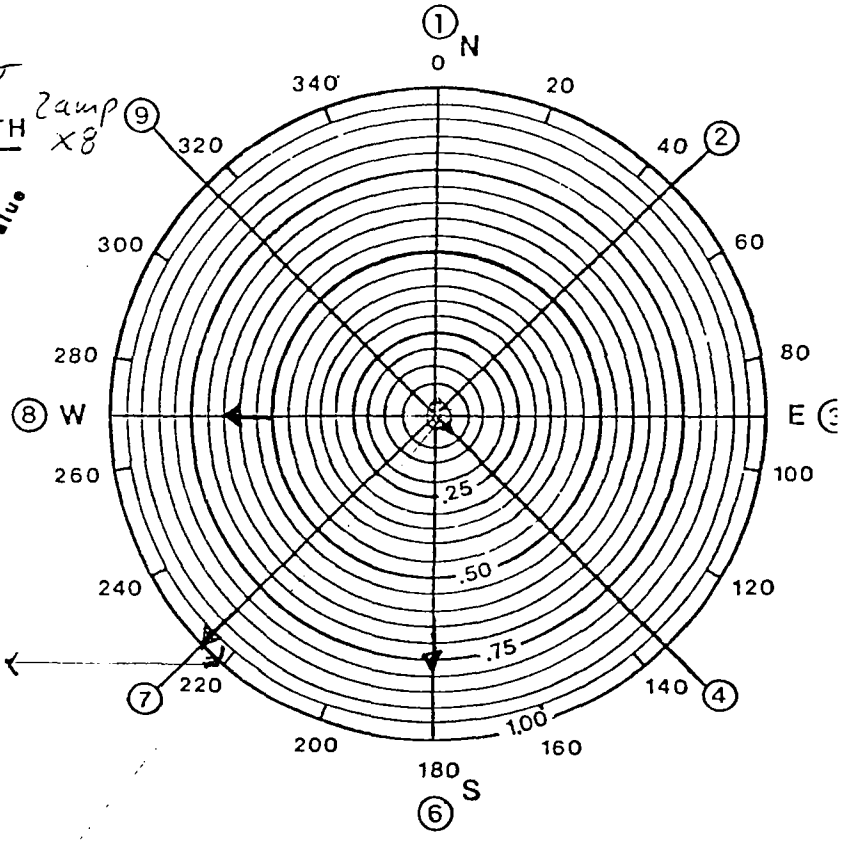
ROTATE PROBE 180° AT SAME DEPTH

Earth 1st 2 amp x8

1→S

Probe pair	D start	E end	S E-D	F N-S / 2	G F / max. value
+1/-6	±27	+247	+220	-53	0.73
+2/-7	+2	+204	+202	-68	1
+3/-8	-19	-40	-21	-44	0.65
+4/-9	±56	-48	-104	+8.4	0.06

2.64
255 | 68

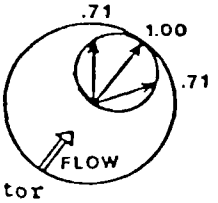


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). ±68 2.6 ft

Direction: 220 Velocity: 2.3

Form 104 available from your local K-V Associates, Inc. dealer.

9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

PROBE 2

Operator: SM Date: 11/12/95

Station: GW45S Time: 930

Location: Olin / Wilmington

Soil Conditions: /

Depth to Measurement: 19.80

Table of LCD Readout

Ramp X8

1→N

Probe pair	A (start)	B (end)	C (B-A)
+1/-6	-75	+163	-18
+2/-7	-15	+96	-81
+3/-8	-25	-113	-88
+4/-9	+25	-63	-88

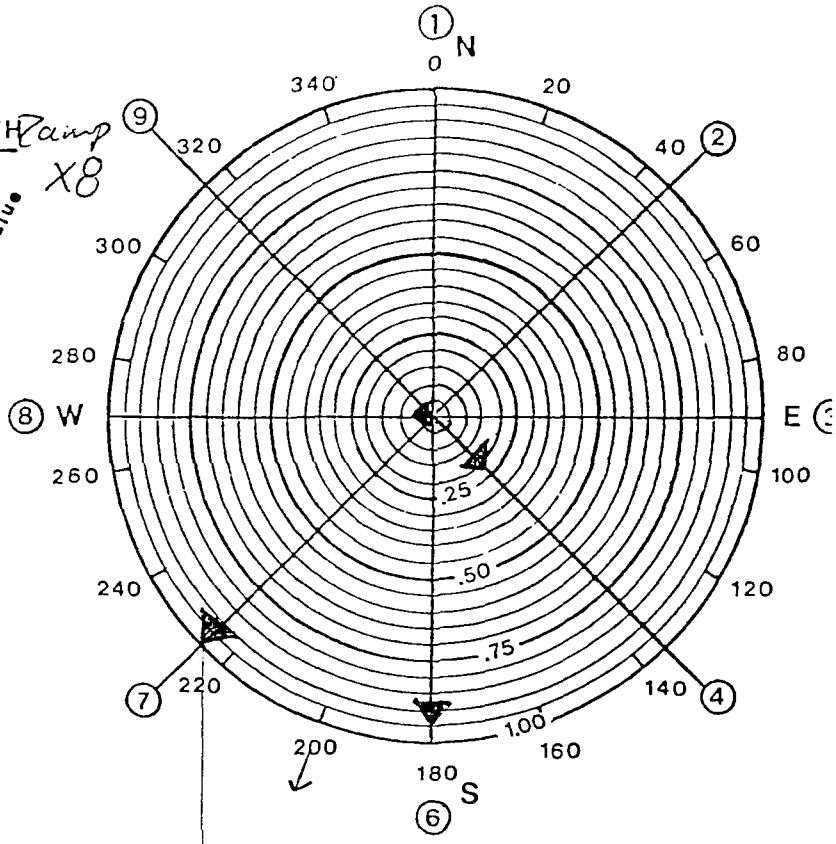
ROTATE PROBE 180° AT SAME DEPTH

Ramp X8

1→S

Probe pair	D (start)	E (end)	S (E-D)	F (N-S/2)	G (F / max. value)
+1/-6	-21	-242	-221	-51.5	.99
+2/-7	0	-190	-190	-53.5	1
+3/-8	-20	-57	-37	-2.3	.04
+4/-9	-56	-58	-114	-13	.23

2.02
258 / 52

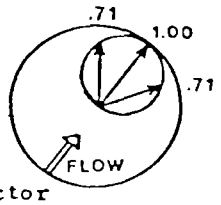


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day).

198 52 2.02 Fld

Direction: 200 Velocity: 1.8

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

PROBE 2

Operator: GEP/SM Date: 11/13/95

Station: GW 58.5 Time: ~11 a.m.

Location: Olin / Wilmington

Soil Conditions: /

Depth to Measurement: 21 BG

Table of LCD Readout 2 temps x8

1→N

Probe pair	A start	B end	B-A
+1/-6	+37	-54	-71
+2/-7	+15	-43	-58
+3/-8	-11	-161	-150
+4/-9	+6	+17	-31

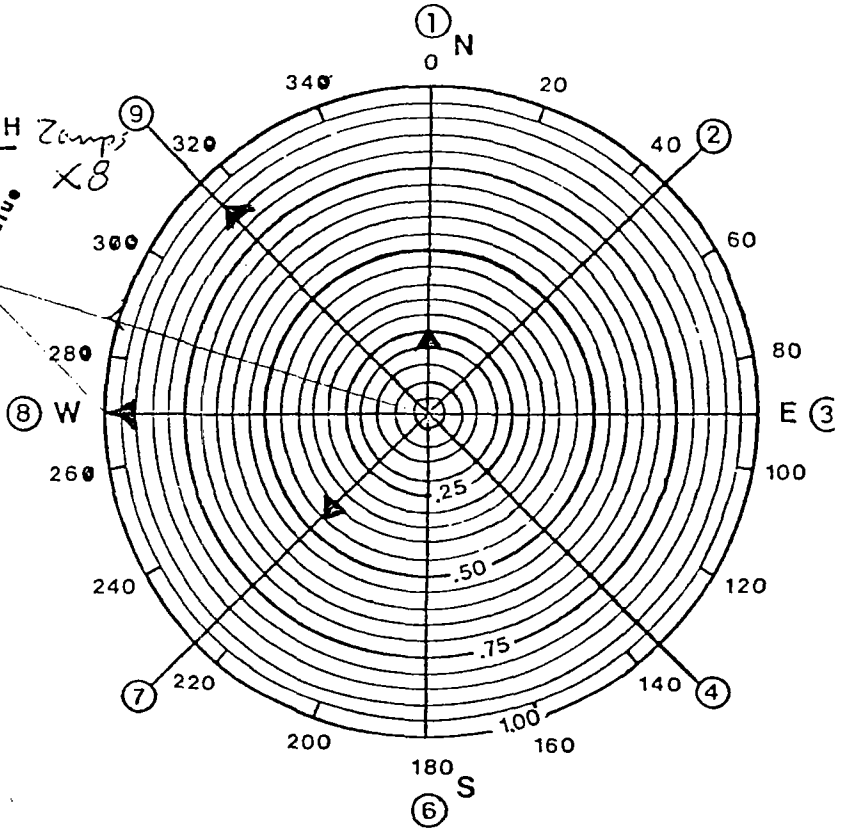
ROTATE PROBE 180° AT SAME DEPTH 2 temps x8

1→S

Probe pair	D start	E end	E-D	N-S / 2	F max. value
+1/-6	+37	-55	-90	+9.5	.25
+2/-7	+18	-7?	-25	-16.5	.74
+3/-8	0	-106	-106	-37	1
+4/-9	-56	+91	+35	-33	.59

(-25.5) (17?)

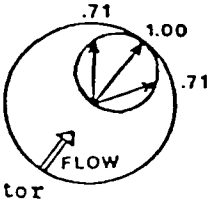
1.47
25.5 | 38



Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow



Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.

Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculators

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). 38 1.47

Direction: 286° Velocity: 1.2

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

PROBE 2

Operator: SM/AEP Date: 11/13/95

Station: GW58S Time: ~1145

Location: Olin/Wilmington

Soil Conditions:

Depth to Measurement: 21 BG

Table of LCD Readout 2 amps x8

1→N

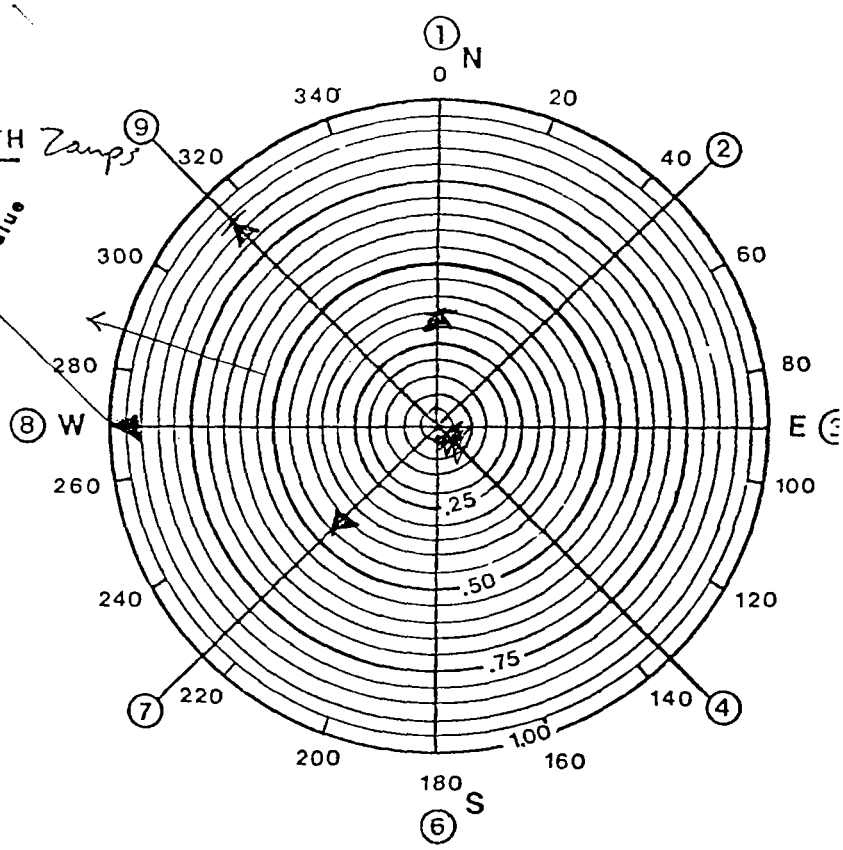
Probe pair	A start	B end	C B-A
+1/-6	+45	-14	-59
+2/-7	+21	-23	+44
+3/-8	+41	-127	-181
+4/-9	+48	+16	-32

ROTATE PROBE 180° AT SAME DEPTH South 15° 2 amps

1→S

Probe pair	D start	E end	S E-D	F N-S/2	G F max. value
+1/-6	+34	-52	-86	+ 13.5	35
+2/-7	+18	+9	-9	- 17.5	145
+3/-8	0	-104	-104	- 38.5	1
+4/-9	+60	+95	+35	~~+ 15~~	~~63~~

- 35.5 187

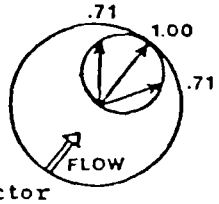


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day).

289 40

Direction: 345 Velocity: ~~+2.8~~

Form 104 available from your local K-V Associates, Inc. dealer.

9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

PROBE 2

Operator: AEP/SM Date: 11/13/95

Station: GW42S Time: 3 pm

Location: Olin/Wilmington

Soil Conditions: /

Depth to Measurement: 12 BG

Table of LCD Readout 2 amps x8

1→N

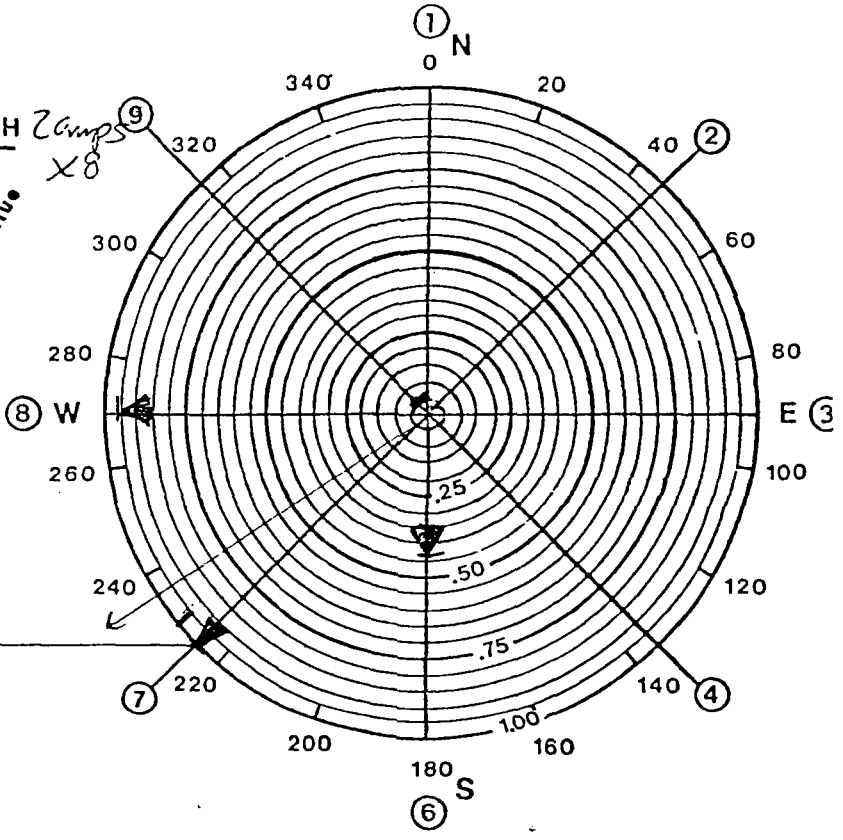
Probe pair	A start	B end	C B-A
+1/-6	+25	-76	-101
+2/-7	0	-45	-45
+3/-8	+24	-163	-139
+4/-9	+46	+66	+40

ROTATE PROBE 180° AT SAME DEPTH 2 amps x8

1→S

Probe pair	D start	E end	S E-D	F N-S/2	G F max. value
+1/-6	+22	-85	-87	-7	.43
+2/-7	0	-13	-13	-16	1
+3/-8	-15	-123	-108	-15.5	.96
+4/-9	+55	+96	+41	-5	.03

62
25.8 | 16

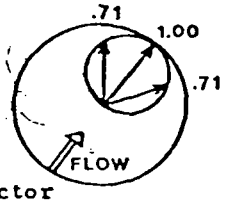


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator:

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). .62 16

Direction: 236 Velocity: .053

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

Probe 2

Operator: SM/AEP Date: 11/13/95

Station: GW425 Time:

Location: Olin / Wilmington

Soil Conditions:

Depth to Measurement: 12 Du

Table of LCD Readout

1→N

Probe pair	A start	B end	C B-A
+1/-6	+29	-114	-143
+2/-7	+5	-45	-50
+3/-8	-19	-138	-119
+4/-9	+18	-113	-65

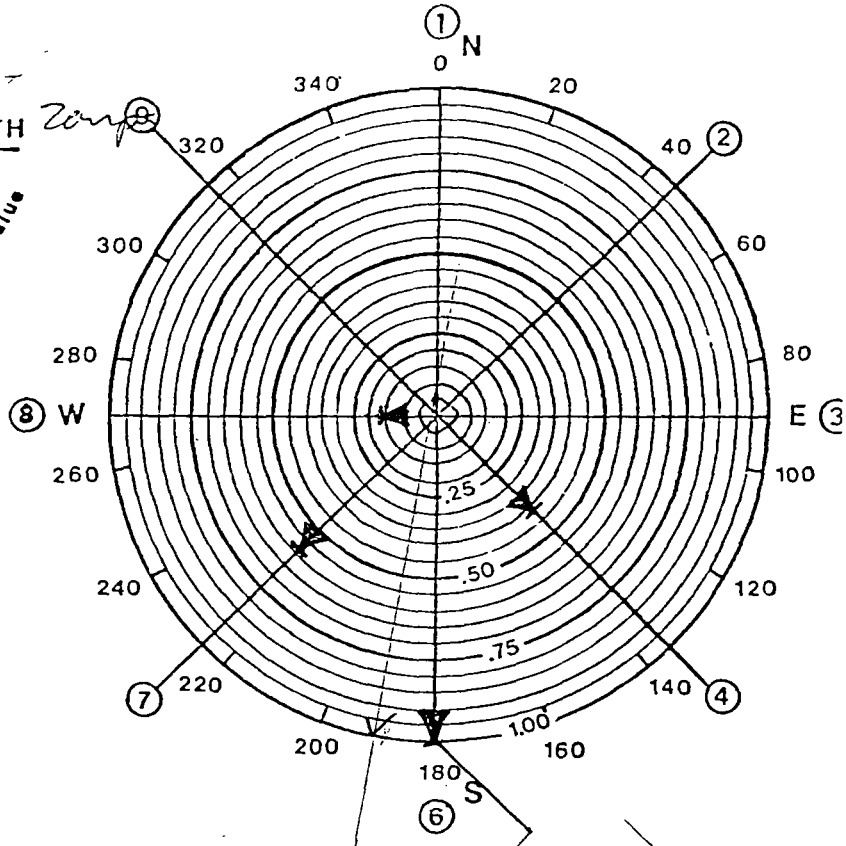
ROTATE PROBE 180° AT SAME DEPTH

South 1st Zone

1→S

Probe pair	D start	E end	S E-D	F N-S/2	G F max. value
+1/-6	+18	-75	-93	- 25.	1
+2/-7	0	-21	-21	- 14.5	.58
+3/-8	-16	-127	-111	- 4.	.16
+4/-9	+58	+100	+44	+ 10.5	.42

.853
25.8 | 22

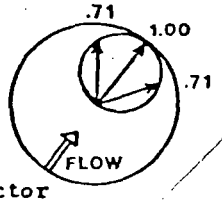


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator:

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day).

189 SSW .85 ft

Direction: 192 Velocity: ~~22~~ 185

Form 104 available from your local K-V Associates, Inc. dealer.

9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

PROBE 2

Operator: SM/REP Date: 11/13/95

Station: GW42S Time: 1:15p

Location: Olin/Wilmington

Soil Conditions: /

Depth to Measurement: 16 BG

Table of LCD Readout 2 amps x8

1→N

Probe pair	A (start)	B (end)	C (B-A)
+1/-6	+51	-38	-89
+2/-7	+49	-20	-69
+3/-8	+27	-119	-146
+4/-9	+50	+67	+17

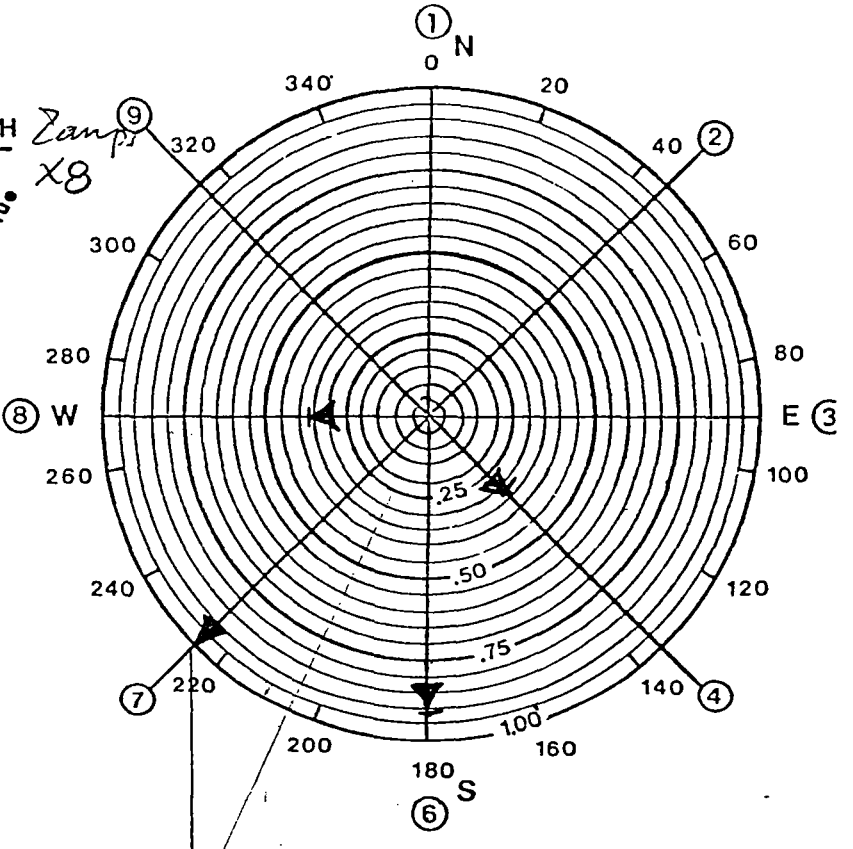
ROTATE PROBE 180° AT SAME DEPTH 2 amps x8

1→S

Probe pair	D (start)	E (end)	S (E-D)	F (N-S/2)	G (F/max. value)
+1/-6	+23	-70	-93	-23	.92
+2/-7	+10	-9	-19	-25	1
+3/-8	+0	-128	-128	-9	.36
+4/-9	+60	+61	1	8	.32

+

25.8 | 25 .97

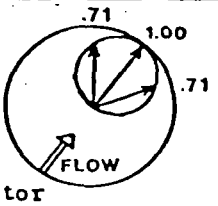


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator;
OR
2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). .97 ft/d

25

Direction: 205 SSW Velocity: 83

Form 104 available from your local K-V Associates, Inc. dealer.

9/82

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

PROBE 2

Operator: SM/REP Date: 11/13/95

Station: GW-25 Time: ~2:00

Location: Olin/Wilmington

Soil Conditions:

Depth to Measurement: 16.36 Dc

Table of LCD Readout

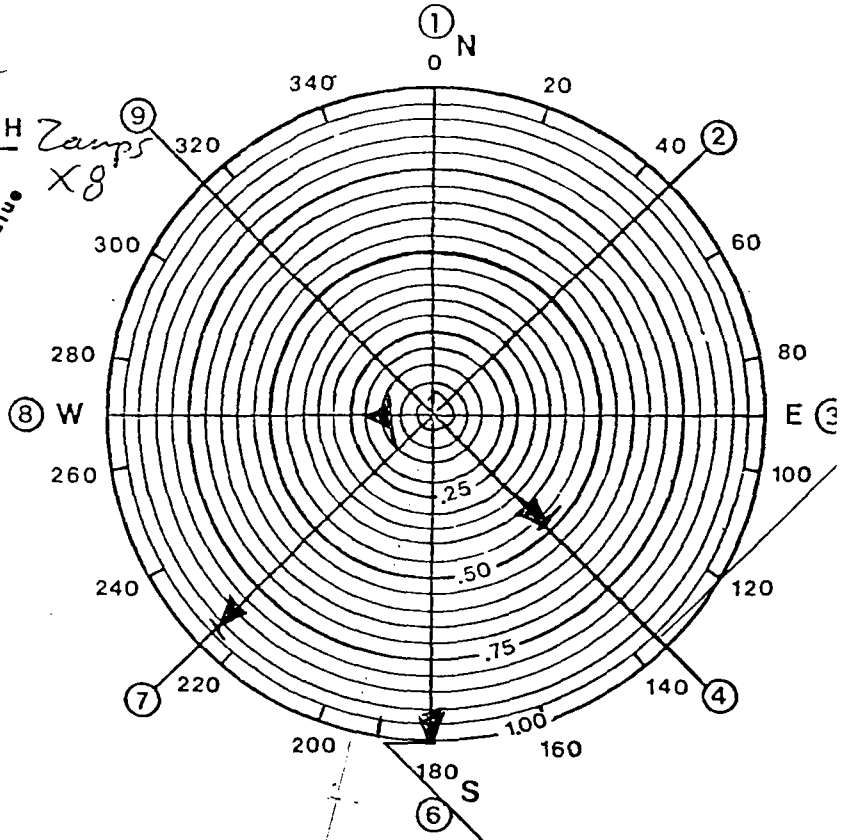
1→N

Probe pair	A start	B end	C B-A
+1/-6	+38	-37	-75
+2/-7	+19	-29	-48
+3/-8	0	-133	-133
+4/-9	+57	+67	+16

ROTATE PROBE 180° AT SAME DEPTH South 1st 2 temps X8

1→S

Probe pair	D start	E end	S E-D	F N-S/2	G F max. value
+1/-6	+22	-17	-39	-18	1
+2/-7	+2	-13	-15	-16.5	0.42
+3/-8	-12	-140	-128	-2.5	0.14
+4/-9	+56	+55	-1	+8.5	0.47

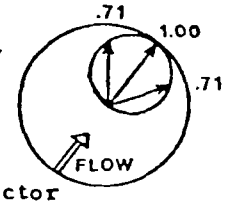


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day).

.70 (1) 18

Direction: 195 SSW Velocity: 0.6

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

PROBE 2

Operator: AET/SM Date: 11/14/85

Station: GW50S Time: 1400

Location: Olin / Wilmington

Soil Conditions: —

Depth to Measurement: 12.36

Table of LCD Readout

1→N

Probe pair	A start	B end	C B-A
+1/-6	-52	-128	-76
+2/-7	+40	+85	+45
+3/-8	+12	-120	-132
+4/-9	+46	-33	-79

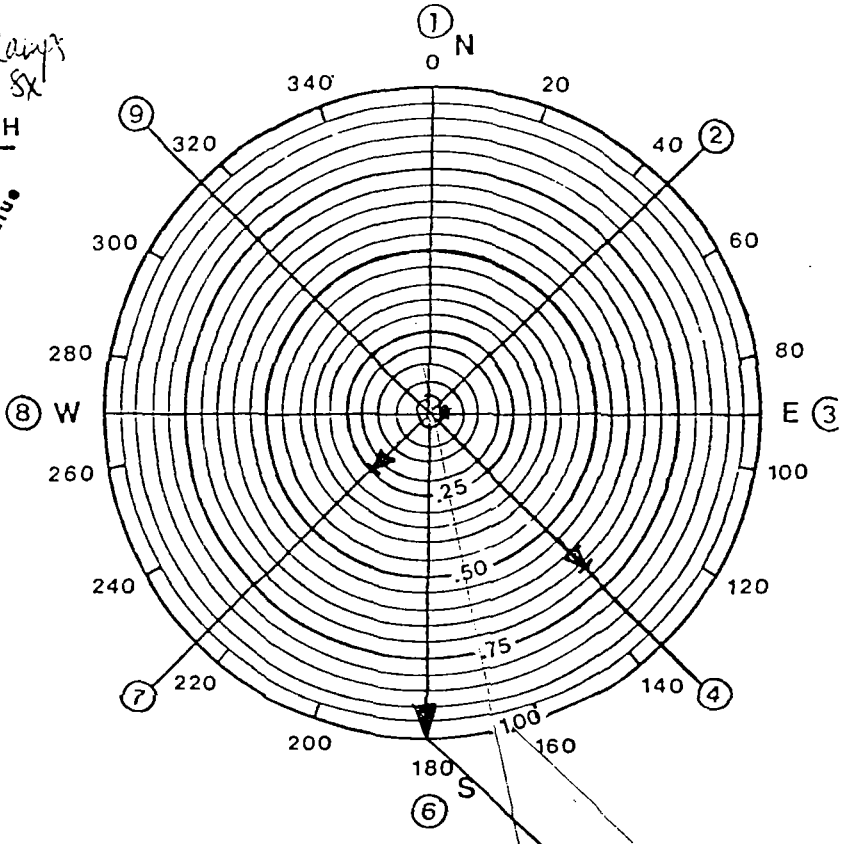
2 avgs 8x

ROTATE PROBE 180° AT SAME DEPTH

1→S

Probe pair	D start	E end	S E-D	F N-S / 2	G F max. value
+1/-6	+40	+353	+243	108.5	1
+2/-7	-47	+214	+97	26	0.24
+3/-8	0	-131	-131	3.5	0.03
+4/-9	-51	-172	-123	72	0.66

TRAN 11:25

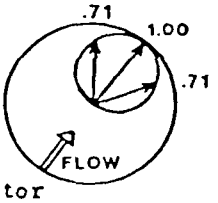


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program for TI-58/59-HP41C calculators

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). 11 (1) 3.52 ft/d

Direction: 168° S Velocity: 3.6

Form 104 available from your local K-V Associates, Inc. dealer.

9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

PROBE 2

Operator: ALP/SM Date: 11/14/95

Station: QW505 Time: 1130

Location: Elm Wilmington

Soil Conditions:

Depth to Measurement: 12' bg

Table of LCD Readout

1→N

Probe pair	A start	B end	C B-A
+1/-6	-5	-160	-155
+2/-7	-24	-278	-254
+3/-8	-5	-176	-171
+4/-9	+83	+159	+76

(4 readings 5x)

South 1st

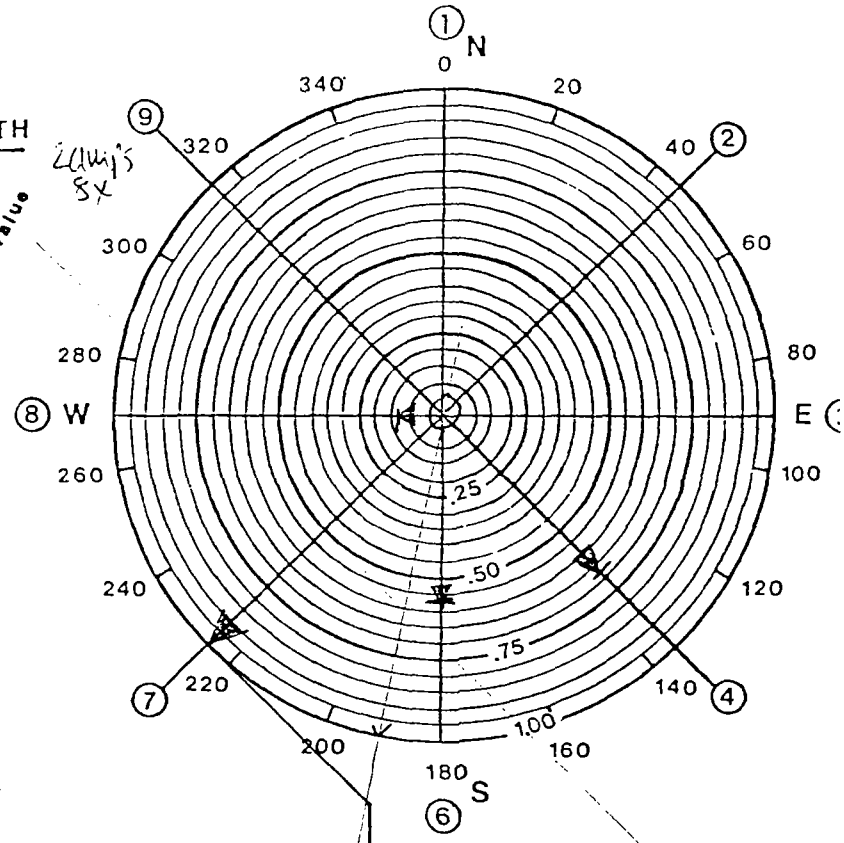
ROTATE PROBE 180° AT SAME DEPTH

1→S

Probe pair	D start	E end	S E-D	F N-S / 2	G F / max. value
+1/-6	+55	+164	+109	-132	-1.00
+2/-7	+30	+236	+206	-230	-1.00
+3/-8	0	+135	-135	-18	-0.08
+4/-9	+43	+145	-238	+157	+0.68

(QA)

(4 readings 5x)

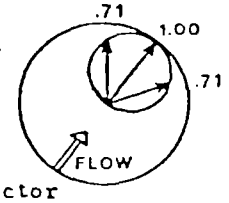


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). 7.98 (3) 206

Direction: 190 SSW Velocity: 7.67

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

PROBE 2

Operator: SHEP Date: 11/14/95

Station: SOS/GW Time:

Location: Qin/Lathrop Ln

Soil Conditions:

Depth to Measurement: 8' BG

Table of LCD Readout

1→N

Probe pair	A (start)	B (end)	C (B-A)
+1/-6	+59	20	-79
+2/-7	+60	-149	-209
+3/-8	+42	-556	-598
+4/-9	+44	-715	-759

2 amps 8X

south 1st

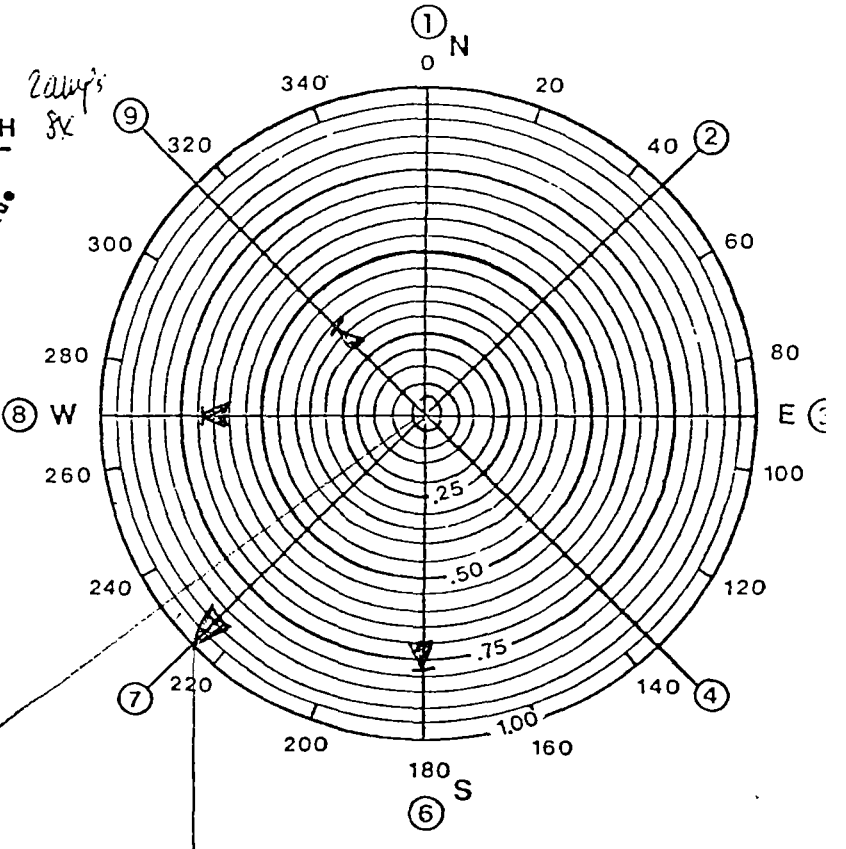
2 amps 8X

ROTATE PROBE 180° AT SAME DEPTH

1→S

Probe pair	D (start)	E (end)	S (E-D)	F (N-S/2)	G (F/max. value)
+1/-6	+30	0	-30	-24.5	0.77
+2/-7	-23	-168	-145	-32	1
+3/-8	-66	-890	-824	-22	0.69
+4/-9	+10	-725	-735	-12	0.38

1.279
25.3 | 33

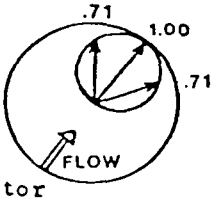


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day).

1.2
(+)-33

Direction: 235 Velocity: 1.1

Form 104 available from your local K-V Associates, Inc. dealer.

9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

PROBE 2

Operator: MIKE P Date: 11/14/95

Station: GW505 Time: 1230

Location: Burlington MA

Soil Conditions:

Depth to Measurement: 8' bg

Table of LCD Readout 2 pumps

1→N

Probe pair	A start	B end	C B-A
+1/-6	+47	-102	-147
+2/-7	+54	-173	-227
+3/-8	+30	-690	-720
+4/-9	+66	-600	-666

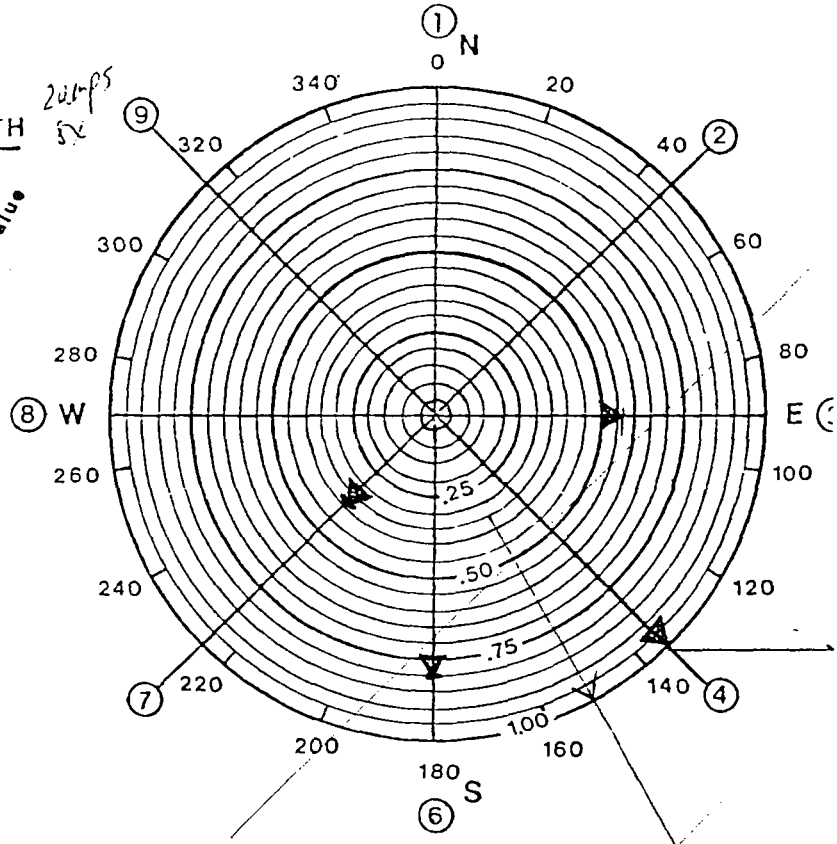
ROTATE PROBE 180° AT SAME DEPTH

1→S

Probe pair	D start	E end	S E-D	F N-S / 2	G F / max. value
+1/-6	+37	+22	-15	-66	-.80
+2/-7	0	-165	-165	-31	-.38
+3/-8	-43	-805	-762	+76	+.92
+4/-9	+19	-710	-729	+83	1

TRAIN 12:27 - middle of test (North)

253 | 79

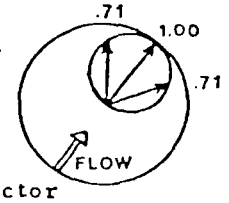


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). 3.06

149 79

Direction: ~~151~~ Velocity: 2.7

Form 104 available from your local K-V Associates, Inc. dealer.

9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

PROBE 2

Operator: AEP/SM Date: 11/14/95

Station: ~~GTO~~ GT6S Time:

Location: Olin / Wilmington

~~Soil Conditions~~: Dry

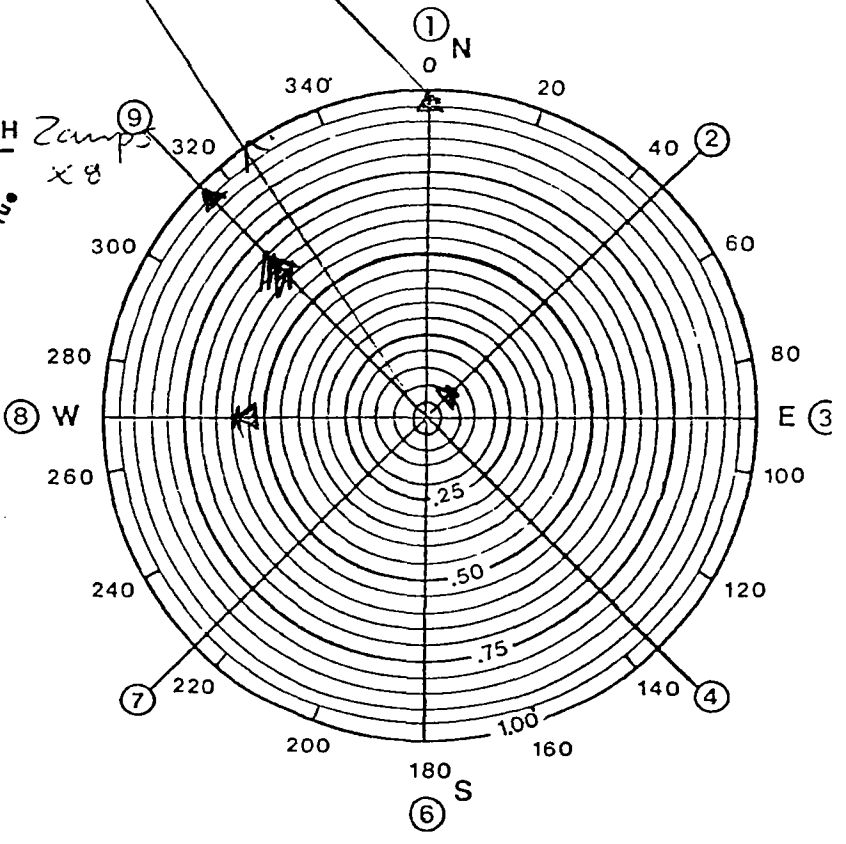
Depth to Measurement: 7 BG

Table of LCD Readout

Zeros x8

1→N

Probe pair	A start	B end	C B-A
+1/-6	+6	-217	-223
+2/-7	0	-263	-263
+3/-8	0	-289	-289
+4/-9	-75	+678	



ROTATE PROBE 180° AT SAME DEPTH

South 1st

Zeros x8

1→S

Probe pair	D start	E end	S E-D	F N-S / 2	G F / max. value
+1/-6	+24	-334	-358	+ 62.5	1
+2/-7	+5	-275	-280	- 8.5	.12
+3/-8	-17	-229	-212	- 38.5	.57
+4/-9	-50	+174	+124	- 66.	.97

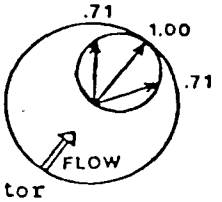
2.79
253 | 72

Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculators

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day).

2.7

Direction: 325 Velocity: ~~2.25~~

Form 104 available from your local K-V Associates, Inc. dealer.

9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

PROBE 2

Operator: SMITH Date: 11/14/95

Station: GT6S Time: ~3 pm

Location: Olin/Wilmington

Soil Conditions: /

Depth to Measurement: 7'13G

Table of LCD Readout

Zeros x8

1→N

Probe pair	A start	B end	C B-A
+1/-6	+11	-227	-264
+2/-7	+25	-177	-202
+3/-8	-6	-213	-219
+4/-9	+46	+118	+72

ROTATE PROBE 180° AT SAME DEPTH

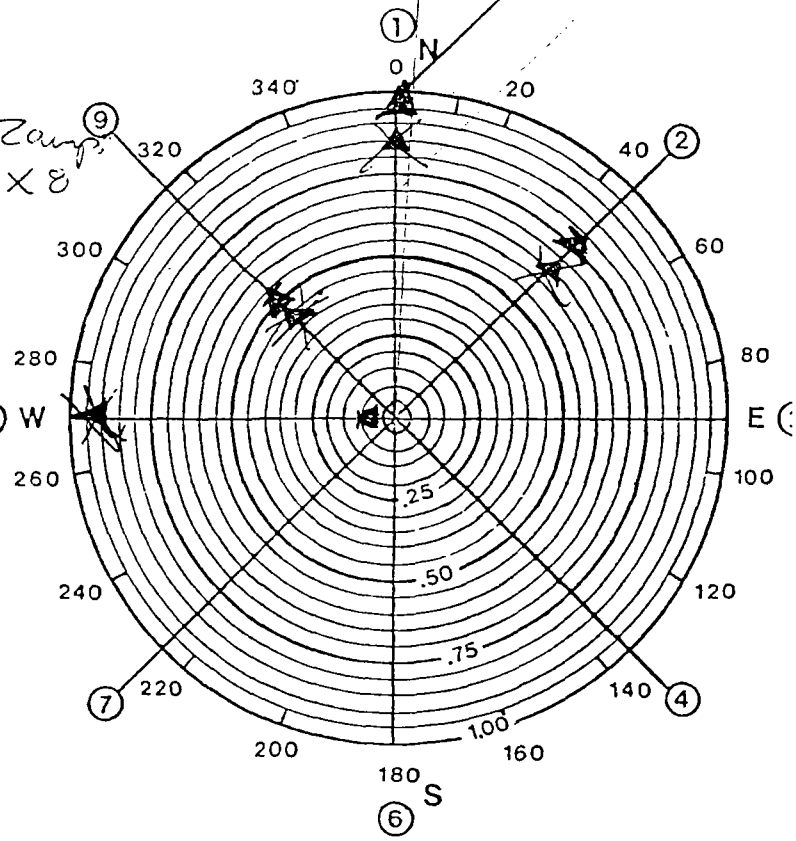
Zeros x8

1→S

Probe pair	D start	E end	S E-D		F N-S / 2	G F / max. value	
+1/-6	+35	-326	-361	+	485	.88	1
+2/-7	+12	-266	-278	+	38	.69	.70°
+3/-8	-15	-223	-208	-	55	1	.11
+4/-9	+42	+167	+125	-	265	.48	8.54

1.82

258 | 47

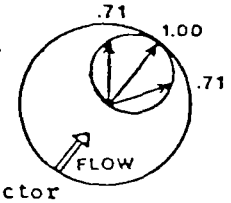


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). 1.82 / 47

Direction: 2° Velocity: 1.6

Form 104 available from your local K-V Associates, Inc. dealer.

9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

PROBE 2

Operator: SM/AEP Date: 11/15/55

Station: GT-6D Time: 10:30

Location: OLIN WILMINGTON

Soil Conditions:

Depth to Measurement: 29' bg (dup)

Table of LCD Readout

1→N

Probe pair	A start	B end	C B-A
+1/-6	+20	-100	-120
+2/-7	+12	-135	-147
+3/-8	0	-432	-432
+4/-9	+72	-30	-102

20 cps 8x

South 1st

20 cps 8x

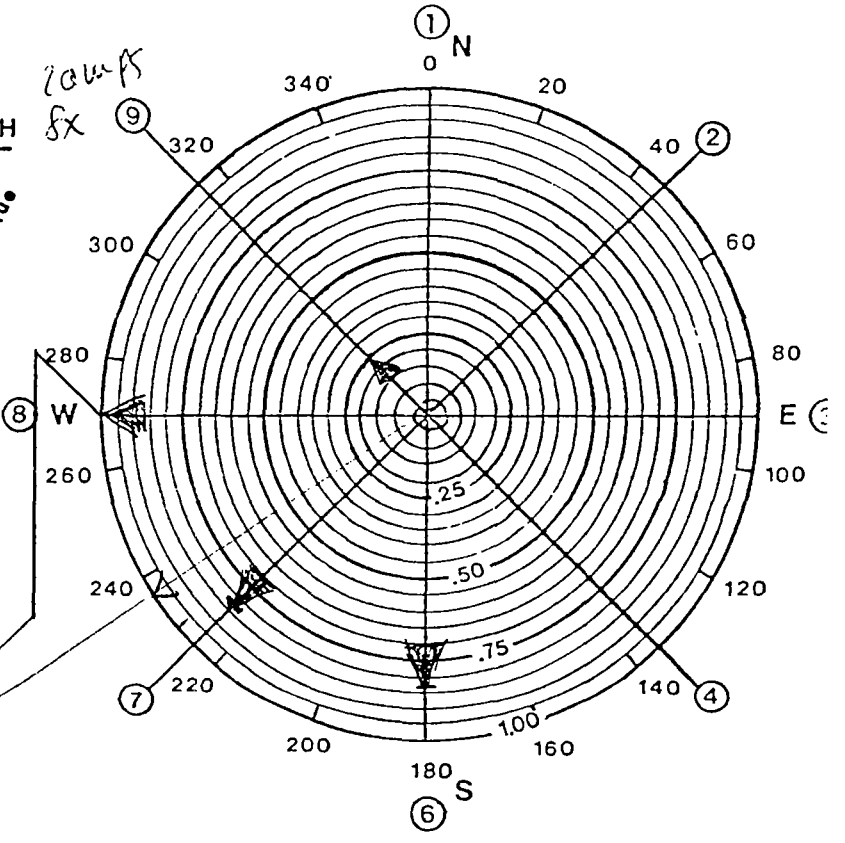
ROTATE PROBE 180° AT SAME DEPTH

1→S

Probe pair	D start	E end	S E-D	F N-S/2	G F max. value
+1/-6	+40	+70	-110	-5	0.83
+2/-7	+25	-112	-137	-5	0.83
+3/-8	0	-420	-420	-6	1
+4/-9	+56	-44	-99	-1.5	0.25

23

25316

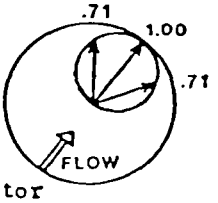


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day).

Direction: 237 Velocity: 0.20 ft

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

PROBE 2

Operator: A&P/SM Date: 11/15/95

Station: GTEO Time:

Location: Olin / Wilmington

Soil Conditions:

Depth to Measurement: 29' BG

Table of LCD Readout

1→N

Probe pair	A start	B end	C B-A
+1/-6	+37	-72	-109
+2/-7	+20	-125	-145
+3/-8	+1	-442	-443
+4/-9	+60	-65	-125

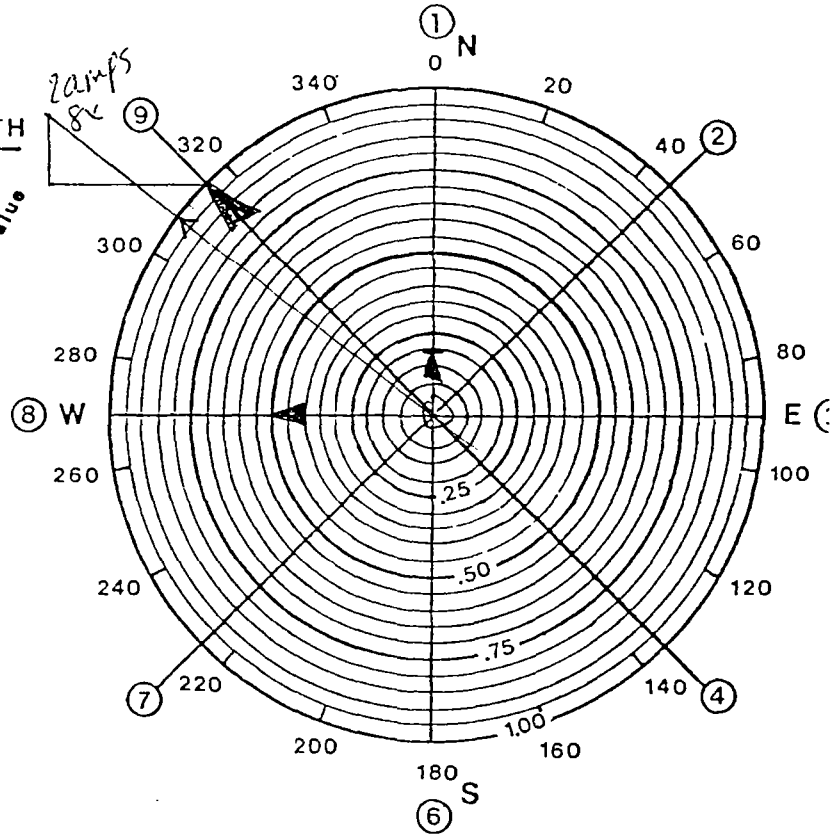
2 amps 8x

ROTATE PROBE 180° AT SAME DEPTH

1→S

Probe pair	D start	E end	S E-D	F N-S / 2	G F / max. value
+1/-6	+34	-80	-114	-125	0.19
+2/-7	+22	-123	-145	0	0
+3/-8	0	-430	-430	-6.5	0.5
+4/-9	+61	-38	-99	-13	1

95.8 | 10 .38

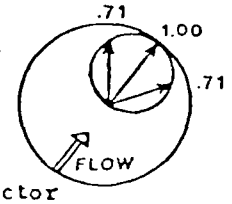


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). (T) .381

Direction: 308 Velocity: ~~0.93~~

Form 104 available from your local K-V Associates, Inc. dealer.

9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

PROBE 2

Operator: SM/JEP Date: 11/15/95

Station: GT-6D Time: 11 00

Location: Olin Wilmington

Soil Conditions:

Depth to Measurement: 25' bg

Table of LCD Readout

1→N

Probe pair	A start	B end	C B-A
+1/-6	+42	-80	-122
+2/-7	+26	-119	-145
+3/-8	0	-403	-403
+4/-9	+52	-30	-82

2 avgs 8x

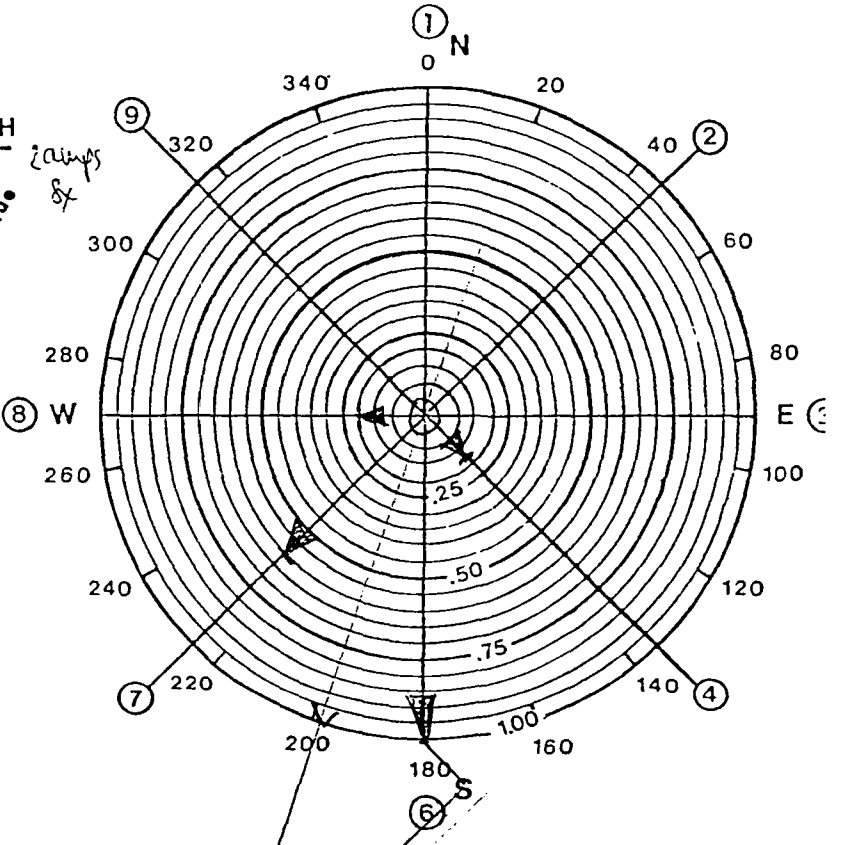
ROTATE PROBE 180° AT SAME DEPTH

1→S

Probe pair	D start	E end	S E-D	F N-S / 2	G F max. value
+1/-6	+32	-60	-92	-30	1
+2/-7	+15	-94	-109	-18	0.60
+3/-8	0	-390	-390	-6	0.20
+4/-9	+58	-35	-93	+5.5	0.18

2 avgs 8x

253 | 24

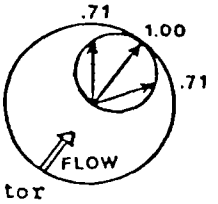


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). .93 ft/d

Direction: 198° SW Velocity: 10

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

PROBE 2

Operator: SM/AEP Date: 11/15/95

Station: GT-6D Time: 12 00

Location: Olin Wilmington

Soil Conditions:

Depth to Measurement: 25' bg dup

Table of LCD Readout

1→N

Probe pair	A (start)	B (end)	C (B-A)
+1/-6	+32	-76	-123
+2/-7	+16	-124	-140
+3/-8	-11	-397	-386
+4/-9	-52	-249	-81

20 w.p. SE

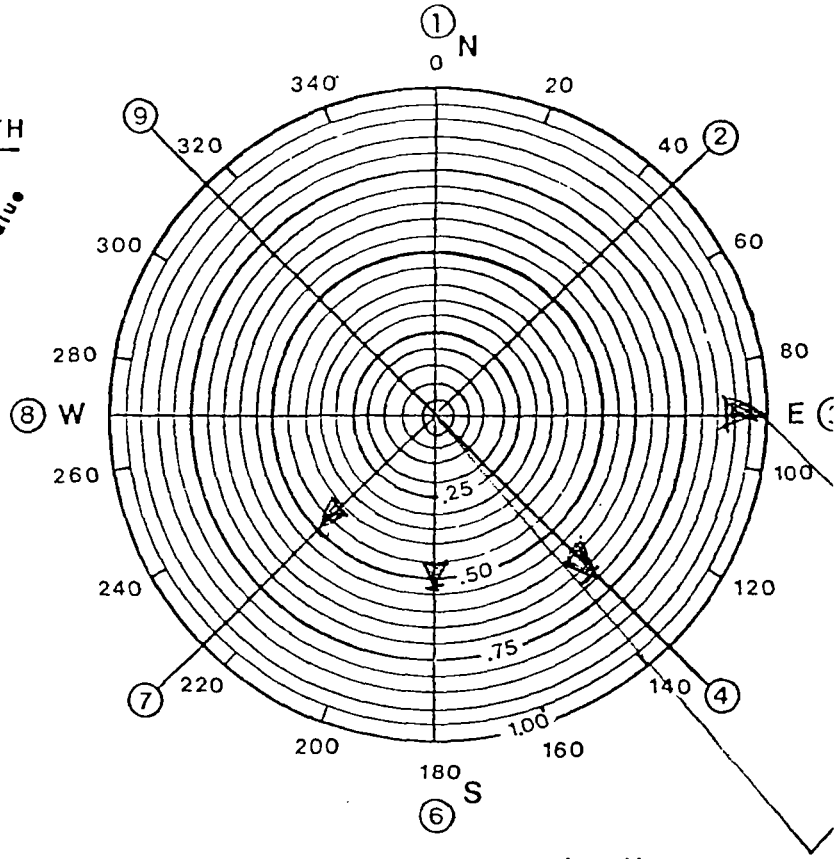
South 1st

ROTATE PROBE 180° AT SAME DEPTH

1→S

Probe pair	D (start)	E (end)	S (E-D)	F (N-S/2)	G (F/max. value)
+1/-6	132	-70	-102	-10.5	-0.53
+2/-7	+18	-102	-120	-10	-0.50
+3/-8	0	-426	-426	+20	1
+4/-9	+58	-50	-108	13.5	0.68

~~38~~ ~~25~~ ~~10~~ 25.8 √18 .697

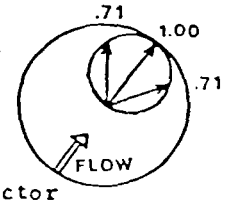


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day). .704 18

Direction: 140 SE Velocity: 0.67

Form 104 available from your local K-V Associates, Inc. dealer.

 9/82

GROUNDWATER FLOW WORKSHEET

For use with K-V Associates, Inc. Groundwater Flowmeters, 4 channel probe

PROBE 2

Operator: SM/AEP Date: 11/15/95

Station: GT-6D Time: 12:45

Location: Elm Wilmington

Soil Conditions:

Depth to Measurement: In Casing

Table of LCD Readout

1→N

Probe pair	A start	B end	C B-A
+1/-6	+33	-94	-127
+2/-7	+20	-184	-204
+3/-8	+3	-289	-292
+4/-9	+58	+8	-50

2 amps SF

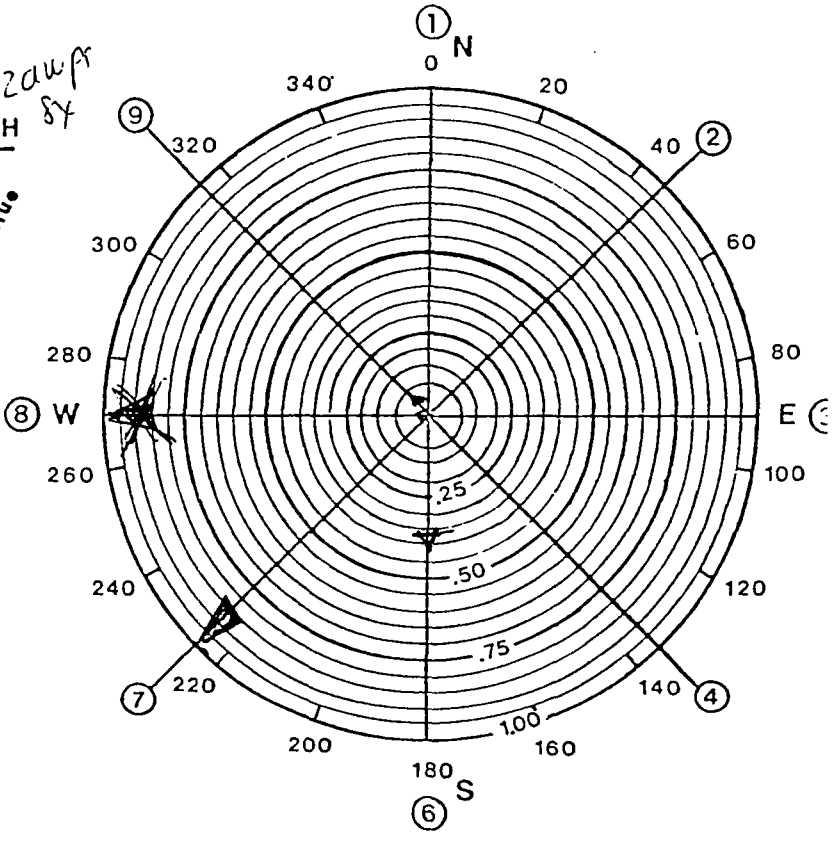
ROTATE PROBE 180° AT SAME DEPTH

1→S

Probe pair	D start	E end	S E-D	F N-S/2	G F max. value
+1/-6	+32	-50	-82	-22.5	0.36
+2/-7	+6	-62	-78	-63	1
+3/-8	0	-290	-290	-1	0.02
+4/-9	+55	+15	-40	-5	0.05

2 amps SF

VERTICAL/NON UNIFORM FLOW

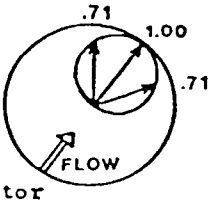


Use of Table

COLUMN G - Divide each reading in column F by the largest absolute value. Draw these 4 vectors on the circle chart according to the scale provided (i.e. strongest vector = 1.00).

Cosine Test Shows Uniform Flow

Vector end points will closely fit a circle inscribed about the longest vector. Values in column G will approximate vector lengths shown at right.



Vector Resolution to Determine Direction

1. Use KVA Vector Addition Program (TI-58/59-HP41C) calculator

OR

2. Solve graphically by placing 4 individual vector segments sequentially head to tail. (See manual for detailed instructions).

Velocity Determination

Refer to your calibration curve of readout versus preferred units of flow (e.g. feet per day).

Direction: Velocity:

Form 104 available from your local K-V Associates, Inc. dealer.

9/82

Appendix I

SMITH

SMITH

APPENDIX J

WELL AND MULTI-LEVEL PIEZOMETER LOGS

BCM/Smith Environmental — **Well Log**

Sheet: 1 of 1

Project: Olin Corporation - Offsite Monitoring Wells — Well/Boring No.: GW-65BR

Project No.: 00-7074-0102 — Date(s): 9/13 - 9/21/95 — Logged By: Peter R. Chronowski

Well/Boring Location: Towpath of Middle Sex Canal off of Butters Row

Drilling Method: Dual Wall Air Rotary (Barber drill) — Drilling Contractor: Maher Environmental

Depth to Groundwater: 16.15' bgs — Date: 10/08/95 — Reference: TOIC

Elevations - Ground Surface: 82.8' msl — Inner Casing: 84.77' msl — Outer Casing: 84.94' msl

Water Table: 68.62' msl — Date: 10/08/95 — Reference: TOIC

Remarks: NIR - no instrument response; Monitoring well was completed with 10-inch protective steel casing and locking cover.

Depth (ft)	Sample No.	Sample Rec. (in)	Blows (n)	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Graphical Logs: Strata	Organic Vapor Headspace Analysis (ppm)	Remarks
				⊛ See Boring log for GW-65C for overburden description.			
100				Gravel: green to brown; medium to very coarse, angular; little to some coarse sand (weathered Bedrock)			high water production ~150gpm @ 101' bgs.
105							cement/bentonite grout 0-108'
				Bedrock: Granite grey to black mafic minerals, some Alkaline (Plagioclase) and Quartz, little to trace mica.			8" Schedule 80 PVC Casing 0-110'
110							
				Bedrock: As above			BENTONITE PELLET SEAL 108'-110' BGS
115							
				Bedrock: As above			6" open bedrock hole 110-140' BGS
120							
				Bedrock: As above			
125							
				Bedrock: As above ⊛ small fracture (>0.5') @ 126' ~1gpm			
130							
				Bedrock: As above			
135							
				Bedrock: As above: trace smokey quartz crystals			
140							
				End of Boring @ 140' bgs.			
145							

Note: Not all portions of this form are applicable to all projects — 6\94

Smith Environmental Technologies Corp. — Well Log

Sheet: 1 of 1

Project: OLIN CORP (WILMINGTON, MA) Well/Boring No.: GW-765
Project No.: 00-7074-0102 Date(s): 1/17/95 Logged By: A.E. PERRY
Well/Boring Location: ADJ. WEST DITCH; BEHIND MULKERIN DISTRIBUTORS
Drilling Method: 4 1/4" ID; 8" OD AUGER Drilling Contractor: SOIL EX
Depth to Groundwater: ~4' BGS Date: 1/17/95 Reference: GROUND
Elevations - Ground Surface: 85.9' msl Inner Casing: 87.1' msl Outer Casing: 88.42' msl
Water Table: ~81.9' msl Date: 1/17/95 Reference: ground
Remarks: GW at 6.16' bgs from TOIC on 2/01/95, = 80.94' msl

Depth of Samp.(ft) BGS	Sample No.	Blows	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Graphical Logs: Strata	Graphical Logs: Well Construction	Organic Vapor Headspace Analysis (ppm)	Comments	Elevation
							1' STICK-UP	
1			0-6" BGS - SAND + GRAVEL W/ LG. COBBLES				0.5' - 1.5' BGS BENTONITE PLUG	
2			6" - 5' STONY SOIL					
3							1.5' - 13' BGS SANDPACK NO. 1 SILICA SAND	
4								
5			5'-7' SPLIT SPOON REFUSAL CUTTINGS = GRAY-BROWN SAND AND GRAVEL W/ LITTLE SILT AND CLAY				3 - 13' BGS 2" PVC 10 SLOT SCREEN	
6								
7								
8			▽ WATER LEVEL (STABILIZED @ 4' BGS)					
9								
10			10-12' SPLIT SPOON SATURATED, ORANGE-BROWN TO GRAY GRAVEL AND SAND, TRACE SILT POORLY SORTED, MIXED GRAIN: LITHOLOGIC ORIGINS.					
11								
12								
13							13' BGS BOTTOM OF WELL	
14								
15		9-8	15-17' ORANGE-LGT BROWN, COARSE TO MED. SAND, SOME GRAVEL, MODERATELY SORTED, W/ MIXED SOURCE ROCK					
16		17-						
17		13					17' BGS BOTTOM OF HOLE	
18								
19							WELL DEVELOPED 25 MINS WATER RUNNING CLEAR	

Note: Not all portions of this form are applicable to all projects 11/94

Smith Environmental Technologies Corp. — Well Log

Sheet: 1 of 1

Project: OLIN CORP (WILMINGTON, MA) Well/Boring No.: GW-775
Project No.: 00 7074 0102 Date(s): 1/17/95 Logged By: A.E. PERRY
Well/Boring Location: ADJ WEST DITCH, NEAR CARPET WORLD (JEWEL DRIVE)
Drilling Method: 4 1/4" ID; 8" OD AUGER Drilling Contractor: SOIL EX
Depth to Groundwater: ~4' BGS Date: 1/17/95 Reference: GROUND
Elevations - Ground Surface: 84.0' msl Inner Casing: 86.51 Outer Casing: 85.78' msl
Water Table: ∨ 80.0' msl Date: 1/17/95 Reference: Ground
Remarks: GW at 4.34' bgs from TOIC on 2/01/95, = 81.17' msl

Depth of Samp.(ft)	Sample No.	Blows	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Graphical Logs: Strata / Well Construction	Organic Vapor Headspace Analysis (ppm)	Comments	Elevation
						1.5' STICK UP	
1			SANDY LOAM			0.5'-1' BENTONITE PLUG	
2						1'-11' SAND PACK NO. 1 SILICA	
3							
4			∨ WATER LEVEL		∨	1'-11' PVC WELL 2" PVC 10' SLOT SCREEN	
5		9	5-7' BGS SATURATED RUSTY BROWN FINE SAND				
6		15					
7		17 17					
8							
9							
10		4	10-11' BROWN-GRAY FINE SAND, WELL SORTED OCCASSIONAL PODS OF ORGANICS.				
11		8 10					
12		10	11-11.5' LGT ORANGE-SILT AND FINE SAND - WELL SORTED.			BOTTOM OF WELL 11' BGS.	
			11.5-12' TAN SILT, WELL SORTED			WELL DEVELOPED WATER RUNNING CLEAR. 20 MINS	

Note: Not all portions of this form are applicable to all projects 11/94

Smith Environmental Technologies Corp. — Well Log

Sheet: 1 of 1

Project: OLIN CORP (WILMINGTON, MA) Well/Boring No.: GW-785
Project No.: 00-7074-0102 Date(s): A.E. PERRY Logged By: 1/16/95
Well/Boring Location: ADT SOUTH DITCH / DOWNSTREAM OF WEIR
Drilling Method: 4 1/4" ID, 8" OD AUGER Drilling Contractor: SOIL EX
Depth to Groundwater: 4' BGS Date: 1/16/95 Reference: GROUND
Elevations - Ground Surface: 82.5' msl Inner Casing: 84.87' msl Outer Casing: 85.07' msl
Water Table: ~ 78.5' msl Date: 1/16/95 Reference: Ground
Remarks: GW at 4.27' bgs from TOIC on 2/01/95, = 80.60' msl

Depth of Samp.(ft)	Sample No.	Blows	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Graphical Logs: Strata / Well Construction	Organic Vapor Headspace Analysis (ppm)	Comments	Elevation
						2.5' STICK UP	
1			0-6" DK BROWN - ORANGE BROWN, LEAF DEBRIS, SOIL, SANDY LOAM			0-6" BGS BENTONITE PLUG	
2							
3						6"-9' BGS NOISILICA SANDPACK	
4			4-6' ROCKY MATERIAL ENCOUNTERED DURING DRILLING.		▽ WATER LEVEL		
5	X		5-7' BROWN-GRAY GRAVEL AND SAND; LITTLE SILT VERY POORLY SORTED MIXED LITHOLOGY (PROBABLY FILL)			0-9' 2" PVC 10 SLOT SCREEN	
6	X						
7	X						
8							
9			- REFUSAL @ 9' BGS			BOTTOM OF HOLE @ 9' BGS	
10							
						WELL DEVELOPED 35 MINS WATER RUNNING SLIGHTLY CLOUDY	

Note: Not all portions of this form are applicable to all projects 11/94

Smith Environmental Technologies Corp. — Well Log

Sheet: 1 of 1

Project: OLIN CORP (WILMINGTON, MA) Well/Boring No.: GW-79S
Project No.: 00-7074-0102 Date(s): 1/16/95 Logged By: A.E. PERRY
Well/Boring Location: NEAR POND
Drilling Method: 4 1/4" ID; 8" OD AUGER Drilling Contractor: SOIL EX
Depth to Groundwater: 11' BGS Date: 1/16/95 Reference: GROUND
Elevations - Ground Surface: 79.3' msl Inner Casing: 81.39' msl Outer Casing: 81.67' msl
Water Table: ~ 80.39' msl Date: 1/16/95 Reference: Ground
Remarks: GW at 2.60' bgs from TOIC on 2/01/95 = 78.79' msl

Depth of Samp.(ft)	Sample No.	Blows	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Graphical Logs: Strata	Graphical Logs: Well Construction	Organic Vapor Headspace Analysis (ppm)	Comments	Elevation
							2' STICK UP	
1			0-6" DK. BROWN LEAF DEBRIS				0-6" BENTONITE CHIPS	
2							▽ WATER LEVEL	
3							6"-10' SANDBACIC NO. 1 SILICA SAND	
4								
5		5	5-7' SPLIT SPOON					
6		10 20 29	5-6.5' WET, LGT BROWN MED-FINE SAND EXTREMELY WELL SORTED - GRAINS A MIXTURE OF LITHOLOGIES				2" PVC 10 SLOT WELL SCREEN	
7			6.5'-7' WET, MED GRAY MED-FINE SAND					
8								
9			SOME DK. GRAY BANDS.					
10			7-9' HARDER DRILLING				BOTTOM OF HOLE 10'	
			10' RUNNING sands Light brown, med-fine sands					
							WELL DEVELOPED 20 MINS WATER RUNNING CLEAR	

Note: Not all portions of this form are applicable to all projects 11/94

BCM/Smith Environmental — **Well Log**

Sheet: 1 of 2

Project: Olin Corporation - Offsite Monitoring Wells — Well/Boring No.: GW-30BR

Project No.: 00-7074-0102 — Date(s): 7/19/95 — Logged By: Peter R. Chronowski

Well/Boring Location: Woburn St. parking lot (rear)

Drilling Method: Dual Wall Air Rotary (Barber drill) — Drilling Contractor: Maher Environmental

Depth to Groundwater: 3.34' bgs — Date: 10/08/95 — Reference: TOIC

Elevations - Ground Surface: 79.3' msl — Inner Casing: 78.91' msl — Outer Casing: 79.31' msl

Water Table: 75.57' msl — Date: 10/08/95 — Reference: TOIC

Remarks: NIR - no instrument response; Monitoring well was completed with a flush mount, locking, cover.

Depth (ft)	Sample No.	Sample Rec. (in)	Blows (n)	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Graphical Logs: Strata	Organic Vapor Headspace Analysis (ppm)	Remarks
5				See GW-24C boring log for description to 15' bgs.		NIR	
10						0.3ppm	← Cement/Bentonite grout 0-28.5' BGS.
15							← 8" schedule 80 PVC casing 0-30' BGS
20				weathered Bedrock - granite fine sand wt coarse gravel, angular.		NIR	
25				Bedrock: granite fine to medium grained quartz & mafics			
30				Bedrock - As above		NIR	← Bentonite hole seal 28.5'-30' BGS
35				Bedrock: As above			
40				Bedrock - As above		NIR	
45				④ soft drilling @ 44-46' bgs Bedrock - As above			← Open rock hole 6-inches O.D 30-70' BGS
50				⑤ higher silica content Bedrock: As above		NIR	

Note: Not all portions of this form are applicable to all projects — 6\94

BCM/Smith Environmental — **Well Log**

Sheet: 2 of 2

Project: Olin Corporation - Offsite Monitoring Wells — Well/Boring No.: GW-90BR

Project No.: 00-7074-0102 — Date(s): 7/19/95 — Logged By: Peter R. Chronowski

Well/Boring Location: Woburn St. Parking lot (rear)

Drilling Method: Dual Wall Air Rotary (Barber drill) — Drilling Contractor: Maher Environmental

Depth to Groundwater: 3.34' bgs — Date: 10/08/95 — Reference: TOIC

Elevations - Ground Surface: 79.3' msl — Inner Casing: 78.91' msl — Outer Casing: 79.31' msl

Water Table: 75.57' msl — Date: 10/08/95 — Reference: TOIC

Remarks: NIR - no instrument response; Monitoring well was completed with a flush mount, locking, cover.

Depth (ft)	Sample No.	Sample Rec. (in)	Blows (n)	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Graphical Logs: Strata	Organic Vapor Headspace Analysis (ppm)	Remarks
55				Bedrock - (granite) as above			
60				Bedrock As above			open rock hole 6" inches O.D
65				Bedrock As above			
70				Bedrock As above			
				END of Boring @ 70' bgs.			

Note: Not all portions of this form are applicable to all projects.

6/94

BCM/Smith Environmental — **Well Log**

Sheet: 1 of

Project: Olin Corporation - Offsite Monitoring Wells — Well/Boring No.: MW-30D

Project No.: 00-7074-0102 — Date(s): 7/21/95 — Logged By: Peter R. Chronowski

Well/Boring Location: Woburn St. parking Lot. (rear)

Drilling Method: Dual Wall Air Rotary (Barber drill) — Drilling Contractor: Maher Environmental

Depth to Groundwater: 3.46' bgs — Date: 10/02/95 — Reference: TOIC

Elevations - Ground Surface: 79.4' msl — Inner Casing: 79.06' msl — Outer Casing: 79.41' msl

Water Table: 75.60' msl — Date: 10/08/95 — Reference: TOIC

Remarks: NIR - no instrument response; Monitoring well was completed with a flush mount, locking, cover.

Depth, (ft)	Sample No.	Sample Rec. (in)	Blows (n)	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Graphical Logs: Strata	Organic Vapor Headspace Analysis (ppm)	Remarks
				Asphalt & Gravel			
		10"	21, 19, 24, 50 (43)	Sand & gravel (GP): light brown, fine to medium sand with fine to coarse gravel, subround, dry.		NIR	Cement/Bentonite grout to groundsurface 0-6' BGS
5							
		6"	7, 3, 3, 3 (6)	Sand (SW): dark grey - black; fine with little medium, trace coarse, little silt, trace gravel fine to coarse, subangular to sub round, saturated. ⊗ slight "solvent" type odor		0.2ppm	Bentonite Pellet Seal 6'-8' BGS
10							
		6"	3, 2, 2, 3 (4)	Sand (SW): black; fine with little medium, little silt and clay, saturated. ⊗ oily sheen on water extracted f/ split spoon		1.2ppm	
							4" OD 10' of 20 slot screen 10'-20' BGS
15							
		12"	12, 13, 21, 25 (33)	Weathered Bedrock: granite fragments: fine sand w/ coarse to very coarse gravel, angular			#2 Jessie Morie Sand 8'-22' BGS
				Bedrock: granite			
20							
				End of Boring @ 22' bgs.			
25							

Note: Not all portions of this form are applicable to all projects — 6\94

BCM/Smith Environmental — **Well Log**

Sheet: 1 of 1

Project: Olin Corporation - Offsite Monitoring Wells — Well/Boring No.: GW-805

Project No.: 00-7074-0102 — Date(s): 7/24/95 — Logged By: Peter R. Chronowski

Well/Boring Location: Woburn St. Parking Lot (rear)

Drilling Method: Dual Wall Air Rotary (Barber drill) — Drilling Contractor: Maher Environmental

Depth to Groundwater: 3.28' bgs — Date: 10/08/95 — Reference: TOIC

Elevations - Ground Surface: 79.6' msl — Inner Casing: 79.17' msl — Outer Casing: 79.55' msl

Water Table: 75.89' msl — Date: 10/08/95 — Reference: TOIC

Remarks: NIR - no instrument response; Monitoring well was completed with a flush mount, locking, cover.

Depth (ft)	Sample No.	Sample Rec. (in)	Blows (n)	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Graphical Logs: Strata	Organic Vapor Headspace Analysis (ppm)	Remarks
				Asphalt & Gravel			Cement/Bentonite grout 0-1' BGS
				Sand & Gravel (GP): light brown; fine to medium sand with fine to coarse gravel, subround; dry.		NIR	Bentonite pellet seal 1-2.5' BGS
5							
				Sand (SW): dark grey to black; fine with little medium to coarse, little silt; trace gravel, fine to coarse, subangular; saturated.		0.2ppm	4" O.D. 20 slot PVC screen 3-9' BGS
10				⊗ Slight "solvent" type odor. End of boring @ 10' bgs.		3.2ppm	#2 Sessie Marie Sand 2.5-10' BGS
15							
20							

Note: Not all portions of this form are applicable to all projects. 6\94

BCM/Smith Environmental — **Well Log**

Sheet: 1 of 1

Project: Olin Corporation - Offsite Monitoring Wells — Well/Boring No.: GW-81BR

Project No.: 00-7074-0102 — Date(s): 7/25-26/95 — Logged By: Peter R. Chronowski

Well/Boring Location: 14 Jewel Dr. - East side of building

Drilling Method: Dual Wall Air Rotary (Barber drill) — Drilling Contractor: Maher Environmental

Depth to Groundwater: 16.56' bgs — Date: 10/08/95 — Reference: TOIC

Elevations - Ground Surface: 86.2' msl — Inner Casing: 86.01' msl — Outer Casing: 86.20' msl

Water Table: 69.45' msl — Date: 10/08/95 — Reference: TOIC

Remarks: NIR - no instrument response; Monitoring well was completed with a flush mount, locking, cover.

Depth, (ft)	Sample No.	Sample Rec. (in)	Blows (n)	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Graphical Logs: Strata	Organic Vapor Headspace Analysis (ppm)	Remarks
5				See Boring Log for GW-81C for description to 15'		NIR	
10							Cement/Bentonite grout 0-19.5'
15				Sand & gravel (GW): coarse sand with fine to very coarse gravel, round to well rounded, saturated. Bedrock: siliceous mafic (mylonite).		NIR	8" schedule 80 PVC casing 0-21' BGS
20				Bedrock: As above			
25				Bedrock: As above; Fracture @ 24		NIR	Bentonite pellet seal 19.5-21' BGS
30				Bedrock: As above, less silica; fracture @ 35'			open rock hole 10-inch O.D. 21'-50' BGS.
35				Bedrock: As above		NIR	
40				Bedrock: As above; fracture @ 42			
45				Bedrock: As above		NIR	
50				Bedrock: As above			50' BGS END OF EXPLORATION

Note: Not all portions of this form are applicable to all projects — 6\94

BCM/Smith Environmental — **Well Log**

Sheet: 1 of 1

Project: Olin Corporation - Offsite Monitoring Wells — Well/Boring No.: GW-81D

Project No.: 00-7074-0102 — Date(s): 7/26/95 — Logged By: Peter R. Chronowski

Well/Boring Location: 14 Jewel Dr. - East side of Building.

Drilling Method: Dual Wall Air Rotary (Barber drill) — Drilling Contractor: Maher Environmental

Depth to Groundwater: 6.35' bgs — Date: 10/08/95 — Reference: TOIC

Elevations - Ground Surface: 86.1' msl — Inner Casing: 85.86' msl — Outer Casing: 86.14' msl

Water Table: 79.51 — Date: 10/08/95 — Reference: TOIC

Remarks: NIR - no instrument response; Monitoring well was completed with a flush mount, locking, cover.

Depth (ft)	Sample No.	Sample Rec. (in)	Blows (n)	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Graphical Logs / Strata	Organic Vapor Headspace Analysis (ppm)	Remarks
		8"	3, 11, 19, 26 (30)	Asphalt & Gravel Gravelly Sand (SW): orange/brown; fine to medium sand with fine to medium gravel, round to sub-round; dry.		NIR	Cement/Bentonite grout to surface. 0-2' BGS Bentonite Pellet seal 2-4' BGS
5							
		12"	7, 11, 16, 10 (27)	Sand (SP): light brown; fine to medium sand; little coarse; little to trace medium gravel, subround to round; trace mica; moist.		NIR	
10							10' of 20 slot PVC screen (4" OD) (5-15' BGS)
		12"	30, 100/6	Sand (SP): As above; gets coarser with depth; saturated.		NIR	
				Sandy Gravel (GW): med - crs gvl, well round; crs - svd; saturated; glacial outwash.			#2 Jessie Marie Sand (4'-15' BGS)
15				Bedrock: See GW-81BR boring Log for Lithologic Descriptions End of Boring @ 15.6' bgs			
20							

Note: Not all portions of this form are applicable to all projects — 6\94

Smith Environmental Technologies Corp. — Well Construction Log

Sheet: 1 of 1

Project: Olin Corporation — Well/Boring No.: GW- 825

Project No.: 00-7074-0102 — Date(s): 9/28/96 — Logged By P. Newdeck

Well/Boring Location: Maple Meadow Brook Wetland / Behind Rutland Corp. stockpile yard

Drilling Method: Rotasonic — Drilling Contractor: Maher / BOART LONGYEAR

Depth to Groundwater: 6.05' bgs — Date: 10/25/96 — Reference: inner casing

Elevations - Ground Surface: 80.2' msl — Inner Casing: 87.57' msl — Outer Casing: 88.03' msl

Water Table: 81.52' msl — Date: 10/25/96 — Reference: TOIC

Remarks:

Depth of Samp.(ft)	Sample No.	Blows	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Strata	Well Construction	Health and Safety Screen (CGI)	Comments	Elevation
			0-4' DK. BROWN ORGANIC MUCK			NIR	0-14' SCHEDULE 40 PVC RISER (2" ID)	
5			4-14' (50% RECOVERY) TOP 1' = MUCK BOTTOM 4' = DK. BROWN, POORLY SORTED SAND AND GRAVEL GRADING DOWN TO A YELLOW-BROWN				0-8 GROUT COLLAR	
10			SORTED SAND AND GRAVEL GRAVEL IS SUBROUNDED-ROUNDED VARIES IN SIZE FROM 1/4 TO >4" DIAMETER.			NIR	8-10.7 BENTONITE PLUG	
15			14-24' (EXCELLENT RECOVERY) 14-15' SORTED, MEDIUM-COARSE GRAIN SAND AND PEA SIZED GRAVEL (DK. BROWN)				10.7-24' BGS NO. 1 SILICA SAND PACK	
20			15-19' SORTED, MEDIUM-COARSE GRAINED SAND W/ SOME VARIABLY SIZED, SUB-ROUNDED GRAVEL			NIR		
25			19-24' V. FINE, V. WELL SORTED LIGHT BROWN SAND W/ TAN-YELLOW ORANGE MOTTLES END OF BOREHOLE @ 24' BGS				14-24 20 SLOT (2" ID) SCHEDULE 40 PVC SCREEN	
30								
35								
40								
45								
50								

Note: Not all portions of this form are applicable to all projects. 11/94

Smith Technology Corporation — **Well Construction Log**

Sheet: 1 of 2

Project: Olin Corporation — Well/Boring No.: GW-82-D

Project No.: 00-7074-0102 — Date(s): 9/27/96 — Logged By: P. Newdeck

Well/Boring Location: Maple Meadow Brook Wetland/Behind Rutland Corp. stockpile yard

Drilling Method Rotasonic — Drilling Contractor: Maher/Boart Longyear

Depth to Groundwater: 5.50 bgs — Date: 10/25/96 — Reference: TOIC

Elevations - Ground Surface: 80.2' msl — Inner Casing: 87.09' msl — Outer Casing: 87.47' msl

Water Table: 81.59' msl — Date: 10/25/96 — Reference: TOIC

Remarks: NIR: no instrument response.

