248903

SDMS DocID 248903

COMPREHENSIVE SITE ASSESSMENT PHASE II FIELD INVESTIGATION REPORT VOLUME II (Appendix E through K)

Wilmington Facility
Wilmington, MA

Olin Corporation

JUNE 1993
REF. NO. 3683 (13)
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CONESTOGA-ROVERS & ASSOCIATES

COMPREHENSIVE SITE ASSESSMENT PHASE II FIELD INVESTIGATION REPORT VOLUME II (Appendix E through K)

Wilmington Facility
Wilmington, MA

Olin Corporation

PRINTED ON
JUN 25 1993

E

Massachusetts Department of Environmental Protection **BWSC-108**

Bureau of Waste Site Cleanup

COMPREHENSIVE RESPONSE ACTION TRANSMITTAL FORM & PHASE I COMPLETION STATEMENT

Pursuant to 310 CMR 40.0484 (Subpart D) and 40.0800 (Subpart H)

Release Tracking Number: 3 - 0471

A. SITE LOCATION:

Site Name: (optional) Wilmington, Olin Corporation

Street: 51 Eames Street Location Aid:

City/Town: Wilmington, MA ZIP Code: 01887

Related Release Tracking Numbers that this Form Addresses:

Tier Classification: (check one of the following) [x] Tier IA [ ] Tier IB [ ] Tier IC [ ] Tier II [ ] Not Tier Classified

If a Tier I Permit has been issued, state the Permit Number: 83005

B. THIS FORM IS BEING USED TO: (check all that apply)

- [ ] Submit a **Phase I Completion Statement**, pursuant to 310 CMR 40.0484 (complete Sections A, B, C, G, H, I and J).
- [ ] Submit a **Phase II Scope of Work**, pursuant to 310 CMR 40.0834 (complete Sections A, B, C, G, H, I and J).
- [x] Submit a final **Phase II Comprehensive Site Report and Completion Statement**, pursuant to 310 CMR 40.0836 (complete Sections A, B, C, D, G, H, I and J). (Supplemental)
- [ ] Submit a **Phase III Remedial Action Plan and Completion Statement**, pursuant to 310 CMR 40.0862 (complete Sections A, B, C, G, H, I and J).
- [ ] Submit a **Phase IV Remedy Implementation Plan**, pursuant to 310 CMR 40.0874 (complete Sections A, B, C, G, H, I and J).
- [ ] Submit an **As-Built Construction Report**, pursuant to 310 CMR 40.0875 (complete Sections A, B, C, G, H, I and J).
- [ ] Submit a **Phase IV Final Inspection Report and Completion Statement**, pursuant to 310 CMR 40.0878 and 40.0879 (complete Sections A, B, C, E, G, H, I and J).
- [ ] Submit a periodic **Phase V Inspection & Monitoring Report**, pursuant to 310 CMR 40.0892 (complete Sections A, B, C, G, H, I and J).
- [ ] Submit a final **Phase V Inspection & Monitoring Report and Completion Statement**, pursuant to 310 CMR 40.0893 (complete Sections A, B, C, F, G, H, I and J).

You must attach all supporting documentation required for each use of form indicated, including copies of any Legal Notices and Notices to Public Officials required by 310 CMR 40.1400.

C. RESPONSE ACTIONS:

- [ ] Check here if any response action(s) that serves as the basis for the Phase submittal(s) involves the use of Innovative Technologies. (DEP is interested in using this information to create an Innovative Technologies Clearinghouse.)

Describe Technologies:

D. PHASE II COMPLETION STATEMENT:

Specify the outcome of the Phase II Comprehensive Site Assessment:

- [x] Additional Comprehensive Response Actions are necessary at this Site, based on the results of the Phase II Comprehensive Site Assessment.
- [ ] The requirements of a Class A Response Action Outcome have been met and a completed Response Action Outcome Statement (BWSC-104) will be submitted to DEP.
- [ ] The requirements of a Class B Response Action Outcome have been met and a completed Response Action Outcome Statement (BWSC-104) will be submitted to DEP.
- [ ] Rescoring of this Site using the Numerical Ranking System is necessary, based on the results of the final Phase II Report.

E. PHASE IV COMPLETION STATEMENT:

Specify the outcome of Phase IV activities:

- [ ] Phase V operation, maintenance or monitoring of the Comprehensive Response Action is necessary to achieve a Response Action Outcome. (This site will be subject to a Phase V Operation, Maintenance and Monitoring Annual Compliance Fee.)
- [ ] The requirements of a Class A Response Action Outcome have been met. No additional operation, maintenance or monitoring is necessary to ensure the integrity of the Response Action Outcome. A completed Response Action Outcome Statement (BWSC-104) will be submitted to DEP.
- [ ] The requirements of a Class C Response Action Outcome have been met. No additional operation, maintenance or monitoring is necessary to ensure the integrity of the Response Action Outcome. A completed Response Action Outcome Statement (BWSC-104) will be submitted to DEP.

SECTION E IS CONTINUED ON THE NEXT PAGE

Massachusetts Department of Environmental Protection **BWSC-108**

Bureau of Waste Site Cleanup

COMPREHENSIVE RESPONSE ACTION TRANSMITTAL FORM & PHASE I COMPLETION STATEMENT

Pursuant to 310 CMR 40.0484 (Subpart D) and 40.0800 (Subpart H)

Release Tracking Number: 3 - 0471

E. PHASE IV COMPLETION STATEMENT: (continued)

☐ The requirements of a Class C Response Action Outcome have been met. Further operation, maintenance or monitoring of the remedial action is necessary to ensure that conditions are maintained and that further progress is made toward a Permanent Solution. A completed Response Action Outcome Statement (BWSC-104) will be submitted to DEP.

Indicate whether the operation and maintenance will be Active or Passive. (Active Operation and Maintenance is defined at 310 CMR 40.0006.):

◯ Active Operation and Maintenance ◯ Passive Operation and Maintenance

(Active Operation and Maintenance makes the Site subject to a Post-RAO Class C Active Operation and Maintenance Annual Compliance Fee.)

F. PHASE V COMPLETION STATEMENT:

Specify the outcome of Phase V activities:

☐ The requirements of a Class A Response Action Outcome have been met and a completed Response Action Outcome Statement (BWSC-104) will be submitted to DEP.

☐ The requirements of a Class C Response Action Outcome have been met. No additional operation, maintenance or monitoring is necessary to ensure the integrity of the Response Action Outcome. A completed Response Action Outcome Statement (BWSC-104) will be submitted to DEP.

☐ The requirements of a Class C Response Action Outcome have been met. Further operation, maintenance or monitoring of the remedial action is necessary to ensure that conditions are maintained and that further progress is made toward a Permanent Solution. A completed Response Action Outcome Statement (BWSC-104) will be submitted to DEP.

Indicate whether the operation and maintenance will be Active or Passive. (Active Operation and Maintenance is defined at 310 CMR 40.0006.):

◯ Active Operation and Maintenance ◯ Passive Operation and Maintenance

(Active Operation and Maintenance makes the Site subject to a Post-RAO Class C Active Operation and Maintenance Annual Compliance Fee.)

G. LSP OPINION:

I attest under the pains and penalties of perjury that I have personally examined and am familiar with the information contained in this transmittal form, including any and all documents accompanying this submittal. In my professional opinion and judgment based upon application of (i) the standard of care in 309 CMR 4.02(1), (ii) the applicable provisions of 309 CMR 4.02(2) and (3), and (iii) the provisions of 309 CMR 4.03(5), to the best of my knowledge, information and belief,

> *if Section B indicates that a **Phase I, Phase II, Phase III, Phase IV or Phase V Completion Statement** is being submitted*, the response action(s) that is (are) the subject of this submittal (i) has (have) been developed and implemented in accordance with the applicable provisions of M.G.L. c. 21E and 310 CMR 40.0000, (ii) is (are) appropriate and reasonable to accomplish the purposes of such response action(s) as set forth in the applicable provisions of M.G.L. c. 21E and 310 CMR 40.0000, and (iii) complies(y) with the identified provisions of all orders, permits, and approvals identified in this submittal;

> *if Section B indicates that a **Phase II Scope of Work** or a **Phase IV Remedy Implementation Plan** is being submitted*, the response action(s) that is (are) the subject of this submittal (i) has (have) been developed in accordance with the applicable provisions of M.G.L. c. 21E and 310 CMR 40.0000, (ii) is (are) appropriate and reasonable to accomplish the purposes of such response action(s) as set forth in the applicable provisions of M.G.L. c. 21E and 310 CMR 40.0000, and (iii) complies(y) with the identified provisions of all orders, permits, and approvals identified in this submittal;

> *if Section B indicates that an **As-Built Construction Report** or a **Phase V Inspection and Monitoring Report** is being submitted*, the response action(s) that is (are) the subject of this submittal (i) is (are) being implemented in accordance with the applicable provisions of M.G.L. c. 21E and 310 CMR 40.0000, (ii) is (are) appropriate and reasonable to accomplish the purposes of such response action(s) as set forth in the applicable provisions of M.G.L. c. 21E and 310 CMR 40.0000, and (iii) complies(y) with the identified provisions of all orders, permits, and approvals identified in this submittal.

DEP NOV 12 1998

I am aware that significant penalties may result, including, but not limited to, possible fines and imprisonment, if I submit information which I know to be false, inaccurate or materially incomplete.

☐ Check here if the Response Action(s) on which this opinion is based, if any, are (were) subject to any order(s), permit(s) and/or approval(s) issued by DEP or EPA. If the box is checked, you MUST attach a statement identifying the applicable provisions thereof.

LSP Name: M. Margret Hanley LSP #: 8494 Stamp:

Telephone: 781-721-4022 Ext.:

FAX: (optional) 781-721-4073

Signature: M. Margret Hanley

Date: November 12, 1998

COMMONWEALTH OF MASSACHUSETTS M. MARGRET HANLEY No. 8494 REGISTERED LICENSED SITE PROFESSIONAL

Massachusetts Department of Environmental Protection **BWSC-108**
Bureau of Waste Site Cleanup

COMPREHENSIVE RESPONSE ACTION TRANSMITTAL FORM & PHASE I COMPLETION STATEMENT

Pursuant to 310 CMR 40.0484 (Subpart D) and 40.0800 (Subpart H)

Release Tracking Number: 3 - 0471

H. PERSON UNDERTAKING RESPONSE ACTION(S):

Name of Organization: Olin Corporation

Name of Contact: Steve Morrow Title: Principal Environmental Specialist

Street: Lower River Road

City/Town: Charleston State: TN ZIP Code: 37310

Telephone: 423-336-4511 Ext.: FAX: (optional)

☐ Check here if there has been a change in the person undertaking the Response Action.

I. RELATIONSHIP TO SITE OF PERSON UNDERTAKING RESPONSE ACTION(S): (check one)

☒ RP or PRP Specify: (X) Owner ( ) Operator ( ) Generator ( ) Transporter Other RP or PRP:

☐ Fiduciary, Secured Lender or Municipality with Exempt Status (as defined by M.G.L. c. 21E, s. 2)

☐ Agency or Public Utility on a Right of Way (as defined by M.G.L. c. 21E, s. 5(j))

☐ Any Other Person Undertaking Response Action Specify Relationship:

J. CERTIFICATION OF PERSON UNDERTAKING RESPONSE ACTION(S):

I, STEVE MORROW, attest under the pains and penalties of perjury (i) that I have personally examined and am familiar with the information contained in this submittal, including any and all documents accompanying this transmittal form, (ii) that, based on my inquiry of those individuals immediately responsible for obtaining the information, the material information contained in this submittal is, to the best of my knowledge and belief, true, accurate and complete, and (iii) that I am fully authorized to make this attestation on behalf of the entity legally responsible for this submittal. I/the person or entity on whose behalf this submittal is made am/is aware that there are significant penalties, including, but not limited to, possible fines and imprisonment, for willfully submitting false, inaccurate, or incomplete information.

By: Steve Morrow Title: PRINCIPAL ENVIRONMENTAL SPECIALIST
(signature)

For: Date:
(print name of person or entity recorded in Section H)

Enter address of the person providing certification, if different from address recorded in Section H:

Street:

City/Town: State: ZIP Code:

Telephone: Ext.: FAX: (optional)

YOU MUST COMPLETE ALL RELEVANT SECTIONS OF THIS FORM OR DEP MAY RETURN THE DOCUMENT AS INCOMPLETE. IF YOU SUBMIT AN INCOMPLETE FORM, YOU MAY BE PENALIZED FOR MISSING A REQUIRED DEADLINE.

DEC NOV 12 1998

APPENDIX E

MONITORING WELL STRATIGRAPHIC AND INSTRUMENTATION LOGS

HISTORIC MONITORING WELL
STRATIGRAPHIC AND INSTRUMENTATION LOGS

TEST BORING LOGS

MILLER ENGINEERING & TESTING, INC.

Project: OLIN CHEMICAL
Wilmington, MA
Project No: 60321.01
Date Start: 6/27/86
Date End: 6/27/86

Sheet 2 of 2
Boring No: B-7D
Location: See Plan
Surface Elev:

	Casing	Sampler
TYPE:	Hollow Stem Auger	Split Spoon
SIZE:	2 1/4" ID	1-3/8" ID
HAMMER:	---	140 pounds
FALL:	---	30 inches

Groundwater Observations

DATE	DEPTH	CASING AT	STABILIZATION PERIOD
6/30/86	0.9'		Overnight

Depth	Cas bl/ft	Sample No.	Sample Depth	Pen.	Rec.	Blows/6"	Strata Change	Sample Description	Note
30.0'		S-13	30.0-31.5'	18"	12"	15-31-34		S-13: Wash, medium to fine, brown sand with gravel. (wet)	(1)
35.0		S-14	35.0-35.5'	6"	0"	50		S-14:-------	
40.0'		S-15	40.0-41.5'	18"	4"	66-44-24		S-15: Same as S-9. (wet)	
								Terminated at 42.7', bedrock.	
45.0'									
50.0'									
55.0'									
60.0'									

Proportions used: TRACE (0 - 10%), LITTLE (10 - 20%), SOME (20 - 35%), and (35 - 50%)

COHESIVE CONSISTENCY (blows/foot)	
0 - 2	VERY SOFT
2 - 4	SOFT
4 - 8	MEDIUM STIFF
8 - 15	STIFF
15+	HARD

COHESIONLESS DENSITY (blows/foot)	
0 - 4	VERY LOOSE
4 - 10	LOOSE
10 - 30	MEDIUM DENSE
30 - 50	DENSE
50+	VERY DENSE

Driller: T. Gomoulka
Helper: R. Marcoux
Inspector: B. Childs

Remarks: (1) Boulder core at 36.9'-38.0'.

Notes:
1) The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
2) Water level readings have been made in the drill holes at times and under conditions stated on the boring logs. Fluctuations in the level of the groundwater may occur due to other factors than those present at the time measurements were made.

Sheet # ___ of ___

148 Pioneer Dr.
Leominster, MA 01453
(617) 840-0391

SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St
Nashua, NH 03060
(603) 882-3601

Client: OLIN CORPORATION Date: 04/18/88 Job No: 58-238

Location: EAMES STREET, WILMINGTON, MASSACHUSETTS

BORING NO: GW-31 DEEP Ground Elev.: Date Start: 04/11/88 Date Complete: 04/12/88 Drilling Foreman: M.Z. Eng Hydro Geologist: M.R.

Depth	Sample No	Sample Depth (ft)	Blows/6" Penetration	Rec Inches	Casing Blows Per ft	Strata Change Depth	Visual Identification of Soil and/or Rock Strata
	1	0'0"- 2'0"	2-3-4-4				Loose to medium dense, dry, fine SAND, trace inorganic silt, trace root matter.
	2	2'0"- 4'0"	5-5-5-6				
5	3	4'0"- 6'0"	7-6-7-8			4'0"	Medium dense, moist to wet, fine SAND, trace inorganic silt.
	4	6'0"- 8'0"	9-10-13-14				
	5	8'0"- 10'0"	7-10-9-14				
10	6	10'0"- 12'0"	7-8-10-10				
	7	12'0"- 14'0"	7-7-9-10				
15	8	14'0"- 16'0"	25-36-31-24			14'0"	Very dense, wet, fine to coarse SAND, and gravel, some inorganic silt, trace cobbles, and boulders.
	9	16'0"- 18'0"	35-24-23-21				
	10	18'0"- 20'0"	18-28-46-51				
20	11	20'0"- 20'9"	49-120/3"				
	Run #1	22'0" to 23'0"	14	min/foot		22'0"	Refusal at 22'0" with hollow stem auger Run #1 CORED ROCK from 22'0" to 27'0" Some fractures in rock, started with water return. Had total loss of water at 23'6". Recovery 25"/60" = 41.6%
		23'0" to 24'0"	10	"			
25		24'0" to 25'0"	9	"			
		25'0" to 26'0"	10	"			
		26'0" to 27'0"	11	"			
						27'0"	End of boring at 27'0" Set 2" STAINLESS STELL well point 22'0" Water level at 7'3" upon completion Well Materials; 1 - 2" end plugs 1 - 10' x 2" STAINLESS STEEL screen 1 - 10' x 2" STAINLESS STEEL riser 1 - 2' x 2" STAINLESS STEEL riser 1 - protective locking casing 1 bag- sakrete sand 7 bags-silica sand 1 pail-bentonite pellets 1 bag -bentonite powder 3 bags-Portland cement
30							
35							
40							

Type of Boring Casing Size. Hollow Stem Auger Size: 6¼ HSA & NX Core (2 1/8")

Proportion Percentages	Granular Soils (blows per ft.)		Cohesive Soils (blows per ft.)	
Trace 0 to 10%	0 to 4 Very Loose	30 to 50 Dense	0 to 2 Very Soft	8 to 15 Stiff
Some 10 to 40%	4 to 10 Loose	Over 50 Very Dense	2 to 4 Soft	15 to 30 Very Stiff
And 40 to 50%	10 to 30 Medium Dense		4 to 8 Medium Stiff	Over 30 Hard

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

TEST BORING LOGS

MILLER ENGINEERING & TESTING, INC.

Project: OLIN CHEMICAL
Wilmington, MA
Project No: 60321.01
Date Start: 7/1/86
Date End: 7/2/86

Sheet 1 of 1
Boring No: B-7S
Location: See Plan
Surface Elev:

	Casing	Sampler
TYPE:	Hollow Stem Auger	
SIZE:	2 1/4" ID	
HAMMER:	---	
FALL:	---	

Groundwater Observations

DATE	DEPTH	CASING AT	STABILIZATION PERIOD
7/1/86	9.0'	-----	Overnight.

Depth	Cas bl/ ft	Sample No.	Depth	Pen.	Rec.	Blows/6"	Strata Change	Sample Description	Note
							8.0'	Medium to fine, light brown, silty sand with gravels. (fill)	(1)
5.0'									
10.0'							10.0'	Peat organics with silty sand. (moist)	
							13.0'	Light to dark brown, medium to fine silty sand. (wet)	
15.0'							19.0'	Gray, medium to fine, silty sand with gravels. (wet)	
20.0'								Terminated at 19.0'.	
25.0'									
30.0'									

Proportions used: Trace (0 - 10%), Little (10 - 20%), Some (20 - 35%), and (35 - 50%)

Cohesive Consistency (tons/foot)		Cohesionless Density (blows/foot)	
0 - 2	very soft	0 - 4	very loose
2 - 4	soft	4 - 10	loose
4 - 8	medium stiff	10 - 30	medium dense
8 - 15	stiff	30 - 50	dense
30+	hard	50+	very dense

Driller: T. Gomoulka
Helper: R. Marcoux
Inspector: B. Childs

Remarks: (1) No samples needed.

Notes:
1) The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
2) Water level readings have been made in the drill holes at times and under conditions stated on the boring logs. Fluctuations in the level of the groundwater may occur due to other factors than those present at the time measurements were made.

TEST BORING LOGS

MILLER ENGINEERING & TESTING, INC.

Project: OLIN CHEMICAL
Wilmington, MA
Project No: 60321.01
Date Start: 6/27/86
Date End: 6/30/86

Sheet 1 of 2
Boring No: B-7D
Location: See Plan
Surface Elev: ____

	Casing	Sampler
TYPE:	Hollow Stem Auger	Split Spoon
SIZE:	2 1/4" ID	1 3/8" ID
HAMMER:	---	140 pounds
FALL:	---	30 inches

Groundwater Observations

DATE	DEPTH	CASING AT	STABILIZATION PERIOD
6/30/86	9.0'		Overnight

Depth	Cas bl/ft	Sample No.	Sample Depth	Pen.	Rec.	Blows/6"	Strata Change	Sample Description	Note
		S-1	0-1.5'	18"	12"	4-5-7		S-1: Loose, light brown, medium to fine sand with gravel. (fill)	
		S-2	1.5-3.0'	18"	12"	9-20-22		S-2: Same as S-1.	
5.0'		S-3	3.0-4.5'	18"	12"	7-6-6		S-3: Same as S-1.	
		S-4	4.5-6.0'	18"	12"	5-2-3		S-4: Same as S-1.	
		S-5	6.0-7.5'	18"	4"	2-10-4	8.0'	S-5: Same as S-1.	
		S-6	7.5-9.0'	18"	18"	2-2-2		S-6: Peat, organics with trace of silt. (moist)	
10.0'		S-7	9.0-10.5'	18"	2"	5-6-13	10.0'	S-7: Very dense, light to dark brown, medium to fine silty sand (wet).	
		S-8	10.5-12.0'	18"	18"	16-22-31	13.0'	S-8: Same as S-7. (wet)	(1)
		S-9	12-13.5'	18"	14"	50-23-27		S-9: Very dense, grey, medium to fine silty sand with gravel (wet).	(2)
15.0'		S-10	13.5-14.4'	10"	9"	27-50/5		S-10: Same as S-9 (wet).	
20.0'		S-11	20.0-21.5'	18"	9"	34-27-19		S-11: Same as S-9. (wet)	
25.0'		S-12	25.0-26.5'	18"	9"	12-13-17		S-12: Wash, fine gravel, medium sand. (wet)	(3)
30.0'									

Proportions used: TRACE (0 - 10%), LITTLE (10 - 20%), SOME (20 - 35%), and (35 - 50%)

COHESIVE CONSISTENCY (tons/foot)	
0 - 2	VERY SOFT
2 - 4	SOFT
4 - 8	MEDIUM STIFF
8 - 15	STIFF
30+	HARD

COHESIONLESS DENSITY (blows/foot)	
0 - 4	VERY LOOSE
4 - 10	LOOSE
10 - 30	MEDIUM DENSE
30 - 50	DENSE
50+	VERY DENSE

Driller: T. Gomoulka
Helper: R. Marcoux
Inspector: B. Childs

Remarks:
(1) High blow count due to pushing pebble.
(2) Changed to threaded casing w/300lb hammer at 14.5'.
(3) Wash, material from sides of hole, not bottom.

Notes:
1) The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
2) Water level readings have been made in the drill holes at times and under conditions stated on the boring logs. Fluctuations in the level of the groundwater may occur due to other factors than those present at the time measurements were made.

Sheet # ____ of ____

148 Pioneer Dr.
Leominster, MA 01453
(617) 840-0391

SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St
Nashua NH 03060
(603) 882-3601

Client: OLIN CORPORATION — Date: 04/18/88 — Job No: 88-238

Location: EAMES STREET, WILMINGTON, MASSACHUSETTS

BORING NO.: GW-32 SHALLOW — Ground Elev: — Date Start: 04/13/88 — Date Complete: 04/14/88 — Drilling Foreman: M.Z. — Eng./Hydrol Geologist: M.B.

DEPTH	Sample No	Sample Depth (ft.)	Blows 6" Penetration	Rec. Inches	Casing Blows Per ft.	Strata Change Depth	Visual Identification of Soil and/or Rock Strata
							TOPSOIL
						0'6"	Moist to wet, fine SAND, trace inorganic silt.
5							
						8'6"	Wet, fine to medium SAND, grading to fine to coarse sand, and fine gravel, trace inorganic silt.
10							
						14'0"	Wet, fine to medium SAND, some inorganic silt, some fine to coarse gravel, trace cobbles.
15						15'0"	End of boring at 15'0" Set 2" STAINLESS STEEL well point 15'0" Water level at 7'0" upon completion
20							
							Well Materils; 1 - 2" end plugs 1 - 10' x 2" STAINLESS STEEL screen 1 - 5' x 2" STAINLESS STEEL riser 1 bag - sakrete sand 7 bags - silica sand 1 pail - bentonite pellets 1 bag - Portland cement
25							
30							
35							
40							

Type of Boring: Casing Size: — Hollow Stem Auger Size: 6¼

Proportion Percentages	Granular Soils (blows per ft.)		Cohesive Soils (blows per ft.)	
Trace 0 to 10%	0 to 4 Very Loose	30 to 50 Dense	0 to 2 Very Soft	8 to 15 Stiff
Some 10 to 40%	4 to 10 Loose	Over 50 Very Dense	2 to 4 Soft	15 to 30 Very Stiff
And 40 to 50%	10 to 30 Medium Dense		4 to 8 Medium Stiff	Over 30 Hard

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

148 Pioneer Dr
Leominster, MA 01453
(617) 840-0391

SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St
Nashua NH 03060
(603) 882-3601

Client: OLIN CORPORATION — Date: 04/18/88 — Job No: 88-238

Location: EAMES STREET, WILMINGTON, MASSACHUSETTS

BORING NO.: GW-32 DEEP — Ground Elev.: — Date Start: 04/11/88 — Date Complete: 04/14/88 — Drilling Foreman: M.Z. — Eng./Hydrol. Geologist: M.B.

Depth	Sample No	Sample Depth (ft.)	Blows 6" Penetration	Rec. Inches	Casing Blows Per ft.	Strata Change Depth	Visual Identification of Soil and/or Rock Strata
							TOPSOIL.
	1	0'6"- 2'6"	2-3-3-4			0'6"	Loose, dry, fine SAND, trace inorganic silt.
	2	2'6"- 4'6"	3-3-4-4				
5	3	4'6"- 6'6"	7-10-11-11			4'6"	Medium dense, moist to wet, fine SAND, trace inorganic silt.
	4	6'6"- 8'6"	10-11-12-13				
	5	8'6"- 10'0"	11-12-16			8'6"	Medium dense to dense, wet, fine to medium SAND, grading to fine to coarse sand, and fine gravel, trace inorganic silt.
10	6	10'0"- 12'0"	7-10-17-21				
	7	12'0"- 14'0"	12-14-16-17				
15	8	14'0"- 16'0"	43-40-24-30			14'0"	Very dense, wet, light grey to brown, fine to medium SAND, some inorganic silt, some fine to coarse gravel, trace cobbles, and boulders.
	9	16'0"- 18'0"	28-32-35-28				
	10	18'0"- 20'0"	13-12-13-20				
20	11	20'0"- 22'0"	21-16-47-20				
	12	22'0"- 24'0"	14-21-34-30			22'0"	Very dense, wet, fine to coarse SAND, and gravel, some cobbles, and inorganic silt.
25	13	24'0"-25'10"	29-38-33-120/4"			24'0"	Very dense, wet, fine SAND, some inorganic silt, trace to some fine to coarse gravel, trace cobbles & boulders
	Run #1	26'0"-	27'0" 12	min./foot		26'0"	Refusal at 26'0" with hollow stem auger Run #1 CORED ROCK from 26'0" to 31'0" Trace to some fractures, no loss of water. Recovery 44"/60" = 73.3%
		27'0"-	28'0" 15	"			
		28'0"-	29'0" 10	"			
30		29'0"-	30'0" 9	"			
		30'0"-	31'0" 11	"			
	Well Materials;					31'0"	End of boring at 31'0" Set 2" STAINLESS STEEL well point 31'0" Water level at 7'0" upon completion
	1 - 2" end plugs						
	1 - 10' x 2"		STAINLESS STEEL	screen			
35	2 - 10' x 2"		STAINLESS STEEL	riser			
	1 - 2' x 2"		STAINLESS STEEL	riser			
	1 - protective locking casing						
	1 bag - sakrete sand						
	5 bags- silica sand						
40	1 pail- bentonite pellets						
	1 bag - bentonite powder						

Type of Boring: Casing Size: Hollow Stem Auger Size: 6¼ HSA & NX Core (2 1/8")

Proportion Percentages
Trace 0 to 10%
Some 10 to 40%
And 40 to 50%

Granular Soils (blows per ft.)
0 to 4 Very Loose
4 to 10 Loose
10 to 30 Medium Dense
30 to 50 Dense
Over 50 Very Dense

Cohesive Soils (blows per ft.)
0 to 2 Very Soft
2 to 4 Soft
4 to 8 Medium Stiff
8 to 15 Stiff
15 to 30 Very Stiff
Over 30 Hard

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.

Project: OLIN CHEMICAL CORPORATION
Wilmington, MA
Project No: 90718.01
Date Start: 11/13/89
Date End: 11/13/89

Sheet 1 **of** 2
Boring No: GW-33
Location: #2 Shallow
Surface Elev:

	Casing	Sampler
Type	Hollow Stem Auger	Split Spoon
Size	3-3/4" ID	1-3/8" ID
Hammer	---	140 pounds
Fall	---	30 inches

Groundwater Observations

DATE	DEPTH	CASING AT	STABILIZATION PERIOD
11/13/89	7.0'	--	Upon Completion

Depth	Cas bl/ft.	SAMPLE No.	Depth	Pen.	Rec.	Blows/6"	Strata Change	Sample Description	Notes
5.0'		S-1	4.0-6.0'	AUGER	SAMPLE			S-1: Brown, fine to coarse sand and gravel, trace of cobbles	
10.0'		S-2	9.0-11.0'	AUGER	SAMPLE			S-2: Same as S-1	
15.0'		S-3	14.0-16.0'	AUGER	SAMPLE			S-3: Same as S-1	
20.0'		S-4	19.0-21.0'	AUGER	SAMPLE			S-4: Brown, fine to coarse sand	
25.0'								Terminated Exploration at	
30.0'								Installed Monitoring Well	

Driller: R. Marcoux
Helper: L. Love
Inspector:

COHESIVE CONSISTENCY (Blows/Foot)	
0 - 2	VERY SOFT
2 - 4	SOFT
4 - 8	MEDIUM STIFF
8 - 15	STIFF
15 - 30	HARD

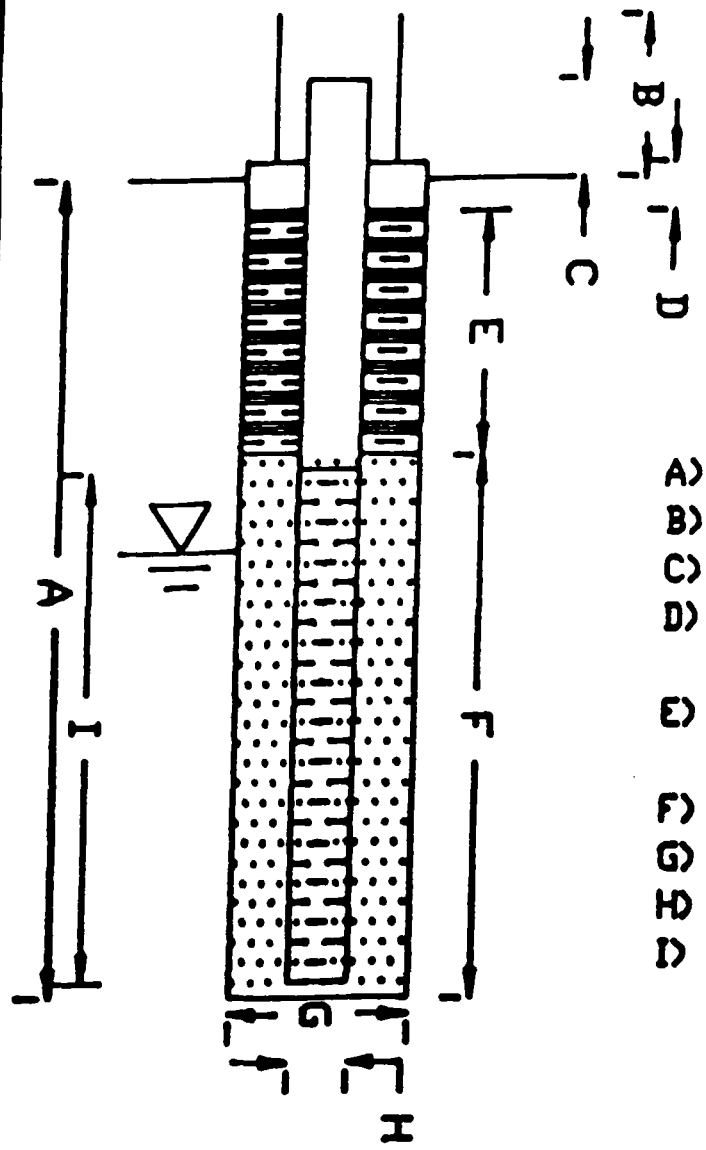
COHESIONLESS DENSITY (Blows/Foot)	
0 - 4	VERY LOOSE
4 - 10	LOOSE
10 - 30	MEDIUM DENSE
30 - 50	DENSE
50+	VERY DENSE

PROPORTIONS USED	
TRACE	0 - 10%
LITTLE	10 - 20%
SOME	20 - 35%
AND	35 - 50%

NOTES
See attached sheet for Monitoring Well installation

REMARKS: THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES; TRANSITION MAY BE GRADUAL. WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

MONITORING WELL DIAGRAM



A) Borehole Depth: 20.0'
B) Cover Pipe Stickup: 2.5'
C) Riser Pipe Stickup: 2.5'
D) Concrete Seal Thickness: 6"
E) Bentonite Seal Thickness: Slurry 8.5'
F) Sand Pack: Bottom of 9.0'
G) Borehole Diameter: 8" - 3-3/4" ID
H) Wellscreen Diameter: 2"
I) Wellscreen Length: 10.0'

Driller: R. Marcoux
Helper: L. Love
Inspector: _____

MILLER ENGINEERING, INC.

Project: OLIN CHEMICAL CORP.
Wilmington, MA
Project No.: 90718.01
Installation Date: 11/13/89

Sheet 2 of 2
Boring No.: GW-33
Well No.: _____
Surface Elev.: _____

TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.

Project: OLIN CHEMICAL CORPORATION
Wilmington, MA
Project No: 90718.01
Date Start: 11/8/89
Date End: 11/13/89

Sheet 1 **of** 2
Boring No: GW-33
Location: #1 Deep
Surface Elev:

	Casing	Sampler
Type	Flush Joint	Split Spoon
Size	4" ID	1-3/8" ID
Hammer	---	140 pounds
Fall	---	30 inches

Groundwater Observations

DATE	DEPTH	CASING AT	STABILIZATION PERIOD
11/13/89	7.0'	---	Upon Completion

Depth	Cas bl/ft	SAMPLE No.	Depth	Pen.	Rec.	Blows/6"	Strata Change	Sample Description	Notes
		S-1	0.0-2.0'	24"	18"	3-4		S-1: Light brown, fine sand	
						8-11			
		S-2	2.0-4.0'	24"	20"	12-12		S-2: Brown, fine to medium sand, silt, gravel, cobbles	
						32-37			
5.0'		S-3	4.0-5.0'	12"	12"	37-65		S-3: Brown, fine to coarse sand, little silt, gravel, cobbles (wet)	
		S-4	5.0-7.0'	24"	18"	38-65		S-4: Same as S-3	
						77-70			
		S-5	7.0-9.0'	24"	18"	28-39		S-5: Same as S-3	
						55-64			
10.0'		S-6	9.0-11.0'	24"	12"	23-31		S-6: Same as S-3	
						48-48			
		S-7	11.0-13.0'	24"	14"	12-33		S-7: Same as S-3	
						50-45			
		S-8	13.0-15.0'	24"	10"	11-13		S-8: Brown, fine to coarse sand, trace of silt, small amounts of gravel	
15.0'						16-13			
		S-9	15.0-17.0'	24"	14"	4-5		S-9: Brown, fine to medium sand, trace of gravel	
						11-14			
		S-10	17.0-19.0'	24"	12"	3-4		S-10: Same as S-9	
						8-7			
20.0'		S-11	19.0-19.4'	5"	5"	100/5"		S-11: Fine to coarse sand - Advanced casing to 21.0' Cored rock 21.0-26.0'	
25.0'								Installed Monitoring Well	
							26.0'		
								Terminated Exploration at 26.0'	
30.0'									

Driller: R. Marcoux
Helper: L. Love
Inspector:

COHESIVE CONSISTENCY (Blows/Foot)
0 - 2 VERY SOFT
2 - 4 SOFT
4 - 8 MEDIUM STIFF
8 - 15 STIFF
15 - 30 HARD

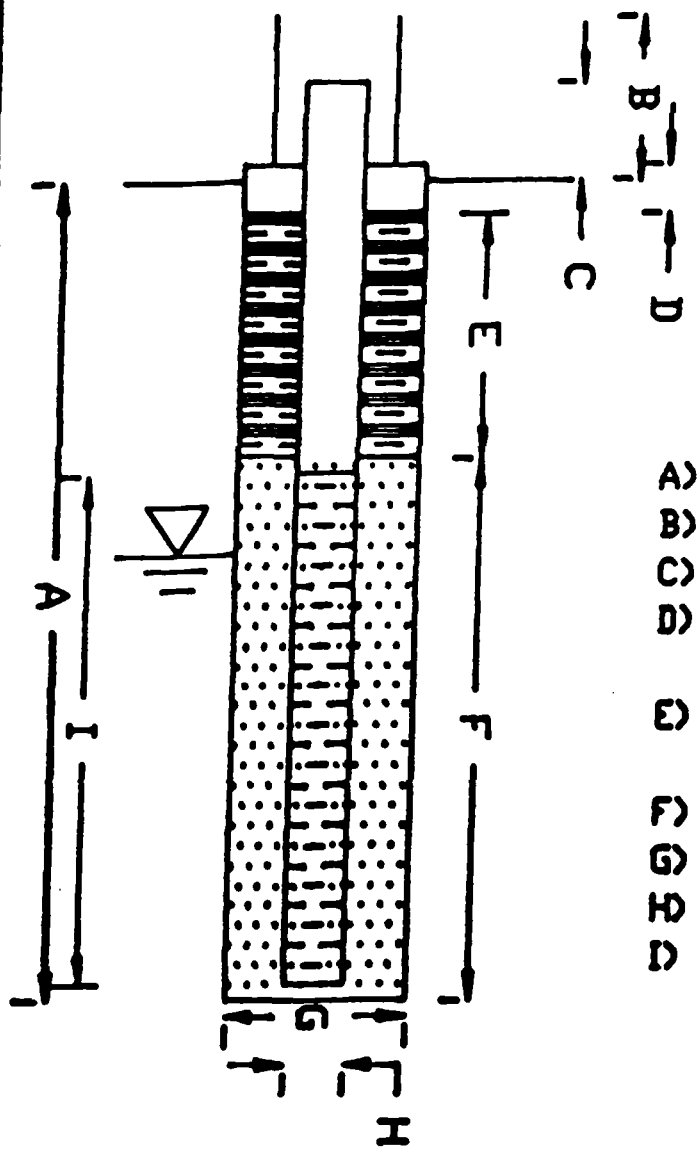
COHESIONLESS DENSITY (Blows/Foot)
0 - 4 VERY LOOSE
4 - 10 LOOSE
10 - 30 MEDIUM DENSE
30 - 50 DENSE
50+ VERY DENSE

PROPORTIONS USED
TRACE 0 - 10%
LITTLE 10 - 20%
SOME 20 - 35%
AND 35 - 50%

NOTES See attached sheet for Monitoring Well installation

REMARKS: THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITION MAY BE GRADUAL. WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

MONITORING WELL DIAGRAM



A) Borehole Depth: 26.0'
B) Cover Pipe Stickup: 2.5'
C) Riser Pipe Stickup: 2.5'
D) Concrete Seal Thickness: 6"
E) Bentonite Seal Thickness: 11.5'
F) Sand Pack: 12.0'
G) Borehole Diameter: 4"
H) Wellscreen Diameter: 2"
I) Wellscreen Length: 10.0'

Driller: R. Marcoux
Helper: L. Lowe
Inspector: _____

MILLER ENGINEERING, INC.