Depth of Samp.(ft)	Sample No.	Blows	Recovery (ft)	Lithologic Description	Graphical Logs: Strata	Graphical Logs: Well Construction	Health and Safety Screen (CGI)	Comments	Elevation
				0-4' bgs - V. dk brown MUCK and organic matter			NIR	8" protective steel casing - 7.3' a.g.s to ≈ 10' bgs 0-50' bgs - PVC riser (2" ID)	
5				4-14' bgs - (75% recovery) pH = 6 Top 2' = MUCK Middle 2' = Light brown, poorly sorted SAND w/ some pea sized gravel (sub-ang. to sub rounded). Bottom 6' = Yellow orange, poorly sorted SAND w/ some sub-a to sub-r, pea sized (w/ some 1" diameter) gravel				0-42.5' bgs - Cement/grout mix	
10									
15				14-24' bgs - (75% recovery) pH=5 SAND - well sorted, v. fine to fine grained sand, light brown w/ tan and yellow-orange mottles. Bottom 4" = red, poorly sorted sand and gravel, sub-rounded, 2" diameter. Sand has dark brown mixed within.					
20									
25				24-34' bgs - (80% recovery) pH=5 SAND - Same as light brown sand above with trace of subrounded, variable sized gravel; less mottled.					
30									
35				34-44' bgs - (75% recovery) pH=6 SAND - Same as above except no mottles and no gravel - very clean.					
40								42.5-46.5' bgs - Bentonite plug	
45				44-54' bgs - (80% recovery) pH=6 Top 2.5' = Brown, poorly sorted SAND and GRAVEL (gravel is sub-a to sub-r, 1/4" to 3" in diameter)				No. 0 silica sandpack 46.5-60' bgs	
50									

Note: Not all portions of this form are applicable to all projects

Smith Technology Corporation — **Well Construction Log**

Sheet: 2 of 2

Project: Olin Corporation — Well/Boring No.: GW-82-D

Project No.: 00-7074-0102 — Date(s): 9/27/96 — Logged By: P. Newdeck

Well/Boring Location: Maple Meadow Brook Wetland/Behind Rutland Corp. stockpile yard

Drilling Method: Rotasonic — Drilling Contractor: Maher/Boart Longyear

Depth to Groundwater: 5.50 bgs — Date: 10/25/96 — Reference: TOIC

Elevations - Ground Surface: 80.2' msl — Inner Casing: 87.09' msl — Outer Casing: 87.47' msl

Water Table: 81.59' msl — Date: 10/25/96 — Reference: TOIC

Remarks: NIR: no instrument response.

Depth of Samp.(ft)	Sample No.	Blows	Recovery (ft)	Lithologic Description	Graphical Logs: Strata	Graphical Logs: Well Construction	Health and Safety Screen	Comments	Elevation
				Bottom 2.5' - clayey SAND and GRAVEL. Yellow brown to red-brown. Gravel variable (1/4" - 3" diam), angular w/some sub-rounded			NIR	50-60' bgs - 10 slot screen Schedule 40 PVC (2" ID)	
				54-60' bgs - Green-gray angular rock fragments w/sub-rounded gravel, increasing in clay content towards the bottom.					
				- End of borehole @ 60' bgs - Bedrock @ 60' bgs - No "weathered" rock.					

Note: Not all portions of this form are applicable to all projects

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Smith Technology Corporation — **Well Construction Log**

Sheet: 1 of 1

Project: Olin Corporation — Well/Boring No.: GW-83-S

Project No.: 00-7074-0102 — Date(s): 10/1-2/96 — Logged By: P. Newdeck

Well/Boring Location: Maple Meadow Brook Wetland

Drilling Method: Rotasonic — Drilling Contractor: Maher/Boart Longyear

Depth to Groundwater: 7.05' bgs — Date: 10/25/96 — Reference: TOIC

Elevations - Ground Surface: 79.9' msl — Inner Casing: 88.23' msl — Outer Casing: 88.55' msl

Water Table: 81.18' msl — Date: 10/25/96 — Reference: TOIC

Remarks: NIR: no instrument response. / approximately 5' east of GW-83-M

Depth of Samp. (ft)	Sample No.	Blows	Recovery (ft)	Lithologic Description	Graphical Logs: Strata	Graphical Logs: Well Construction	Health and Safety Screen (CGI)	Comments	Elevation
				0-29.5' bgs - Dark brown, dense organic material - muck			NIR	0-39' bgs - Schedule 40 PVC riser (2" ID)	
5								0-30' bgs - cement/grout mix = tremie to surface	
10									
15									
20									
25									
30				29.5'-36' bgs - V. well sorted, dark gray, fine grained SAND				30-35' bgs - Bentonite plug	
35				36'-44' bgs - V. well sorted, light gray, fine grained SAND				35-49' bgs - No. 0 silica sand pack	
40								39-49' bgs - 10 slot (2" ID) Schedule 40 PVC screen	
45				44'-49' bgs - V. well sorted, tan, fine grained SAND					
50				End of bore hole @ 49' bgs					

Note: Not all portions of this form are applicable to all projects

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Smith Environmental Technologies Corp. — Well Construction Log

Sheet: 1 of 2

Project: Olin Corporation — Well/Boring No.: GW- 83M
Project No.: 00-7074-0102 — Date(s): 9/30/96-10/1/96 — Logged By P. Newdeck
Well/Boring Location: Maple Meadow Brook Wetland
Drilling Method: Rotasonic — Drilling Contractor: Maher / BOART LONGYEAR
Depth to Groundwater: 7.15' bgs — Date: 10/25/96 — Reference: TOIC
Elevations - Ground Surface: 79.9' msl — Inner Casing: 88.35' msl — Outer Casing: 88.56' msl
Water Table: 81.20' msl — Date: 10/25/96 — Reference: TOIC
Remarks: NIR = No instrument response

Depth of Samp.(ft)	Sample No.	Blows	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Strata	Well Construction	Health and Safety Screen (CGI)	2" DIAMETER WELL — Comments	Elevation
5			0-24' DK. BRWN DENSE ORGANIC MATERIAL			NIR	0-64' bgs -	
10			MUCK				SCHEDULE 40 PVC RISER (2" ID)	
15							0-59' bgs - cement/ grout mix	
20								
25								
30			24-62' V. WELL SORTED SAND FINE GRAIN					
35			TOP 10' light gray sand grading down to light brown sand					
40			w/ tan mottles.					
45								
50								

Note: Not all portions of this form are applicable to all projects — 11/94

Smith Environmental Technologies Corp. — Well Construction Log

Sheet: 2 of 2

Project: Olin Corporation — Well/Boring No.: GW-83M
Project No.: 00-7074-0102 — Date(s): — Logged By: P. Newdeck
Well/Boring Location: Maple Meadow Brook Wetland
Drilling Method: Rotasonic — Drilling Contractor: Maher
Depth to Groundwater: — Date: — Reference:
Elevations - Ground Surface: — Inner Casing: — Outer Casing:
Water Table: — Date: — Reference:
Remarks:

Depth of Samp.(ft)	Sample No.	Blows	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Strata	Well Construction	Health and Safety Screen	Comments	Elevation
55						NIR		
60								
65			62'-84' GRAVEL & light brown gravel and cobbles, subrounded-rounded, mixed origin variable in size (1/2"-73") in a sand matrix w/ little clay.				59'-62.5' BENTONITE SEAL	
70							62.5'-84' NO. 1 SILICA SAND BACK	
75			64-74' very poorly sorted sand and gravel. Sand = med.-coarse grain gravel = subrounded-subangular (pea size - 73").					
80							64-84' SCHEDULE 40 20 SLOT PVC SCREEN (2" ID)	
85			74-84' poor recovery. GRAVEL AND COBBLES. SAME AS ABOVE w/ little matrix.	End of borehole @ 84' bgs				
90								
95								
100								

Note: Not all portions of this form are applicable to all projects

11/94

Smith Environmental Technologies Corp. — Well Construction Log

Sheet: 1 of 3

Project: Olin Corporation — Well/Boring No.: GW-83D

Project No.: 00-7074-0102 — Date(s): 9/27/96 - 9/28/96 — Logged By: P. Newdeck

Well/Boring Location: Maple Meadow Brook Wetland

Drilling Method: Rotasonic — Drilling Contractor: Maher / Boart Longyear

Depth to Groundwater: 6.79' bgs — Date: 10/25/96 — Reference: TOIC

Elevations - Ground Surface: 79.9' msl — Inner Casing: 87.38' msl — Outer Casing: 87.76' msl

Water Table: 80.49' msl — Date: 10/25/96 — Reference: TOIC

Remarks: NIR: No instrument response

Depth of Samp.(ft)	Sample No.	Blows	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Strata	Well Construction	Health and Safety Screen (CGI)	Comments	Elevation
5			0-4' BGS (100% RECOVERY) V. DK BRWN ORGANIC RICH MATERIAL. MUCK			NIR	8' protective steel casing 7.8' bgs to ≈ 30' bgs Schedule 40 (2" ID) PVC riser = 0-110.8' bgs	
10			4-14' MUCK SAME AS ABOVE				0-110' bgs - cement/grout mix	
15			14-24' MUCK SAME AS ABOVE DOWN TO AN OLIVE GRAY SOFT ORGANIC RICH SILT. *TIP OF BIT COATED W/ DK GRAY SAND.					
20								
25								
30			24-34' (75% REC.) PH=5 SAND DK. GRAY, WELL SORTED V. FINE GRAIN SAND GRADING DOWN TO A LIGHT GRAY WELL SORTED, FINE GRAIN SAND W/ SOME TAN MOTTLES					
35			34-44' (75% REC.) PH=5 SAND MIX OF V. FINE, TAN SAND AND FINE GRAIN LT GRAY SAND GRADING DOWN TO A V. FINE GRAIN TAN SAND W/ MOTTLES OF YELLOW ORANGE SAND.					
40								
45			44-55' (100% REC.) PH=6 V. FINE GRAIN, WELL SORTED LIGHT BROWN, TAN MIX OF SAND					
50								

Note: Not all portions of this form are applicable to all projects — 11/94

Smith Environmental Technologies Corp. — Well Construction Log

Sheet: 2 of 3

Project: Olin Corporation — Well/Boring No.: GW-83D
Project No.: 00-7074-0102 — Date(s): — Logged By: P. Newdeck
Well/Boring Location: Maple Meadow Brook Wetland
Drilling Method: Rotasonic — Drilling Contractor: Maher
Depth to Groundwater: — Date: — Reference:
Elevations - Ground Surface: — Inner Casing: — Outer Casing:
Water Table: — Date: — Reference:
Remarks:

Depth of Samp.(ft)	Sample No.	Blows	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Strata	Well Construction	Health and Safety Screen	Comments	Elevation
55			SAND			NIR	SCHEDULE 40 2" ID PVC RISER	
60			54-64' SAND SAME AS ABOVE				0' - 110.8' 0-100' bgs: cement/grout mix	
65								
70			64-74' (<50% REC) GRAVEL - SUBROUNDED MIXED ORIGIN, VARIABLE SIZE ('4" - 7 4")					
75			NOTE - very fine sand within but probably wash from above since casing was advanced from [illegible] bgs.)					
80			74-84' GRAVEL/COBBLES W/ BROWN, CLAYEY COARSE SAND. GRAVEL = SUBROUNDED, MIXED ORIGIN (1"-7 4") IN SIZE (smaller gravel held together by compacted dk brown/black micaceous silt.					
85								
90			84-94' (75% REC'V) gravel - same as above					
95								
100			94-104' (100%) pH=6 TOP 2' = olive green clayey silt. w/ some subrounded - subangular pea size gravel. BOTTOM 8' = grey green gravel + cobbles (subrounded/angular) suspended in a clayey sand. gravel size increases w/ depth					

Note: Not all portions of this form are applicable to all projects

11/94

Smith Environmental Technologies Corp. — Well Construction Log

Sheet: 3 of 3

Project: Olin Corporation — Well/Boring No.: GW-830

Project No.: 00-7074-0102 — Date(s): — Logged By: P. Newdeck

Well/Boring Location: Maple Meadow Brook Wetland

Drilling Method: Rotasonic — Drilling Contractor: Maher

Depth to Groundwater: — Date: — Reference:

Elevations - Ground Surface: — Inner Casing: — Outer Casing:

Water Table: — Date: — Reference:

Remarks:

Depth of Samp.(ft)	Sample No.	Blows	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Strata	Well Construction	Health and Safety Screen	Comments	Elevation
105						NIR	100'-105.4' Bentonite plug.	
			104-114 (100%) gray green silt and gravel. silt has little clay & fine grain sand. gravel content varies					
110			more abundant @ top of profile (pea size > 3" diam) but less abundant @ bottom of profile				NO. 0 SILICA SAND PACK 105.4-110.8'	
115			114'-117' light grey gravel (same as above) w/ more angular rock @ bottom of profile				110.8'-120.8'	
120			117'-119' gray clayey silt. w/ pea sized angular rock				10 SLOT SCHEDULE 40 2" ID SCREEN	
125			119-120 - V. compacted silt light grey w/ angular pieces of rock.				Bottom of borehole @ 120.8' bgs	
130								
135			*Driller states we hit rock @ 114-116! Believes sample retrieved from borehole is pulverized rock Mixed w/ drilling fluids. Becomes an extremely compact clay.					
140								
145								
150								

Note: Not all portions of this form are applicable to all projects

11/94

Smith Environmental Technologies Corp. — Well Construction Log

Sheet: 1 of 1

Project: Olin Corporation — Well/Boring No.: GW-84-S

Project No.: 00-7074-0102 — Date(s): 11-11-96 — Logged By: E. PINTO

Well/Boring Location: Maple Meadow Brook Wetland

Drilling Method: Rotasonic — Drilling Contractor: Maher / BOART LONGYEAR

Depth to Groundwater: 7.43' bgs. — Date: 12-18-96 — Reference: TOIC

Elevations - Ground Surface: 79.4' msl — Inner Casing: 87.94' msl — Outer Casing: 88.39' msl

Water Table: 80.51' msl — Date: 12-18-96 — Reference: TOIC

Remarks: NIR: No Instrument Response

Depth of Samp. (ft)	Sample No.	Blows	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Strata	Well Construction	Health and Safety Screen CGI	Comments	Elevation
5			0-4' (rec=100%) PEAT - organic material (roots...) in a dk red-brown clay-silt. moist.			NIR	5/8" 6" Protective Steel Casing 8.99' a.g.s to 33' bgs.	
10			4-9' (rec=100%) muck continues...					
15			9-14' (rec=100%) muck continues.. root material diminish ~12'. silt-clay content increasing..		SCH. 40-2 INCH PVC RISER		pH=6-7	
20			14-19' (rec=100%) muck continues..					
25			19-24' (rec=100%); muck continues.				SCHEDULE 40 10-SLOT SCREEN 35-45' b.g.s.	
30			24-29' (rec=100%); muck continues..				2" PVC RISER +8.54 - 35' b.g.s.	
35			29-34' (rec=80%); SILTY-CLAY at 30', grey-brown, cohesive and sticky, trace mica.				No 1 SAND PACK 32-45' b.gs.	
40			32' - fine-to-med, grey to-brown, sand, some coarse sands, subrounded to angular, trace cobbles from 31.0-32.0.		10-SLOT SCREEN / NO. 1 SAND		BENTONITE SEAL 30-32'.	
45			34-39' (rec=80%); coarse sands and gravel to 38', some poorly sorted med sands., grey-green.					
50			39-45' (40%) - mod. well sorted fine sand w/ little silt, slightly cohesive, red-brown grading to tan, trace mica and opaques.. continue to 45'. EOB!					

Note: Not all portions of this form are applicable to all projects

11/94

Smith Environmental Technologies Corp. — Well Construction Log

Sheet: 1 of 2

Project: Olin Corporation — Well/Boring No.: GW-84-M

Project No.: 00-7074-0102 — Date(s): 11-11-96 — Logged By: E. PINTO

Well/Boring Location: Maple Meadow Brook Wetland

Drilling Method: Rotasonic — Drilling Contractor: Maher - BOART LONGYEAR

Depth to Groundwater: 7.64' bgs — Date: 12-18-96 — Reference: TOIC

Elevations - Ground Surface: 79.4 msl — Inner Casing: 88.17' msl — Outer Casing: 88.46' msl

Water Table: 80.53' msl — Date: 12-18-96 — Reference: TOIC

Remarks: NIR: No Instrument Response

Depth of Samp.(ft)	Sample No.	Blows	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Strata	Well Construction	Health and Safety Screen CGI	Comments 6 5/8" Protective Steel Casing 9.06' a.g.s. to 33' b.g.s.	Elevation
5			0-4' CORE (REC=100%) PEAT- humus organic matter in a red-brown silty matrix, moist.			NIR		
10			4-9' core (rec=100%) muck continues... silty-clay content increasing downward.					
15			9-14' core (rec=100%) at 10' start silty-clay, red-brown, some organic matter stick yand cohesive..				pH~6	
20			14-19 core (rec=100%) muck continuing as silty-clay, red-brown, some organic fibers..		2 INCH PVC RISER			
25			19-24 core (rec=100%) continuing					
30			24-29 core (rec=100%) at 26.5' muck continues but organic roots much less evident...		SCH. 40 -			
35			29-34 core (rec=100%) at 30' SAND, fine-to-medium, light-grey, angular grains, trace opaques, mod. well sorted.					
40			34-39 core (rec=50%) fine-grained light-grey sand continues, trace-to little medium and coarse sands, opaques.					
45			39-44' core (rec=100%) sand continues				pH~7.	
50			44-49' core (rec=80%) sand continues., gravels at 46.5', reddish-brown, poorly sorted, wet, predominantly fine-to med to 47.5'.					

Note: Not all portions of this form are applicable to all projects

11/94

Smith Environmental Technologies Corp. — Well Construction Log

Sheet: 2 of 2

Project: Olin Corporation — Well/Boring No.: GW- 84-M
Project No.: 00-7074-0102 — Date(s): — Logged By
Well/Boring Location: Maple Meadow Brook Wetland
Drilling Method: Rotasonic — Drilling Contractor: Maher - BOART LONGYEAR
Depth to Groundwater: — Date: — Reference:
Elevations - Ground Surface: — Inner Casing: — Outer Casing:
Water Table: — Date: — Reference:
Remarks:

Depth of Samp.(ft)	Sample No.	Blows	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Strata	Well Construction	Health and Safety Screen CGI	Comments	Elevation
55			at 47.5' fine grained sand- light-grey, little opaques, trace mica..			NIR		
60			54-59' Core (rec = 50%). SANDY-SILT - with some fine-grained sands, grey, little opaques, wet.					
65			59-64 core (rec = 80%) at 64' CLAYEY-SILT - sticky, wet, grey, mottling of dk. brown.				pH = ~6-7	
70			64-69 core (rec = 80%) at 67→68' fine-to-med. sand w/gravels and coarse sands, little opaquer and mica, angular.		NO 1 SAND / 10 SLOT SCREEN			
75			69-75 core (rec = 80%) at 68' - fine to med sand, angular, some mica flakes, trace opaques, light grey.				SCHEDULE 40	
80			END OF BOREHOLE @ 75' b.g.s.				10-SLOT SCREEN 60-75' b.g.s.	
85							2" PVC RISER +8.77' a.g.s. - 60' b.g.s.	
90							No. 1 SAND PACK 58- 75' b.g.s	
95							BENTONITE SEAL 56- 58' b.g.s.	
100								

Note: Not all portions of this form are applicable to all projects

11/94

Smith Environmental Technologies Corp. — Well Construction Log

Sheet: 1 of 3

Project: Olin Corporation — Well/Boring No.: GW- 84D
Project No.: 00-7074-0102 — Date(s): 11-08-96 — Logged By: E. PINTO
Well/Boring Location: Maple Meadow Brook Wetland
Drilling Method: Rotasonic — Drilling Contractor: Maher / BOART LONG YEAR
Depth to Groundwater: 7.12' bgs. — Date: 12-18-96 — Reference: TOIC
Elevations - Ground Surface: 79.4 msl — Inner Casing: 87.61 — Outer Casing: 88.19
Water Table: 80.49' msl — Date: 12-18-96 — Reference: TOIC
Remarks: NIR: No Instrument Response

Depth of Samp.(ft)	Sample No.	Blows	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Strata	Well Construction	Health and Safety Screen CGI	Comments	Elevation
5			PEAT - dk brown to reddish-brown organic roots and fibers in a silt matrix, trace fine sands			NIR	6 5/8" Protective Steel Casing - 8.8'ags to 33' bgs. 0-4' = 100% RECOVERY.	
10			PEAT continues, wet				4-9' = 100%	
15			PEAT continuing .. silt and clay content increasing, some plasticity, wet.		6" SCH. 40 - 2 INCH PVC RISER		9-14' = 90%	
20			PEAT continues				14-19' = 90%	
25			PEAT continues				19-24' = 90%	
30			PEAT continues				24-29' = 90%	
35			SAND (33') well sorted fine to v. fine sand., grey-to tan with trace mica flakes and opaques.				29-33' = 90%	
40			well sorted silty sand continues, tan.				33-39' = 80%	
45			silty sand continues.. grey-to tan.				39-44' = 20%	
50			SAND AND GRAVELS (49') - medium-to coarse				44-49' = 80%	

Note: Not all portions of this form are applicable to all projects. 11/94

Smith Environmental Technologies Corp. — **Well Construction Log**

Sheet: 2 of 3

Project: Olin Corporation — Well/Boring No.: GW-84D
Project No.: 00-7074-0102 — Date(s): — Logged By
Well/Boring Location: Maple Meadow Brook Wetland
Drilling Method: Rotasonic — Drilling Contractor: Maher
Depth to Groundwater: — Date: — Reference:
Elevations - Ground Surface: — Inner Casing: — Outer Casing:
Water Table: — Date: — Reference:
Remarks:

Depth of Samp.(ft)	Sample No.	Blows	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Strata	Well Construction	Health and Safety Screen CGI	Comments	Elevation
55			poorly sorted, red-brown, some fines, angular gravels. SILTY-SAND (50.5) - grey, some medium sand, little mica and opaques			NIR	49-54' = 80% rec.	
60			SAND (59') - medium-grained, grey, trace coarse sand, angular grains, wet.				54-59' = 50% rec.	
65			SAND AND GRAVEL (62.8) - medium-to coarse sand and gravel layer, angular to-subrounded				59-64' = 70% rec.	
70			SILTY-SAND (63.0) - grey-green, silty-fine sand, well sorted, v. slightly cohesive. SILTY-CLAYEY SAND (64.0) LIGHT-Brown, silty-clayey sand, some cohesiveness, wet, fine-grained sands.				64-69 = 80% rec.	
75			SAND (74) - medium-to coarse, reddish-brown, subrounded to angular, trace gravels, wet.				69-74 = 80% rec.	
80							74-78 = 80% rec.	
85			sand continues				78-83 = 75% rec. Bentonite Seal (84-87')	
90			BASAL TILL (87') - cobbles and fragments of assorted mafic mylonites, gabbros, quartz cobbles, feldspars, with some chlorite				83-88' = 20% rec.	
95			and quartz veining (mineralization), some fragments incorporated into light grey-green clay.		10 SLOT SCREEN		88-94' = recovery unknown.	
100			rocky fragments + cobbles in light green-grey silty-clay fabric continue. BEDROCK (100') - felsic mylonite, angular		#0.4 SAND		94-99' = 50% rec.	

Note: Not all portions of this form are applicable to all projects — 11/94

Smith Environmental Technologies Corp. — Well Construction Log

Sheet: 3 of 3

Project: Olin Corporation — Well/Boring No.: GW- 84D
Project No.: 00-7074-0102 — Date(s): — Logged By
Well/Boring Location: Maple Meadow Brook Wetland
Drilling Method: Rotasonic — Drilling Contractor: Maher
Depth to Groundwater: — Date: — Reference:
Elevations - Ground Surface: — Inner Casing: — Outer Casing:
Water Table: — Date: — Reference:
Remarks:

Depth of Samp.(ft)	Sample No.	Blows	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Strata	Well Construction	Health and Safety Screen CGI	Comments	Elevation
105			fragments, striations in rock fragments are linear and multi-directional, chlorite predominant,			NIR		
110			rock fragments show occassional laminar opaque mineral banding, fragments smaller due to grinding, occassional mafic mylonite fragments.		BENTONITE SLURRY		104-109' = 40%	
115							109-114 = 0%	
120							114-119 = 0%	
125			END OF BOREHOLE @ 119' bgs BEDROCK @ 100' b.g.s				10-SLOT SCREEN 90-105' bgs No1 SAND PACK 87-105' b.g.s Bentonite SEAL 84-87' b.g.s.	
130								
135								
140								
145								
150								

Note: Not all portions of this form are applicable to all projects

Smith Environmental Technologies Corp. — Well Construction Log

Sheet: 1 of 2

Project: Olin Corporation — Well/Boring No.: GW- 85M

Project No.: 00-7074-0102 — Date(s): 10/14/96 — Logged By P. Newdeck

Well/Boring Location: Maple Meadow Brook Wetland

Drilling Method: Rotasonic — Drilling Contractor: Maher / BOART LONGYEAR

Depth to Groundwater: none taken — Date: — — Reference: —

Elevations - Ground Surface: 79.1' bgs — Inner Casing: 87.13' msl — Outer Casing: 87.57' msl

Water Table: — — Date: — — Reference: —

Remarks: NIR = No instrument response

Depth of Samp.(ft)	Sample No.	Blows	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Strata	Well Construction	Health and Safety Screen (CGI)	Comments	Elevation
5			0-20' MUCK (100% REC) 0-15' DK BROWN, RICH IN ORGANIC MATERIAL FIRM.			NIR	STICK UP CONSTRUCTION/ ≈7.5' ags to 30' bgs = 6 5/8" protective steel casing	
10								
15			15-20' MUCK					
20			OLIVE GRAY - MORE PLIABLE - LESS FIRM. ORGANIC MATERIAL PRESENT BUT NOT FIBROUS.				0-30' 6 5/8" OD PROTECT STEEL CASING.	
25			20-40' MUCK/SAND DRILLER ESTIMATES OUT OF MUCK ~ 28' BGS.					
30			@ ~30' SAND OLIVE GRAY, WELL SORTED, FINE SAND GRADING DOWN TO A COARSE-MED GRAIN SAND W/					
35			PEA GRAVEL (BOTTOM 1' CONSISTS OF 1/2 THE COARSER MATERIAL DESCRIBED ABOVE)				0-36' CEMENT/ BENTONITE GROUT	
40			@ ~36' LENSE (6" THICK) OF MED GRAY, WELL SORTED SILT.				36-40' BGS BENTONITE PLUG	
45			40-44' SAND → GRAVEL (100% REC) SAME SEQUENCE DESCRIBED ABOVE FINE SAND GRADING DOWN TO COARSER MATERIAL				40-64' NO. 0 SILICA SANDPACK	
50			44+ SEE PAGE 2					

Note: Not all portions of this form are applicable to all projects — 11/94

Smith Environmental Technologies Corp. — Well Construction Log

Sheet: 2 of 2

Project: Olin Corporation — Well/Boring No.: GW-85M

Project No.: 00-7074-0102 — Date(s): 10/14/96 — Logged By: P. Newdeck

Well/Boring Location: Maple Meadow Brook Wetland

Drilling Method: Rotasonic — Drilling Contractor: Maher / BOART LONGYEAR

Depth to Groundwater: — Date: — Reference:

Elevations - Ground Surface: — Inner Casing: — Outer Casing:

Water Table: — Date: — Reference:

Remarks:

Depth of Samp.(ft)	Sample No.	Blows	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Strata	Well Construction	Health and Safety Screen (CGI)	Comments	Elevation
55			44-60' SAND-GRAVEL (<50% FINES) MED GRAY, POORLY SORTED, COARSE GRAIN SAND AND GRAVEL.			NIR	0-44' BGS 2" ID PVC SCHEDULE 40 PVC RISER	
60			GRAVEL RANGES FROM 1/4" - 1" DIAM. MIXED ORIGIN (ROUNDED - SUBA) AVG GRAVEL SIZE = 1/2" VERY CLEAN - NO CLAY.				44-64' BGS 10 SLOT, SCHEDULE 40 2" ID PVC SCREEN	
65			60-64 - SAND MED - COARSE SAND W/ SOME GRAVEL AVG SIZE - 1/2" (SUBR-SUBA) NO CLAY.					
70			END OF HOLE @ 64' BGS					
75								
80								
85								
90								
95								
100								

Note: Not all portions of this form are applicable to all projects

11/94

Smith Environmental Technologies Corp. — Well Construction Log

Sheet: 1 of 2

Project: Olin Corporation — Well/Boring No.: GW-85D
Project No.: 00-7074-0102 — Date(s): 10/13/96 — Logged By: P. Newdeck
Well/Boring Location: Maple Meadow Brook Wetland
Drilling Method: Rotasonic — Drilling Contractor: Maher / BOART LONGYEAR
Depth to Groundwater: None taken — Date: — Reference: —
Elevations - Ground Surface: 79.1' msl — Inner Casing: 87.24' msl — Outer Casing: 87.71' msl
Water Table: — — Date: — — Reference: —
Remarks: NIR - No instrument response

Depth of Samp.(ft)	Sample No.	Blows	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Strata	Well Construction	Health and Safety Screen (OGI)	Comments	Elevation
			0-3' MUCK - V. DK BROWN RICH IN ORGANICS			NIR	STICK UP CONSTRUCTION	
5			3-13' MUCK - SAME AS ABOVE (EASY DRILLING)				8+1 AGS = 30' bgs	
10							6 5/8" OD STEEL PROTECT. CASING 7.5'+AGS	
							2" ID PVC RISER	
15			13-23' MUCK - SAME AS ABOVE				3' AGS + 2' BGS	
			EXCEPT LESS ORGANIC MATERIAL OLIVE GRAY COLOR ELASTIC TEXTURE				10' SCHEDULE 40 PVC OUTER CASING	
20			(EASY DRILLING)				0-30' BGS	
							6 5/8" OD STEEL PROTECT. CASING.	
25			23-33' MUCK SAME AS ABOVE					
			EXCEPT W/ V. FINE SAND (MED GRAY)					
30			(EASY DRILLING)					
35			33-43' SAND (100% RECOVERY)					
			MED. GRAY, WELL SORTED, V. FINE GRAIN SAND W/ MICA FLAKES.					
40			@ ~40-42' MED-COARSE, SORTED SAND W/ PEA GRAVEL. (EASY DRILLING)					
45			43-53' SAND					
			FINE GRAIN, SORTED, MED GRAY SAND W/ LITTLE PEA GRAVEL AND FEW LARGER, (1/2") SUBANGULAR GRAVEL					
50								

Note: Not all portions of this form are applicable to all projects. 11/94

(EASY DRILLING)

Smith Environmental Technologies Corp. — Well Construction Log

Sheet: 2 of 2

Project: Olin Corporation — Well/Boring No.: GW-85D

Project No.: 00-7074-0102 — Date(s): — Logged By: P. Newdeck

Well/Boring Location: Maple Meadow Brook Wetland

Drilling Method: Rotasonic — Drilling Contractor: Maher / BOART LONGYEAR

Depth to Groundwater: JUST BELOW SURFACE — Date: 10/12/96 — Reference:

Elevations - Ground Surface: WATER — Inner Casing: — Outer Casing:

Water Table: — Date: — Reference:

Remarks: NIR = NO instrument response

Depth of Samp. (ft)	Sample No.	Blows	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Strata	Well Construction	Health and Safety Screen (CGI)	Comments	Elevation
						NIR		
55			**53-63' SAND & GRAVEL**				0'-79.5' BGS	
60			SAME AS ABOVE, BUT COARSENING DOWN TO A MED GRAY, MED-COARSE GRAIN, POORLY SORTED SAND & GRAVEL				SCHEDULE 40 2" ID PVC RISER	
			GRAVEL SIZE RANGES FROM PEA TO 3" DIAM. MIXED ORIGIN SUBROUND-SUBANGU. (EASY DRILL)				0-70' BGS CEMENT/BENTONITE GROUT	
65			**63-73' SILT** (50% RECOVERY)					
70			WET, MED. OLIVE GRAY HOMOGENOUS, SOFT, SILT (EASY DRILLING)					
							70-76' BGS BENTONITE SEAL	
75			**73-85' SAND & GRAVEL / GRAVEL & COBBLES**					
			73-78' SAME AS (53-63')				76'-90±' BGS NO. 0 SILICA SAND PACK	
80			78-83' GRAVEL & COBBLES W/ A CLAYEY SAND MATRIX. ~~POORLY SORTED, OLIVE GREEN,~~ SUBR-SUBA OF MIXED ORIGIN. (1/4" -> 4" DIAM) (DRILL SMOOTHLY)					
							79.6'-89.6' BGS SCHEDULE 40; 10 SLOT; 2" ID PVC SCREEN	
85			**83-85' GRAVEL & COBBLES** SAME AS ABOVE					
			85-95' ROCK (90% REC). 85-90' SILICEOUS MYLONITE ANGULAR FRAGMENTS IN @ MED GRAIN SALT & PEPPER MATRIX				93-95' 6' core of siliceous mylonite w/ fragmented pieces of mixed origin. Driller pushes casing to top of rock after drilling to 95'	
90			W/ TRACE ROUNDED COBBLES OF MIXED ORIGIN. 90'93' - PULVERIZED BLACK, MAFIC					
95			RK. W/ ANGULAR FRAG OF SILICEOUS MYLONITE. FEW ROUNDED PIECES.				90-95' SAND & ~~COLLASPED~~ MATERIAL @ BOTTOM OF BORE HOLE DUE TO CASING ADVANCE	
100			END OF HOLE ——— @ 95' Broke drilling rods @ 85' bgs, 90' bgs, 93' bgs					

Note: Not all portions of this form are applicable to all projects

11/94

Smith Environmental Technologies Corp. — Well Construction Log

Sheet: 1 of 1

Project: Olin Corporation — Well/Boring No.: GW-86S

Project No.: 00-7074-0102 — Date(s): 11-23-96 — Logged By E. PINTO

Well/Boring Location: Maple Meadow Brook Wetland

Drilling Method: Rotasonic — Drilling Contractor: Maher / BOART LONGYEAR

Depth to Groundwater: 7.41' bgs. — Date: 12-18-96 — Reference: TOIC

Elevations - Ground Surface: 77.9' msl — Inner Casing: 87.21' msl — Outer Casing: 87.87' msl

Water Table: 79.80' msl — Date: 12-18-96 — Reference: TOIC

Remarks: NIR: No Instrument Response

Depth of Samp.(ft)	Sample No.	Blows	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Strata	Well Construction	Health and Safety Screen CGI	Comments 8" Protective Steel Casing +9.3' a.g.s. to 10' b.g.s.	Elevation
5			PEAT - red-brown organic roots and fiber in silt-matrix, soft., moist, sulfurous odor.		2" I.D. PVC RISER	NIR	0-4 core = 100%	
10			SILTY-SAND (5') - brown, trace medium grained sand, wet		SCH. 40		4-9' core = 20% Bentonite Seal 9.0-12.0' bgs	
15			SAND (13') fine-grained, well sorted, trace mica, little silt, moist, light-grey.				9-14' core = 100%	
20			sand continues. silt content increasing		NO 1 SAND		14-19' core = 100%	
25			SANDY-SILT (22-23'), light-grey, wet, cohesive SILTY-SAND (23') light grey, wet, mod. well sorted		10-SLOT SCREEN		19-25' core = 100%	
30			END OF BOREHOLE 25' b.g.s.				SCHEDULE 40 10-SLOT 2" ID. WELL SCREEN 14.5-24.5' bgs. No 1 SAND PACK 12-25' bgs BENTONITE SEAL 9-12' bgs.	
35								
40								
45								
50								

Note: Not all portions of this form are applicable to all projects

11/94

Smith Environmental Technologies Corp. — Well Construction Log

Sheet: 1 of 2

Project: Olin Corporation — Well/Boring No.: GW-86-M

Project No.: 00-7074-0102 — Date(s): 11-22-96 — Logged By: E. PINTO

Well/Boring Location: Maple Meadow Brook Wetland

Drilling Method: Rotasonic — Drilling Contractor: Maher / BOART LONGYEAR

Depth to Groundwater: 7.30' bgs. — Date: 12-18-96 — Reference: TOIC

Elevations - Ground Surface: 97.9'msl — Inner Casing: 87.16'msl — Outer Casing: 87.66'msl

Water Table: 79.86' m.s.l — Date: 12-18-96 — Reference: TOIC

Remarks: NIR; No Instrument Response

Depth of Samp.(ft)	Sample No.	Blows	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Strata	Well Construction	Health and Safety Screen CGI	Comments 8" protective Steel Casing - 9.8'a.g.s to 10' b.g.s	Elevation
5			PEAT-red-brown silt w/ organic roots and fibers, sulfurous odor, moist			NIR	0-4' core = 100%	
10			SAND (6') - fine-grained, well sorted, light brown, little silt, moist.				4-9' core = 100%	
15			color change to light-grey at 10'.. fining downward. SILTY-SAND (14') lt grey to brown, fine-grained sands, some plasticity, wet		SCH. 40 2" I.D. PVC RISER		9-14' core = 100%	
20			light-grey silty-sand continues..				14-19' core = 20%	
25							19-24' core = 100%	
30			SAND (28') fine-grained w/ some med. sand, lt grey, moist, trace mica				24-29' core = 100%	
35			SILTY SAND (29') silty fine-grained sand with possible clay, wet, cohesive				29-34' core = 100%	
40			silty sand continues				34-39' core = 0%	
45			med. brown silty-sand continues., trace med. sand and mica flakes SAND (44') medium-grained, some fine-grained sands, brown, moderately well-sorted, moist, trace gravel.				BENTONITE SEAL (41-44') 39-44' core = 30%	
50			SAND AND GRAVELS (47') - medium- to coarse sands w/ coarse gravel and				44-49' core = 100%	

Note: Not all portions of this form are applicable to all projects

11/94

Smith Environmental Technologies Corp. — Well Construction Log

Sheet: 2 of 2

Project: Olin Corporation — Well/Boring No.: GW-86M

Project No.: 00-7074-0102 — Date(s): — Logged By: E PINTO

Well/Boring Location: Maple Meadow Brook Wetland

Drilling Method: Rotasonic — Drilling Contractor: Maher

Depth to Groundwater: — Date: — Reference:

Elevations - Ground Surface: — Inner Casing: — Outer Casing:

Water Table: — Date: — Reference:

Remarks:

Depth of Samp.(ft)	Sample No.	Blows	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Strata	Well Construction	Health and Safety Screen CGI	Comments	Elevation
55			mica flakes, gravels subrounded to angular. SAND (51') - fine- to medium grained, mod. well sorted, light grey, trace coarse sand, trace gravels		10-SLOT screen	NIR	49-54' core = 90%	
60							54-57' core = 100%	
65			medium sand w/ trace fine-grained, and trace gravels continue.. SAND AND GRAVEL (64') - medium- to coarse grained sands and subrounded gravels, light-grey, wet				57-62' core = 100% 62-67' core = 100%	
70			SAND (66') - medium-grained, light-grey, trace gravel,					
75			END OF BOREHOLE @ 67' b.g.s.				Schedule 40 10-SLOT PVC Screen 47-62' b.g.s.	
80							No 1. Sand Pack 44-67' b.g.s. Bentonite Seal 41-44' b.g.s.	
85								
90								
95								
100								

Note: Not all portions of this form are applicable to all projects

11/94

Smith Environmental Technologies Corp. — Well Construction Log

Sheet: 1 of 2

Project: Olin Corporation — Well/Boring No.: GW-86D

Project No.: 00-7074-0102 — Date(s): 11-20-96 — Logged By: E. PINTO

Well/Boring Location: Maple Meadow Brook Wetland

Drilling Method: Rotasonic — Drilling Contractor: Maher / BOART LONGYEAR

Depth to Groundwater: 6.90' bgs. — Date: 12-18-96 — Reference: TOIC

Elevations - Ground Surface: 77.9' msl. — Inner Casing: 86.76' msl — Outer Casing: 87.12' msl

Water Table: 79.86' m.s.l — Date: 12-18-96 — Reference: TOIC

Remarks: NIR: No Instrument Response

Depth of Samp.(ft)	Sample No.	Blows	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Strata	Well Construction	Health and Safety Screen CGI	Comments 8" Protective Steel Casing 9.2' ags. to 10' b.g.s.	Elevation
5			PEAT - dk-brown organic material, roots, in some silt matrix, sulfurous odor on breaking., spongy...			NIR	0-4 (100%)	
10			SAND (5') - fine-grained, well sorted, light brown grading to light grey., trace mica flakes, moist.				4-9' (100%)	
15			same, color change from light grey-to greenish-grey ~13', wet.				9-14' (100%) pH = 6-7	
20			brown, silty-fine sand, little medium, wet.		4" ID. PVC RISER		14-19' (20%)	
25			same., color change at 19' to green-grey. Increasing silt % at 23.5', slightly cohesive				19-24' (95%)	
30			silty-fine sand continues.. grey-green		2 INCH SCH 40 -		24-29' (100%)	
35			same-, MEDIUM SAND (34') - greenish-grey to				29-34' (100%)	
40			brown, with some fine sand., little coarse, trace mica flakes., gravel AND coarse sands increase to some at 38'., gravels subrounded-to-angular.				34-39' (100%)	
45			med. sand continues.. w/ some coarse gravel absent., fining downwards.				39-44' (100%)	
50			SAND + GRAVELS (47') - poorly sorted med., grey-green sand w/ cobbles and coarse sands				44-49' (90%)	

Note: Not all portions of this form are applicable to all projects

11/94

Smith Environmental Technologies Corp. — Well Construction Log

Sheet: 2 of 2

Project: Olin Corporation — Well/Boring No.: GW- 86D
Project No.: 00-7074-0102 — Date(s): — Logged By:
Well/Boring Location: Maple Meadow Brook Wetland
Drilling Method: Rotasonic — Drilling Contractor: Maher
Depth to Groundwater: — Date: — Reference:
Elevations - Ground Surface: — Inner Casing: — Outer Casing:
Water Table: — Date: — Reference:
Remarks:

Depth of Samp.(ft)	Sample No.	Blows	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Strata	Well Construction	Health and Safety Screen CGI	Comments	Elevation
55			gravels subrounded, cobbles subrounded, color to green-grey at 52.5', no cobbles, trace gravels in med-to coarse sands at 52.5'			NIRV	49-54(100%)	
60			-greenish-grey med. sand w/ some coarse sands continue., gravel intensity increase to little.				54-59'(20%)	
65			same.				59-64(100%)	
70			COARSE SAND AND GRAVEL (66-67.5') subrounded-to-angular, moist, green-grey. SAND (67.5') fine-grained, mod. well sorted, trace silt and gravel., grey-green., moist.				64-69'(100%)	
75			well sorted fine-sand continues.				69-74'(100%) BENTONITE SEAL (73-77')	
80			BASAL TILL (77') - SAND AND GRAVELS embedded into a dk-brown clay matrix,				74-77'(?)	
85			gravels subrounded to angular., some mottling to clay matrix upon breakage.		10 SLOT SCREEN NO 1 SAND		77-82'(100%)	
90			BEDROCK (85') - felsic granitic-mylonite, coarse-grained, light-greenish to tan, some chlorite filled veins, angular porphyroclasts, quartz grains are angular "much of rock is crushed to fine white powder" j crumbled fragments, pinkish feldspathic clasts in rock as well.				82-87'(100%) 87-90'(100%)	
95							SCHEDULE 40 - 2" ID. 10-SLOTTED PVC SCREEN	
100			END OF BOREHOLE @ 90'				80-90' b.g.s No1 SAND PACK - 77-90' bgs Bentonite Seal - 73-77' bgs	

Note: Not all portions of this form are applicable to all projects

11/94

Smith Environmental Technologies Corp. — Well Construction Log

Sheet: 1 of 3

Project: Olin Corporation — Well/Boring No.: GW-87D

Project No.: 00-7074-0102 — Date(s): 11-21-96 — Logged By: E. PINTO

Well/Boring Location: Maple Meadow Brook Wetland

Drilling Method: Rotasonic — Drilling Contractor: Maher / BOART LONGYEAR

Depth to Groundwater: 7.55' bgs — Date: 12-18-96 — Reference: TOIC

Elevations - Ground Surface: 78.3' msl — Inner Casing: 87.45' msl — Outer Casing: 87.80' msl

Water Table: 79.90' msl — Date: 12-18-96 — Reference: TOIC

Remarks: NIR: No Instrument Response

Depth of Samp.(ft)	Sample No.	Blows	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Strata	Well Construction	Health and Safety Screen	Comments	Elevation
5			PEAT - reddish-brown organic fibers in a matrix of clayey-silt., "mushy", cohesive and sticky..			NIR	8" Protective Steel Casing - 9.5' ags. to 20' b.g.s. 0-5' (100%)	
10			PEAT continues..				5-10' (80%)	
15			PEAT continues..				10-15' (100%)	
20			diminished roots and organic material color changing to lighter brown to brown. SAND (18.5') fine-grained, mod. well-sorted, dk. grey., trace med. to coarse		2 INCH I.D. PVC RISER		15-20' (100%)	
25			sands and silt, slightly cohesive, moist V. well-sorted fine sands, light-grey in color (22').		SCH 40 -		pH=7 at 19'. 20-25' (100%)	
30							25-30' (0%)	
35							30-35' (0%)	
40			light-grey fine sands continue MEDIUM-SAND (39'), dk-grey, trace				35-40' (100%)	
45			gravel and fine sands., trace mica flakes FINE SAND (42'), mod. well sorted, lite grey, trace mica flakes and medium sand.				40-45' (100%)	
50			fine sand continues..				45-50' (50%)	

Note: Not all portions of this form are applicable to all projects

11/94

Smith Environmental Technologies Corp. — Well Construction Log

Sheet: 2 of 3

Project: Olin Corporation — Well/Boring No.: GW- 87D
Project No.: 00-7074-0102 — Date(s): — Logged By
Well/Boring Location: Maple Meadow Brook Wetland
Drilling Method: Rotasonic — Drilling Contractor: Maher
Depth to Groundwater: — Date: — Reference:
Elevations - Ground Surface: — Inner Casing: — Outer Casing:
Water Table: — Date: — Reference:
Remarks:

Depth of Samp.(ft)	Sample No.	Blows	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Strata	Well Construction	Health and Safety Screen CGI	Comments	Elevation
55			fine sand continues			NIR	50-55' (100%)	
60			fine sand continues				55-60' (90%)	
65			MEDIUM TO-COARSE SAND (62') - w/ gravel and cobbles, sub rounded to angular, wet, grey-green., some fines and trace thick flakes., coarse sand and gravel lens at 62.5-63.0'., poorly sorted.				60-65' (80%)	
70					2 INCH I.D. PVC RISER		65-70' (0%)	
75			FINE TO-MEDIUM SAND (70') - grey-green, mod. well sorted., trace coarse sand., moist.,				70-75' (80%)	
80			MEDIUM-SAND (75') - green-grey, w/ little coarse sand and gravel, wet, with cobble intensity increasing to little at 80'.				75-80' (?) pH= 6.7	
85			continue grey med. sand w/ some cobbles & gravel.		SCH. 40-		80-85' (?)	
90			medium sand continues				85-90' (100%)	
95			medium sand continues .. gravel intensity increasing.				90-95' (100%) Bentonite Seal 91-94' b.g.	
100			BASALT TILL (95') - gravels, cobbles and poorly sorted sands in a grey-blue clay. moist, angular gravel				95-100' (100%)	

Note: Not all portions of this form are applicable to all projects

11/94

Smith Environmental Technologies Corp. — Well Construction Log

Sheet: 3 of 3

Project: Olin Corporation — Well/Boring No.: GW-67D

Project No.: 00-7074-0102 — Date(s): — Logged By:

Well/Boring Location: Maple Meadow Brook Wetland

Drilling Method: Rotasonic — Drilling Contractor: Maher

Depth to Groundwater: — Date: — Reference:

Elevations - Ground Surface: — Inner Casing: — Outer Casing:

Water Table: — Date: — Reference:

Remarks:

Depth of Samp. (ft)	Sample No.	Blows	Lithologic Description (Material, USCS, Color, Density, Consistency, Other Modifiers, Hardness, Moisture)	Strata	Well Construction	Health and Safety Screen CGI	Comments	Elevation
			BEDROCK (104')					
105			Broken rock fragments and pulverized (rock); some rounded cobbles appear to be mafic mylonite, dk-green, aphanitic - driller unable to retrieve larger amt		10 SLOT SCREEN	NIR	TOUGH DRILLING AT 104-109' (0%)	
110			of core (32 attempts).; END OF BOREHOLE @ 109' b.g.s.				Schedule 40, 2" I.D. 10-SLOT screen - 97-107' bgs.	
115			Bedrock @ 104' b.g.s.				No. 1. SAND PACK - 94-107' bgs.	
120							Bentonite Seal - 91-94' bgs.	
125								
130								
135								
140								
145								
150								

Note: Not all portions of this form are applicable to all projects

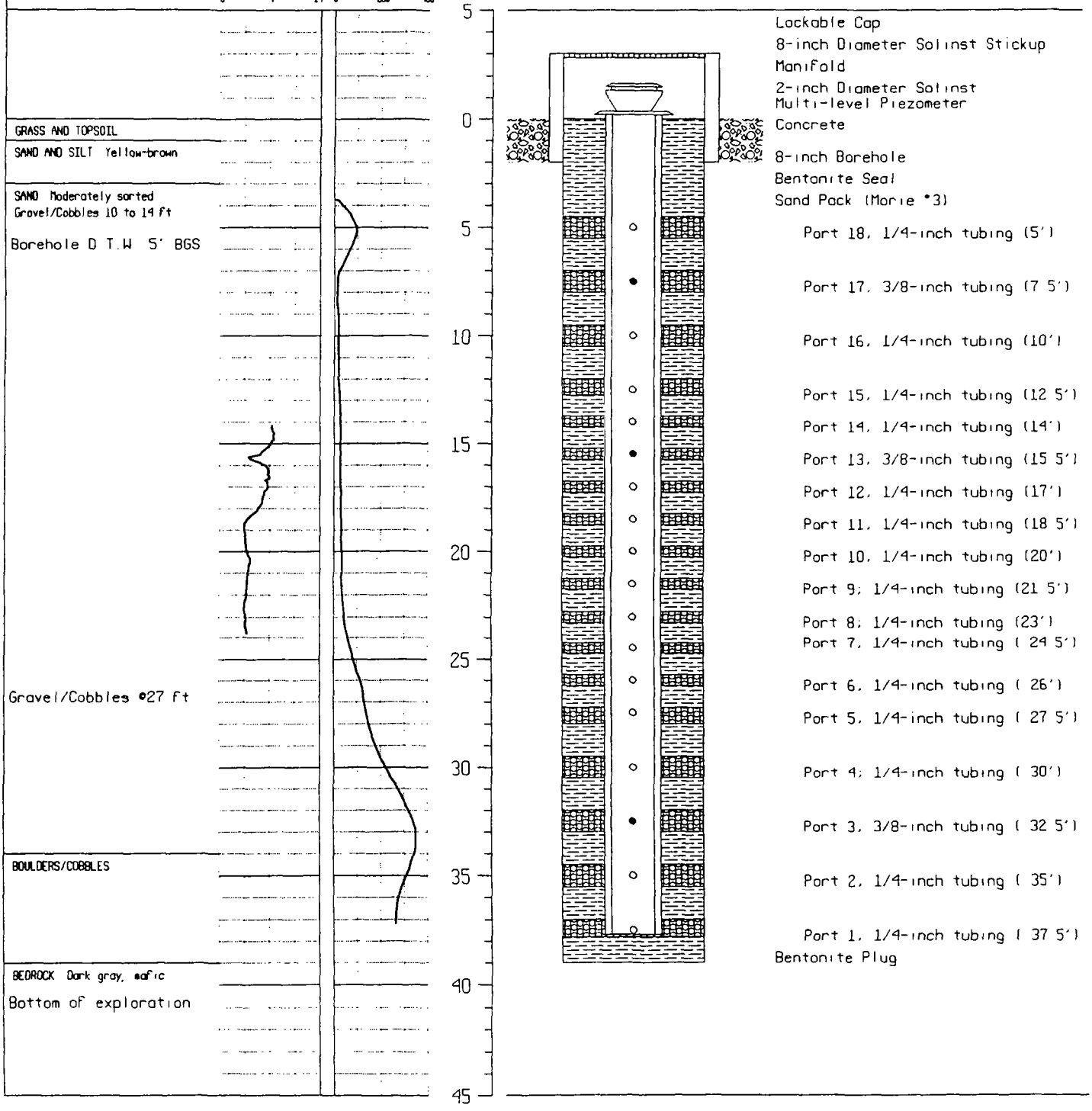
11/94

MULTI-LEVEL PIEZOMETER: MP-1

PIEZOMETER NO.: MP-1 | **PAGE: 1 OF 1**

PROJECT: OLIN, Wilmington MA		PROJECT NO.: 00-7074-0102	
LOCATION: Olin property near center of former lagoons	DATE(S) DRILLED: 03/01 to 3/04/96		
DRILLING CONTRACTOR: DL Maher	DRILLING METHOD: Dual-wall Barber		
SAMPLING METHODOLOGY: Cuttings		TOTAL DEPTH: 39 feet	
LOGGED BY: E. Perry		BORING DIA.: 8 inch	

REMARKS: pH profile from CPT-1; Conductivity from GW-36 inductance log

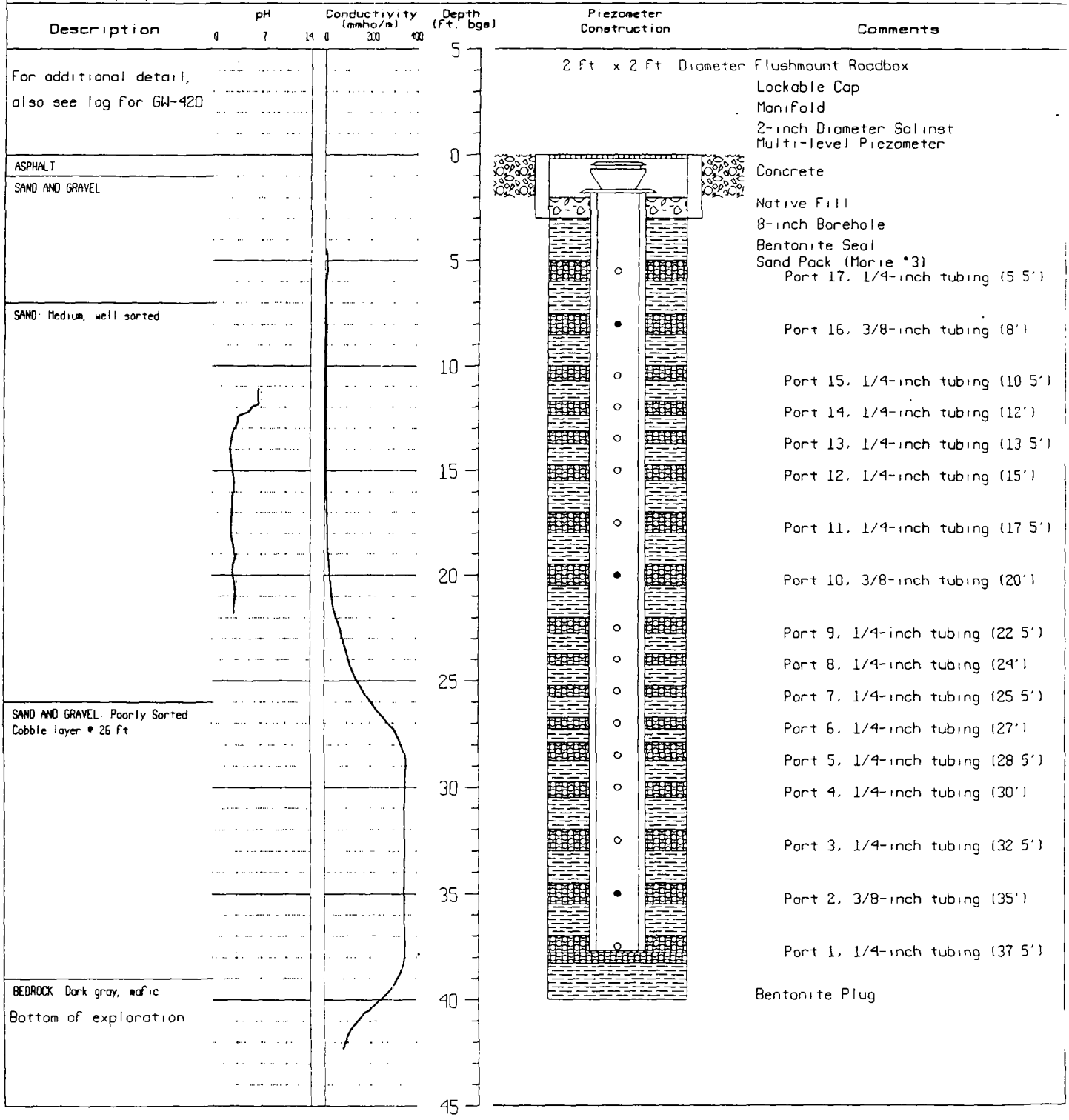


MULTI-LEVEL PIEZOMETER: MP-2

PIEZOMETER NO.: MP-2 | **PAGE:** 1 OF 1

PROJECT: OLIN, Wilmington MA	PROJECT NO.: 00-7074-0102
LOCATION: At Mulkerin Distributors near GW-42	DATE(S) DRILLED: 03/04 to 3/07/96
DRILLING CONTRACTOR: DL Maher	DRILLING METHOD: Dual-wall Barber
SAMPLING METHODOLOGY: Cuttings	TOTAL DEPTH: 41 feet
LOGGED BY: E. Perry	BORING DIA.: 8 inch

REMARKS: pH profile from CPT-2, Conductivity from GW-42D inductance log

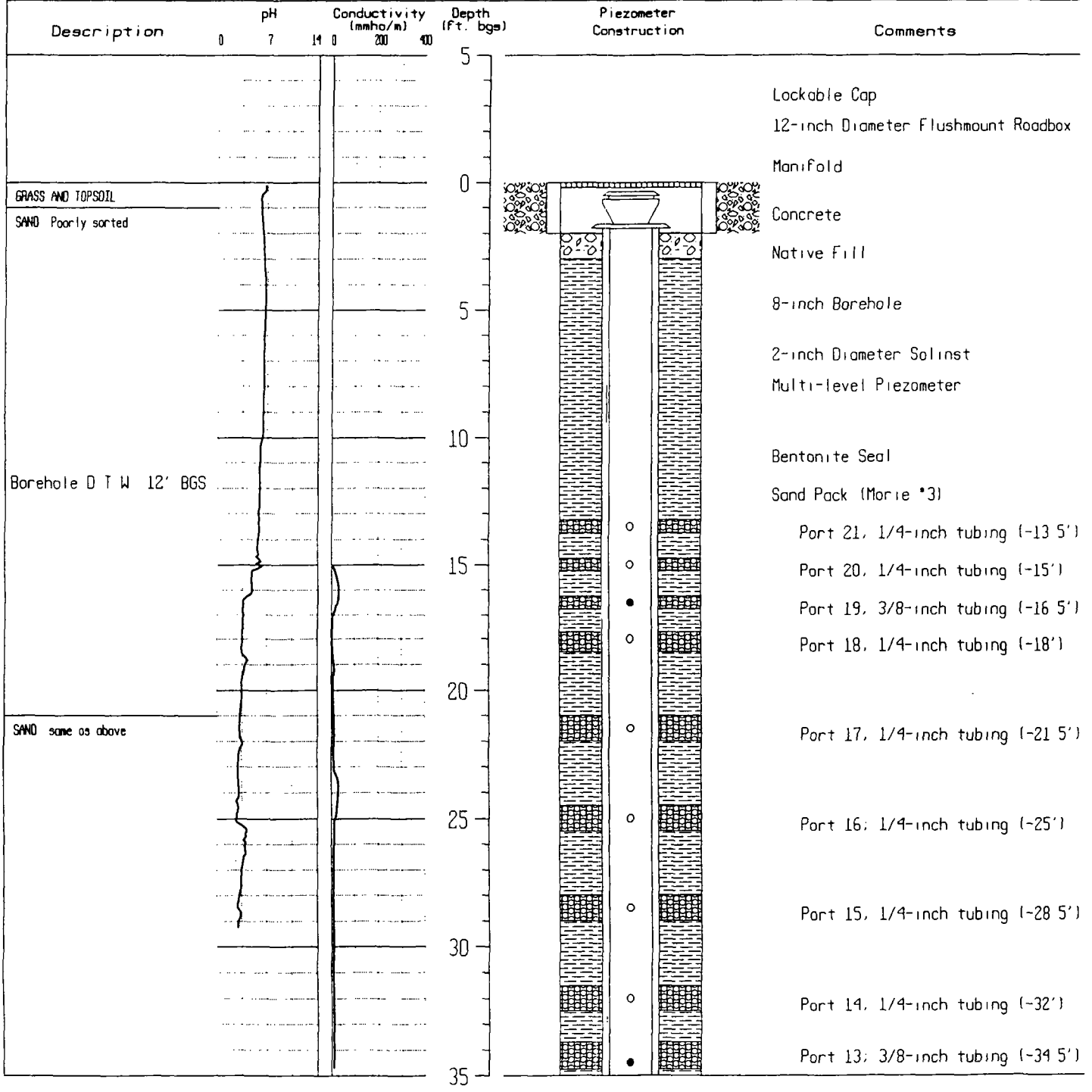


MULTI-LEVEL PIEZOMETER MP-3

PIEZOMETER NO.: MP-3 PAGE: 1 OF 2

PROJECT: OLIN, Wilmington MA		PROJECT NO.: 00-7074-0102
LOCATION: On Koch property up hill from GW-44	DATE(S) DRILLED:	03/11 to 3/14/96
DRILLING CONTRACTOR: DL Maher	DRILLING METHOD:	Dual-wall Barber
SAMPLING METHODOLOGY: Cuttings		TOTAL DEPTH: 67 feet
LOGGED BY: E. Perry		BORING DIA.: 8 inch

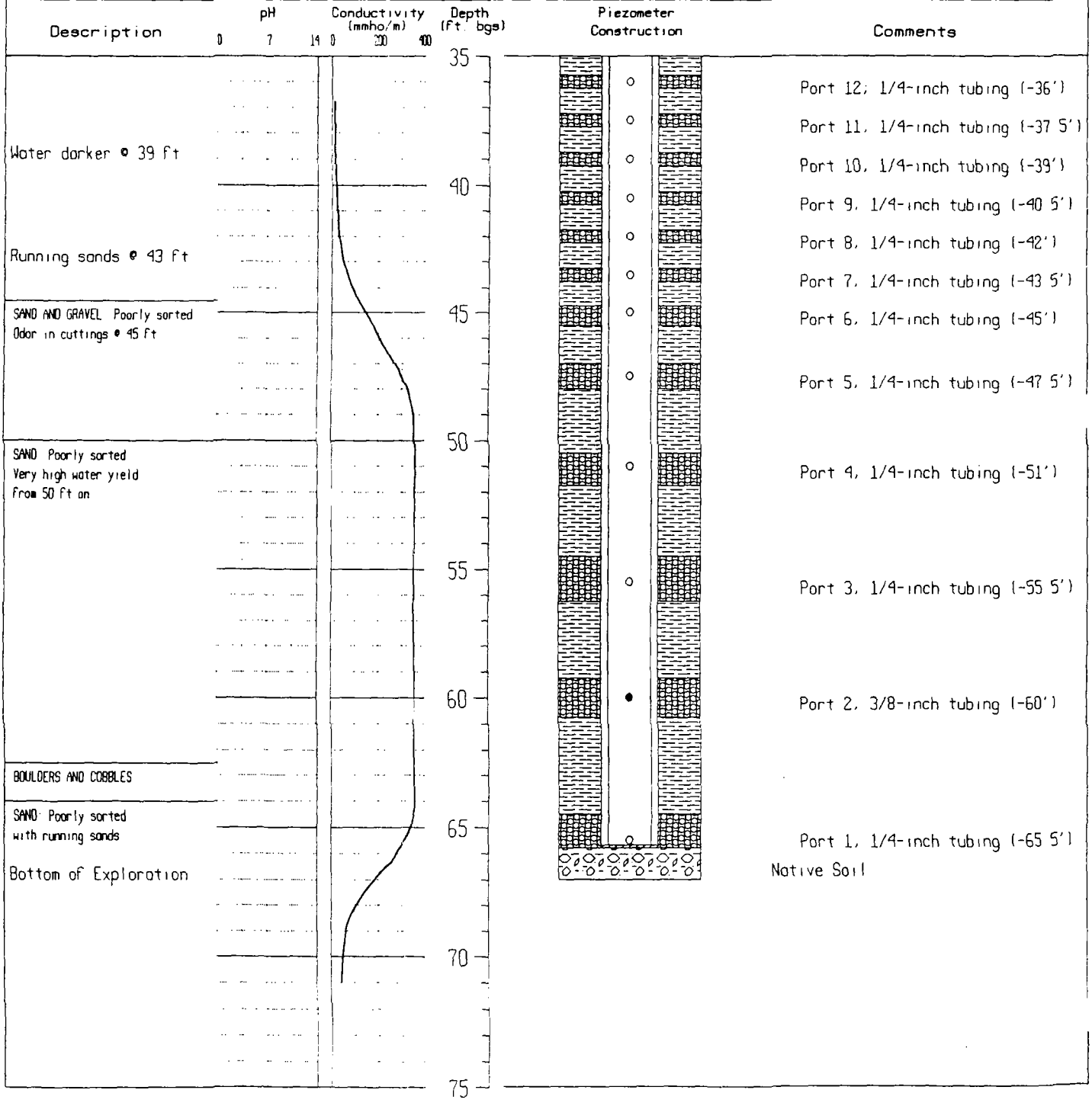
REMARKS: pH profile from CPT-4; Conductivity from GW-44D inductance log



MULTI-LEVEL PIEZOMETER MP-3

PIEZOMETER NO.: MP-3 PAGE: 2 OF 2

PROJECT: OLIN, Wilmington MA	PROJECT NO.: 00-7074-0102
LOCATION: On Koch property up hill from GW-99	DATE(S) DRILLED: 03/11 to 3/14/96
DRILLING CONTRACTOR: DL Maher	DRILLING METHOD: Dual-wall Barber
SAMPLING METHODOLOGY: Cuttings	TOTAL DEPTH: 67 feet
LOGGED BY: E. Perry	BORING DIA.: 8 inch
REMARKS: pH profile from CPT-4, Conductivity from GW-99D inductance log	



Appendix J

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APPENDIX J

SOUTH DITCH FLOW STUDY CALCULATIONS

APPENDIX J

South Ditch Flow Study Calculations

Olin Corporation
Wilmington, MA Facility

Flume	Width	Distance from flume 1	3-May-96 H2O Depth	3-May-96 Total Flow	21-May-96 H2O Depth	21-May-96 Total Flow	3-Jun-96 H2O Depth	3-Jun-96 Total Flow	18-Jun-96 H2O Depth	18-Jun-96 Total Flow
	(in)	(ft)	(ft)	(gpm)	(ft)	(gpm)	(ft)	(gpm)	(ft)	(gpm)
1	78	0	0.40	28.95	0.36	21.01	0.18	-4.85	0.20	-25.58
2	88	190	0.40	35.86	0.32	16.28	0.27	-12.42	0.14	-21.73
3	86	410	0.31	73.92	0.23	-4.22	0.07	2.25	0.02	NM
4	88	610	0.45	96.11	0.33	19.63	0.25	-7.01	0.01	NM
5	40	1150	0.39	79.81	0.33	49.37	0.29	2.17	0.23	NM

Flume Dimensions

	Meas. Pt.	Width	3-May-96 Velocity	3-May-96 Flow	21-May-96 Velocity	21-May-96 Flow	3-Jun-96 Velocity	3-Jun-96 Flow	18-Jun-96 Velocity	18-Jun-96 Flow
	(in)	(ft)	(ft/sec)	(gpm)	(ft/sec)	(gpm)	(ft/sec)	(gpm)	(ft/sec)	(gpm)
Flume 1	0									
	6	0.75	-0.02	-2.02	-0.02	-2.42	-0.02	-1.21	-0.06	-4.04
	12	0.75	-0.01	-1.35	-0.02	-2.42	-0.02	-1.21	-0.04	-2.69
	24	1.00	0.01	1.80	0.01	1.62	-0.03	-2.42	-0.04	-3.59
	36	1.00	0.04	6.58	0.02	3.23	-0.02	-1.62	-0.04	-3.59
	48	1.00	0.07	11.97	0.06	9.69	0.02	1.62	-0.05	-4.49
	60	1.00	0.08	13.76	0.06	9.69	0.02	1.62	-0.04	-3.59
	72	1.00	-0.01	-1.80	0.01	1.62	-0.02	-1.62	-0.04	-3.59
				28.95		**21.01**		**-4.85**		**-25.58**
Flume2	0									
	6	1.00	0.02	3.59	0.01	1.44	-0.02	-2.42	-0.02	-1.26
	18	1.00	0.07	13.17	0.07	10.05	0.00	0.00	-0.05	-3.14
	30	1.00	0.05	8.98	0.05	7.18	0.01	1.21	-0.05	-3.14
	42	1.00	0.08	13.76	0.04	5.75	-0.01	-1.21	-0.04	-2.51
	54	1.00	0.01	2.39	0.00	0.00	-0.03	-3.64	-0.05	-3.14
	66	1.00	-0.01	-2.39	-0.03	-4.31	-0.02	-2.42	-0.05	-3.14
	78	0.75	-0.02	-2.24	-0.02	-2.15	-0.02	-1.82	-0.06	-2.83
	84	0.58	-0.01	-1.40	-0.02	-1.68	-0.03	-2.12	-0.07	-2.57
				35.86		**16.28**		**-12.42**		**-21.73**

APPENDIX J

South Ditch Flow Study Calculations

Olin Corporation
Wilmington, MA Facility

Flume	Width	Distance from flume 1	3-May-96 H2O Depth	3-May-96 Total Flow	21-May-96 H2O Depth	21-May-96 Total Flow	3-Jun-96 H2O Depth	3-Jun-96 Total Flow	18-Jun-96 H2O Depth	18-Jun-96 Total Flow
	(in)	(ft)	(ft)	(gpm)	(ft)	(gpm)	(ft)	(gpm)	(ft)	(gpm)
1	78	0	0.40	28.95	0.36	21.01	0.18	-4.85	0.20	-25.58
2	88	190	0.40	35.86	0.32	16.28	0.27	-12.42	0.14	-21.73
3	86	410	0.31	73.92	0.23	-4.22	0.07	2.25	0.02	NM
4	88	610	0.45	96.11	0.33	19.63	0.25	-7.01	0.01	NM
5	40	1150	0.39	79.81	0.33	49.37	0.29	2.17	0.23	NM

Flume Dimensions

	Meas. Pt.	Width	3-May-96 Velocity	3-May-96 Flow	21-May-96 Velocity	21-May-96 Flow	3-Jun-96 Velocity	3-Jun-96 Flow	18-Jun-96 Velocity	18-Jun-96 Flow
	(in)	(ft)	(ft/sec)	(gpm)	(ft/sec)	(gpm)	(ft/sec)	(gpm)	(ft/sec)	(gpm)
Flume3	0			0.00						
	4	0.83	-0.02	-2.32	-0.06	-5.16	-0.02	-0.52		
	16	1.00	-0.01	-0.70	-0.06	-6.19	-0.01	-0.31		
	28	1.00	0.08	10.44	-0.02	-2.06	0.00	0.00		
	40	1.00	0.18	24.35	0.11	11.36	0.07	2.20		
	52	1.00	0.15	20.87	0.03	3.10	0.09	2.83		
	64	1.00	0.10	13.91	0.02	2.06	-0.01	-0.31		
	76	0.75	0.09	9.39	-0.04	-3.10	-0.03	-0.71		
	82	0.58	-0.03	-2.03	-0.07	-4.22	-0.05	-0.92		
				73.92		**-4.22**		**2.25**		
Flume4	0									
	6	1.00	-0.02	-4.04	-0.03	-4.44	-0.03	-3.37		
	18	1.00	0.07	13.46	0.02	2.96	-0.01	-1.12		
	30	1.00	0.10	19.52	0.04	5.92	0.01	1.12		
	42	1.00	0.10	20.20	0.07	10.37	0.00	0.00		
	54	1.00	0.12	23.56	0.03	4.44	0.00	0.00		
	66	1.00	0.10	20.20	0.02	2.96	0.00	0.00		
	78	0.75	0.04	5.55	0.00	0.00	-0.02	-1.68		
	84	0.58	-0.02	-2.36	-0.03	-2.59	-0.03	-1.96		
				96.11		**19.63**		**-7.01**		

APPENDIX J

South Ditch Flow Study Calculations

Olin Corporation
Wilmington, MA Facility

Flume	Width	Distance from flume 1	3-May-96 H2O Depth	3-May-96 Total Flow	21-May-96 H2O Depth	21-May-96 Total Flow	3-Jun-96 H2O Depth	3-Jun-96 Total Flow	18-Jun-96 H2O Depth	18-Jun-96 Total Flow
	(in)	(ft)	(ft)	(gpm)	(ft)	(gpm)	(ft)	(gpm)	(ft)	(gpm)
1	78	0	0.40	28.95	0.36	21.01	0.18	-4.85	0.20	-25.58
2	88	190	0.40	35.86	0.32	16.28	0.27	-12.42	0.14	-21.73
3	86	410	0.31	73.92	0.23	-4.22	0.07	2.25	0.02	NM
4	88	610	0.45	96.11	0.33	19.63	0.25	-7.01	0.01	NM
5	40	1150	0.39	79.81	0.33	49.37	0.29	2.17	0.23	NM

Flume Dimensions

	Meas. Pt.	Width	3-May-96 Velocity	3-May-96 Flow	21-May-96 Velocity	21-May-96 Flow	3-Jun-96 Velocity	3-Jun-96 Flow	18-Jun-96 Velocity	18-Jun-96 Flow
	(in)	(ft)	(ft/sec)	(gpm)	(ft/sec)	(gpm)	(ft/sec)	(gpm)	(ft/sec)	(gpm)
Flume5	0									
	4	0.67			0.03	2.96				
	12	0.83			0.15	18.51				
	24	1.00			0.13	19.25				
	36	0.83			0.07	8.64				
						49.37				
Flume5	0									
	6	1.08	0.08	15.41						
	20	1.17	0.22	45.44						
	34	1.08	0.10	18.96						
				79.81						
Flume5	0									
	4	0.67					0.00	0.00	-0.03	-2.06
	12	0.67					0.00	0.00	-0.03	-2.06
	20	0.50					0.01	0.65	-0.04	-2.06
	24	0.33					0.02	0.87	-0.04	-1.38
	28	0.50					0.01	0.65	-0.02	-1.03
	36	0.67					0.00	0.00	-0.03	-2.06
								2.17		**-10.67**

APPENDIX J

South Ditch Flow Study Calculations

Olin Corporation
Wilmington, MA Facility

Flume	Width	Distance from flume 1	12-Nov-96 H2O Depth	12-Nov-96 Total Flow	3-Dec-96 H20 Depth	3-Dec-96 Total Flow	7-Jan-97 H20 Depth	7-Jan-97 Total Flow	16-Apr-97 H20 Depth	16-Apr-97 Total Flow	30-Apr-97 H20 Depth	30-Apr-97 Total Flow
	(in)	(ft)	(ft)	(gpm)	(ft)	(gpm)	(ft)	(gpm)	(ft)	(gpm)	(ft)	(gpm)
1	78	0	0.6	-46.45	0.56	203.24	0.33	32.17	0.37	26.57	0.35	115.07
2	88	190	0.48	-89.77	0.56	198.82	0.39	31.32	0.33	35.30	0.35	43.99
3	86	410	0.220	9.71	0.46	200.23	0.25	26.56	0.25	50.77	0.25	47.13
4	88	610	0.66	-85.66	0.83	194.81	0.69	22.11	0.62	33.86	0.64	25.61
5	40	1150	0.39	25.67	0.56	236.90	0.38	49.65	0.43	77.20	0.43	86.21

Flume Dimensions

	Meas. Pt.	Width	12-Nov-96 Velocity	12-Nov-96 Flow	3-Dec-96 Velocity	3-Dec-96 Flow	7-Jan-97 Velocity	7-Jan-97 Flow	16-Apr-97 Velocity	16-Apr-97 Flow	30-Apr-97 Velocity	30-Apr-97 Flow
	(in)	(ft)	(ft/sec)	(gpm)	(ft/sec)	(gpm)	(ft/sec)	(gpm)	(ft/sec)	(gpm)	(ft/sec)	(gpm)
Flume 1	0											
	6	0.75	-0.07	-14.14	0.01	1.89	-0.04	-4.49	-0.03	-3.74	0.03	3.53
	12	0.75	-0.08	-16.16	0.05	9.47	0.14	15.71	-0.01	-1.25	0.04	4.71
	24	1.00	-0.05	-13.46	0.15	37.87	0.12	17.95	0.05	8.30	-0.04	-6.28
	36	1.00	0	0.00	0.16	40.39	0.06	8.98	-0.03	-4.98	0.36	56.55
	48	1.00	0	0.00	0.22	55.54	0.01	1.50	-0.05	-8.30	0.07	11.00
	60	1.00		0.00	0.22	55.54	-0.05	-7.48	0.26	43.18	-0.10	-15.71
	72	1.00	-0.01	-2.69	0.01	2.52		0.00	-0.04	-6.64	0.39	61.27
				-46.45		**203.24**		**32.17**		**26.57**		**115.07**
Flume2	0											
	6	1.00	-0.05	-10.77	0.08	20.20	0.05	8.66	0.03	4.44	0.01	1.57
	18	1.00	-0.03	-6.46	0.18	45.44	0.08	13.85	0.09	13.33	0.08	12.57
	30	1.00	-0.01	-2.15	0.24	60.59	0.11	19.05	0.08	11.85	0.08	12.57
	42	1.00	-0.05	-10.77	0.23	58.07	0.01	1.73	0.05	7.41	0.14	21.99
	54	1.00	-0.07	-15.08	0.06	15.15	0.00	0.00	0.01	1.48	-0.03	-4.71
	66	1.00	-0.1	-21.54	0.03	7.57	-0.01	-1.73	-0.01	-1.48	0.01	1.57
	78	0.75	-0.08	-12.93	-0.02	-3.79	-0.04	-5.20	0	0.00	0.01	1.18
	84	0.58	-0.08	-10.05	-0.03	-4.42	-0.05	-5.05	-0.02	-1.73	-0.03	-2.75
				-89.77		**198.82**		**31.32**		**35.30**		**43.99**

APPENDIX J

South Ditch Flow Study Calculations

Olin Corporation
Wilmington, MA Facility

Flume	Width	Distance from flume 1	12-Nov-96 H2O Depth	12-Nov-96 Total Flow	3-Dec-96 H20 Depth	3-Dec-96 Total Flow	7-Jan-97 H20 Depth	7-Jan-97 Total Flow	16-Apr-97 H20 Depth	16-Apr-97 Total Flow	30-Apr-97 H20 Depth	30-Apr-97 Total Flow
	(in)	(ft)	(ft)	(gpm)	(ft)	(gpm)	(ft)	(gpm)	(ft)	(gpm)	(ft)	(gpm)
1	78	0	0.6	-46.45	0.56	203.24	0.33	32.17	0.37	26.57	0.35	115.07
2	88	190	0.48	-89.77	0.56	198.82	0.39	31.32	0.33	35.30	0.35	43.99
3	86	410	0.220	9.71	0.46	200.23	0.25	26.56	0.25	50.77	0.25	47.13
4	88	610	0.66	-85.66	0.83	194.81	0.69	22.11	0.62	33.86	0.64	25.61
5	40	1150	0.39	25.67	0.56	236.90	0.38	49.65	0.43	77.20	0.43	86.21

Flume Dimensions

	Meas. Pt.	Width	12-Nov-96 Velocity	12-Nov-96 Flow	3-Dec-96 Velocity	3-Dec-96 Flow	7-Jan-97 Velocity	7-Jan-97 Flow	16-Apr-97 Velocity	16-Apr-97 Flow	30-Apr-97 Velocity	30-Apr-97 Flow
	(in)	(ft)	(ft/sec)	(gpm)	(ft/sec)	(gpm)	(ft/sec)	(gpm)	(ft/sec)	(gpm)	(ft/sec)	(gpm)
Flume3	0											
	4	0.83	-0.06	-4.94	-0.01	-1.71	-0.01	-0.94	-0.02	-1.87	-0.05	-4.68
	16	1.00	-0.02	-1.97	0.03	6.17	0.04	4.49	0	0.00	-0.02	-2.24
	28	1.00	0.04	3.95	0.18	37.03	0.05	5.61	0.09	10.10	0.07	7.85
	40	1.00	-0.01	-0.99	0.21	43.20	0.06	6.73	0.14	15.71	0.17	19.08
	52	1.00	0.06	5.92	0.24	49.37	0.10	11.22	0.13	14.59	0.10	11.22
	64	1.00	0.1	9.87	0.20	41.14	0.01	1.12	0.11	12.34	0.15	16.83
	76	0.75	0.01	0.74	0.17	26.23	-0.02	-1.68	0.03	2.52	0.02	1.68
	82	0.58	-0.05	-2.88	-0.01	-1.20		0.00	-0.04	-2.62	-0.04	-2.62
				9.71		**200.23**		**26.56**		**50.77**		**47.13**
Flume4	0											
	6	1.00	-0.04	-11.85	0.01	3.74	-0.02	-6.17	-0.02	-5.57	-0.07	-20.11
	18	1.00	-0.04	-11.85	0.04	14.96	0.01	3.09	0.01	2.78	0.01	2.87
	30	1.00	-0.03	-8.89	0.09	33.66	0.02	6.17	0.03	8.35	0.03	8.62
	42	1.00	-0.02	-5.92	0.11	41.14	0.02	6.17	0.03	8.35	0.05	14.36
	54	1.00	-0.03	-8.89	0.11	41.14	0.02	6.17	0.04	11.13	0.03	8.62
	66	1.00	-0.03	-8.89	0.11	41.14	0.02	6.17	0.03	8.35	0.02	5.75
	78	0.75	-0.07	-15.55	0.06	16.83	0.01	2.31	0.01	2.09	0.01	2.15
	84	0.58	-0.08	-13.82	0.01	2.18	-0.01	-1.80	-0.01	-1.62	0.02	3.35
				-85.66		**194.81**		**22.11**		**33.86**		**25.61**

APPENDIX J

South Ditch Flow Study Calculations

Olin Corporation
Wilmington, MA Facility

Flume	Width	Distance from flume 1	12-Nov-96 H2O Depth	12-Nov-96 Total Flow	3-Dec-96 H20 Depth	3-Dec-96 Total Flow	7-Jan-97 H20 Depth	7-Jan-97 Total Flow	16-Apr-97 H20 Depth	16-Apr-97 Total Flow	30-Apr-97 H20 Depth	30-Apr-97 Total Flow
	(in)	(ft)	(ft)	(gpm)	(ft)	(gpm)	(ft)	(gpm)	(ft)	(gpm)	(ft)	(gpm)
1	78	0	0.6	-46.45	0.56	203.24	0.33	32.17	0.37	26.57	0.35	115.07
2	88	190	0.48	-89.77	0.56	198.82	0.39	31.32	0.33	35.30	0.35	43.99
3	86	410	0.220	9.71	0.46	200.23	0.25	26.56	0.25	50.77	0.25	47.13
4	88	610	0.66	-85.66	0.83	194.81	0.69	22.11	0.62	33.86	0.64	25.61
5	40	1150	0.39	25.67	0.56	236.90	0.38	49.65	0.43	77.20	0.43	86.21

Flume Dimensions

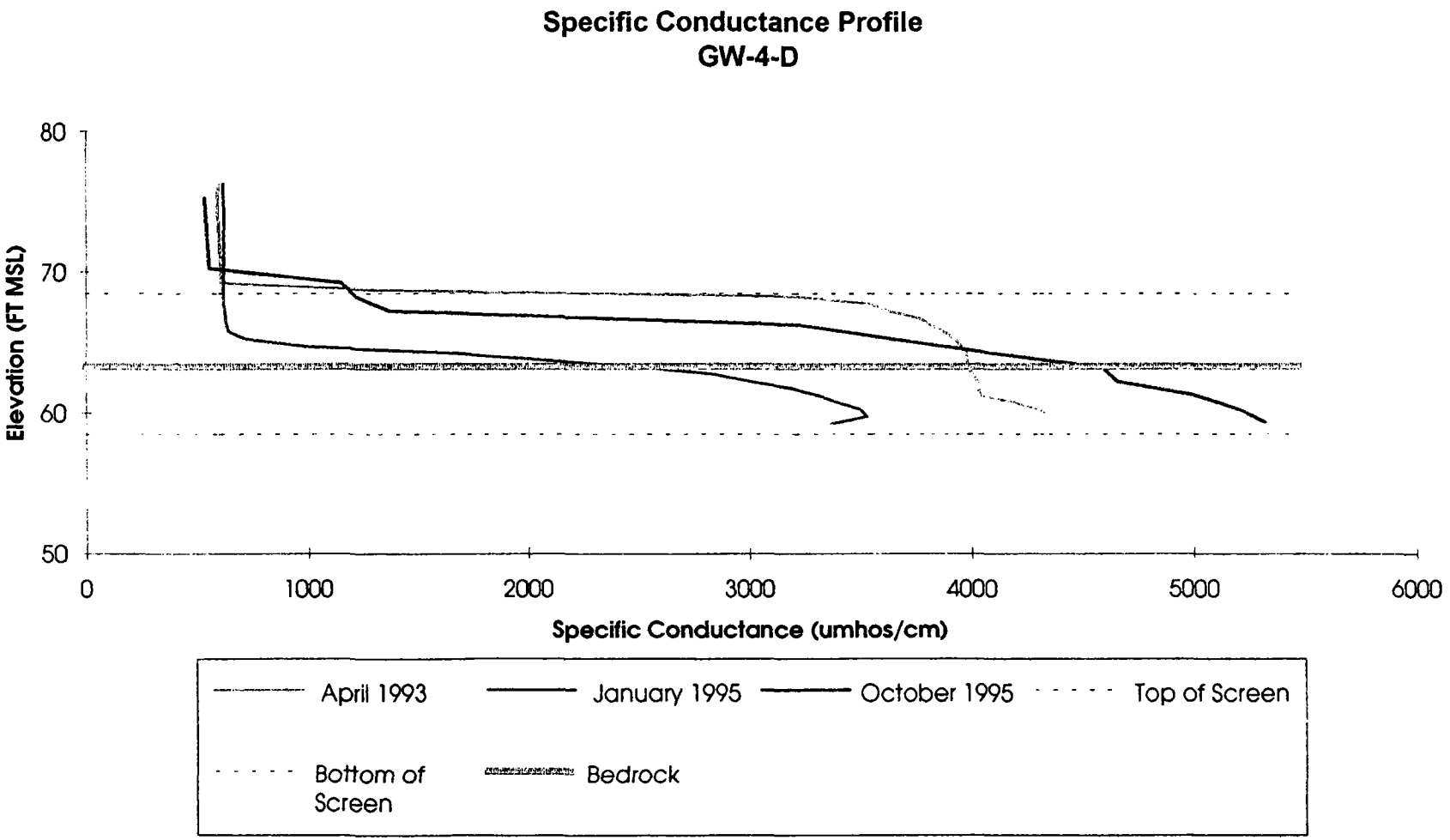
	Meas. Pt.	Width	12-Nov-96 Velocity	12-Nov-96 Flow	3-Dec-96 Velocity	3-Dec-96 Flow	7-Jan-97 Velocity	7-Jan-97 Flow	16-Apr-97 Velocity	16-Apr-97 Flow	30-Apr-97 Velocity	30-Apr-97 Flow
	(in)	(ft)	(ft/sec)	(gpm)	(ft/sec)	(gpm)	(ft/sec)	(gpm)	(ft/sec)	(gpm)	(ft/sec)	(gpm)
Flume5	0											
	4	0.67										
	12	0.83										
	24	1.00										
	36	0.83										
Flume5	0											
	6	1.08										
	20	1.17										
	34	1.08										
Flume5	0											
	4	0.67	0.02	2.33	0.72	121.18	0.10	11.22	0.13	16.73	0.07	9.01
	12	0.67	0.08	9.34	0.68	114.45	0.14	15.71	0.18	23.16	0.24	30.88
	20	0.50	0.09	7.88	0.18	22.72	0.11	9.26	0.27	26.05	0.23	22.19
	24	0.33	0.08	4.67	-0.03	-2.52	0.08	4.49	0.17	10.94	0.12	7.72
	28	0.50	0.03	2.63	-0.07	-8.84	0.08	6.73	0.07	6.75	0.13	12.54
	36	0.67	-0.01	-1.17	-0.06	-10.10	0.02	2.24	-0.05	-6.43	0.03	3.86
				25.67		**236.90**		**49.65**		**77.20**		**86.21**

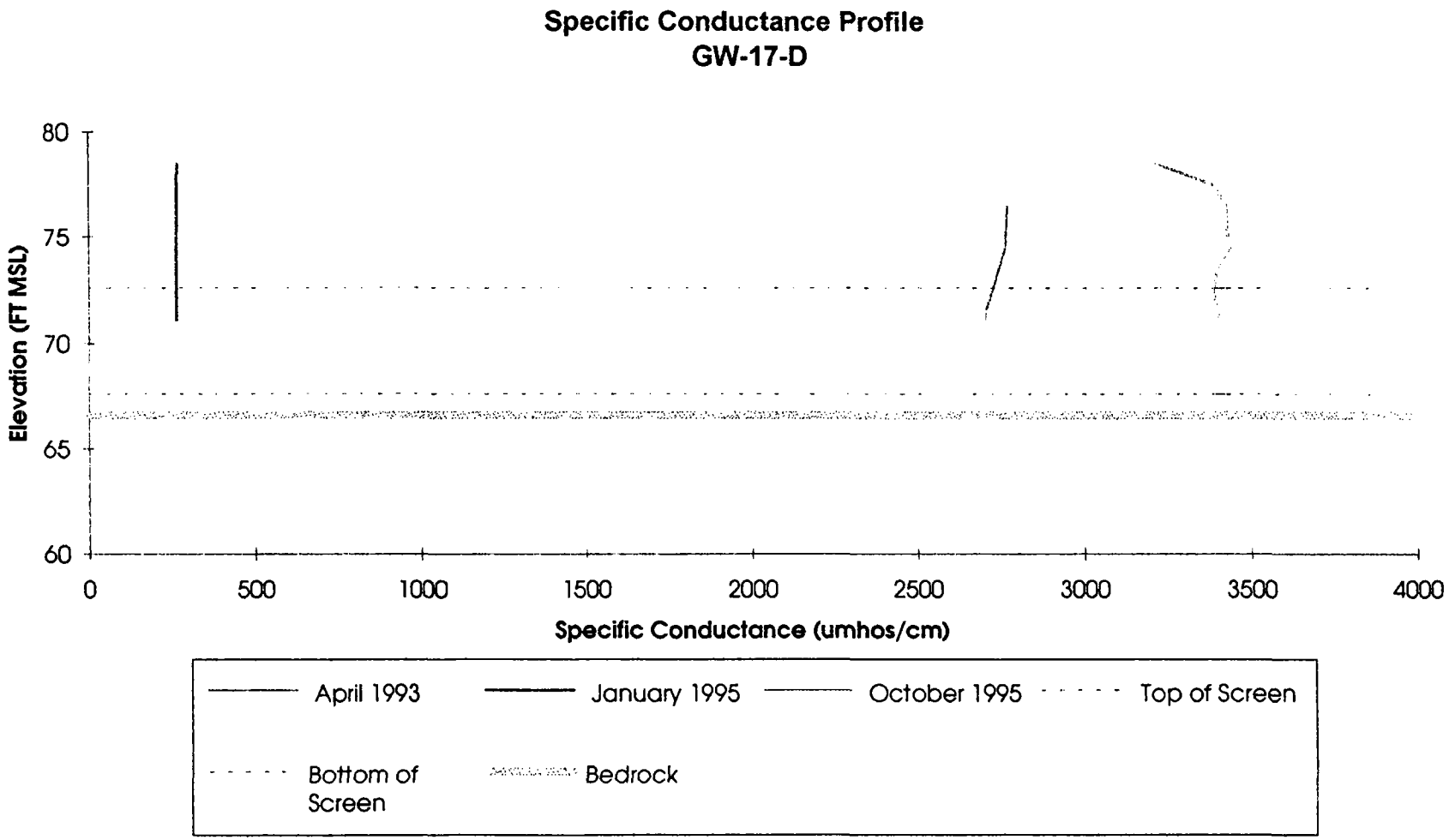
Appendix K

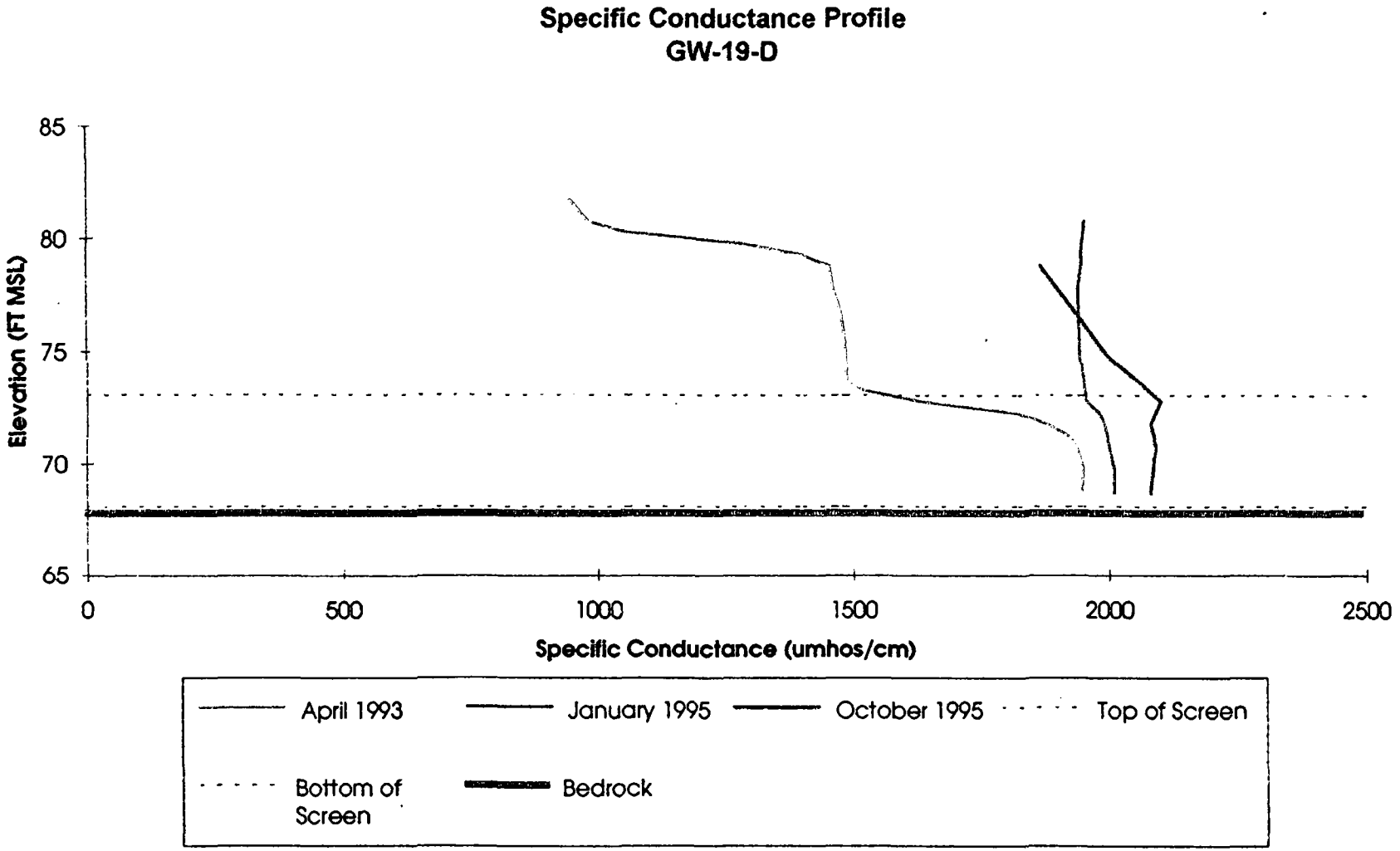
SMITH

APPENDIX K

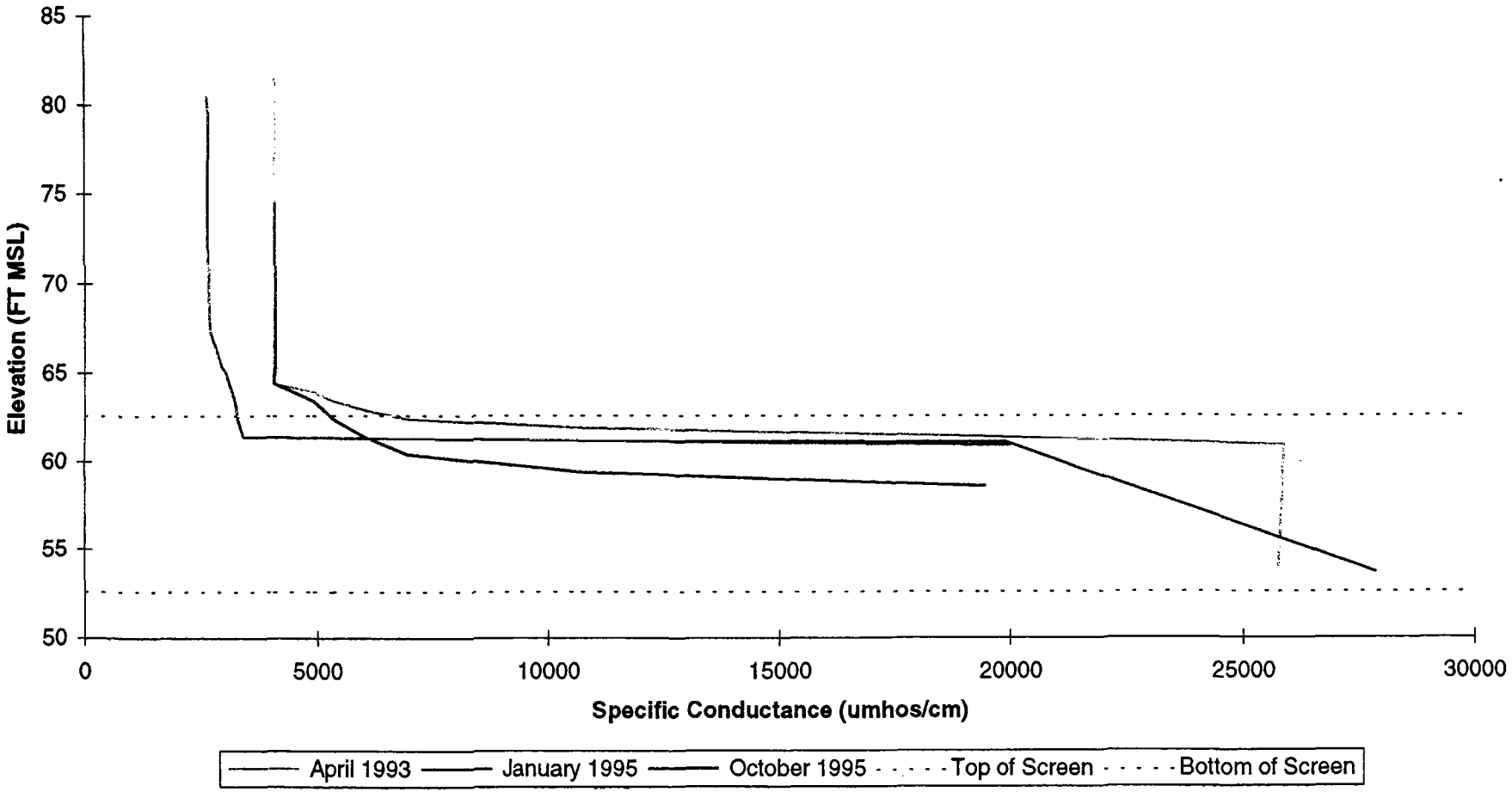
SPECIFIC CONDUCTANCE PROFILES AND DATA



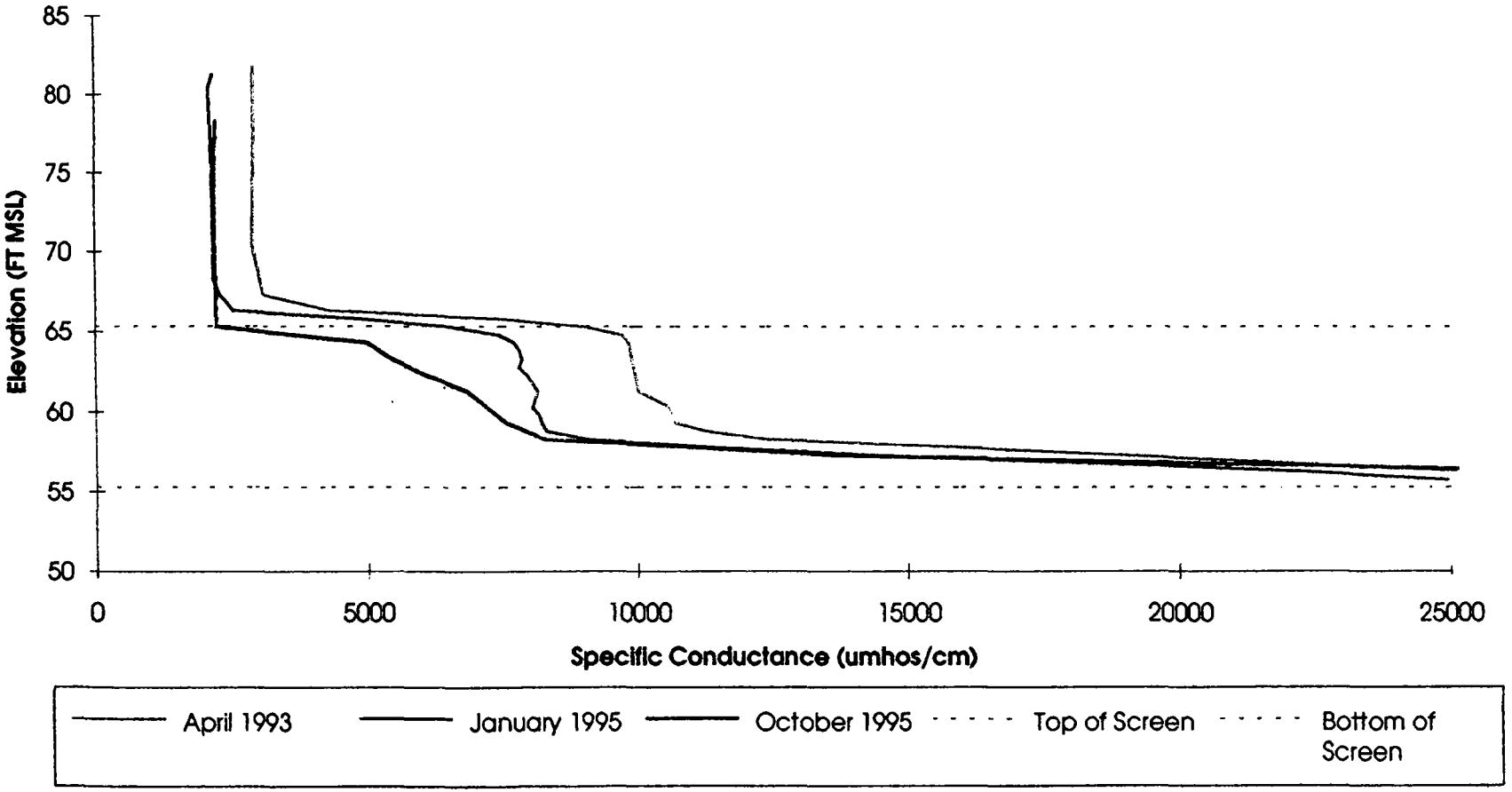




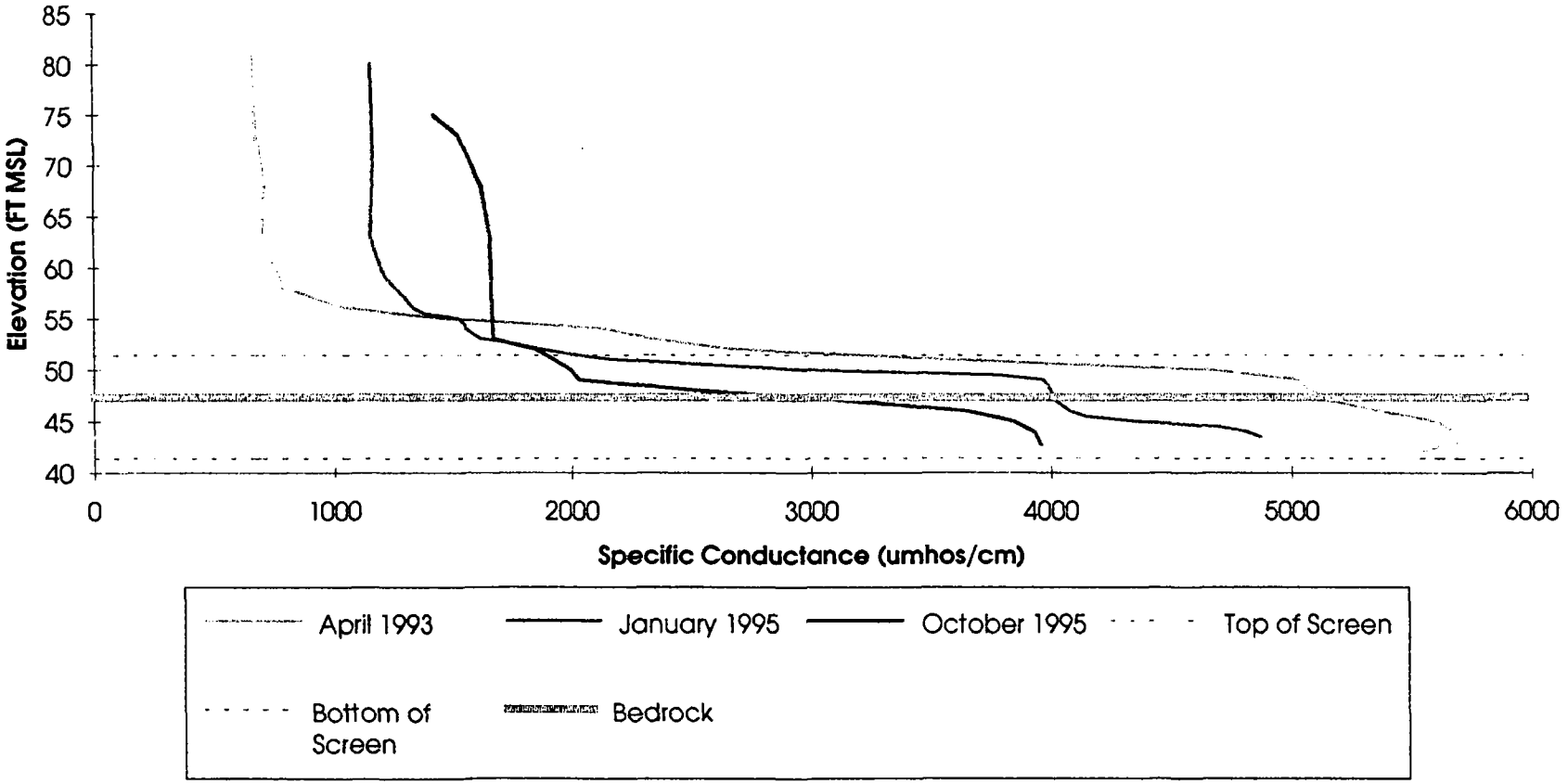
Specific Conductance Profile
GW-27-D

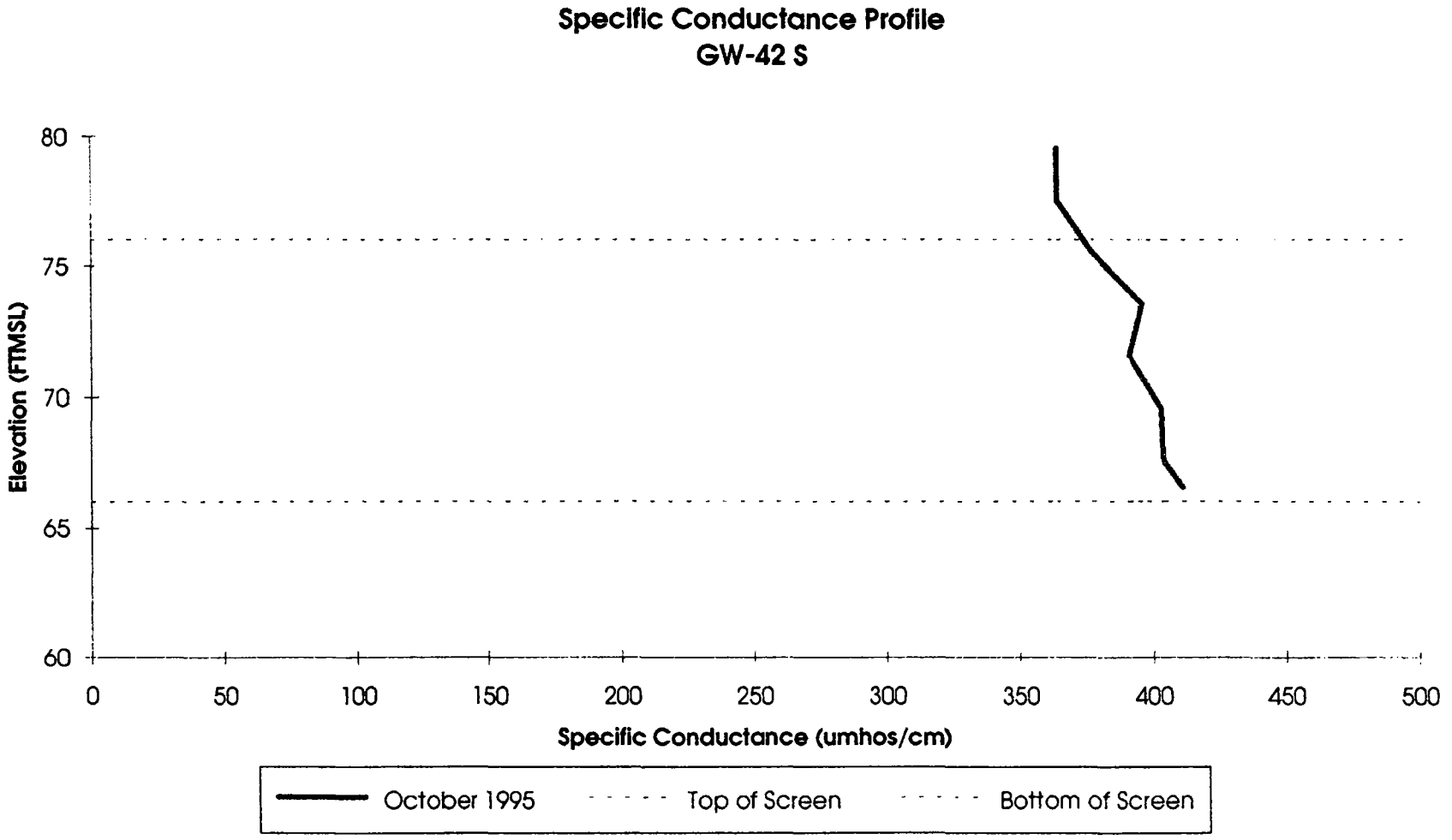


Specific Conductance Profile
GW-34-D

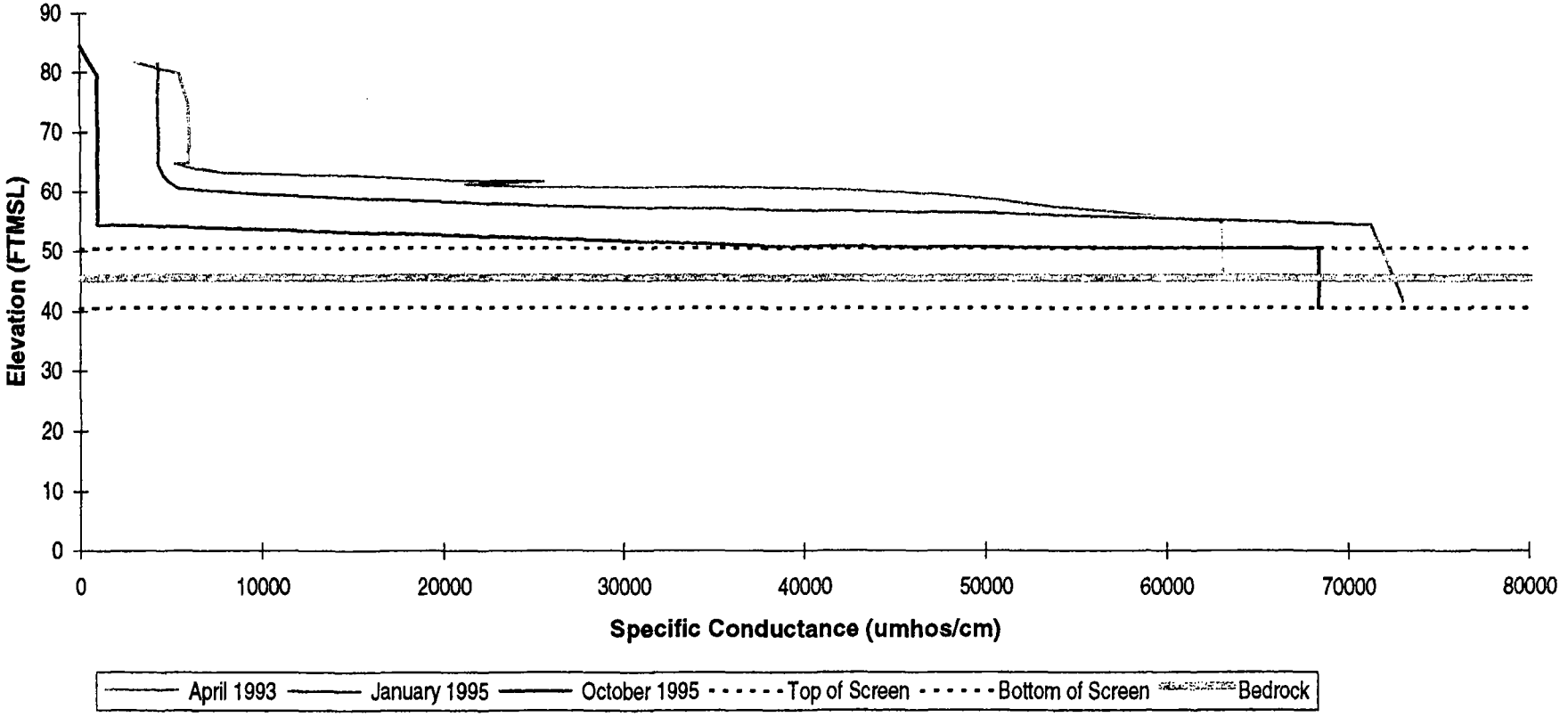


Specific Conductance Profile
GW-40-D

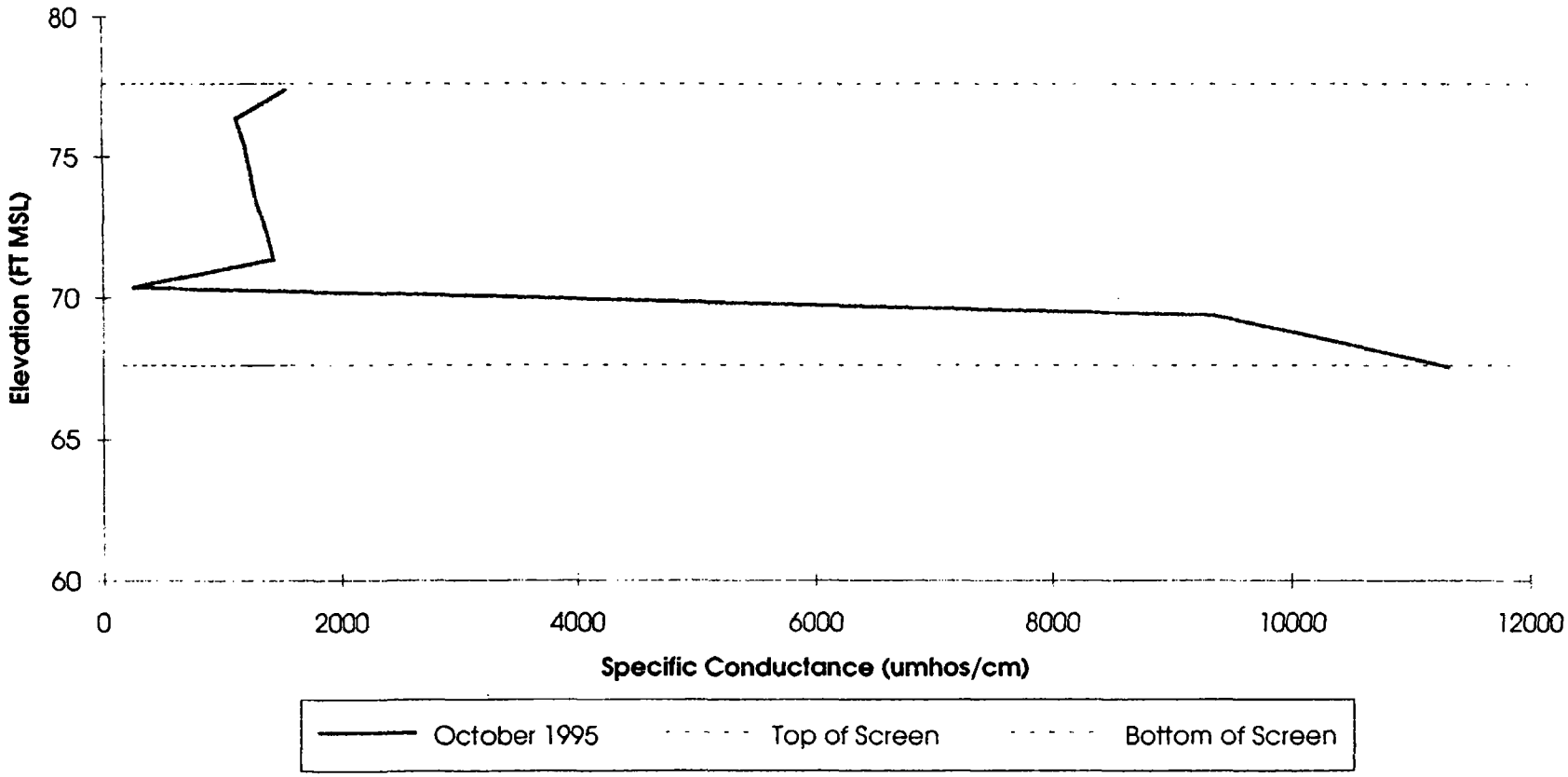




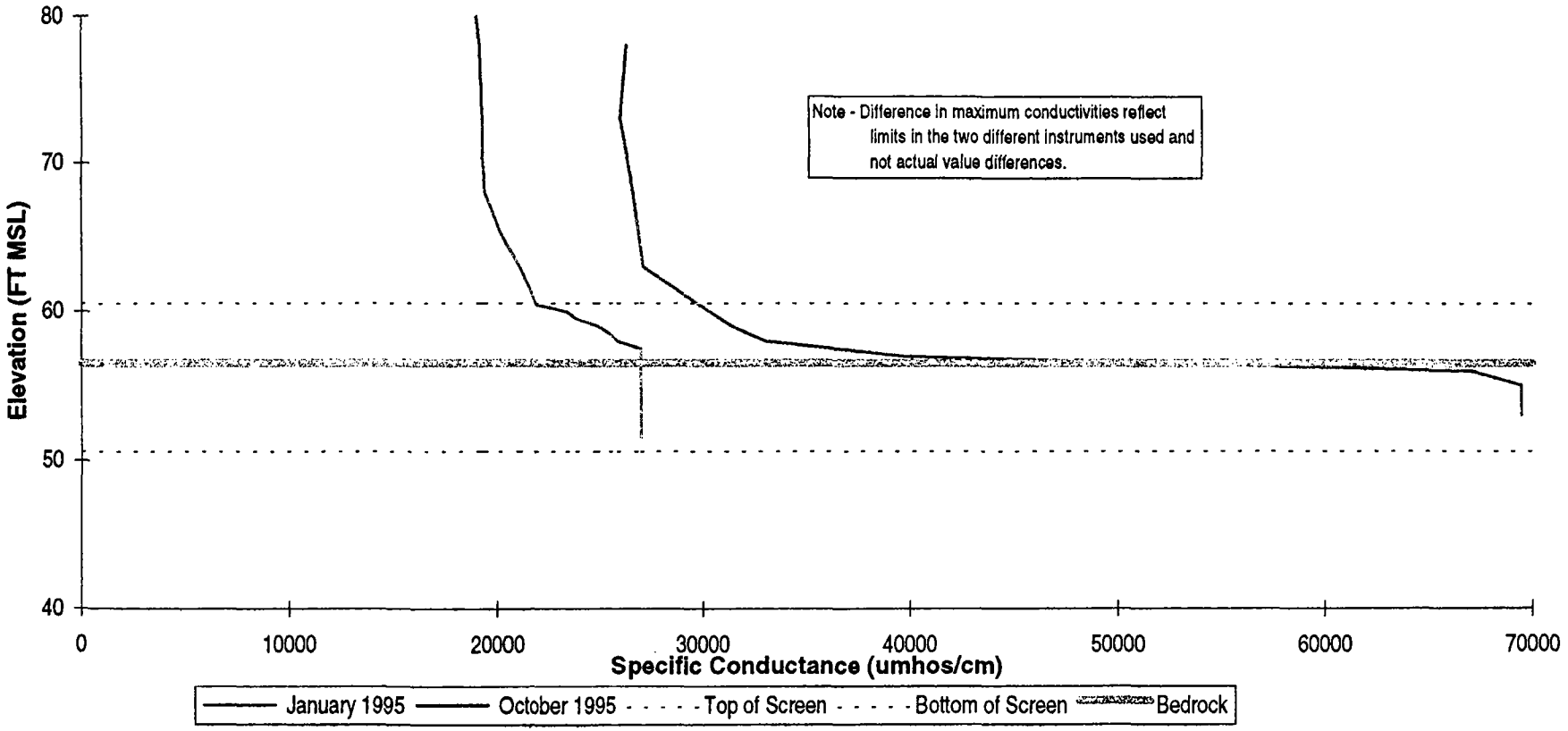
Specific Conductance Profile
GW-42-D



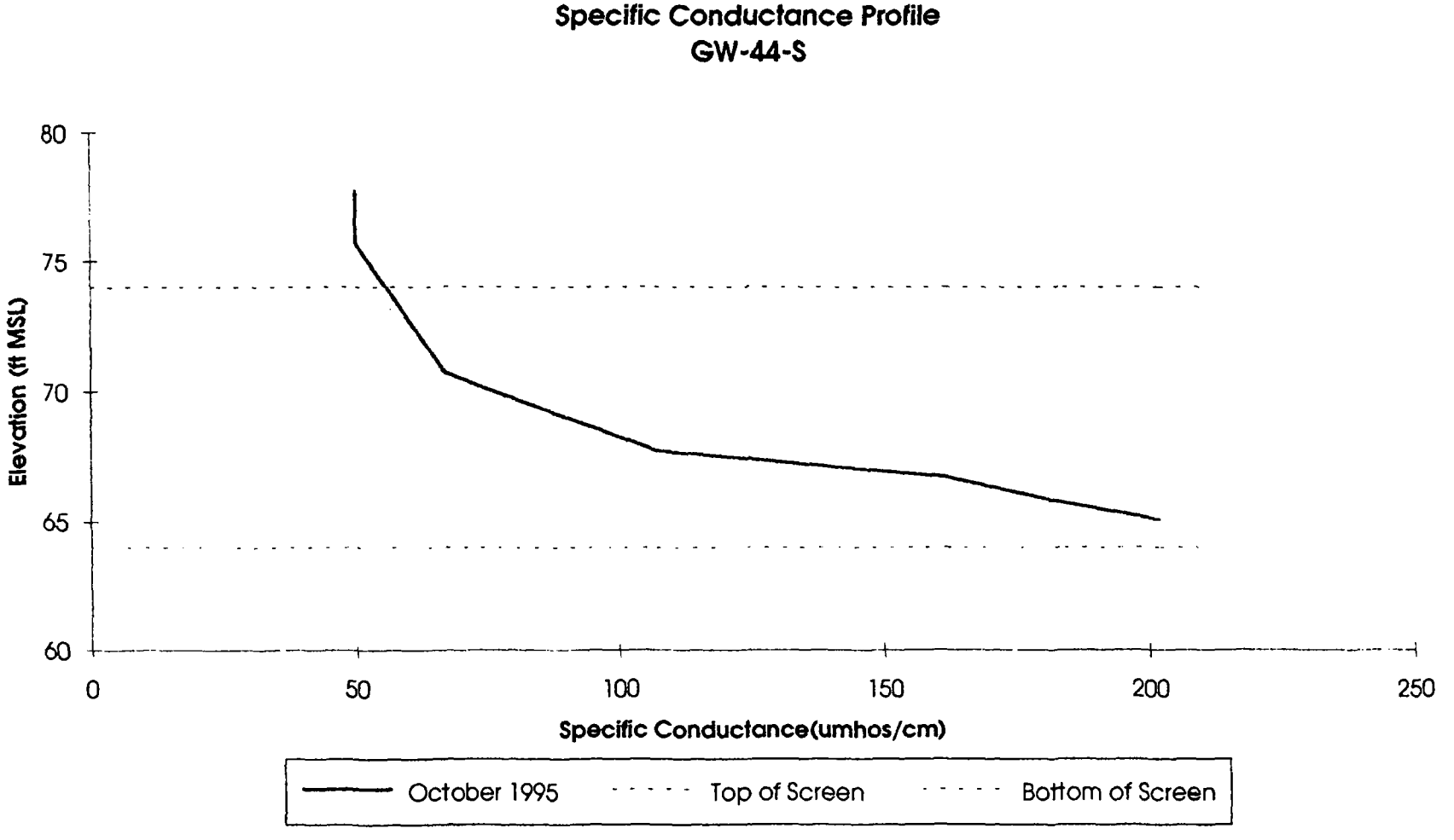
Specific Conductance Profile
GW-43-S



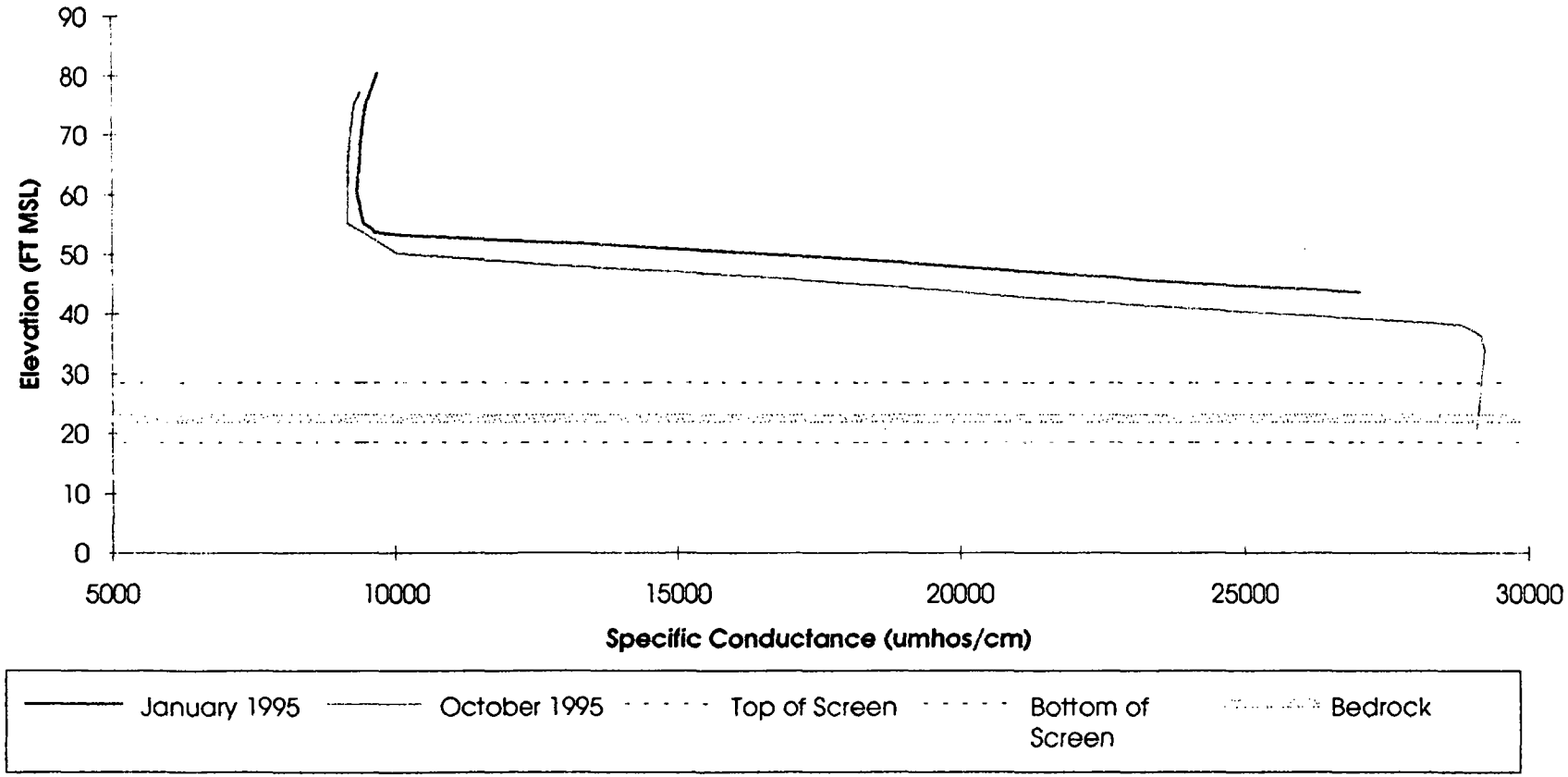
Specific Conductance Profile
GW-43-D



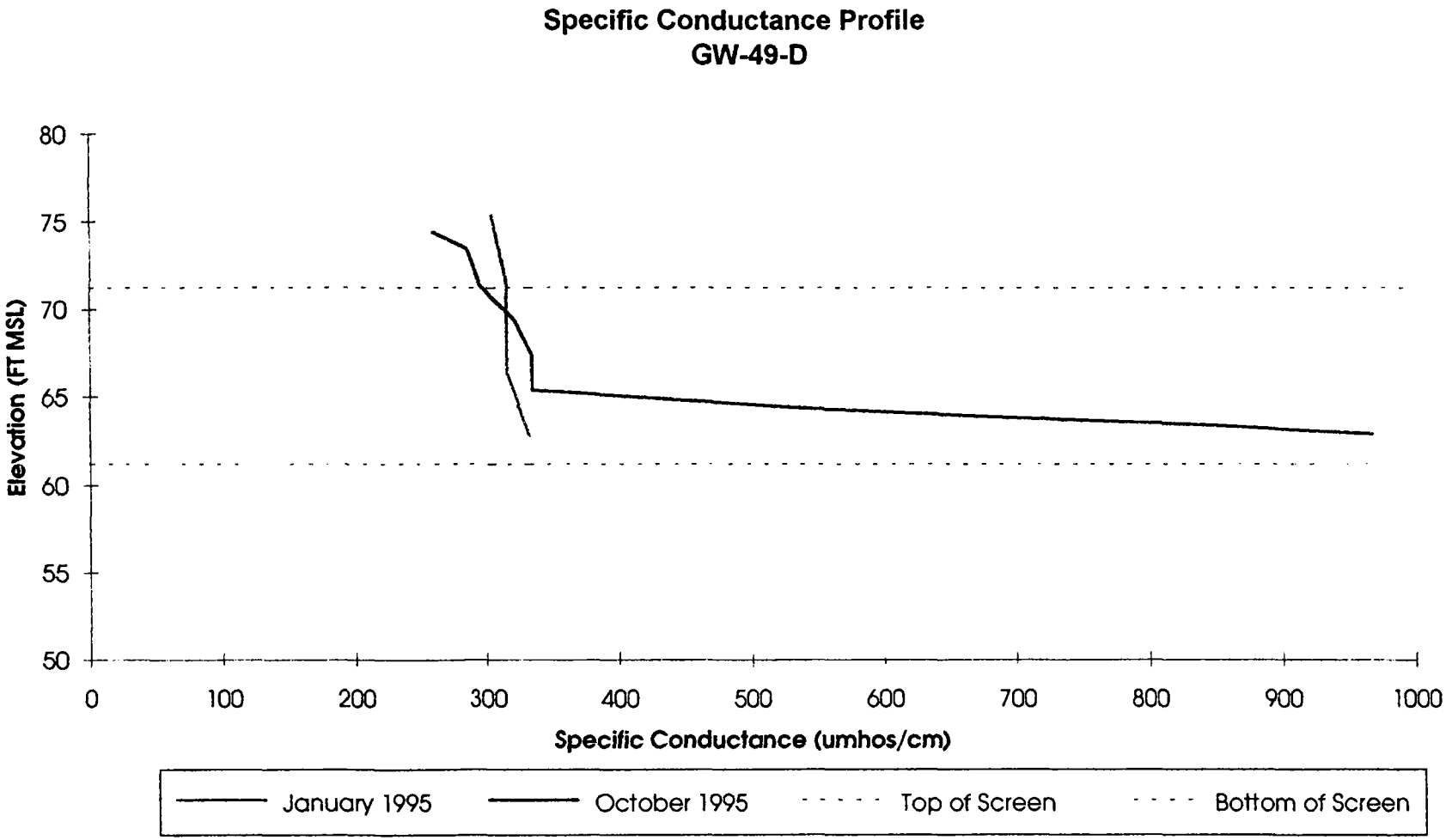
Dashed lines represent screened interval



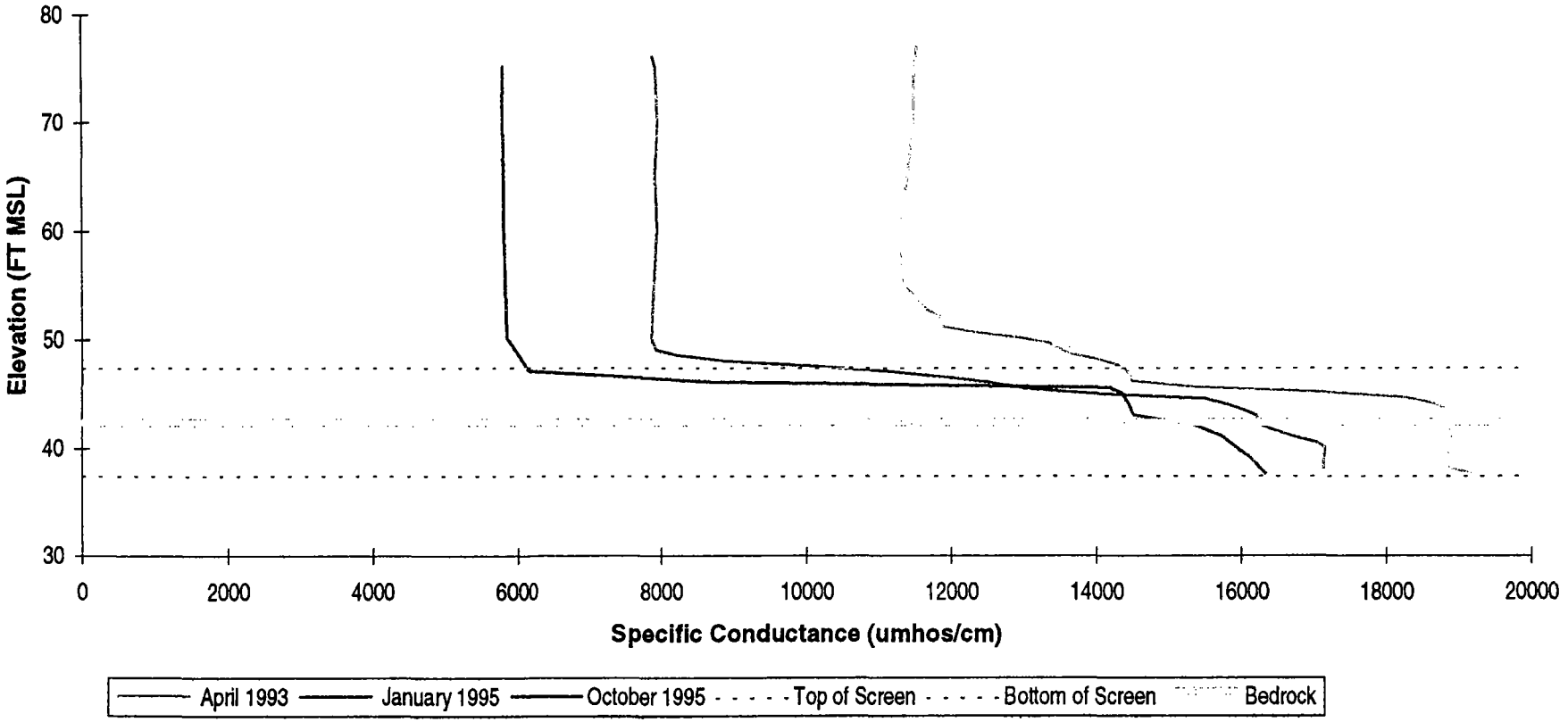
Specific Conductance Profile
GW-44-D



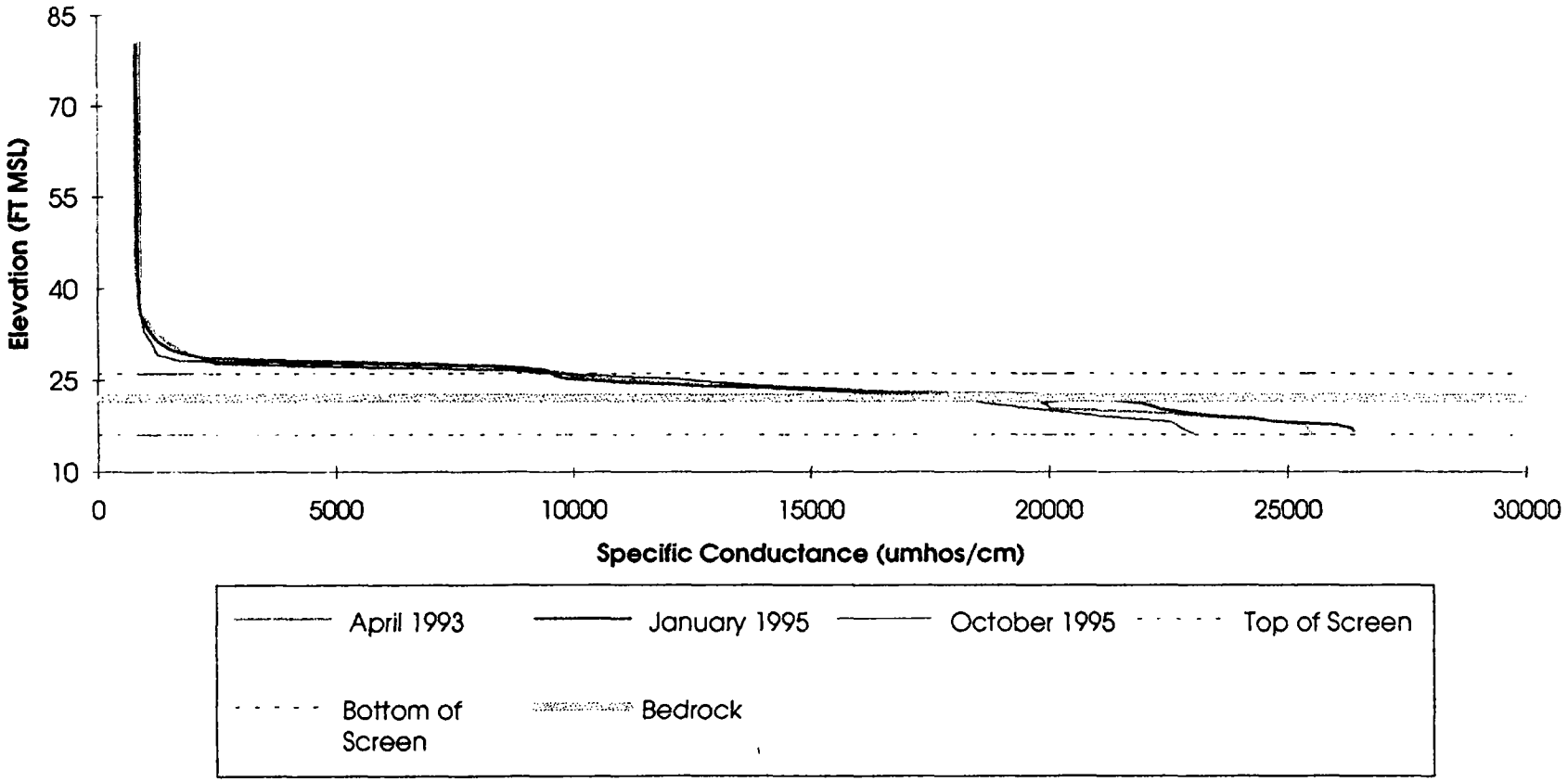
Dashed lines represent screened interval