Project: OLIN CHEMICAL CORP.
Wilmington, MA
Project No: 90718.01
Installation Date: 11/13/89

Sheet 2 of 2
Boring No: GW-33
Well No: #1 Deep
Surface Elev: _____

GEOLOGIC LOG

MILLER ENGINEERING, INC.

PROJECT: OLIN CHEMICAL CORPORATION Wilmington, MA
BORING NO. GW-31
LOCATION See Plan

PROJECT NO. 90718.01
SURFACE ELEV.
DATE START 11/8/89
COMPANY MILLER ENGINEERING & TESTING
DATE END 11/13/89
DRILLER B. Marcoux
MEI REP None

DEPTHS:
OVERBURDEN
TOTAL
WATER

TYPE & SIZE OF HOLE	CORE RECOVERY %	ELEVATION	DEPTH	LOG	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION OF ROCK	DRILLING BEHAVIOR FEED	DRILLING BEHAVIOR WATER	NOTES
			21.0			RUN #1: Light gray, fine grained calc-silicate gneiss. Central one foot section of core highly fractured with no pieces greater than 4" long. Foliation trends 30 degrees to horizontal, as evident with thin (less than 1/2") felsic layers. Scattered thin felsic intrusions randomly oriented throughout core. Fracture sub-horizontal in central area, 45 degrees to horizontal in remaining section of core. REC: 55"/60" = 92% RQD: 38"/60" = 63%			
			26.0						

CORE LOSS

CORE RECOVERY

REMARKS:

TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.

Project: OLIN CHEMICAL CORPORATION
Wilmington, MA
Project No: 90718.01
Date Start: 11/17/89
Date End: 11/17/89

Sheet 1 **of** 2
Boring No: GW-34
Location:
#2 Shallow
Surface Elev:

	Casing	Sampler
Type	Hollow Stem Auger	Split Spoon
Size	3-3/4" ID	1-3/8" ID
Hammer	---	140 pounds
Fall	---	30 inches

Groundwater Observations

DATE	DEPTH	CASING AT	STABILIZATION PERIOD
11/17/89	9.0'	---	Upon Completion

Depth	Cas bl/ ft.	SAMPLE No.	Depth	Pen.	Rec.	Blows/6"	Strata Change	Sample Description	Notes
5.0'		S-1	4.0-6.0'	AUGER	SAMPLE			S-1: Brown, fine to coarse sand, gravel, cobbles	
10.0'		S-2	9.0-11.0'	AUGER	SAMPLE			S-2: Same as S-1	
15.0'		S-3	14.0-16.0'	AUGER	SAMPLE			S-3: Brown, fine to coarse sand	
20.0'		S-4	19.0-21.0'	AUGER	SAMPLE			S-4: Same as S-3	
								Terminated Exploration	
								Installed Monitoring Well	
25.0'									
30.0'									

Driller: R. Marcoux
Helper: R. Gagnon
Inspector:

COHESIVE CONSISTENCY (Blows/Foot)	
0 - 2	VERY SOFT
2 - 4	SOFT
4 - 8	MEDIUM STIFF
8 - 16	STIFF
16 - 32	HARD

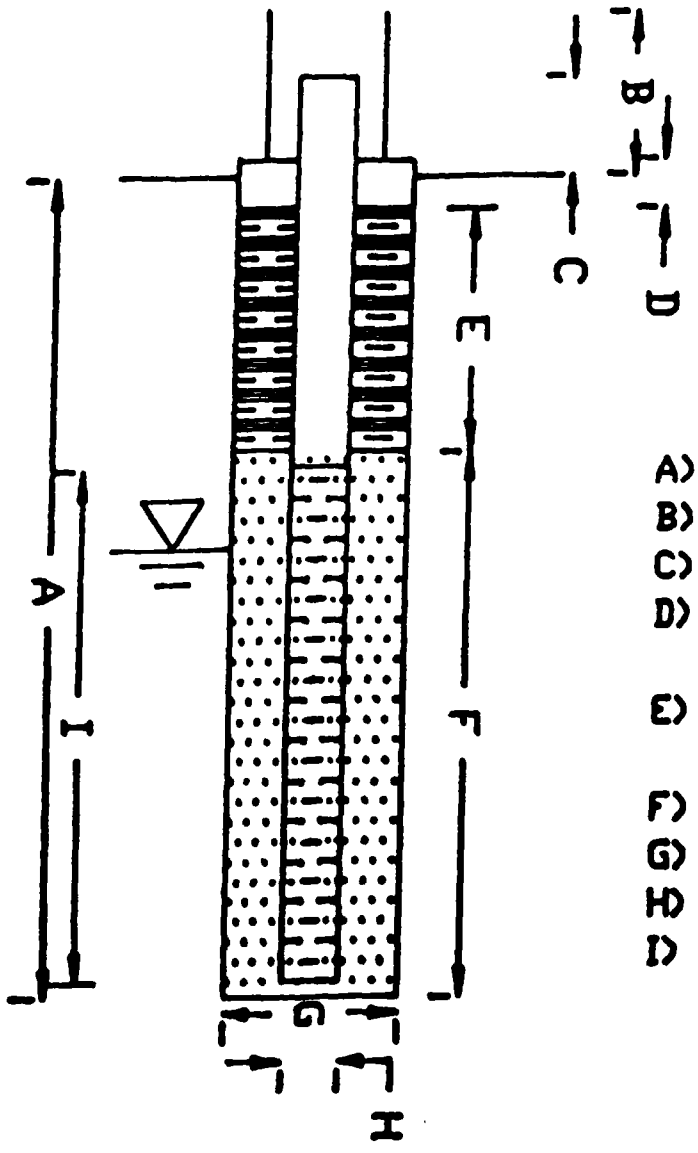
COHESIONLESS DENSITY (Blows/Foot)	
0 - 4	VERY LOOSE
4 - 10	LOOSE
10 - 30	MEDIUM DENSE
30 - 50	DENSE
50+	VERY DENSE

PROPORTIONS USED	
TRACE	0 - 10%
LITTLE	10 - 20%
SOME	20 - 35%
AND	35 - 50%

NOTES
See attached sheet for Monitoring Well installation

REMARKS: THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITION MAY BE GRADUAL. WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

MONITORING WELL DIAGRAM



A) Borehole Depth: 20.0'
B) Cover Pipe Stickup: 2.5'
C) Riser Pipe Stickup: 2.5'
D) Concrete Seal Thickness: 6"
E) Bentonite Seal Thickness: Slurry 8.0'
F) Sand Pack: Bottom to 9.0'
G) Borehole Diameter: 8" 3-3/4" ID
H) Wellscreen Diameter: 2"
I) Wellscreen Length: 10.0'

Driller: R. Marcoux
Helper: R. Gagnon
Inspector: _____

MILLER ENGINEERING, INC.

Project: OLIN CHEMICAL CORP.
Wilmington, MA
Project No: 90718.01
Installation Date: 11/17/89

Sheet 2 of 2
Boring No: GW-34
Well No: #2 Shallow
Surface Elev: _____

TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.

Project: OLIN CHEMICAL CORPORATION
Wilmington, MA
Project No: 90718.01
Date Start: 11/14/89
Date End: 11/20/89

Sheet 1 **of** 3
Boring No: GW-34
Location: #1 Deep
Surface Elev:

	Casing	Sampler
Type	Flush Joint	Split Spoon
Size	4" ID	1-3/8" ID
Hammer	---	140 pounds
Fall	---	30 inches

Groundwater Observations

DATE	DEPTH	CASING AT	STABILIZATION PERIOD
11/19/89	17.0'	---	Upon Completion

Depth	Cas bl/ft	SAMPLE No.	Depth	Pen.	Rec.	Blows/6"	Strata Change	Sample Description	Notes
		S-1	0.0-2.0'	24"	6"	4-10		S-1: Light brown, fine to medium sand, little silt, some gravel	
						11-15			
		S-2	2.0-4.0'	24"	15"	12-28		S-2: Same as S-1, some cobbles	
						60-48			
5.0'		S-3	4.0-4.3'	3"	0"	100/3"		S-3: Same as S-2, pushed cobble - no recovery - sample from auger	
		S-4	6.0-6.4'	5"	2"	100/5"		S-4: Brown, fine to coarse sand, gravel, cobbles-boulders	
		S-5	8.0-10.0'	24"	12"	45-46		S-5: (wet), brown, fine to coarse sand, gravel, cobbles-boulders	
10.0'						57-68			
		S-6	10.0-10.7'	8"	5"	42-100/2"		S-6: Same as S-5	
							12.0'		*
		S-7	12.0-14.0'	24"	6"	10-25		S-7: Fine to coarse sand, trace of fine gravel	
						21-29			
15.0'		S-8	14.0-16.0'	24"	8"	13-19		S-8: Same as S-7	
						31-27			
		S-9	16.0-18.0'	24"	10"	No Blow Counts - Retained		S-9: Same as S-7	
		S-10	18.0-20.0'	24"	8"	No Blow Counts - Retained		S-10: Same as S-7	
20.0'									
		S-11	20.0-22.0'	24"	8"	10-27		S-11: Same as S-7	
						17-16			
		S-12	22.0-24.0'	24"	11"	9-18		S-12: Same as S-7	
						23-20			
25.0'			24.5	Casing	Refusal			Cored rock from 24.5-26.0'. Lost grease fitting from core barrel. Roller cored to 26.0'.	
								Cored rock from 26.0-31.0' - Boulders?	
30.0'									

Driller: R. Marcoux
Helper: R. Gagnon
Inspector:

COHESIVE CONSISTENCY (Blows/Foot)
0 - 2 VERY SOFT
2 - 4 SOFT
4 - 8 MEDIUM STIFF
8 - 16 STIFF
16 - 32 HARD

COHESIONLESS DENSITY (Blows/Foot)
0 - 4 VERY LOOSE
4 - 10 LOOSE
10 - 30 MEDIUM DENSE
30 - 50 DENSE
50+ VERY DENSE

PROPORTIONS USED
TRACE 0 - 10%
LITTLE 10 - 20%
SOME 20 - 35%
AND 35 - 50%

NOTES
* 12.0' pulled augers out and advanced casing
See attached sheet for Monitoring Well installation

REMARKS: THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITION MAY BE GRADUAL. WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.

Project: OLIN CHEMICAL CORPORATION
Wilmington, MA
Project No: 90718.01
Date Start: 11/14/89
Date End: 11/20/89

Sheet 2 **of** 3
Boring No: GW-34
Location:
#1 Deep
Surface Elev:

	Casing	Sampler
Type	Flush Joint	Split Spoon
Size	4" ID	1-3/8" ID
Hammer	---	140 pounds
Fall	---	30 inches

Groundwater Observations

DATE	DEPTH	CASING AT	STABILIZATION PERIOD

Depth	Cas bl/ft	SAMPLE No.	Depth	Pen.	Rec.	Blows/6"	Strata Change	Sample Description	Notes
35.0'								Advanced casing to 34.5' Installed Monitoring Well at 33.0' See attached sheet for Monitoring Well installation	
40.0'									
45.0'									
50.0'									
55.0'									
60.0'									

Driller: R. Marcoux
Helper: R. Gagnon
Inspector:

COHESIVE CONSISTENCY (Blows/Foot)	
0 - 2	VERY SOFT
2 - 4	SOFT
4 - 8	MEDIUM STIFF
8 - 16	STIFF
16 - 32	HARD

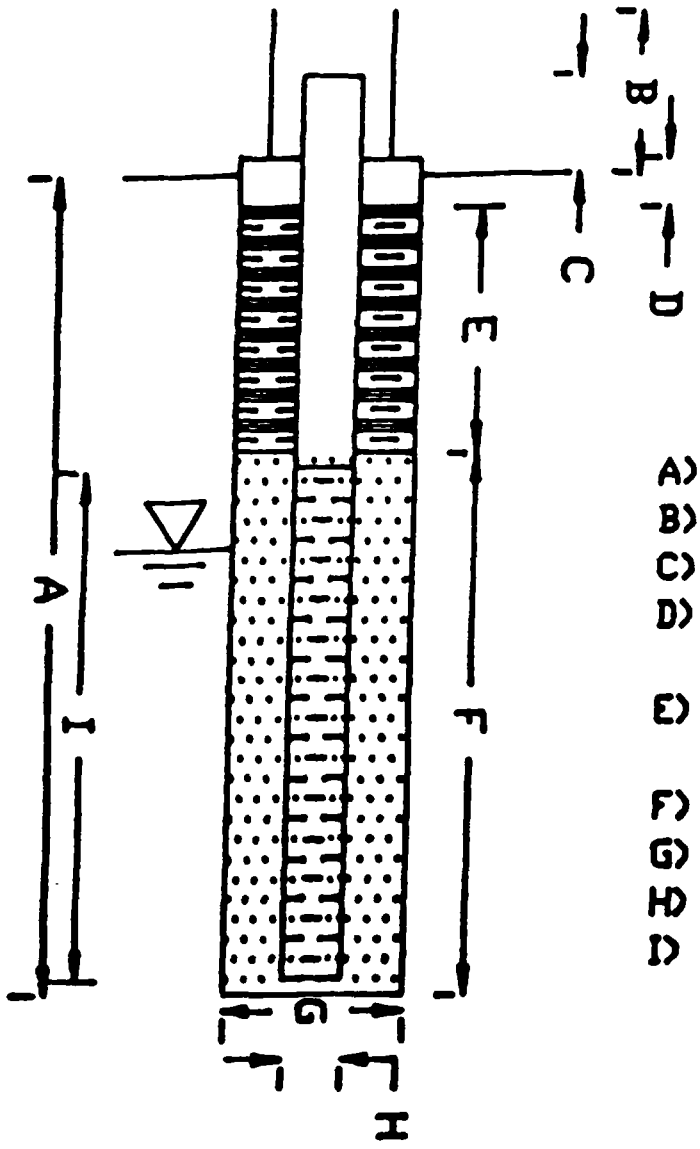
COHESIONLESS DENSITY (Blows/Foot)	
0 - 4	VERY LOOSE
4 - 10	LOOSE
10 - 30	MEDIUM DENSE
30 - 50	DENSE
50+	VERY DENSE

PROPORTIONS USED	
TRACE	0 - 10%
LITTLE	10 - 20%
SOME	20 - 35%
AND	35 - 50%

NOTES

REMARKS: THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES; TRANSITION MAY BE GRADUAL. WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

MONITORING WELL DIAGRAM



A) Borehole Depth: 33.0'
B) Cover Pipe Stickup: 2.5'
C) Riser Pipe Stickup: 2.0'
D) Concrete Seal Thickness: 6"
E) Bentonite Seal Thickness: Slurry 19.0'
F) Sand Pack: 13.0'
G) Borehole Diameter: 4"
H) Wellscreen Diameter: 2"
I) Wellscreen Length: 10.0'

Driller: R. Marcoux
Helper: R. Gagnon
Inspector: _____

MULLER ENGINEERING, INC.

Project: OLIN CHEMICAL CORP.
Wilmington, MA
Project No: 90718.01
Installation Date: 11/20/89

Sheet 3 of 3
Boring No: GW-34
Well No: #1 Deep
Surface Elev: _____

GEOLOGIC LOG

MILLER ENGINEERING, INC.

PROJECT: OLIN CHEMICAL CORPORATION
Wilmington, MA

BORING NO. GW-34 LOCATION See Plan

PROJECT NO. 90718.01 SURFACE ELEV.

DATE START 11/16/89 COMPANY MILLER ENGINEERING & TESTING

DATE END 11/20/89 DRILLER B. Marcoux

MEI REP None

DEPTHS:
OVERBURDEN
TOTAL
WATER

TYPE & SIZE OF HOLE	CORE RECOVERY %	ELEVATION	DEPTH	LOG	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION OF ROCK	DRILLING BEHAVIOR FEED	DRILLING BEHAVIOR WATER	NOTES
			24.5			RUN #1: Upper 10" a medium grained non-foliated gabbro. Below 10" gabbro section, is a highly fractured area with numerous gravel-site, weathered rock fragments. The upper 6" of the fractured zone composed of a black, fine gravel basalt. Fragmented rock consists of a wide variety of igneous compositions. REC: 36"/66" = 55% RQD: 12"/66" = 18%			
			31.0						

CORE LOSS

CORE RECOVERY

REMARKS:

TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.

Project: OLIN CHEMICAL CORPORATION
Wilmington, MA
Project No: 90718.01
Date Start: 11/28/89
Date End: 11/28/89

Sheet 1 **of** 2
Boring No: GW-35
Location:
#2 Shallow
Surface Elev:

	Casing	Sampler
Type	Hollow Stem Auger	Split Spoon
Size	3-3/4" ID	1-3/8" ID
Hammer	---	140 pounds
Fall	---	30 inches

Groundwater Observations

DATE	DEPTH	CASING AT	STABILIZATION PERIOD
11/28/89	9.0'	---	Upon Completion

Depth	Cas bl/ft	SAMPLE No.	Depth	Pen.	Rec.	Blows/6"	Strata Change	Sample Description	Notes
5.0'		S-1	4.0-6.0'	AUGER SAMPLE				S-1: Brown, fine to medium sand, silt, trace of gravel	
10.0'		S-2	9.0-11.0'	AUGER SAMPLE				S-2: Same as S-1	
15.0'		S-3	14.0-16.0'	AUGER SAMPLE				S-3: Brown, fine to medium sand	
20.0'		S-4	19.0-21.0'	AUGER SAMPLE				S-4: Same as S-3	
								Terminated Exploration at	
25.0'								Installed Monitoring Well	
30.0'									

Driller: R. Marcoux
Helper: R. Gagnon
Inspector:

COHESIVE CONSISTENCY (Blows/Foot)	
0 - 2	VERY SOFT
2 - 4	SOFT
4 - 8	MEDIUM STIFF
8 - 16	STIFF
16 - 32	HARD

COHESIONLESS DENSITY (Blows/Foot)	
0 - 4	VERY LOOSE
4 - 10	LOOSE
10 - 30	MEDIUM DENSE
30 - 50	DENSE
50>	VERY DENSE

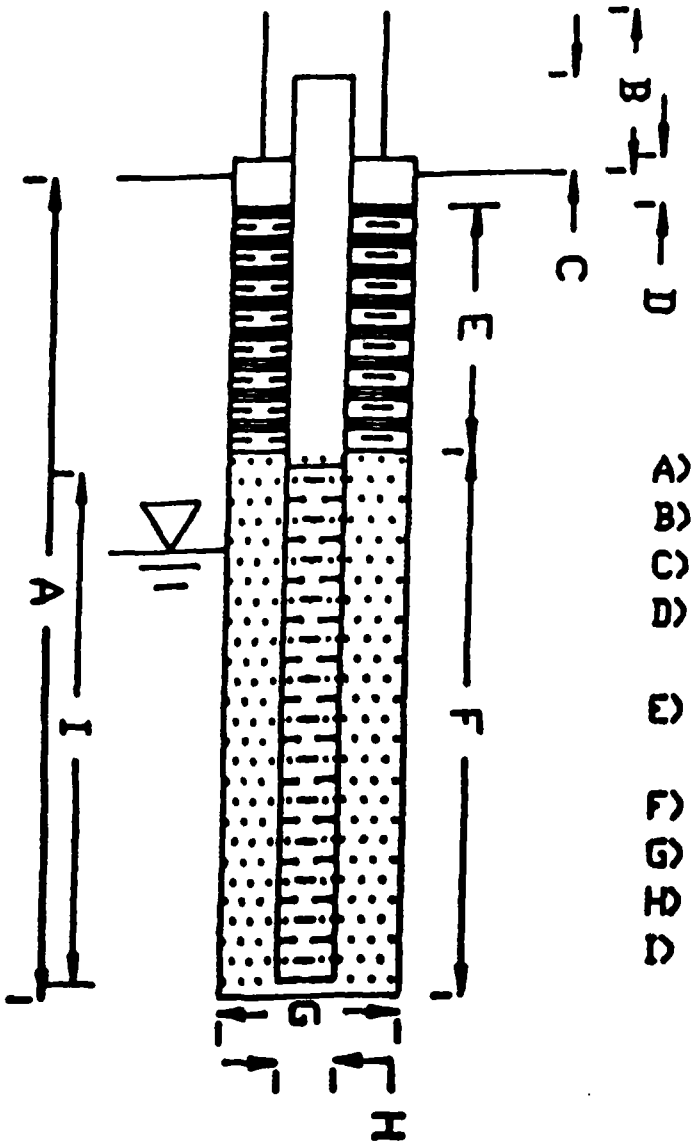
PROPORTIONS USED	
TRACE	0 - 10%
LITTLE	10 - 20%
SOME	20 - 35%
AND	35 - 50%

NOTES

See attached sheet for Monitoring Well Installation

REMARKS: THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITION MAY BE GRADUAL. WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

MONITORING WELL DIAGRAM



A) Borehole Depth: 20.0'
B) Cover Pipe Stickup: 2.5'
C) Riser Pipe Stickup: 2.5'
D) Concrete Seal Thickness: 6"
E) Bentonite Seal Thickness: Slurry 7.0'
F) Sand Pack: Bottom to 8.0'
G) Borehole Diameter: 8" 3-3/4" ID
H) Wellscreen Diameter: 2"
I) Wellscreen Length: 10.0'

Driller: R. Marcoux
Helper: R. Gagnon
Inspector: _____

MULLER ENGINEERING, INC.

Project: OLIN CHEMICAL CORP.
Wilmington, MA
Project No.: 90718.01
Installation Date: 11/28/89

Sheet 2 of 2
Boring No.: GW-35
Well No.: #2 Shallow
Surface Elev.: _____

TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.

Project: OLIN CHEMICAL CORPORATION
Wilmington, MA
Project No: 90718.01
Date Start: 11/21/89
Date End: 11/28/89

Sheet 1 **of** 3
Boring No: GW-35
Location:
#1 Deep
Surface Elev:

	Casing	Sampler
Type	Flush Joint	Split Spoon
Size	4" ID/3" ID	1-3/8" ID
Hammer	---	140 pounds
Fall	---	30 inches

Groundwater Observations

DATE	DEPTH	CASING AT	STABILIZATION PERIOD
11/28/89	9.0'	---	Upon Completion

Depth	Cas bl/ ft.	SAMPLE No.	Depth	Pen.	Rec.	Blows/6"	Strata Change	Sample Description	Notes
		S-1	0.0-2.0'	24"	8"	4-5		S-1: Brown, fine to medium sand, silt, trace of gravel	
						5-7			
		S-2	2.0-4.0'	24"	12"	6-8		S-2: Same as S-1	
						7-9			
5.0'		S-3	4.0-6.0'	24"	3"	7-7		S-3: Fine to medium sand	
						2-4			
		S-4	6.0-8.0'	24"	12"	3-7		S-4: (wet), brown, fine sand, silt, fine gravel	
						10-19			
		S-5	8.0-10.0'	24"	18"	20-36		S-5: Same as S-4	
10.0'						38-43			
		S-6	10.0-11.2'	14"	12"	23-64		S-6: Same as S-4, some cobbles	
						100/2"	12.0'		
		S-7	12.0-14.0'	24"	10"	17-33		S-7: Gray, fine to coarse sand, fine gravel	
						41-64			
15.0'		S-8	14.0-16.0'	24"	12"	20-85		S-8: Same as S-7	
						45-45			
		S-9	16.0-18.0'	24"	10"	12-26		S-9: Same as S-7	
						29-47			
		S-10	18.0-20.0'	24"	14"	8-35		S-10: Same as S-7	
20.0'						29-15	20.0'		
		S-11	20.0-22.0'	24"	18"	5-12		S-11: Brown, fine to coarse sand, gravel	
						18-26			
		S-12	22.0-24.0'	24"	12"	9-16		S-12: Same as S-11	
						19-29			
25.0'		S-13	24.0-26.0'	24"	12"	10-13		S-13: Same as S-11	
						26-18	26.0'		
		S-14	26.0-28.0'	24"	6"	19-24		S-14: Same as S-11, cobbles - boulders	
						43-30			
		S-15	28.0-30.0'	24"	12"	26-54		S-15: Same as S-14	
30.0'						14-11			

Driller: R. Marcoux
Helper: R. Gagnon
Inspector:

COHESIVE CONSISTENCY (Blows/Foot)		COHESIONLESS DENSITY (Blows/Foot)		PROPORTIONS USED	
0 - 2	VERY SOFT	0 - 4	VERY LOOSE	TRACE:	0 - 10%
2 - 4	SOFT	4 - 10	LOOSE	LITTLE:	10 - 20%
4 - 8	MEDIUM STIFF	10 - 30	MEDIUM DENSE	SOME:	20 - 35%
8 - 16	STIFF	30 - 50	DENSE	AND:	35 - 50%
16 - 32	HARD	50+	VERY DENSE		

NOTES See attached sheet for Monitoring Well installation

REMARKS: THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITION MAY BE GRADUAL. WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.

Project: OLIN CHEMICAL CORPORATION
Wilmington, MA
Project No: 90718.01
Date Start: 11/21/89
Date End: 11/28/89

Sheet 2 **of** 3
Boring No: GW-35
Location: #1 Deep
Surface Elev:

	Casing	Sampler
Type	Flush Joint	Split Spoon
Size	4" ID/3" ID	1-3/8" ID
Hammer	---	140 pounds
Fall	---	30 inches

Groundwater Observations

DATE	DEPTH	CASING AT	STABILIZATION PERIOD

Depth	Cas bl/ ft.	SAMPLE No.	Depth	Pen.	Rec.	Blows/6"	Strata Change	Sample Description	Notes
								Encountered Boulders at 26.0'	
								Drove 4" casing to 35.0' Refusal	
35.0'								Cored from 34.5-36.5' Telescoped 3" casing to 34.5' - Spun casing through boulders to 36.5-39.0'. Final depth of 40.5' Refusal	
								Attempted to wash out - last wheel off roller cone - notified Mike Bolat	
40.0'								Installed Monitoring Well at 40.0'	
								Terminated Exploration at	
45.0'									
50.0'									
55.0'									
60.0'									

Driller: R. Marcoux
Helper: R. Gagnon
Inspector:

COHESIVE CONSISTENCY (Blows/Foot)	
0 - 2	VERY SOFT
2 - 4	SOFT
4 - 8	MEDIUM STIFF
8 - 15	STIFF
15 - 30	HARD

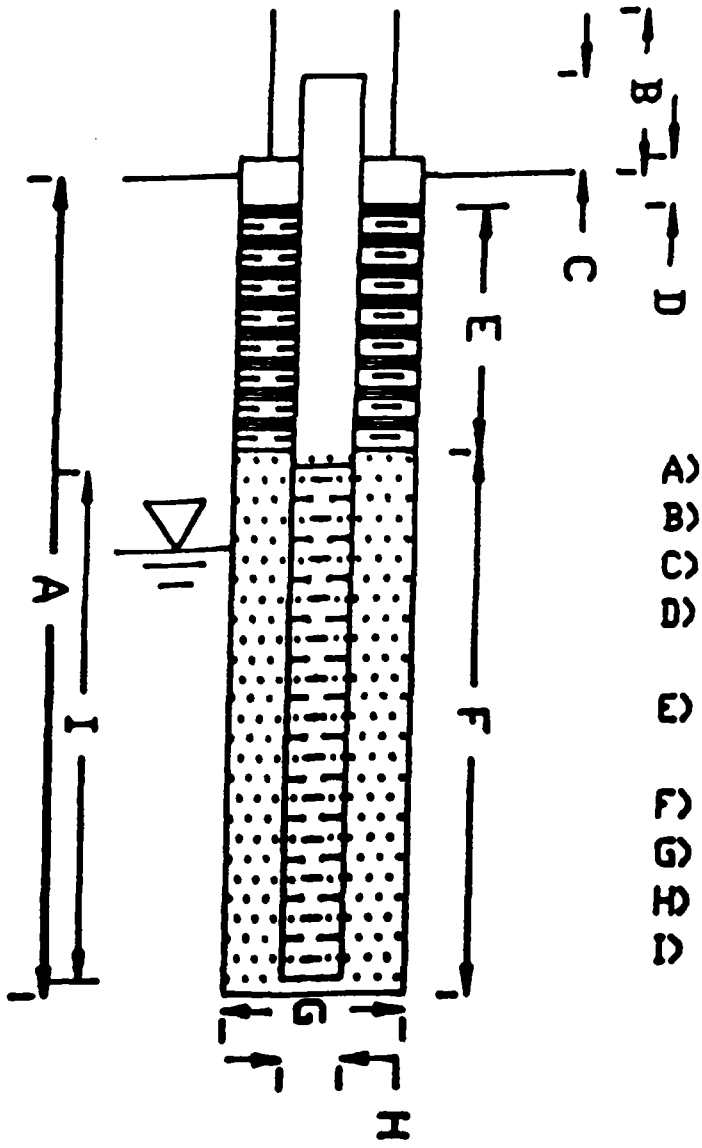
COHESIONLESS DENSITY (Blows/Foot)	
0 - 4	VERY LOOSE
4 - 10	LOOSE
10 - 30	MEDIUM DENSE
30 - 50	DENSE
50+	VERY DENSE

PROPORTIONS USED	
TRACE	0 - 10%
LITTLE	10 - 20%
SOME	20 - 35%
AND	35 - 50%

NOTES

REMARKS: THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITION MAY BE GRADUAL. WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

MONITORING WELL DIAGRAM



A) Borehole Depth: 40.0'
B) Cover Pipe Stickup: 2.5'
C) Riser Pipe Stickup: 2.5'
D) Concrete Seal Thickness: 6"
E) Bentonite Seal Thickness: Slurry 27.0'
F) Sand Pack: Bottom to 28.0'
G) Borehole Diameter: 4" casing
H) Wellscreen Diameter: 2"
I) Wellscreen Length: 10.0'

Driller: R. Marcoux
Helper: R. Gagnon
Inspector: _____

MILLER ENGINEERING, INC.

Project: OLIN CHEMICAL CORP.
Wilmington, MA
Project No.: 90718.01
Installation Date: 11/25/89

Sheet 3 of 3
Boring No.: GW-35
Well No.: #1 Deep
Surface Elev.: _____

GEOLOGIC LOG

MILLER ENGINEERING, INC.

PROJECT: OLIN CHEMICAL CORPORATION Wilmington, MA
BORING NO. GW-35
LOCATION See Plan

PROJECT NO. 90718.01
SURFACE ELEV.
DATE START 11/21/89
COMPANY MILLER ENGINEERING & TESTING
DATE END 11/28/89
DRILLER R. Marcoux
MEI REP None

DEPTHS:
OVERBURDEN
TOTAL
WATER

TYPE & SIZE OF HOLE	CORE RECOVERY %	ELEVATION	DEPTH	LOG	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION OF ROCK	DRILLING BEHAVIOR: FEED	DRILLING BEHAVIOR: WATER	NOTES
			34.5			RUN #1: Fine grained, weakly foliated, two-mica granite. Fracturing is sub-horizontal as widely spread (greater than 9") Little oxidation evident in fractures. REC: 23"/24" = 96% RQD: 20"/24" = 83%			
			36.5			RUN #2: Light gray, fine grained calc-silicate gneiss. Core is highly fractured with no sections greater than 4". REC: 30"/30" = 100% RQD: 4"/30" = 13%			
			39.0						

CORE LOSS
CORE RECOVERY

REMARKS:

SHEET 1 OF 1

TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.

Project: OLIN CHEMICAL CORPORATION
Wilmington, MA
Project No: 90718.01
Date Start: 11/13/89
Date End: 11/16/89

Sheet 1 **of** 1
Boring No: GW-36
Location:
Surface Elev:

	Casing	Sampler
Type	Flush Joint	Split Spoon
Size	4" ID	1-3/8" ID
Hammer	---	140 pounds
Fall	---	30 inches

Groundwater Observations

DATE	DEPTH	CASING AT	STABILIZATION PERIOD
11/16/89	3.0'	---	Upon Completion

Depth	Cas Wt/ft.	SAMPLE No.	Depth	Pen.	Rec.	Blows/6"	Strata Change	Sample Description	Notes
		S-1	0.0-2.0'	24"	18"	1-1/12"		S-1: 6" dark brown topsoil with leaves and roots, yellow-brown, fine to medium sand	
						2			
		S-2	2.0-4.0'	24"	21"	4-6		S-2: Yellow-brown, medium to fine sand	
						8-16	4.0'		
5.0'		S-3	4.0-5.0'	12"	12"	48-57		S-3: Yellow-brown, fine to coarse sand and gravel, boulders	
								NOTE: Hitting boulders - took next sample at 7.0'	
		S-4	7.0-8.0'	12"	12"	59-68		S-4: Yellow-brown, fine to coarse sand and gravel, boulders	
							9.0'		
10.0'		S-5	9.0-11.0'	24"	24"	12-14		S-5: Yellow-brown, medium to fine sand, trace gravel (NOTE: Sand started to blow in augers)	
						21-21			
		S-6	11.0-13.0'	24"	24"	7-9		S-6: Same as S-5	
						14-18			
		S-7	13.0-15.0'	24"	8"	11-19		S-7: Same as S-5	
15.0'						22-24		NOTE: Sand blowing in augers - no samples - down to 19.0' - switched to casing	
							17.0'		
20.0'		S-8	19.0-21.0'	24"	6"	24-19		S-8: Yellow-brown, fine to coarse sand and gravel (poor recovery - rock stuck in tip of spoon)	
						19-17			
		S-9	21.0-23.0'	24"	12"	7-12		S-9: Yellow-brown, fine to coarse sand, little gravel	
						14-17			
		S-10	23.0-25.0'	24"	18"	10-12		S-10: Orange-brown, fine to coarse sand and gravel	
25.0'						14-17	25.0'		
		S-11	25.0-26.0'	12"	8"	59-47		S-11: Gray-brown, fine to coarse sand, gravel and boulders	
						50/0"		NOTE: Kept hitting boulders - no samples down to 29.0'	
						24-42	29.0'		
30.0'		S-12	29.0-31.0'	24"	1"	34-30		S-12: Gray- brown, fine to coarse sand and gravel	

Driller: M. D'Ambrosio
Helper: K. Smith
Inspector:

COHESIVE CONSISTENCY (Blows/Foot)
0 - 2 VERY SOFT
2 - 4 SOFT
4 - 8 MEDIUM STIFF
8 - 16 STIFF
16 - 32 HARD

COHESIONLESS DENSITY (Blows/Foot)
0 - 4 VERY LOOSE
4 - 10 LOOSE
10 - 30 MEDIUM DENSE
30 - 50 DENSE
50+ VERY DENSE

PROPORTIONS USED
TRACE 0 - 10%
LITTLE 10 - 20%
SOME 20 - 35%
AND 35 - 50%

NOTES See attached sheet for Monitoring Well installation

REMARKS: THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES; TRANSITION MAY BE GRADUAL. WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.