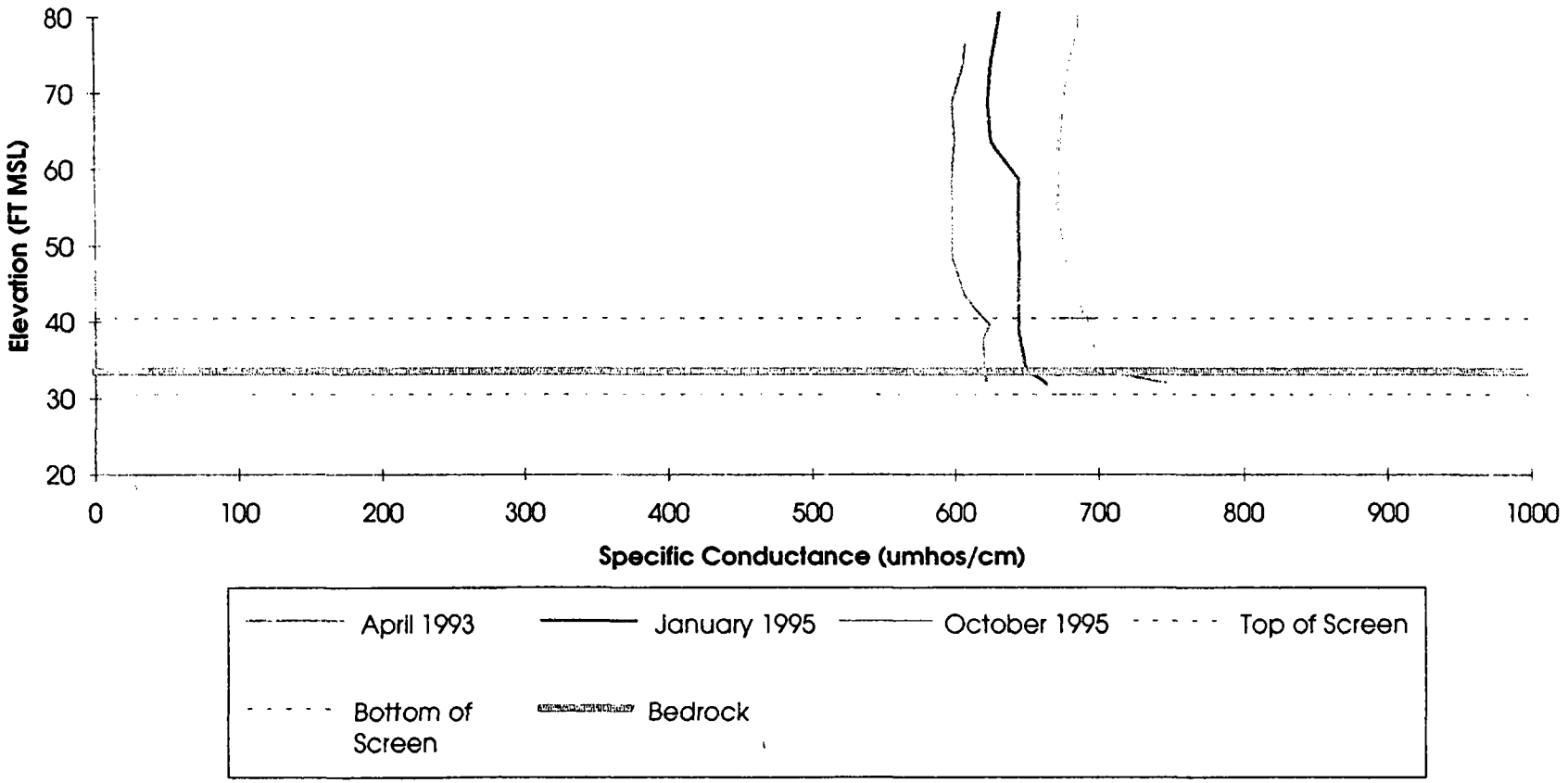
Specific Conductance Profile
GW-50-D



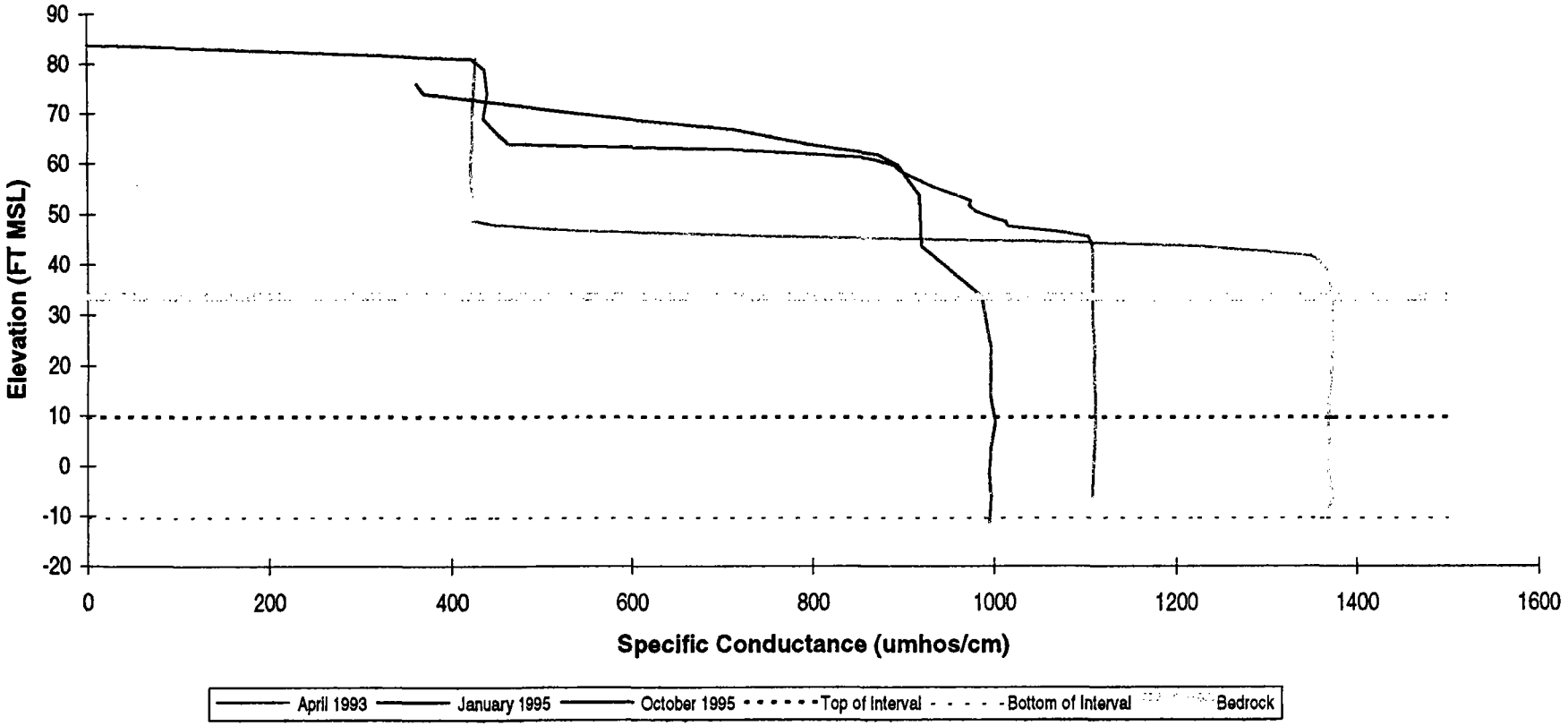
Specific Conductance Profile
GW-58-D



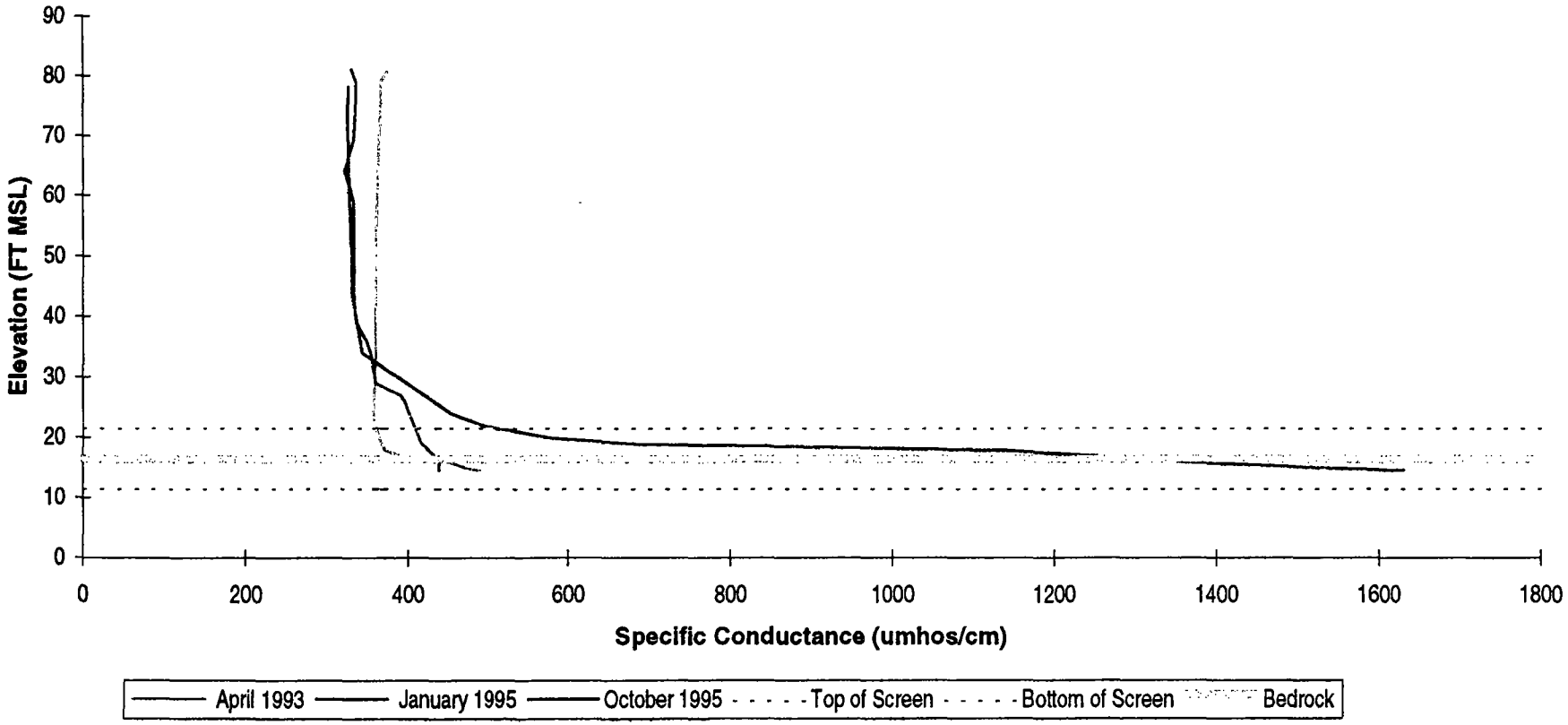
Specific Conductance Profile
GW-61-D



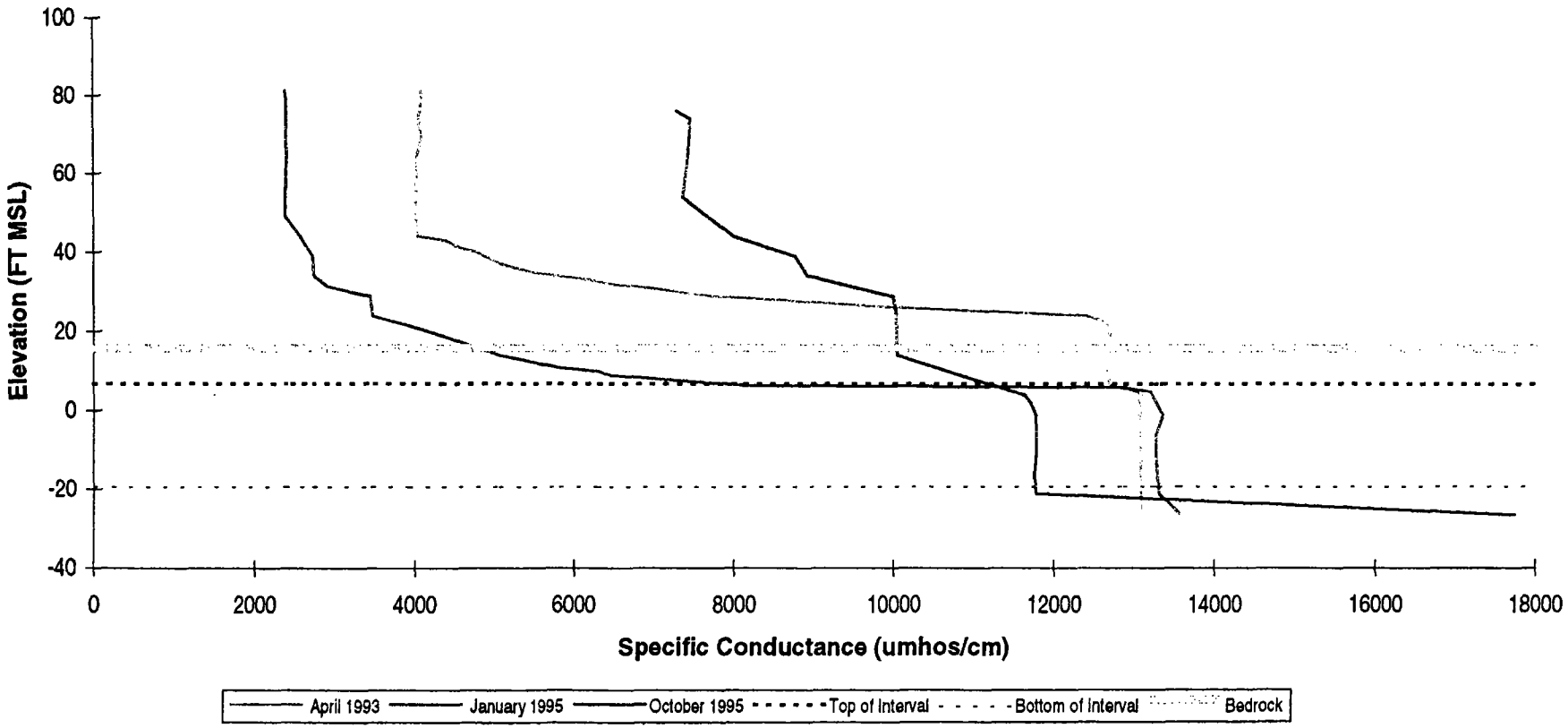
Specific Conductance Profile
GW-61-BR



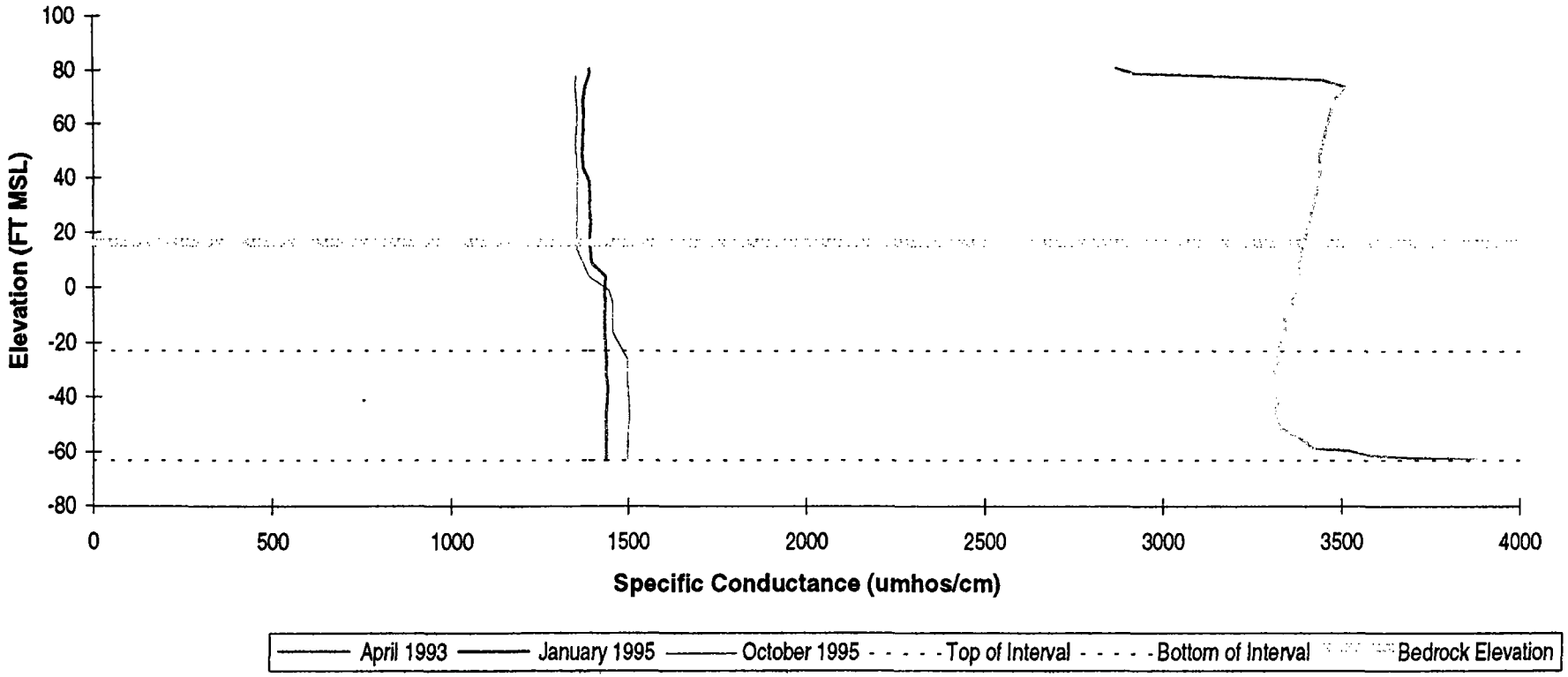
Specific Conductance Profile
GW-62-D

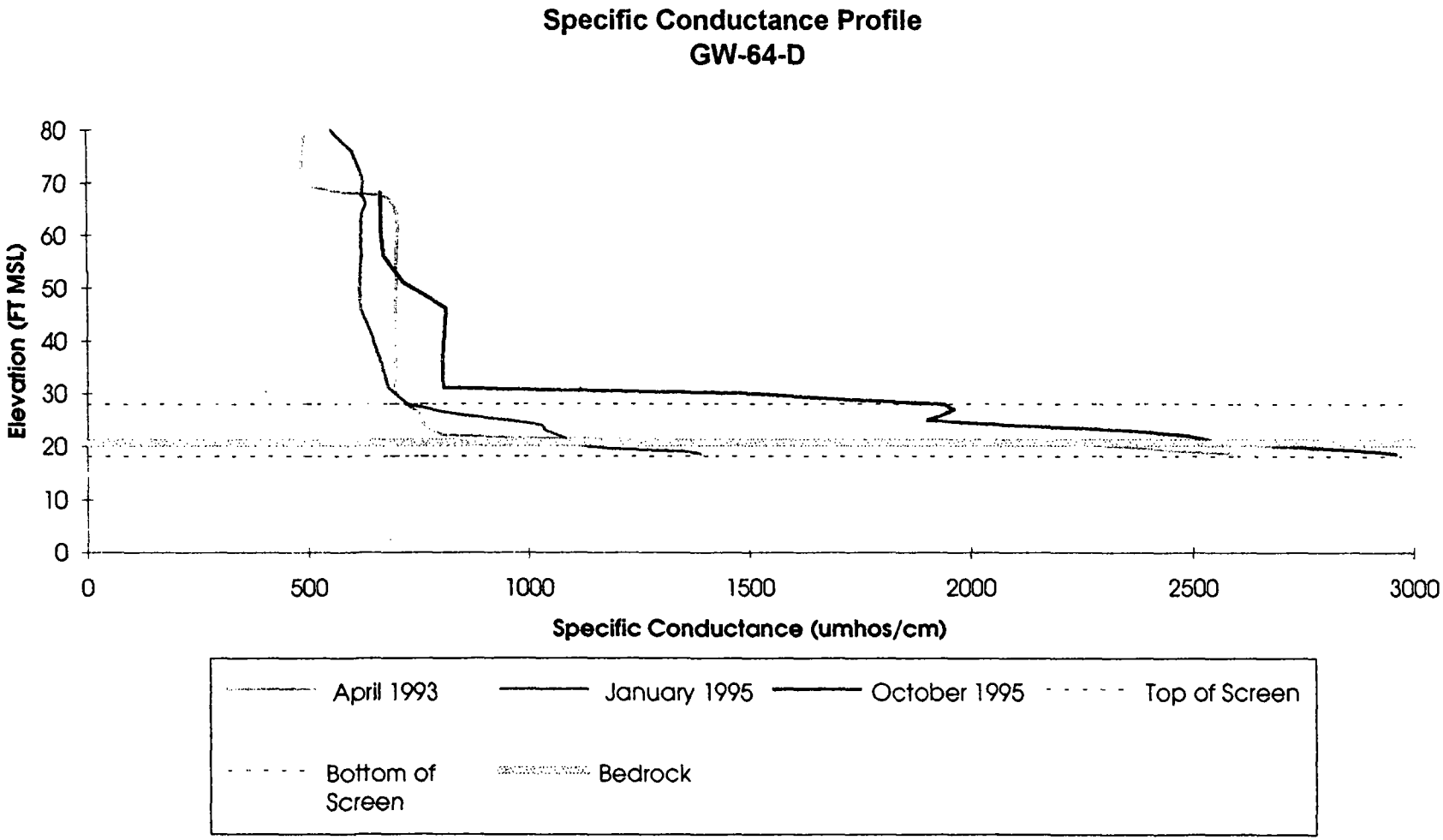


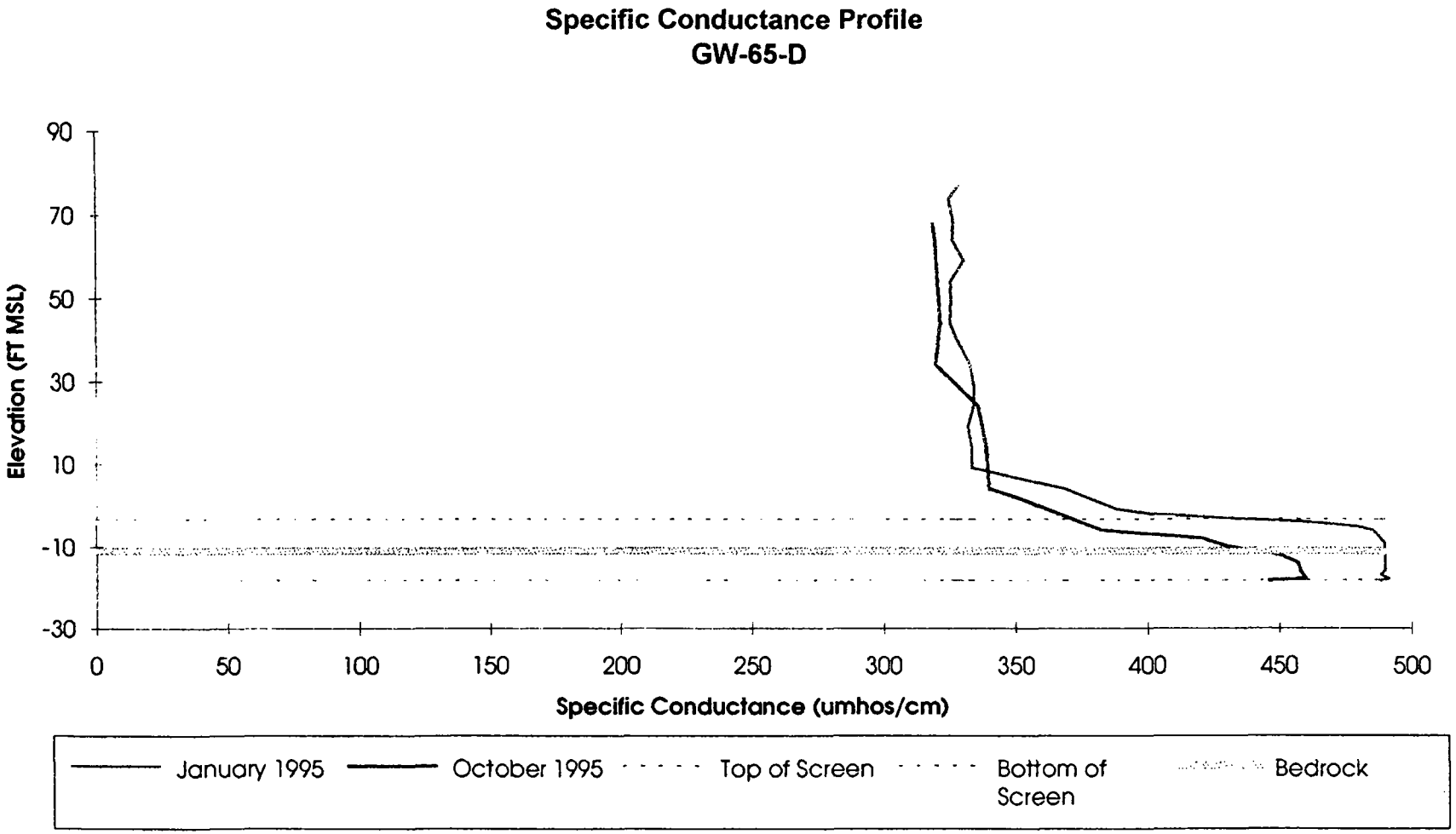
Specific Conductance Profile
GW-62-BR



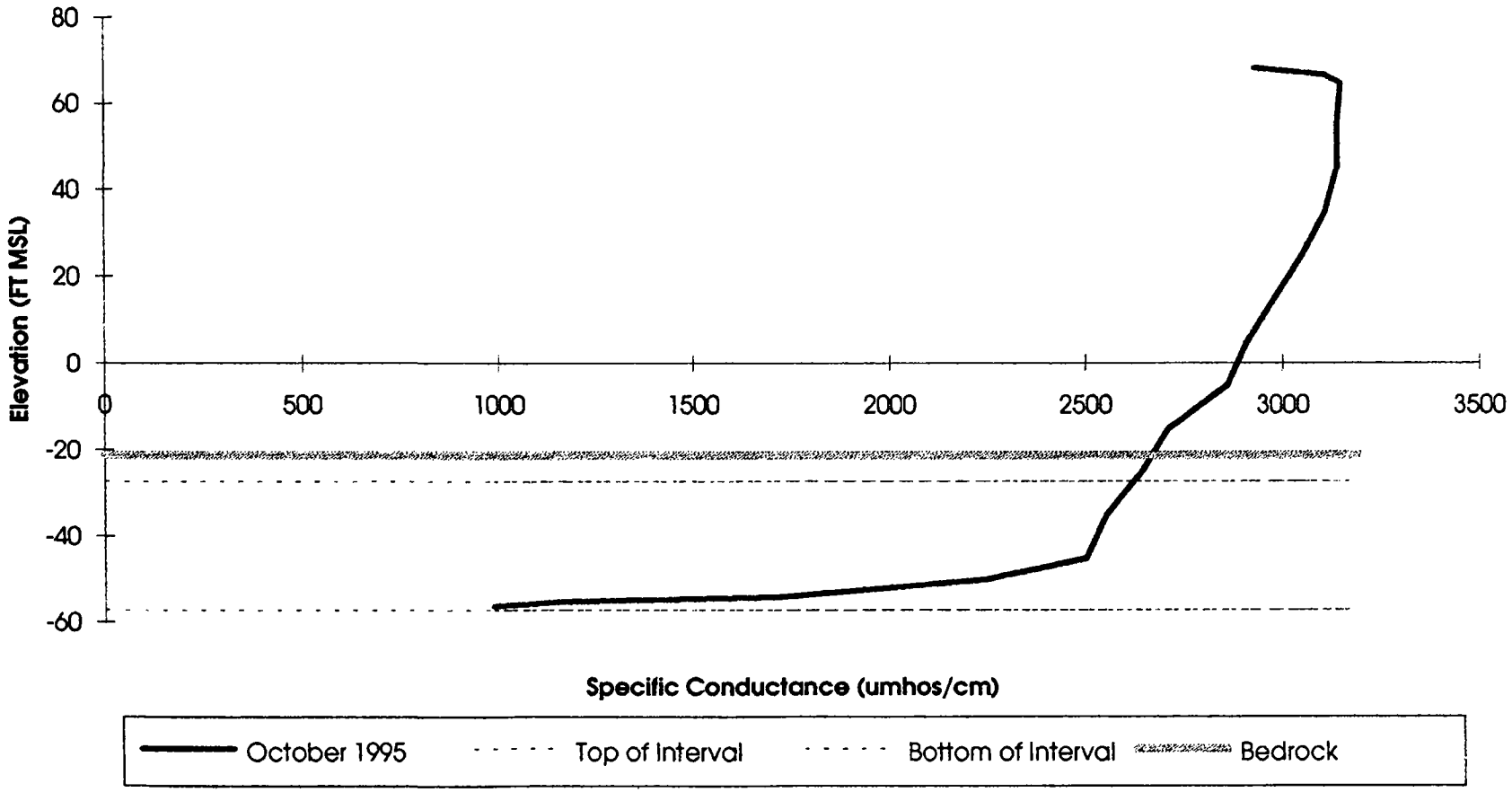
Specific Conductance Profile
GW-62-BRD



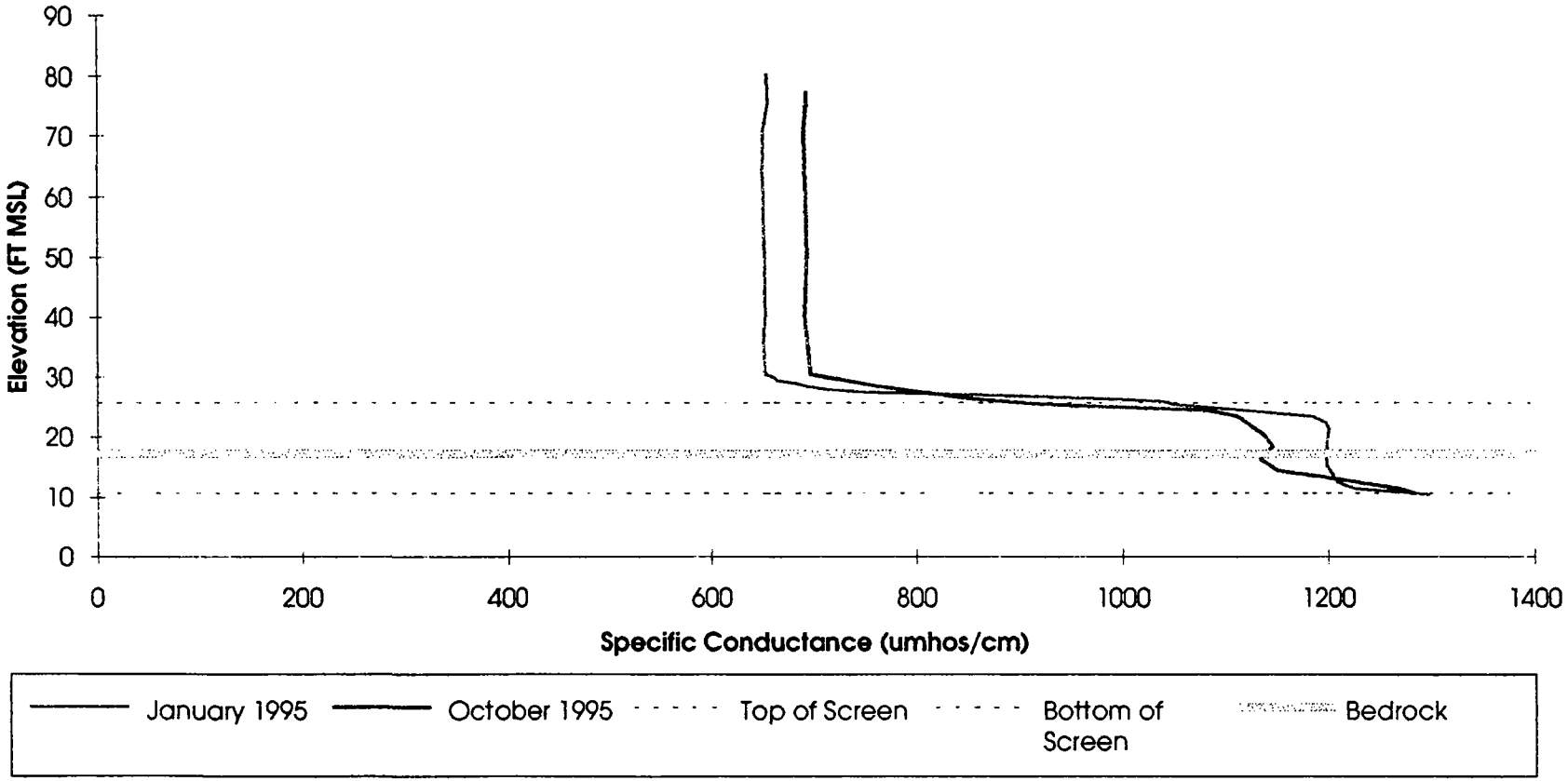




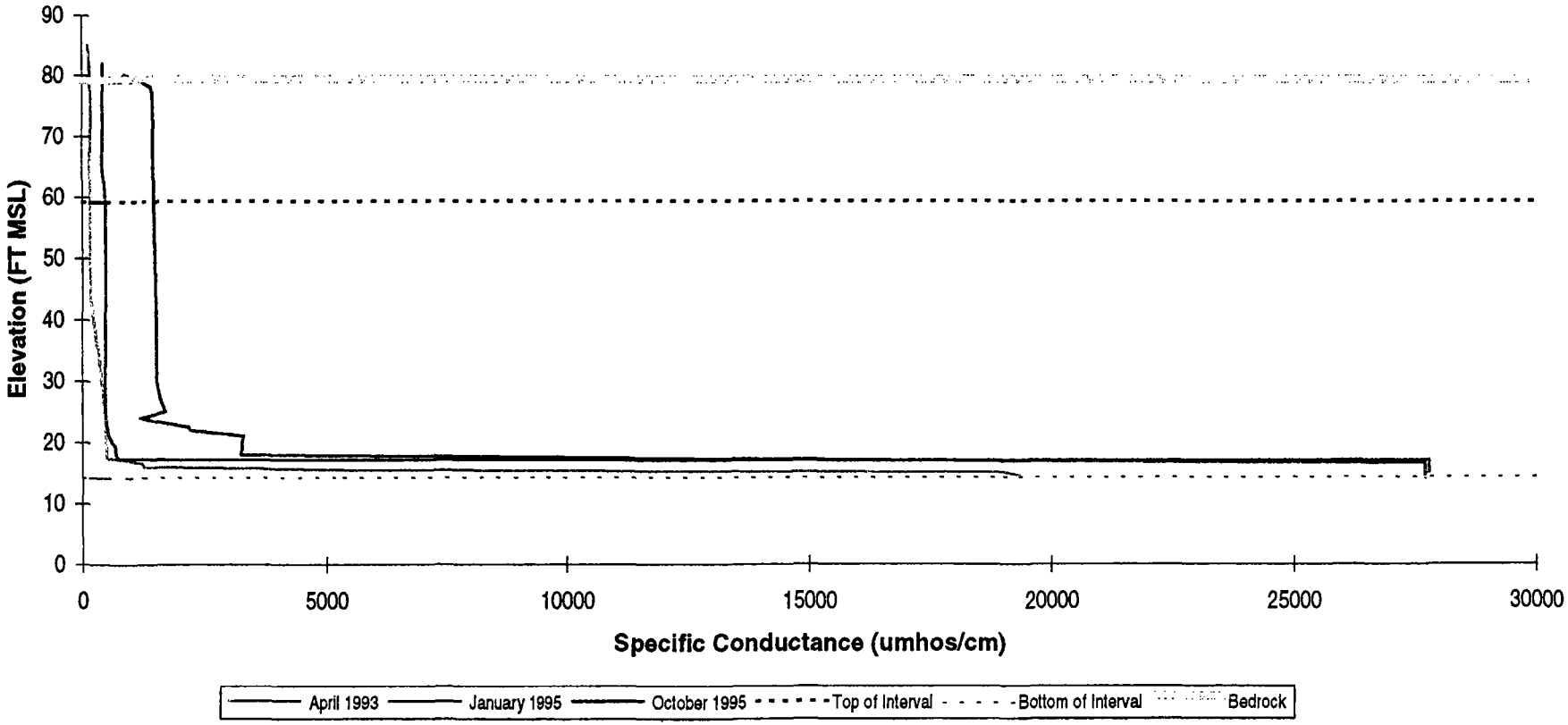
Specific Conductance Profile
GW-65-BR



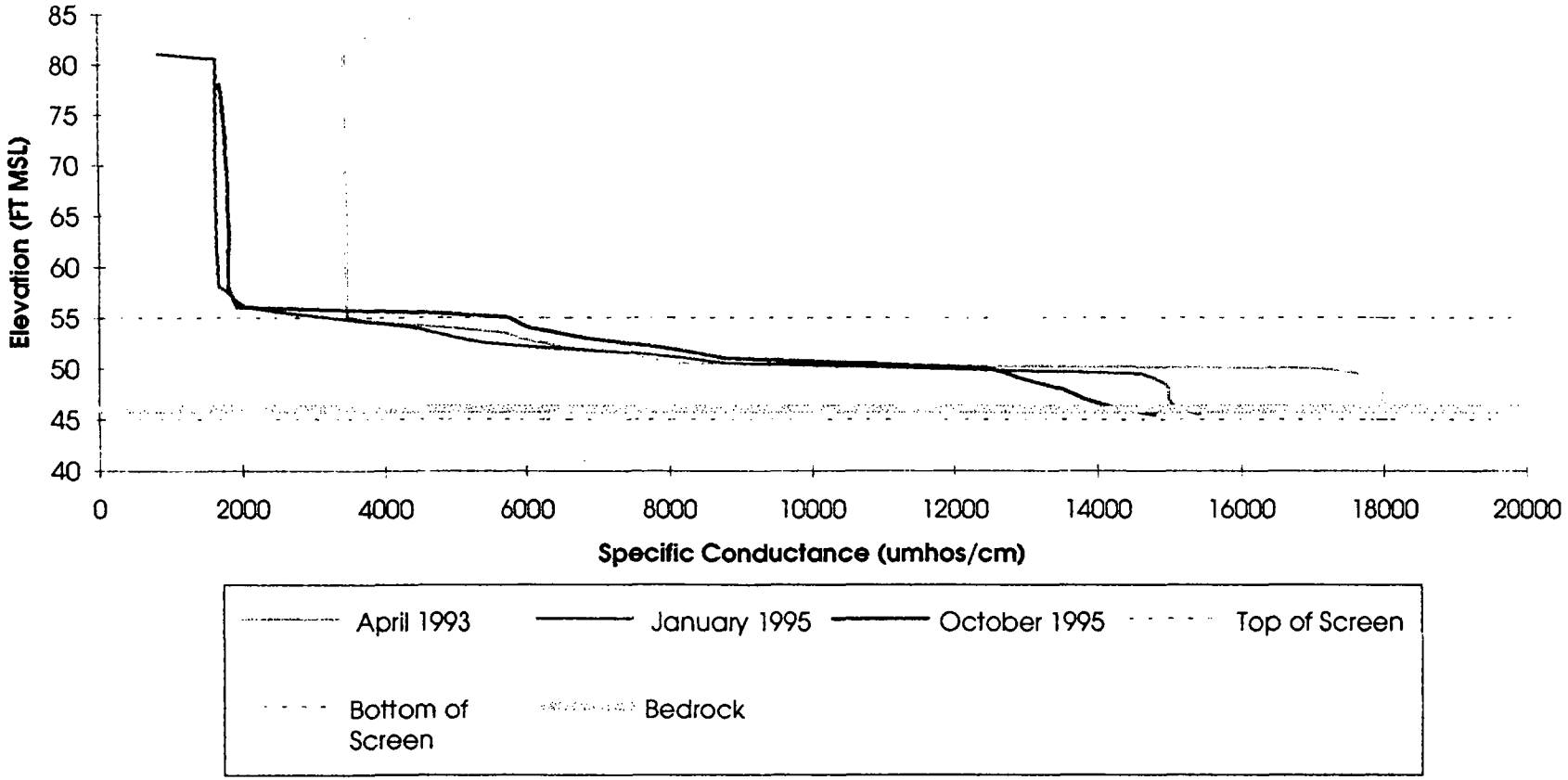
Specific Conductance Profile
GW-67-D



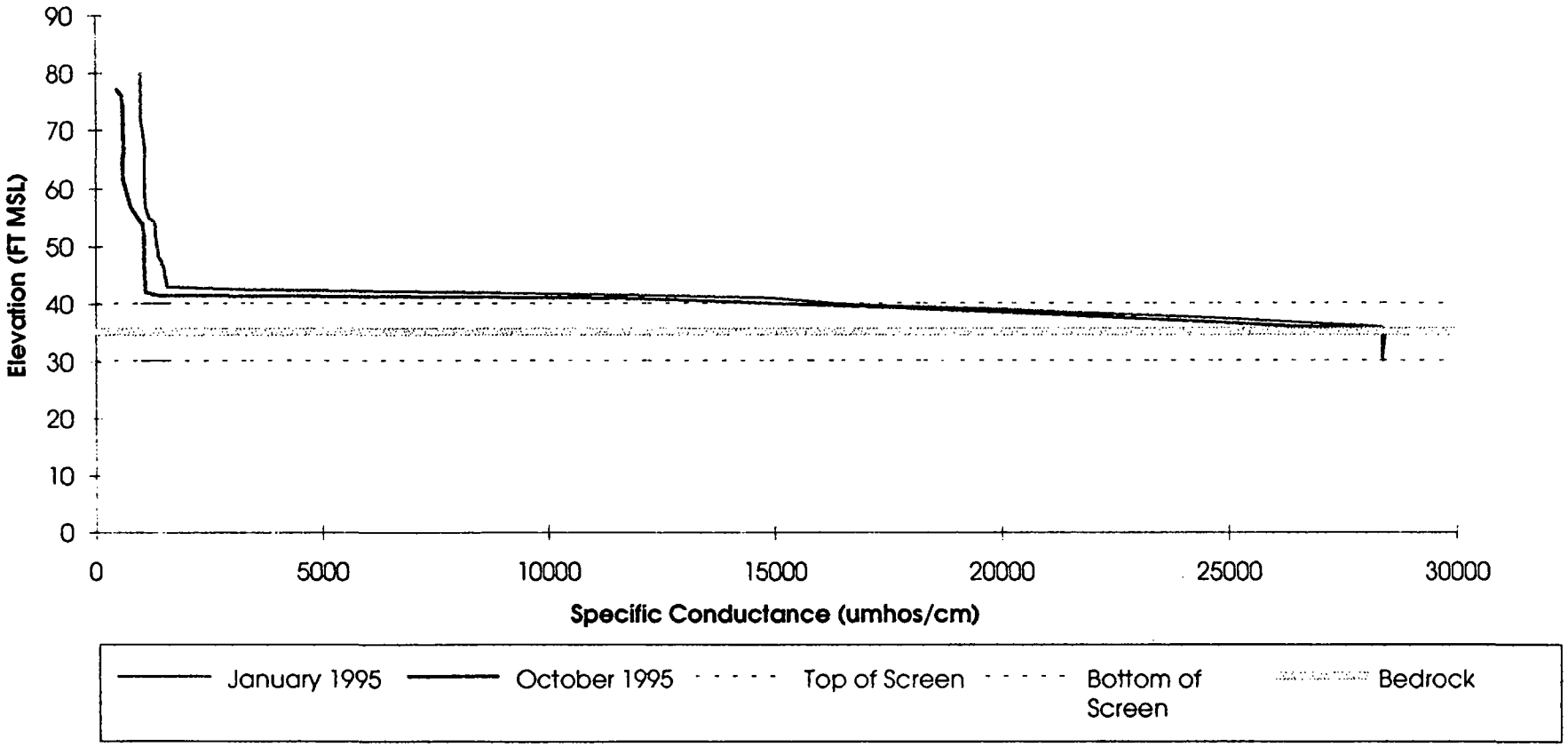
Specific Conductance Profile
GW-68-BR



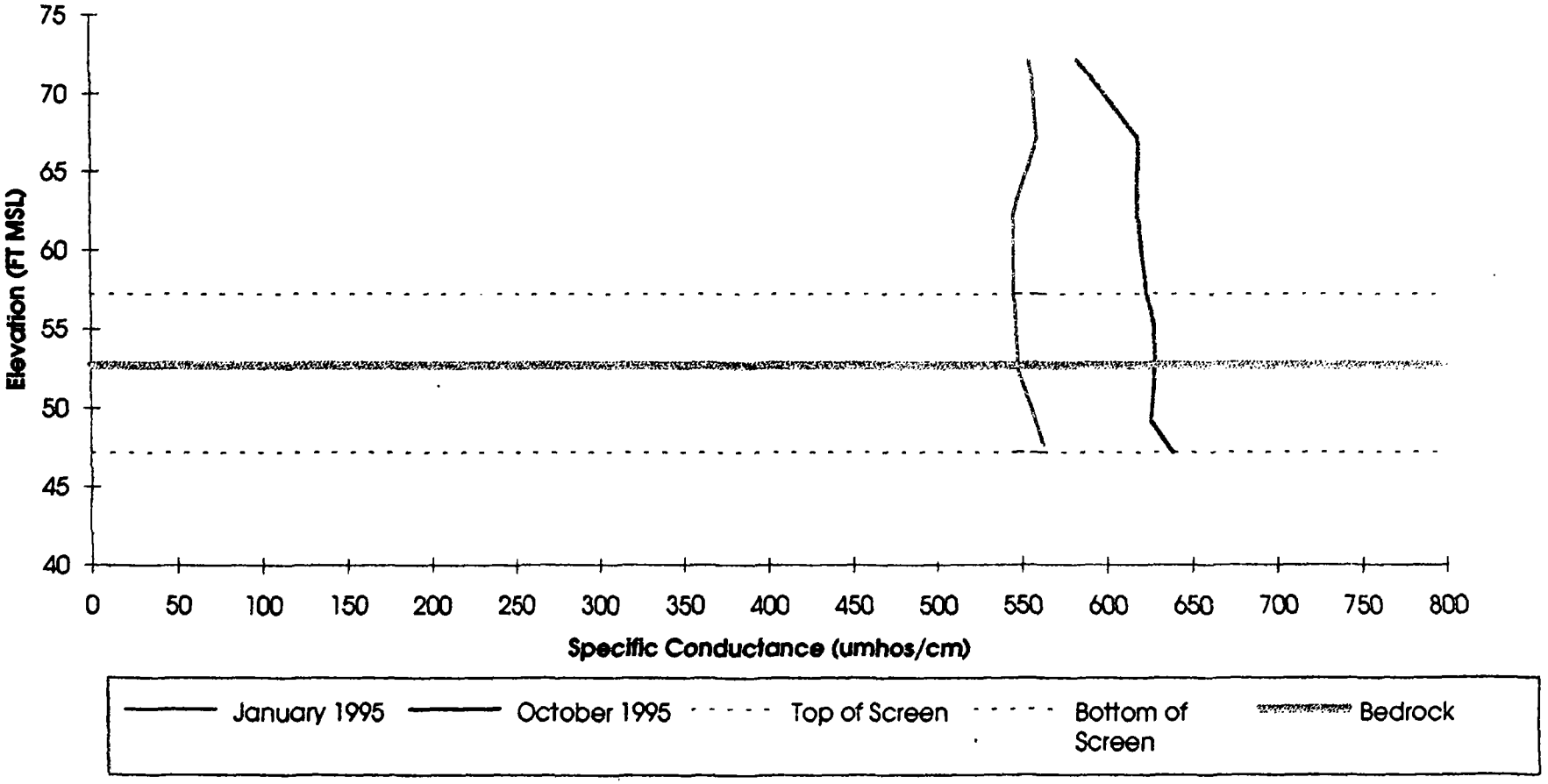
Specific Conductance Profile
GW-69-D



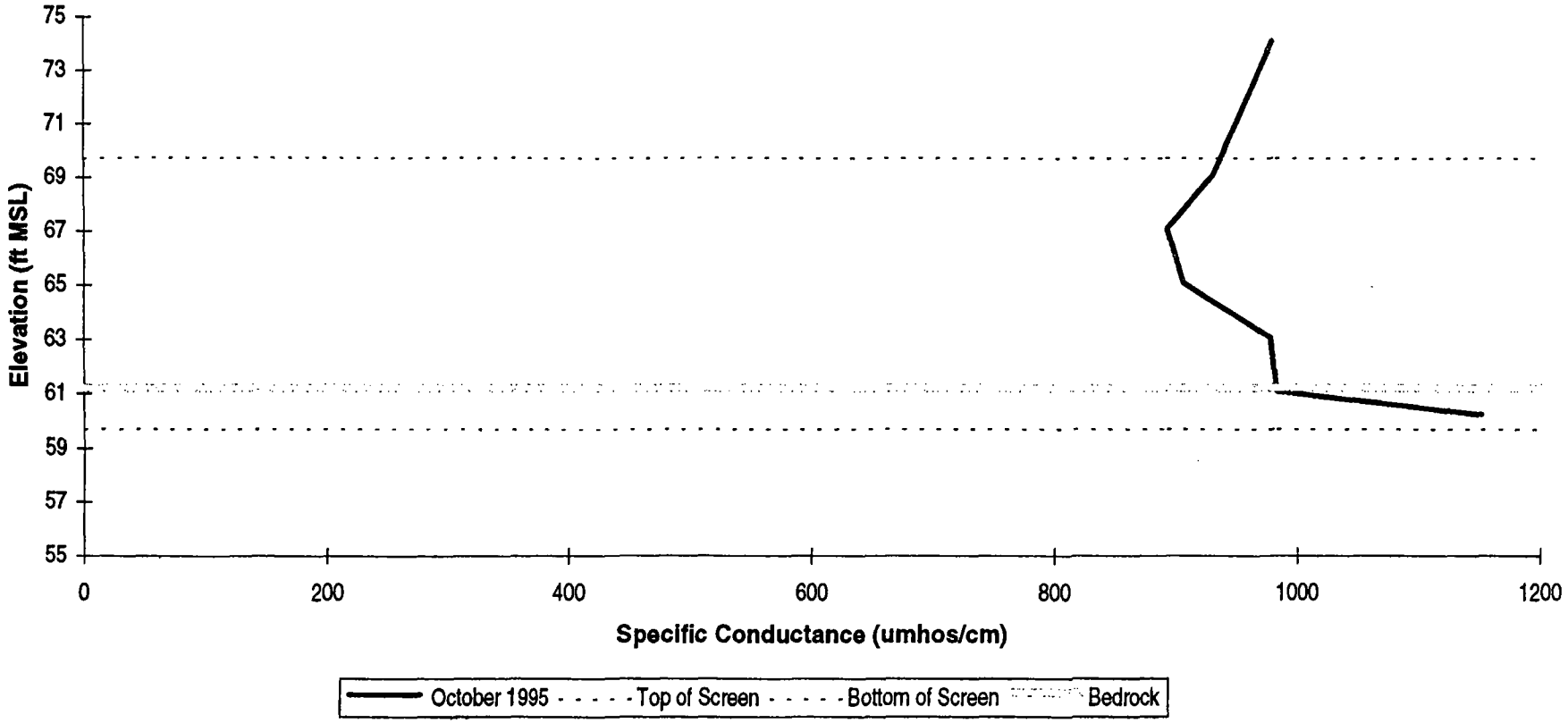
Specific Conductance Profile
GW-70-D

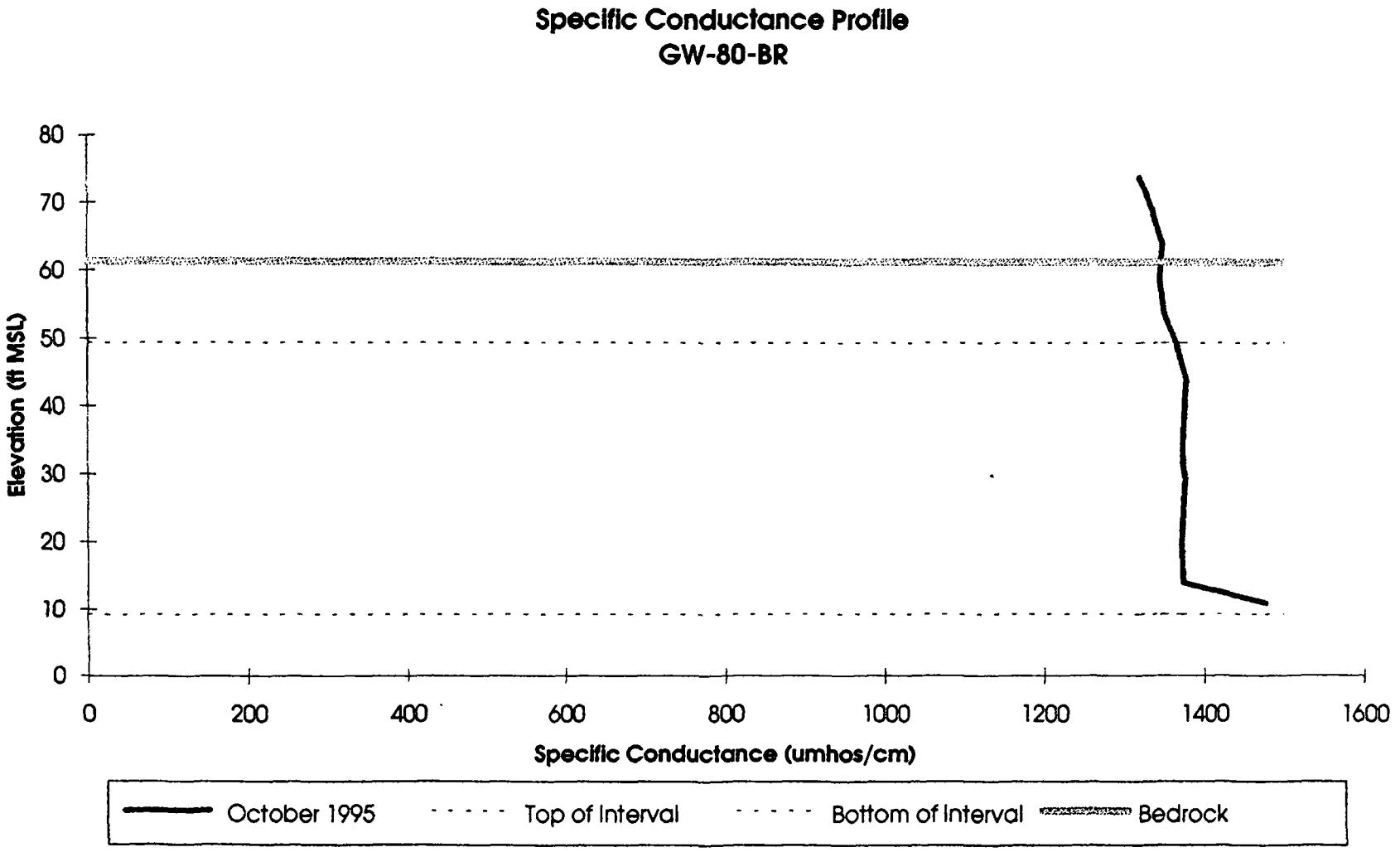


Specific Conductance Profile
GW-74-D

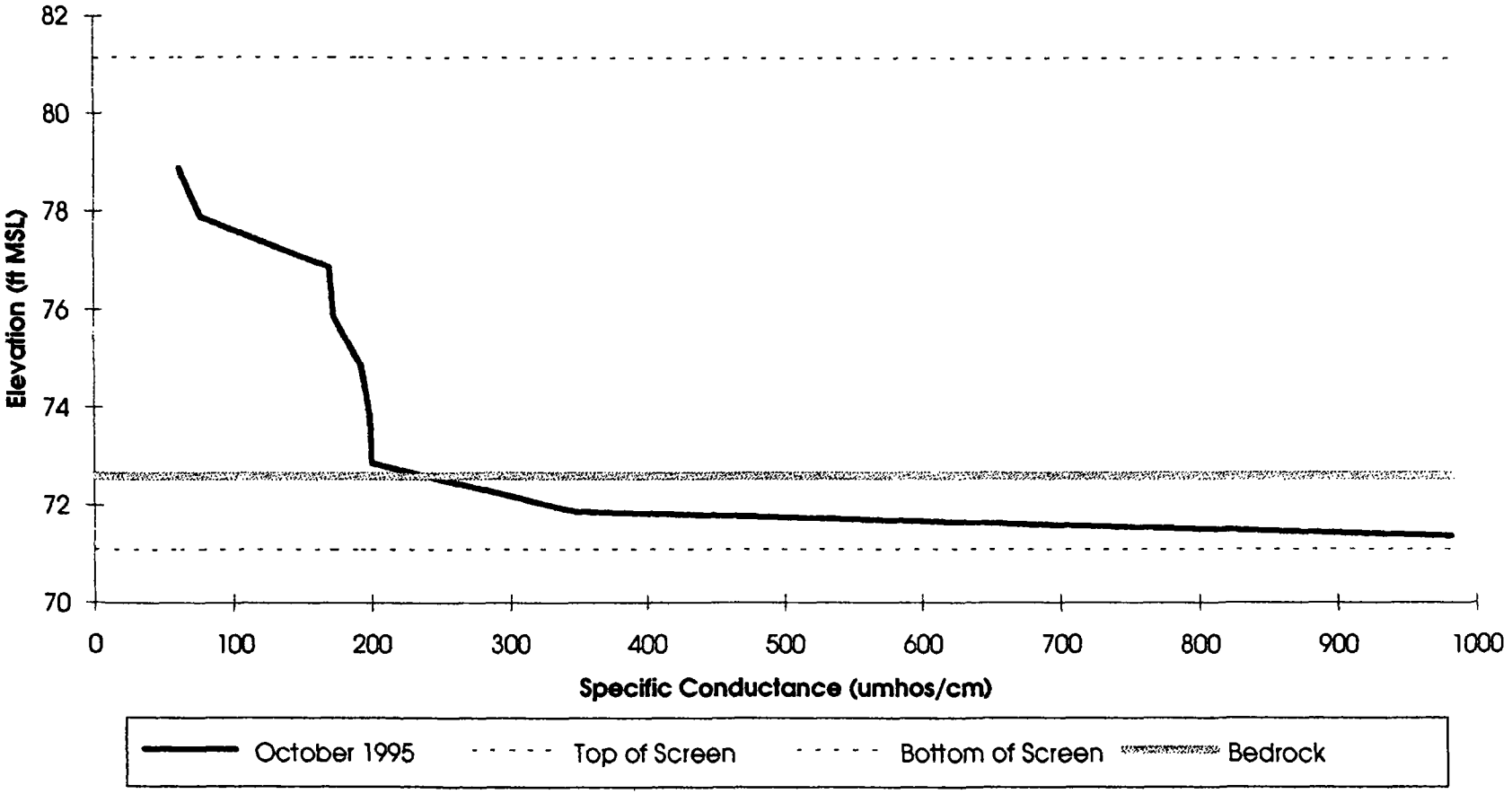


Specific Conductance Profile
GW-80-D

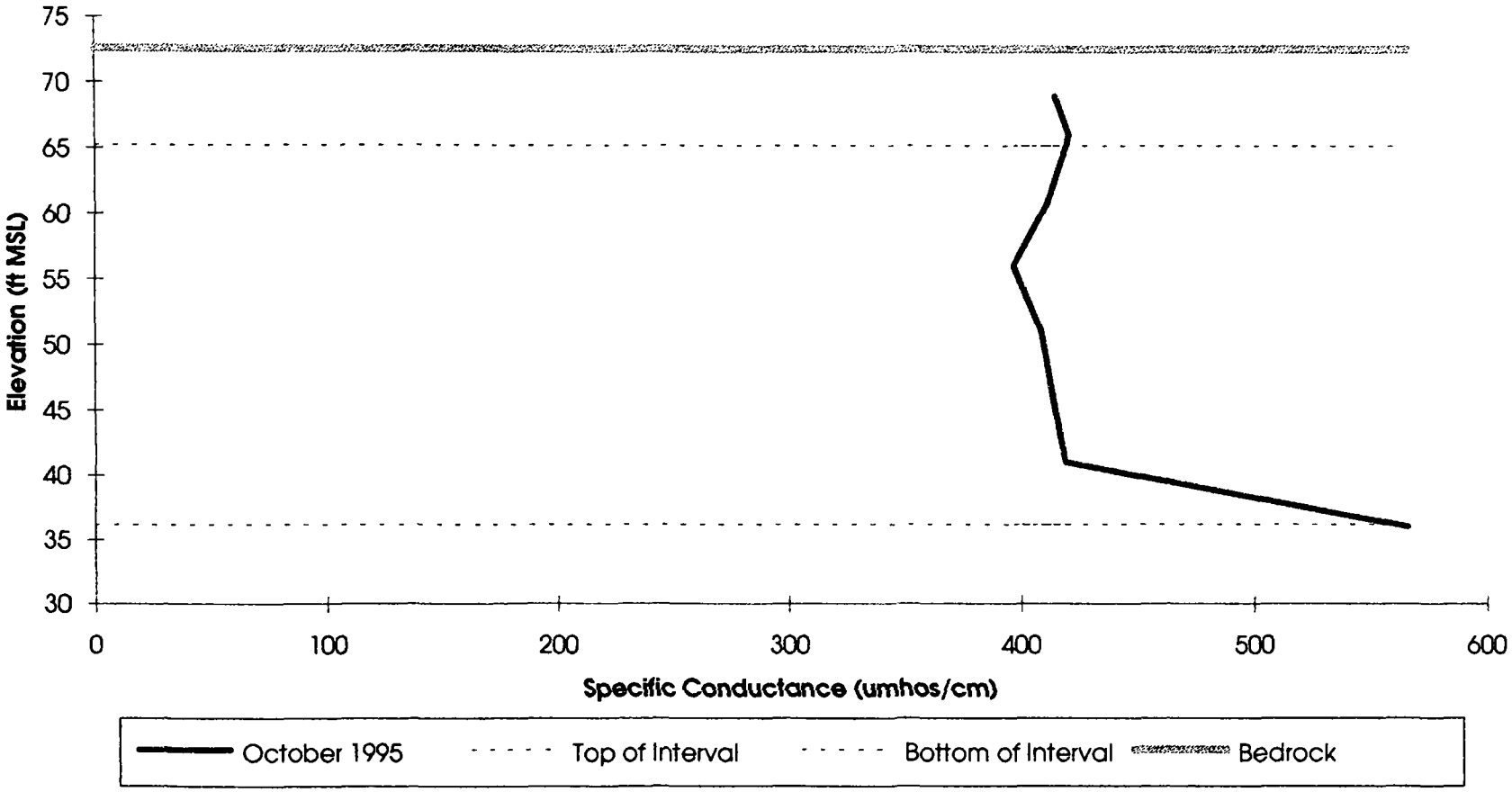




Specific Conductance Profile
GW-81-D



Specific Conductance Profile
GW-81-BR



Specific Conductivity Profile Data

GW-4-D						GW-17-D					
April 1993		January 1995		October 1995		April 1993		January 1995		October 1995	
Specific Conduct.	Elevation	Specific Conduct.	Elevation	Specific Conduct.	Elevation	Specific Conduct.	Elevation	Specific Conduct.	Elevation	Specific Conduct.	Elevation
600	76.23	621	76.23	539	75.23	3220	78.46	266	78.46	2776	76.46
598	74.23	624	74.23	558	70.23	3390	77.46	265	76.46	2746	74.46
609	70.23	623	69.23	1152	69.23	3430	76.46	263	71.46	2727	72.46
609	69.23	621	68.23	1215	68.23	3430	75.46	264	71.06	2707	71.46
1315	68.73	632	66.23	1367	67.23	3440	74.46			2707	71.06
3210	68.23	646	65.73	3220	66.23	3400	73.46				
3550	67.73	721	65.23	3660	65.23	3390	72.46				
3630	67.23	987	64.73	4100	64.23	3400	71.46				
3770	66.73	1650	64.23	4590	63.23	3410	71.06				
3820	66.23	2090	63.73	4660	62.23						
3880	65.73	2520	63.23	5010	61.23						
3930	65.23	2840	62.73	5210	60.23						
3980	64.23	3000	62.23	5320	59.33						
3990	63.23	3180	61.73								
4030	62.23	3310	61.23								
4040	61.23	3400	60.73								
4200	60.73	3500	60.23								
4310	60.23	3530	59.73								
4350	59.73	3370	59.23								

Specific Conductivity Profile Data

GW-19-D

April 1993		January 1995		October 1995	
Specific Conduct.	Elevation	Specific Conduct.	Elevation	Specific Conduct.	Elevation
948	81.78	1952	80.78	1887	78.78
985	80.78	1948	79.78	2000	74.78
1060	80.28	1947	78.78	2100	72.78
1286	79.78	1941	77.78	2080	71.78
1402	79.28	1944	74.78	2090	70.78
1456	78.78	1955	72.78	2080	68.68
1463	77.78	1980	72.28		
1478	76.78	1990	71.78		
1485	75.78	2010	69.78		
1488	74.78	2010	68.68		
1487	73.78				
1520	73.28				
1640	72.78				
1821	72.28				
1881	71.78				
1919	71.28				
1937	70.78				
1950	69.78				
1947	68.78				

GW-27-D

April 1993		January 1995		October 1995	
Specific Conduct.	Elevation	Specific Conduct.	Elevation	Specific Conduct.	Elevation
4090	81.4	2620	80.4	2641	78.4
4090	79.4	2850	79.4	2854	74.4
4080	74.4	2840	74.4	2900	69.4
4080	69.4	2650	69.4	3445	66.4
4050	64.4	2680	67.4	3793	65.4
4900	63.9	2740	66.9	4784	64.4
5330	63.4	2810	66.4	6987	63.4
6000	62.9	2920	65.4	24273	62.4
6920	62.4	3030	64.9	25747	61.4
10730	61.9	3090	64.4	30156	60.4
19440	61.4	3150	63.9	40221	59.4
25880	60.9	3210	63.4	44357	58.6
25760	53.8	3240	62.9		
		3270	62.4		
		3330	61.9		
		3390	61.4		
		20000	60.9		
		10720	61.2		
		19900	61.1		
		27854	53.7		

Specific Conductivity Profile Data

GW-34-D

April 1993		January 1995		October 1995	
Specific Conduct.	Elevation	Specific Conduct.	Elevation	Specific Conduct.	Elevation
2930	81.77	2180	81.27	2200	75.27
2920	80.27	2090	80.27	2200	70.27
2920	75.27	2160	75.27	2220	65.27
2900	70.27	2180	70.27	5000	64.27
3090	67.27	2170	68.27	5450	63.27
4310	66.27	2230	67.77	6080	62.27
7470	65.77	2280	67.27	6820	61.27
9050	65.27	2420	66.77	7200	60.27
9740	64.77	2530	66.27	7550	59.27
9850	64.27	4800	65.77	8280	58.27
9900	63.27	6530	65.27	13630	57.27
9970	62.27	7440	64.77	27364	56.27
10020	61.27	7710	64.27	25343	55.77
10600	60.27	7800	63.77		
10710	59.27	7860	63.27		
11250	58.77	7790	62.77		
12400	58.27	7970	62.27		
15980	57.77	8080	61.77		
19080	57.27	8170	61.27		
22155	56.77	8070	60.27		
25320	56.27	8190	59.77		
25320	55.47	8240	59.27		
		8330	58.77		
		9090	58.27		
		11460	57.77		
		14530	57.27		
		18700	56.77		
		22291	56.27		
		24944	55.77		

GW-40-D

April 1993		January 1995		October 1995	
Specific Conduct.	Elevation	Specific Conduct.	Elevation	Specific Conduct.	Elevation
662	82	0		1521	73
667	78	1158	80	1619	68
677	73	1160	78	1655	63
711	68	1164	73	1658	58
702	63	1163	68	1665	53
788	58	1155	63	1848	52
1048	56	1195	60	1924	51
1434	55	1213	59	1996	50
2138	54	1253	58	2030	49
2333	53	1296	57	2510	48
2644	52	1331	56	3150	47
3533	51	1376	55.5	3650	46
4645	50	1519	55	3850	45
5039	49	1543	54.5	3930	44
5078	48	1552	54	3960	42.7
5155	47	1616	53		
5370	46	1779	52.5		
5603	45	1868	52		
5681	44	2000	51.5		
5694	43	2160	51		
5538	42.1	2550	50.5		
		2960	50		
		3780	49.5		
		3970	49		
		3990	48.5		
		4000	48		
		4020	47		
		4080	46		
		4150	45.5		
		4350	45		
		4700	44.5		
		4810	44		
		4870	43.5		
		4930	43		

Specific Conductivity Profile Data

GW-42-S		GW-42-D						GW-43-S	
October 1995		April 1993		January 1995		October 1995		October 1995	
Specific Conduct.	Elevation	Specific Conduct.	Elevation	Specific Conduct.	Elevation	Specific Conduct.	Elevation	Specific Conduct.	Elevation
364	79.52	3010	81.41	[illegible]	81.41	965	79.41	1544	77.36
364	77.52	5420	79.41	[illegible]	79.41	977	74.41	1130	76.36
377	75.52	5950	74.41	[illegible]	74.41	980	69.41	1206	75.36
396	73.52	5950	69.41	[illegible]	69.41	976	64.41	1239	74.36
391	71.52	5940	64.41	[illegible]	64.41	973	59.41	1284	73.36
403	69.52	6300	63.41	[illegible]	63.41	962	54.41	1376	72.36
404	67.52	7830	62.91	[illegible]	62.41	37800	50.91	1432	71.36
411	66.52	13250	62.41	[illegible]	61.41	27354	50.41	250	70.36
		17600	61.91	[illegible]	60.41	[illegible]	40.41	9350	69.36
		20982	61.41	[illegible]	59.41			10450	68.36
		21235	60.91	[illegible]	58.41			11320	67.54
		25280	60.41	[illegible]	57.41				
		5200	64.41	[illegible]	56.41				
		6760	63.41	[illegible]	54.41				
		15312	62.41	[illegible]	41.41				
		25573	61.41						
		39626	60.41						
		47073	59.41						
		50732	58.41						
		53383	57.41						
		57042	56.41						
		60324	55.41						
		62848	54.91						
		63100	54.41						
		63100	45.41						

Specific Conductivity Profile Data

GW-43-D				GW-44-S		GW-44-D			
January 1995		October 1995		October 1995		January 1995		October 1995	
Specific Conduct.	Elevation	Specific Conduct.	Elevation	Specific Conduct.	Elevation	Specific Conduct.	Elevation	Specific Conduct.	Elevation
18570	79.97	25436	77.97	50	77.7	9741	88.97	9410	85.97
19152	77.97	25949	72.97	50	75.7	9547	83.97	9300	83.97
19244	72.97	26904	67.97	87	70.7	9421	78.97	9240	78.97
19250	70.47	27067	62.97	107	67.7	9384	73.97	9190	73.97
19345	67.97	31342	58.97	162	66.7	9326	68.97	9180	68.97
20038	65.47	33014	57.97	184	65.7	9401	63.97	9170	63.97
21016	62.97	36483	56.97	202	65.05	9427	62.97	10050	58.97
21872	60.47	87124	55.97			9652	62.47	11380	57.97
22560	57.97	89455	54.97			10132	61.97	12900	56.97
23201	59.97	89455	52.97			11162	61.47	14850	55.97
23648	59.47					12310	60.97	16630	54.97
24838	58.97					13718	60.47	18030	53.97
25457	58.47					14481	59.97	19480	52.97
26939	57.47					15482	59.47	20531	51.97
26939	51.47					16446	58.97	21979	50.97
						17443	58.47	23706	49.97
						18281	57.97	25385	48.97
						19026	57.47	27042	47.97
						19731	56.97	28808	46.97
						20403	56.47	29017	45.97
						21203	55.97	29178	44.97
						21940	55.47	29171	43.97
						22774	54.97	29230	42.97
						23256	54.47	29310	26.97
						24127	53.97		
						25047	53.47		
						26102	52.97		
						27032	52.47		
						28260	51.97		
						28834	51.47		
						29574	26.47		

Specific Conductivity Profile Data

GW-49-D				GW-50-D					
January 1995		October 1995		April 1993		January 1995		October 1995	
Specific Conduct.	Elevation	Specific Conduct.	Elevation	Specific Conduct.	Elevation	Specific Conduct.	Elevation	Specific Conduct.	Elevation
304	75.37	259	74.37	11550	77.11	7890	76.11	5810	75.11
315	71.37	285	73.37	11510	75.11	7930	75.11	5800	70.11
315	66.37	295	71.37	11480	70.11	7950	70.11	5820	65.11
332	62.77	321	69.37	11410	65.11	7920	65.11	5820	60.11
		334	67.37	11270	60.11	7940	60.11	5830	55.11
		334	65.37	11330	55.11	7900	55.11	5850	50.11
		530	64.37	11680	52.61	7860	50.11	6140	47.11
		670	63.87	12900	50.11	7920	49.11	8650	46.11
		845	63.37	13470	49.11	8210	48.61	14180	45.61
		967	62.87	11840	52.11	8850	48.11	14360	45.11
				11870	51.11	10030	47.61	14450	44.11
				12300	50.61	11130	47.11	14510	43.11
				12920	50.11	11900	46.61	15350	42.11
				13340	49.61	12520	46.11	15720	41.11
				13500	49.11	12990	45.61	15920	40.11
				13640	48.61	13860	45.11	16120	39.11
				14060	48.11	15500	44.61	16330	37.61
				14290	47.61	15810	44.11		
				14420	47.11	16020	43.61		
				14470	46.61	16200	43.11		
				14490	46.11	16240	42.61		
				15350	45.61	16270	42.11		
				17200	45.11	16700	41.11		
				16270	44.61	17030	40.61		
				18640	44.11	17140	40.11		
				18830	43.61	17140	39.61		
				18830	43.11	17130	39.11		
				18880	42.11	17130	38.61		
				18890	41.11	17130	38.11		
				18880	40.11	17120	37.61		
				18880	39.11				
				18880	38.11				
				19150	37.61				

Specific Conductivity Profile Data

GW-58-D

April 1993		January 1995		October 1995	
Specific Conduct.	Elevation	Specific Conduct.	Elevation	Specific Conduct.	Elevation
885	80.69	812	80.19	788	76.19
881	78.19	812	78.19	786	73.19
878	73.19	812	73.19	782	68.19
880	68.19	826	68.19	783	58.19
879	63.19	826	63.19	780	48.19
879	58.19	826	58.19	810	42.19
876	53.19	828	53.19	872	38.19
878	48.19	830	48.19	951	33.19
876	43.19	830	43.19	1115	31.19
874	38.19	836	42.19	1247	29.19
929	35.69	840	41.19	1720	28.19
986	35.19	849	40.19	8200	27.19
1079	34.19	849	39.19	9130	26.19
1166	33.19	855	38.19	12050	25.19
1262	32.69	871	37.19	13840	24.19
1358	32.19	893	36.19	16590	23.19
1397	31.69	911	35.69	18100	22.19
1464	31.19	939	35.19	18630	21.19
1555	30.69	976	34.69	21001	19.19
1660	30.19	998	34.19	22541	18.19
1790	29.69	1030	33.69	24179	17.19
1907	29.19	1066	33.19	25031	16.19
2180	28.69	1122	32.69		
2320	28.19	1166	32.19		
2470	27.69	1222	31.69		
4470	27.19	1281	31.19		
7590	26.69	1375	30.69		
9780	26.19	1463	30.19		
9890	25.69	1628	29.69		
10400	25.19	1887	29.19		
11550	24.69	2010	28.89		
12700	24.19	2190	28.69		
14450	23.69	2720	28.59		
15500	23.19	3550	28.29		
19950	22.69	4050	28.19		
19234	22.19	6450	27.69		
20416	21.69	8440	27.19		
19863	21.19	9370	26.69		
19992	20.69	9540	26.19		
20043	20.19	9600	25.69		
21956	19.69	9850	25.19		
23048	19.19	10880	24.69		
24011	18.69	12450	24.19		
24845	18.19	14300	23.69		

GW-61-BR

April 1993		January 1995		October 1995	
Specific Conduct.	Elevation	Specific Conduct.	Elevation	Specific Conduct.	Elevation
427	80.67	422	80.67	362	75.67
426	78.67	437	78.67	370	73.67
424	73.67	440	73.67	598	68.67
422	68.67	435	68.67	712	66.67
422	63.67	462	63.67	797	63.67
421	58.67	712	62.67	872	61.67
422	53.67	805	61.67	895	59.67
422	48.67	856	61.17	918	53.67
448	47.67	869	60.67	920	43.67
540	46.67	890	59.67	986	33.67
744	45.67	897	58.67	996	23.67
1045	44.67	906	57.67	996	13.67
1225	43.67	919	56.67	1001	8.67
1298	42.67	931	55.67	996	3.67
1350	41.67	943	54.67	994	-1.33
1360	40.67	961	53.67	996	-6.33
1368	38.67	975	52.67	994	-11.33
1373	33.67	973	51.67		
1373	28.67	979	50.67		
1373	23.67	995	49.67		
1372	18.67	1013	48.67		
1370	13.67	1015	47.67		
1369	8.67	1069	46.67		
1370	3.67	1103	45.67		
1369	-1.33	1106	44.67		
1373	-6.33	1107	43.67		
1367	-9.33	1108	42.67		
1500		1108	38.67		
		1108	33.67		
		1108	28.67		
		1110	23.67		
		1109	18.67		
		1111	13.67		
		1111	8.67		
		1110	3.67		
		1108	-1.33		
		1107	-6.33		
		1102	-9.28		

GW-58-D (continued)

April 1993		January 1995	
Conduct	Elevation	Conduct.	Elevation
25385	17.19	16970	22.69
25475	16.69	18230	22.19
25500	16.19	21365	21.69
		21947	21.19
		22174	20.69
		22442	20.19
		22646	19.69
		22976	19.19
		24353	18.69
		24756	18.19
		25467	17.69
		26336	17.19

Specific Conductivity Profile Data

GW-61-D

April 1993		January 1995		October 1995	
Specific Conduct.	Elevation	Specific Conduct.	Elevation	Specific Conduct.	Elevation
686	80.66	632	80.66	608	76.66
688	78.66	630	76.66	606	73.66
679	73.66	625	73.66	598	68.66
675	68.66	623	68.66	600	63.66
673	63.66	625	63.66	598	58.66
672	58.66	645	58.66	598	53.66
672	53.66	644	53.66	598	48.66
676	48.66	645	48.66	606	43.66
683	43.66	644	43.66	614	41.66
686	42.66	644	38.66	624	39.66
687	41.66	649	33.66	619	37.66
691	40.66	662	32.16	620	35.66
693	38.66	663	31.86	620	33.66
696	36.66			622	31.96
696	33.66				
750	31.66				

GW-62-BRD

April 1993		January 1995		October 1995	
Specific Conduct.	Elevation	Specific Conduct.	Elevation	Specific Conduct.	Elevation
2870	80.66	1391	80.66	1355	77.66
2920	78.66	1393	78.66	1353	73.66
3450	76.16	1381	73.66	1358	63.66
3510	73.66	1374	68.66	1353	53.66
3480	68.66	1376	63.66	1355	43.66
3470	63.66	1374	58.66	1357	33.66
3460	58.66	1372	53.66	1355	23.66
3450	53.66	1371	48.66	1355	13.66
3440	48.66	1372	43.66	1389	3.66
3440	43.66	1390	38.66	1446	-1.34
3440	38.66	1394	33.66	1457	-6.34
3430	33.66	1391	28.66	1454	-16.34
3420	28.66	1395	23.66	1497	-26.34
3410	23.66	1392	18.66	1498	-36.34
3400	18.66	1394	13.66	1502	-46.34
3390	13.66	1397	8.66	1498	-56.34
3380	8.66	1435	3.66	1499	-62.88
3380	3.66	1433	-1.34	1500	
3370	-1.34	1434	-6.34		
3360	-6.34	1433	-11.34		
3340	-11.34	1433	-16.34		
3340	-16.34	1434	-21.34		
3320	-21.34	1438	-26.34		
3320	-26.34	1436	-31.34		
3310	-31.34	1440	-36.34		
3310	-36.34	1439	-41.34		
3320	-41.34	1435	-46.34		
3310	-46.34	1438	-51.34		
3330	-51.34	1437	-56.34		
3400	-56.34	1437	-61.34		
3420	-58.84	1438	-62.84		
3490	-59.34				
3520	-59.84				
3540	-60.34				
3550	-60.84				
3580	-61.34				
3620	-61.84				
3680	-62.34				
3880	-62.84				

Specific Conductivity Profile Data

GW-62-BR

April 1993		January 1995		October 1995	
Specific Conduct.	Elevation	Specific Conduct.	Elevation	Specific Conduct.	Elevation
4080	80.67	[illegible]	80.67	6760	77.67
4090	78.67	[illegible]	78.67	7290	75.67
4050	73.67	[illegible]	73.67	7460	73.67
4080	68.67	[illegible]	68.67	7420	63.67
4020	63.67	[illegible]	63.67	7360	53.67
4020	58.67	[illegible]	58.67	7990	43.67
4010	53.67	[illegible]	53.67	8760	38.67
4000	48.67	[illegible]	48.67	8920	33.67
4030	43.67	[illegible]	43.67	10000	28.67
4380	42.67	[illegible]	38.67	10030	23.67
4480	41.67	[illegible]	33.67	10040	13.67
4570	40.67	[illegible]	31.17	11630	3.67
4760	39.67	[illegible]	28.67	11710	1.67
4850	38.67	[illegible]	23.67	11770	-1.33
4960	37.67	[illegible]	21.17	11780	-6.33
5060	36.67	[illegible]	18.67	11780	-11.33
5230	35.67	[illegible]	13.67	11760	-16.33
5450	34.67	[illegible]	10.67	11770	-21.33
5750	33.67	[illegible]	9.67	17740	-26.63
6200	32.67	[illegible]	8.67		
6410	31.67	[illegible]	6.17		
6950	30.67	[illegible]	5.67		
7300	29.67	[illegible]	4.67		
7720	28.67	[illegible]	3.67		
8560	27.67	[illegible]	-1.33		
9300	26.67	[illegible]	-6.33		
10100	25.67	[illegible]	-11.33		
11300	24.67	[illegible]	-16.33		
12400	23.67	[illegible]	-21.33		
12560	22.67	[illegible]	-26.33		
12630	21.67				
12670	20.67				
12670	19.67				
12710	18.67				
12700	16.17				
12710	13.67				
12670	11.17				
12670	8.67				
12700	6.17				
12830	5.67				
13030	4.67				
13080	3.67				
13050	2.67				
13070	1.67				

GW-62-BR (continued)

April 1993	
Conduct.	Elevation
13070	-3.83
13060	-6.33
13080	-8.83

GW-62-D

April 1993		January 1995		October 1995	
Specific Conduct.	Elevation	Specific Conduct.	Elevation	Specific Conduct.	Elevation
376	80.84	0	83.84	326	77.84
366	78.84	330	80.84	325	73.84
366	73.84	335	78.84	326	63.84
364	68.84	335	73.84	329	53.84
362	63.84	332	68.84	330	43.84
362	58.84	321	63.84	342	33.84
360	53.84	332	58.84	452	23.84
360	48.84	332	53.84	492	21.84
360	43.84	332	48.84	577	19.84
359	38.84	332	43.84	681	18.84
359	33.84	335	38.84	1140	17.84
358	28.84	345	36.34	1254	16.84
356	23.84	348	35.84	1371	15.84
360	21.34	350	34.84	1538	14.84
366	18.84	353	33.84	1630	14.45
371	17.84	360	28.84		
390	16.84	389	26.84		
436	16.34	394	25.84		
451	15.84	400	23.84		
471	14.84	415	18.84		
488	14.34	436	16.34		
		437	15.84		
		437	14.34		

Specific Conductivity Profile Data

GW-64-D						GW-65-BR		GW-65-D			
April 1993		January 1995		October 1995		October 1995		January 1995		October 1995	
Specific Conduct.	Elevation	Specific Conduct.	Elevation	Specific Conduct.	Elevation	Specific Conduct.	Elevation	Specific Conduct.	Elevation	Specific Conduct.	Elevation
496	79.96	[illegible]	76.96	665	67.96	2930	-16.5	[illegible]	77.19	319	68.19
488	75.96	[illegible]	75.96	665	65.96	3110	-18	[illegible]	74.19	320	64.19
489	70.96	[illegible]	70.96	665	60.96	3150	-20	[illegible]	69.19	321	54.19
498	69.96	[illegible]	65.96	672	55.96	3140	-30	[illegible]	64.19	322	44.19
519	68.96	[illegible]	60.96	714	50.96	3140	-40	[illegible]	59.19	320	34.19
587	67.96	[illegible]	59.96	812	45.96	3110	-50	[illegible]	54.19	336	24.19
667	67.46	[illegible]	58.96	807	40.96	3050	-60	[illegible]	49.19	339	14.19
682	66.96	[illegible]	57.96	804	35.96	2980	-70	[illegible]	44.19	340	4.19
693	65.96	[illegible]	56.96	805	30.96	2910	-80	[illegible]	39.19	350	2.19
702	63.96	[illegible]	55.96	1540	29.96	2860	-90	[illegible]	34.19	383	-5.81
704	60.96	[illegible]	54.96	1680	28.96	2710	-100	[illegible]	29.19	421	-7.81
700	55.96	[illegible]	53.96	1940	27.96	2640	-110	[illegible]	24.19	431	-9.81
698	50.96	[illegible]	52.96	1963	26.96	2550	-120	[illegible]	19.19	450	-11.81
696	45.96	[illegible]	51.96	1940	25.96	2500	-130	[illegible]	14.19	457	-13.81
695	40.96	[illegible]	50.96	1901	24.96	2240	-135	[illegible]	9.19	458	-15.81
696	35.96	[illegible]	45.96	2080	23.96	1716	-139	[illegible]	4.19	460	-17.81
695	30.96	[illegible]	41.96	2350	22.96	1174	-140	[illegible]	-0.81	448	-18.21
717	27.96	[illegible]	40.96	2480	21.96	987	-141	[illegible]	-1.81		
737	26.96	[illegible]	39.96	2550	20.96			[illegible]	-2.81		
752	25.96	[illegible]	38.96	2680	19.96			[illegible]	-3.81		
755	24.96	[illegible]	37.96	2920	18.96			[illegible]	-4.81		
761	23.96	[illegible]	36.96					[illegible]	-5.81		
779	22.96	[illegible]	35.96					[illegible]	-6.81		
805	21.96	[illegible]	35.46					[illegible]	-7.81		
988	21.46	[illegible]	34.96					[illegible]	-8.81		
1420	20.96	[illegible]	33.96					[illegible]	-9.81		
2070	20.46	[illegible]	32.96					[illegible]	-10.81		
2290	19.96	[illegible]	31.96					[illegible]	-11.81		
2390	19.46	[illegible]	30.96					[illegible]	-12.81		
2460	18.96	[illegible]	28.96					[illegible]	-13.81		
2600	18.56	[illegible]	28.46					[illegible]	-14.81		
		[illegible]	27.96					[illegible]	-15.81		
		[illegible]	26.96					[illegible]	-16.81		
		[illegible]	25.96					[illegible]	-17.81		
		[illegible]	23.96					[illegible]	-18.31		
		[illegible]	22.96								
		[illegible]	21.96								
		[illegible]	20.96								
		[illegible]	19.96								
		[illegible]	18.96								

Specific Conductivity Profile Data

				GW-68-BR						GW-68-D	
January 1995		October 1995		April 1993		January 1995		October 1995		January 1995	
Specific Conduct.	Elevation	Specific Conduct.	Elevation	Specific Conduct.	Elevation	Specific Conduct.	Elevation	Specific Conduct.	Elevation	Specific Conduct.	Elevation
654	80.39	692	77.39	133	84.93	0	89.93	844	79.93	519	81.16
655	75.39	692	75.39	170	79.93	418	81.93	1175	78.93	515	80.16
650	70.39	690	70.39	174	74.93	418	79.93	1389	77.93	514	75.16
650	65.39	692	60.39	172	69.93	416	74.93	1421	76.93	506	73.16
651	60.39	693	50.39	169	64.93	418	69.93	1435	74.93		
651	55.39	691	40.39	166	59.93	416	64.93	1447	69.93		
652	50.39	697	30.39	164	54.93	425	63.93	1445	64.93		
652	45.39	763	28.39	163	49.93	438	62.93	1443	59.93		
653	40.39	849	26.39	162	44.93	451	61.93	1462	54.93		
651	35.39	921	25.39	166	43.93	455	60.93	1475	49.93		
653	30.39	1082	24.39	174	42.93	458	59.93	1487	44.93		
661	29.89	1112	23.39	204	41.93	468	58.93	1505	39.93		
663	29.39	1137	20.39	221	40.93	469	57.93	1506	34.93		
683	28.89	1146	18.39	240	39.93	471	56.93	1504	29.93		
693	28.39	1134	16.39	261	38.93	470	54.93	1581	26.93		
713	27.89	1151	14.39	273	37.93	468	49.93	1630	25.93		
746	27.39	1194	13.39	287	36.93	468	44.93	1687	24.93		
870	26.89	1269	11.39	298	35.93	467	39.93	1150	23.93		
977	26.39	1284	10.59	330	34.93	466	34.93	1780	22.93		
1040	25.89			340	33.93	465	29.93	2150	22.43		
1049	25.39			353	32.93	464	24.93	2190	21.93		
1118	24.39			365	31.93	480	22.93	3300	20.93		
1184	23.39			377	30.93	504	21.93	3260	19.93		
1197	22.39			379	29.93	530	20.93	3260	18.93		
1201	21.39			408	28.93	561	20.43	3240	17.93		
1199	20.39			425	27.93	594	19.93	18000	16.93		
1198	15.39			429	26.93	631	19.43	27710	16.43		
1209	12.39			432	25.93	648	18.93	27710	13.93		
1226	11.39			438	24.93	656	17.93				
1297	10.39			450	23.93	702	17.43				
				452	22.93	1650	17.13				
				459	21.93	11200	17.03				
				472	20.93	27782	16.93				
				474	19.93	27782	14.83				
				477	18.93						
				481	17.93						
				500	17.43						
				926	16.93						
				1190	16.43						
				1242	15.93						
				5350	15.43						
				19029	14.93						
				19349	14.43						

Specific Conductivity Profile Data

GW-69-D

April 1993		January 1995		October 1995	
Specific Conduct.	Elevation	Specific Conduct.	Elevation	Specific Conduct.	Elevation
3450	81.05	837	81.05	1684	78.05
3460	78.05	1637	80.55	1722	77.05
3450	73.05	1639	80.05	1766	73.05
3460	68.05	1633	78.05	1800	68.05
3460	63.05	1634	73.05	1810	63.05
3460	58.05	1627	68.05	1800	58.05
3480	55.05	1630	63.05	1925	56.05
3930	54.55	1665	58.05	4700	55.55
4870	54.05	1782	57.55	5750	55.05
5710	53.55	1853	57.05	6030	54.05
5910	53.05	1942	56.55	6830	53.05
6260	52.55	2050	56.05	7960	52.05
6580	52.05	2550	55.55	8770	51.05
7500	51.55	3160	55.05	12510	50.05
7710	51.05	3800	54.55	12950	49.05
8030	50.55	4370	54.05	13530	48.05
17100	50.05	4700	53.55	13820	47.05
17700	49.55	5000	53.05	14320	46.05
17800	49.05	5410	52.55	14800	45.55
17890	48.55	6280	52.05		
17950	48.05	7530	51.55		
17980	47.55	8180	51.05		
17990	47.05	8790	50.55		
18030	46.05	11400	50.05		
18100	45.65	14600	49.55		
		14800	49.05		
		14950	48.55		
		15000	48.05		
		14990	47.55		
		15000	47.05		
		15040	46.55		
		15120	46.05		
		15430	45.55		

SMITH

APPENDIX L

TERRAIN CONDUCTIVITY REPORT

Appendix L

ENVIROSCAN, INC.

March 30, 1995

Mr. Richard Sacks
Project Manager
BCM Engineers, Inc.
1 Plymouth Meeting
Plymouth Meeting, PA 19462

RE: Geophysical Survey
Olin Corporation Facility
Wilmington, MA
Enviroscan Project No. 129426

Dear Mr. Sacks:

Pursuant to our proposal dated January 27, 1995, Enviroscan, Inc. completed a surface geophysical groundwater conductivity survey at the above-referenced site between February 1 and February 10, 1995. The following text, figures, and appendices detail the methods and results of the survey.

Purpose

The purpose of the survey was to delineate an inferred groundwater plume containing ammonium and chromium sulfate, reportedly originating from several closed unlined lagoons on the Olin facility. Since the presence of dissolved ionic compounds (in this case containing SO_4^{5-} among others) dramatically affects the conductivity of water, a terrain conductivity survey was performed to evaluate the conductivity of groundwater beneath the site and within a buried bedrock valley extending northwestward from the facility (see Figure 1, after BCM, 1995).

Background

The site encompasses a former Olin manufacturing facility including production buildings, storage facilities, offices, and waste treatment and disposal facilities. In addition to the Olin facility, adjacent properties and wetlands overlying a buried bedrock valley in the downgradient direction of the facility were also included in the survey area.

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Based on a seismic reflection survey (by others) performed in the western portion of the wetland, bedrock depths range from 30 to 80 feet below ground surface (bgs) in the buried valley and are significantly more shallow adjacent to the valley.

Method

EM terrain conductivity profiling instruments employ an electromagnetic transmitter coil to induce an electrical current in the earth. This current creates a secondary electromagnetic field which is measured by a receiver coil at a fixed separation from the transmitter, and has a strength proportional to the bulk electrical conductivity or terrain conductivity of the subsurface materials within an effective survey depth dictated by the intercoil spacing. In order to survey multiple depth intervals within the inferred bedrock valley, a Geonics EM-34-3-DL (EM-34) instrument was used at two intercoil spacings and in two coil orientations. The various coil configurations and effective depths (see McNeill, 1980a) surveyed were:

10 meter separation, horizontal dipole(10H) - approximately 0 to 30 feet

10 meter separation, vertical dipole(10V) - approximately 5 to 50 feet

20 meter separation, horizontal dipole(20H) - approximately 0 to 65 feet

20 meter separation, vertical dipole(20V) - approximately 10 to 95 feet

The proposed survey was also to include 40 meter separation horizontal and vertical dipole measurements; however, field conditions precluded the collection of these measurements (and the configurations employed provided sufficient survey depth based on the seismic reflection survey results).

The terrain conductivity measured by an EM instrument is primarily sensitive to the following parameters: the relative proportions of porous (soil) versus less porous (rock) material within the effective survey depth, the moisture content of the material, and the ionic content of the pore moisture. Therefore, EM surveys can identify areas of increased terrain conductivity associated with ion-enriched (and electrically conductive) groundwater plumes.

Field Survey

For this survey, terrain conductivity data were collected along a series of 11 profiles (see Figure 1). Originally 12 profiles were planned; however, access to the location of Line 11 could not be obtained during this phase of the field program. In addition, the value of any data collected from Line 11 would be questionable due to the proximity of the survey line to an overhead high voltage electrical transmission line that would represent a significant source of EM interference.

Where practical, the profiles were located perpendicular to the inferred axis of the buried valley and coincident with existing monitoring wells and seismic reflection lines. Profiles were cleared of dense vegetation prior to data collection by BCM Engineers, Inc. (BCM) or others. In most cases the length of each profile was limited by the end of the cleared vegetation.

Along each profile an Enviroscan geophysicist and a geologist provided by BCM used a Geonics EM-34 terrain conductivity meter and an Omnidata Series 500 data logger to collect and record conductivity readings. Readings were collected for 10H, 10V, 20H and 20V coil orientations at pre-marked (by BCM or others) 50 foot intervals along each profile line.

Prior to data collection each day, the EM-34 was set-up according to the manufacturer's instructions and tuned for DC offsets and coil compensation. After the set-up procedure and tuning were performed, terrain conductivity readings were obtained at a fixed calibration station to assure that the instrument was performing properly and consistently. Note that a coil misalignment was detected shortly after collection of the February 1 base station reading, and all profile readings collected with the misaligned coil were re-collected following correction. As demonstrated in the table below, subsequent base station readings (in millimhos per meter or mmho/m) displayed no significant drift.

Date	10 Meter Vertical Dipole	10 Meter Horizontal Dipole	20 Meter Vertical Dipole	20 Meter Horizontal Dipole
Feb. 1, 1995	25	17	19	21
Feb. 2, 1995	32	25	27	25
Feb. 3, 1995	31	23	27	30
Feb. 9, 1995	29	22	30	28
Feb. 10, 1995	30	21	26	28

At the completion of each profile the data in the data logger were downloaded to a field computer. At this time any necessary positioning corrections (due to inaccessible stations, etc.) were performed.

Data Reduction and Analysis

The terrain conductivity data were prepared for interpretation using the DAT34 software package supplied by Geonics for use with the EM-34. Field data were converted to a format suitable for generating profiles and contour plots. Because surveyed coordinates for the geophysical survey stations along each line were not available, coordinates for each station were digitized from an AutoCAD drawing supplied by BCM.

Profile plots of the EM-34 field data (Appendix A) were generated using Microsoft Excel for Windows. Contour plots (Figure 2 and Appendix B) of the data were generated using the statistical kriging algorithm in Surfer for Windows by Golden Software. The raw field data are tabulated in Appendix C.

Data Interpretation

The terrain conductivity profiles and contour plots were examined for the presence of anomalies (areas of higher terrain conductivity) which could indicate the presence of conductive groundwater. These data were also compared with groundwater quality data from wells located along the profile lines as well as geologic and seismic reflection data provided by BCM, and with typical terrain conductivities for saturated sandy glacial outwash similar to that which reportedly underlies the site. Note that since the extent of the inferred plume was not known a-priori, and the site is bounded by developed areas representing significant sources of EM noise, a reliable site-specific "background" or non-plume terrain conductivity value could not be collected. Therefore, typical terrain conductivity values for clean-water-saturated-sand (i.e. less than 8 to 10 mmho/m — see McNeill, 1980b) were considered to represent a reasonable background.

As expected, with the exception of Line 9 (see explanation below), the highest observed conductivities (i.e. approximately 20 to 35 mmhos/m) were observed on the Olin property in the vicinity of the closed lagoons which presumably represent the source of the inferred groundwater plume (see Appendix A, Line 1, range 0' through 200' for all coil orientations, and Line 12, range 800' through 950' for the 10H, 10V, and 20V coil orientations). Note the negative values at range 850' on Line 12 and 600' on Line 1 for the 20V coil orientation. Negative values actually indicate exceptionally high conductivities beyond the dynamic range of the EM-34. Therefore, the negative conductivities on Lines 1 and 12 probably represent "hot" or extremely high conductivity zones within the inferred groundwater plume.

Line 2 does not exhibit any significant anomalies except for a 10 mmho/m anomaly at range 200 on the 20H coil orientation. This anomaly may be the result of cultural interference since this profile traversed an area of random dumping, or it could indicate a fracture or bedrock channel containing high conductivity material (i.e. clay or ion-rich water). Analytical results from a monitoring well to the east of this profile (GW-58D) indicated sulfate contamination, and therefore support the latter interpretation.

Line 3 also extended through the area of random dumping described above. Therefore, the anomalies observed from range 0' through 400' on the 10H coil orientation are probably also the result of cultural interference. The remaining coil orientations (10V, 20H, and 20V) exhibit a well-defined anomaly between range 200' and 700'. The conductivities observed at the two deeper survey depths (16 to -6 mmhos/m for the 20H and 20V coil orientations) suggest channelized occurrence of highly conductive material. Conductivities of this magnitude (noting that negative values indicate high conductivity) generally do not result from naturally occurring soils or bedrock (see McNeill, 1980b) and are therefore probably the result of ionic compounds in the groundwater.

Negative terrain conductivity values observed at range 0' on Line 4 (10H and 10V) are the result of cultural interference from a monitoring well cluster at this location. A significant broad anomaly (range 100' to 800', centered on range 500') occurs on this profile at all coil orientations (10V shows the most distinct example of this feature). The lower magnitude of this anomaly at depth (approximately 11 mmhos/m in the 20V coil orientation) and the stronger, more defined anomaly at the 10V coil orientation (approximately 19 mmhos/m) may indicate that the channel is less defined at this location, or that dissipation and dilution of the inferred plume occurs between Lines 3 and 4, causing the inferred plume to be evident in both the shallow and deep surveys.

A well-defined anomaly representing the inferred plume or other highly conductive material along the axis of the buried valley is absent in the 10H and 10V coil orientation data from Line 5. Although the conductivities observed for these coil orientations (6 to 10 mmhos/m) could result from a weak or diffuse ionic groundwater plume, the values observed at these coil orientations are also consistent with conductivities expected for saturated uncontaminated clay (see McNeill, 1980b).

The deeper survey depths (20H and 20V) for Line 5 exhibit a 12 to 13 mmho/m anomaly at range 350'. Since the geology of the deeper portions of the buried valley are presumed to be glacial outwash (sands and gravels with little clay), and these materials are not likely to produce terrain conductivities of this magnitude, the presence of this anomaly suggests that the inferred groundwater plume may be present at depth beneath Line 5. In addition, if the inferred plume is following the buried valley, the deepest part of the valley occurs at approximately range 350' on this profile — coincident with the terrain conductivity anomaly.

The interpretation of Line 6 is similar to Line 5; the shallow survey depths (10H and 10V coil orientations) are suggestive of saturated clay, possibly containing low concentrations of sulfates or other ions. The 20H coil orientation exhibits a broad anomaly from range 500' to 950' suggesting higher concentrations of sulfate or other conductive material at depths less than approximately 65 feet bgs. The deeper expression of the same anomaly is observed between range 700' and 950' from the 20V coil orientation. This anomaly is better defined and has a slightly higher magnitude than the anomaly seen at the 20H coil orientation, suggesting that if the inferred plume is present, it is restricted to the center of the buried valley at a depth between approximately 65 and 100 feet bgs.

With the exception of the 20H coil orientation, which exhibits a broad anomaly from range 750' to 1150', the terrain conductivities observed on Line 7 are consistent with the range expected for natural materials occurring in this depositional environment. The anomaly observed from the 20H coil orientation may suggest that a portion of the plume is still present at this location at less than 65 feet bgs.

Line 8 probably exhibits natural terrain conductivities in all coil orientations. The high conductivity values observed between range 500' and 600' are most likely the result of cultural interference from the monitoring well at the end of this profile, and possibly from inferred man-made or reinforced levees along the nearby former canal.

Line 9 exhibits huge anomalies (in excess of 100 mmhos/m) that can only be attributed to highly conductive material (i.e. metal) in the subsurface. These anomalies are probably associated with unmapped utilities, metal-debris-rich fill, or buried metallic structures associated with the nearby canal (see Figure 1). The data from this profile display evidence of metallic interference; therefore, they were not considered in the EM survey interpretation.

Likewise, the data for Line 10 were collected adjacent to power lines, underground water lines, nearby buildings, and automobiles. These data were used to generate the contour maps but the contours should be given little weight in interpreting the maps.

Due to its proximity to Line 1, Line 12 was described in the beginning of this section. As explained previously, data were not collected from Line 11.

In an attempt to perform calibration between the terrain conductivities and measured groundwater conductivities (see Figure 3, GW-61D, GW-61BR, GW-62D, and GW-62BR), the terrain conductivities were compared to specific conductance data from selected wells. The results of this comparison are presented in Figure 3. In general, there is not a good correlation between the groundwater specific conductance and the terrain conductivity from nearby profiles. However, the specific conductance data were collected at discrete depth intervals, while the EM-34 data represent averages over an effective survey depth. In addition, the specific conductance for groundwater from different wells in the same well cluster do not show a strong correlation. The lack of correlation between the EM-34 terrain conductivities and monitoring well specific conductances (and between specific conductance for individual wells within clusters) should not be interpreted as indicating that either data set is flawed. Instead, the difference is probably due to the difference in resolution between the data sets — the EM-34 data sample the bulk conductivity of the subsurface within a generally large depth interval, while the monitoring well data may sample individual bedrock fractures (many of which with differing water qualities may lie within an EM-34 effective measurement range).

Summary

The following summary is based on the data and interpretations described above:

- The highest terrain conductivities not attributed to cultural interference occur adjacent to the former lagoons on the Olin facility property.
- The level of these conductivities (i.e. 20 to 35 mmho/m) is well above typical conductivities for saturated granular native material, and therefore indicate dissolved ionic compounds (e.g. sulfates or other charged ions) associated with the inferred plume near its source.
- Distinctly elevated terrain conductivities associated with a possible plume appear to be present at coil orientations 20H and 20V in the data for Lines 3 and 4 — hydraulically downgradient from the inferred plume source.
- The deeper EM data from Lines 5 and 6 also display slightly elevated terrain conductivities in areas that could represent a thin or diffuse extension of the inferred plume, or zones of outwash at depth with elevated clay content.
- The inferred plume is confined to the center of the valley in the vicinity of Line 3, but (if present) diffuses horizontally and vertically in hydraulically downgradient directions from this profile.
- Evidence of the inferred plume is not apparent beyond (downgradient from) Line 7.
- The highlighted areas on Figure 2 and on the individual contour maps in Appendix B depict the most likely overall configuration of the inferred plume.

Limitations

The geophysical survey described above was completed using standard and/or routinely accepted practices of the geophysical industry and equipment representing the best available technology. Enviroscan does not accept responsibility for survey limitations due to inherent technological limitations or unforeseen site-specific conditions. However, we make every effort to identify and notify the client of such limitations or conditions.

As always, we have enjoyed and appreciated this opportunity to work with you. If you have any questions, please do not hesitate to contact me.

Sincerely,
Enviroscan, Inc.

Jeffrey D. Loeffler, P.G.
Senior Project Manager

enc: Figure 1 through 3
Appendices A, B, and C
References

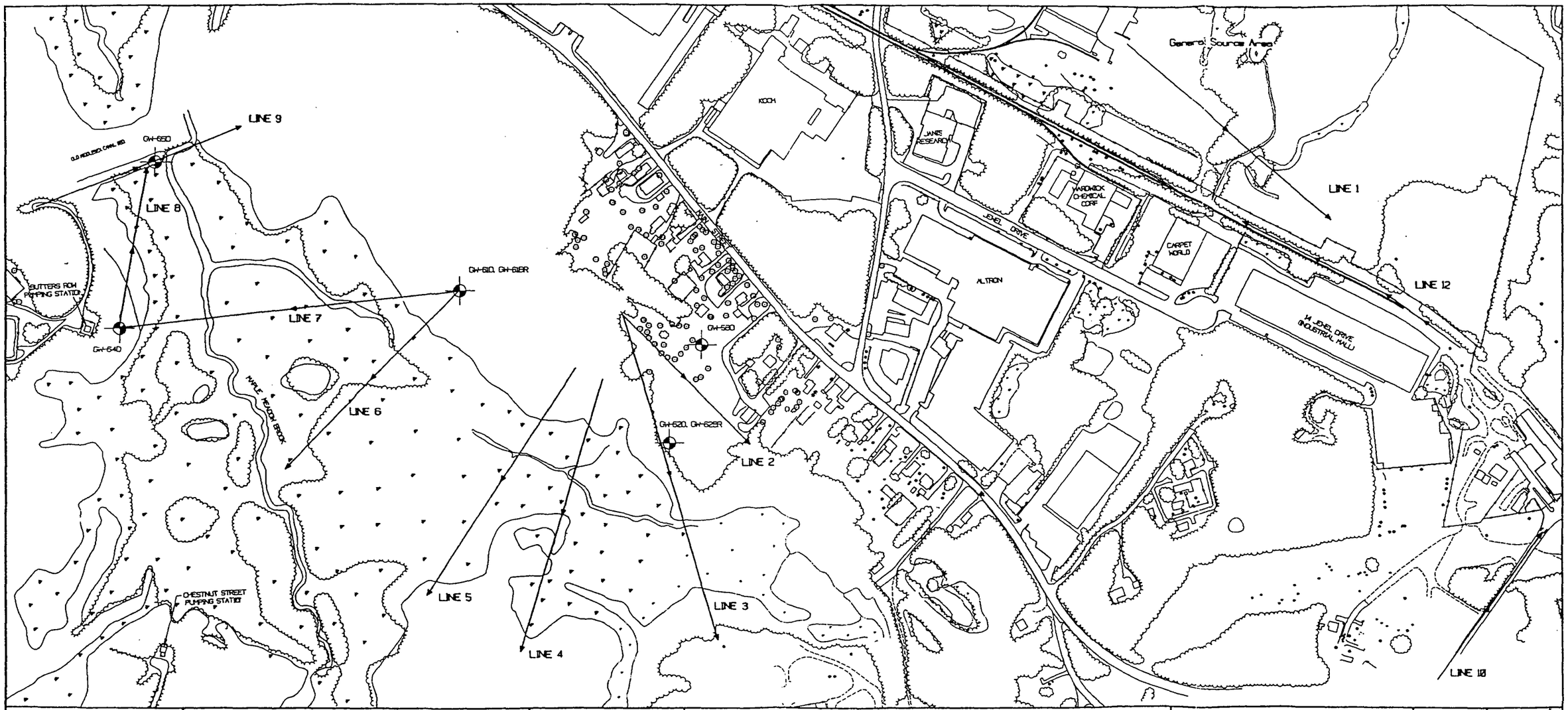
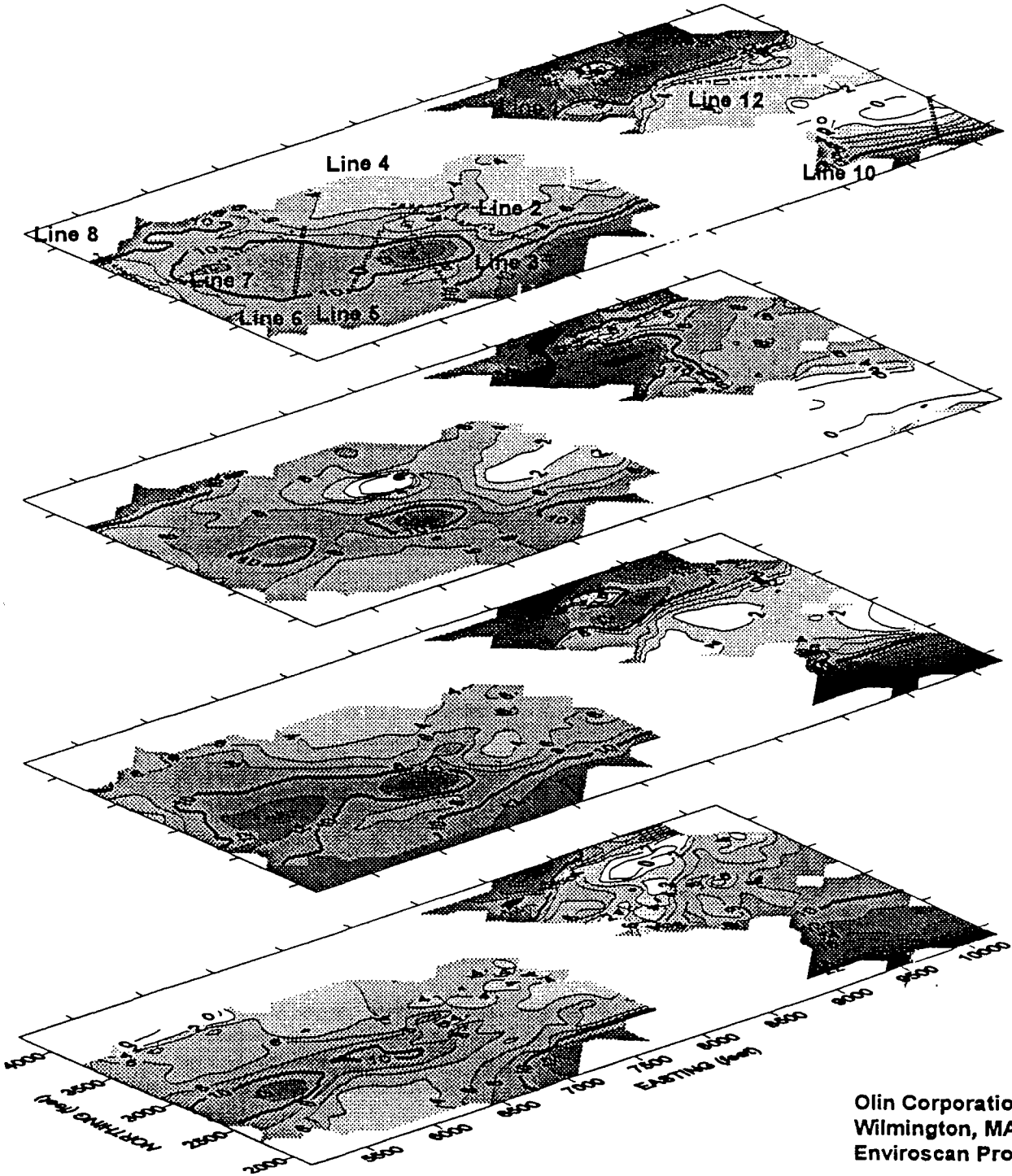


Figure 1	EM Terrain Conductivity Survey Layout Olin Corporation Facility and Environs Wilmington, Massachusetts	Enviroscan, Inc. Project Number 129426	Base map from Un-numbered AutoCAD drawing by BCM Engineers, Inc., Project No. 3683, File No. P-88	Scale: 1"=350' 0' 350' 700'	ENVIROSCAN, INC.



10 Meter Coil Separation, Horizontal Dipole

Max. Depth = 30 feet

10 Meter Coil Separation, Vertical Dipole

Max. Depth = 50 feet

20 Meter Coil Separation, Horizontal Dipole

Max. Depth = 65 feet

20 Meter Coil Separation, Vertical Dipole

Max. Depth = 95 feet

Figure 2

EM-34 Terrain Conductivities (mmhos/m)

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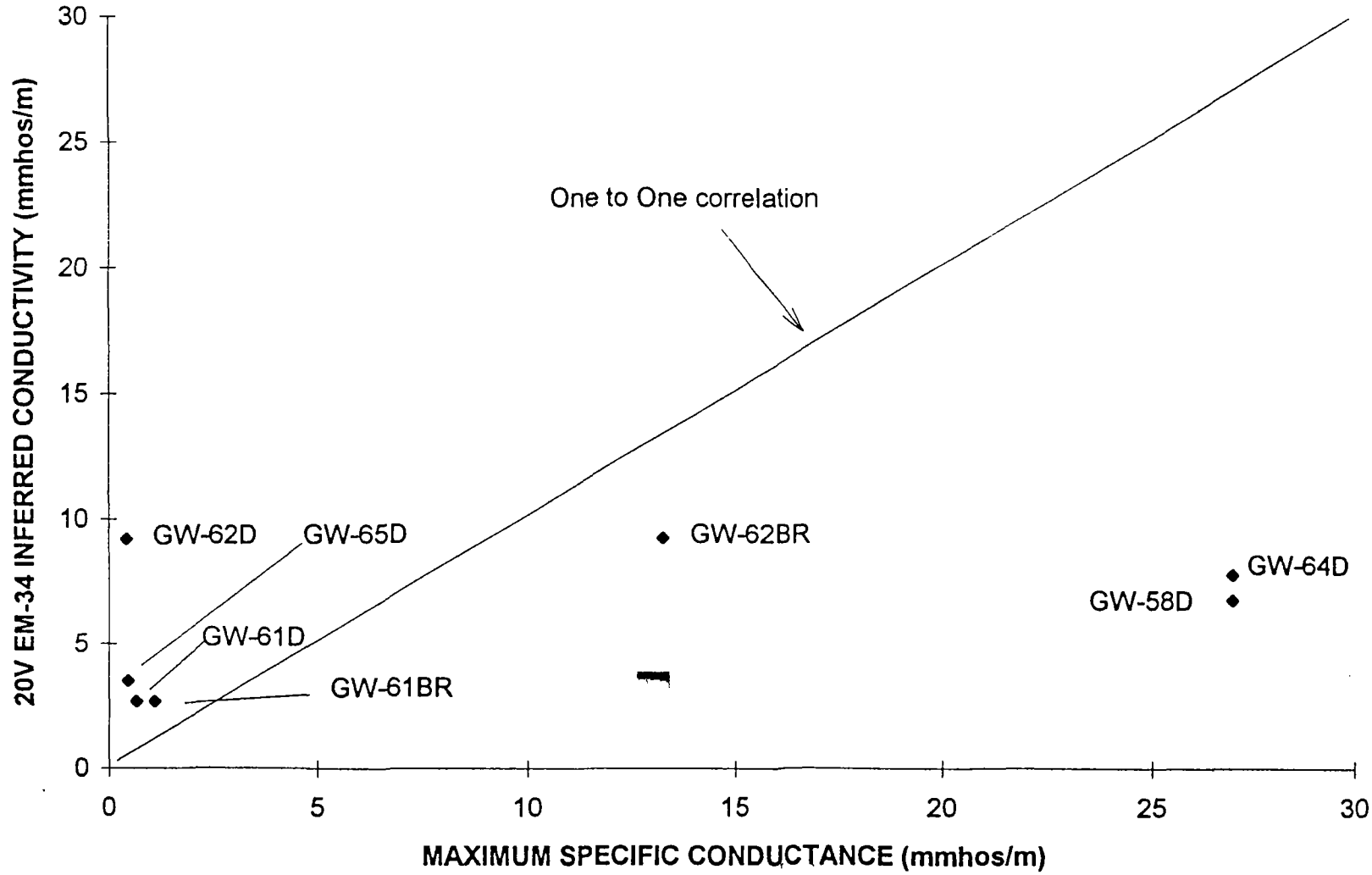
FIGURE 3
TERRAIN CONDUCTIVITY CORRELATION



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Wilmington Mass.