Project: OLIN CHEMICAL CORPORATION
Wilmington, MA
Project No: 90718.01
Date Start: 11/13/89
Date End: 11/16/89

Sheet 2 **of** 3
Boring No: GW-36
Location:
Surface Elev:

	Casing	Sampler
Type	Flush Joint	Split Spoon
Size	4" ID	1-3/8" ID
Hammer	---	140 pounds
Fall	---	30 inches

Groundwater Observations

DATE	DEPTH	CASING AT	STABILIZATION PERIOD

Depth	Casbl/ft.	SAMPLE No.	Depth	Pen.	Rec.	Blows/6"	Strata Change	Sample Description	Notes
								Gray-brown, fine to coarse sand and gravel	
							33.0'		
								NOTE: Casing driving real hard at 33.0'	
35.0'								S-13: Gray, medium to fine sand, little to some silt, little fine gravel	
		S-13	35.5-36.4'	11"	11"	11 - 50/5"	36.5'	Started to core at 36.5'	
								RUN #1 36.5-41.5' RECOVERY: 56" Core Time per/foot 10:-7:-6:-9:-8:	
40.0'									
							41.5'		
								Bottom of Exploration at 41.5'	
								NOTE: Reamed out core hole from 36.5-37.0'	
45.0'								Placed well point at 37.0' - filled core hole with sand and bentonite	
50.0'									
								NOTE: Made attempts (#1 at 26.6' depth and #2 at 9.7' depth) - boulders.	
55.0'									
60.0'									

Driller: M. D'Ambrosio
Helper: K. Smith
Inspector:

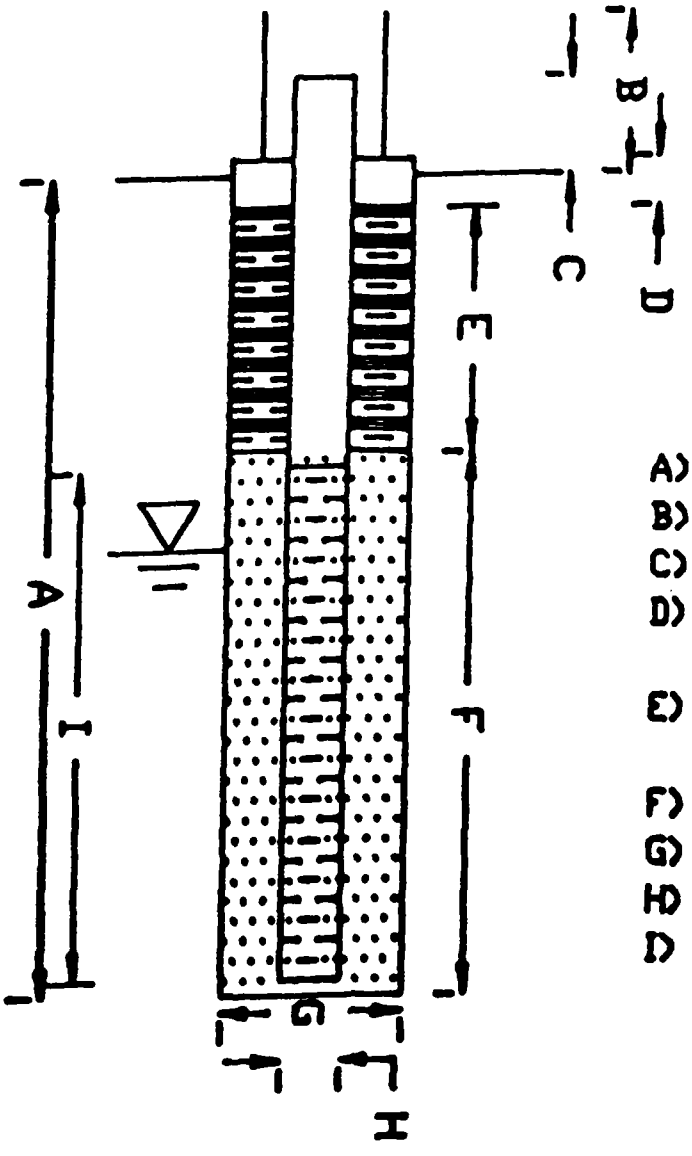
COHESIVE CONSISTENCY (Blows/Foot)		COHESIONLESS DENSITY (Blows/Foot)		PROPORTIONS USED	
0 - 2	VERY SOFT	0 - 4	VERY LOOSE	TRACE	0 - 10%
2 - 4	SOFT	4 - 10	LOOSE	LITTLE	10 - 20%
4 - 8	MEDIUM STIFF	10 - 30	MEDIUM DENSE	SOME	20 - 35%
8 - 16	STIFF	30 - 50	DENSE	AND	35 - 50%
16 - 32	HARD	50+	VERY DENSE		

NOTES

NOTE: Sample 13.0' had green color to it - drilling water during rock coring was green

REMARKS: THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITION MAY BE GRADUAL. WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

MONITORING WELL DIAGRAM



A) Borehole Depth: 37.0'
B) Cover Pipe Stickup: 2.0'
C) Riser Pipe Stickup: 1.5'
D) Concrete Seal Thickness: 1.0'
E) Bentonite Seal Thickness: 22.0'
F) Sand Pack: 14.0'
G) Borehole Diameter: 4"
H) Wellscreen Diameter: 2"
I) Wellscreen Length: 10.0'

Driller: M. D'Ambrosio
Helper: K. Smith
Inspector: _____

MILLER ENGINEERING, INC.

Project: OLIN CHEMICAL CORP.
Wilmington, MA
Project No: 90718.01
Installation Date: 11/16/89

Sheet 3 of 3
Boring No: GW-36
Well No: GW-36
Surface Elev: _____

GEOLOGIC LOG

MILLER ENGINEERING, INC.

PROJECT: OLIN CHEMICAL Wilmington, MA
BORING NO. GW-36
LOCATION See Plan
PROJECT NO. 90718.01
SURFACE ELEV.
DATE START 11/8/89
COMPANY Miller Engineering & Testing
DATE END 11/13/89
DRILLER M. D'Ambrosio
MEI REP
DEPTHS:
OVERBURDEN
TOTAL
WATER

TYPE & SIZE OF HOLE	CORE RECOVERY %	ELEVATION	DEPTH	LOG	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION OF ROCK	DRILLING BEHAVIOR FEED	DRILLING BEHAVIOR WATER	NOTES
			36.5'			Dark grey to black, fine-grained calc-silicate gneiss, felsic intrusions oriented horizontally. Core moderately fractured throughout, but high RQD and recovery. No oxidation on fractured surfaces.			
			41.5'			Recovery: 56" RQD - 51"/56" = 91%			

CORE LOSS

CORE RECOVERY

REMARKS:

SHEET __ OF __

TOTAL P.32

GEOLOGIC LOG

MILLER ENGINEERING, INC.

PROJECT: OLIN CHEMICAL CORPORATION Wilmington, MA
BORING NO. CW-37
LOCATION See Plan

PROJECT NO. 90718.01
SURFACE ELEV.
DATE START
COMPANY MILLER ENGINEERING & TESTING
DATE END
DRILLER M. D'Ambrosio
MEI REP None

DEPTHS:
OVERBURDEN
TOTAL
WATER

TYPE & SIZE OF HOLE	CORE RECOVERY %	ELEVATION	DEPTH	LOG	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION OF ROCK	DRILLING BEHAVIOR: FEED	DRILLING BEHAVIOR: WATER	NOTES
			27.0'			RUN #1: Dark gray to black, fine grained gneiss. Dominant foliation approximately 30 degrees from horizontal. Felsic layering averages 1" thick and is abundant throughout core length. Natural fractures are oriented approximately 40 degrees to horizontal and have an average spacing of approximately 9 inches. Some fracturing spaced closer, especially toward bottom fo core. Lower fractures exhibit oxidation more than upper fractures, indicating greater fracture flow at depth. Fractures do not show preferred orientation relative to foliation. REC: 56"/60" = 93% RQD: 42"/60" = 70%			
			32.0'						

CORE LOSS

CORE RECOVERY

REMARKS:

SHEET 1 OF 1

TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.

Project: OLIN CHEMICAL CORPORATION
Wilmington, MA
Project No: 90718.01
Date Start: 11/8/89
Date End: 11/13/89

Sheet 1 **of** 3
Boring No: GW-38
Location:
Surface Elev:

	Casing	Sampler
Type	Hollow Stem Auger	Split Spoon
Size	3-3/4" ID	1-3/8" ID
Hammer	---	140 pounds
Fall	---	30 inches

Groundwater Observations

DATE	DEPTH	CASING AT	STABILIZATION PERIOD
11/13/89	6.0'	---	Upon Completion

Depth	Cas bl/ft	SAMPLE No.	Depth	Pen.	Rec.	Blows/6"	Strata Change	Sample Description	Notes
		S-1	0.0-2.0'	24"	12"	2-10		S-1: Brown, fine to coarse sand, little gravel, fill	
						9-4			
		S-2	2.0-4.0'	24"	1"	2-4		S-2: Same as S-1, rock in tip of spoon	
						8-8	4.0'		
							4.5'	S-3: Black peat	
5.0'		S-3	4.0-4.5'						
		S-3A	4.5-6.0'	18"	12"	3-4		S-3A: Brown, fine to medium peaty sand	
						5-6			
		S-4	6.0-8.0'	24"	24"	10-19		S-4: Brown, medium to fine sand, trace gravel	
						19-26			
10.0'		S-5	8.0-10.0'	24"	24"	6-7		S-5: Same as S-4	
						9-15			
		S-6	10.0-12.0'	24"	24"	21-17		S-6: Same as S-4, sand blowing in augers	
						22-20			
		S-7	12.0-14.0'	24"	24"	4-5		S-7: Grayish brown, fine to medium sand	
15.0'						7-9	15.0'	S-8: Same as S-7, Gravel in tip of spoon	
		S-8	14.0-16.0'	24"	24"	6-8		Lost 1.0' sampling, due to sand blowing in augers	
						14-21			
		S-9	17.0-19.0'	24"	18"	20-33		S-9: Brown, fine to coarse sand, gravel and boulders, trace silt	
						29-41			
20.0'		S-10	19.0-21.0'	24"	20"	40-30		S-10: Same as S-9	
						31-35			
		S-11	21.0-23.0'	24"	17"	12-18		S-11: Brown, fine to medium sand, little gravel	
						21-34			
		S-12	23.0-25.0'	24"	24"	16-24		S-12: Brown, fine to coarse sand and gravel, boulders	
25.0'						39-33			
		S-13	25.0-27.0'	24"	18"	14-29		S-13: Same as S-12	
						34-41			
		S-14	27.0-27.8'	9"	9"	47-50/3"	28.0'	S-14" Same as S-12	
								Started to core at 28.0'	
30.0'									

Driller: M. D'Ambrosio
Helper: K. Smith
Inspector:

COHESIVE CONSISTENCY (Blows/Foot)	
0 - 2	VERY SOFT
2 - 4	SOFT
4 - 8	MEDIUM STIFF
8 - 16	STIFF
16 - 32	HARD

COHESIONLESS DENSITY (Blows/Foot)	
0 - 4	VERY LOOSE
4 - 10	LOOSE
10 - 30	MEDIUM DENSE
30 - 50	DENSE
50+	VERY DENSE

PROPORTIONS USED	
TRACE	0 - 10%
LITTLE	10 - 20%
SOME	20 - 35%
AND	35 - 50%

NOTES

See attached sheet for Monitoring Well installation

REMARKS: THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES; TRANSITION MAY BE GRADUAL. WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.

Project: OLIN CHEMICAL CORPORATION
Wilmington, MA
Project No: 90718.01
Date Start: 11/8/89
Date End: 11/13/89

Sheet 2 **of** 3
Boring No: GW-38
Location:
Surface Elev:

	Casing	Sampler
Type	Hollow Stem Auger	Split Spoon
Size	3-3/4" ID	1-3/8" ID
Hammer	---	140 pounds
Fall	---	30 inches

Groundwater Observations

DATE	DEPTH	CASING AT	STABILIZATION PERIOD

Depth	Casing bl/ft.	SAMPLE No.	Depth	Pen.	Rec.	Blows/6"	Strata Change	Sample Description	Notes
								RUN #L 28.0-33.0' RECOVERY: 59"	
							33.0'		
35.0'								Bottom of Exploration at 33.0'	
								NOTE: Reamed out core hole from 28.0' down to 30.5' - Had to reseat casing to keep sands from above going in to core hole - drove casing to 29.0'	
40.0'								See bottom of well screen at 30.5'	
								NOTE: Used augers down to 21.0' depth; From 21.0' to 28.0' used 4.0" flush-joint casing.	
45.0'									
50.0'									
55.0'									
60.0'									

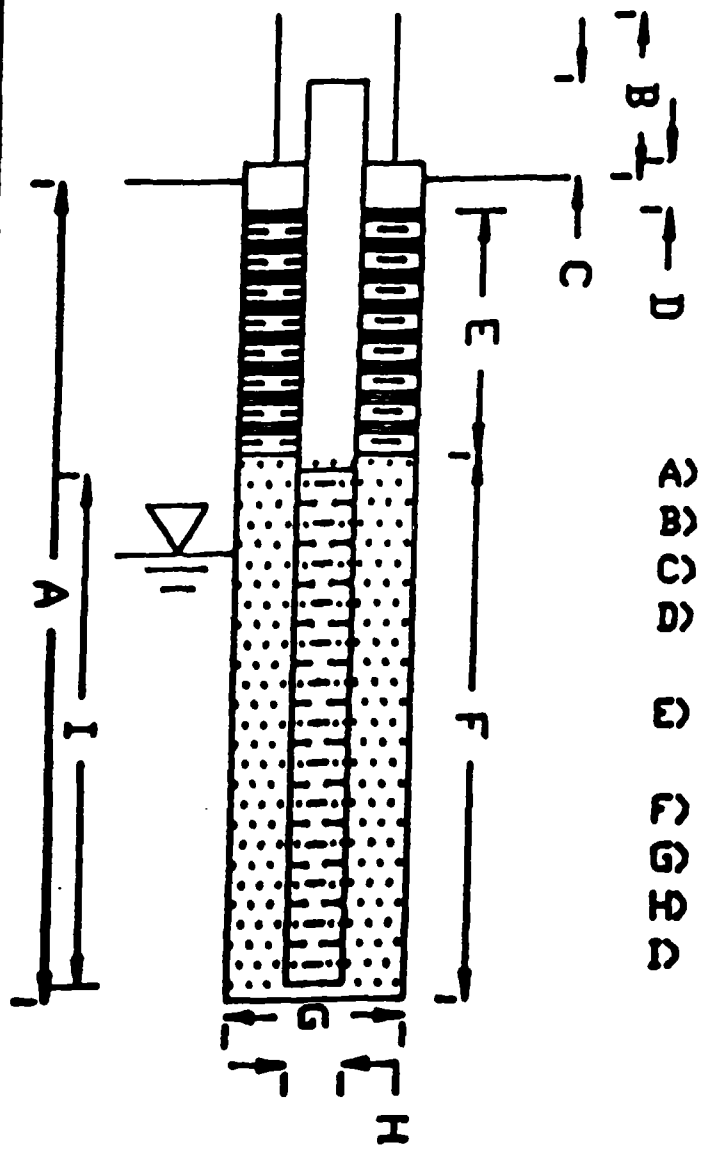
Driller: M. D'Ambrosio
Helper: K. Smith
Inspector:

COHESIVE CONSISTENCY (Blows/Foot)		COHESIONLESS DENSITY (Blows/Foot)		PROPORTIONS USED	
0 - 2	VERY SOFT	0 - 4	VERY LOOSE	TRACE	0 - 10%
2 - 4	SOFT	4 - 10	LOOSE	LITTLE	10 - 20%
4 - 8	MEDIUM STIFF	10 - 30	MEDIUM DENSE	SOME	20 - 35%
8 - 16	STIFF	30 - 50	DENSE	AND	35 - 50%
16 - 32	HARD	50>	VERY DENSE		

NOTES

REMARKS: THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITION MAY BE GRADUAL. WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

MONITORING WELL DIAGRAM



A) Borehole Depth: 30.5'
B) Cover Pipe Stickup: 2.0'
C) Riser Pipe Stickup: 1.5'
D) Concrete Seal Thickness: 1.0'
E) Bentonite Seal Thickness: From 14.0' to ground
F) Sand Pack from 30.5 to 14.0'
G) Borehole Diameter: _____
H) Wellscreen Diameter: 2"
I) Wellscreen Length: 10.0'

Driller: M. D'Ambrosio
Helper: K. Smith
Inspector: _____

MILLER ENGINEERING, INC.

Project: OLIN CHEMICAL CORP.
Wilmington, MA
Project No: 90718.01
Installation Date: 11/13/89

Sheet 3 of 3
Boring No: GW-38
Well No: GW-38
Surface Elev: _____

GEOLOGIC LOG

MILLER ENGINEERING, INC.

PROJECT: OLIN CHEMICAL CORPORATION Wilmington, MA **BORING NO.** GW-18 **LOCATION** See Plan

PROJECT NO. 90718.01 **SURFACE ELEV.** _____ **DEPTHS:**

DATE START 11/8/89 **COMPANY** MILLER ENGINEERING & TESTING **OVERBURDEN** _____

DATE END 11/13/89 **DRILLER** M. D'Ambrosio **TOTAL** _____

MEI REP None **WATER** _____

TYPE & SIZE OF HOLE	CORE RECOVERY %	ELEVATION	DEPTH	LOG	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION OF ROCK	DRILLING BEHAVIOR: FEED	DRILLING BEHAVIOR: WATER	NOTES
			28.0'			RUN #1: Dark gray to black, very fine grained calc-silicate gneiss. Thin (less than 1 inch) felsic intrusions randomly oriented throughout core. Upper one foot heavily fractured with no pieces greater than 3" in size. Remainder of core moderately fractured with intersecting fractures trending 45 degrees from horizontal. Fracuture spacing averages 9", except for lower one foot of core, which exhibits closer spaced fractures (average 5"). Oxidation present on most fracture surfaces. REC: 59"/60" = 98% RQD: 45"/60" = 70%			
			33.0'			RUN #2: Same general composition as RUN #1, fracturing in RUN #2 oriented approximately 20 degrees to horizontal and widely spread (79") on average. No densely fractured area as in RUN #1. Minimum oxidation on fractures compared to RUN #1. REC: 56"/60" = 93% RQD: 51"/60" = 85%			
			36.5'						
			41.5'						

CORE LOSS

CORE RECOVERY

REMARKS:

TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.

Project: OLIN CHEMICAL CORPORATION
Wilmington, MA
Project No: 90718.01
Date Start: 11/28/89
Date End: 11/28/89

Sheet 1 **of** 2
Boring No: GW-39
Location:
Surface Elev:

	Casing	Sampler
Type	Hollow Stem Auger	Split Spoon
Size	3-3/4" ID	1-3/8" ID
Hammer	---	140 pounds
Fall	---	30 inches

Groundwater Observations

DATE	DEPTH	CASING AT	STABILIZATION PERIOD
11/28/89	2.0'	---	Upon Completion

Depth	Casing Blows	SAMPLE No.	Depth	Pen.	Rec.	Blows/6"	Strata Change	Sample Description	Notes
		S-1	0.0-2.0'	24"	18"	1-1		S-1: Dark black peat and peaty sand	
						3-1	2.0'		
								NOTE: No sample at 2.0' hitting boulders	
5.0'		S-2	4.0-5.5'	18"	18"	14-28		S-2: Yellow-brown, fine to coarse sand, gravel and boulders, trace silt	
						35			
							8.0'	NOTE: No sample - hitting boulders	
10.0'								RUN #1: 8.0-13.0' RECOVERY: 56" Core Time per/foot 12:-9:-9:-14:-16:	
							13.0'		
15.0'								Bottom of Exploration at 13.0'	
20.0'								NOTE: Made four attempts getting down through boulders. Hitting refusals at 5.2', 5.7', 6.5', and 6.0'. Augered down to 8.0' depth, then switched to casing with spinning shoe.	
25.0'									
30.0'									

Driller: M. D'Ambrosia
Helper: K. Smith
Inspector:

COHESIVE CONSISTENCY (Blows/Foot)
0 - 2 VERY SOFT
2 - 4 SOFT
4 - 8 MEDIUM STIFF
8 - 16 STIFF
16 - 32 HARD

COHESIONLESS DENSITY (Blows/Foot)
0 - 4 VERY LOOSE
4 - 10 LOOSE
10 - 30 MEDIUM DENSE
30 - 50 DENSE
50> VERY DENSE

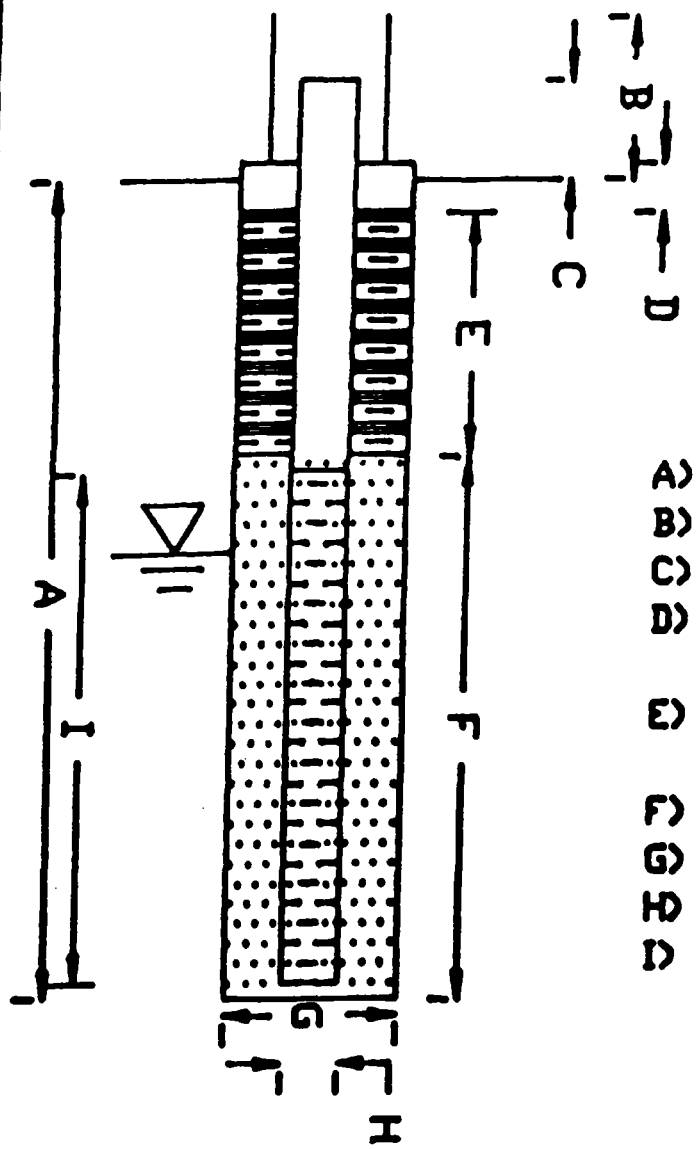
PROPORTIONS USED
TRACE 0 - 10%
LITTLE 10 - 20%
SOME 20 - 35%
AND 35 - 50%

NOTES

See attached sheet for Monitoring Well installation

REMARKS: THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITION MAY BE GRADUAL. WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

MONITORING WELL DIAGRAM



A) Borehole Depth: 13.0'
B) Cover Pipe Stickup: 2.5'
C) Riser Pipe Stickup: 2.0'
D) Concrete Seal Thickness: 1.0'
E) Bentonite Seal Thickness: 1.0'
F) Sand Pack: 12.0'
G) Borehole Diameter: 4"
H) Wellscreen Diameter: 2"
I) Wellscreen Length: 10.0'

Driller: M. D'Ambrosio
Helper: K. Smith
Inspector: _____

MULLER ENGINEERING, INC.