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Appendix A

Terrain Conductivity Profiles

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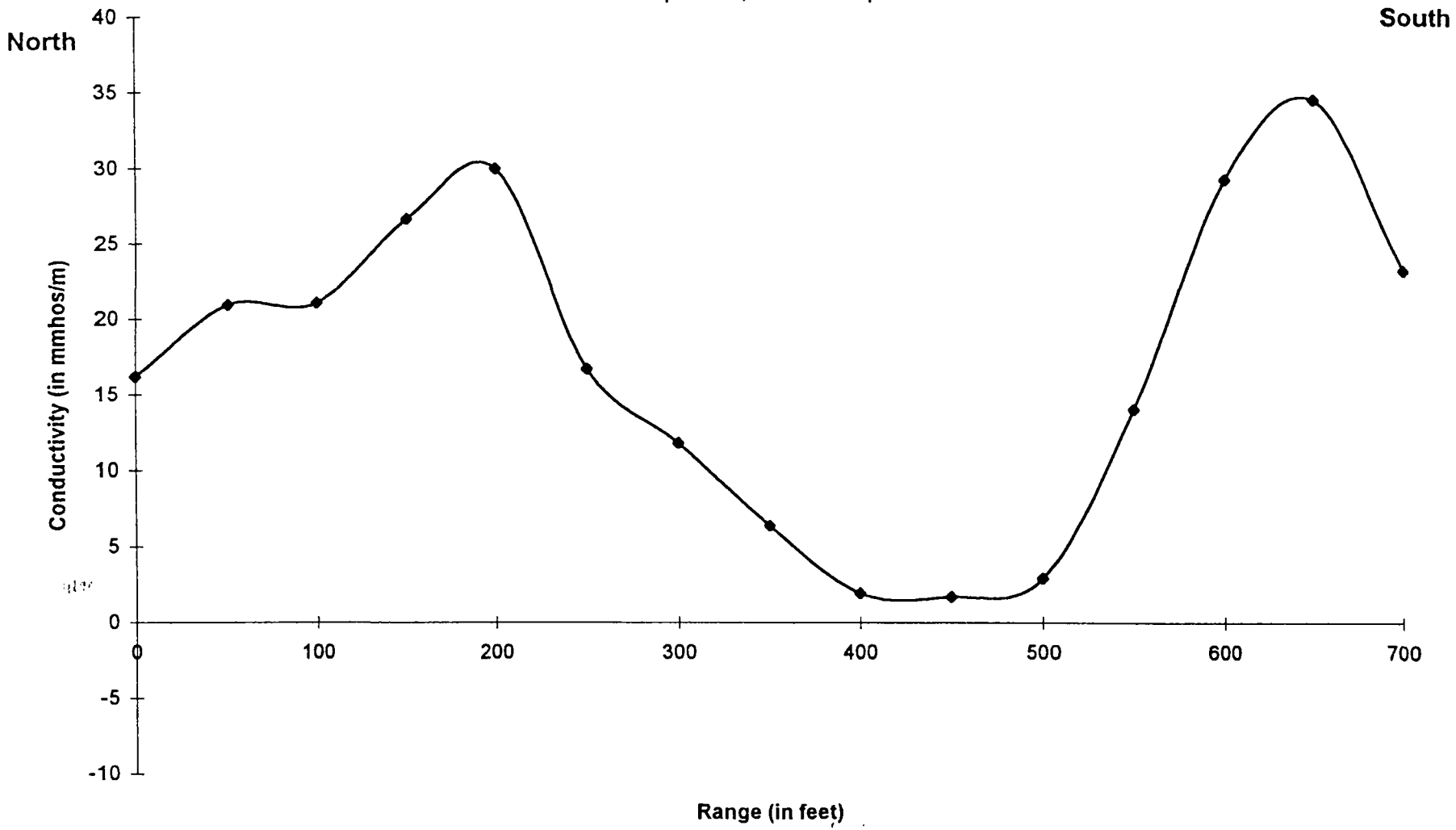
APPENDIX A
Terrain Conductivity Profiles
Line 1

10 meter separation, horizontal dipole



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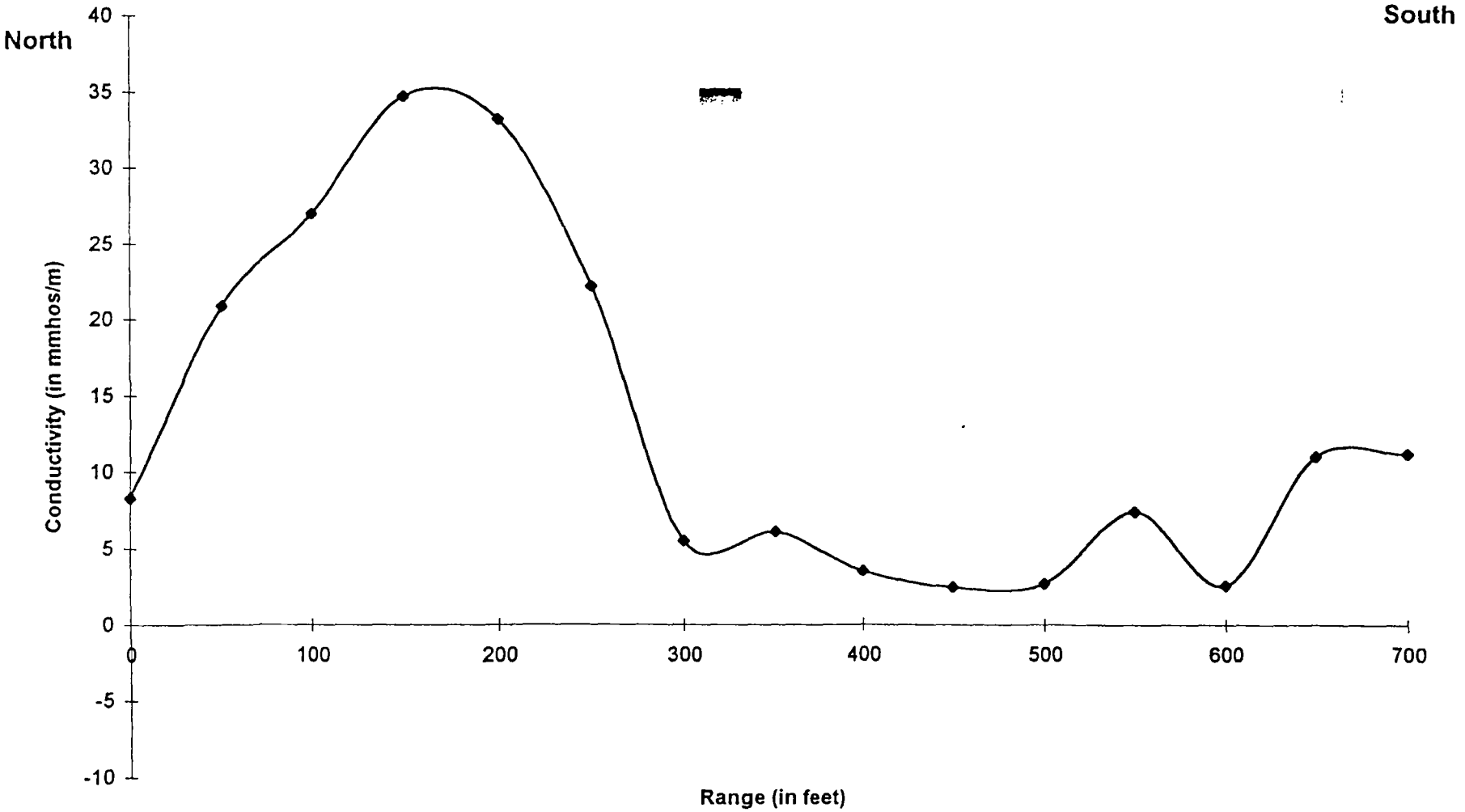
APPENDIX A
Terrain Conductivity Profiles
Line 1
10 meter separation, vertical dipole



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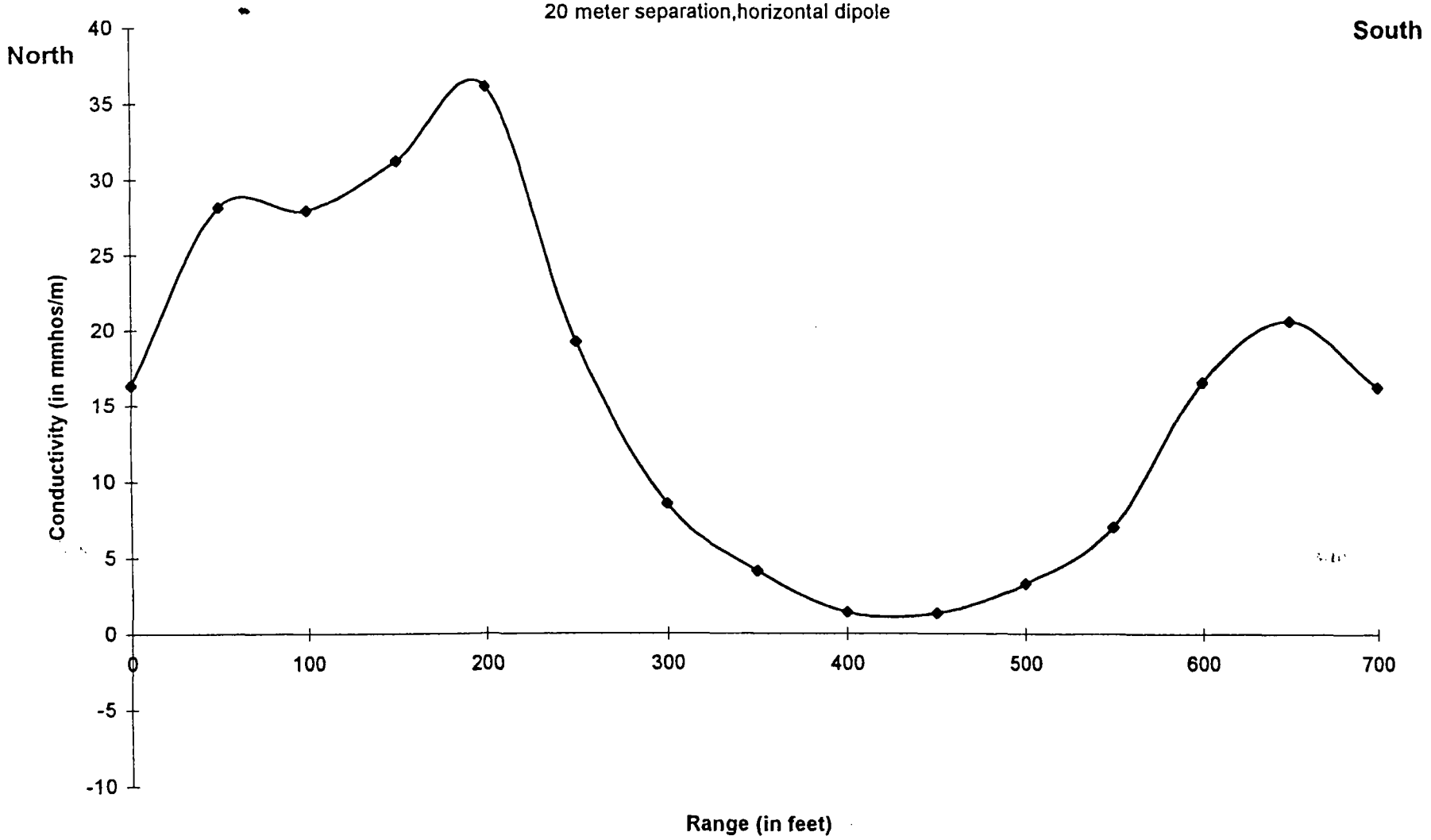
APPENDIX A
Terrain Conductivity Profiles
Line 1
20 meter separation,horizontal dipole



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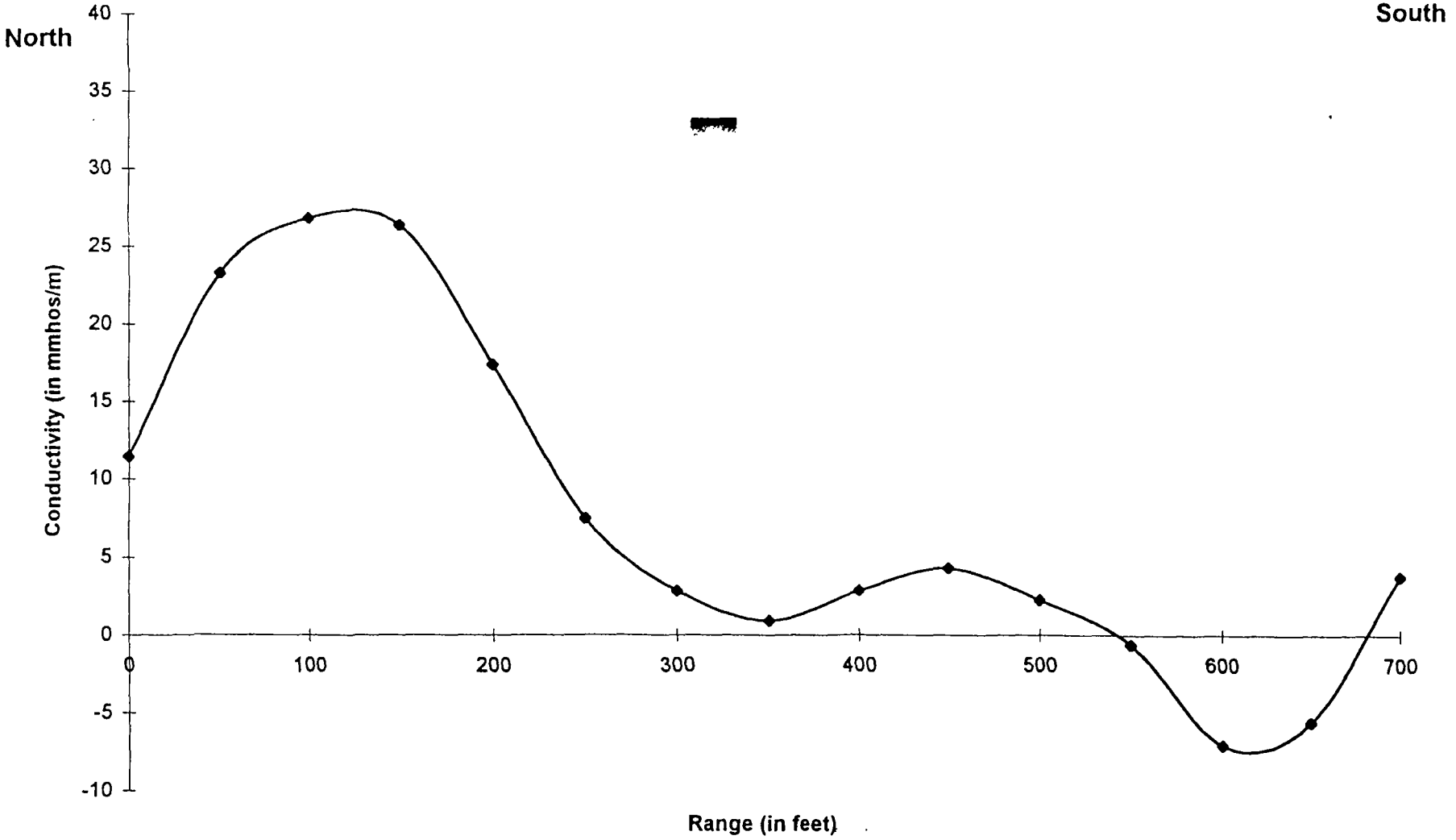
APPENDIX A
Terrain Conductivity Profiles
Line 1
20 meter separation, vertical dipole



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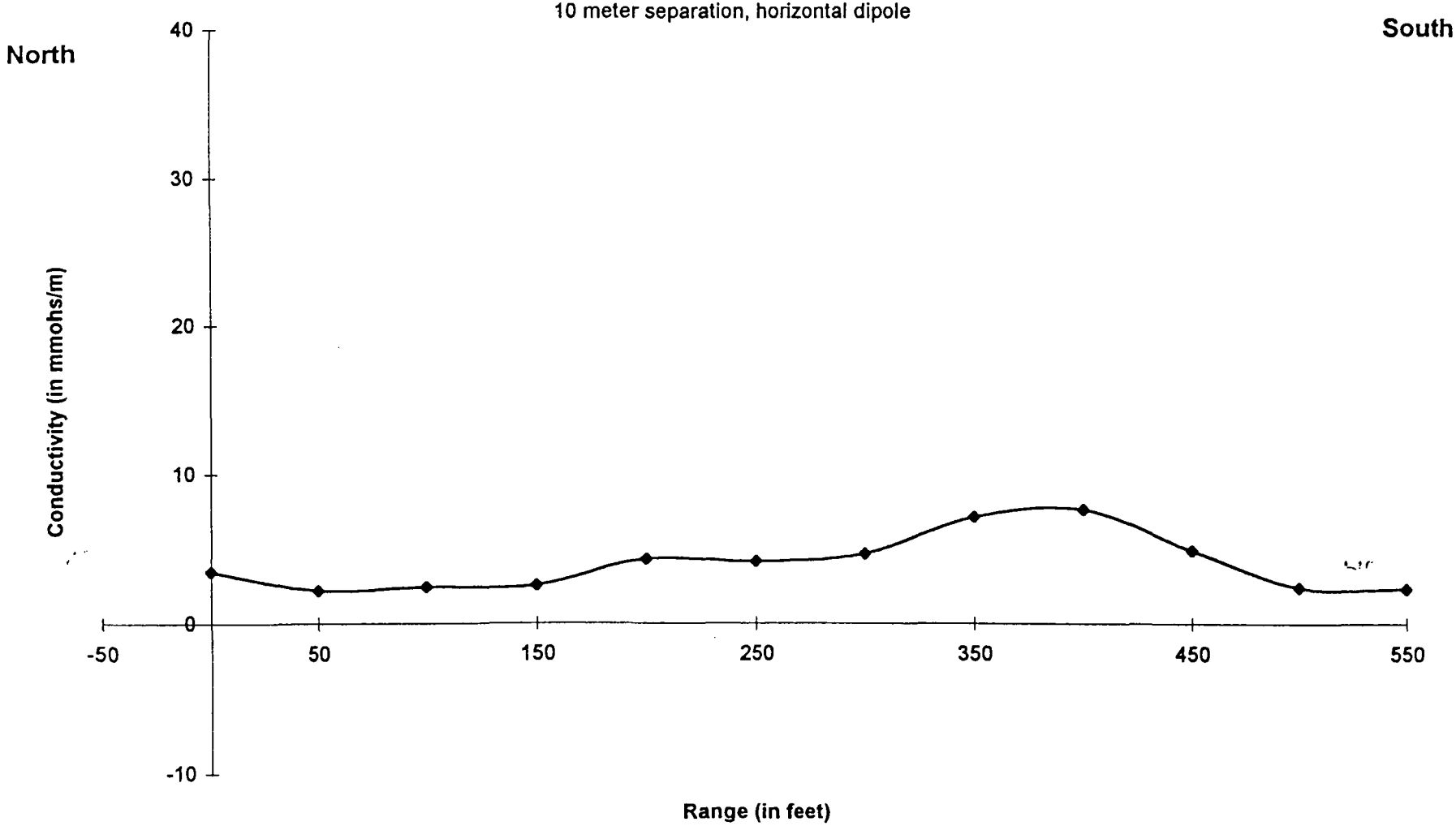
APPENDIX A
Terrain Conductivity Profiles

Line 2
10 meter separation, horizontal dipole



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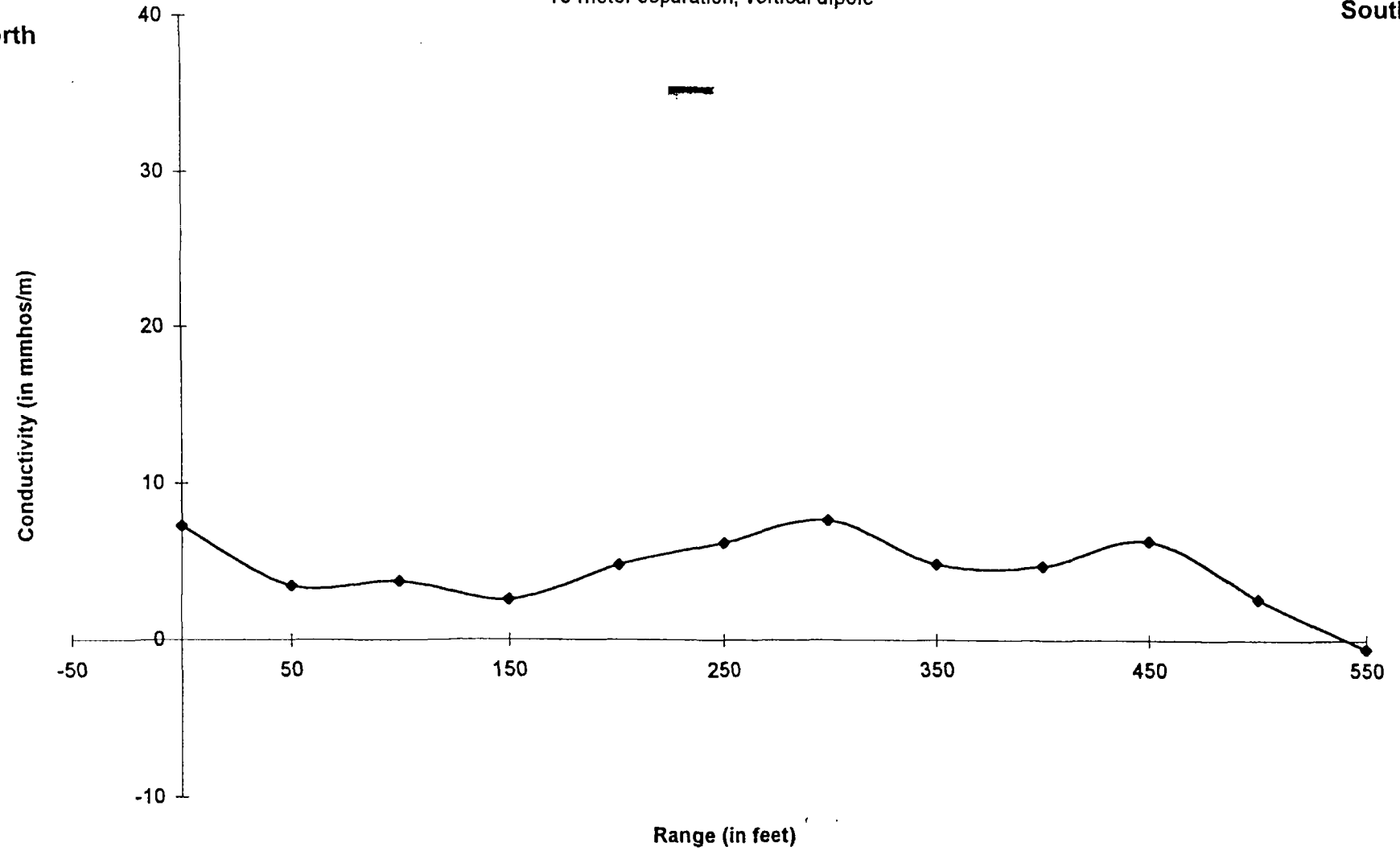
APPENDIX A
Terrain Conductivity Profiles

Line 2
10 meter separation, vertical dipole

North

South



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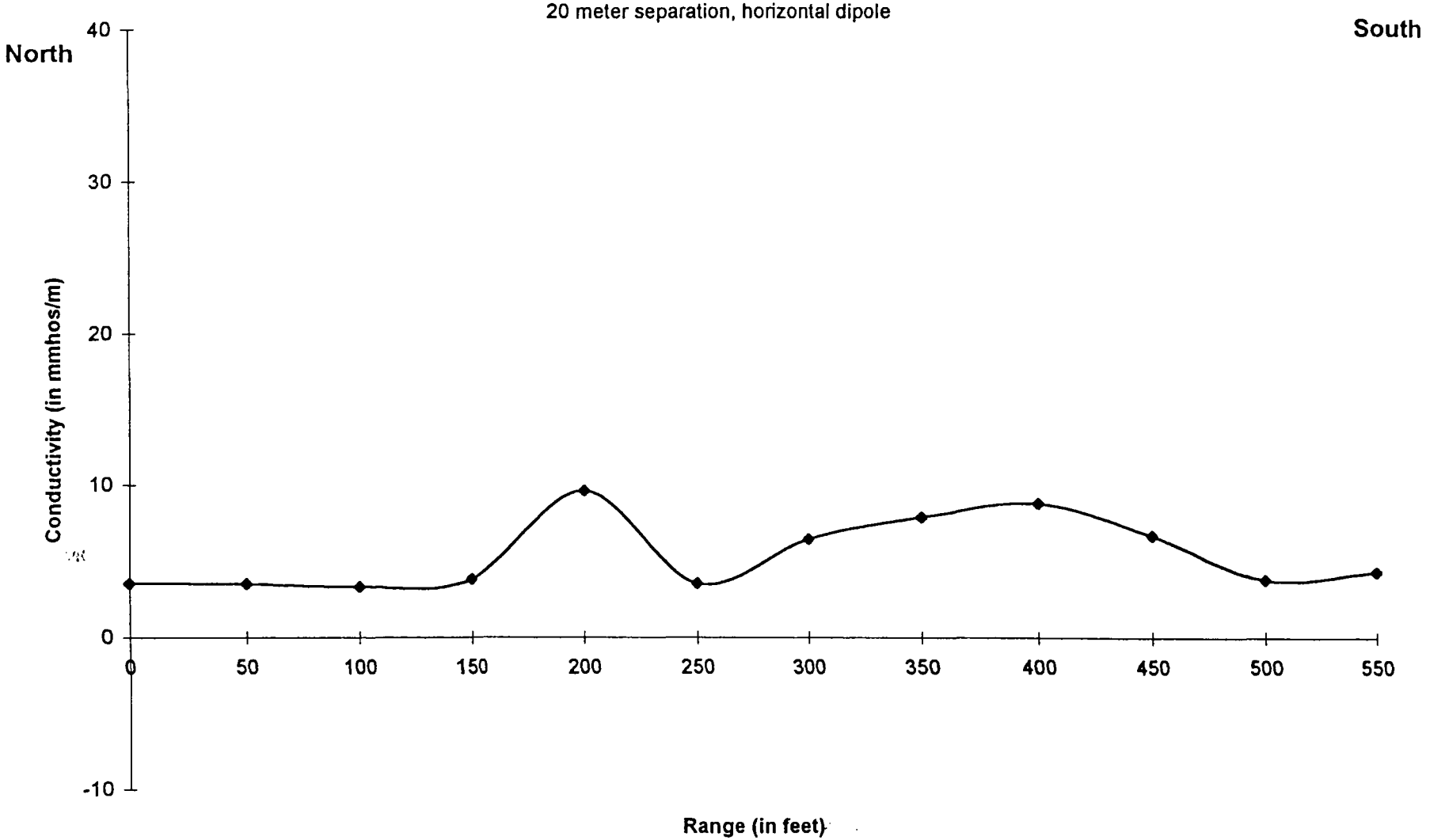
APPENDIX A
Terrain Conductivity Profiles

Line 2
20 meter separation, horizontal dipole



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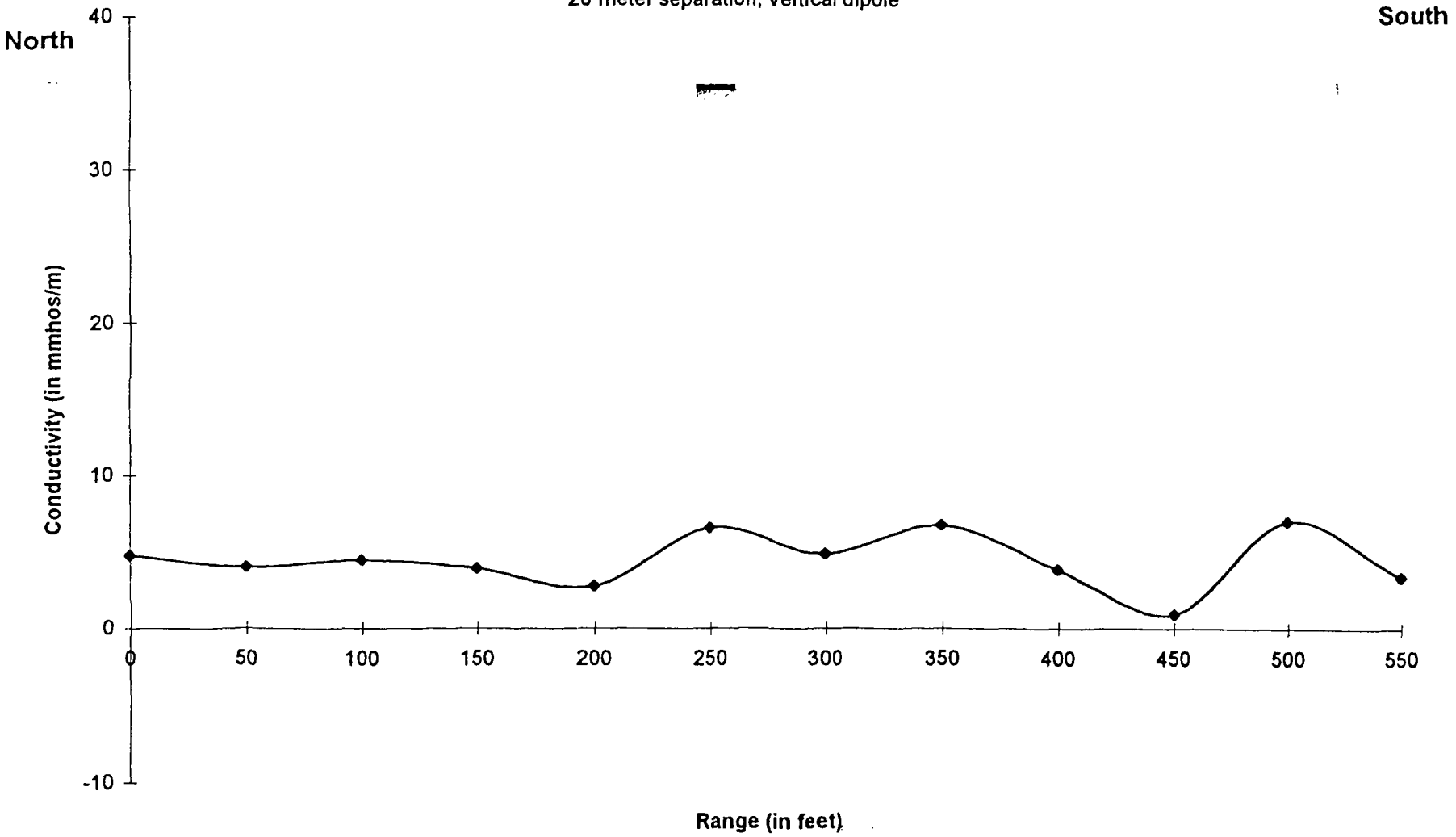
APPENDIX A
Terrain Conductivity Profiles

Line 2

20 meter separation, vertical dipole



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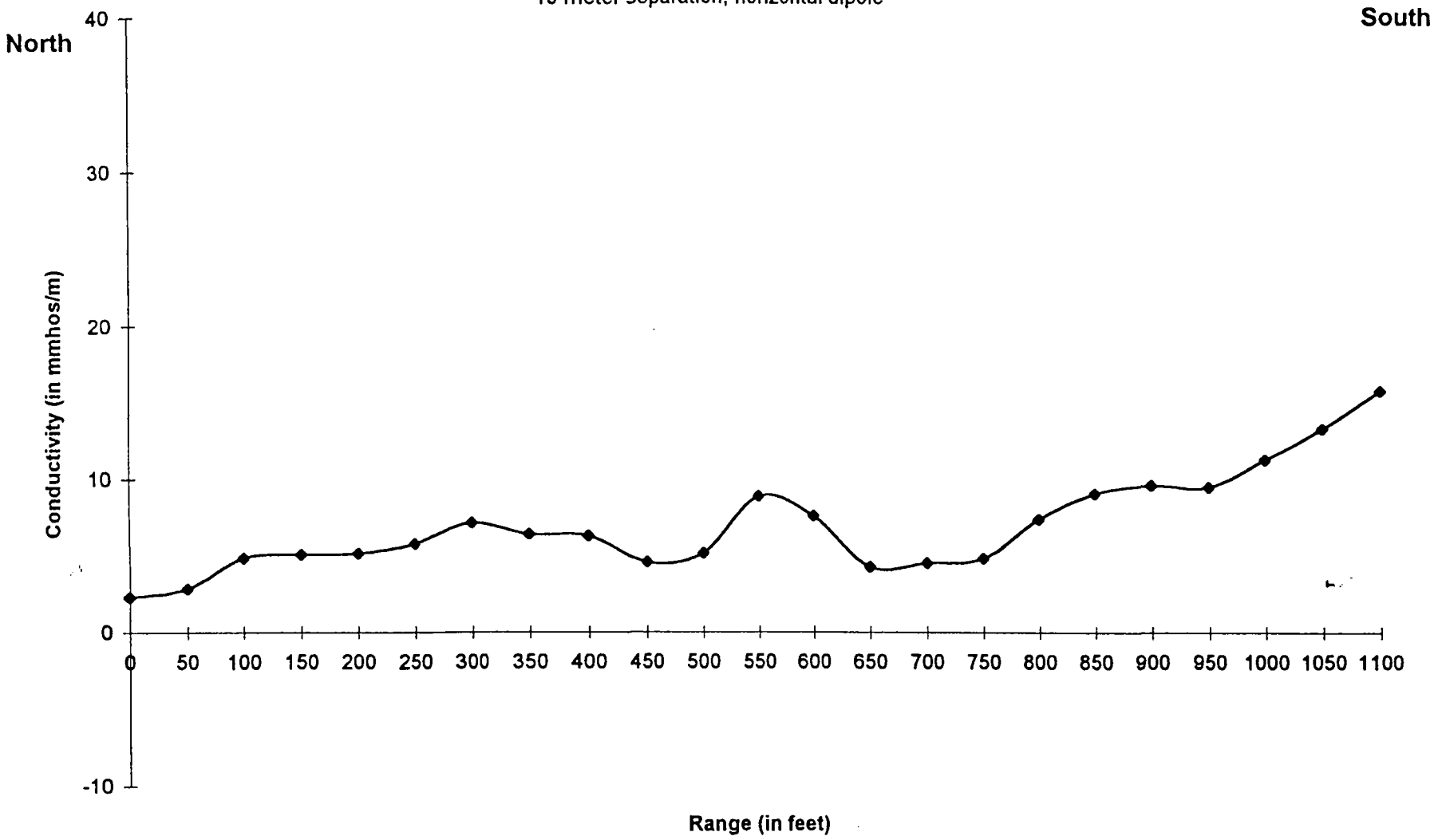
APPENDIX A
Terrain Conductivity Profiles

Line 3

10 meter separation, horizontal dipole



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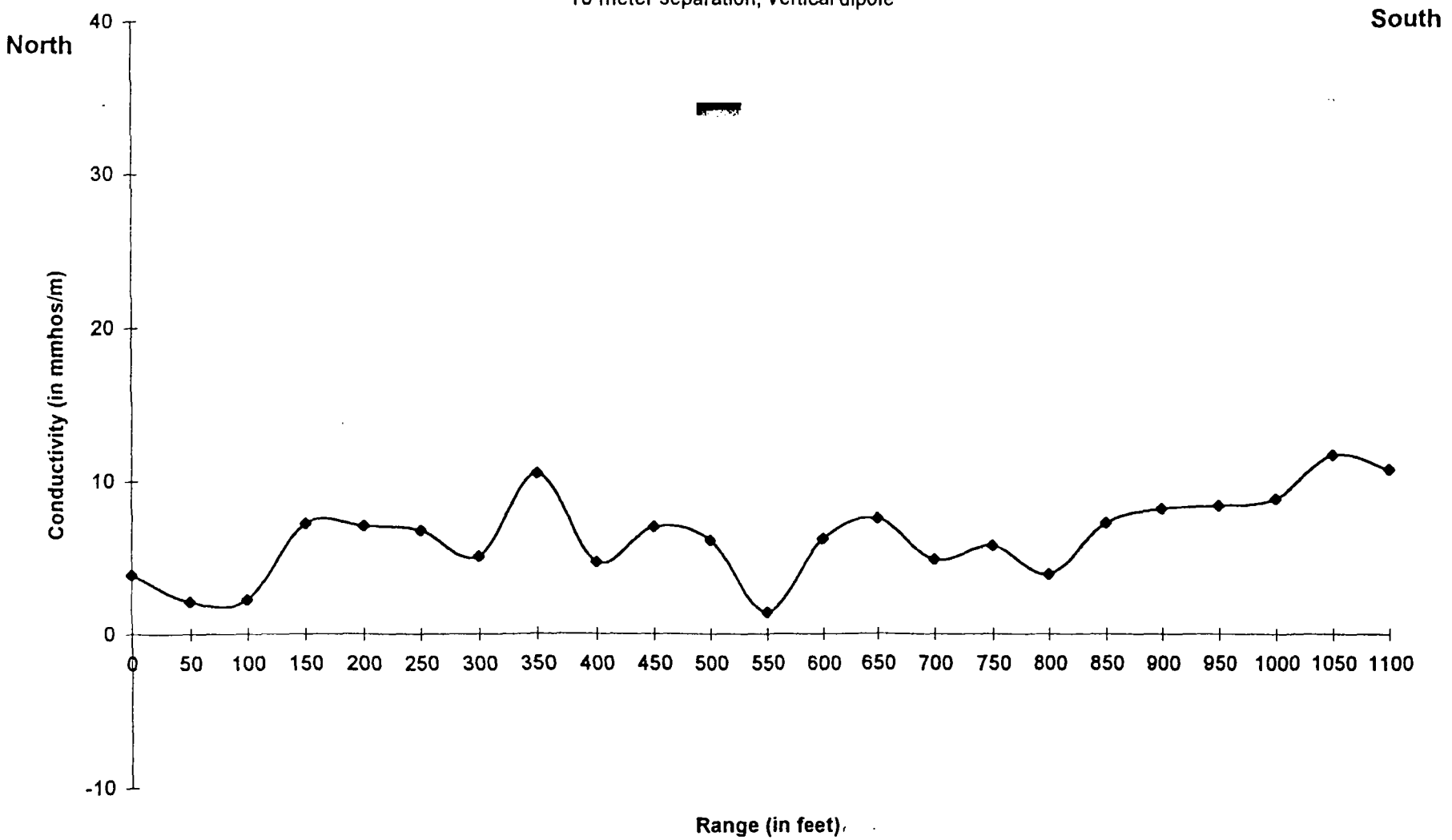
APPENDIX A
Terrain Conductivity Profiles

Line 3
10 meter separation, vertical dipole



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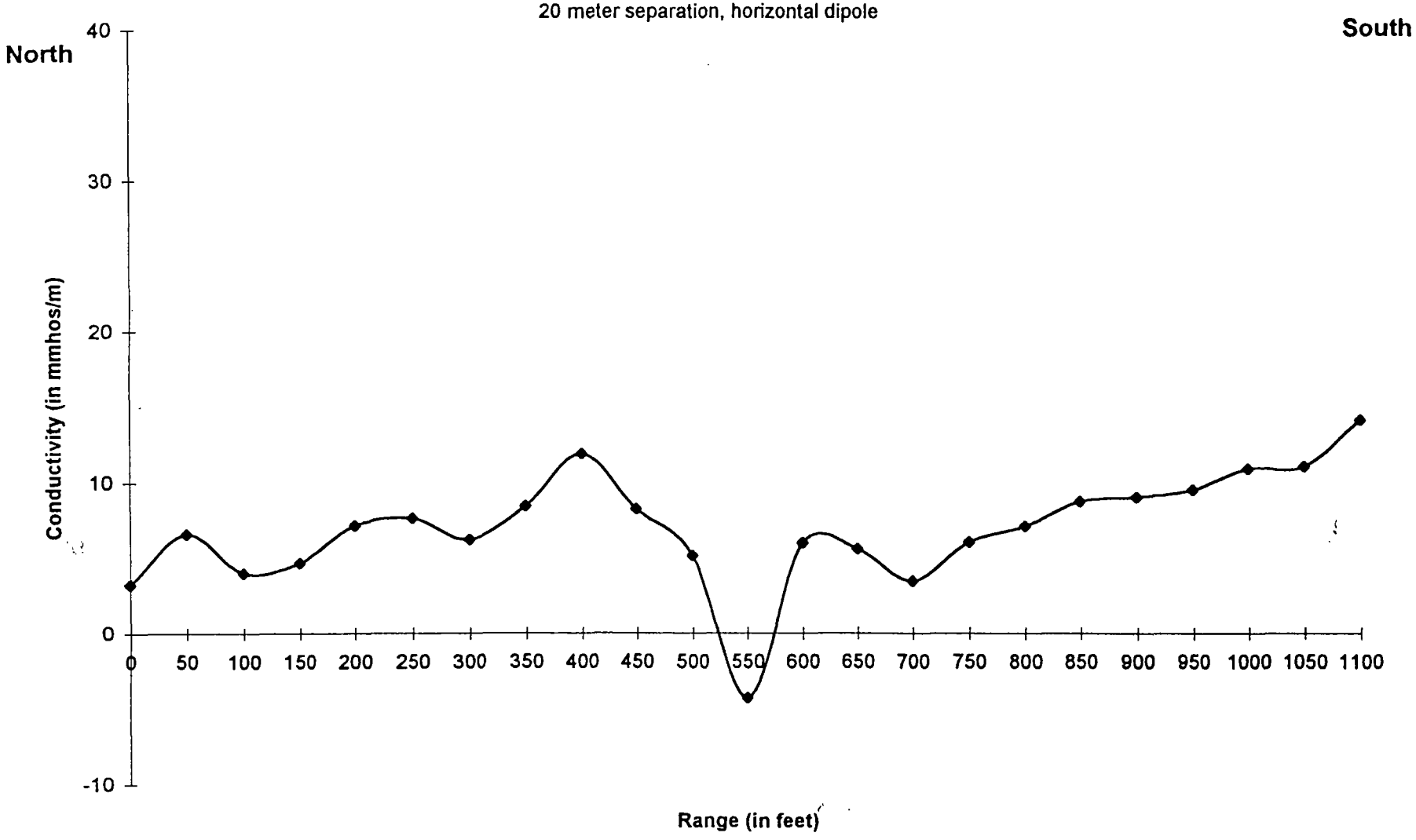
APPENDIX A
Terrain Conductivity Profiles

Line 3

20 meter separation, horizontal dipole



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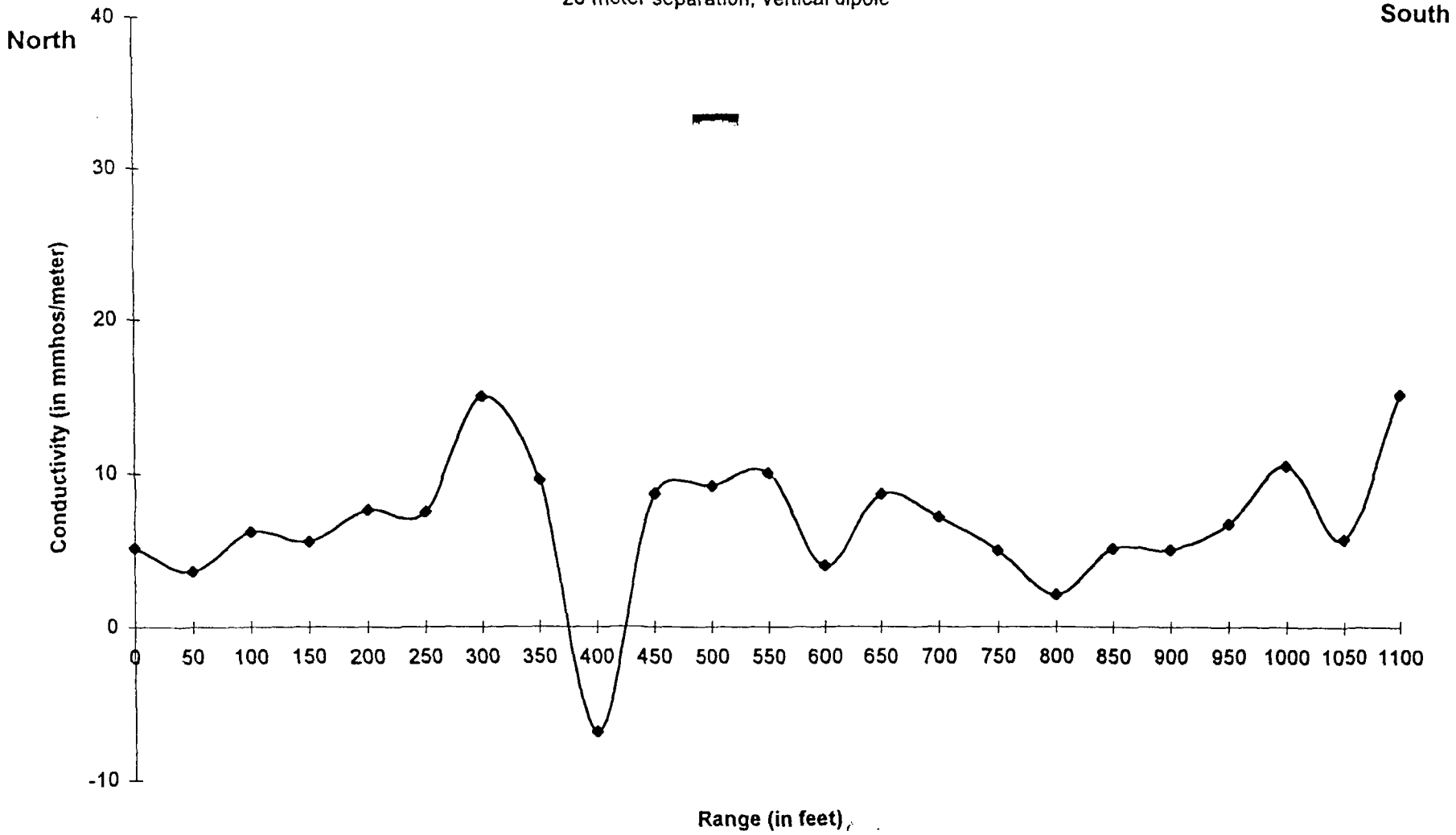
APPENDIX A
Terrain Conductivity Profiles

Line 3
20 meter separation, vertical dipole



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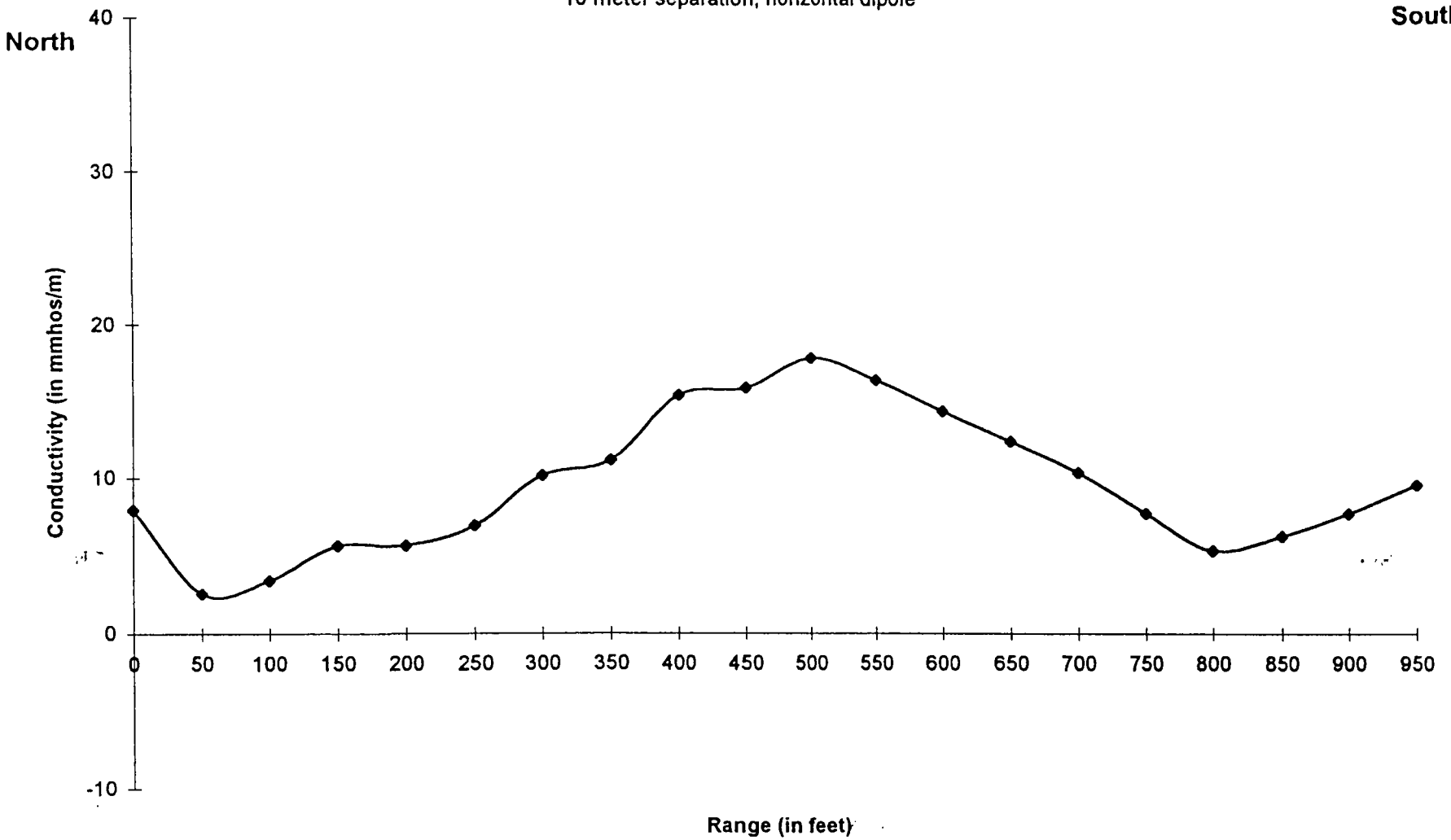
APPENDIX A
Terrain Conductivity Profiles

Line 4
10 meter separation, horizontal dipole



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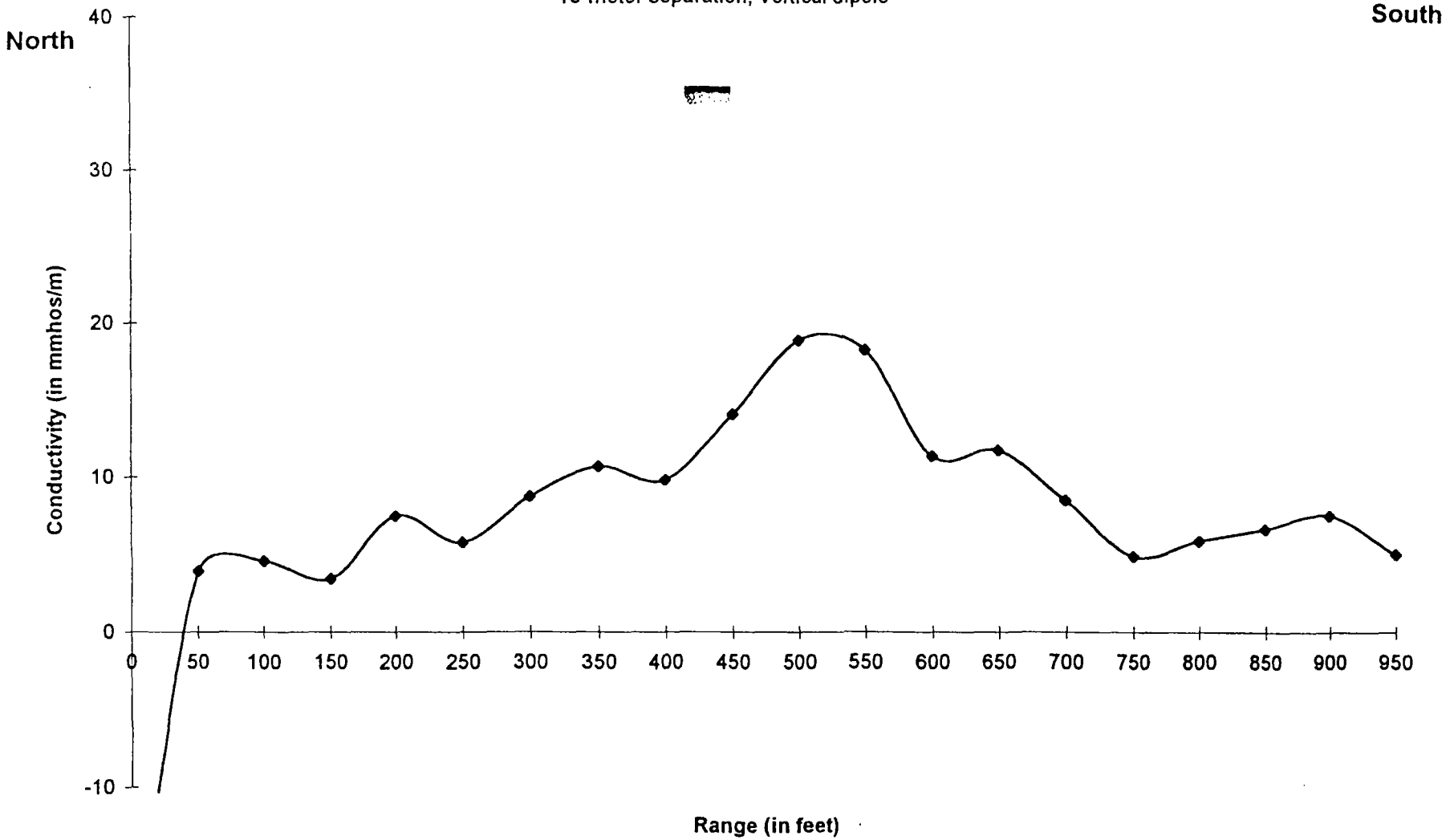
APPENDIX A
Terrain Conductivity Profiles

Line 4
10 meter separation, vertical dipole



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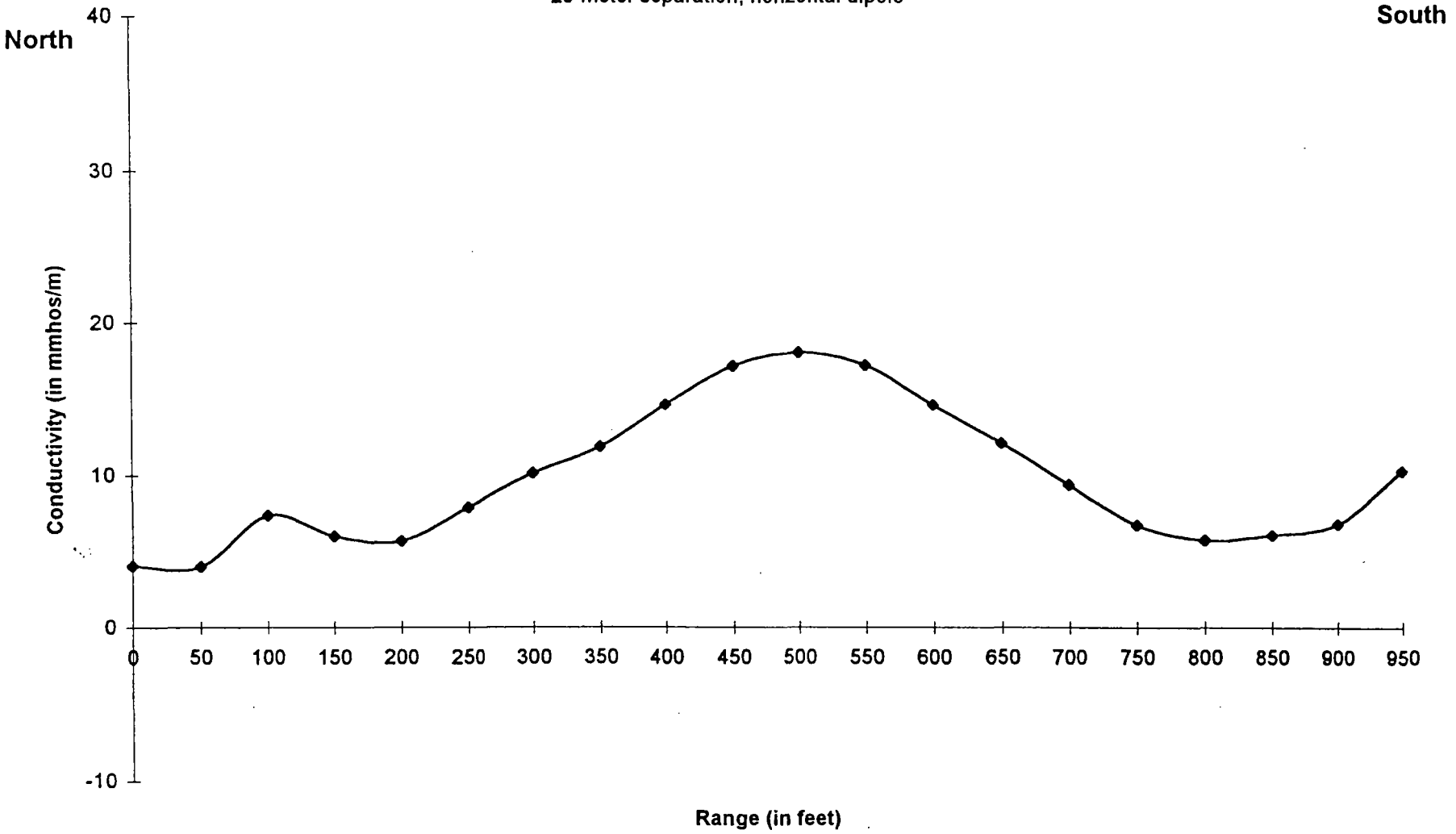
APPENDIX A
Terrain Conductivity Profiles

Line 4

20 meter separation, horizontal dipole



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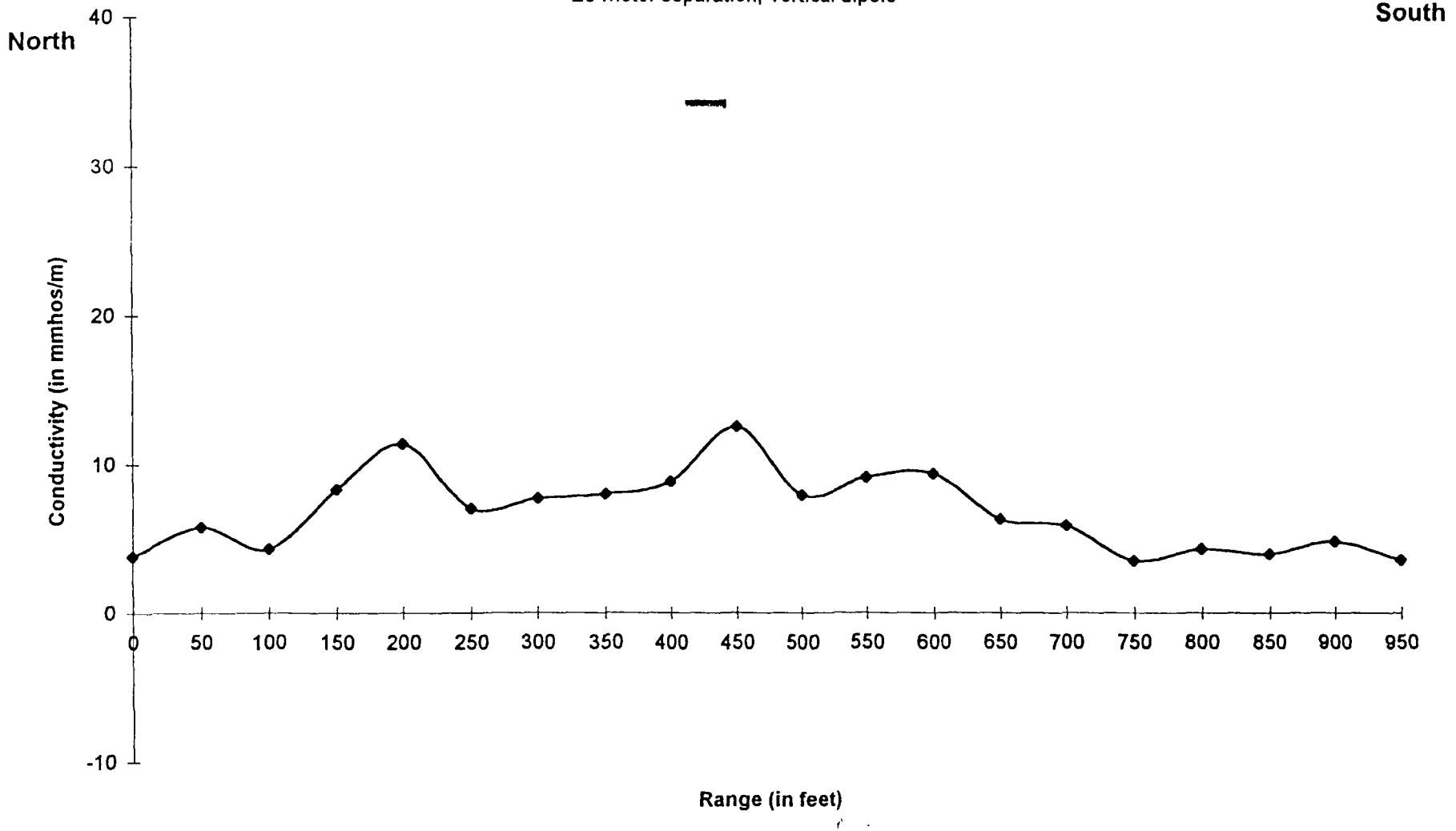
20 meter separation, vertical dipole



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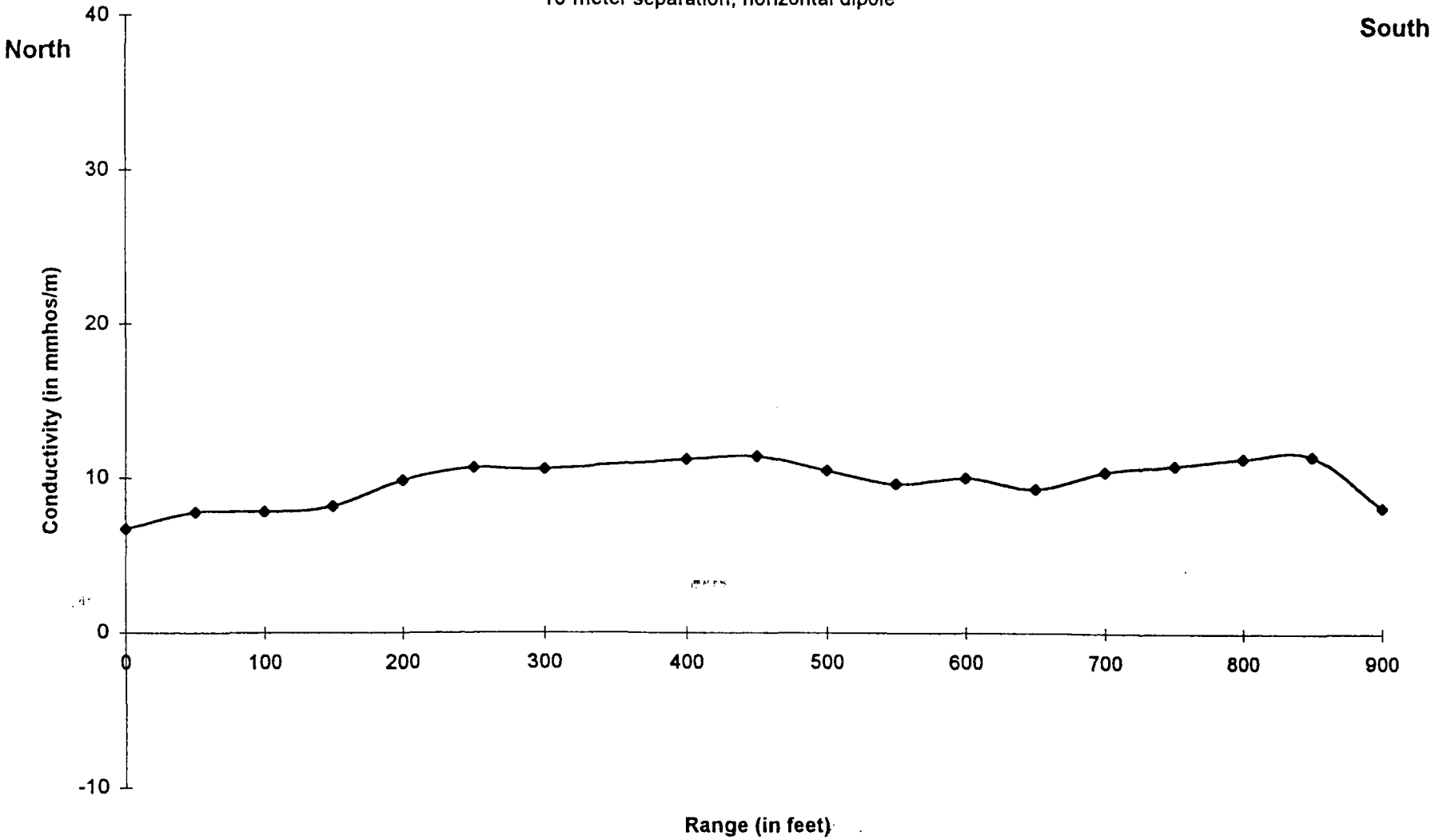
APPENDIX A
Terrain Conductivity Profiles

Line 5
10 meter separation, horizontal dipole



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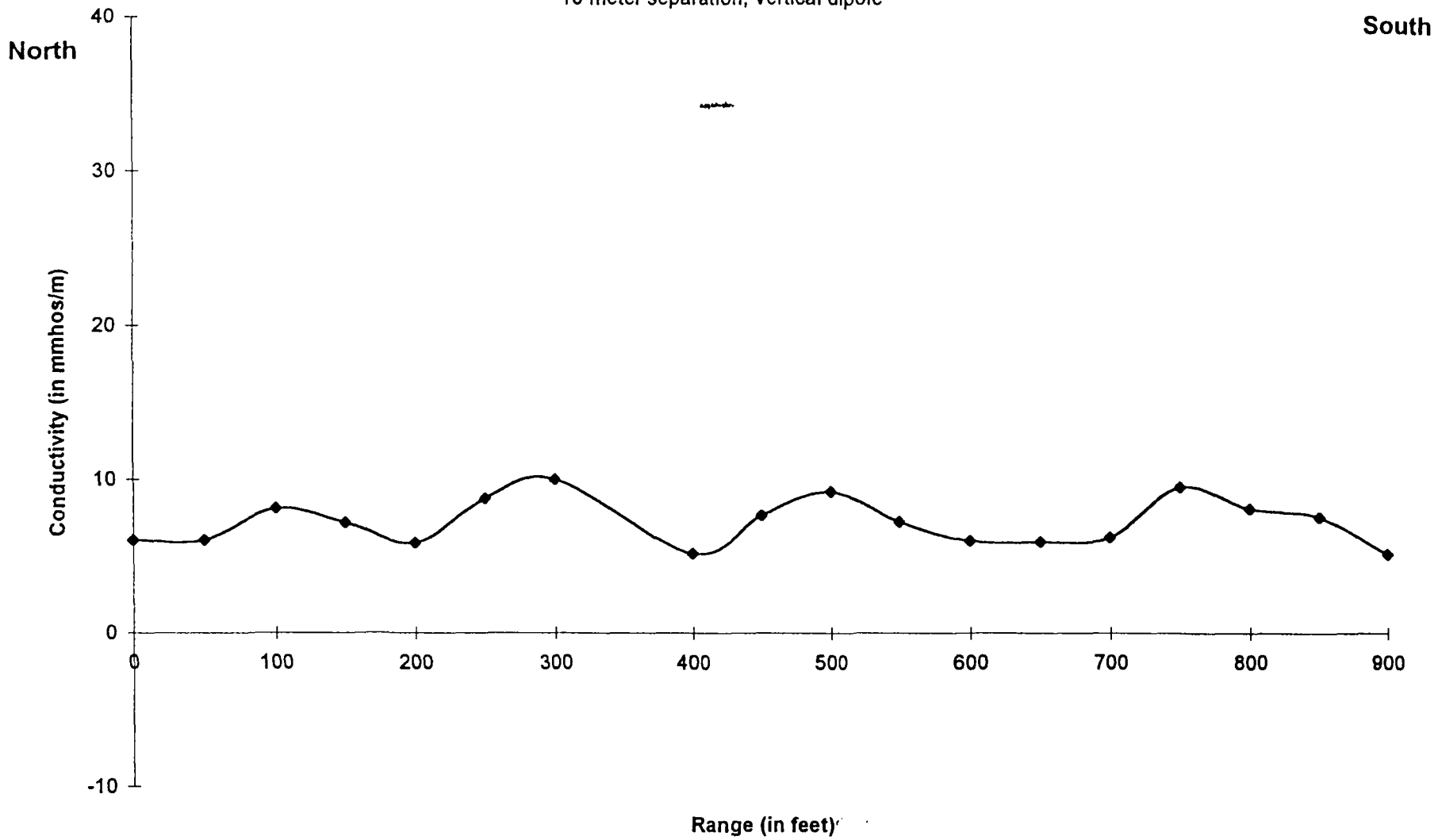
APPENDIX A
Terrain Conductivity Profiles
Line 5
10 meter separation, vertical dipole



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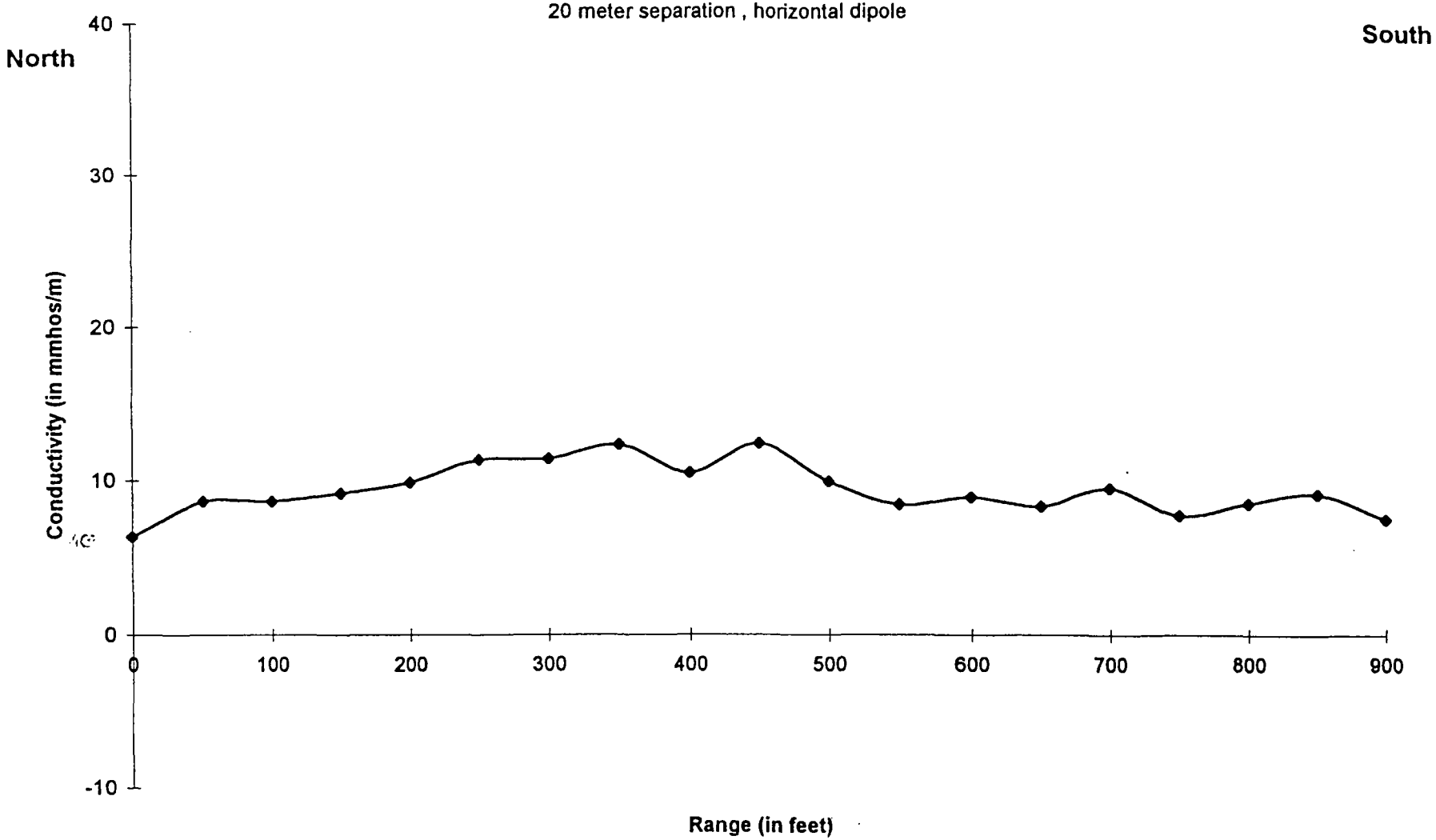
APPENDIX A
Terrain Conductivity Profiles
Line 5
20 meter separation , horizontal dipole



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APPENDIX A
Terrain Conductivity Profiles

Line 5
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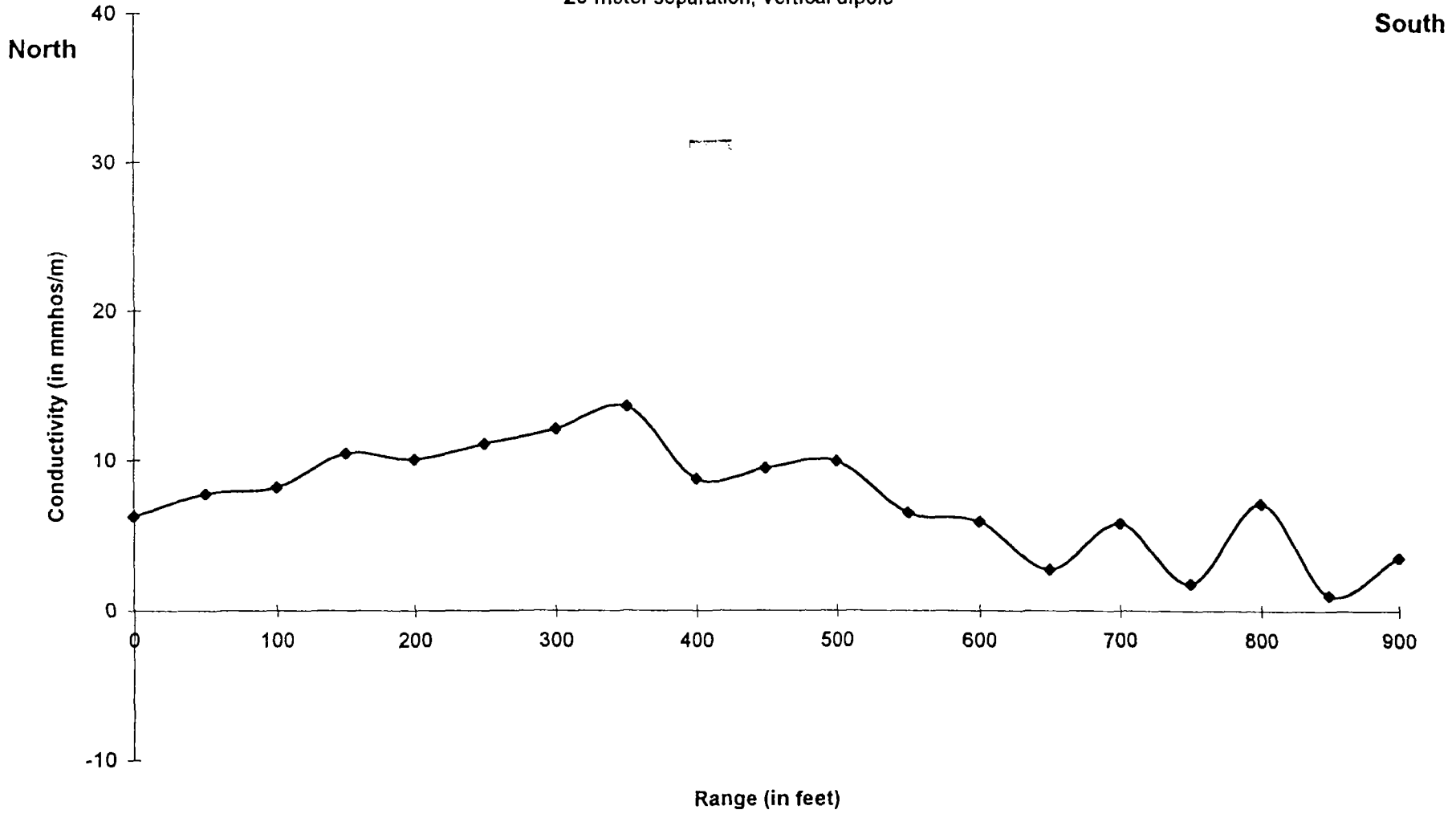

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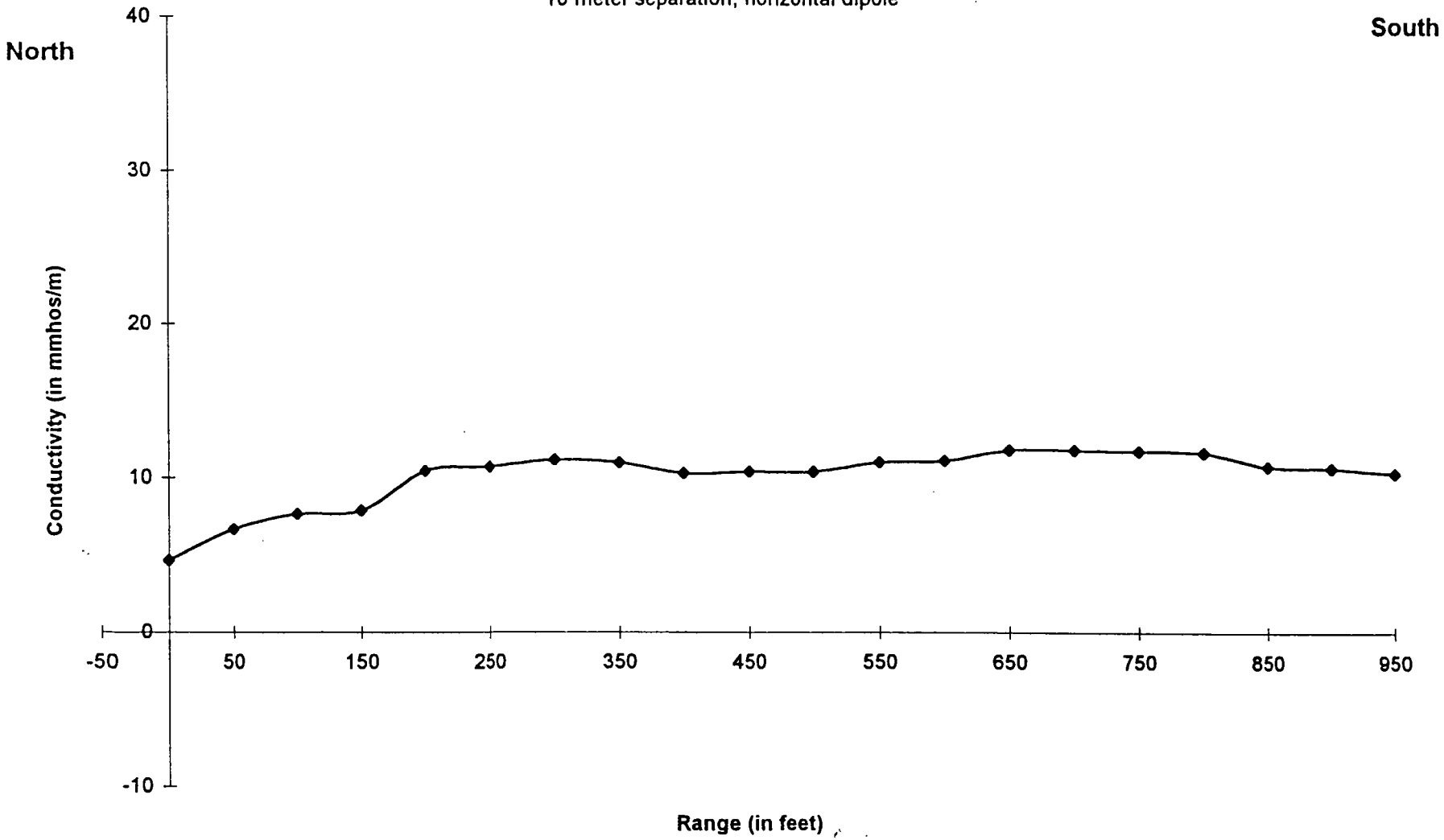
APPENDIX A
Terrain Conductivity Profiles
Line 6
10 meter separation, horizontal dipole



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APPENDIX A
Terrain Conductivity Profiles
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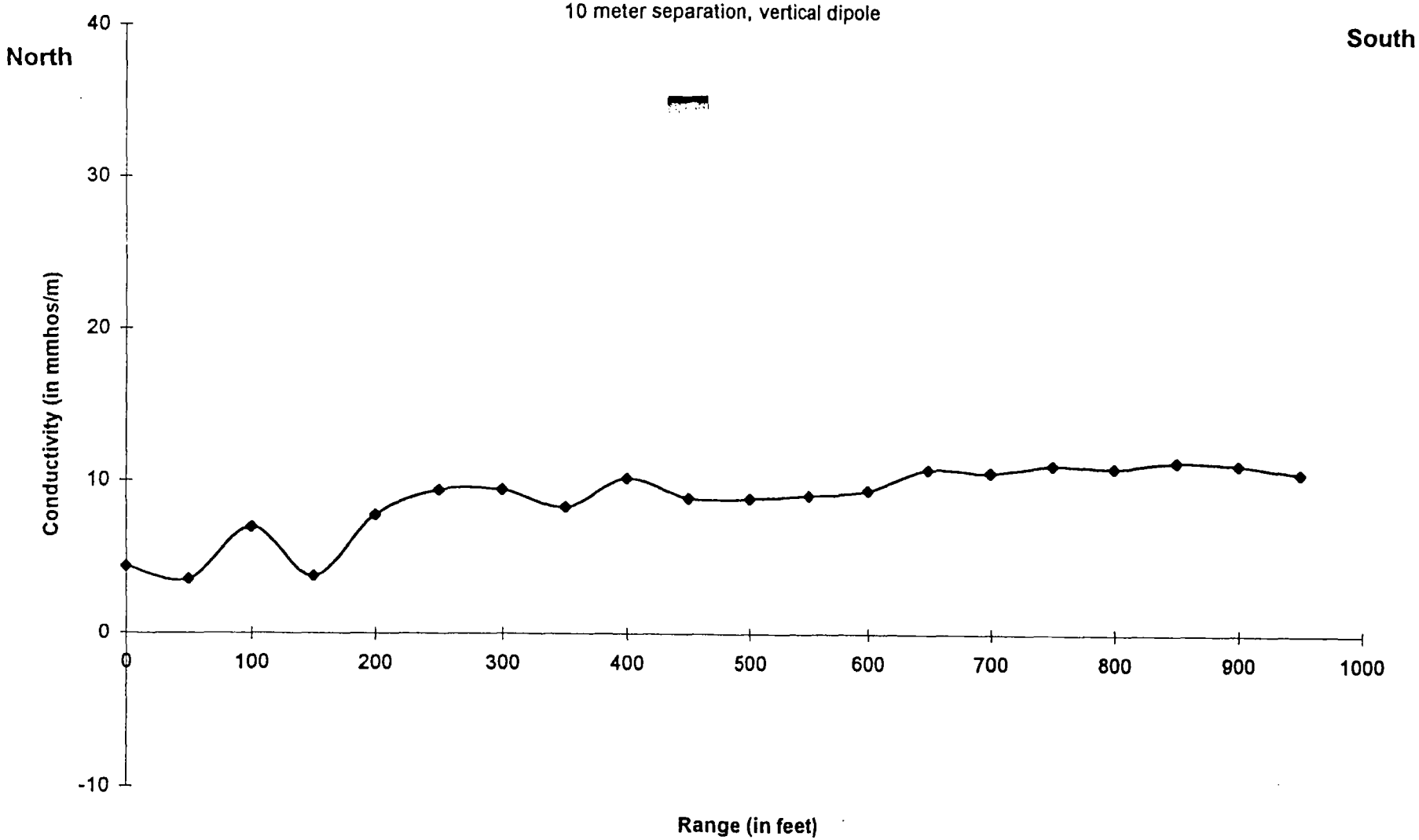
10 meter separation, vertical dipole



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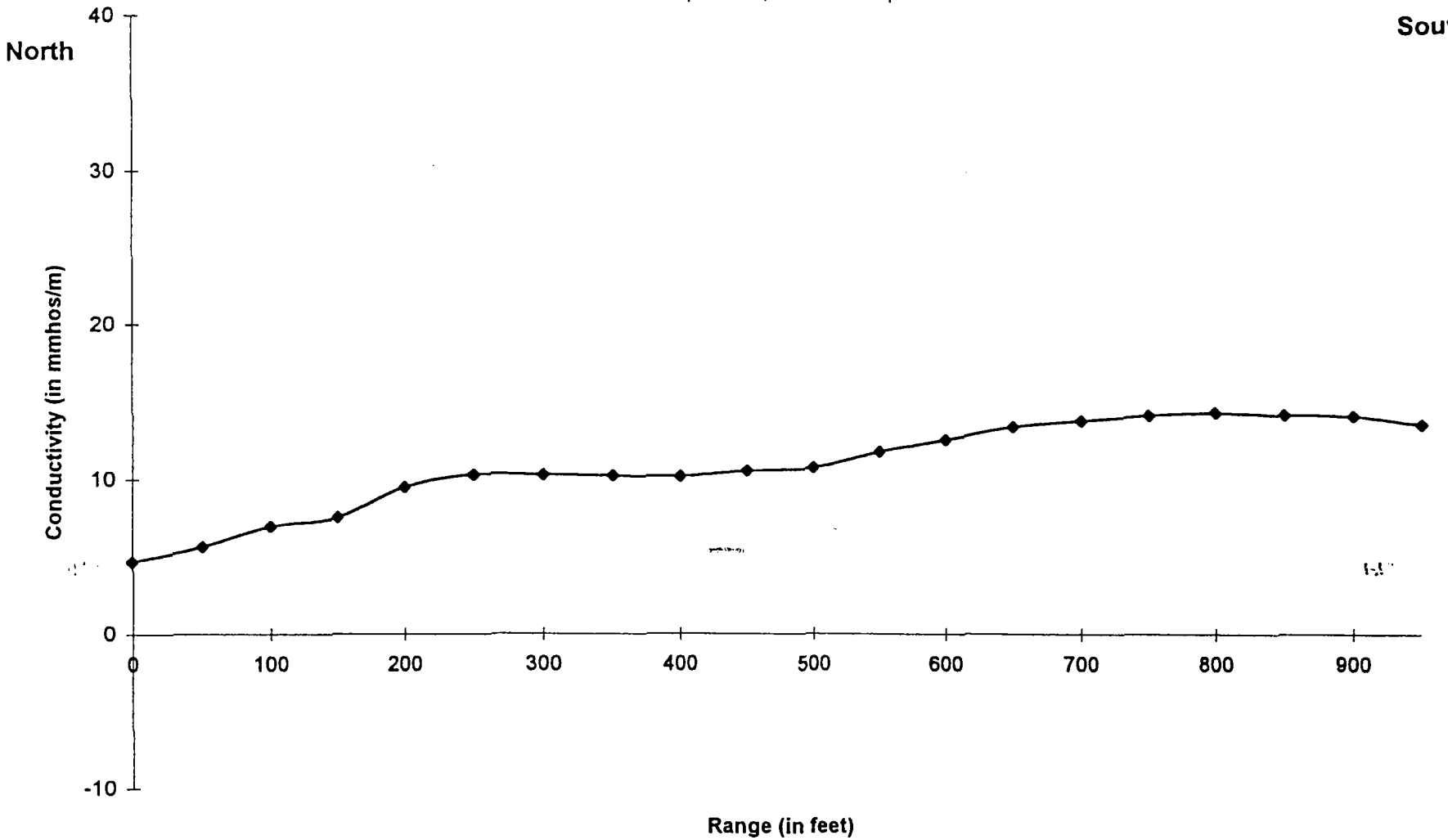
APPENDIX A
Terrain Conductivity Profiles
Line 6
20 meter separation, horizontal dipole



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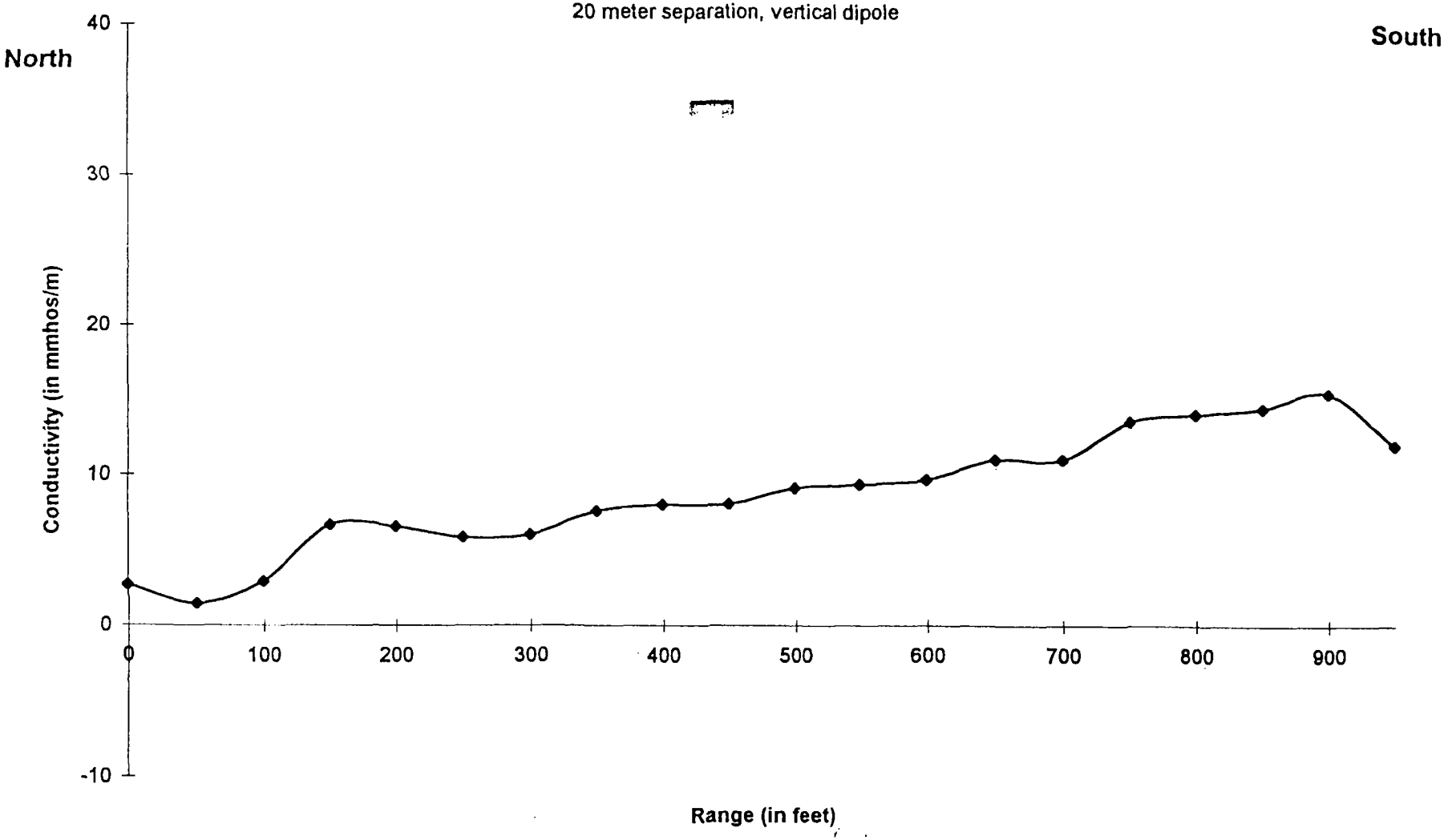

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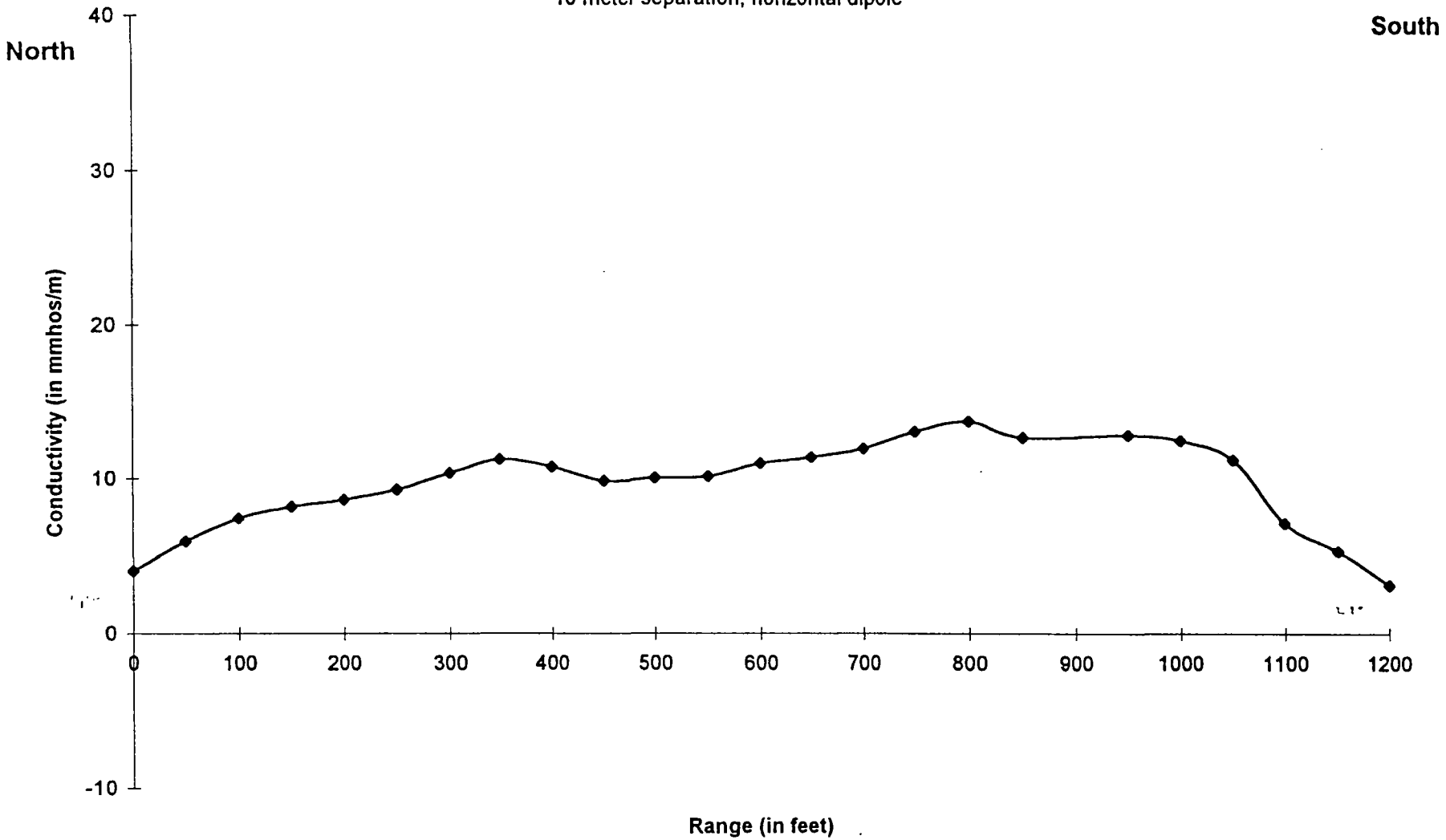
APPENDIX A
Terrain Conductivity Profiles
Line 7
10 meter separation, horizontal dipole



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Terrain Conductivity Profiles
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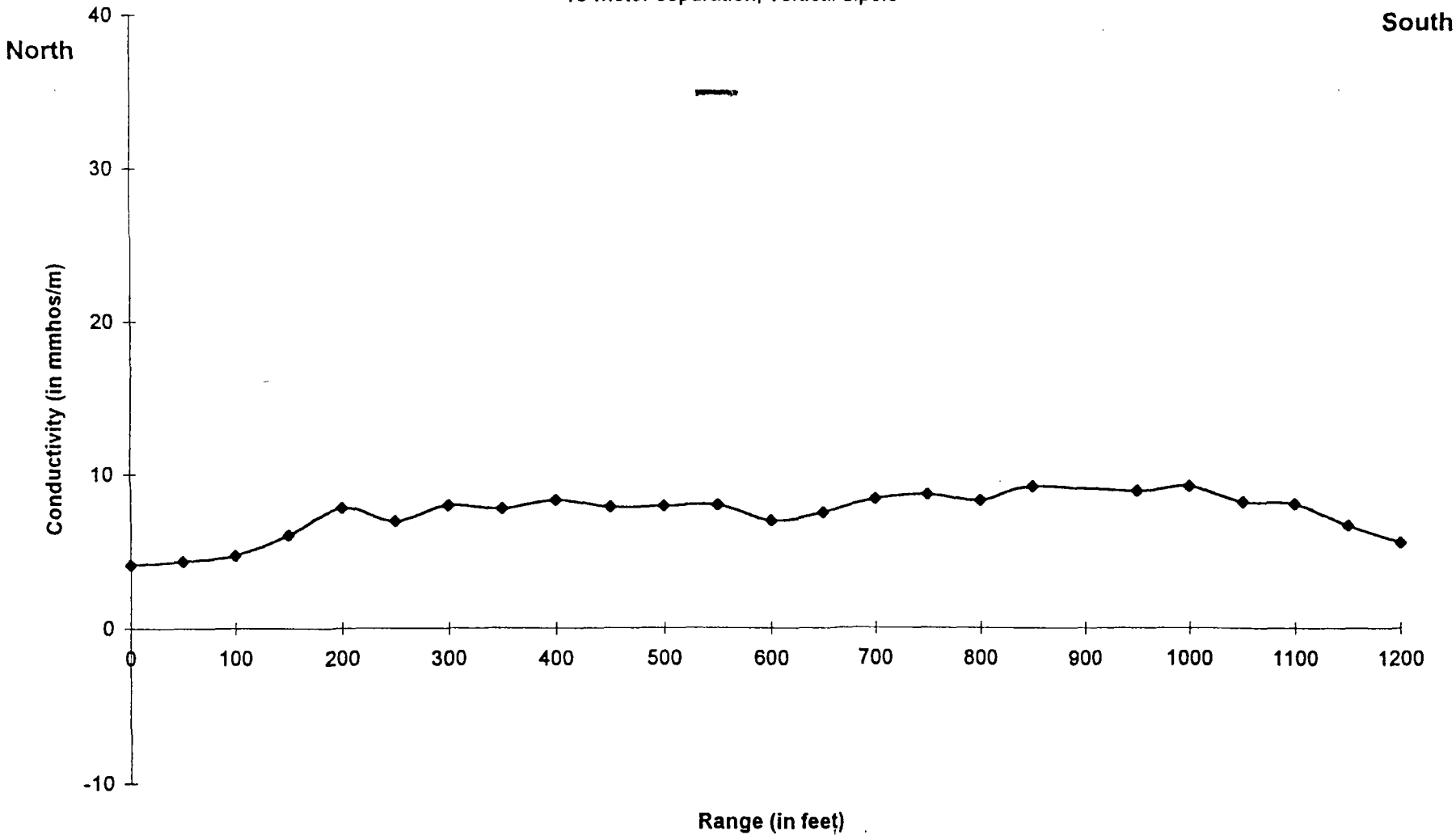
10 meter separation, vertical dipole



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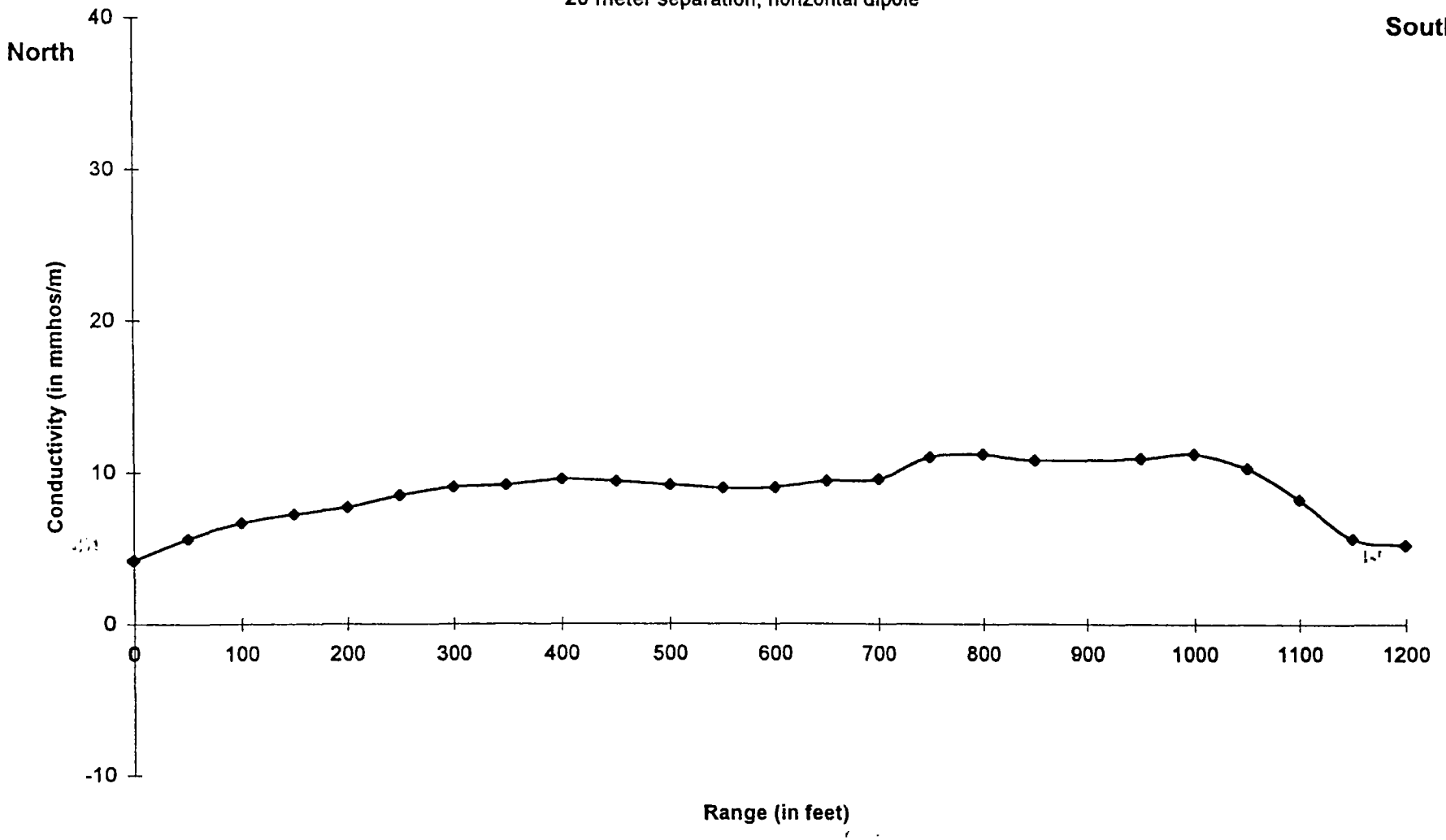

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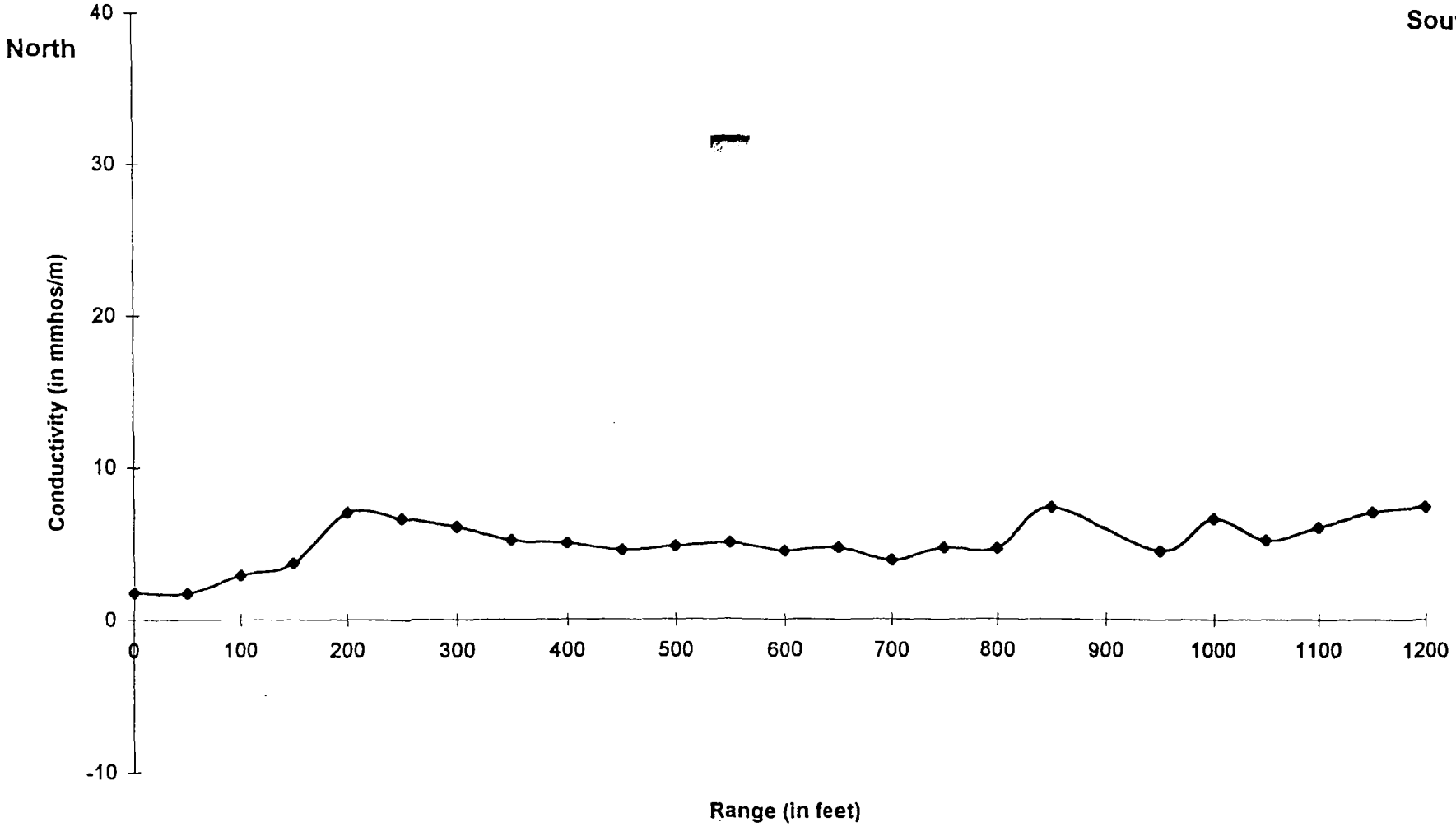

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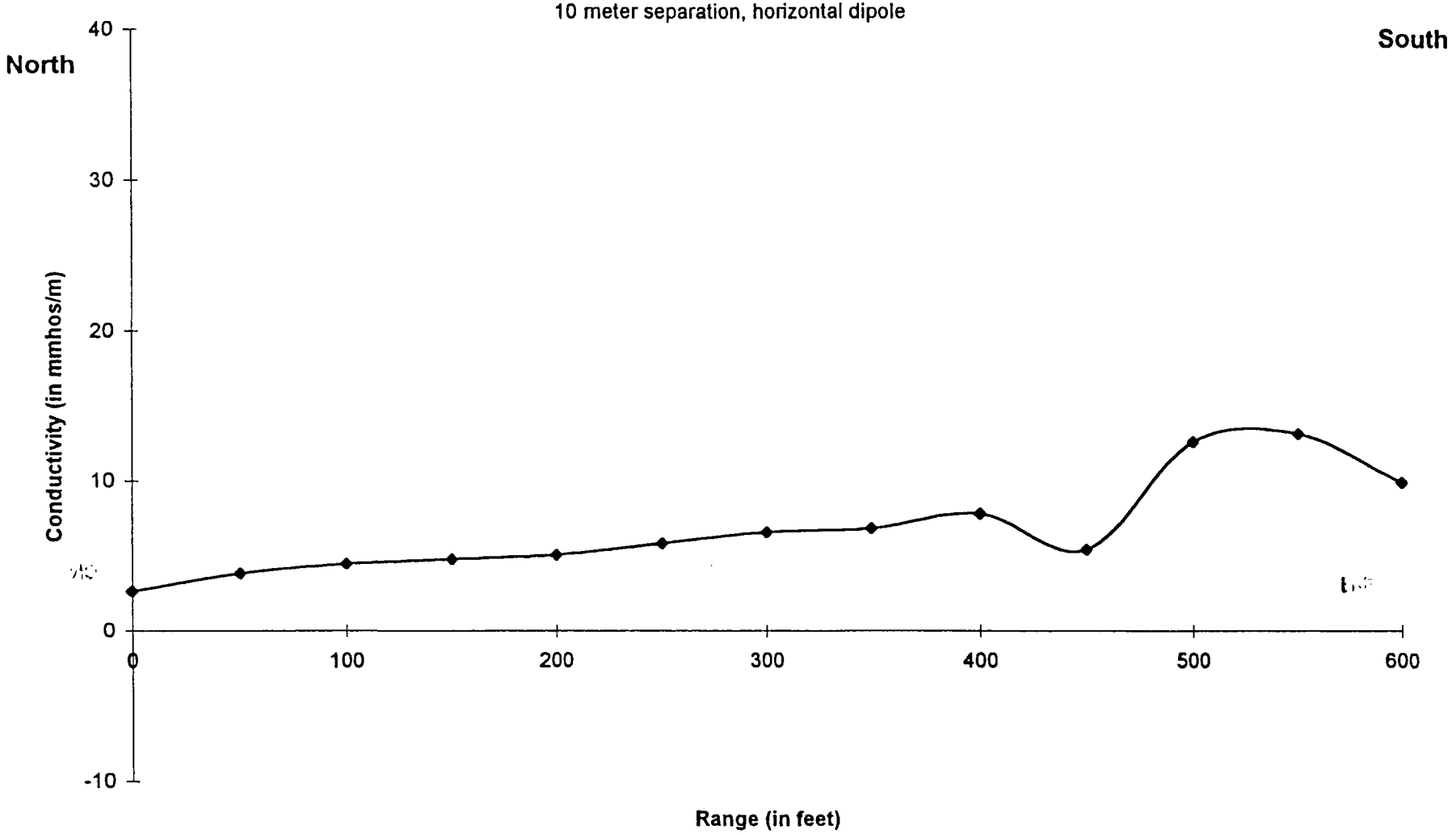
APPENDIX A
Terrain Conductivity Profiles

Line 8
10 meter separation, horizontal dipole



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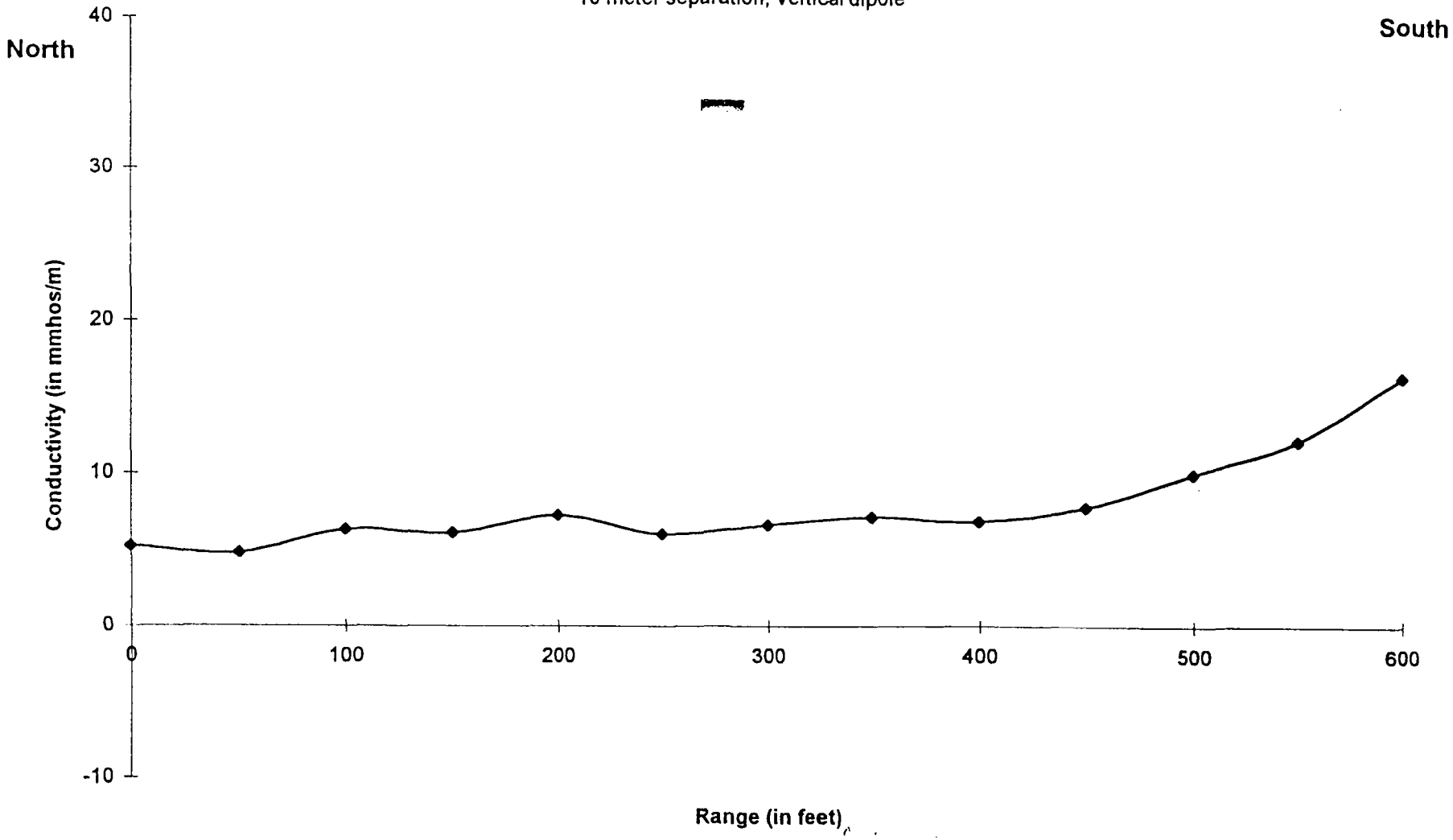
Terrain Conductivity Profiles

Line 8
10 meter separation, vertical dipole



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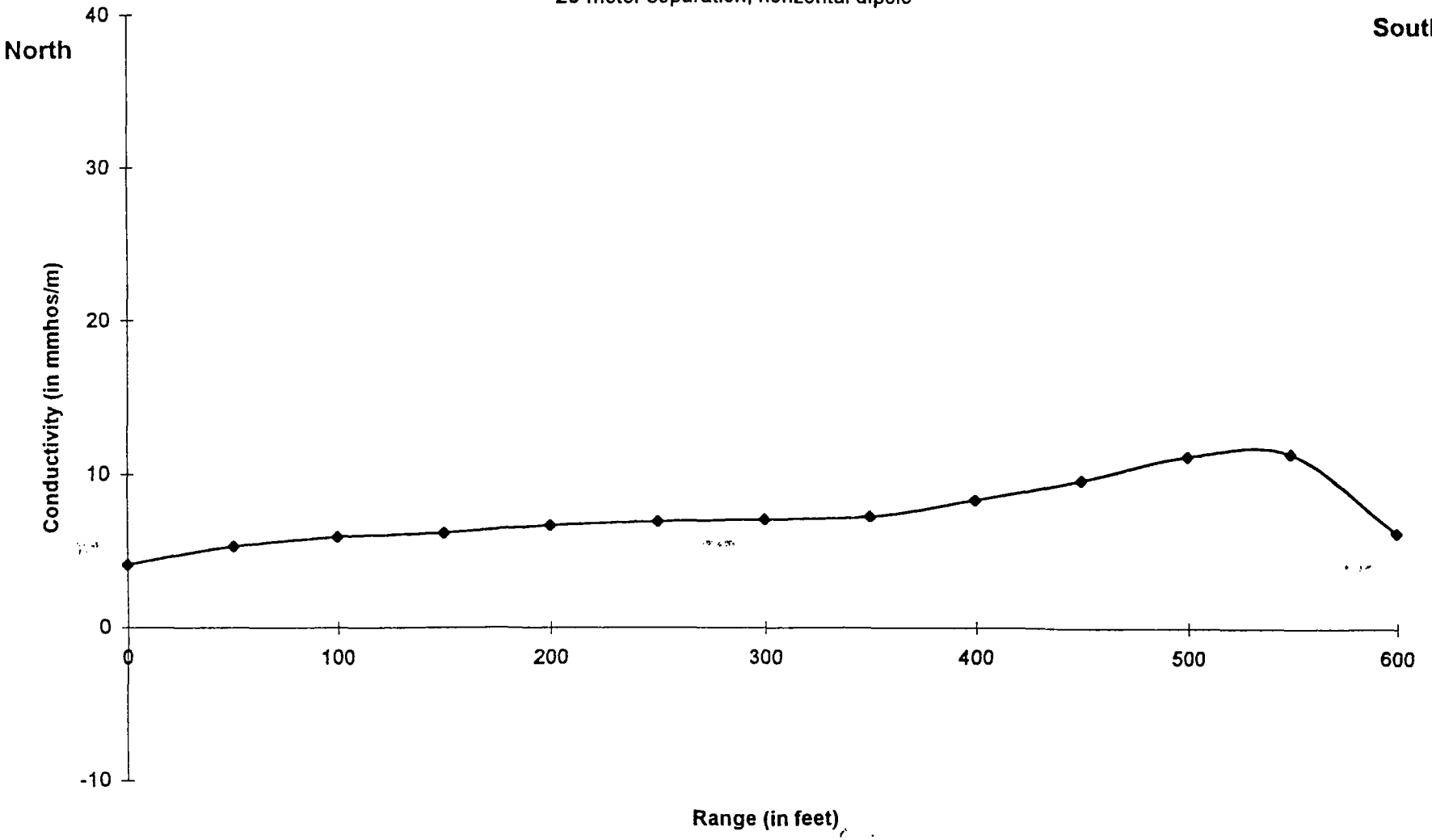

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Terrain Conductivity Profiles

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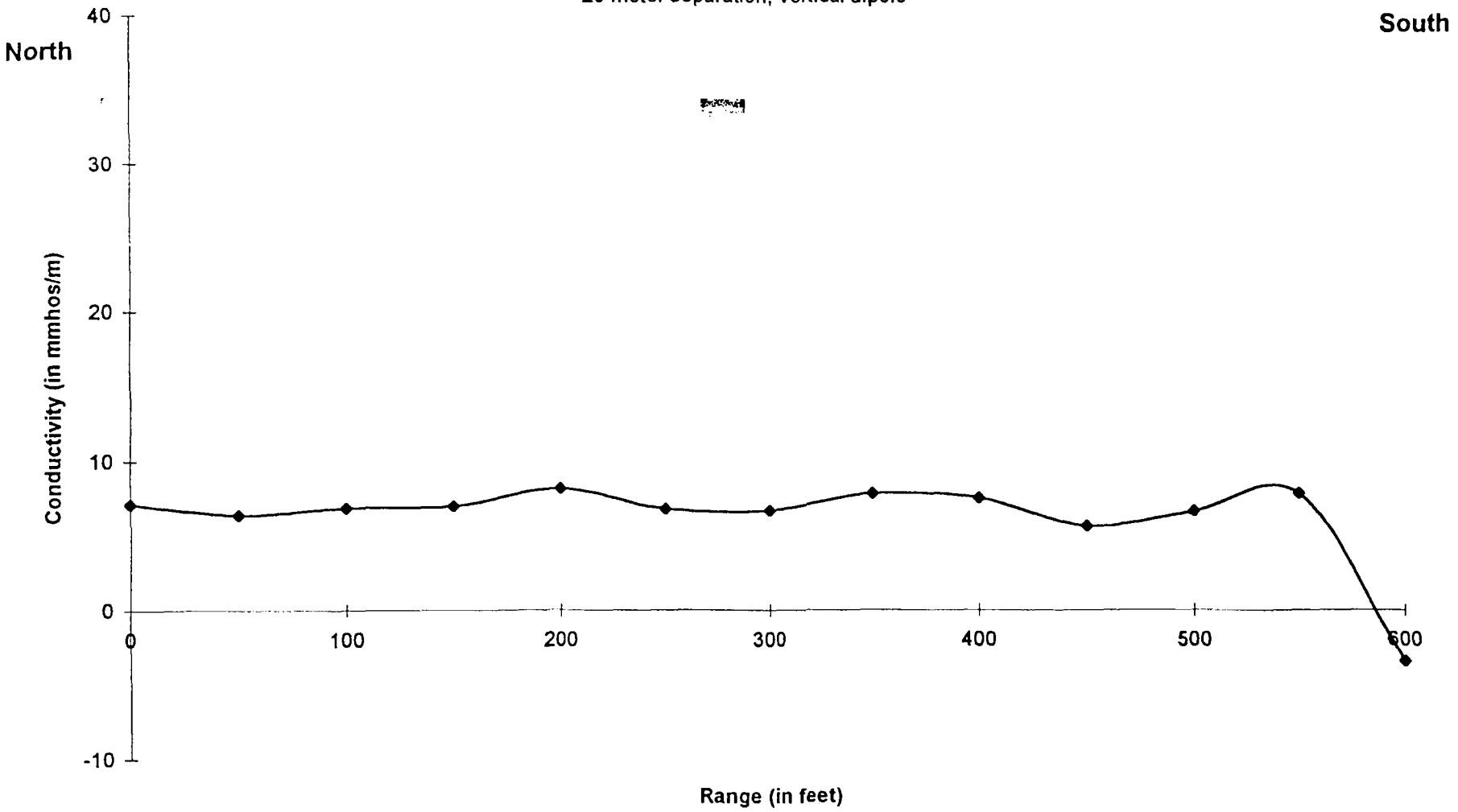

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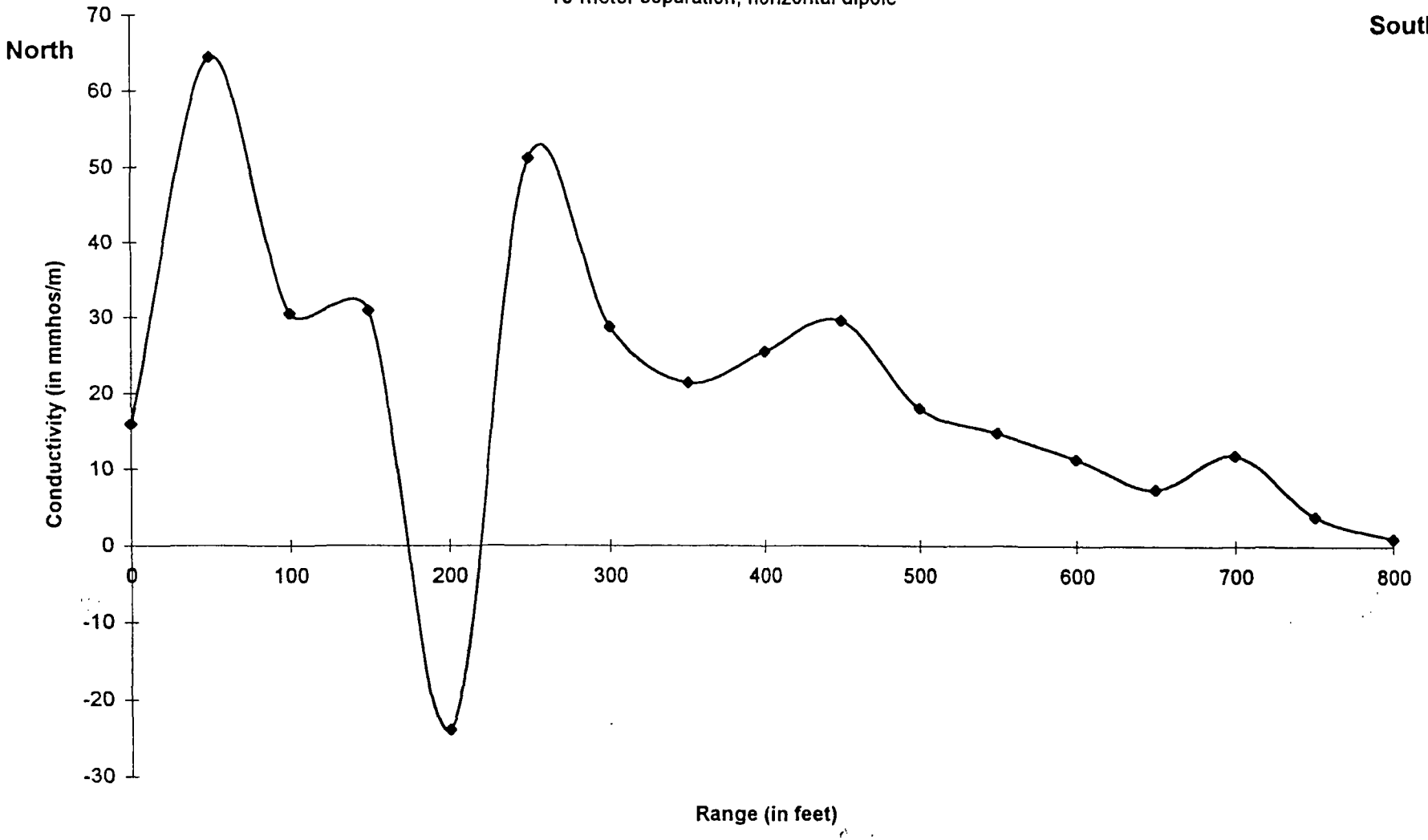
APPENDIX A
Terrain Conductivity Profiles

Line 9
10 meter separation, horizontal dipole



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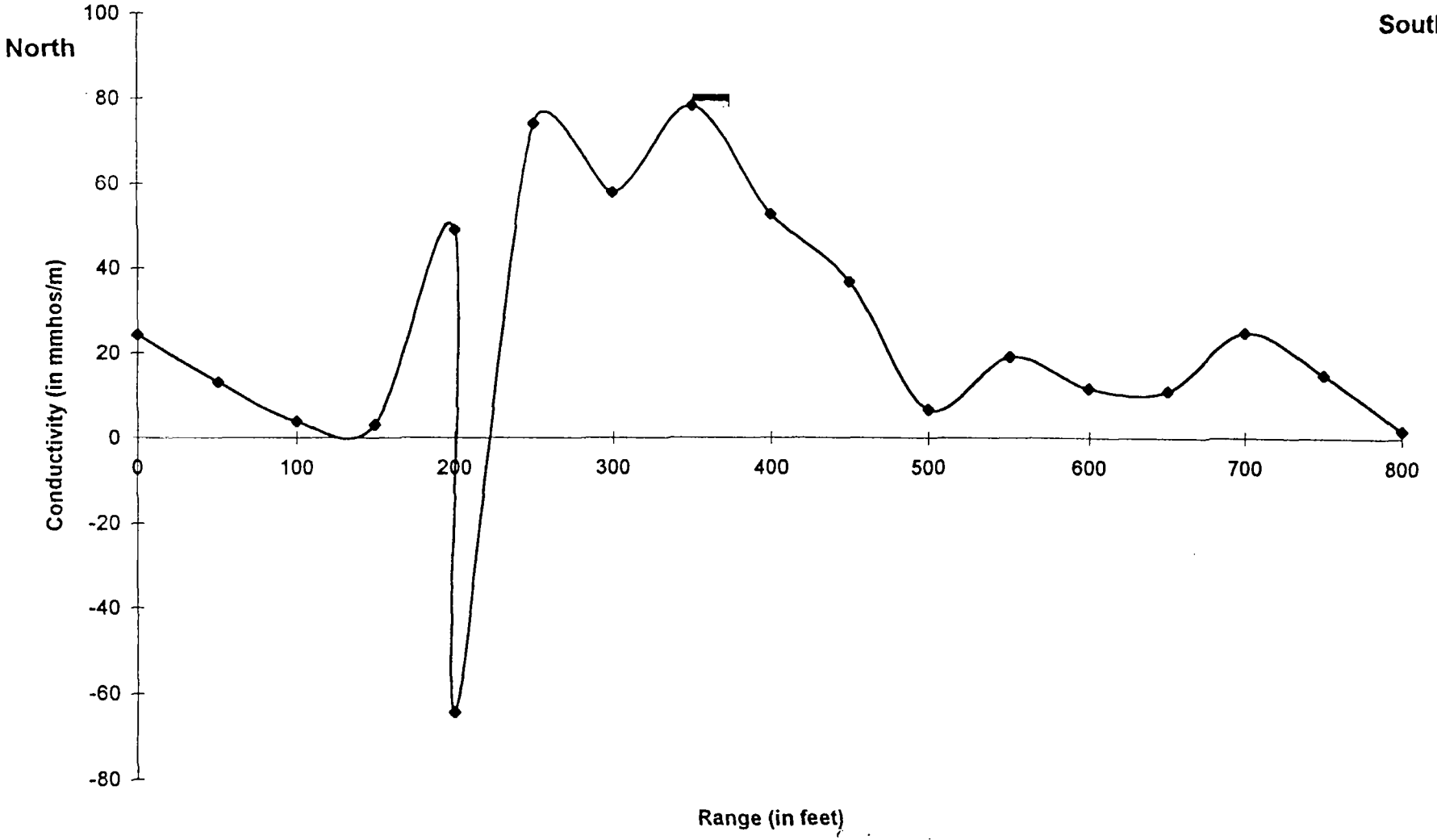
APPENDIX A
Terrain Conductivity Profiles

Line 9
10 meter separation, vertical dipole



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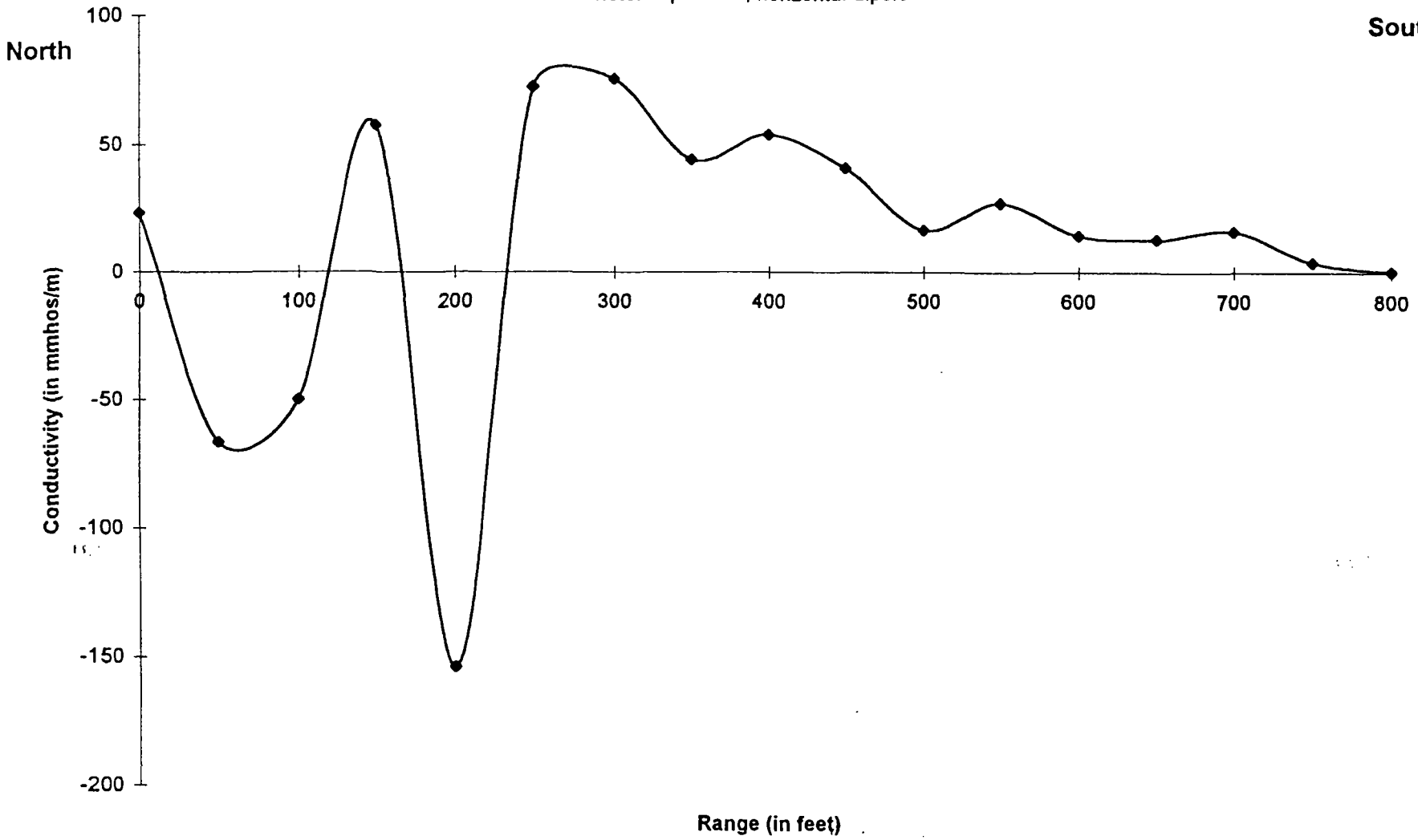
APPENDIX A
Terrain Conductivity Profiles
Line 9
20 meter separation, horizontal dipole

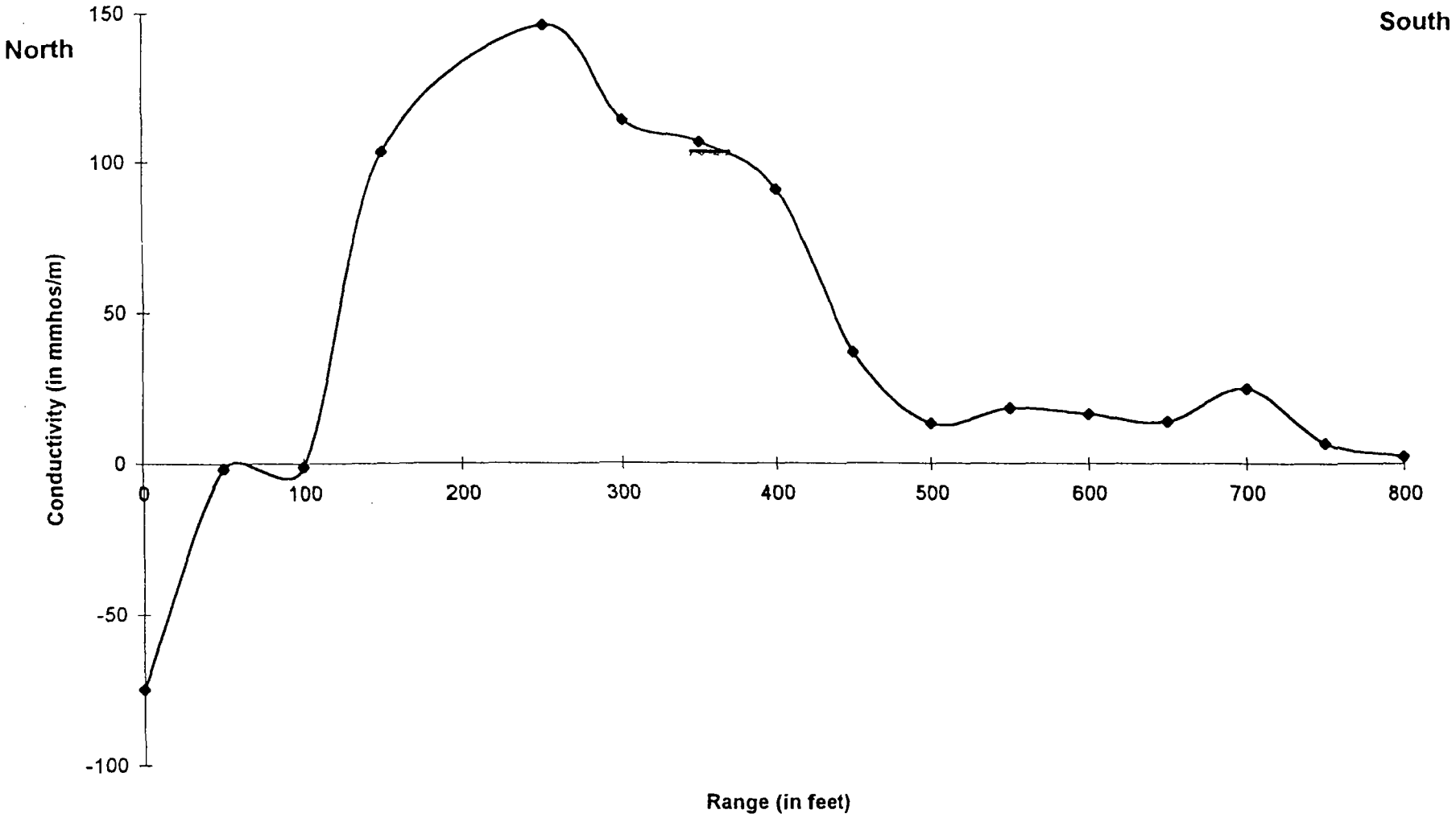


BCM ENGINEERS, INC.
OLIN FACILITY
WILMINGTON, MA

Enviroscan, Inc
Project No.
129426

APPENDIX A
Terrain Conductivity Profiles
Line 9

20 meter separation, vertical dipole



BCM ENGINEERS, INC.
OLIN FACILITY
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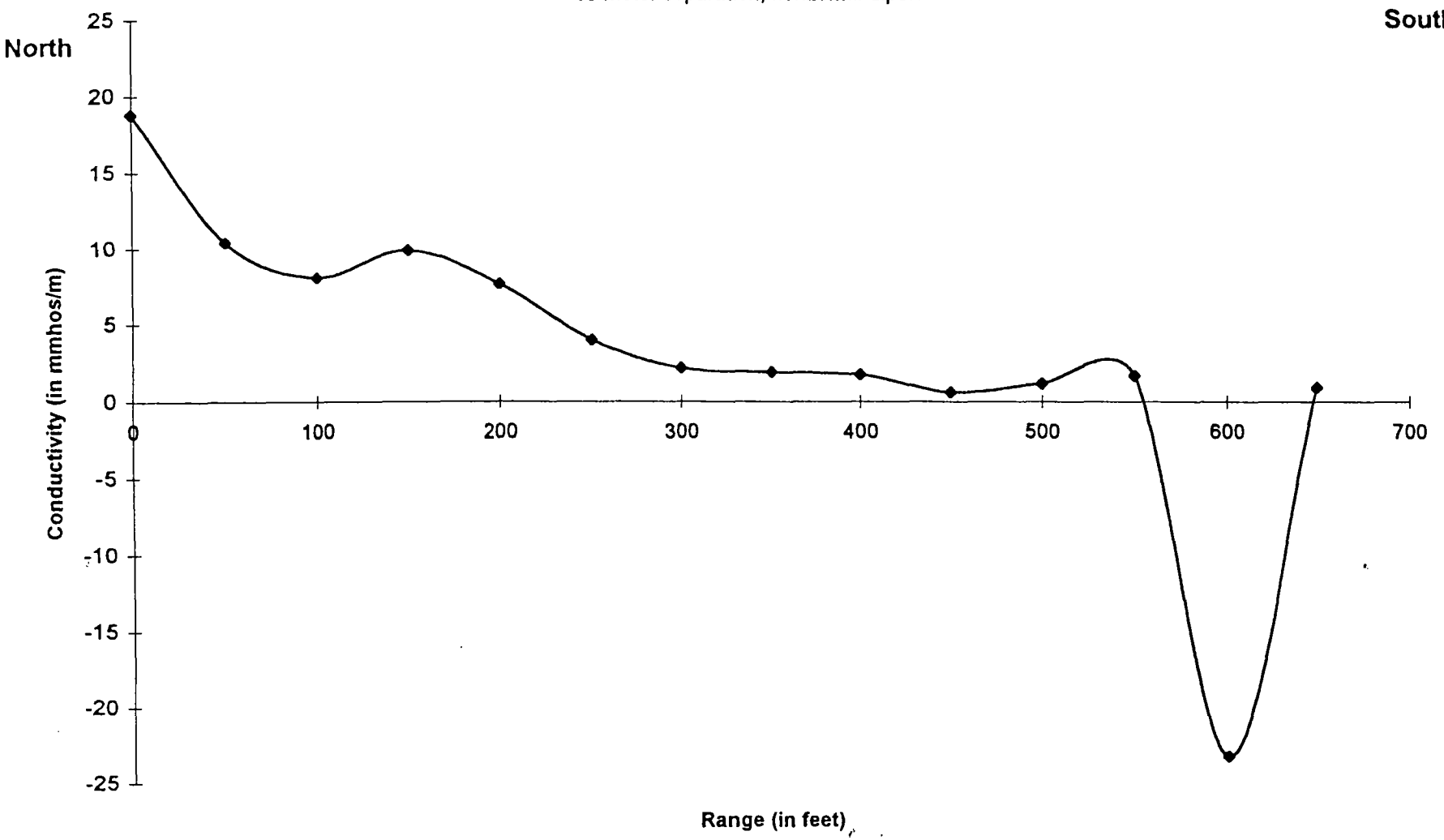
Project No.
129426

APPENDIX A
Terrain Conductivity Profiles
Line 10
10 meter separation, horizontal dipole



BCM ENGINEERS, INC.
OLIN FACILITY
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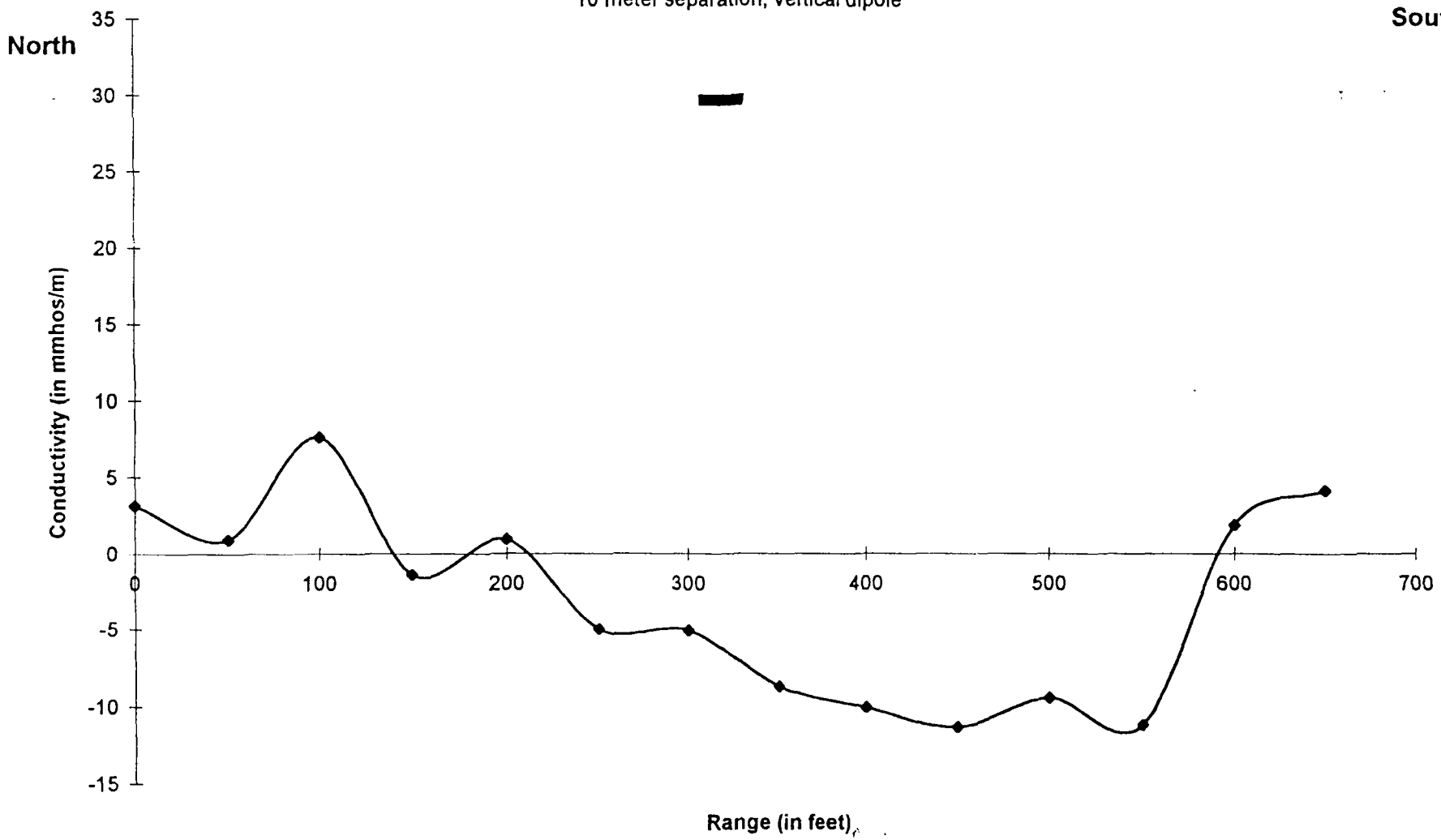
Enviroscan, Inc
Project No.
129426

APPENDIX A
Terrain Conductivity Profiles

Line 10

10 meter separation, vertical dipole



BCM ENGINEERS, INC.
OLIN FACILITY
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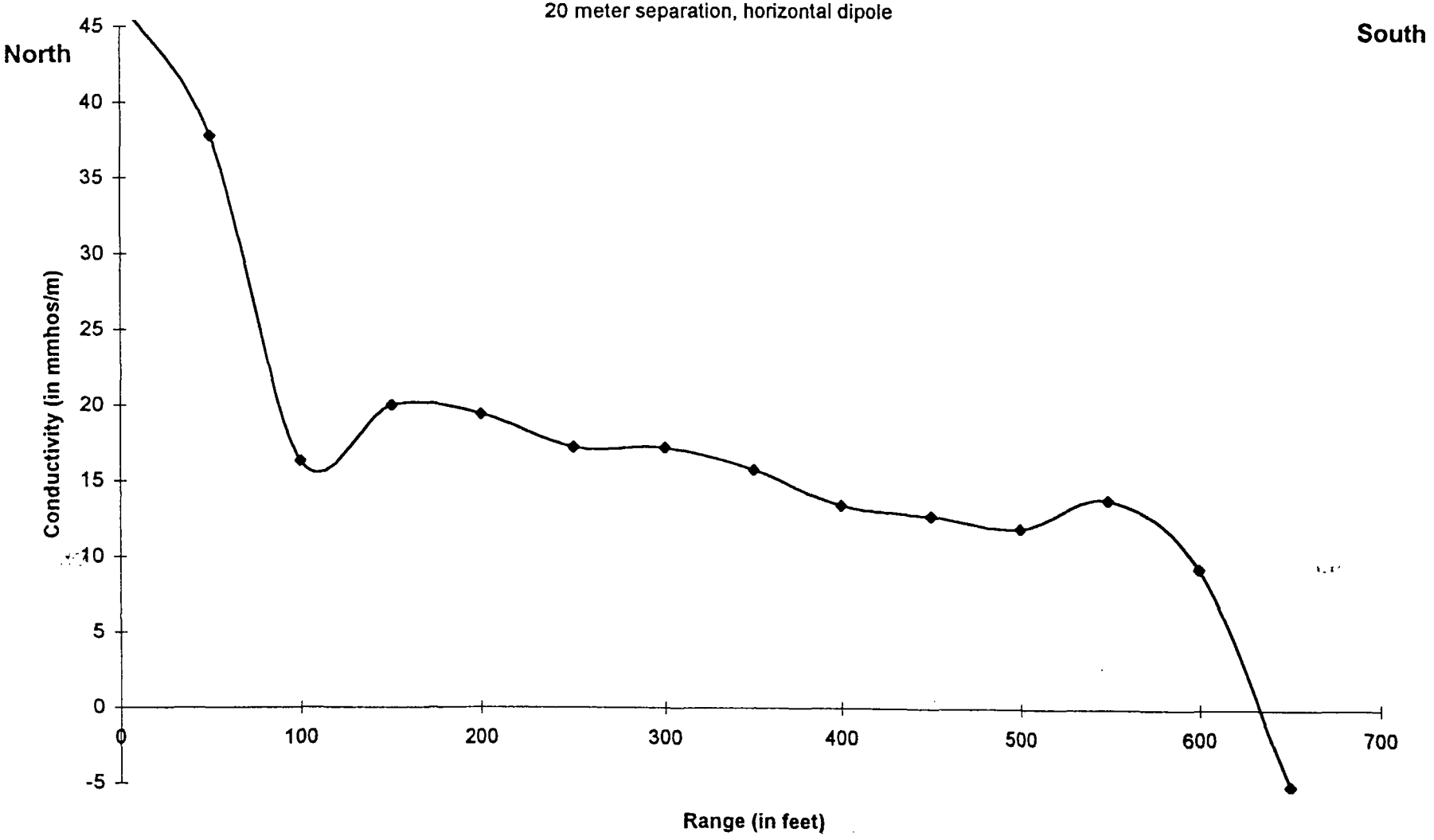
Enviroscan, Inc
Project No.
129426

APPENDIX A
Terrain Conductivity Profiles

Line10

20 meter separation, horizontal dipole



BCM ENGINEERS, INC.
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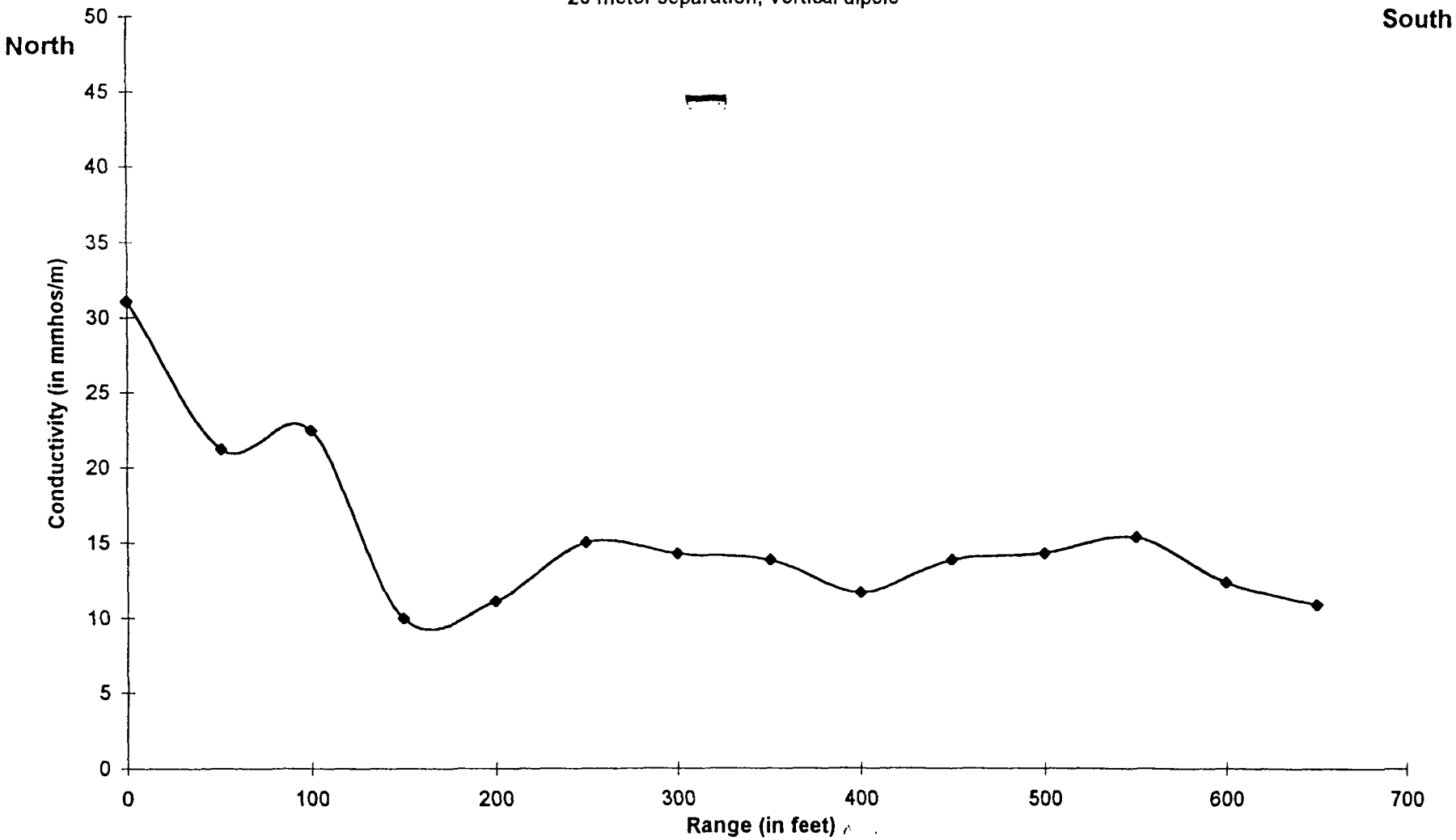
Project No.
129426

APPENDIX A
Terrain Conductivity Profiles

Line 10

20 meter separation, vertical dipole



BCM ENGINEERS, INC.
OLIN FACILITY
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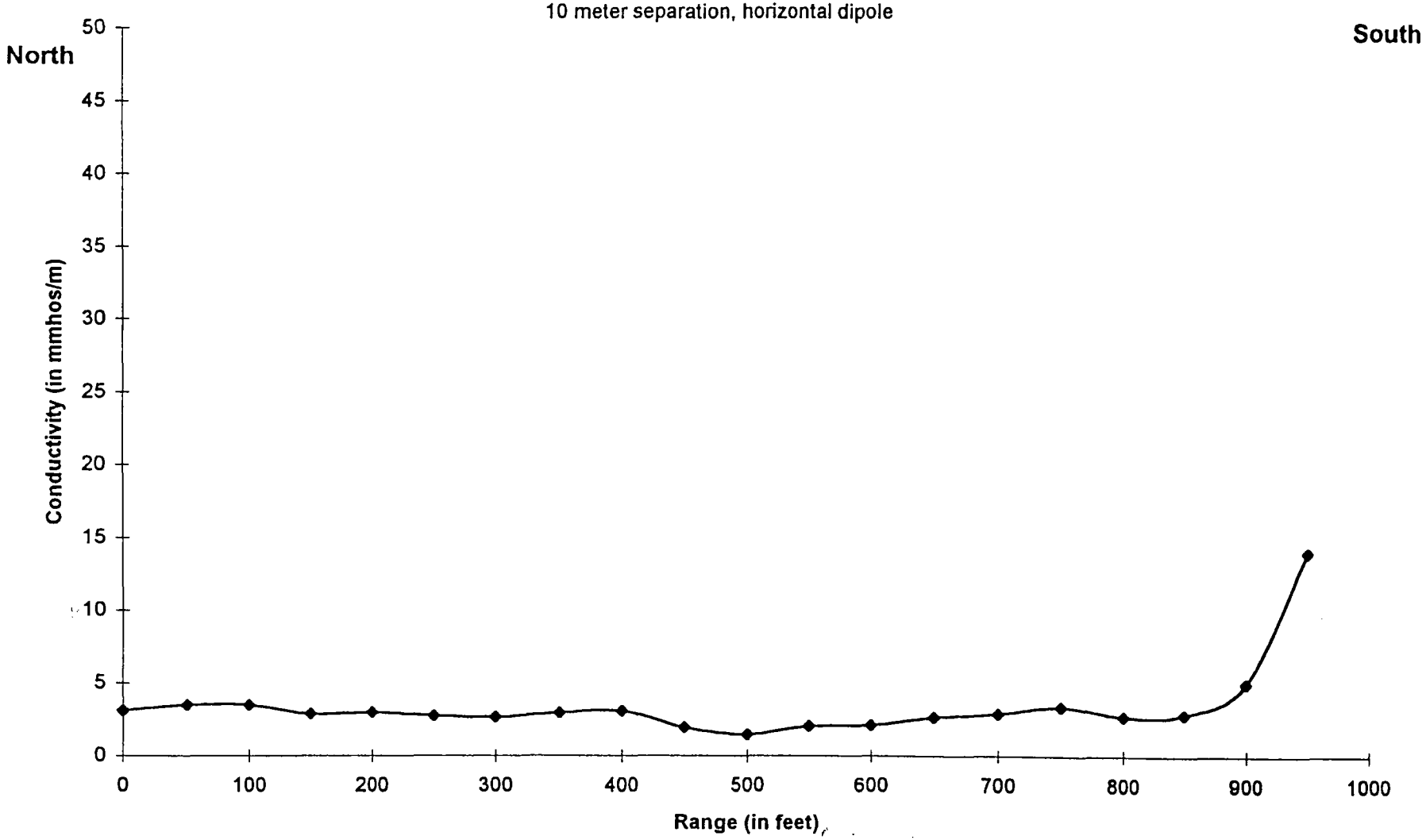
Enviroscan, Inc
Project No.
129426

APPENDIX A
Terrain Conductivity Profiles

Line 12

10 meter separation, horizontal dipole



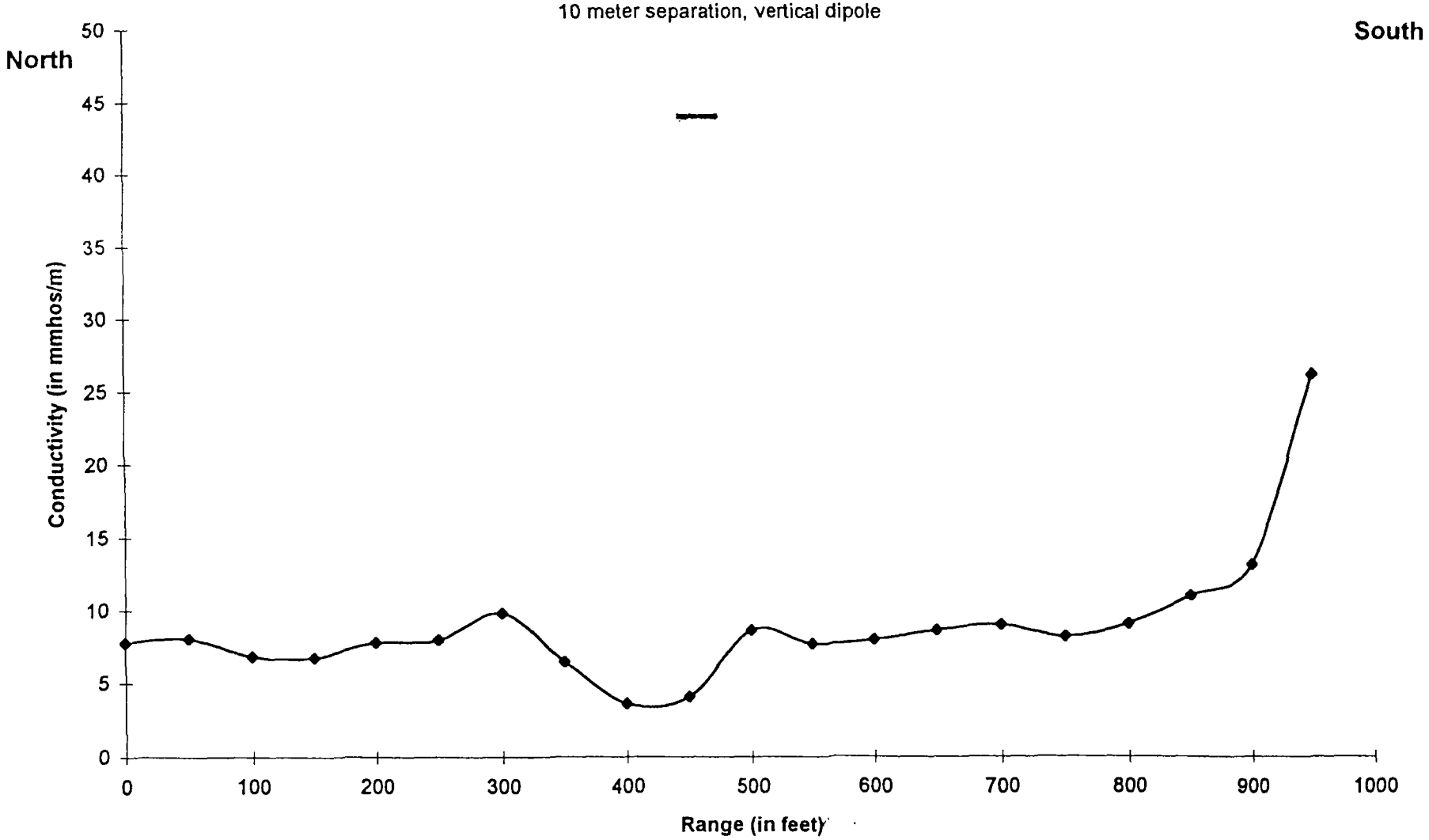
BCM ENGINEERS, INC.
OLIN FACILITY
WILMINGTON, MA

Enviroscan, Inc
Project No.
129426

APPENDIX A
Terrain Conductivity Profiles

Line 12

10 meter separation, vertical dipole



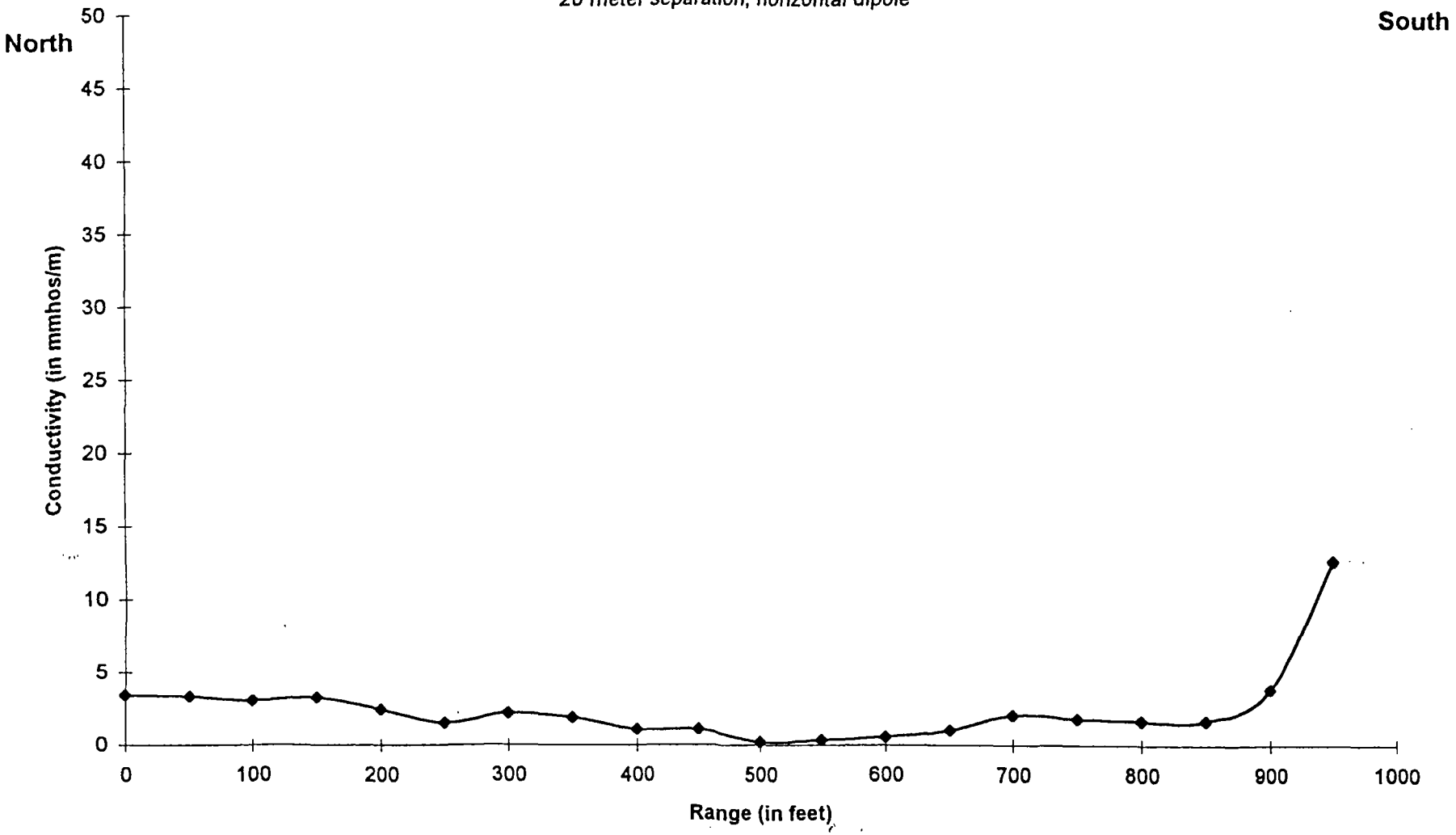
BCM ENGINEERS, INC.
OLIN FACILITY
WILMINGTON, MA

Enviroscan, Inc
Project No.
129426

APPENDIX A
Terrain Conductivity Profiles

Line 12

20 meter separation, horizontal dipole



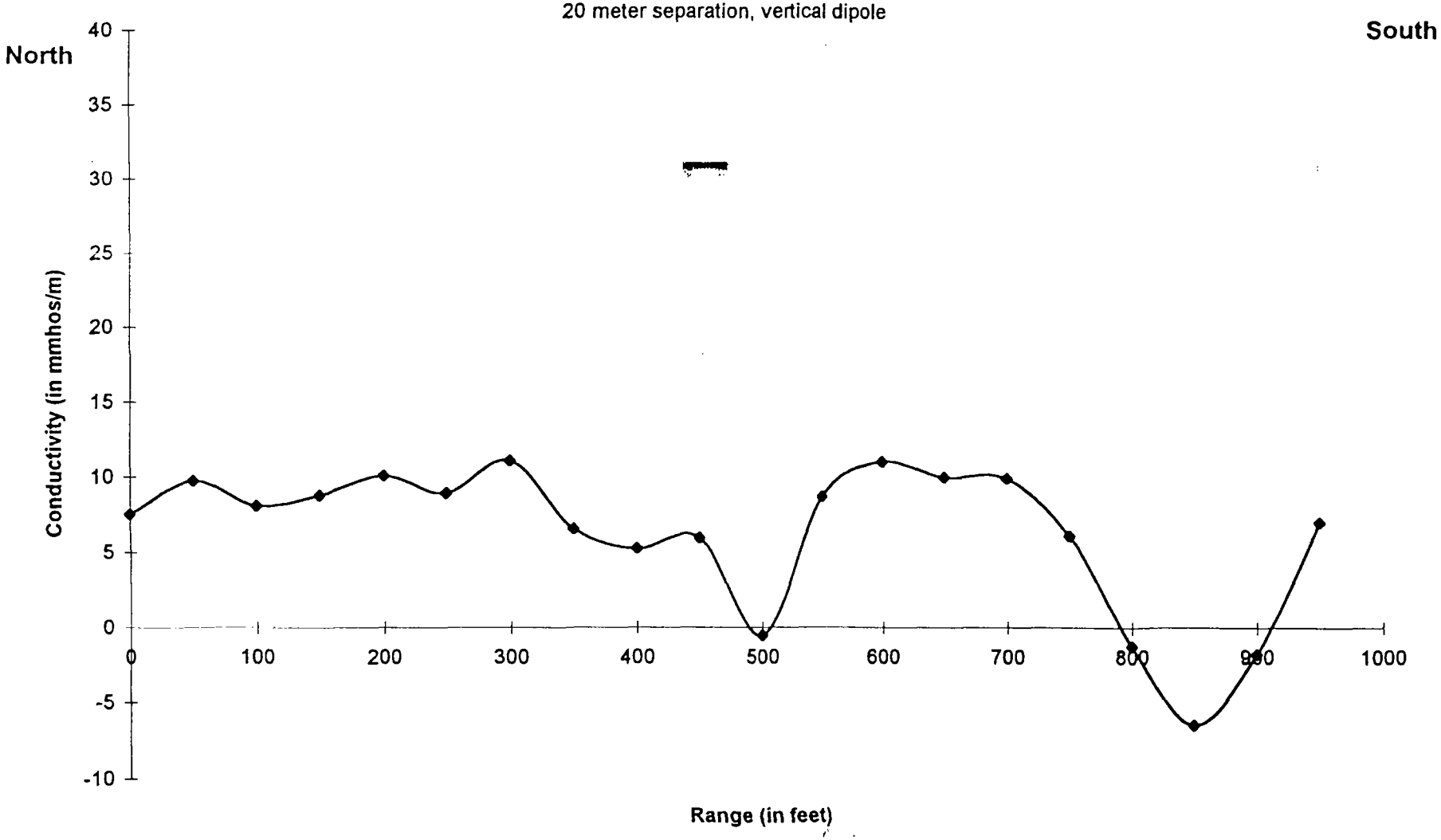
BCM ENGINEERS, INC.
OLIN FACILITY
WILMINGTON, MA

Enviroscan, Inc
Project No.
129426

APPENDIX A
Terrain Conductivity Profiles

Line 12

20 meter separation, vertical dipole



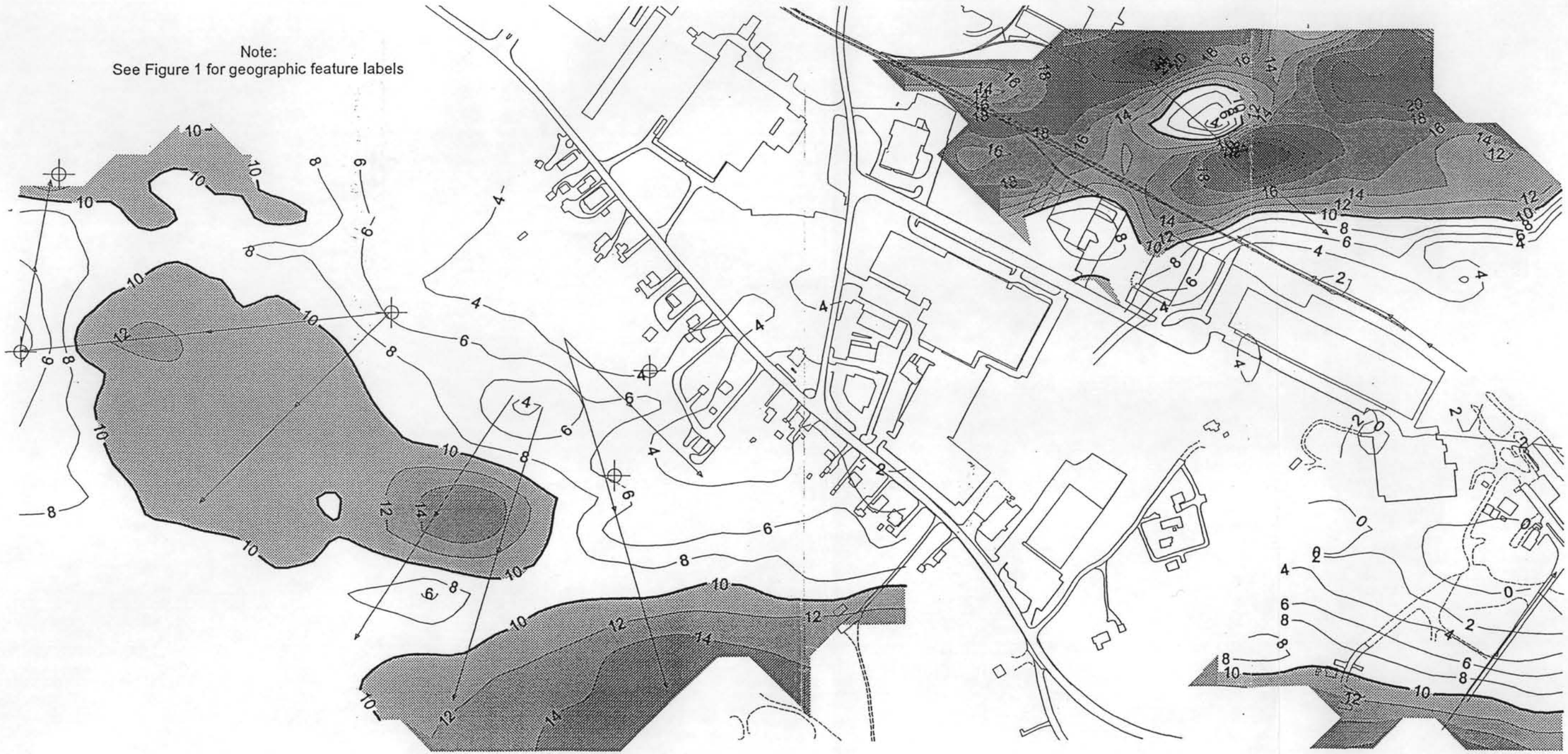
BCM ENGINEERS, INC.
OLIN FACILITY
WILM''GTON, MA

Enviroscan, Inc
Project No.
129426

Appendix B

APPENDIX B
Terrain Conductivity Contour Map
10 meter separation, horizontal dipole

Note:
See Figure 1 for geographic feature labels



350 700 1050 1400

SCALE 1 in. = 350 ft.

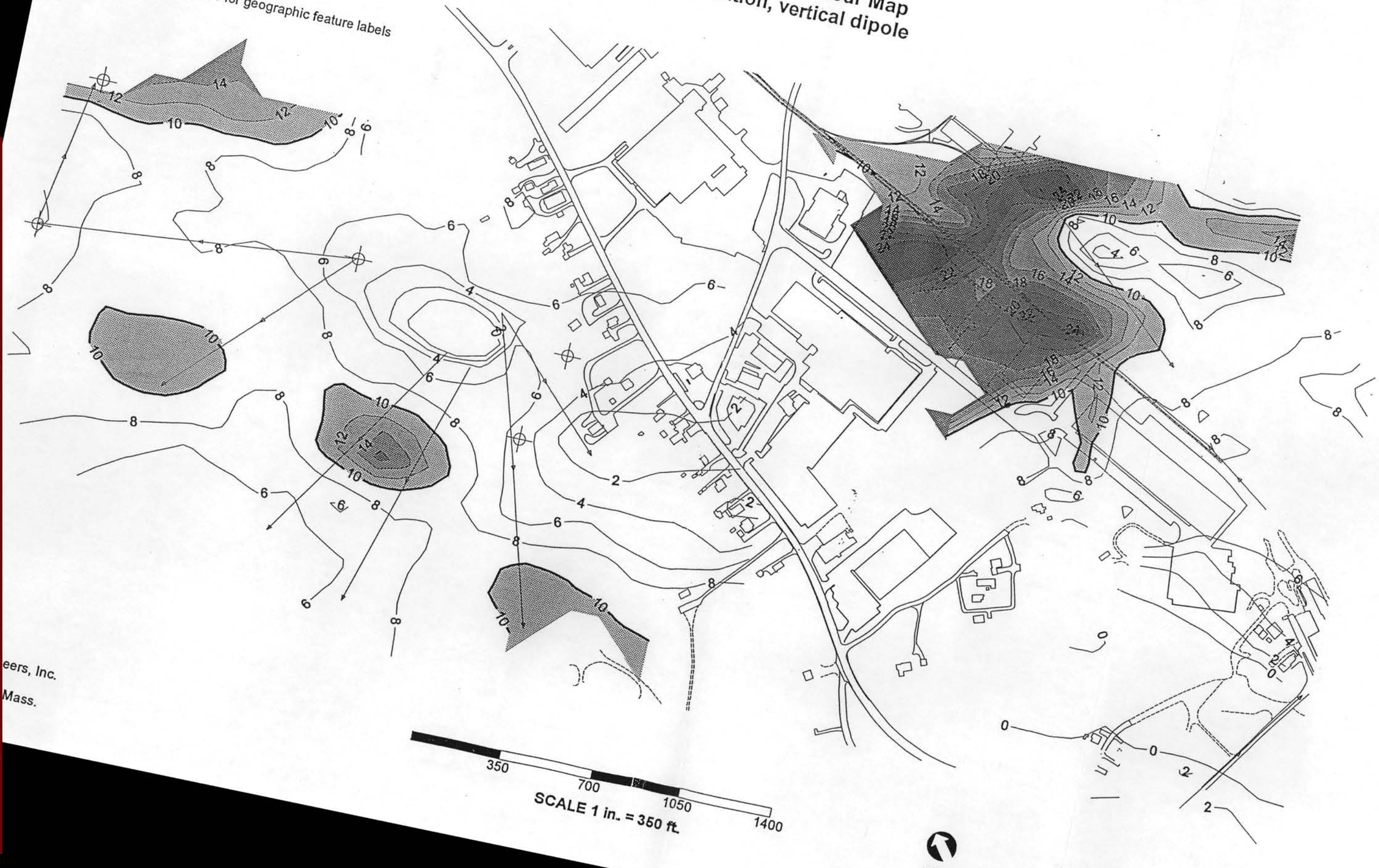
North

BCM Engineers, Inc.
Olin Facility
Wilmington, Mass.

Enviroscan, Inc.
Project No.
129426

APPENDIX B
Terrain Conductivity Contour Map
10 meter separation, vertical dipole

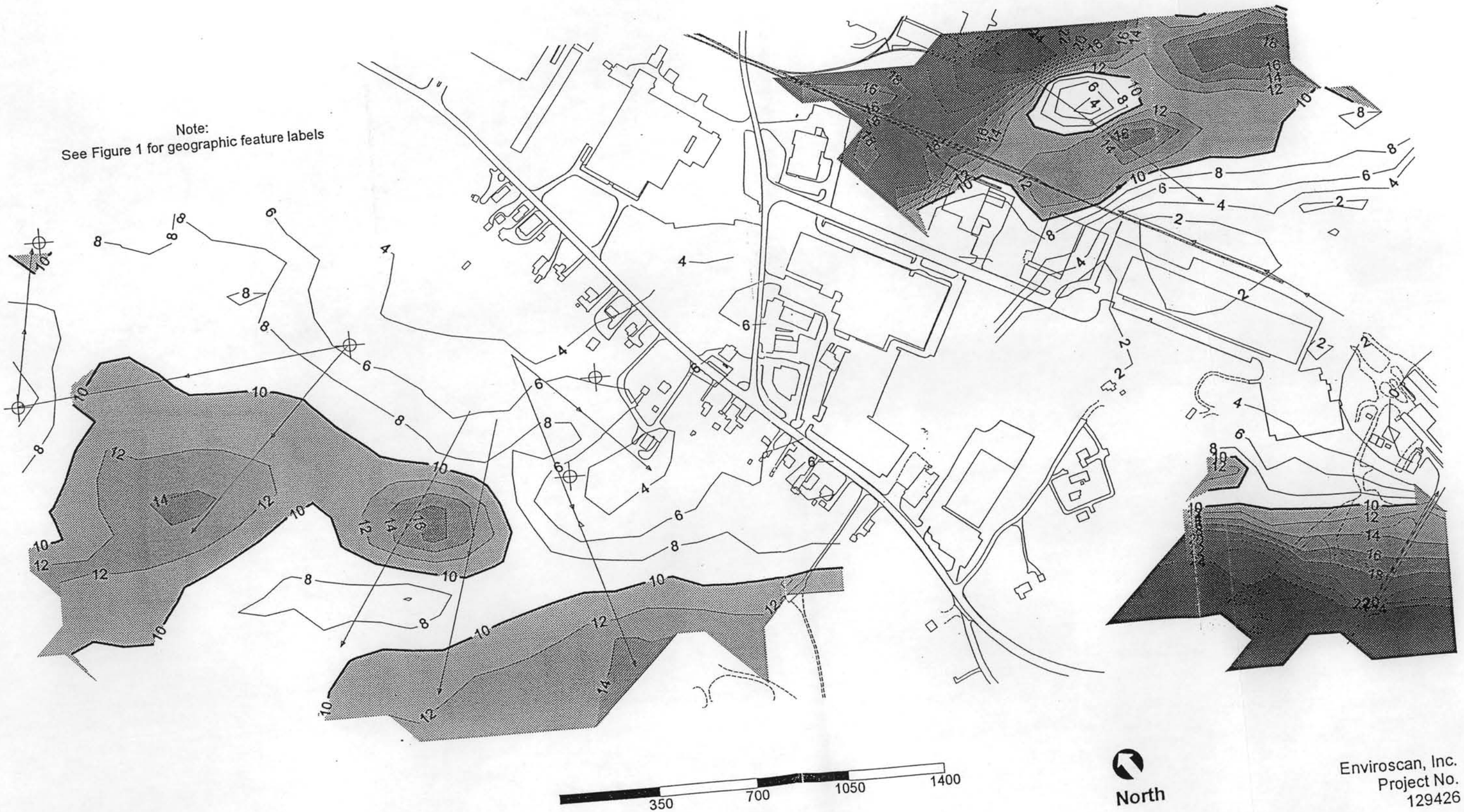
Note:
See Figure 1 for geographic feature labels



eers, Inc.
Mass.

APPENDIX B
Terrain Conductivity Contour Map
20 meter separation, horizontal dipole

Note:
See Figure 1 for geographic feature labels



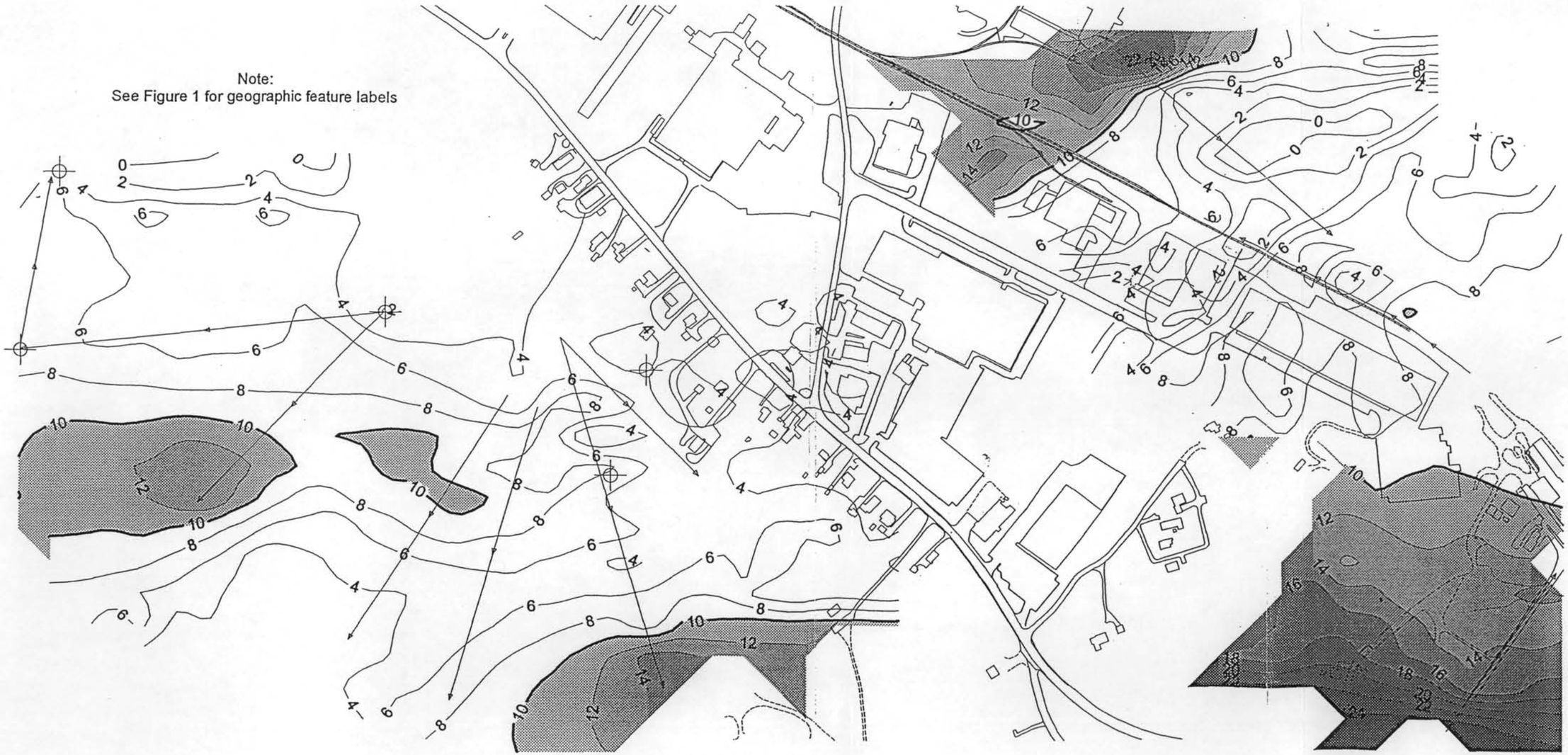
SCALE 1 in. = 350 ft.

North

Enviroscan, Inc.
Project No.
129426

APPENDIX B
Terrain Conductivity Contour Map
20 meter separation,vertical dipole

Note:
See Figure 1 for geographic feature labels



350 700 1050 1400

SCALE 1 in. = 350 ft.

North

BCM Engineers, Inc.
Olin Facility
Wilmington, Mass.