Project: OLIN CHEMICAL CORP.
Wilmington, MA
Project No.: 90718.01
Installation Date: 11/28/89

Sheet 2 of 2
Boring No.: GW-39
Well No.: GW-39
Surface Elev.: _____

GEOLOGIC LOG

MILLER ENGINEERING, INC.

PROJECT: OLIN CHEMICAL CORPORATION
Wilmington, MA

BORING NO. GW-39 LOCATION See Plan

PROJECT NO. 90718.01 SURFACE ELEV.

DATE START 11/28/89 COMPANY MILLER ENGINEERING & TESTING

DATE END 11/28/89 DRILLER M. D'Ambrosio

MEI REP None

DEPTHS:
OVERBURDEN
TOTAL
WATER

TYPE & SIZE OF HOLE	CORE RECOVERY %	ELEVATION	DEPTH	LOG	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION OF ROCK	DRILLING BEHAVIOR: FEED	DRILLING BEHAVIOR: WATER	NOTES
			8.0'			RUN #1: Light gray, medium grained auger gneiss, with abundant dime-size feldspar crystals in finer grained matrix in felsic layers. Foliation trend ranges from sub-horizontal to approximately 60 degrees. Fracturing trends to occur along the more felsic layers. Fracture spacing averages about 10-12" throughout core length, with some closer spaced and intersecting sets. Alteration of feldspars to clay minerals evident on some fracture surfaces. REC: 56"/60" = 93% RQD: 48"/60" = 80%			
			13.0'						

CORE LOSS

CORE RECOVERY

REMARKS:

SHEET 1 OF 1

148 Pioneer Dr.
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SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St
Nashua, NH 03060
(603) 882-3601

Client: OLIN CHEMICAL — Date: 11/23/87 — Job No. 87-891

Location: OLIN CHEMICAL [redacted] EAMES STREET, WILMINGTON, MA

BORING NO.: Type #1 [redacted] Surface Landfill SHALLOW #1 — Date Start: 11/11/87 — Date Complete: 11/11/87 — Drilling Foreman: P.N. — Eng./Hydrol. Geologist: D.C.

Depth (ft.)	Sample No	Sample Depth (ft.)	Blows 6" Penetration	Rec. Inches	Casing Blows Per ft.	Strata Change Depth	Visual Identification of Soil and/or Rock Strata
	1	0'0"- 1'0"	4-4-				Medium stiff, moist organic SILT, some fine to medium SAND, trace root matter
	1A	1'0"- 2'0"	8-7			1'0"	Medium dense, dry to wet, fine SAND, trace to some inorganic silt.
	2	2'0"- 4'0"	7-8-8-8				
5	3	4'0"- 5'0"	4-6				
	4	5'0"- 7'0"	4-6-10-11				
	5	7'0"- 9'0"	13-16-17-20				
10	6	9'0"- 10'0"	46-70			9'0"	Very dense, wet, fine SAND, and fine to coarse gravel, some inorganic silt, and medium to coarse sand, trace to some cobbles, and boulders.
	7	10'0"- 12'0"	64-34-27-35				
	8	12'0"- 12'9"	58-120/3"				
15	9	14'0"- 14'7"	53-120/1"				
						15'0"	End of boring at 15'0" Set well point at 15'0" Water level at 5'6" upon completion
20							Well Materials; 1 - 2" PVC end plug 1 - 10' x 2" PVC screen 2 - 5' x 2" PVC screen 1 - 2" PVC slip cap 1 - protective locking casing 1 bag - sakrete sand 2 bags - Portland cement 3 bags - silica sand 2 pails- bentonite pellets 1 bag - bentonite powder
25							
30							
35							
40							

Type of Boring: Casing Size: Hollow Stem Auger Size: 6¼

Proportion Percentages	Granular Soils (blows per ft.)		Cohesive Soils (blows per ft.)	
Trace 0 to 10%	0 to 4 Very Loose	30 to 50 Dense	0 to 2 Very Soft	8 to 15 Stiff
Some 10 to 40%	4 to 10 Loose	Over 50 Very Dense	2 to 4 Soft	15 to 30 Very Stiff
And 40 to 50%	10 to 30 Medium Dense		4 to 8 Medium Stiff	Over 30 Hard

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

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SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St
Nashua, NH 03060
(603) 882-3601

Client: OLIN CHEMICAL — Date: 11/23/87 — Job No. 87-891

Location: OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA

BORING NO. Type #2 SL-1D Sulfate Landfill DEEP #1 — Date Start: 11/12/87 — Date Complete: 11/12/87 — Drilling Foreman: P.N. — Eng./Hydrol Geologist: D.C.

Depth (Feet)	Sample No	Sample Depth (ft.)	Blows 6" Penetration	Rec. Inches	Casing Blows Per ft.	Strata Change Depth	Visual Identification of Soil and/or Rock Strata
		0'0"- 1'0"	4-4-				Medium stiff, moist, organic SILT, some fine to medium sand, trace root matter.
	1A	1'0"- 2'0"	8-7			1'0"	Medium dense, dry to wet, fine SAND, trace to some inorganic silt.
	2	2'0"- 4'0"	7-8-8-8				
5	3	4'0"- 5'0"	4-6				
	4	5'0"- 7'0"	4-6-10-11				
	5	7'0"- 9'0"	13-16-17-20				
10	6	9'0"- 10'0"	46-70			9'0"	Very dense, wet, fine SAND, and fine to coarse gravel, some inorganic silt, and medium to coarse sand, some cobbles and boulders.
	7	10'0"- 12'0"	64-34-27-35				
	Run #1	12'6"- 13'6"	14 min./foot			12'6"	Run #1 NX CORED ROCK from 12'6" to 14'6". Recovery 24"/24" = 100%.
		13'6"- 14'6"	17 min./foot				
15						14'6"	End of boring at 14'6" Set well point at 14'6" Water level at 5'6" upon completion
20							Well Materials; 1 - 2" PVC end plug 1 - 10' x 2" PVC screen 1 - 5' x 2" PVC riser 1 - 2" PVC slip cap 1 - protective locking casing 2 bags - sakrete sand 2 bags - Portland cement 3 bags - silica sand 2 pails- bentonite pellets 1 bag - bentonite powder
25							
30							NOTE : Blows And Soil Descriptions Used From SL-1S (Shallow), Per Client.
35							
40							

Type of Boring: Casing Size: Hollow Stem Auger Size: 6¼

Proportion Percentages	Granular Soils (blows per ft.)		Cohesive Soils (blows per ft.)	
Trace 0 to 10%	0 to 4 Very Loose	30 to 50 Dense	0 to 2 Very Soft	8 to 15 Stiff
Some 10 to 40%	4 to 10 Loose	Over 50 Very Dense	2 to 4 Soft	15 to 30 Very Stiff
And 40 to 50%	10 to 30 Medium Dense		4 to 8 Medium Stiff	Over 30 Hard

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

148 Pioneer Dr
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SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St
Nashua, NH 03060
(603) 882-3601

Client: OLIN CHEMICAL — Date: 11/23/87 — Job No. 87-891

Location: OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA

BORING NO: Type #2 SL-2D Sulfate Landfill DEEP #2 — Date Start: 11/13/87 — Date Complete: 11/13/87 — Drilling Foreman: P.N. — Eng./Hydrol. Geologist: D.C.

Elevation	Sample No.	Sample Depth (ft.)	Blows 6" Penetration	Rec. Inches	Casing Blows Per ft.	Strata Change Depth	Visual Identification of Soil and/or Rock Strata
	1	0'0"- 1'0"	3-4-				Loose, moist, fine to medium SAND, some organic silt, trace root matter.
	1A	1'0"- 2'0"	9-9			1'0"	
	2	2'0"- 4'0"	5-7-7-6				Medium dense, dry to wet, fine SAND, trace to some inorganic silt.
5	3	4'0"- 5'0"	6-7				
	4	5'0"- 7'0"	7-10-10-12				
	5	7'0"- 9'0"	10-14-11-15				
10	6	9'0"- 10'0"	7-7				
	7	10'0"- 12'0"	6-9-9-8				
	8	12'0"-12'10"	27-120/4"			12'0"	Very dense, wet, fine to medium SAND, and fine to coarse gravel, some coarse and inorganic silt, few cobbles and boulders.
	Run #1	13'0"-	14'0" 18 min./foot			13'0"	Run #1 NX CORED ROCK from 13' to 15'. Recovery 18"/24" = 75%
15		14'0"-	15'0" 21 min./foot			15'0"	End of boring at 15'0" Set well point at 15'0" Water level at 5'7" upon completion
20							
25							Well Materials; 1 - 2" PVC end plug 1 - 10' x 2" PVC screen 2 - 5' x 2" PVC riser 1 - protective locking casing 1 bag - sakrete sand 1 bag - Portland cement 3 bags - silica sand 2 pails- bentonite pellets 1 bag - bentonite powder
30							
35							
40							

Type of Boring: Casing Size: Hollow Stem Auger Size: 6¼

Proportion Percentages	Granular Soils (blows per ft.)		Cohesive Soils (blows per ft.)	
Trace 0 to 10%	0 to 4 Very Loose	30 to 50 Dense	0 to 2 Very Soft	8 to 15 Stiff
Some 10 to 40%	4 to 10 Loose	Over 50 Very Dense	2 to 4 Soft	15 to 30 Very Stiff
And 40 to 50%	10 to 30 Medium Dense		4 to 8 Medium Stiff	Over 30 Hard

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

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SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St
Nashua, NH 03060
(603) 882-3601

Client: OLIN CHEMICAL — Date: 11/23/87 — Job No. 87-891

Location: OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA

BORING NO. Type #2 SL-3D Sulfate Landfill DEEP #3 — Date Start: 11/20/87 — Date Complete: 11/20/87 — Drilling Foreman: P.N. — Eng./Hydrol. Geologist: D.C.

Elevation	Sample No	Sample Depth (ft.)	Blows 6" Penetration	Rec. Inches	Casing Blows Per ft.	Strata Change Depth	Visual Identification of Soil and/or Rock Strata
	1	0'0"- 0'6"	1-				TOPSOIL.
	1A	0'6"- 2'0"	2-2-3			0'6"	Loose, moist, fine SAND, some inorganic silt, trace root matter.
	2	2'0"- 3'6"	3-3-4-				
	2A	3'6"- 4'0"	5				
5						3'6"	
	3	5'0"- 7'0"	9-11-11-12				Medium dense, dry to wet, medium to coarse SAND, some fine sand, trace inorganic silt, and medium gravel.
	4	7'0"- 9'0"	15-10-8-12				
10							
	5	10'0"- 12'0"	5-5-6-6			(1)	
	6	12'0"- 13'6"	7-13-10-				
	6A	13'6"- 14'0"	21				
15							
	7	15'0"- 17'0"	14-17-14-12				
	8	17'0"- 17'7"	29-120/1"			17'0" (2)	Very dense, wet, fine to medium SAND, some medium to coarse gravel, and inorganic silt, few cobbles and boulders.
20	Run #1	19'0"- 20'0"	6 min./foot			19'0"	Run #1 NX CORED ROCK from 19' to 21'.
		20'0"- 21'0"	10 min./foot				Recovery 14"/24" = 58.3%
						21'0"	End of boring at 21'0"
							Set well point at 21'0"
							Water level at 12'6" upon completion
25							
							Well Materials;
							1 - 2" PVC end plug
							1 - 10' x 2" PVC screen
30							1 - 10' x 2" PVC riser
							1 - 5' x 2" PVC riser
							1 - protective locking casing
							1 bag - sakrete sand
							2 bags - Portland cement
35							2 bags - silica sand
							1 pail - bentonite pellets
							1 bag - bentonite powder
40							

Type of Boring: Casing Size: Hollow Stem Auger Size: 4¼

Proportion Percentages	Granular Soils (blows per ft.)		Cohesive Soils (blows per ft.)	
Trace 0 to 10%	0 to 4 Very Loose	30 to 50 Dense	0 to 2 Very Soft	8 to 15 Stiff
Some 10 to 40%	4 to 10 Loose	Over 50 Very Dense	2 to 4 Soft	15 to 30 Very Stiff
And 40 to 50%	10 to 30 Medium Dense		4 to 8 Medium Stiff	Over 30 Hard

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

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SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St
Nashua, NH 03060
(603) 882-3601

Client: OLIN CHEMICAL — Date: 11/23/87 — Job No. 87-891

Location: OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA

BORING NO. Type #2 SL-4D Sulfate Landfill DEEP #4 — Date Start: 11/16/87 — Date Complete: 11/16/87 — Drilling Foreman: P.N. — Eng./Hydrol. Geologist: D.C.

Depth (ft.)	Sample No	Sample Depth (ft.)	Blows 6" Penetration	Rec. Inches	Casing Blows Per ft.	Strata Change Depth	Visual Identification of Soil and/or Rock Strata
	1	0'0"- 1'0"	1-2-				Loose, moist TOPSOIL.
	1A	1'0"- 2'0"	6-6			1'0"	Loose, moist GYPSUM.
	2	2'0"- 4'0"	3-4-4-4				
5	3	4'0"- 4'0"	120/0"			4'0"	Very dense, dry, fine SAND, some medium to coarse gravel, and inorganic silt, few cobbles, and boulders.
	4	5'0"- 7'0"	15-29-31-36				
	5	7'0"- 7'8"	41-120/2"				
	Run #1	8'0"- 9'0"	3 min./foot			8'0"	Run #1 NX CORED ROCK from 8'0" to 13'0". Recovery 14"/60" = 23.3% Weathered and many fractures.
10		9'0"- 10'0"	3 "				
		10'0"- 11'0"	5 "				
		11'0"- 12'0"	9 "				
		12'0"- 13'0"	8 "				
15						13'0"	End of boring at 13'0" Set well point at 10'8" (Due to obstruction in core hole). No water encountered upon completion
20							Well Materials; 1 - 2" PVC end plug; 1 - 5' x 2" PVC screen; 1 - 10' x 2" PVC riser; 1 - protective locking casing; 1 bag - sakrete sand; 2 bags - silica sand; 1 pail - bentonite pellets
25							
30							
35							
40							

Type of Boring: Casing Size: Hollow Stem Auger Size: 4¼

Proportion Percentages	Granular Soils (blows per ft.)		Cohesive Soils (blows per ft.)	
Trace 0 to 10%	0 to 4 Very Loose	30 to 50 Dense	0 to 2 Very Soft	8 to 15 Stiff
Some 10 to 40%	4 to 10 Loose	Over 50 Very Dense	2 to 4 Soft	15 to 30 Very Stiff
And 40 to 50%	10 to 30 Medium Dense		4 to 8 Medium Stiff	Over 30 Hard

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

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Leominster, MA 01453
(617) 840-0391

SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St
Nashua, NH 03060
(603) 882-3601

Client: OLIN CHEMICAL — Date: 11/23/87 — Job No. 87-891

Location: OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA

BORING NO. Type #2 SL-5D Sulfate Landfill DEEP #5 — Date Start: 11/17/87 — Date Complete: 11/17/87 — Drilling Foreman: P.N. — Eng./Hydrol. Geologist: D.C.

Depth	Sample No.	Sample Depth (ft.)	Blows 6" Penetration	Rec. Inches	Casing Blows Per ft.	Strata Change Depth	Visual Identification of Soil and/or Rock Strata
	1	0'0"- 2'0"	3-2-4-3				Loose to medium dense, dry to moist, fine SAND, some inorganic silt, trace medium to coarse sand, medium to coarse gravel, wood, and blasted rock.
	2	2'0"- 4'0"	9-5-6-8				
5	3	5'0"- 7'0"	3-3-5-4				
	4	7'0"- 7'5"	120/5"			7'0"	Very dense, dry to moist, fine SAND, and medium to coarse gravel, some inorganic silt, and medium to coarse snad, few cobbles, and boulders, trace weathered rock.
10	5	10'0"- 10'7"	37-120/1"				
	Run #1	13'0"- 14'0"	8 min./foot			13'0"	Run #1 NX CORED ROCK from 13'0" to 15'6". Recovery 23"/30" 76.6%
15		14'0"- 15'0"	7 min./foot				
		15'0"- 15'6"	5 min./½ foot			15'6"	End of boring at 15'6" Set well point at 15'0" No water encountered upon completion NOTE : Water at 14'6" after 24 Hours Well Materials; 1 - 2" PVC end plug 1 - 10' x 2" PVC screen 2 - 5' x 2" PVC riser 1 - protective locking casing 1 bag - sakrete sand 1 bag - Portland cement 2 bags - silica sand 1 pail - bentonite pellets ½ bag - bentonite powder NOTE : This hole was a second attempt. On the first attempt the hole went off due to blasted rock. Moved 4'0" forward.
20							
25							
30							
35							
40							

Type of Boring: Casing Size: Hollow Stem Auger Size: 4¼

Proportion Percentages	Granular Soils (blows per ft.)		Cohesive Soils (blows per ft.)	
Trace 0 to 10%	0 to 4 Very Loose	30 to 50 Dense	0 to 2 Very Soft	8 to 15 Stiff
Some 10 to 40%	4 to 10 Loose	Over 50 Very Dense	2 to 4 Soft	15 to 30 Very Stiff
And 40 to 50%	10 to 30 Medium Dense		4 to 8 Medium Stiff	Over 30 Hard

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

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Client: OLIN CHEMICAL — Date: 11/23/87 — Job No. 87-891

Location: OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA

BORING NO. Type #2 ~~SE-6D~~ Sulfate Landfill DEEP #6 — Date Start: 11/18/87 — Date Complete: 11/18/87 — Drilling Foreman: P.N. — Eng./Hydrol. Geologist: D.C.