Enviroscan, Inc.
Project No.
129426

Appendix C

EM-34 Raw Field Data

Appendix C
Terrain Conductivity Survey Data
Olin Facility
Wilimington MA

Range (in feet)	10H (in mmhos/m)	10V (in mmhos/m)	20H (in mmhos/m)	20V (in mmhos/m)
		LINE 1		
0	16.186	8.256	16.305	11.439
50	20.947	20.915	28.161	23.24
100	21.075	26.925	27.955	26.765
	26.664	34.637	31.189	26.28
200	29.984	33.096	36.118	17.321
250	16.717	22.146	19.226	7.44
300	11.805	5.499	8.54	2.826
350	6.381	6.089	4.121	0.896
400	1.937	3.529	1.381	2.808
450	1.707	2.459	1.322	4.267
500	2.914	2.711	3.266	2.217
550	14.021	7.428	7.009	-0.624
600	29.282	2.609	16.543	-7.076
650	34.592	11.004	20.663	-5.616
700	23.285	11.201	16.282	3.77
		LINE 2		
0	3.479	7.287	3.543	4.768
50	2.194	3.469	3.506	4.037
100	2.444	3.764	3.3	4.495
150	2.531	2.559	3.793	3.945
200	4.284	4.785	9.649	2.792
250	4.11	6.202	3.524	6.578
300	4.618	7.63	6.45	4.888
350	7.109	4.85	7.905	6.733
400	7.589	4.705	8.802	3.851
450	4.875	6.32	6.654	0.933
500	2.398	2.627	3.781	7.008
550	2.302	-0.581	4.307	3.414
		LINE 3		
0	2.288	3.886	3.268	5.204
50	2.864	2.093	6.596	3.648
100	4.857	2.224	3.996	6.216
150	5.076	7.229	4.664	5.607
200	5.154	7.04	7.131	7.621
250	5.757	6.733	7.63	7.507
300	7.136	5.035	6.216	14.955
350	6.399	10.446	8.436	9.571
400	6.317	4.65	11.897	-6.825
450	4.586	6.953	8.226	8.679
500	5.172	6.079	5.163	9.182
550	8.871	1.396	-4.284	10.006
600	7.589	6.179	5.969	4.032
650	4.261	7.525	5.593	8.656
700	4.541	4.852	3.469	7.186
750	4.815	5.758	6.042	5.003
800	7.371	3.881	7.104	2.105
850	9.063	7.255	8.757	5.131
900	9.622	8.184	9.031	5.053
950	9.489	8.39	9.526	6.747
1000	11.283	8.834	10.935	10.482
1050	13.334	11.7	11.096	5.758
1100	15.825	10.807	14.167	15.069

Appendix C
Terrain Conductivity Survey Data
Olin Facility
Wilimington MA

Range (in feet)	10H (in mmhos/m)	LINE 4 10V (in mmhos/m)	20H (in mmhos/m)	20V (in mmhos/m)
0	7.922	-21.286	4.051	3.808
50	2.558	3.869	4	5.786
100	3.381	4.527	7.383	4.315
150	5.603	3.396	6.006	8.294
200	5.616	7.447	5.677	11.311
250	6.884	5.738	7.861	6.967
300	10.089	8.697	10.116	7.649
350	11.114	10.647	11.865	7.946
400	15.294	9.759	14.657	8.798
450	15.811	14.012	17.207	12.469
500	17.752	18.818	18.067	7.882
550	16.328	18.177	17.276	9.091
600	14.3	11.329	14.657	9.32
650	12.332	11.714	12.103	6.285
700	10.313	8.473	9.402	5.854
750	7.681	4.87	6.774	3.492
800	5.317	5.816	5.754	4.286
850	6.211	6.594	6.088	3.927
900	7.676	7.479	6.819	4.783
950	9.549	4.989	10.322	3.552
		LINE 5		
0	6.701	6.068	6.372	6.25
50	7.795	6.083	8.642	7.772
100	7.812	8.126	8.637	8.203
150	8.189	7.186	9.155	10.455
200	9.855	5.895	9.819	10.057
250	10.679	8.729	11.325	11.1
300	10.62	9.965	11.37	12.075
350			12.3	13.609
400	11.247	5.2	10.473	8.761
450	11.444	7.644	12.391	9.491
500	10.524	9.168	9.91	9.96
550	9.636	7.228	8.45	6.518
600	10.025	6.01	8.931	5.941
650	9.315	5.95	8.308	2.742
700	10.437	6.253	9.498	5.822
750	10.881	9.489	7.708	1.817
800	11.361	8.097	8.505	7.136
850	11.499	7.548	9.123	1.008
900	8.161	5.163	7.493	3.57

Appendix C
Terrain Conductivity Survey Data
Olin Facility
Wilimington MA

Range (in feet)	30 10H (in mmhos/m)	LINE 6 50 10V (in mmhos/m)	65 20H (in mmhos/m)	95 20V (in mmhos/m)
0	4.657	4.42	4.672	2.676
50	6.674	3.572	5.625	1.463
100	7.644	6.965	6.938	2.916
150	7.864	3.79	7.525	6.642
200	10.441	7.749	9.465	6.573
250	10.688	9.335	10.244	5.854
300	11.151	9.371	10.235	6.034
350	10.986	8.267	10.23	7.626
400	10.295	10.112	10.153	8.052
450	10.4	8.834	10.514	8.093
500	10.414	8.793	10.716	9.146
550	11.009	9.027	11.75	9.402
600	11.123	9.37	12.547	9.704
650	11.787	10.748	13.366	11.004
700	11.801	10.546	13.792	11.022
750	11.741	11.041	14.167	13.572
800	11.65	10.89	14.36	14.062
850	10.771	11.279	14.195	14.46
900	10.647	11.114	14.117	15.486
950	10.354	10.565	13.604	11.975
		LINE 7		
0	4.007	4.118	4.161	1.763
50	5.943	4.351	5.61	1.721
100	7.435	4.753	6.666	2.932
150	8.174	6.056	7.218	3.692
200	8.636	7.806	7.688	6.993
250	9.272	6.957	8.48	6.642
300	10.336	7.974	9.008	6.048
350	11.215	7.733	9.182	5.181
400	10.748	8.28	9.53	4.966
450	9.841	7.82	9.407	4.536
500	10.047	7.916	9.172	4.777
550	10.121	7.96	8.956	4.963
600	10.963	6.947	8.999	4.486
650	11.352	7.466	9.437	4.684
700	11.924	8.354	9.549	3.86
750	13.032	8.665	11.004	4.663
800	13.723	8.261	11.206	4.611
850	12.634	9.184	10.83	7.313
900			11.079	11.031
950	12.816	8.88	10.941	4.485
1000	12.45	9.201	11.262	6.591
1050	11.214	8.193	10.299	5.172
1100	7.095	8.058	8.241	6.042
1150	5.301	6.64	5.639	6.99
1200	3.099	5.567	5.189	7.37

Appendix C
Terrain Conductivity Survey Data
Olin Facility
Wilimington MA

Range (in feet)	10H (in mmhos/m)	10V (in mmhos/m)	20H (in mmhos/m)	20V (in mmhos/m)
		LINE 8		
600	9.905	16.273	6.24	-3.515
550	13.174	12.057	11.439	7.836
500	12.585	9.91	11.224	6.66
450	5.467	7.762	9.677	5.639
400	7.818	6.831	8.377	7.521
350	6.869	7.083	7.273	7.829
300	6.614	6.564	7.098	6.703
250	5.856	5.97	6.961	6.799
200	5.113	7.193	6.697	8.158
150	4.814	6.031	6.182	7.005
100	4.516	6.268	5.911	6.867
50	3.857	4.761	5.29	6.433
0	2.665	5.207	4.092	7.13
		LINE 10		
0	18.782	3.108	46.677	31.067
50	10.395	0.915	37.781	21.194
100	8.07	7.58	16.323	22.453
150	9.924	-1.368	19.972	9.965
200	7.69	0.929	19.427	11.1
250	3.982	-4.948	17.225	14.987
300	2.16	-5.058	17.207	14.232
350	1.881	-8.665	15.779	13.824
400	1.739	-10.043	13.449	11.654
450	0.585	-11.325	12.753	13.819
500	1.13	-9.429	11.952	14.282
550	1.661	-11.196	13.833	15.353
600	-23.245	1.831	9.323	12.36
650	0.885	4.105	-5.081	10.849
		LINE 12		
0	3.112	7.745	3.414	7.516
50	3.488	8.024	3.337	9.713
100	3.488	6.788	3.062	8.065
150	2.874	6.738	3.264	8.729
200	2.957	7.768	2.426	10.02
250	2.737	7.914	1.501	8.862
300	2.618	9.75	2.151	11.009
350	2.906	6.426	1.844	6.513
400	3.025	3.593	1.053	5.241
450	1.931	4.046	1.075	5.946
500	1.442	8.56	0.192	-0.518
550	2.023	7.658	0.337	8.647
600	2.096	7.91	0.546	10.935
650	2.632	8.55	0.988	9.928
700	2.883	8.981	2.009	9.851
750	3.327	8.171	1.785	6.074
800	2.705	9.04	1.629	-1.245
850	2.842	10.959	1.652	-6.495
900	4.971	13.114	3.785	-1.803
950	13.989	26.156	12.615	6.939

References

BCM Engineers, Inc. (1995) Un-numbered AutoCAD Drawing, Project No. 3683, File No. P-88.

McNeill, J.D. (1980a) Electromagnetic Terrain Conductivity Measurement at Low Induction Numbers. Technical Note TN-6, Geonics, Ltd., Mississauga, Ontario.

McNeill, J.D. (1980b) Electrical Conductivity of Soils and Rocks. Technical Note TN-5, Geonics, Ltd., Mississauga, Ontario.

CONETEC

BCM ENGINEERS

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Location: OLIN MA.

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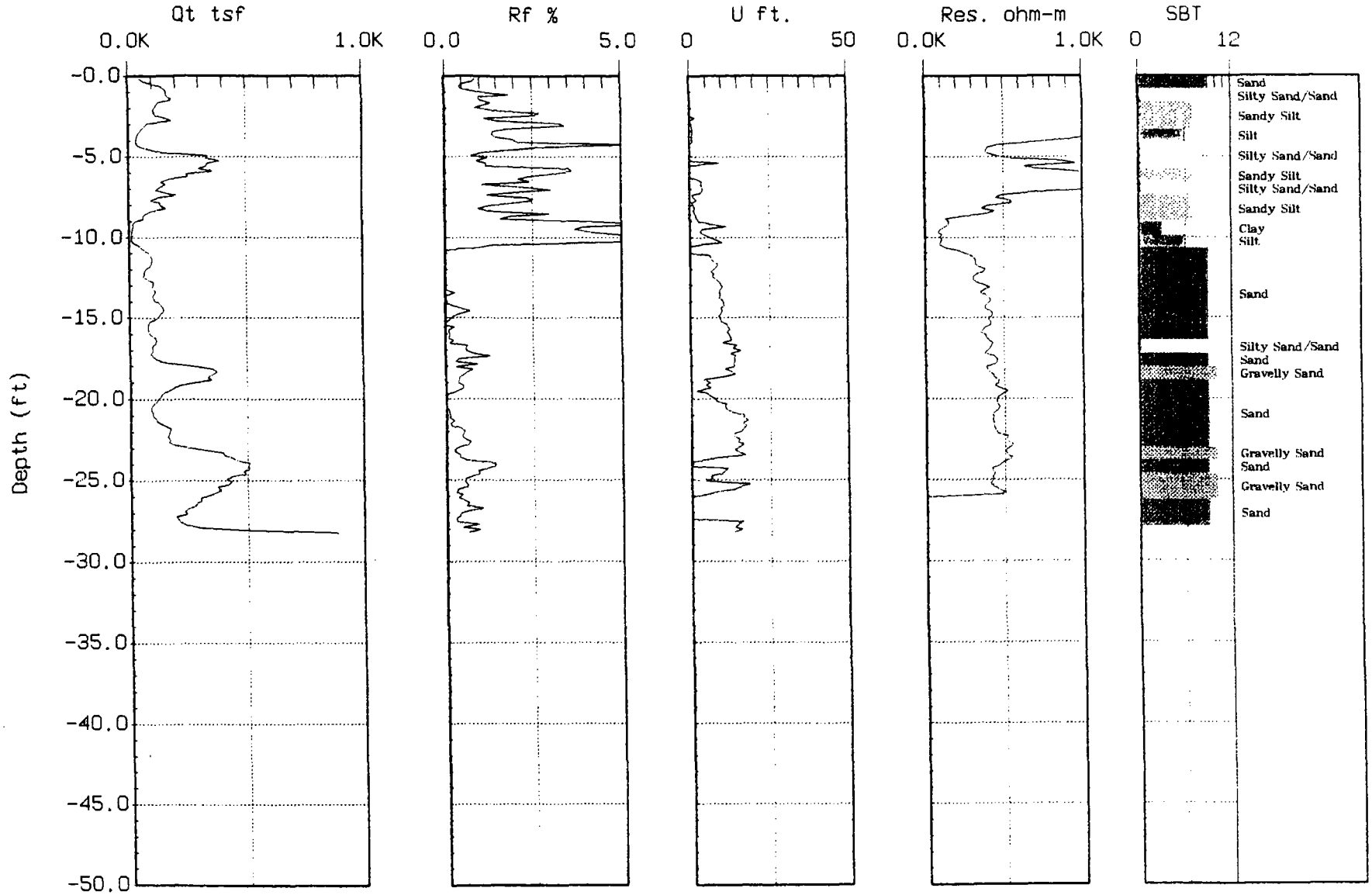

Max. Depth: 28.21 (ft)

Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson and Campanella 1988)

Appendix M

SMITH

APPENDIX M

CONE PENETROMETER TESTING PROFILES

CONETEC

BCM ENGINEERS

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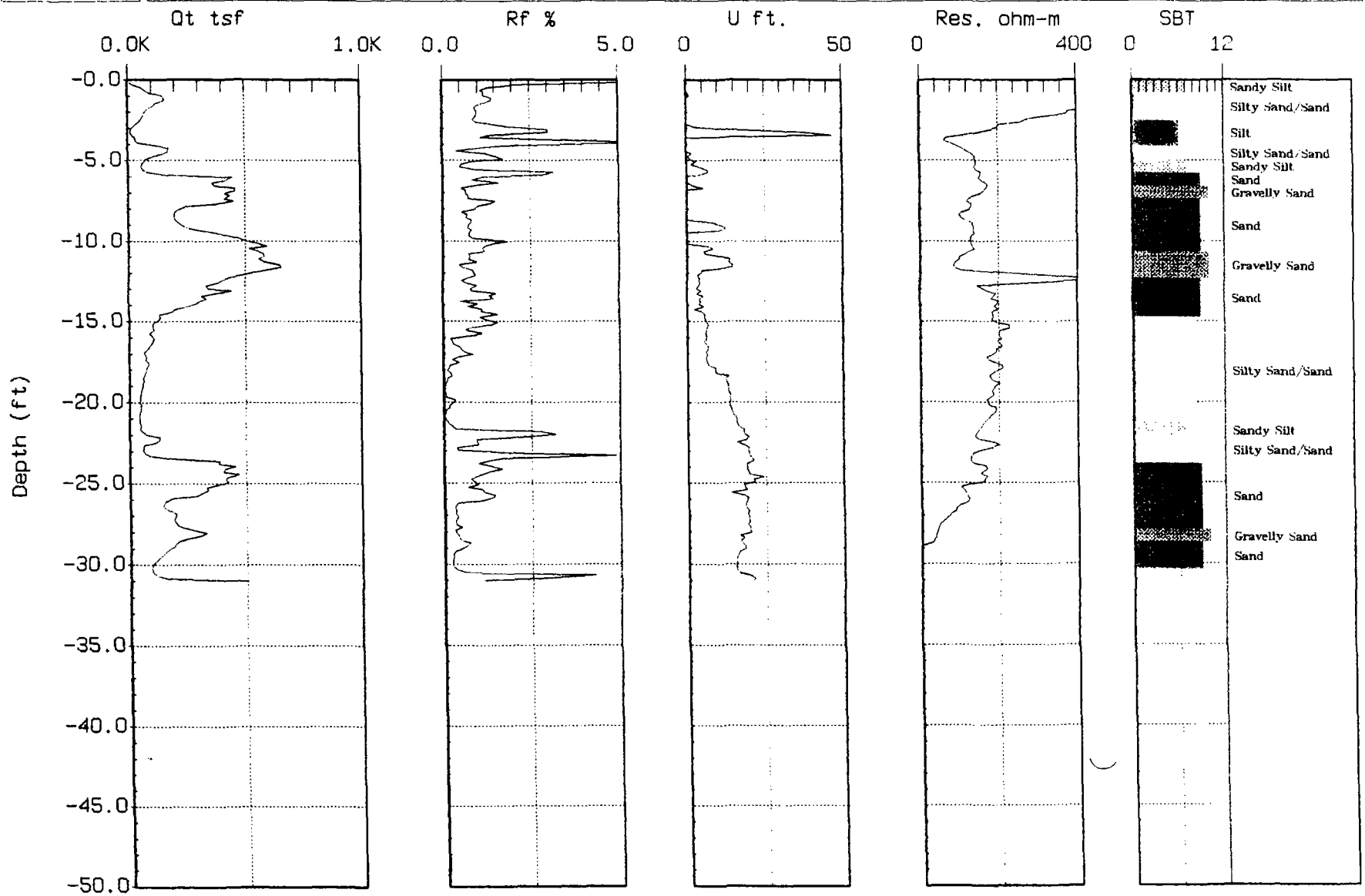
Location: OLIN MA.

Cone: 20 TON A AD024
Date: 06:07:95 10:29



Max. Depth: 31.00 (ft)

Depth Inc.: 0.164 (ft)

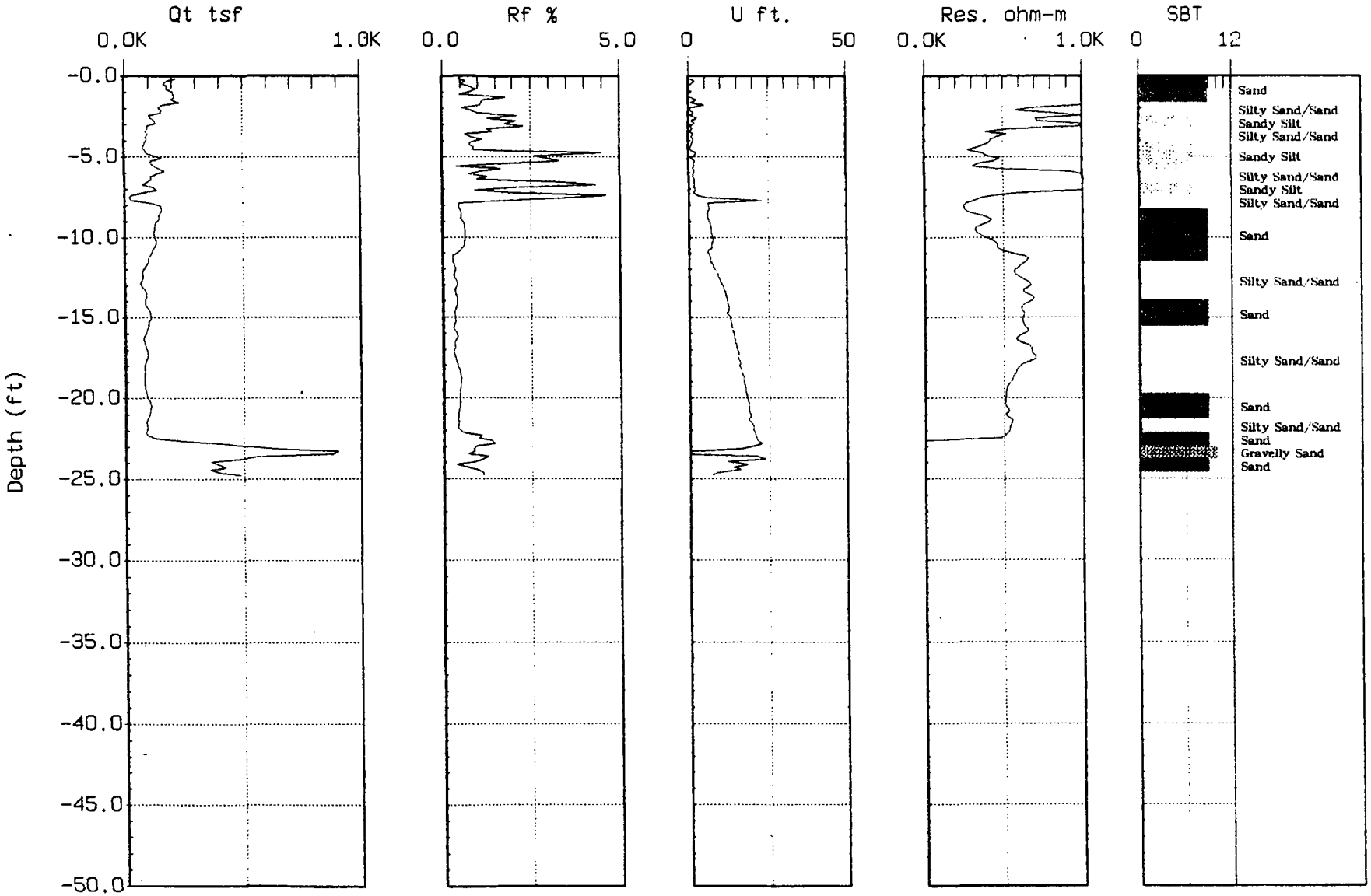
SBT: Soil Behavior Type (Robertson and Campanella 1988)

CONETEC

BCM ENGINEERS

Site: CPT-2
Location: OLIN MA.

Cone: 20 TON A AD035
Date: 06:07:95 16:41

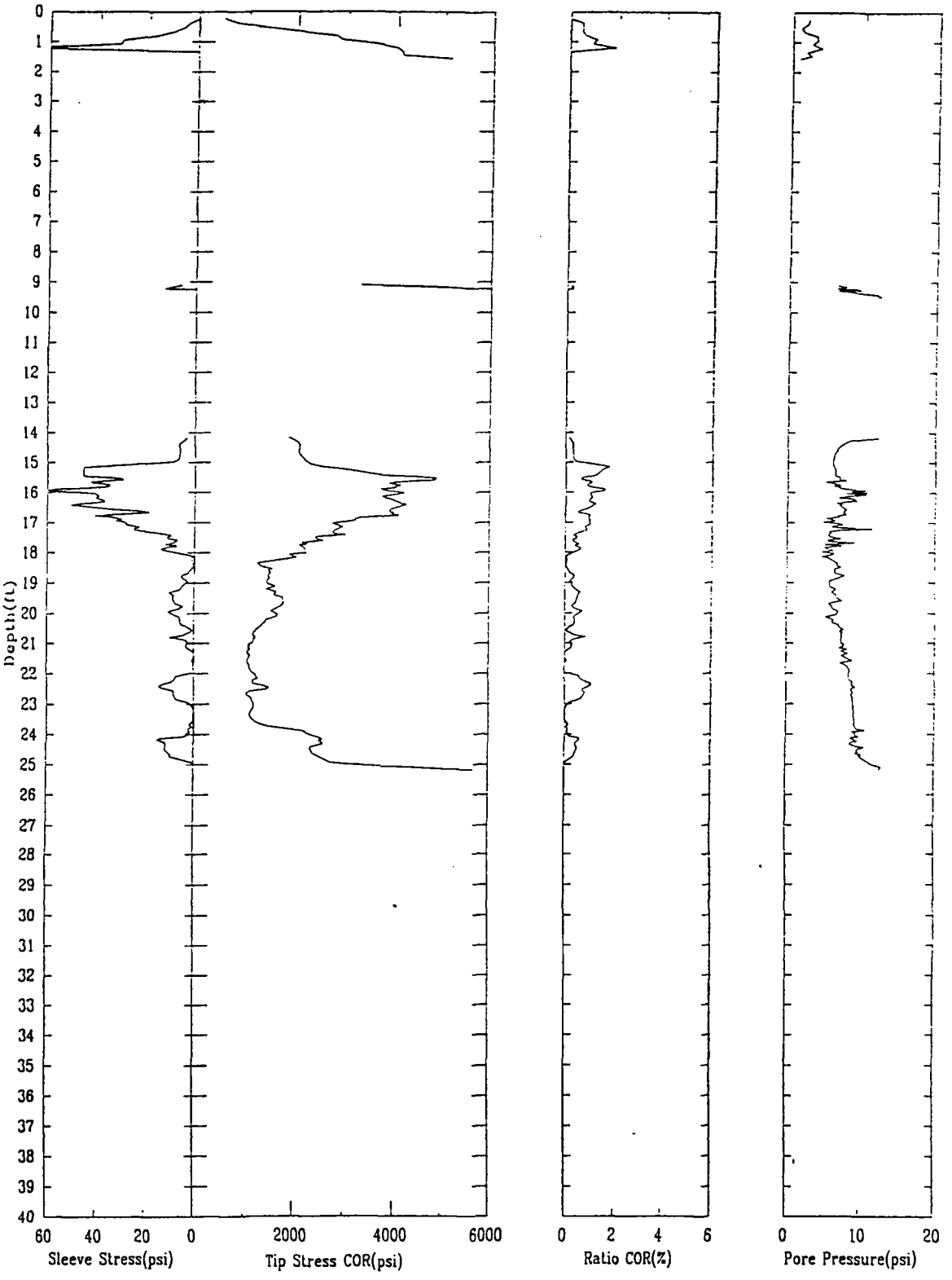


Max. Depth: 24.77 (ft)

Depth Inc.: 0.164 (ft)

SBT: Soil Behavior Type (Robertson and Campanella 1988)

CPT-01 APPLIED RESEARCH ASSOCIATES, INC. 09/19/95



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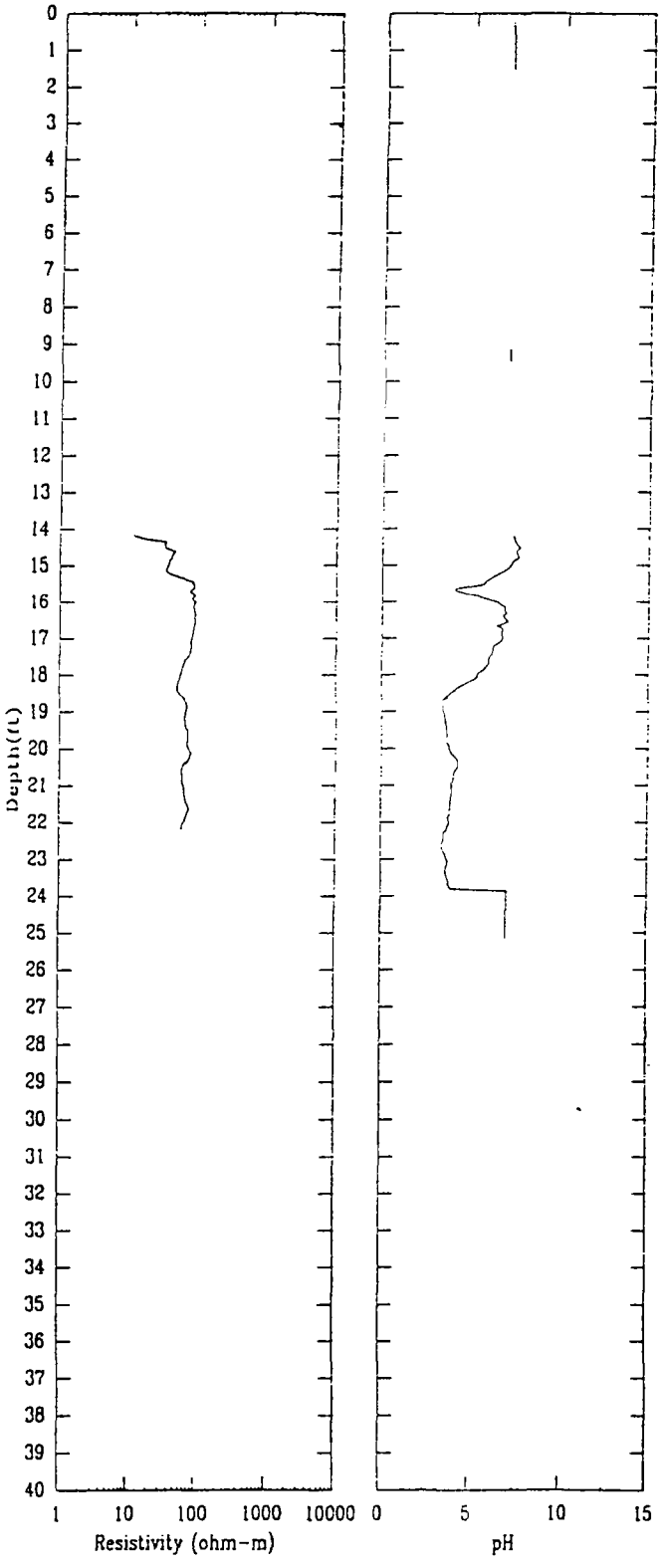

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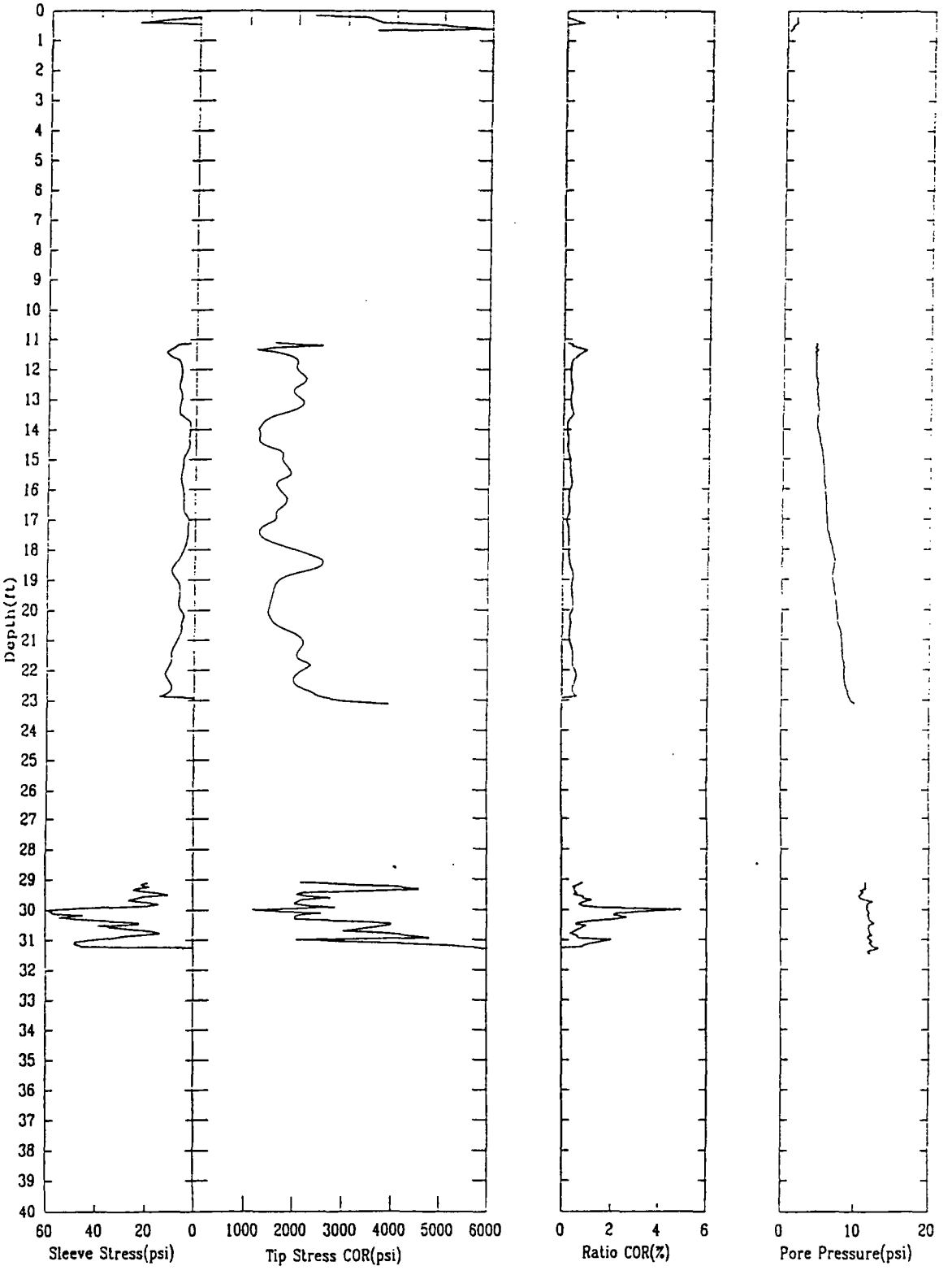

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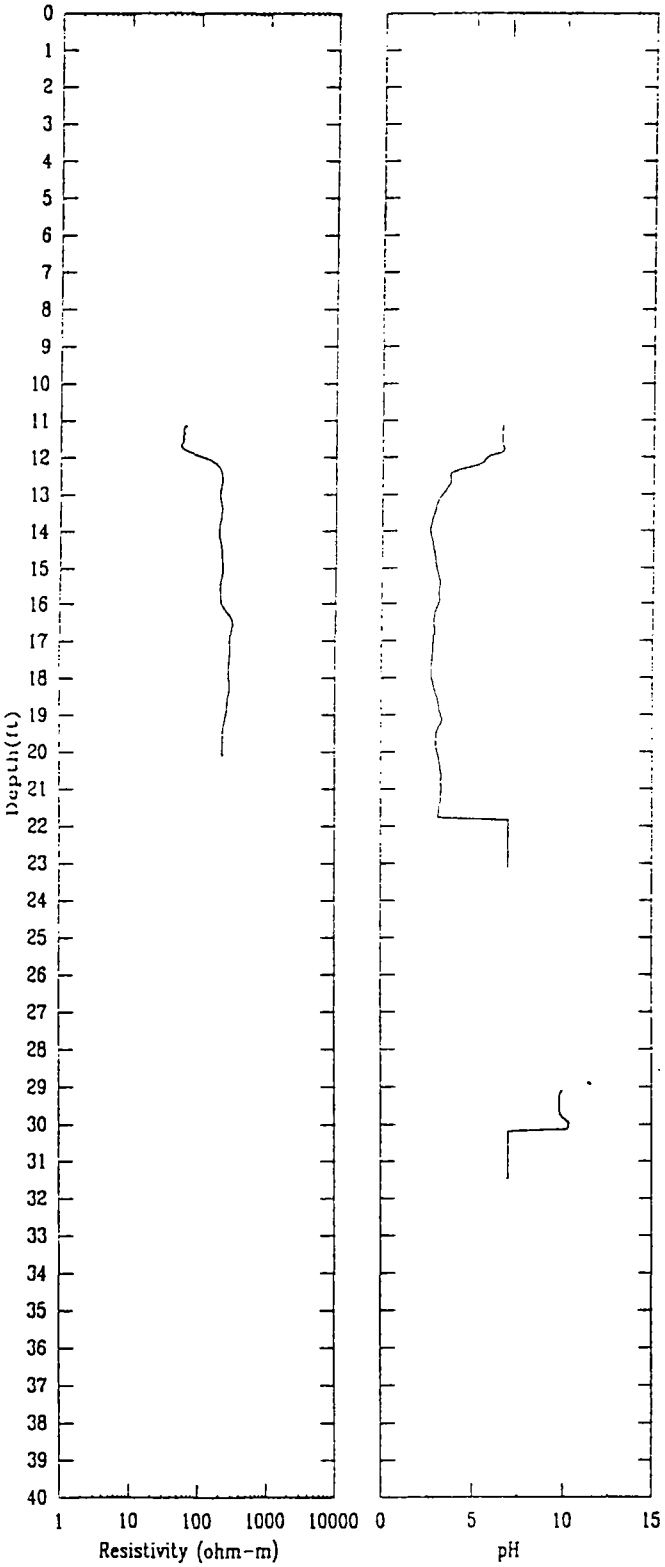

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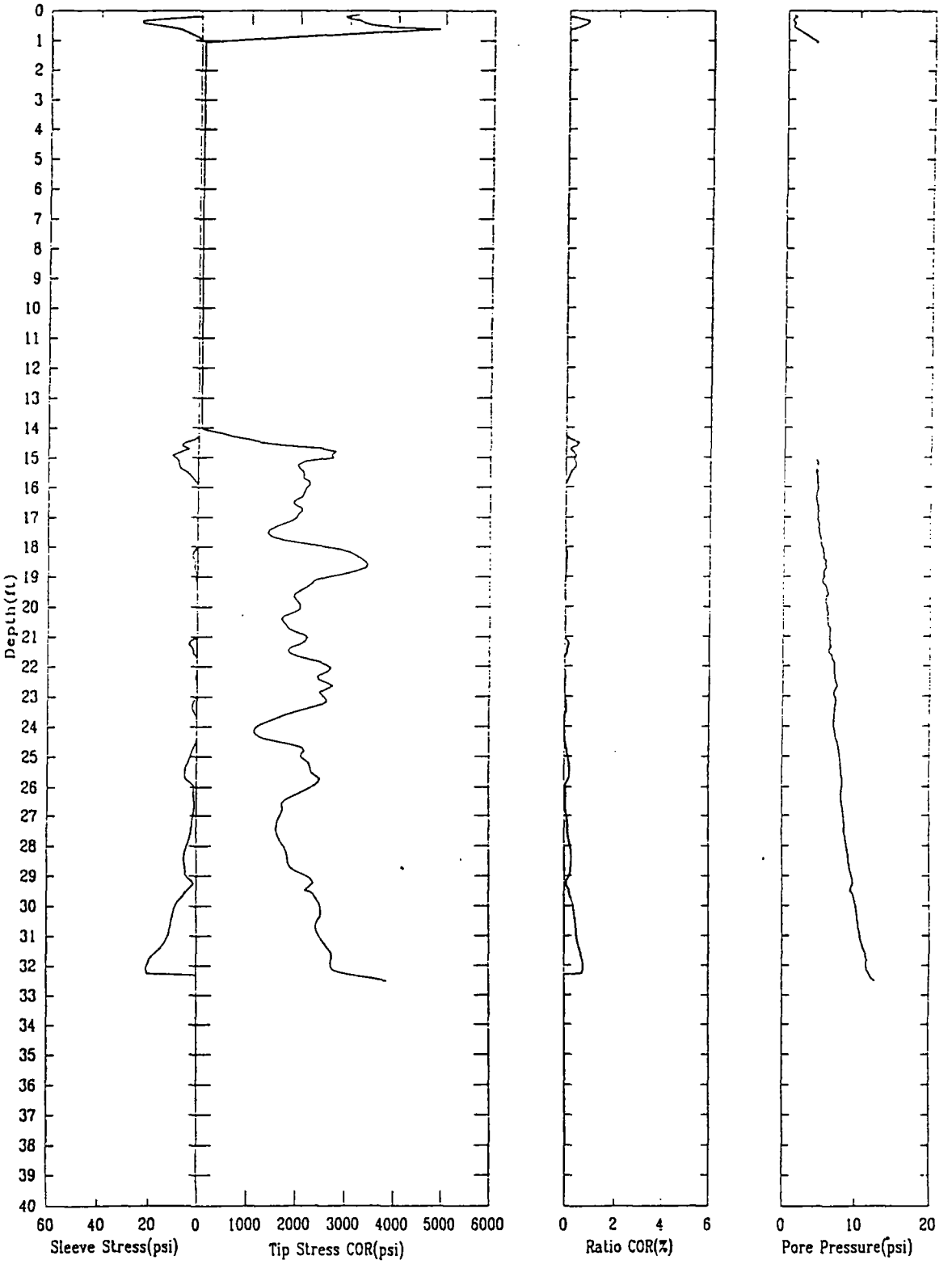
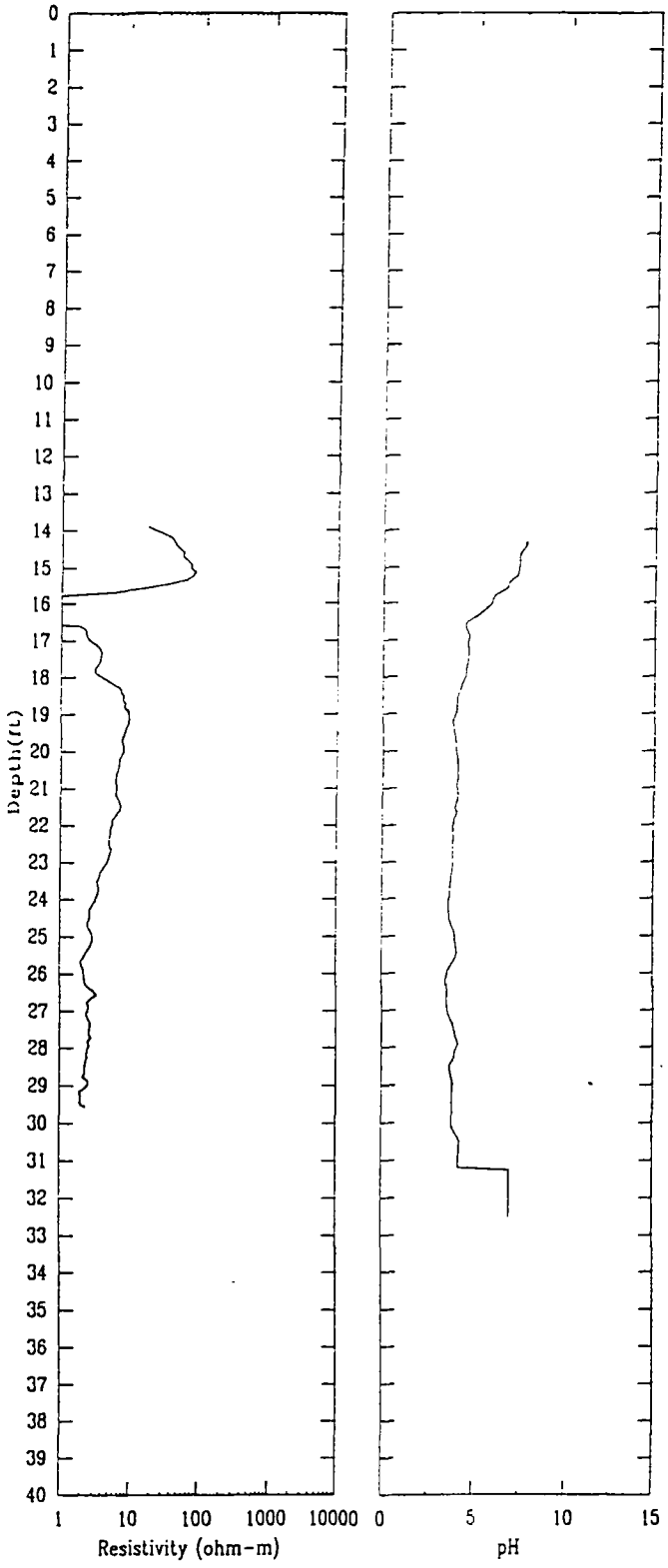


File 221s501.ECP



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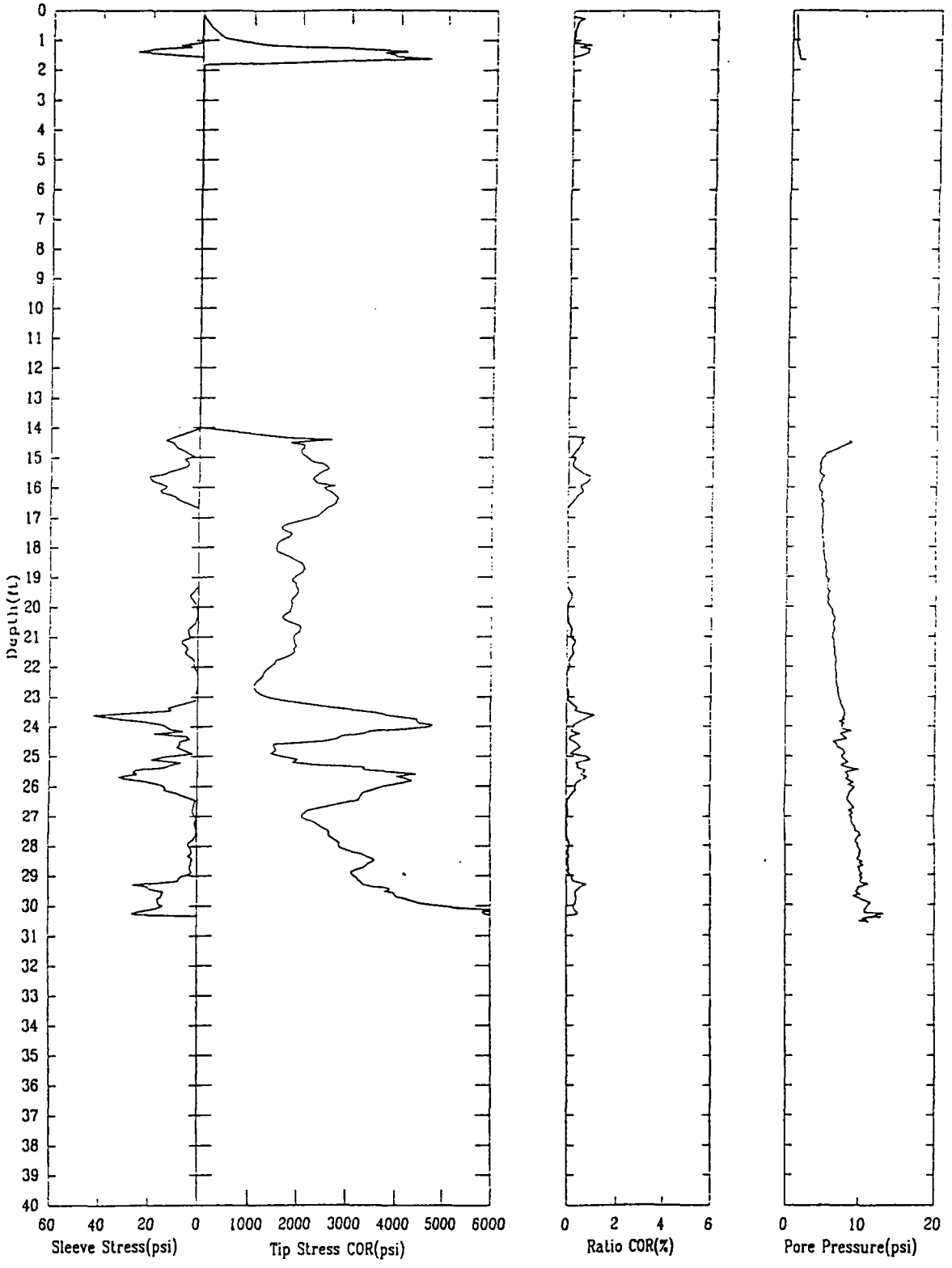

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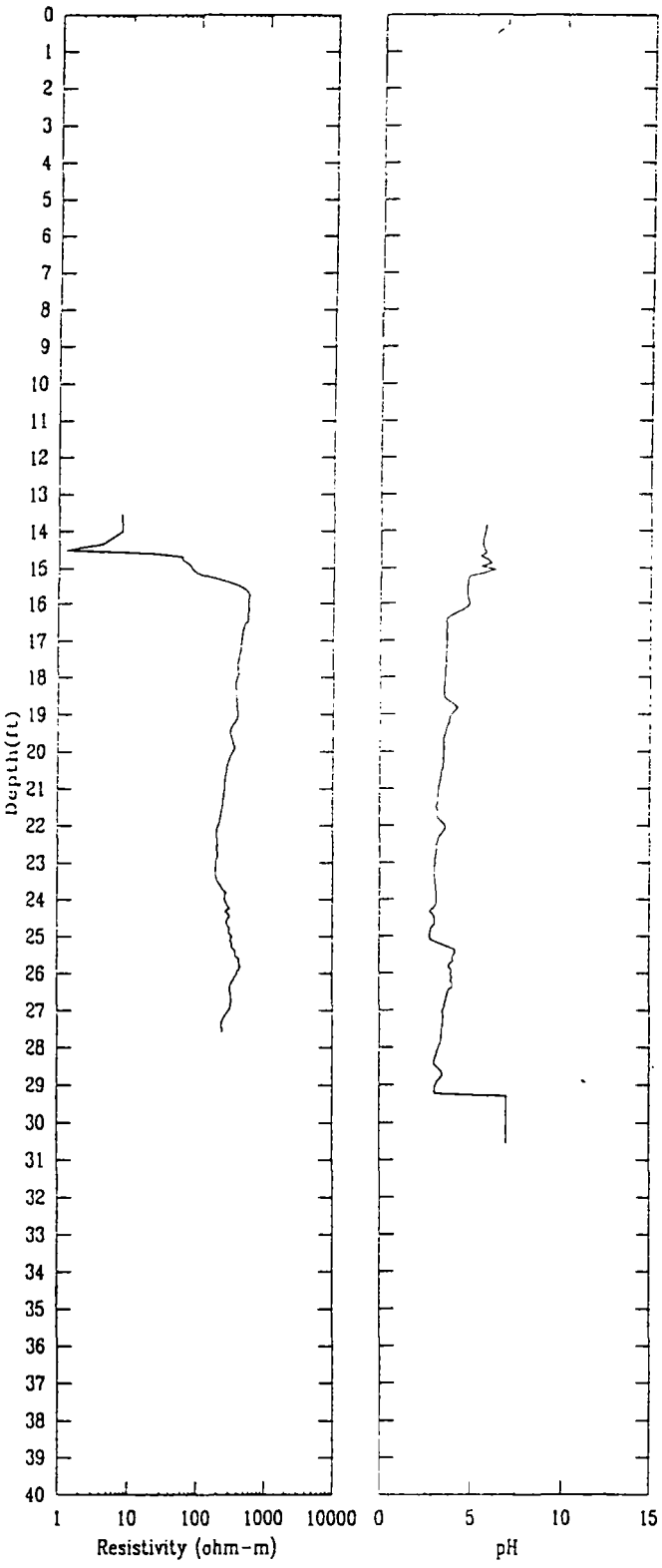
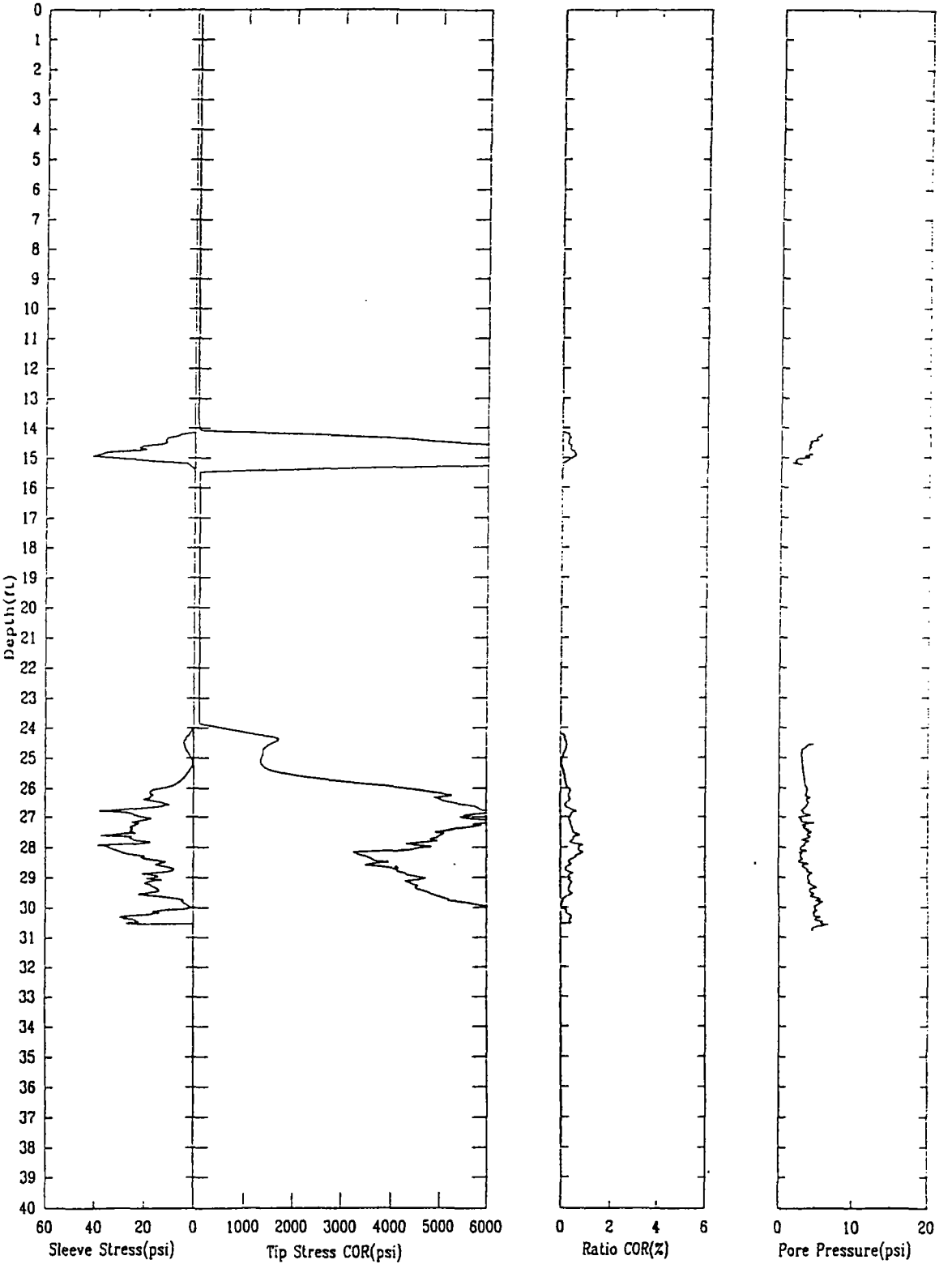
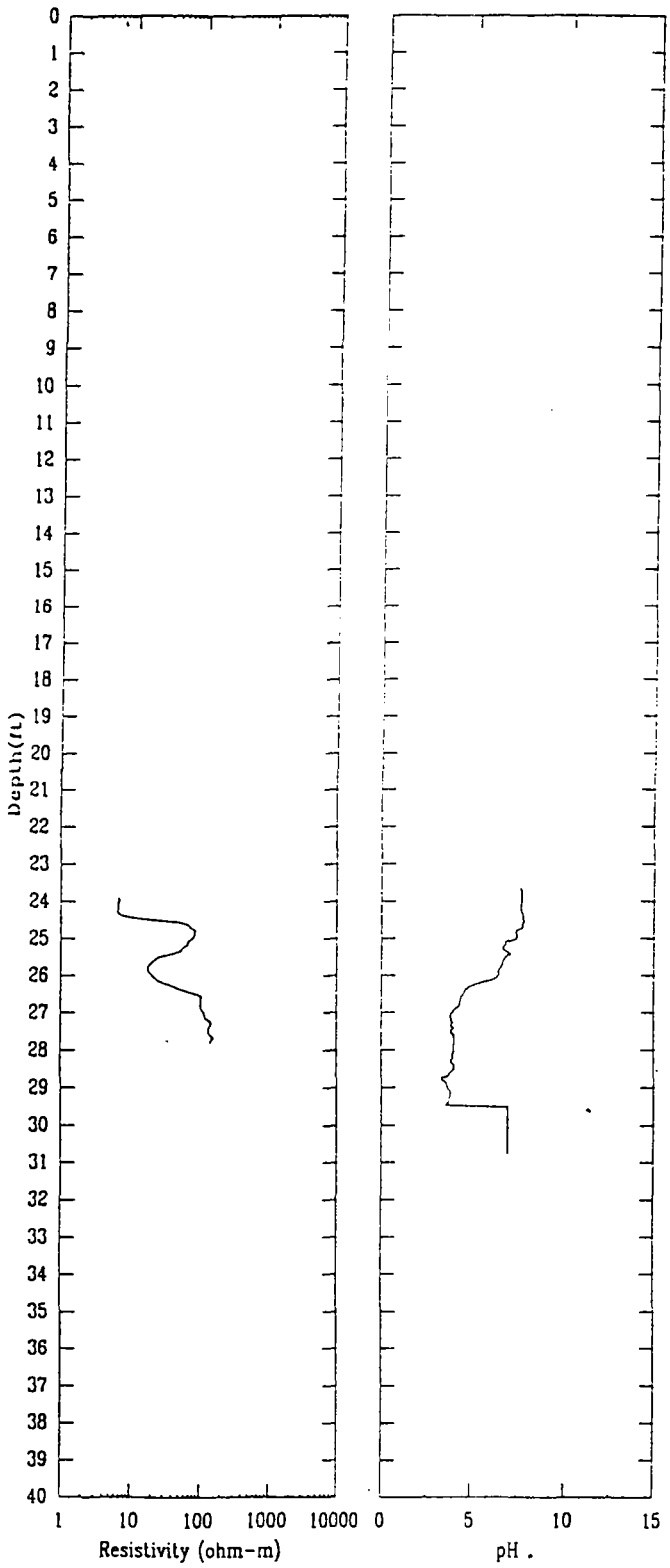


File 222s501.ECP

CPT-05 APPLIED RESEARCH ASSOCIATES, INC. 09/25/95



File 225s501.ECP



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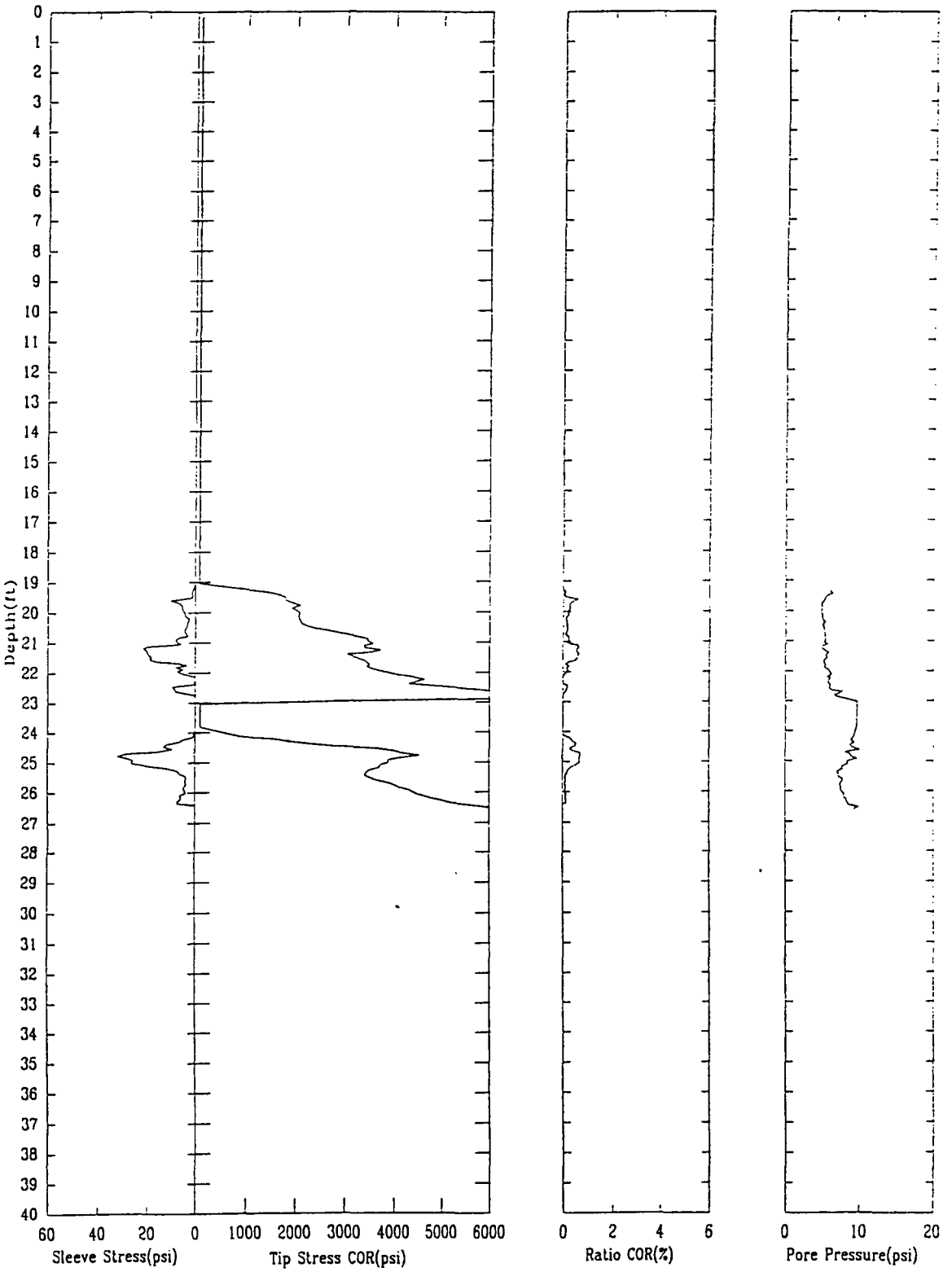

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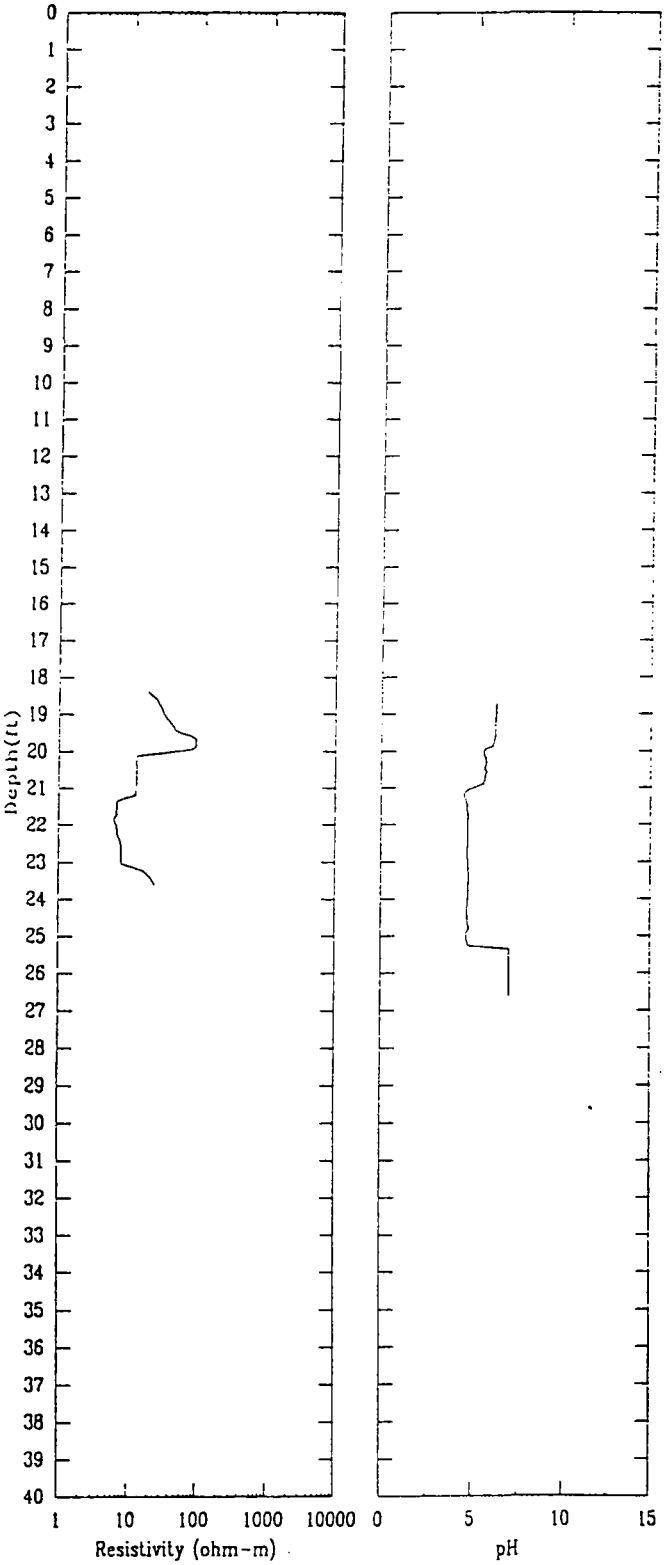


File 226s501.ECP

Appendix N

SMITH

APPENDIX N

ANNOTATED INDUCTANCE LOGS

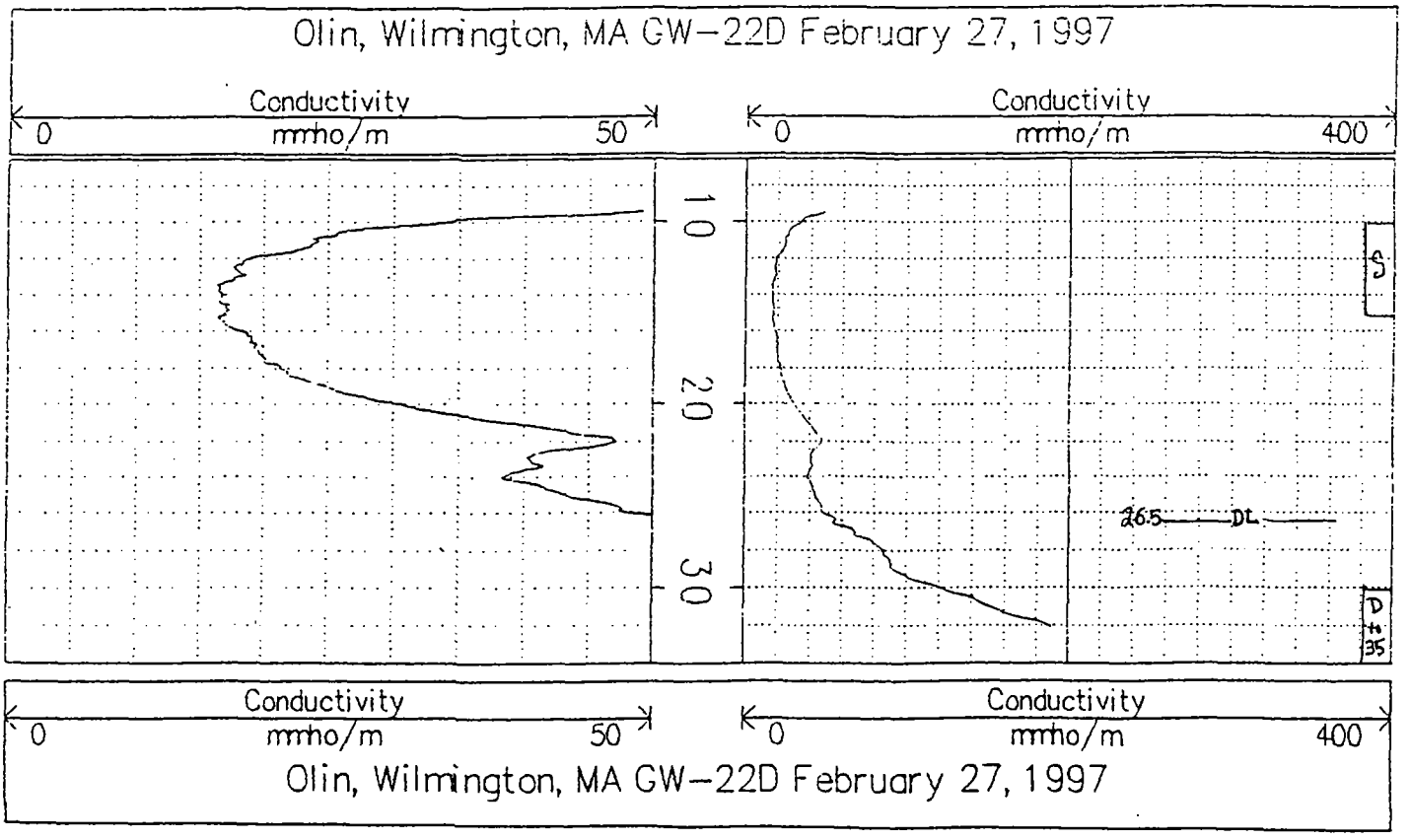
HAGER-RICHTER GEOSCIENCE, INC.
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

Conductivity

Well: GW-22D

PROJECT: Olin, Wilmington
CLIENT: Smith Technology Corporation
LOCATION OF WELL: Wilmington
STATE: MA COUNTY: Middlesex
INSTRUMENTATION: Mt. Sopris MGX II
LOGGING GEOPHYSICIST: Jonathon Puliafico
CLIENT REP: Bruce Cushing
DRILLING CONTRACTOR: Soil Exploration, Inc.
COMMENTS:

DATE: February 27, 1997
H-R FILE: 97J20
ELEVATION: 85.6 ft MSL
LOG DATUM: Ground Level (GL)
CLIENT TD: unknown
H-R TD: N/A
STATIC WATER LEVEL: 3.65 ft below GL
DEPTH OF BEDROCK: 36 ft below GL
CASING DIAMETER: 2 in ID



Monitoring well screened interval
S=shallow
M=intermediate
D=deep

22.5 —— DL —— Proposed interface and depth bgs of dense layer

—— BR —— Location of bedrock surface

- - - - - - - - - - - - Conductivity data from 1992

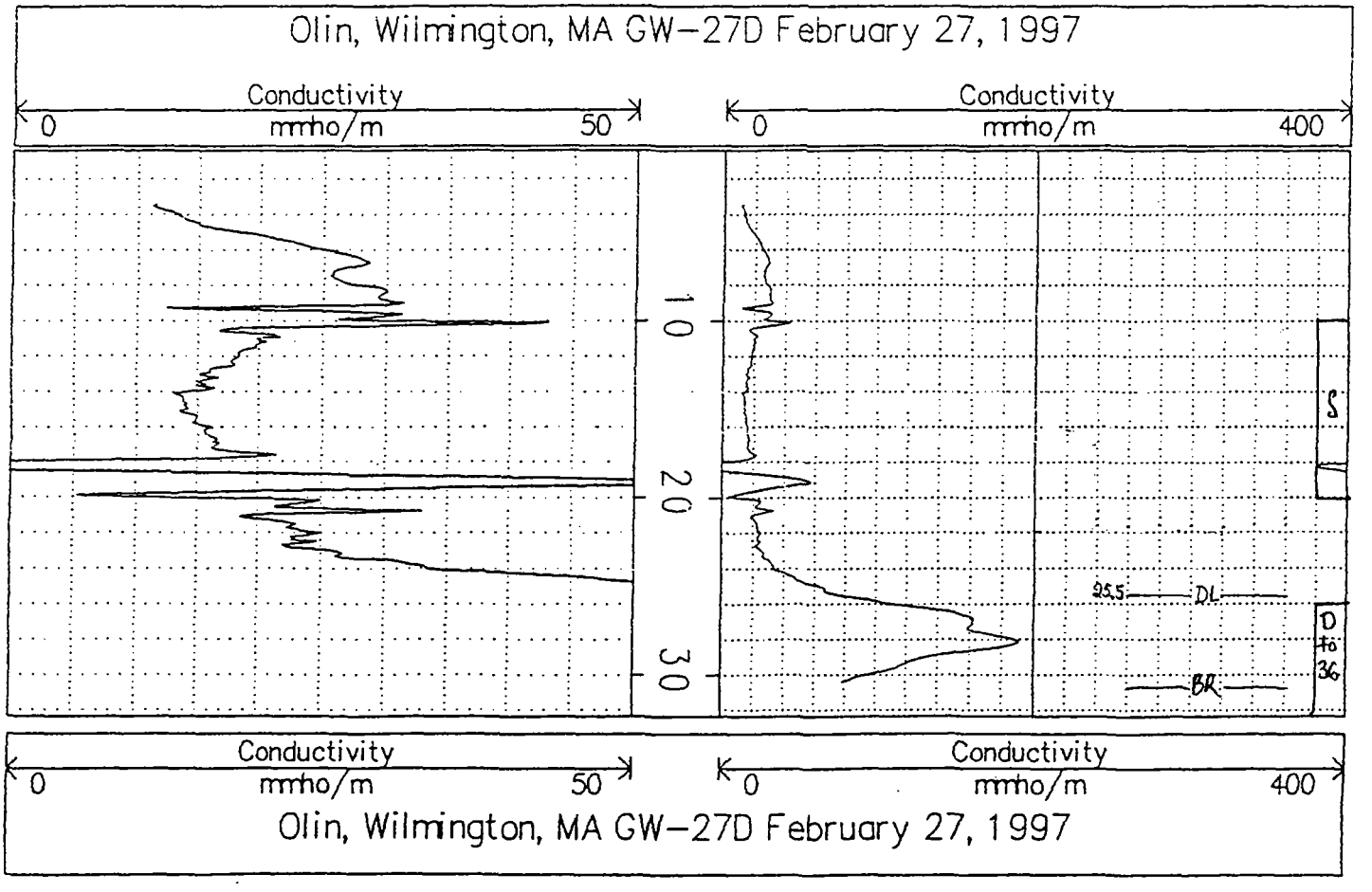
HAGER-RICHTER GEOSCIENCE, INC.
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

Conductivity

Well: GW-27D

PROJECT: Olin, Wilmington
CLIENT: Smith Technology Corporation
LOCATION OF WELL: Wilmington
STATE: MA COUNTY: Middlesex
INSTRUMENTATION: Mt. Sopris MGX II
LOGGING GEOPHYSICIST: Jonathon Puliafico
CLIENT REP: Bruce Cushing
DRILLING CONTRACTOR: Miller Engineering & Testing, Inc.
COMMENTS:

DATE: February 27, 1997
H-R FILE: 97J20
ELEVATION: 88.4 ft MSL
LOG DATUM: Ground Level (GL)
CLIENT TD: 30.9 ft below GL
H-R TD: N/A
STATIC WATER LEVEL: 7.1 ft below GL
DEPTH OF BEDROCK: 30.8 ft below GL
CASING DIAMETER: 2 in ID



Monitoring well screened interval
S=shallow
M=intermediate
D=deep

22.5 DL — Proposed interface and depth bgs of dense layer

BR — Location of bedrock surface

Conductivity data from 1992

HAGER-RICHTER GEOSCIENCE, INC.

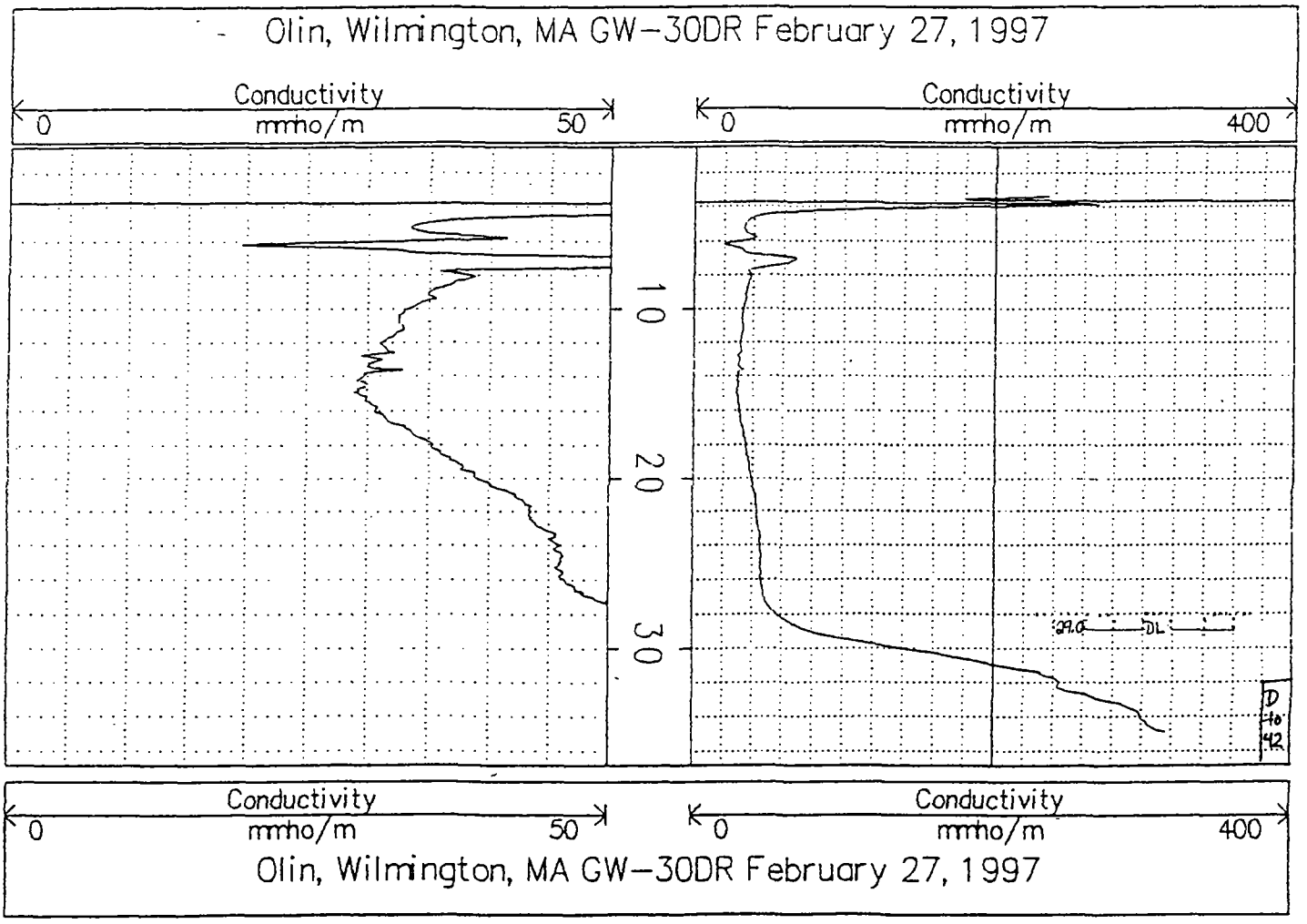
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

Conductivity

Well: GW-30DR

PROJECT: Olin, Wilmington
CLIENT: Smith Technology Corporation
LOCATION OF WELL: Wilmington
STATE: MA COUNTY: Middlesex
INSTRUMENTATION: Mt. Sopris MGX II
LOGGING GEOPHYSICIST: Jonathon Puliafico
CLIENT REP: Bruce Cushing
DRILLING CONTRACTOR: Soil Exploration, Inc.
COMMENTS:

DATE: February 27, 1997
H-R FILE: 97J20
ELEVATION: 87.7 ft MSL
LOG DATUM: Ground Level (GL)
CLIENT TD: 41.5 ft below GL
H-R TD: N/A
STATIC WATER LEVEL: 7.75 ft below GL
DEPTH OF BEDROCK: 39.5 ft below GL
CASING DIAMETER: 2 in ID



Monitoring well screened interval
S=shallow
M=intermediate
D=deep

22.5 DL — Proposed interface and depth bgs of dense layer

BR — Location of bedrock surface

Conductivity data from 1992

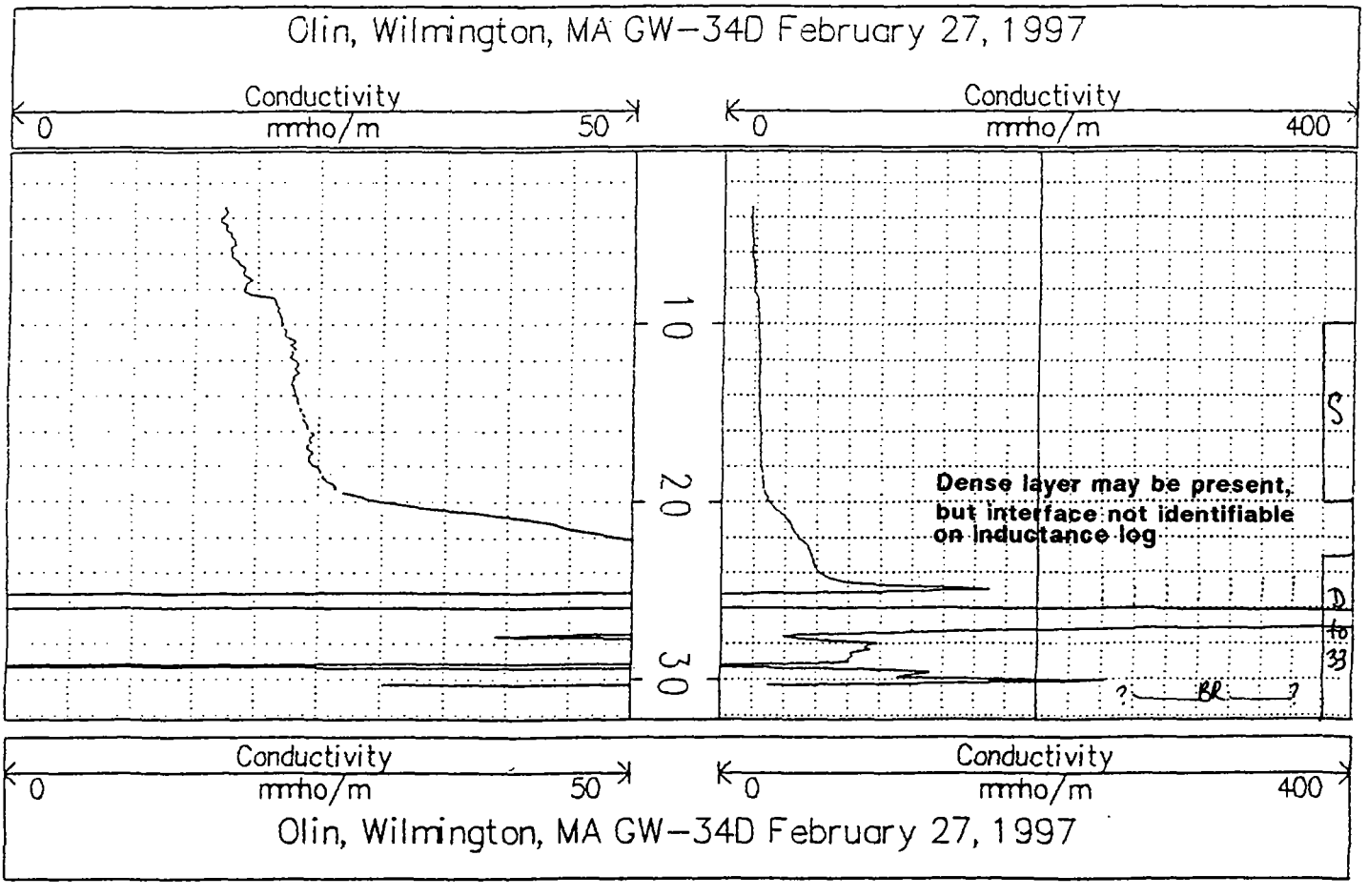
HAGER-RICHTER GEOSCIENCE, INC.
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

Conductivity

Well: GW-34D

PROJECT: Olin, Wilmington
CLIENT: Smith Technology Corporation
LOCATION OF WELL: Wilmington
STATE: MA COUNTY: Middlesex
INSTRUMENTATION: Mt. Sopris MGX II
LOGGING GEOPHYSICIST: Jonathon Puliafico
CLIENT REP: Bruce Cushing
DRILLING CONTRACTOR: Miller Engineering & Testing, Inc.
COMMENTS:

DATE: February 27, 1997
H-R FILE: 97J20
ELEVATION: 88.0 ft MSL
LOG DATUM: Ground Level (GL)
CLIENT TD: 31 ft below GL
H-R TD: N/A
STATIC WATER LEVEL: 7.11 ft below GL
DEPTH OF BEDROCK: 31 ft below GL
CASING DIAMETER: 2 in ID



Monitoring well screened interval
S=shallow
M=intermediate
D=deep

22.5 —— DL —— Proposed interface and depth bgs of dense layer

—— BR —— Location of bedrock surface

- - - - - - - - - - - - Conductivity data from 1992

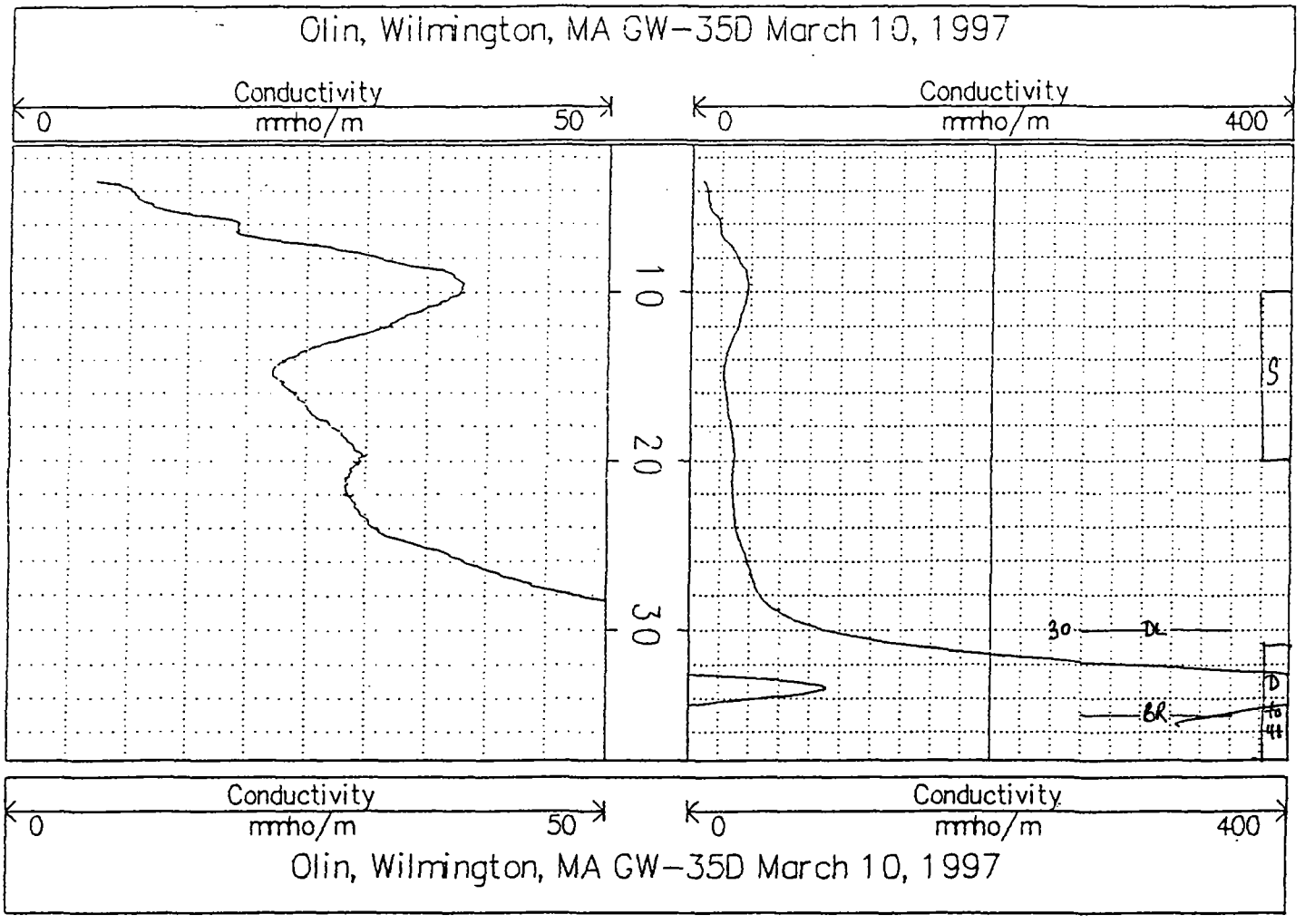
HAGER-RICHTER GEOSCIENCE, INC.
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

Conductivity

Well: GW-35D

PROJECT: Olin, Wilmington
CLIENT: Smith Technology Corporation
LOCATION OF WELL: Wilmington
STATE: MA COUNTY: Middlesex
INSTRUMENTATION: Mt. Sopris MGX II
LOGGING GEOPHYSICIST: Jonathon Puliafico
CLIENT REP: Bruce Cushing
DRILLING CONTRACTOR: Miller Engineering & Testing, Inc.
COMMENTS:

DATE: March 10, 1997
H-R FILE: 97J20
ELEVATION: 88.1 ft MSL
LOG DATUM: Ground Level (GL)
CLIENT TD: 40.5 ft below GL
H-R TD: N/A
STATIC WATER LEVEL: 6.92 ft below GL
DEPTH OF BEDROCK: 35 ft below GL
CASING DIAMETER: 2 in ID