Depth	Sample No	Sample Depth (ft.)	Blows 6" Penetration	Rec. Inches	Casing Blows Per ft.	Strata Change Depth	Visual Identification of Soil and/or Rock Strata
	1	0'0"- 2'0"	3-4-4-4				Loose, moist, fine SAND, some inorganic silt, trace blasted rock, medium to coarse gravel, and organic silt, mixed.
	2	2'0"- 3'0"	9-10-				
	2A	3'0"- 4'0"	5-4				
5	3	5'0"- 7'0"	2-3-3-5				
	4	7'0"- 9'0"	7-7-5-6			7'0"	Medium dense, moist, fine SAND, some organic silt, trace wood and root matter
10	5	10'0"- 12'0"	4-6-5-5			9'0" (1)	Medium dense, dry to moist to wet, fine SAND, trace to some inorganic silt.
	6	12'0"- 14'0"	6-7-7-8				
15	7	15'0"- 17'0"	35-30-31-44			14'6" (2)	Very dense, wet, fine to coarse SAND, some medium to coarse gravel, few cobbles, and boulders, trace inorganic silt.
20	Run #1	19'0"- 20'0"	8 min./foot			19'0"	Run #1 NX CORED ROCK from 19' to 21'. Recovery 24"/24"
		20'0"- 21'0"	8 min./foot				
						21'0"	End of boring at 21'0" Set well point at 21'0" Water level at 12'0" upon completion
25							
30							Well Materials; 1 - 2" PVC end plug 1 - 10' x 2" PVC screen 1 - 10' x 2" PVC riser 1 - 5' x 2" PVC riser 1 - protective locking casing 1 bag - sakrete sand 1 bag - Portland cement 3 bags - silica sand 1 pail - bentonite pellets ½ bag - bentonite powder
35							
40							

Type of Boring: Casing Size: Hollow Stem Auger Size: 4¼

Proportion Percentages	Granular Soils (blows per ft.)		Cohesive Soils (blows per ft.)	
Trace 0 to 10%	0 to 4 Very Loose	30 to 50 Dense	0 to 2 Very Soft	8 to 15 Stiff
Some 10 to 40%	4 to 10 Loose	Over 50 Very Dense	2 to 4 Soft	15 to 30 Very Stiff
And 40 to 50%	10 to 30 Medium Dense		4 to 8 Medium Stiff	Over 30 Hard

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

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(603) 882-3601

Client: OLIN CHEMICAL — Date: 11/23/87 — Job No. 87-891

Location: OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA

BORING NO.: Type #2 ~~SL-7D~~ Sulfate Landfill DEEP #7 — Date Start: 11/19/87 — Date Complete: 11/19/87 — Drilling Foreman: P.N. — Eng./Hydrol. Geologist: D.C.

Elev.	Sample No.	Sample Depth (ft.)	Blows 6" Penetration	Rec. Inches	Casing Blows Per ft.	Strata Change Depth	Visual Identification of Soil and/or Rock Strata
	1	0'0"- 1'9"	15-27-20-120/3"				Very dense, dry, fine SAND, some inorganic silt, and medium to coarse gravel, few cobbles and boulders, trace weathered rock.
5	2	4'0"- 5'1"	67-47-120/1"				
	3	6'0"- 6'5"	120/5"				
	Run #1	7'0"-	8'0"	6 min./foot		7'0"	Run #1 NX CORED ROCK from 7'0" to 10'0". Recovery 28"/36" = 77.7%
		8'0"-	9'0"	11 min./foot			
10		9'0"-	10'0"	10 min./foot		10'0"	End of boring at 10'0" Set well point at 10'0" No water encountered upon completion Well Materials; 1 - 2" PVC end plug 1 - 5' x 2" PVC screen 2 - 5' x 2" PVC riser 1 - protective locking casing 1 bag - sakrete sand ½ bag - Portland cement 2 bags - silica sand ½ pail - bentonite pellets ½ bag - bentonite powder NOTE : This hole is a second attempt. On the first attempt the hole was cored 2' to 5', with cobbles and boulders. Moved 3'0" and started new hole.
15							
20							
25							
30							
35							
40							

Type of Boring: Casing Size: Hollow Stem Auger Size: 4¼

Proportion Percentages	Granular Soils (blows per ft.)		Cohesive Soils (blows per ft.)	
Trace 0 to 10%	0 to 4 Very Loose	30 to 50 Dense	0 to 2 Very Soft	8 to 15 Stiff
Some 10 to 40%	4 to 10 Loose	Over 50 Very Dense	2 to 4 Soft	15 to 30 Very Stiff
And 40 to 50%	10 to 30 Medium Dense		4 to 8 Medium Stiff	Over 30 Hard

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

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(603) 882-3601

Client OLIN CHEMICAL | Date 11/23/87 | Job No. 87-891

Location OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA

BORING NO Type #2 ~~SL-80~~ Sulfate Landfill DEEP #8 | Date Start 11/19/87 | Date Complete 11/19/87 | Drilling Foreman P.N. | Eng./Hydrol. Geologist D.C.

Depth	Sample No	Sample Depth (ft.)	Blows 6" Penetration	Rec. Inches	Casing Blows Per ft.	Strata Change Depth	Visual Identification of Soil and/or Rock Strata
	1	0'0"- 2'0"	5-7-11-9			3'	Medium dense, dry, fine SAND, some medium to coarse sand, fine gravel, trace cobbles, root matter, inorganic and organic silt, (fill).
	Run #1	3'0"-	4'0" 4 min./foot			3'0"	Run #1 NX CORED ROCK from 3'0" to 6'0".
5		4'0"-	5'0" 7 min./foot				Recovery 26"/36" = 72.2%
		5'0"-	6'0" 9 min./foot				Fractures.
						6'0"	End of boring at 6'0"
							Set well point at 6'0"
							No water encountered upon completion
10							
							Well Materials;
							1 - 2" PVC end plug
							1 - 5' x 2" PVC screen
							1 - 5' x 2" PVC riser
15							1 - buffalo box
							1 bag - sakrete sand
							1 bag - silica sand
							½ pail - bentonite pellets
20							
25							
30							
35							
40							

Type of Boring Casing Size: Hollow Stem Auger Size: 4¼

Proportion Percentages	Granular Soils (blows per ft.)		Cohesive Soils (blows per ft.)	
Trace 0 to 10%	0 to 4 Very Loose	30 to 50 Dense	0 to 2 Very Soft	8 to 15 Stiff
Some 10 to 40%	4 to 10 Loose	Over 50 Very Dense	2 to 4 Soft	15 to 30 Very Stiff
And 40 to 50%	10 to 30 Medium Dense		4 to 8 Medium Stiff	Over 30 Hard

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

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SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St.
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(603) 882-3601

Client: OLIN CORPORATION — Date: 10/23/87 — Job No. 87-844

Location: OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA

BORING NO. B-2 — Ground Elev. — Date Start 10/16/87 — Date Complete 10/18/87 — Drilling Foreman SEYMOUR/ JUINTA — Eng./Hydrol. Geologist J.P.

DEPTH	Sample No.	Sample Depth (ft.)	Blows 6" Penetration	Rec. Inches	Casing Blows Per ft.	Strata Change Depth	Visual Identification of Soil and/or Rock Strata
							NOTE : No split-spoon samples required auger probe Soil description made from auger. Medium dense, dry to wet, fine to medium SAND, trace coarse sand, and fine gravel, trace inorganic silt.
5							
10							
						11'0"	Very dense, wet, coarse GRAVEL, cobbles and boulders, some fine to coarse sand, and inorganic silt.
15							
20							
	Run #1	23'0"-	24'0"	16 min./foot		23'0"	Refusal with hollow-stem auger, and carbide roller-bit at 23'0" CORED ROCK from 23'0"- 28'0" Recovered 20" = 33.3% ** See Below
25		24'0"-	25'0"	22	"		
		25'0"-	26'0"	18	"		
		26'0"-	27'0"	31	"		
		27'0"-	28'0"	17	"		
30						28'0"	End of boring at 28'0" Water table at 10'2" upon completion NOTE : Unable to advance hollow-stem auger or roller bit. Few fractures, no detectable voids. No loss of water.
35							
40							

Type of Boring — Casing Size: — Hollow Stem Auger Size: 3¼

Proportion Percentages	Granular Soils (blows per ft.)		Cohesive Soils (blows per ft.)	
Trace 0 to 10%	0 to 4 Very Loose	30 to 50 Dense	0 to 2 Very Soft	8 to 15 Stiff
Some 10 to 40%	4 to 10 Loose	Over 50 Very Dense	2 to 4 Soft	15 to 30 Very Stiff
And 40 to 50%	10 to 30 Medium Dense		4 to 8 Medium Stiff	Over 30 Hard

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

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Client: OLIN CORPORATION — Date: 10/23/87 — Job No. 87-844

Location: OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA

Boring No.: B-3 — Ground Elev.: — Date Start: 10/18/87 — Date Complete: 10/18/87 — Drilling Foreman: SEYMOUR — Eng./Hydrol. Geologist: J.P.

Depth	Sample No.	Sample Depth (ft.)	Blows 6" Penetration	Rec. Inches	Casing Blows Per ft.	Strata Change Depth	Visual Identification of Soil and/or Rock Strata
							NOTE : No split-spoon samples required Soil description made from auger.
5							Medium dense, dry to wet, fine to medium SAND, trace coarse sand and fine gravel, trace inorganic silt.
10							
15						14'0"	Very dense, wet, coarse GRAVEL, cobbles and boulder, some fine to coarse sand, and inorganic silt.
20							
25	Run #1	24'0"-	25'0"	9	min./foot	24'0"	Refusal at 24'0" CORED ROCK from 24'0" - 29'0" Recovered 25" = 41.6% Unable to advance hollow-stem auger or roller bit. Few fractures - no voids. No loss of water.
		25'0"-	26'0"	12	"		
		26'0"-	27'0"	10	"		
		27'0"-	28'0"	10	"		
		28'0"-	29'0"	10			
30						29'0"	End of boring at 29'0" Water level at 10'2" upon completion
35							
40							

Type of Boring: Casing Size: Hollow Stem Auger Size: 3¼

Proportion Percentages	Granular Soils (blows per ft.)		Cohesive Soils (blows per ft.)	
Trace 0 to 10%	0 to 4 Very Loose	30 to 50 Dense	0 to 2 Very Soft	8 to 15 Stiff
Some 10 to 40%	4 to 10 Loose	Over 50 Very Dense	2 to 4 Soft	15 to 30 Very Stiff
And 40 to 50%	10 to 30 Medium Dense		4 to 8 Medium Stiff	Over 30 Hard

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

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SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St.
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(603) 882-3601

Client	OLIN CORPORATION		Date 10/23/87	Job No.	87-844
Location	OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA				
BORING NO. B-4	Ground Elev.	Date Start 10/19/87	Date Complete 10/19/87	Drilling Foreman SEYMOUR	Eng./Hydrol. Geologist J.P.

DEPTH	Sample Data: Sample No.	Sample Depth (ft.)	Blows 6" Penetration	Rec. Inches	Casing Blows Per ft.	Soil and/or bedrock strata descriptions: Strata Change Depth	Visual Identification of Soil and/or Rock Strata
							NOTE : No split-spoon samples required Soil description made from auger.
5							Medium dense, dry to wet, fine to medium SAND, trace coarse sand and fine gravel, trace inorganic silt.
10							
15						15'0"	Very dense, wet, coarse GRAVEL, cobbles and boulders, some fine to coarse sand, and inorganic silt.
20							
25							
30	Run #1	29'0"-	30'0"	13 min./foot		29'0"	Refusal with hollow-stem auger and carbide roller bit at 29'0". CORED ROCK from 29'0" - 32'0" **See Below
		30'0"-	31'0"	28 "			
		31'0"-	32'0"	45 "		32'0"	End of boring at 32'0" Water level at 10'1" upon completion
35							** Recovered 0" = 0% Few fractures- no voids. No loss of water.
40							

Type of Boring Casing Size: Hollow Stem Auger Size: 3¼

Proportion Percentages	Granular Soils (blows per ft.)		Cohesive Soils (blows per ft.)	
Trace 0 to 10%	0 to 4 Very Loose	30 to 50 Dense	0 to 2 Very Soft	8 to 15 Stiff
Some 10 to 40%	4 to 10 Loose	Over 50 Very Dense	2 to 4 Soft	15 to 30 Very Stiff
And 40 to 50%	10 to 30 Medium Dense		4 to 8 Medium Stiff	Over 30 Hard

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

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Client: OLIN CORPORATION — Date: 10/23/87 — Job No. 87-844

Location: OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA

BORING NO. B-5 — Ground Elev. — Date Start 10/19/87 — Date Complete 10/20/87 — Drilling Foreman SEYMOUR — Eng./Hydrol. Geologist J.P.

DEPTH	Sample No.	Sample Depth (ft.)	Blows 6" Penetration	Rec. Inches	Casing Blows Per ft.	Strata Change Depth	Visual Identification of Soil and/or Rock Strata
							NOTE : No split-spoon samples required Soil description made from auger.
5							
10							Medium dense, dry to wet, fine to medium SAND, trace coarse sand, and fine gravel, trace inorganic silt.
15						15'0"	Very dense, wet, coarse GRAVEL, cobbles and boulders, some fine to coarse sand, and inorganic silt.
20							
25	Run #1	24'0"-	25'0"			24'0"	Refusal with hollow-stem auger and roller bit at 24'0" CORED ROCK from 24'0" to 29'0" Recovered 6" = 10% Loss of water. Very irregular core time, many seams and voids. Cored boulders and cobbles.
		25'0"-	26'0"				
		26'0"-	27'0"				
		27'0"-	28'0"				
		28'0"-	29'0"				
30						29'0"	End of boring at 29'0" Water level at 9'8" upon completion
35							
40							

Type of Boring: Casing Size: Hollow Stem Auger Size: 3¼

Proportion Percentages	Granular Soils (blows per ft.)		Cohesive Soils (blows per ft.)	
Trace 0 to 10%	0 to 4 Very Loose	30 to 50 Dense	0 to 2 Very Soft	8 to 15 Stiff
Some 10 to 40%	4 to 10 Loose	Over 50 Very Dense	2 to 4 Soft	15 to 30 Very Stiff
And 40 to 50%	10 to 30 Medium Dense		4 to 8 Medium Stiff	Over 30 Hard

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

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SOIL EXPLORATION CORPORATION

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Client: OLIN CORPORATION — Date: 10/23/87 — Job No.: 87-844

Location: OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA

BORING NO.: B-6 — Ground Elev.: — Date Start: 10/20/87 — Date Complete: 10/21/87 — Drilling Foreman: SEYMOUR — Eng./Hydrol. Geologist: J.P.

DEPTH	Sample No.	Sample Depth (ft.)	Blows 6" Penetration	Rec. Inches	Casing Blows Per ft.	Strata Change Depth	Visual Identification of Soil and/or Rock Strata
	1	0'0"- 1'6"	2-2-4				Medium dense, dry to wet, fine to medium SAND, trace coarse sand, fine gravel and inorganic silt.
5	2	4'0"- 5'6"	6-5-10				
10	3	9'0"- 10'6"	8-6-7				
15	4	14'0"- 15'6"	4-4-6				
						17'6"	Very dense, wet, coarse GRAVEL, cobbles and boulders, some fine to coarse sand, and inorganic silt.
20	5	19'0"-19'10"	42-80/4"-100/0"				
25	6	24'0"- 25'1"	45-35-100/1"				
30	7	29'0"- 30'2"	21-39-80/2"				
	8	32'0"- 32'0"	100/0"			32'0"	Refusal with hollow-stem auger, carbide roller bit and spoon at 32'0"
35							CORED ROCK from 32'0" - 37'0". Recovered 8" = 13.3% Irregular core times. Many seams & voids Loss of drill water. Cored cobbles & boulde
		Well Materials:					
		1 - 2" PVC end plug				37'0"	End of boring at 37'0"
		1 - 10'x 2" PVC screen					Set well point at 28'0"
40		1 - 20'x 2" PVC riser					Water table at 10'0" upon completion.
		1 - 2" PVC slip cap					

Type of Boring: — Casing Size: — Hollow Stem Auger Size: 3¼

Proportion Percentages
Trace 0 to 10%
Some 10 to 40%
And 40 to 50%

Granular Soils (blows per ft.)
0 to 4 Very Loose
4 to 10 Loose
10 to 30 Medium Dense
30 to 50 Dense
Over 50 Very Dense

Cohesive Soils (blows per ft.)
0 to 2 Very Soft
2 to 4 Soft
4 to 8 Medium Stiff
8 to 15 Stiff
15 to 30 Very Stiff
Over 30 Hard

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

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SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

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Nashua, NH 03060
(603) 882-3601

Client: OLIN CORPORATION — Date: 10/23/87 — Job No. 87-844

Location: OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA

BORING NO.: B-7 — Ground Elev.: — Date Start: 10/21/87 — Date Complete: 10/21/87 — Drilling Foreman: M.Z. — Eng./Hydrol. Geologist: J.P.

DEPTH	Sample No.	Sample Depth (ft.)	Blows 6" Penetration	Rec. Inches	Casing Blows Per ft.	Strata Change Depth	Visual Identification of Soil and/or Rock Strata
	1	0'0"- 1'6"	7-8-8				Medium dense, dry to wet, fine to medium SAND, trace coarse sand, fine gravel and inorganic silt.
5	2	4'6"- 6'0"	6-7-6				
10	3	9'6"- 11'0"	4-4-6				
						13'0"	
15	4	14'0"- 15'6"	31-22-24				Very dense, wet, coarse GRAVEL, cobbles and boulders, some fine to coarse sand and inorganic silt.
20	5	19'0"- 20'6"	46-57-39				
	6	23'0"- 23'0"	100/0"				
	Run #1	23'0"-	24'0"	12 min./foot		23'0"	Refusal with hollow-stem auger, carbide roller bit and spoon at 23'0" CORED ROCK from 23'0"- 28'0" Recovered 26" = 43.3% Few seams, no voids. No loss of water.
25		24'0"-	25'0"	10 "			
		25'0"-	26'0"	13 "			
		26'0"-	27'0"	12 "			
		27'0"-	28'0"	15			
						28'0"	End of boring at 28'0" Water level at 9'10" upon completion
30							
35							
40							

Type of Boring: Casing Size: Hollow Stem Auger Size: 3¼

Proportion Percentages
Trace 0 to 10%
Some 10 to 40%
And 40 to 50%

Granular Soils (blows per ft.)
0 to 4 Very Loose
4 to 10 Loose
10 to 30 Medium Dense
30 to 50 Dense
Over 50 Very Dense

Cohesive Soils (blows per ft.)
0 to 2 Very Soft
2 to 4 Soft
4 to 8 Medium Stiff
8 to 15 Stiff
15 to 30 Very Stiff
Over 30 Hard

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

148 Pioneer Dr.
Leominster, MA 01453
(617) 840-0391

SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St.
Nashua, NH 03060
(603) 882-3601

Client	OLIN CORPORATION	Date 10/23/87	Job No. 87-844
Location	OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA		

BORING NO.	B-8	Ground Elev.		Date Start	10/22/87	Date Complete	10/22/87	Drilling Foreman	SEYMOUR	Eng./Hydrol. Geologist	J.P.