Monitoring well screened interval
S = shallow
M = intermediate
D = deep

22.5 — DL — Proposed interface and depth bgs of dense layer

— BR — Location of bedrock surface

- - - - - - - - - - - - Conductivity data from 1992

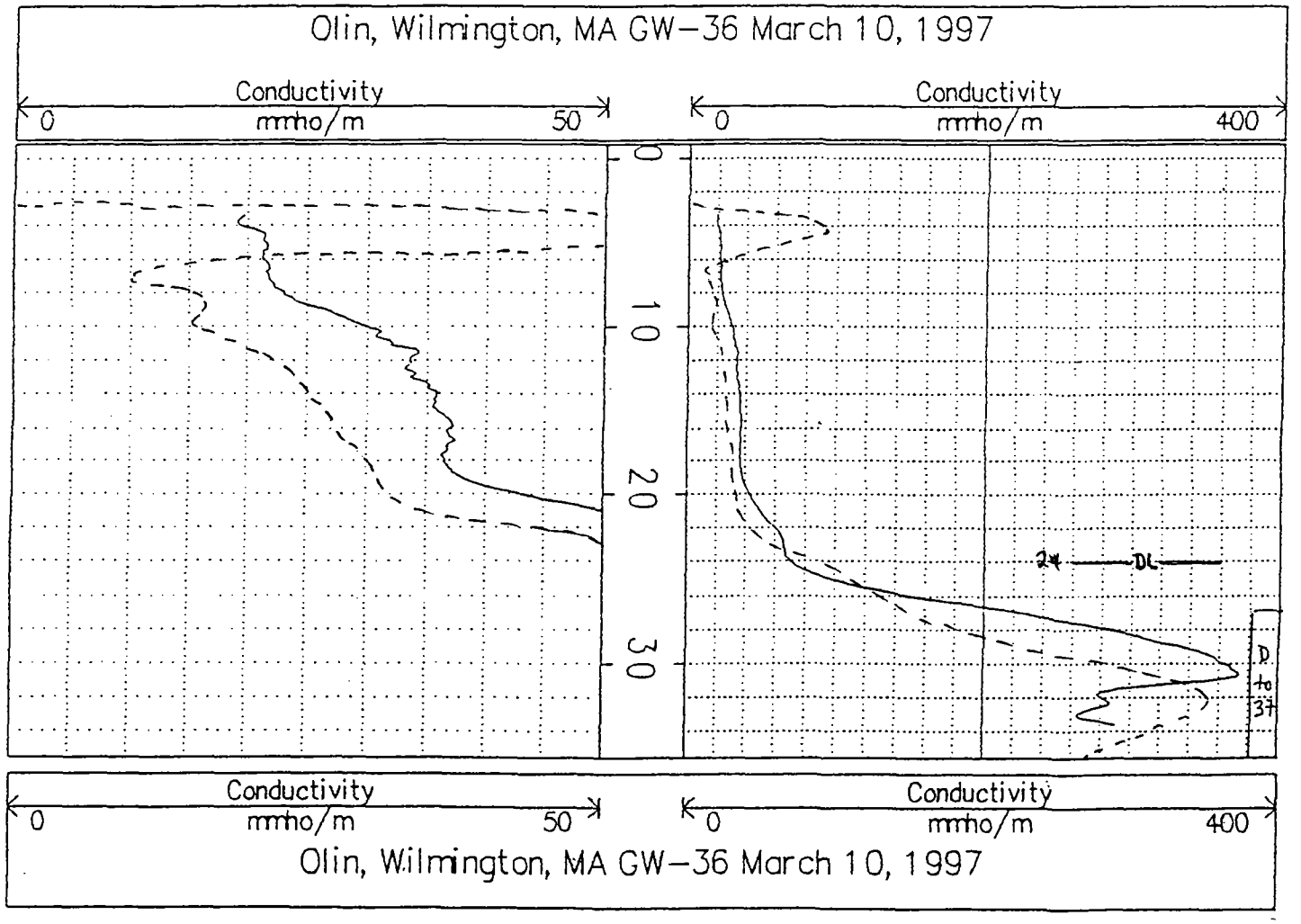
HAGER–RICHTER GEOSCIENCE, INC.
8 INDUSTRIAL WAY, UNIT D–10
SALEM, NH 03079
PHONE: 603 893–9944
FAX: 603 893–8313

Conductivity

Well: GW–36

PROJECT: Olin, Wilmington
CLIENT: Smith Technology Corporation
LOCATION OF WELL: Wilmington
STATE: MA COUNTY: Middlesex
INSTRUMENTATION: Mt. Sopris MGX II
LOGGING GEOPHYSICIST: Jonathon Puliafico
CLIENT REP: Bruce Cushing
DRILLING CONTRACTOR: Miller Engineering & Testing, Inc.
COMMENTS: -

DATE: March 10, 1997
H–R FILE: 97J20
ELEVATION: 84.3 ft MSL
LOG DATUM: Ground Level (GL)
CLIENT TD: 41.5 ft below GL
H–R TD: N/A
STATIC WATER LEVEL: 2.55 ft below GL
DEPTH OF BEDROCK: 36.5 ft below GL
CASING DIAMETER: 2 in ID



Monitoring well screened interval
S = shallow
M = intermediate
D = deep

22.5 —— DL —— Proposed interface and depth bgs of dense layer

—— BR —— Location of bedrock surface

- - - - - - - - - - - - Conductivity data from 1992

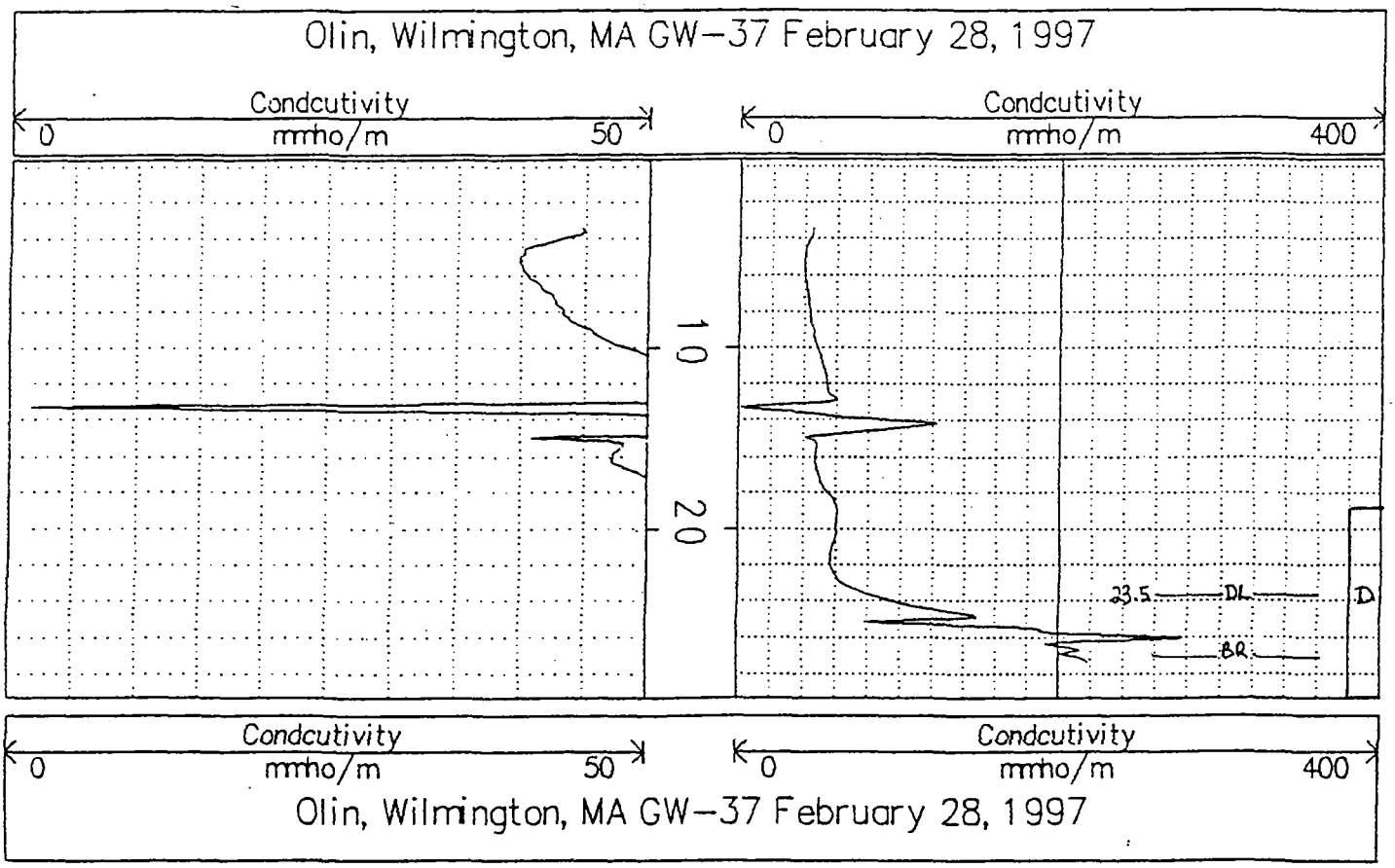
HAGER-RICHTER GEOSCIENCE, INC.
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

Conductivity

Well: GW-37

PROJECT: Olin, Wilmington
CLIENT: Smith Technology Corporation
LOCATION OF WELL: Wilmington
STATE: MA COUNTY: Middlesex
INSTRUMENTATION: Mt. Sopris MGX II
LOGGING GEOPHYSICIST: Jonathon Puliafico
CLIENT REP: Bruce Cushing
DRILLING CONTRACTOR: Maher
COMMENTS:

DATE: February 28, 1997
H-R FILE: 97J20
ELEVATION: 81.8 ft MSL
LOG DATUM: Ground Level (GL)
CLIENT TD: 32 ft below GL
H-R TD: N/A
STATIC WATER LEVEL: 1.2 ft below GL
DEPTH OF BEDROCK: 27 ft below GL
CASING DIAMETER: 2 in ID



Monitoring well screened interval
S=shallow
M=intermediate
D=deep

22.5 —— DL —— Proposed interface and depth bgs of dense layer

—— BR —— Location of bedrock surface

- - - - - - - - - - - - Conductivity data from 1992

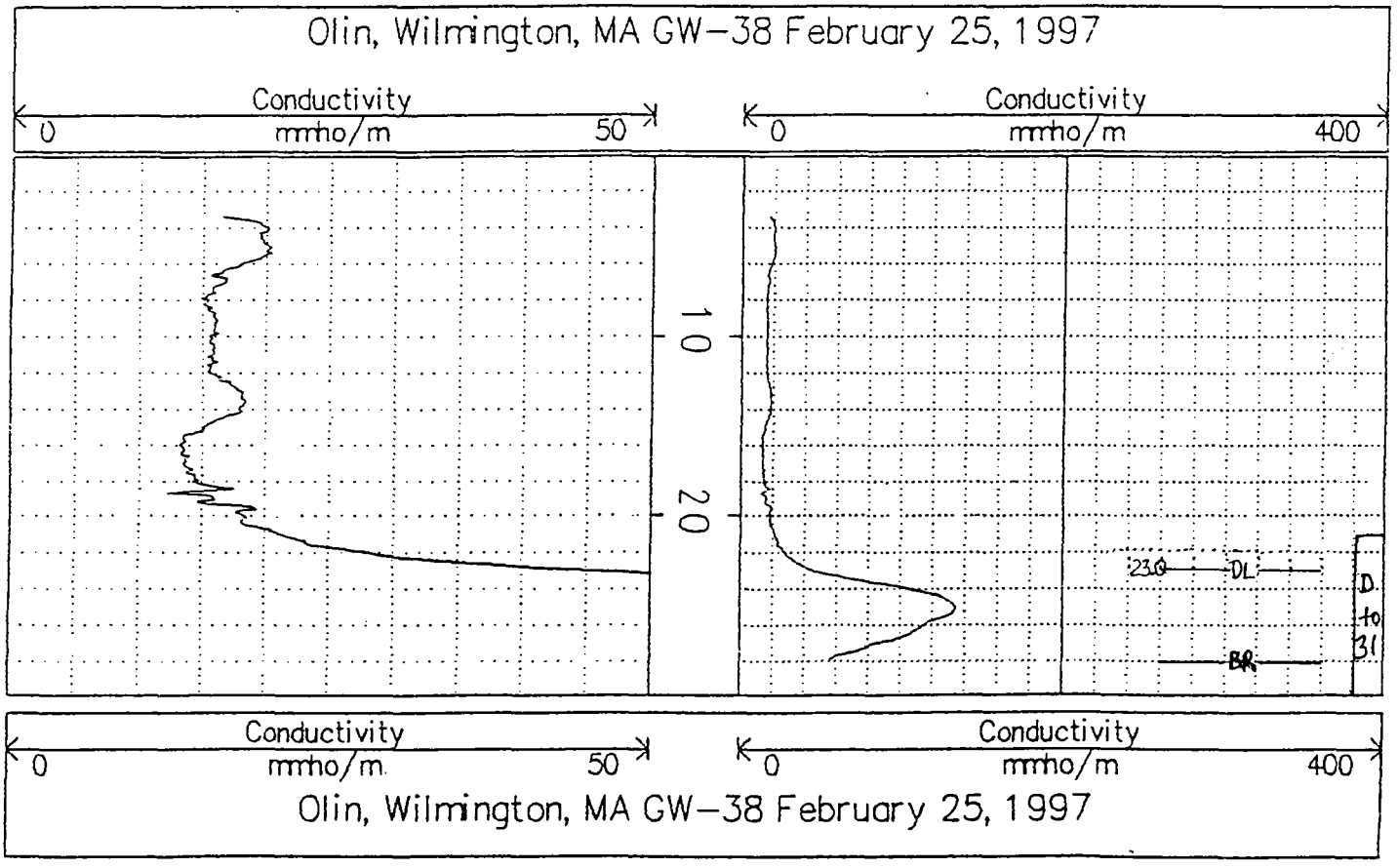
HAGER-RICHTER GEOSCIENCE, INC.
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

Conductivity

Well: GW-38

PROJECT: Olin, Wilmington
CLIENT: Smith Technology Corporation
LOCATION OF WELL: Wilmington
STATE: MA COUNTY: Middlesex
INSTRUMENTATION: Mt. Sopris MGX II
LOGGING GEOPHYSICIST: Jonathon Puliafico
CLIENT REP: Bruce Cushing
DRILLING CONTRACTOR: Miller Engineering & Testing, Inc.
COMMENTS:

DATE: February 25, 1997
H-R FILE: 97J20
ELEVATION: 85.9 ft MSL
LOG DATUM: Ground Level (GL)
CLIENT TD: 33 ft below GL
H-R TD: N/A
STATIC WATER LEVEL: 5.89 ft below GL
DEPTH OF BEDROCK: 28 ft below GL
CASING DIAMETER: 2 in ID



Monitoring well screened interval
S=shallow
M=intermediate
D=deep

22.5 DL Proposed interface and depth bgs of dense layer

BR Location of bedrock surface

Conductivity data from 1992

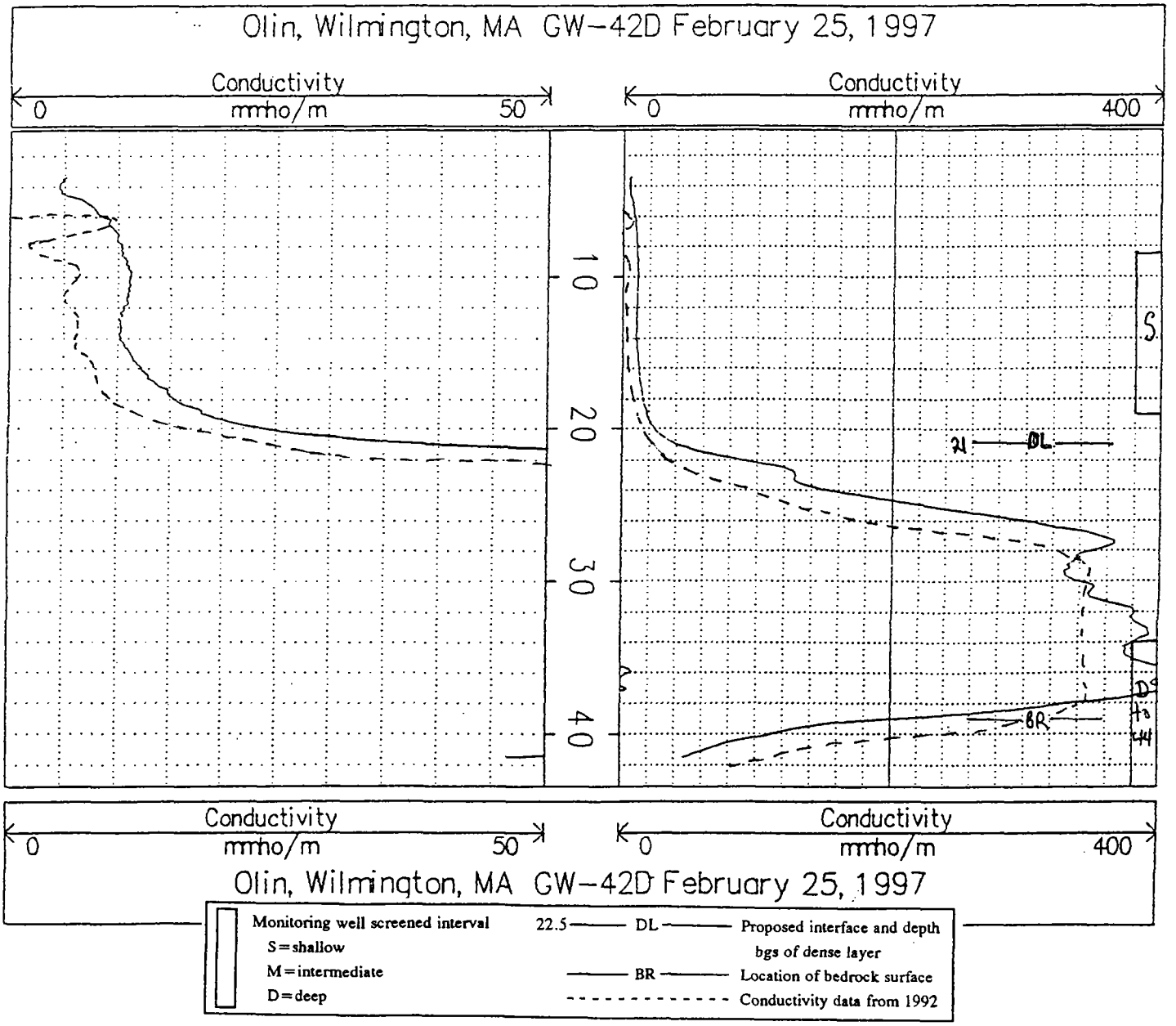
HAGER-RICHTER GEOSCIENCE, INC.
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

Conductivity

Well: GW-42D

PROJECT: Olin, Wilmington
CLIENT: Smith Technology Corporation
LOCATION OF WELL: Wilmington
STATE: MA COUNTY: Middlesex
INSTRUMENTATION: Mt. Sopris MGX II
LOGGING GEOPHYSICIST: Jonathon Puliafico
CLIENT REP: Bruce Cushing
DRILLING CONTRACTOR: Soil Exploration, Inc.
COMMENTS:

DATE: February 25, 1997
H-R FILE: 97J20
ELEVATION: 84.4 ft MSL
LOG DATUM: Ground Level (GL)
CLIENT TD: 44 ft below GL
H-R TD: N/A
STATIC WATER LEVEL: 3.42 ft below GL
DEPTH OF BEDROCK: 39 ft below GL
CASING DIAMETER: 2 in ID



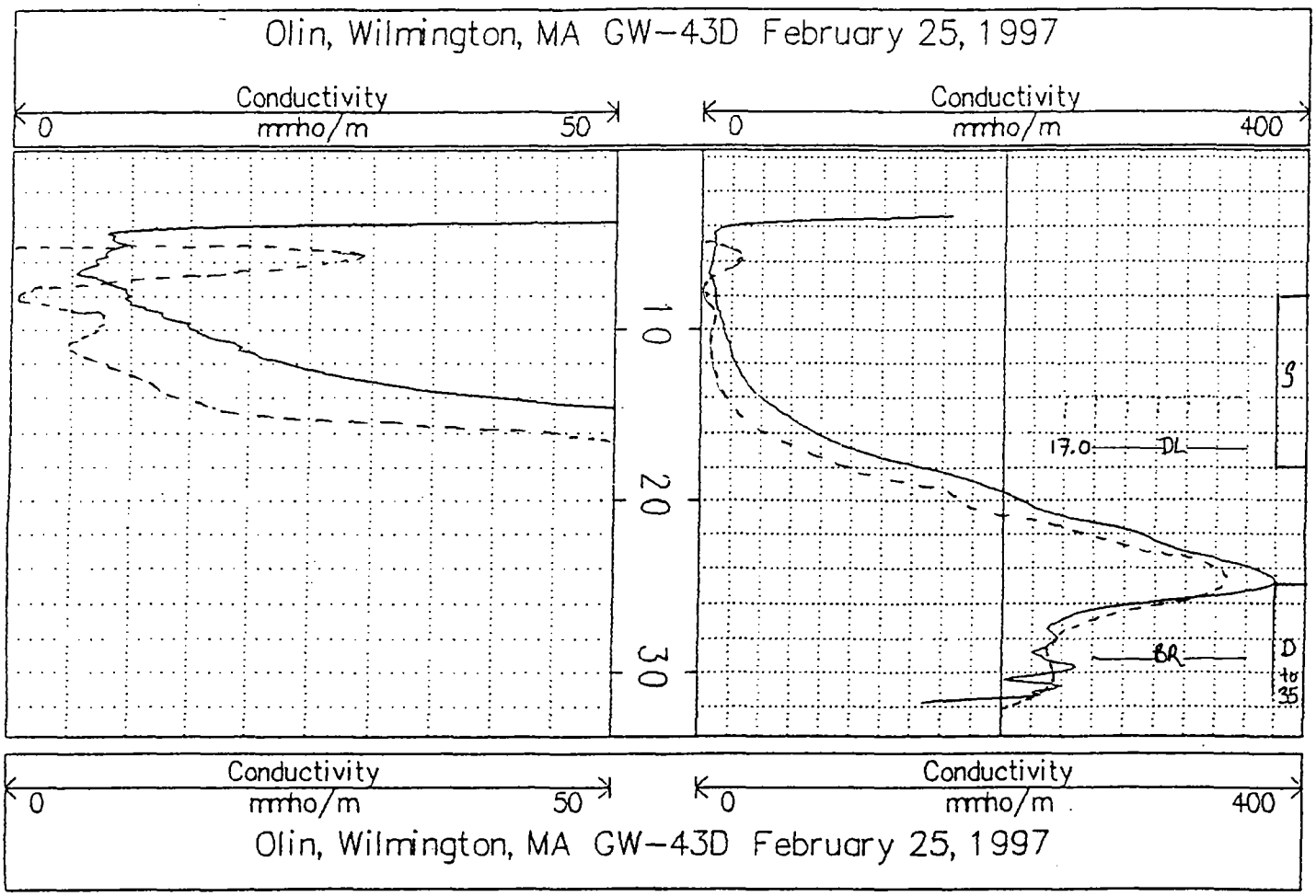
HAGER-RICHTER GEOSCIENCE, INC.
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

Conductivity

Well: GW-43D

PROJECT: Olin, Wilmington
CLIENT: Smith Technology Corporation
LOCATION OF WELL: Wilmington
STATE: MA COUNTY: Middlesex
INSTRUMENTATION: MT. Sopris MGX II
LOGGING GEOPHYSICIST: Jonathon Puliafico
CLIENT REP: Bruce Cushing
DRILLING CONTRACTOR: Soil Exploration, Inc.
COMMENTS:

DATE: February 25, 1997
H-R FILE: 97J20
ELEVATION: 85.6 ft MSL
LOG DATUM: Ground Level (GL)
CLIENT TD: 35 ft below GL
H-R TD: N/A
STATIC WATER LEVEL: 5.33 ft below GL
DEPTH OF BEDROCK: 29 ft below GL
CASING DIAMETER: 2 in ID



Monitoring well screened interval
S=shallow
M=intermediate
D=deep

22.5 —— DL —— Proposed interface and depth bgs of dense layer

—— BR —— Location of bedrock surface

- - - - - - - - - - - - Conductivity data from 1992

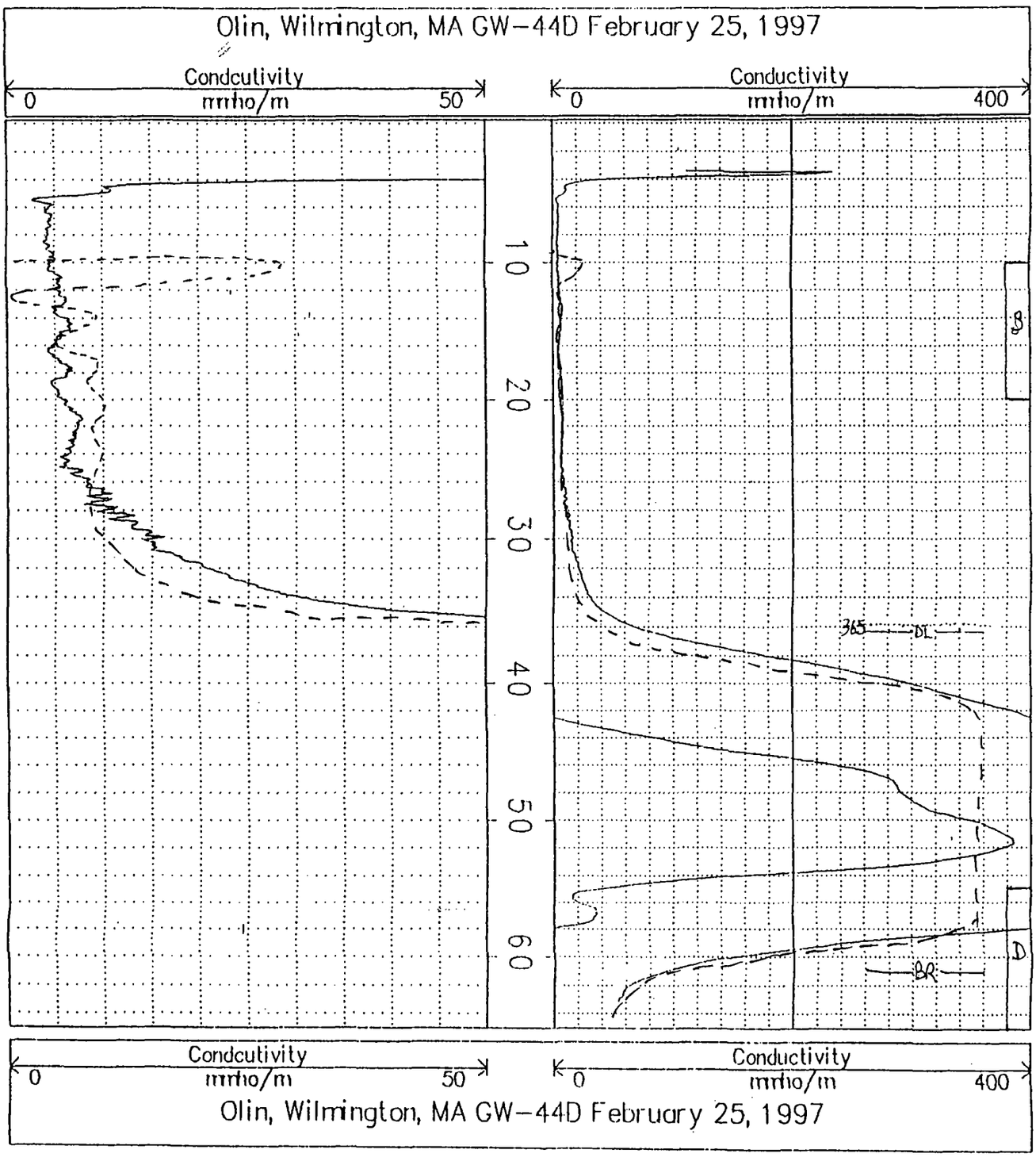
HAGER-RICHTER GEOSCIENCE, INC.
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

Conductivity

Well: GW-44D

PROJECT: Olin, Wilmington
CLIENT: Smith Technology Corporation
LOCATION OF WELL: Wilmington
STATE: MA COUNTY: Middlesex
INSTRUMENTATION: Mt. Sopris MGX II
LOGGING GEOPHYSICIST: Jonathon Puliafico
CLIENT REP: Bruce Cushing
DRILLING CONTRACTOR: Soil Exploration, Inc.
COMMENTS:

DATE: February 25, 1997
H-R FILE: 97J20
ELEVATION: 83.5 ft MSL
LOG DATUM: Ground Level (GL)
CLIENT TD: 67 ft below GL
H-R TD: N/A
STATIC WATER LEVEL: 3.5 ft below GL
DEPTH OF BEDROCK: 61 ft below GL
CASING DIAMETER: 2 In ID



Monitoring well screened interval
S=shallow
M=intermediate
D=deep

22.5 DL Proposed interface and depth bgs of dense layer

BR Location of bedrock surface

Conductivity data from 1992

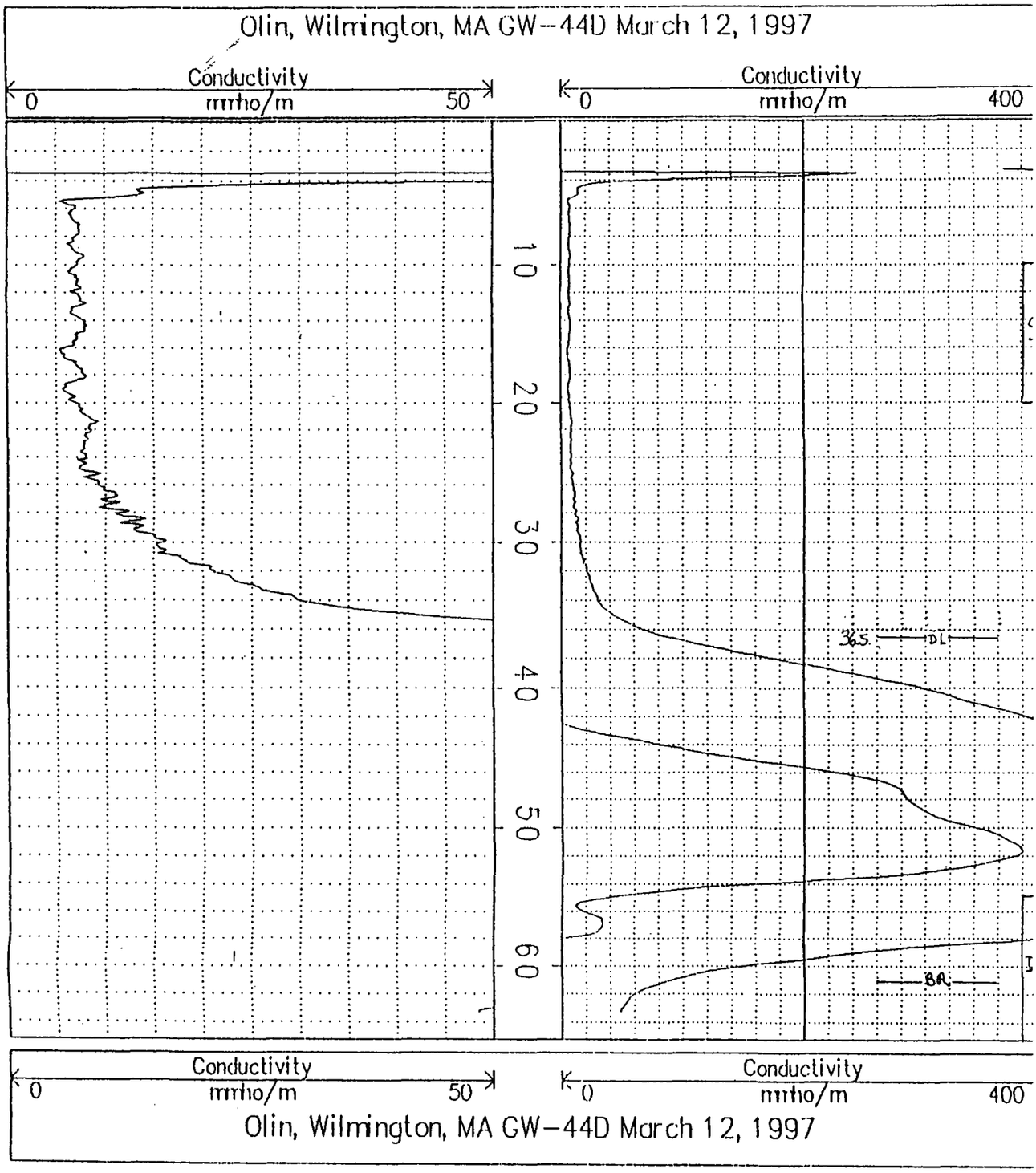
HAGER-RICHTER GEOSCIENCE, INC.
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

Conductivity

Well: GW-44D

PROJECT: Olin, Wilmington
CLIENT: Smith Technology Corporation
LOCATION OF WELL: Wilmington
STATE: MA COUNTY: Middlesex
INSTRUMENTATION: Mt. Sopris MGX II
LOGGING GEOPHYSICIST: Jonathon Puliafico
CLIENT REP: Bruce Cushing
DRILLING CONTRACTOR: Soil Exploration, Inc.
COMMENTS:

DATE: March 12, 1997
H-R FILE: 97J20
ELEVATION: 83.5 ft MSL
LOG DATUM: Ground Level (GL)
CLIENT TD: 67 ft below GL
H-R TD: N/A
STATIC WATER LEVEL: 3.5 ft below GL
DEPTH OF BEDROCK: 61 ft below GL
CASING DIAMETER: 2 in ID



Monitoring well screened interval
S=shallow
M=intermediate
D=deep

22.5 —— DL —— Proposed interface and depth bgs of dense layer

—— BR —— Location of bedrock surface

- - - - - - - - - - - - Conductivity data from 1992

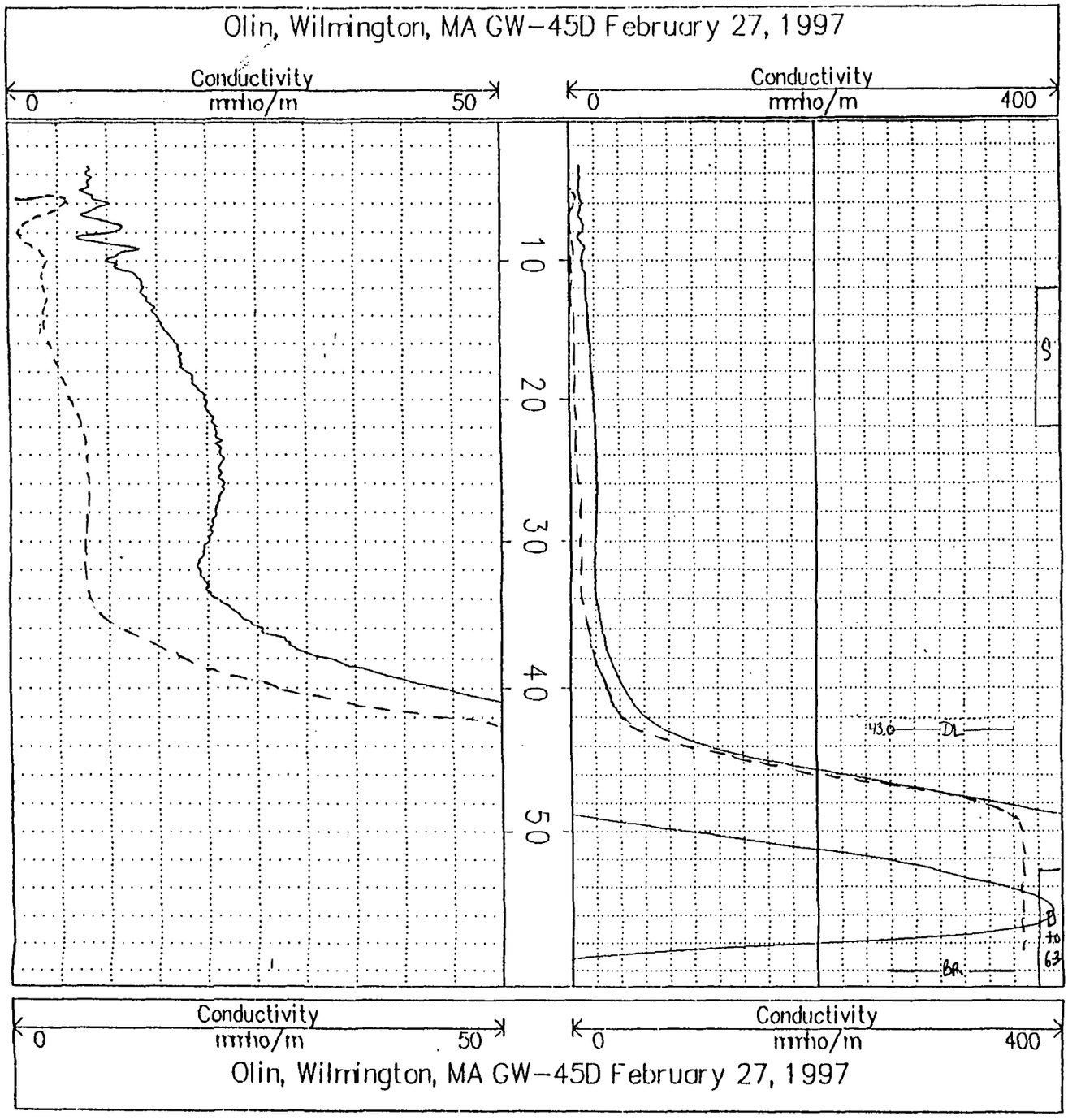
HAGER-RICHTER GEOSCIENCE, INC.
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

Conductivity

Well: GW-45D

PROJECT: Olin, Wilmington
CLIENT: Smith Technology Corporation
LOCATION OF WELL: Wilmington
STATE: MA COUNTY: Middlesex
INSTRUMENTATION: Mt. Sopris MGX II
LOGGING GEOPHYSICIST: Jonathon Pulliafico
CLIENT REP: Bruce Cushing
DRILLING CONTRACTOR: Soil Exploration, Inc.
COMMENTS:

DATE: February 27, 1997
H-R FILE: 97J20
ELEVATION: 89.8 ft MSL
LOG DATUM: Ground Level (GL)
CLIENT TD: 60 ft below GL
H-R TD: N/A
STATIC WATER LEVEL: 9.15 ft below GL
DEPTH OF BEDROCK: 60 ft below GL
CASING DIAMETER: 2 In ID



Monitoring well screened interval
S=shallow
M=intermediate
D=deep

22.5 DL Proposed interface and depth bgs of dense layer

BR Location of bedrock surface

Conductivity data from 1992

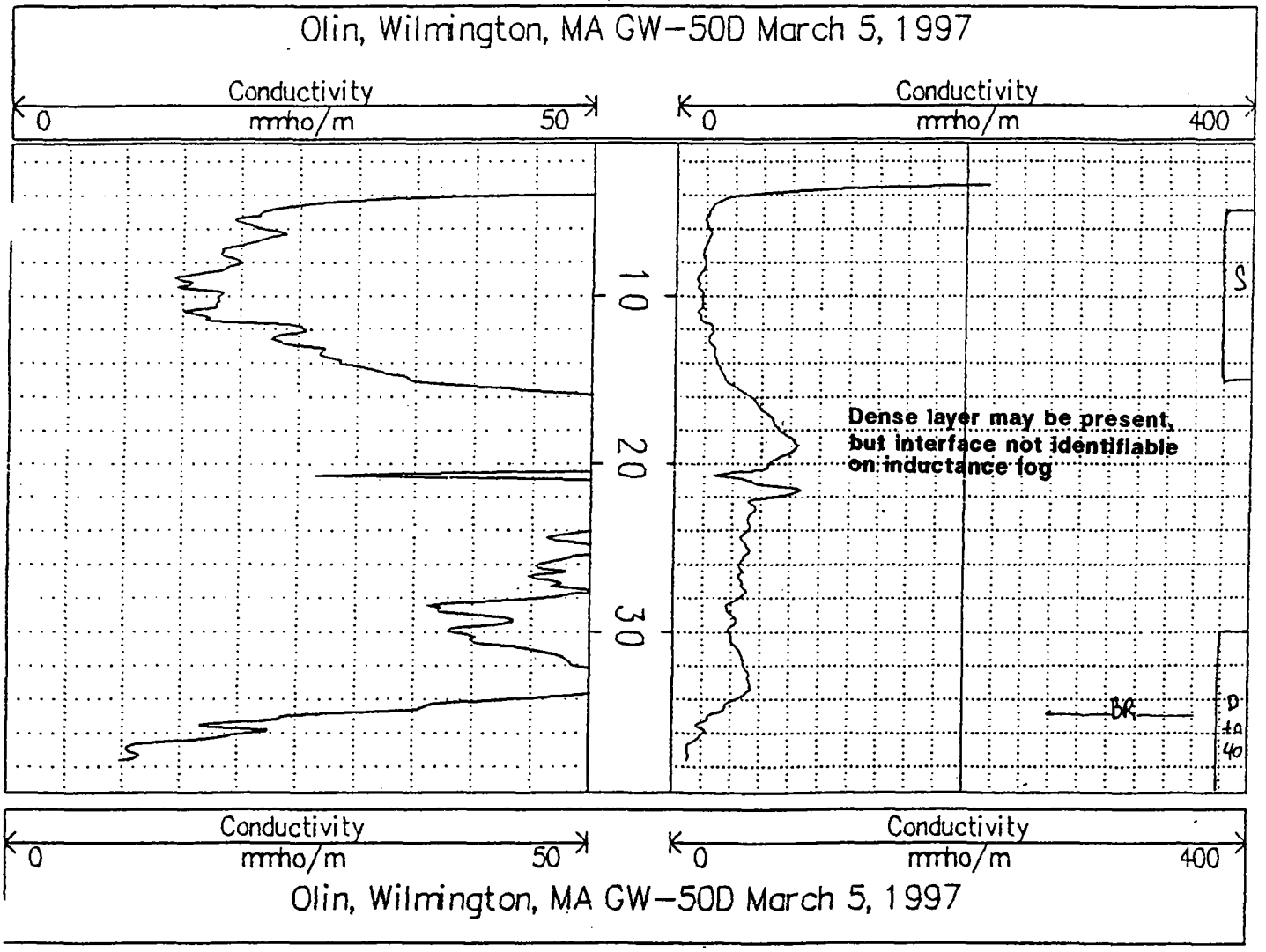
HAGER-RICHTER GEOSCIENCE, INC.
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

Conductivity

Well: GW-50D

PROJECT: Olin, Wilmington
CLIENT: Smith Technology Corporation
LOCATION OF WELL: Wilmington
STATE: MA COUNTY: Middlesex
INSTRUMENTATION: Mt. Sopris MGX II
LOGGING GEOPHYSICIST: Jonathon Puliafico
CLIENT REP: Bruce Cushing
DRILLING CONTRACTOR: Soil Exploration, Inc.
COMMENTS:

DATE: March 5, 1997
H-R FILE: 97J20
ELEVATION: 77.4 ft MSL
LOG DATUM: Ground Level (GL)
CLIENT TD: 40 ft below GL
H-R TD: N/A
STATIC WATER LEVEL: 1.3 ft below GL
DEPTH OF BEDROCK: 35 ft below GL
CASING DIAMETER: 2 in ID



Monitoring well screened interval
S = shallow
M = intermediate
D = deep

22.5 —— DL —— Proposed interface and depth bgs of dense layer

—— BR —— Location of bedrock surface

- - - - - - - - - - - - Conductivity data from 1992

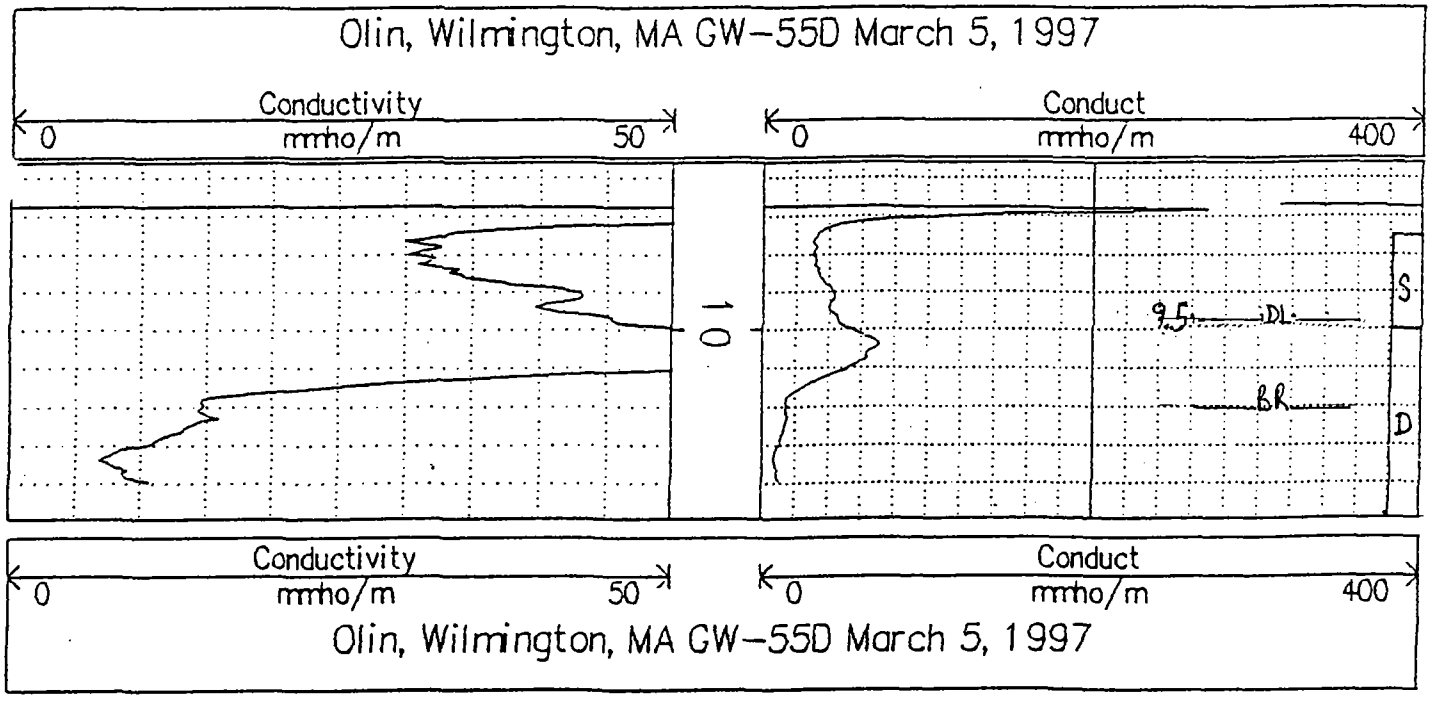
HAGER-RICHTER GEOSCIENCE, INC.
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

Conductivity

Well: GW-55D

PROJECT: Olin, Wilmington
CLIENT: Smith Technology Corporation
LOCATION OF WELL: Wilmington
STATE: MA COUNTY: Middlesex
INSTRUMENTATION: Mt. Sopris MGX II
LOGGING GEOPHYSICIST: Jonathon Puliafico
CLIENT REP: Bruce Cushing
DRILLING CONTRACTOR: Soil Exploration, Inc.
COMMENTS:

DATE: March 5, 1997
H-R FILE: 97J20
ELEVATION: 79.7 ft MSL
LOG DATUM: Ground Level (GL)
CLIENT TD: 20 ft below GL
H-R TD: N/A
STATIC WATER LEVEL: 3.85 ft below GL
DEPTH OF BEDROCK: 14 ft below GL
CASING DIAMETER: 2 in ID



Monitoring well screened interval
S=shallow
M=intermediate
D=deep

22.5 DL — Proposed interface and depth bgs of dense layer

BR — Location of bedrock surface

Conductivity data from 1992

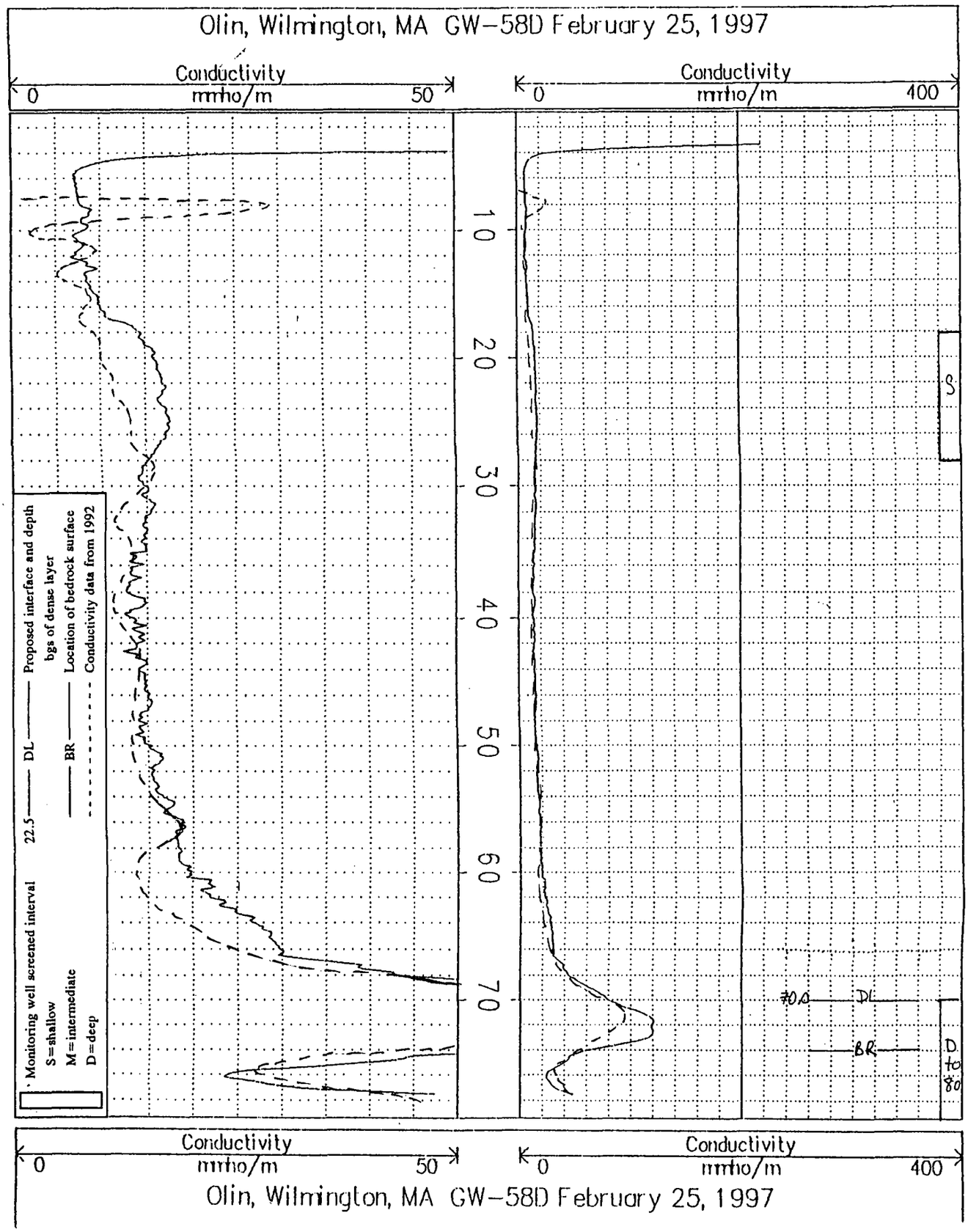
HAGER–RICHTER GEOSCIENCE, INC.
8 INDUSTRIAL WAY, UNIT D–10
SALEM, NH 03079
PHONE: 603 893–9944
FAX: 603 893–8313

Conductivity

Well: GW–58D

PROJECT: Olin, Wilmington
CLIENT: Smith Technology Corporation
LOCATION OF WELL: Wilmington
STATE: MA COUNTY: Middlesex
INSTRUMENTATION: Mt. Sopris MGX II
LOGGING GEOPHYSICIST: Jonathon Pullafico
CLIENT REP: Bruce Cushing
DRILLING CONTRACTOR: Soil Exploration, Inc.
COMMENTS:

DATE: February 25, 1997
H–R FILE: 97J20
ELEVATION: 96.1 ft MSL
LOG DATUM: Ground Level (GL)
CLIENT TD: 79 ft below GL
H–R TD: N/A
STATIC WATER LEVEL: 15.91 ft below GL
DEPTH OF BEDROCK: 74 ft below GL
CASING DIAMETER: 2 in ID



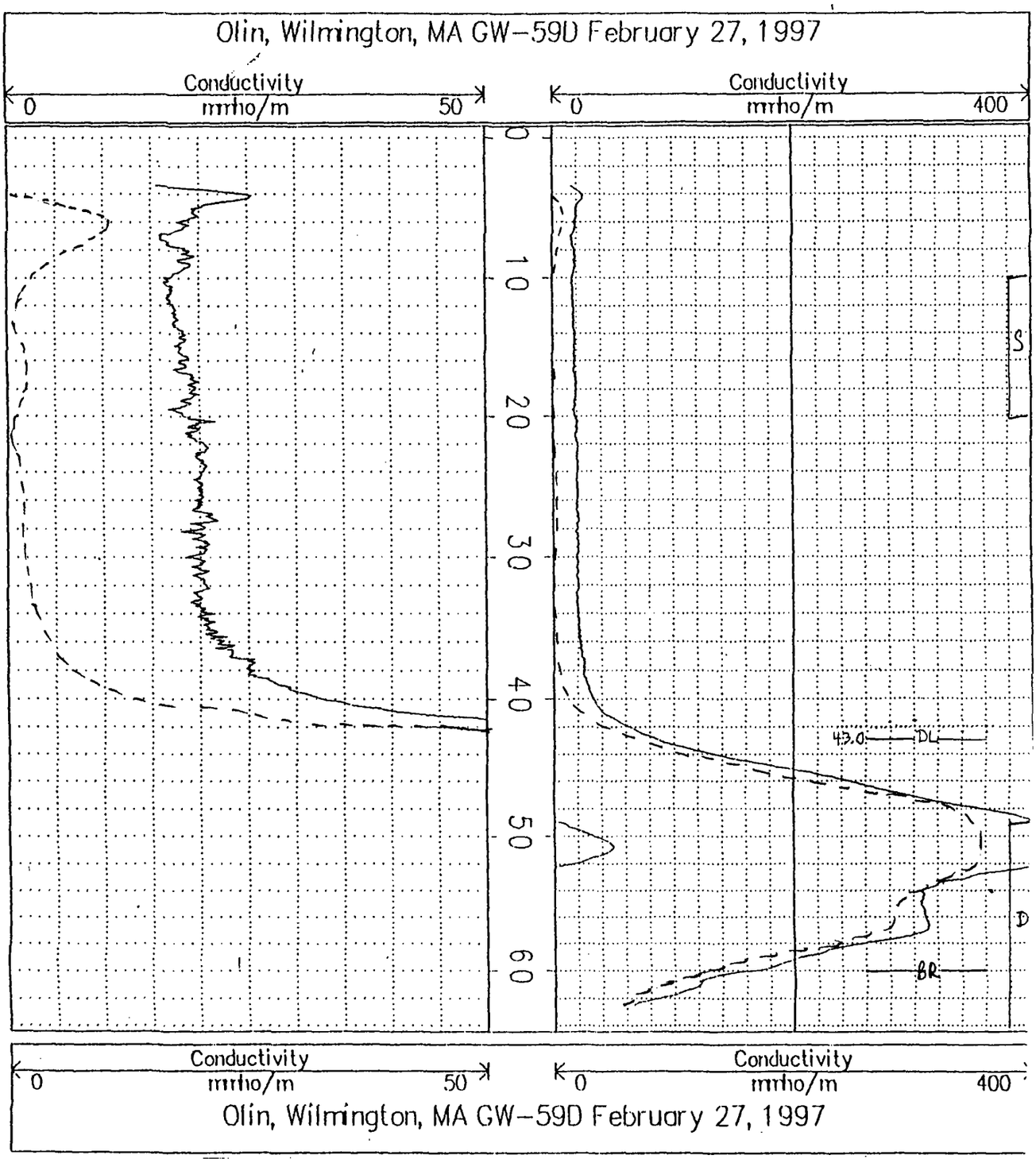
HAGER-RICHTER GEOSCIENCE, INC.
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

Conductivity

Well: GW-59D

PROJECT: Olin, Wilmington
CLIENT: Smith Technology Corporation
LOCATION OF WELL: Wilmington
STATE: MA COUNTY: Middlesex
INSTRUMENTATION: Mt. Sopris MGX II
LOGGING GEOPHYSICIST: Jonathon Pullafico
CLIENT REP: Bruce Cushing
DRILLING CONTRACTOR: Soil Exploration, Inc.
COMMENTS:

DATE: February 27, 1997
H-R FILE: 97J20
ELEVATION: 85.2 ft MSL
LOG DATUM: Ground Level (GL)
CLIENT TD: 65.0 ft below GL
H-R TD: N/A
STATIC WATER LEVEL: 4.54 ft below GL
DEPTH OF BEDROCK: 60 ft below GL
CASING DIAMETER: 2 in ID



Monitoring well screened interval
S=shallow
M=intermediate
D=deep

22.5 DL Proposed interface and depth bgs of dense layer

BR Location of bedrock surface

Conductivity data from 1992

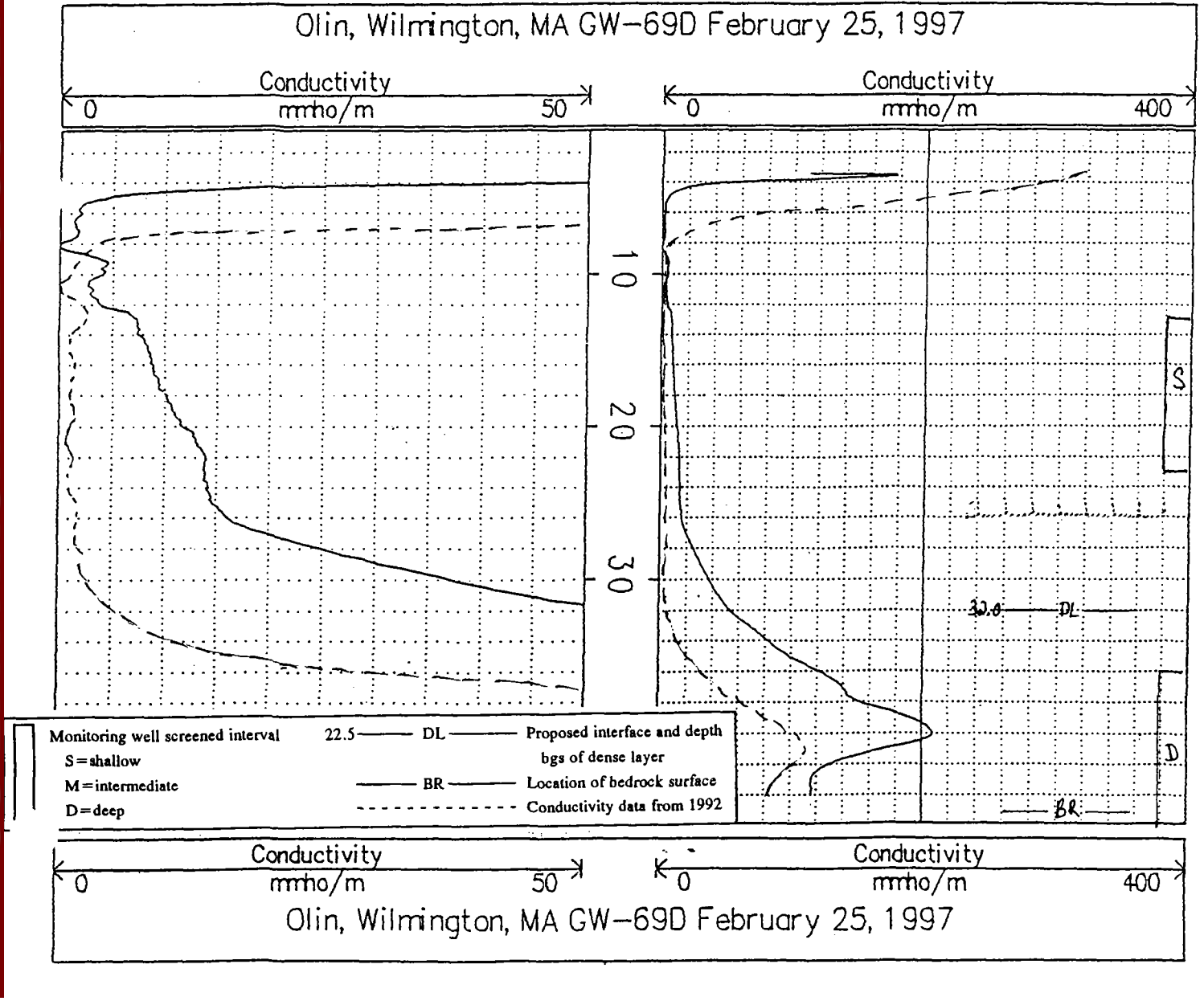
HAGER-RICHTER GEOSCIENCE, INC.
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

Conductivity

Well: GW-69D

PROJECT: Olin, Wilmington
CLIENT: Smith Technology Corporation
LOCATION OF WELL: Wilmington
STATE: MA COUNTY: Middlesex
INSTRUMENTATION: Mt. Sopris MGX II
LOGGING GEOPHYSICIST: Jonathon Puliafico
CLIENT REP: Bruce Cushing
DRILLING CONTRACTOR: Soil Exploration, Inc.
COMMENTS:

DATE: February 25, 1997
H-R FILE: 97J20
ELEVATION: 91.1 ft MSL
LOG DATUM: Ground Level (GL)
CLIENT TD: 48 ft below GL
H-R TD: N/A
STATIC WATER LEVEL: 10.65 ft below GL
DEPTH OF BEDROCK: 45 ft below GL
CASING DIAMETER: 2 in ID



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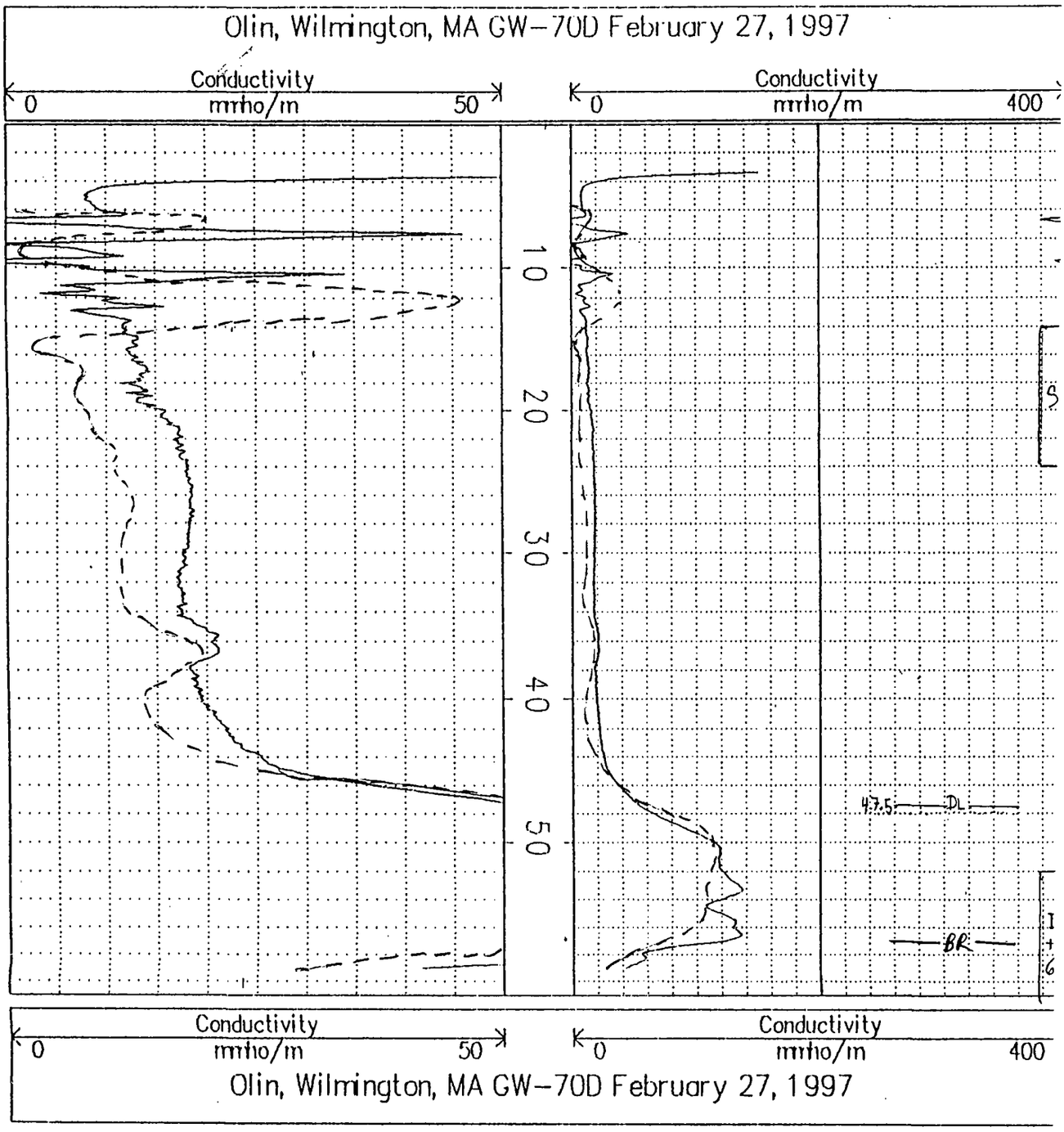
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

Conductivity

Well: GW-70D

PROJECT: Olin, Wilmington
CLIENT: Smith Technology Corporation
LOCATION OF WELL: Wilmington
STATE: MA COUNTY: Middlesex
INSTRUMENTATION: Mt. Sopris MGX II
LOGGING GEOPHYSICIST: Jonathon Puliafico
CLIENT REP: Bruce Cushing
DRILLING CONTRACTOR: Soil Exploration, Inc.
COMMENTS:

DATE: February 27, 1997
H-R FILE: 97J20
ELEVATION: 92.3 ft MSL
LOG DATUM: Ground Level (GL)
CLIENT TD: 62 ft below GL
H-R TD: N/A
STATIC WATER LEVEL: 11.61 ft below GL
DEPTH OF BEDROCK: 57 ft below GL
CASING DIAMETER: 2 in ID



Monitoring well screened interval
S=shallow
M=intermediate
D=deep

22.5 —— DL —— Proposed interface and depth bgs of dense layer

—— BR —— Location of bedrock surface

- - - - - - - - - - - - Conductivity data from 1992

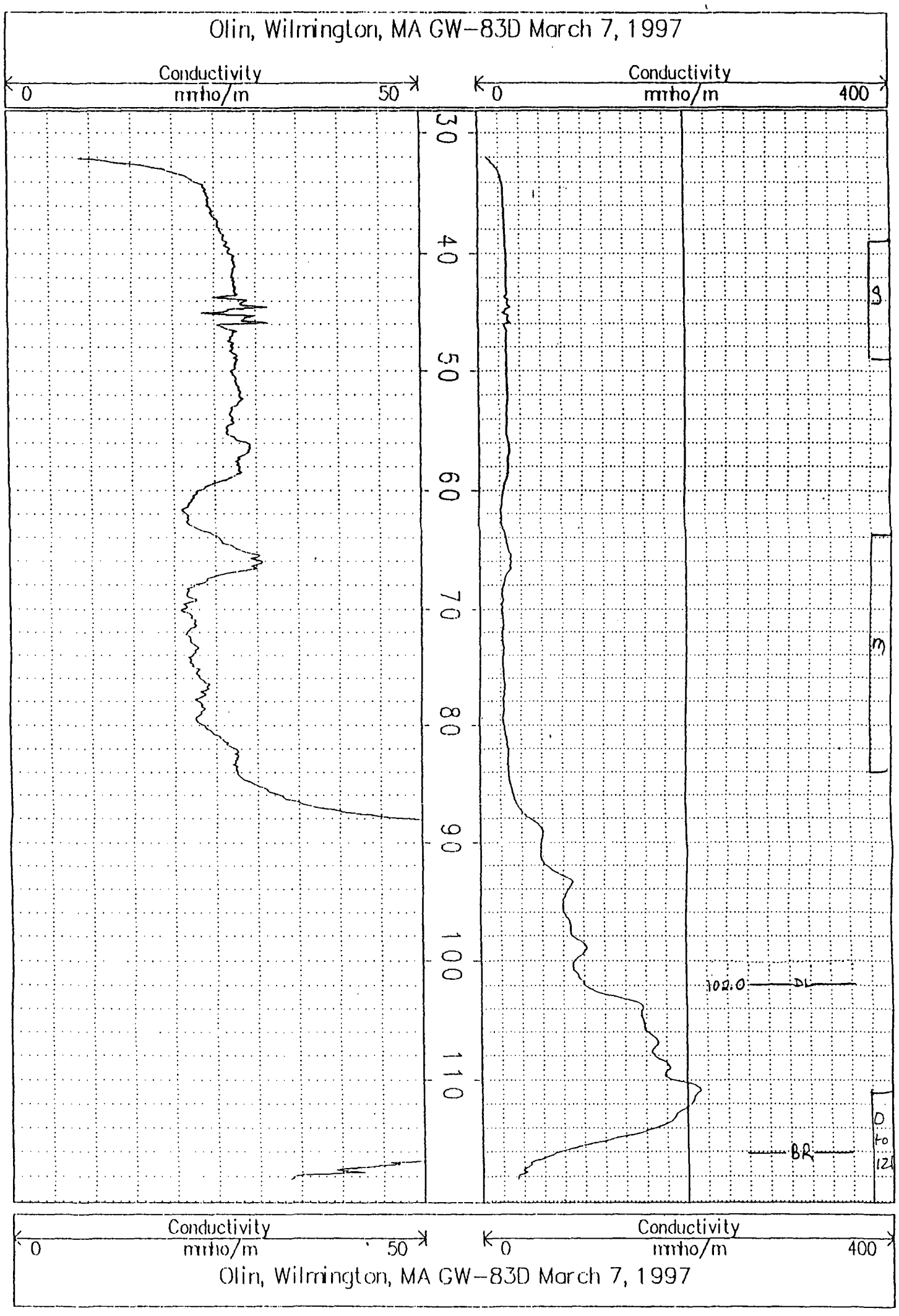
HAGER-RICHTER GEOSCIENCE, INC.
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

Conductivity

Well: GW-83D

PROJECT: Olin, Wilmington
CLIENT: Smith Technology Corporation
LOCATION OF WELL: Wilmington,
STATE: MA COUNTY: Middlesex
INSTRUMENTATION: Mt. Sopris MGX II
LOGGING GEOPHYSICIST: Jonathon Puliafico
CLIENT REP: Bruce Cushing
DRILLING CONTRACTOR: Boart Longyear
COMMENTS:

DATE: March 7, 1997
H-R FILE: 97J20
ELEVATION: 79.9 ft MSL
LOG DATUM: Ground Level (GL)
CLIENT TD: 120.8 ft below GL
H-R TD: N/A
STATIC WATER LEVEL: 0.15 ft above GL
DEPTH OF BEDROCK: 116 ft below GL
CASING DIAMETER: 2 in ID



Monitoring well screened interval
S=shallow
M=intermediate
D=deep

22.5 — DL — Proposed interface and depth bgs of dense layer

— BR — Location of bedrock surface

- - - - - - - - - - - - Conductivity data from 1992

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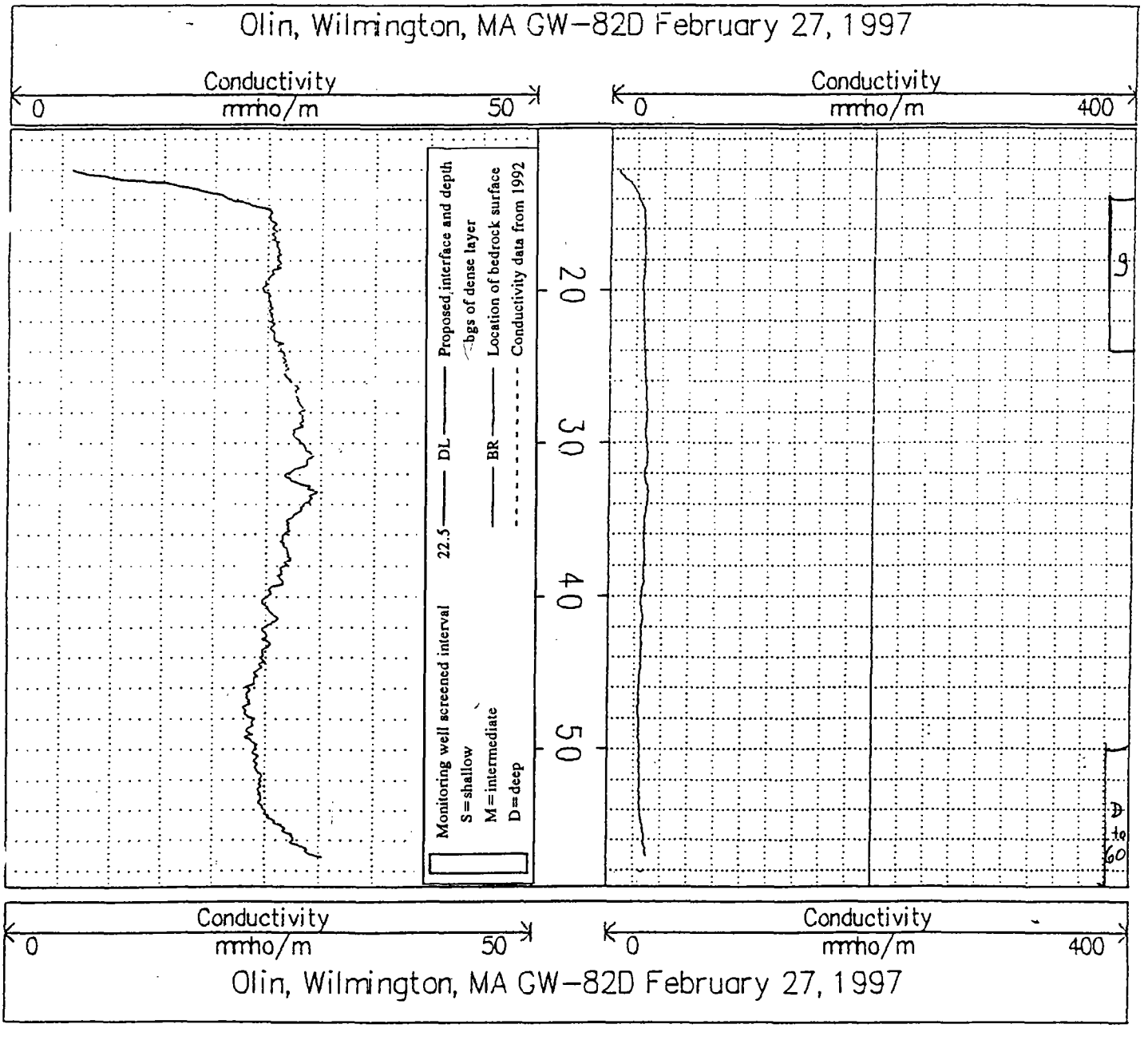
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

Conductivity

Well: GW-82D

PROJECT: Olin, Wilmington
CLIENT: Smith Technology Corporation
LOCATION OF WELL: Wilmington
STATE: MA COUNTY: Middlesex
INSTRUMENTATION: Mt. Sopris MGX II
LOGGING GEOPHYSICIST: Jonathon Puliafico
CLIENT REP: Bruce Cushing
DRILLING CONTRACTOR: Boart Longyear
COMMENTS:

DATE: February 27, 1997
H-R FILE: 97J20
ELEVATION: 80.2 ft MSL
LOG DATUM: Ground Level (GL)
CLIENT TD: 60 ft below GL
H-R TD: N/A
STATIC WATER LEVEL: 0.01 ft below GL
DEPTH OF BEDROCK: 60 ft below GL
CASING DIAMETER: 2 in ID



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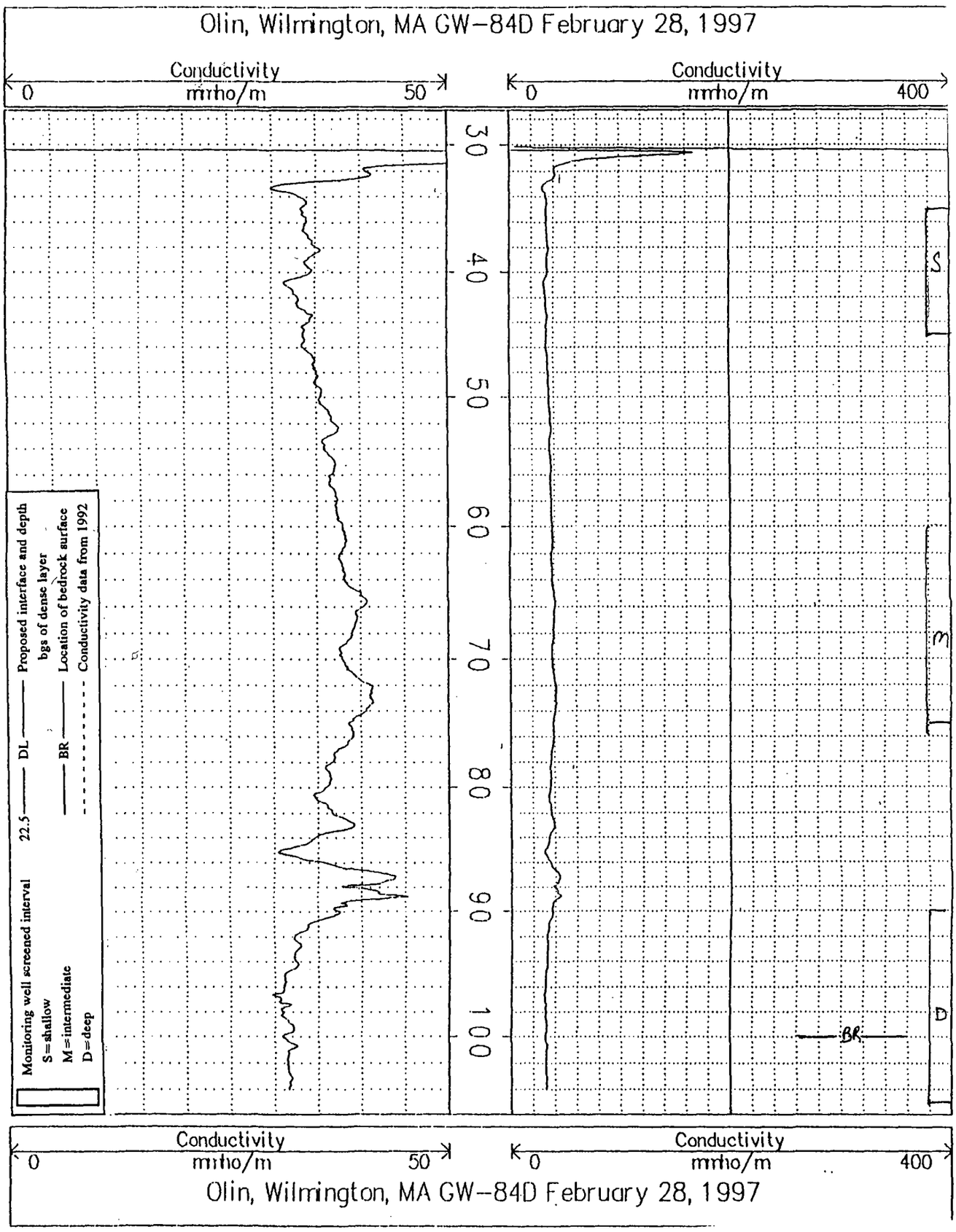
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

Conductivity

Well: GW-84D

PROJECT: Olin, Wilmington
CLIENT: Smith Technology Corporation
LOCATION OF WELL: Wilmington
STATE: MA COUNTY: Middlesex
INSTRUMENTATION: Mt. Sopris MGX II
LOGGING GEOPHYSICIST: Jonathon Puliafico
CLIENT REP: Bruce Cushing
DRILLING CONTRACTOR: Boart Longyear
COMMENTS:

DATE: February 28, 1997
H-R FILE: 97J20
ELEVATION: 79.4 ft MSL
LOG DATUM: Ground Level (GL)
CLIENT TD: 119 ft below GL
H-R TD: N/A
STATIC WATER LEVEL: 0.1 ft above GL
DEPTH OF BEDROCK: 100 ft below GL
CASING DIAMETER: 2 in ID



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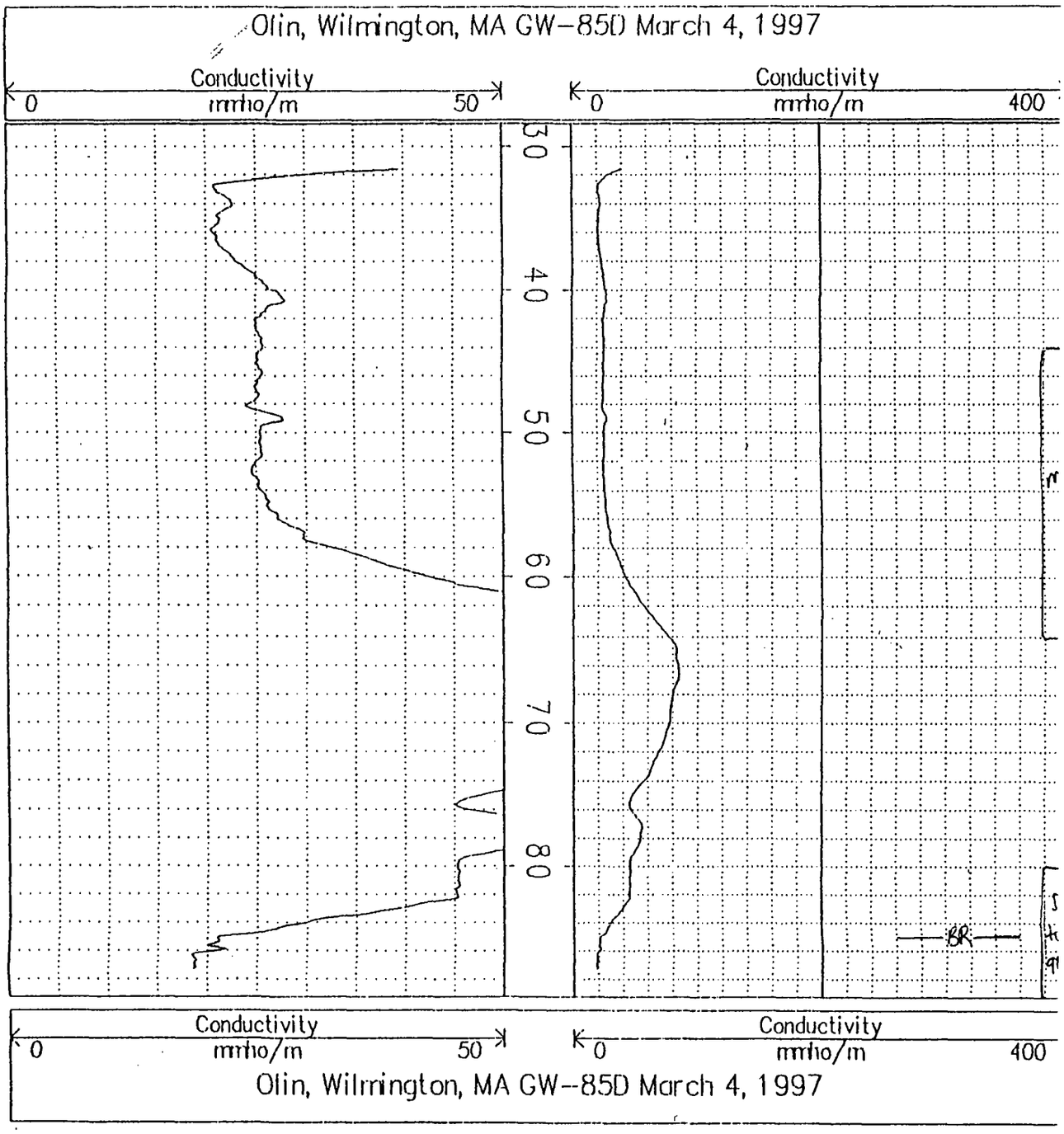
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

Conductivity

Well: GW-85D

PROJECT: Olin, Wilmington
CLIENT: Smith Technology Corporation
LOCATION OF WELL: Wilmington
STATE: MA COUNTY: Middlesex
INSTRUMENTATION: Mt. Sopris MGX II
LOGGING GEOPHYSICIST: Jonathon Pulliafico
CLIENT REP: Bruce Cushing
DRILLING CONTRACTOR: Boart Longyear
COMMENTS:

DATE: March 4, 1997
H-R FILE: 97J20
ELEVATION: 79.1 ft MSL
LOG DATUM: Ground Level (GL)
CLIENT TD: 95 ft below GL
H-R TD: N/A
STATIC WATER LEVEL: 0.05 ft above GL
DEPTH OF BEDROCK: 85 ft below GL
CASING DIAMETER: 2 in ID



Monitoring well screened interval
S=shallow
M=intermediate
D=deep

22.5 DL Proposed interface and depth bgs of dense layer

BR Location of bedrock surface

Conductivity data from 1992

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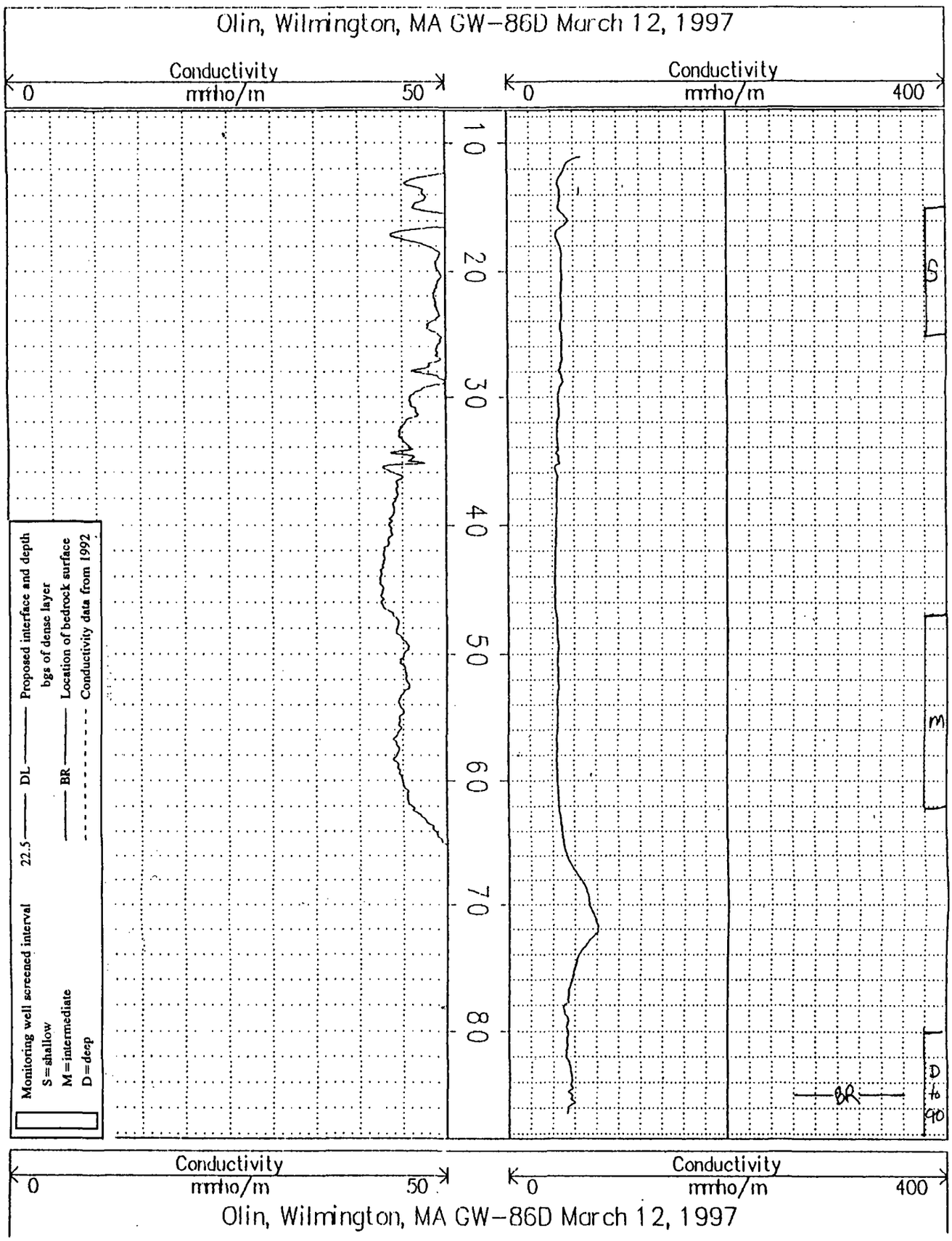
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

Conductivity

Well: GW-86D

PROJECT: Olin, Wilmington
CLIENT: Smith Technology Corporation
LOCATION OF WELL: Wilmington
STATE: MA COUNTY: Middlesex
INSTRUMENTATION: Mt. Sopris MGX II
LOGGING GEOPHYSICIST: Jonathon Puliafico
CLIENT REP: Bruce Cushing
DRILLING CONTRACTOR: Boart Longyear
COMMENTS:

DATE: March 12, 1997
H-R FILE: 97J20
ELEVATION: 77.9 ft MSL
LOG DATUM: Ground Level (GL)
CLIENT TD: 90 ft below GL
H-R TD: N/A
STATIC WATER LEVEL: 1.55 ft above GL
DEPTH OF BEDROCK: 85 ft below GL.
CASING DIAMETER: 2 in ID



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8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

Conductivity

Well: GW-87D

PROJECT: Olin, Wilmington
CLIENT: Smith Technology Corporation
LOCATION OF WELL: Wilmington
STATE: MA COUNTY: Middlesex
INSTRUMENTATION: Mt. Sopris MGX II
LOGGING GEOPHYSICIST: Jonathon Pulliafico
CLIENT REP: Bruce Cushing
DRILLING CONTRACTOR: Boart Longyear
COMMENTS:

DATE: March 12, 1997
H-R FILE: 97J20
ELEVATION: 78.3 ft MSL
LOG DATUM: Ground Level (GL)
CLIENT TD: 109 ft below GL
H-R TD: N/A
STATIC WATER LEVEL: 0.65 ft above GL
DEPTH OF BEDROCK: 104 ft below GL
CASING DIAMETER: 2 in ID