DEPTH	Sample No.	Sample Depth (ft.)	Blows 6" Penetration	Rec. Inches	Casing Blows Per ft.	Strata Change Depth	Visual Identification of Soil and/or Rock Strata
	1	0'0"- 1'6"	4-5-3				Medium dense, dry to moist, fine to medium SAND, trace coarse sand, fine gravel and inorganic silt.
5	2	4'0"- 5'6"	8-4-5				
10	3	9'0"- 10'6"	28-31-44			8'6"	Very dense, wet, coarse GRAVEL, cobbles and boulders, some fine to coarse sand and inorganic silt.
15	4	14'0"- 14'8"	22-80/2"-100/0"				
	5	18'6"- 18'6"	120/0"				
	Run #1	18'6"- 19'6"	12 min./foot			18'6"	Refusal with hollow stem auger, carbide roller bit, and spoon at 18'6". CORED ROCK from 18'6" - 23'6". Recovered 20" = 33.3% Few seams. No voids. No loss of water.
20		19'6"- 20'6"	12	"			
		20'6"- 21'6"	10	"			
		21'6"- 22'6"	12	"			
		22'6"- 23'6"	11	"			
25						23'6"	End of boring at 23'6" Water level at 9'10" upon completion
30							
35							
40							

Type of Boring Casing Size: Hollow Stem Auger Size: 3¼

Proportion Percentages	Granular Soils (blows per ft.)		Cohesive Soils (blows per ft.)	
Trace 0 to 10%	0 to 4 Very Loose	30 to 50 Dense	0 to 2 Very Soft	8 to 15 Stiff
Some 10 to 40%	4 to 10 Loose	Over 50 Very Dense	2 to 4 Soft	15 to 30 Very Stiff
And 40 to 50%	10 to 30 Medium Dense		4 to 8 Medium Stiff	Over 30 Hard

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

NEW ENGLAND POLLUTION CONTROL CO., INC.

7 EDGEWATER PLACE
EAST NORWALK, CT 06855

24 HOUR SERVICE
POLLUTION CONTROL SUPPLIES & SERVICE

- ☐ EAST NORWALK, CT 2
- ☐ NEW HAVEN, CT 2
- ☐ NEW LONDON, CT. 2
- ☐ NEWARK, N.J. 2
- ☐ PHILADELPHIA, PA. 2

Page _____ of _____

Date December 4th, 1980

Job No. _____

Job Address Min Corp. Billington, Mass.

Boring No. 10

Fixed Datum used is _____

Ground Surface this boring is _____

DEPTH From	DEPTH To	CLASSIFICATION Be Careful and Accurate	CASING BLOWS 0-27	CASING BLOWS 28-54	SAMPLE No.	Depth	No. of 30" Blows on Spoon 1st 6"	2nd 6"	3rd 6"	4th 6"	Recovery in.	Lost Rem
0'	1'6"	Brown sand fine to										
		medium grade										
1'6"		Refusal (Possible Metal)										

Ground Surface to _____ ft. used _____ casing.

Water level is _____ ft. below Ground surface _____ hrs. after completion

Water level is _____ ft. below Ground surface _____ hrs. after completion

Boring stopped by _____

Driller D. Fiorentin

Helper G. Birchard,

Rig. No. 21

NEW ENGLAND POLLUTION CONTROL CO., INC.

7 EDGEWATER PLACE
EAST NORWALK, CT 06855

24 HOUR SERVICE
POLLUTION CONTROL SUPPLIES & SERVICE

- ☐ EAST NORWALK, CT 203 853-[illegible]
- ☐ NEW HAVEN, CT 203 [illegible]
- ☐ NEW LONDON, CT 203 443-[illegible]
- ☐ NEWARK, N.J. 201 589-[illegible]
- ☐ PHILADELPHIA, PA 215 563-[illegible]

Page _____ of _____

Date December 4th, 1990

Job No. _____

Job Address Olin Corp. - Villmington, Mass.

Boring No 9

Fixed Datum used is _____

Ground Surface this boring is _____

DEPTH From	DEPTH To	CLASSIFICATION Be Careful and Accurate	CASING BLOWS 0-27	CASING BLOWS 28-54	SAMPLE No.	Depth	No. of 30" Blows on Spoon 1st 6"	2nd 6"	3rd 6"	4th 6"	Recovery In	Lost Water * or Remarks
0'	1'6"	Brown sand										
1'6"		Refusal										
		(Possible Metal)										

Ground Surface to _____ ft. used _____ casing.

Water level is _____ ft. below Ground surface _____ hrs. after completion

Water level is _____ ft. below Ground surface _____ hrs. after completion

Boring stopped by _____

Driller _____

Helper _____

Rig. No. _____

NEW ENGLAND POLLUTION CONTROL CO., INC.

7 EDGEWATER PLACE
EAST NORWALK, CT 06855

24 HOUR SERVICE
POLLUTION CONTROL SUPPLIES & SERVICE

- ☐ EAST NORWALK, CT 203 853-
- ☐ NEW HAVEN, CT 203 [illegible]
- ☐ NEW LONDON, CT 203 443-4[illegible]
- ☐ NEWARK, N.J. 201 589-[illegible]
- ☐ PHILADELPHIA, PA. 215 563-[illegible]

Page _____ of _____

Date Thursday, Dec. 4, 1980

Job No. _____

Job Address Olin Corp. Wilmington, Mass.

Boring No. 3

Fixed Datum used is _____

Ground Surface this boring is _____

DEPTH From	DEPTH To	CLASSIFICATION Be Careful and Accurate	CASING BLOWS 0-27	CASING BLOWS 28-54	SAMPLE No.	Depth	No. of 30" Blows on Spoon 1st 6"	2nd 6"	3rd 6"	4th 6"	Recovery In.	Lost water * or Remarks
0'	8'	Light brown sand fine										
		to medium grade										
8'	10'	Light brown sand fine										
		to medium grade										
10'	11'	Refusal										

Ground Surface to _____ ft. used _____ casing.

Water level is _____ ft. below Ground surface _____ hrs. after completion

Water level is _____ ft. below Ground surface _____ hrs. after completion

Boring stopped by _____

Driller D. Fiorentino

Helper G. Birchard, J. [illegible]

Rig. No. 21

NEW ENGLAND POLLUTION CONTROL CO., INC.

7 EDGEWATER PLACE
EAST NORWALK, CT 06855

24 HOUR SERVICE
POLLUTION CONTROL SUPPLIES & SERVICE

- ☐ EAST NORWALK, CT 203.853-
- ☐ NEW HAVEN, CT 203.777-
- ☐ NEW LONDON, CT. 203.443-
- ☐ NEWARK, N.J. 201.589-
- ☐ PHILADELPHIA, PA. 215.563-

Page _____ of _____

Date December 4th, 1990

Job No. _____

Job Address Olin Corp. Wilmington, Mass.

Boring No. 6

Fixed Datum used is _____

Ground Surface this boring is _____

DEPTH From	DEPTH To	CLASSIFICATION Be Careful and Accurate	CASING BLOWS 0-27	CASING BLOWS 28-54	SAMPLE No.	Depth	No. of 30" Blows on Spoon 1st 6"	2nd 6"	3rd 6"	4th 6"	Recovery in.	Lost Water * or Remarks
0'	4'	Brown sand, heavily										
		stained by Product										
4'	8'	Brown sand										
8'	10'	Brown sand small										
		boulders										
10'	10'6"	Refusal										

Ground Surface to _____ ft. used _____ casing.

Water level is _____ ft. below Ground surface _____ hrs. after completion

Water level is _____ ft. below Ground surface _____ hrs. after completion

Boring stopped by _____

Driller D. Fiorentino

Helper G. Birchard, J. Bac

Rig. No. 21

NEW ENGLAND POLLUTION CONTROL CO., INC.

7 EDGEWATER PLACE
EAST NORWALK, CT 06855

24 HOUR SERVICE
POLLUTION CONTROL SUPPLIES & SERVICE

- ☐ EAST NORWALK, CT 203 853-[illegible]
- ☐ NEW HAVEN, CT 203 777-[illegible]
- ☐ NEW LONDON, CT 203 443-[illegible]
- ☐ NEWARK, N.J. 201 589-[illegible]
- ☐ PHILADELPHIA, PA. 215 563-[illegible]

Page _____ of _____

Date December 3rd, 1980

Job No. _____

Job Address Olin Chemical Wilmington, Mass.

Boring No. 1

Fixed Datum used is _____

Ground Surface this boring is _____

DEPTH From	DEPTH To	CLASSIFICATION Be Careful and Accurate	CASING BLOWS 0-27	CASING BLOWS 28-54	SAMPLE No.	Depth	No. of 30" Blows on Spoon 1st 6"	2nd 6"	3rd 6"	4th 6"	Recovery In	Lost Water or Remarks
0'	10'	Fine Brown Sand										
10'	14'	Fine Brown Sand										
		Medium Boulders										
14'	14'0"	Refusal										

Ground Surface to _____ ft. used _____ casing.

Water level is _____ ft. below Ground surface _____ hrs. after completion

Water level is _____ ft. below Ground surface _____ hrs. after completion

Boring stopped by _____

Driller D. Fiorentino

Helper G. Birchard, J. [illegible]

Rig. No. 21

NEW ENGLAND POLLUTION CONTROL CO., INC.

7 EDGEWATER PLACE
EAST NORWALK, CT 06855

24 HOUR SERVICE
POLLUTION CONTROL SUPPLIES & SERVICE

- ☐ EAST NORWALK, CT 203/853-1990
- ☐ NEW HAVEN, CT 203/777-0333
- ☐ NEW LONDON, CT. 203/443-4461
- ☐ NEWARK, N.J. 201/589-1282
- ☐ PHILADELPHIA, PA. 215/563-9490

Page _____ of _____

Date December 3rd, 1980

Job No. _____

Job Address Olin Chemical Wilmington, Mass.

Boring No 2

Fixed Datum used is _____

Ground Surface this boring is _____

DEPTH From	DEPTH To	CLASSIFICATION Be Careful and Accurate	CASING BLOWS 0-27	CASING BLOWS 28-54	SAMPLE No.	Depth	No. of 30" Blows on Spoon 1st 6"	2nd 6"	3rd 6"	4th 6"	Recovery In	Lost Water * or Remarks
0'	3'	Brown Sand										
3'	3'-6"	Refusal										

Ground Surface to _____ ft. used _____ casing.

Water level is _____ ft. below Ground surface _____ hrs. after completion

Water level is _____ ft. below Ground surface _____ hrs. after completion

Boring stopped by _____

Driller D. Fiorentino

Helper G. Brichard, J. Baxter

Rig. No. 21

NEW ENGLAND POLLUTION CONTROL CO., INC.

7 EDGEWATER PLACE
EAST NORWALK, CT 06855

24 HOUR SERVICE
POLLUTION CONTROL SUPPLIES & SERVICE

- ☐ EAST NORWALK, CT [illegible]
- ☐ NEW HAVEN, CT 203 [illegible]
- ☐ NEW LONDON, CT. 203/443-[illegible]
- ☐ NEWARK, N.J. 201/589-[illegible]
- ☐ PHILADELPHIA, PA. 215/563-[illegible]

Page _____ of _____

Date December 4th, 1980

Job No. _____

Job Address Olin Corp. Wilmington, Mass.

Boring No 4

Fixed Datum used is _____

Ground Surface this boring is _____

DEPTH From	DEPTH To	CLASSIFICATION Be Careful and Accurate	CASING BLOWS 0-27	CASING BLOWS 28-54	SAMPLE No.	Depth	No. of 30" Blows on Spoon 1st 6"	2nd 6"	3rd 6"	4th 6"	Recovery in.	Lost Water * or Remarks
0'	10'	Fine Medium Brown Sand										
10'	12'6"	Fine Medium Brown										
		Sand Small to Medium										
		Boulders										
12'6"		Refusal										

Ground Surface to _____ ft. used _____ casing.

Water level is _____ ft. below Ground surface _____ hrs. after completion

Water level is _____ ft. below Ground surface _____ hrs. after completion

Boring stopped by _____

Driller D. Fiorentino

Helper G. Birchard, Jr.

Rig. No. 21

148 Pioneer Dr.
Leominster MA 01453
(617) 840-0391

SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St
Nashua, NH 03060
(603) 882-3601

Client OLIN CHEMICAL — Date 12/18/87 — Job No. 87-891

Location OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA

BORING NO. Type #4 BEDROCK — Ground Elev. — Date Start 11/30/87 — Date Complete 12/17/87 — Drilling Foreman P.N. — Eng./Hydrol. Geologist D.C.

Depth (Ft.)	Sample No.	Sample Depth (ft.)	Blows 6" Penetration	Rec. Inches	Casing Blows Per ft.	Strata Change Depth	Visual Identification of Soil and/or Rock Strata
							NOTE : NX CORE from 0'0" to 50'0" CORED GROUT from 0'0" to 21'0" CORED BEDROCK from 21'0" to 50'0".
							Run #1 0'0"- 5'0" Recovery 18"/60" = 30%
5						5'0"	Run #2 0'5"- 10'0" Recovery 60"/60" = 100%
10						10'0"	Run #3 10'0"- 15'0" Recovery 60"/60" = 100%
15						15'0"	Run #4 15'0"- 20'0" Recovery 60"/60" = 100%
20						20'0"	Run #5 20'0"- 21'0" Recovery 12"/12" = 100%
						21'0"	Run #6 21'0"- 23'0" Recovery 18"/24" = 75%
						23'0"	Run #7 23'0"- 24'0" Recovery 12"/12" = 100%
25						24'0"	Run #8 24'0"- 28'0" Recovery 48"/48" = 100%
30						28'0"	Run #9 28'0"- 32'0" Recovery 30"/48" = 62.5%
35						32'0"	Run #10 32'0"- 35'0" Recovery 36"/36" = 100%
						35'0"	Run #11 35'0"- 37'0" Recovery 18"/24" = 75%
40						37'0"	Run #12 37'0"- 40'0" Recovery 36"/36" = 100%
						40'0"	

Type of Boring — Casing Size: 8" — NX Core

Proportion Percentages	Granular Soils (blows per ft.)		Cohesive Soils (blows per ft.)	
Trace 0 to 10%	0 to 4 Very Loose	30 to 50 Dense	0 to 2 Very Soft	8 to 15 Stiff
Some 10 to 40%	4 to 10 Loose	Over 50 Very Dense	2 to 4 Soft	15 to 30 Very Stiff
And 40 to 50%	10 to 30 Medium Dense		4 to 8 Medium Stiff	Over 30 Hard

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

148 Pioneer Dr.
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(617) 840-0391

SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St.
Nashua, NH 03060
(603) 882-3601

Client: OLIN CHEMCIAL — Date: 12/18/87 — Job No. 87-891

Location: OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA

BORING NO. Type #4 BEDROCK — Ground Elev. — Date Start 11/30/87 — Date Complete 12/17/87 — Drilling Foreman P.N. — Eng./Hydrol. Geologist D.C.

Elevation	Sample No.	Sample Depth (ft.)	Blows 6" Penetration	Rec. Inches	Casing Blows Per ft.	Strata Change Depth	Visual Identification of Soil and/or Rock Strata
							Run #13 40'0"- 43'0" Recovery 34"/36" = 94.%
						43'0"	Run #14 43'0"- 48'0" Recovery 48"/60" = 80%
45							
						48'0"	Run #15 48'0"- 50'0" Recovery 24"/24" = 100%
50						50'0"	End of boring at 50'0" No water encountered upon completion
55							NOTE : ROCK CORING was performed starting 12/14/87 to 12/17/87.
							AIR ROTARY was performed on 11/30/87 and; 1. 12" Roller bit to 18' in soil 2. 12" Roller bit 18' to 21' in bedrock 3. Set 8" Casing to 21' - drive casing with hammer to refusal. 4. Grouted inside and outside of 8" casing to surface. 80% Portland cement 20% Bentonite pellets
60							
65							
70							
75							
80							

Type of Boring — Casing Size: 8" — NX Core

Proportion Percentages	Granular Soils (blows per ft.)		Cohesive Soils (blows per ft.)	
Trace 0 to 10%	0 to 4 Very Loose	30 to 50 Dense	0 to 2 Very Soft	8 to 15 Stiff
Some 10 to 40%	4 to 10 Loose	Over 50 Very Dense	2 to 4 Soft	15 to 30 Very Stiff
And 40 to 50%	10 to 30 Medium Dense		4 to 8 Medium Stiff	Over 30 Hard

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

GEOLOGICAL LOG OF DRILL HOLE

MILLER ENGINEERING, INC.

PROJECT: OLIN CHEMICAL, Wilmington, MA — BORING NO. B-1 — LOCATION See Plan — SURFACE ELEV.

PROJECT NO. 60321.01 — BORING CO. Miller Eng'ring & Test. — DEPTH OF OVERBURDEN 27'-4"

DATE START: 6/18/86 — DRILLING FOREMAN T. Gomulka — TOTAL DEPTH 32'-4"

DATE END: 6/18/86 — MEAT REPRESENTATIVE W. Childs — WATER DEPTH 6.2'

TYPE & SIZE OF HOLE	CORE RECOVERY %	ELEVATION	DEPTH	LOG	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION OF ROCK	DRILLING feed	BEHAVOIR water	NOTES:
			27'-4"			Run #1: 27'-4" to 29'-7" Dark grey-green fine-grained granodiorite, moderately fractured. Rec: 2'-3"/2'-3" 100% RQD 4"/2'-3" 15%	7-10 min/foot	No change in color some loss	
			29'-7"			Run #2: 29'-7" to 32'-4" Same as run #1, with less fracturing. Rec: 2'-9"/2'-9" 100% RQD 27"/33" 82%	7-12 min/foot	No change in color	
			32'-4"			Terminated at 32'-4" in bedrock.			

CORE LOSS

CORE RECOVERY

REMARKS:

SHEET 1 OF 1

GEOLOGICAL LOG OF DRILL HOLE

MILLER ENGINEERING, INC.

PROJECT: OLIN CHEMICAL, Wilmington, MA
BORING NO. B-3
LOCATION See Plan
SURFACE ELEV.

PROJECT NO. 60321.01
BORING CO. Miller Eng'ring & Test.
DEPTH OF OVERBURDEN 30'-9"
DATE START: 6/23/86
DRILLING FOREMAN T. Gomulka
TOTAL DEPTH 37'-9"
DATE END: 6/24/86
MEAT REPRESENTATIVE W. Childs
WATER DEPTH 7'-3"

TYPE & SIZE OF HOLE	CORE RECOVERY %	ELEVATION	DEPTH	LOG	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION OF ROCK	DRILLING BEHAVOIR feed	DRILLING BEHAVOIR water	NOTES:
			26'-2"			Run #1 26'-2" to 28'-0" Boulder Dark grey, fine-grained granodiorite. REC: 8"/22" 36% RQD 4"/8" 50%	9 min/foot	No change in color	Run #1: Boulder not counted as part of 5' core.
			28'-0"						
			30'-9"						
			33'-9"			Run #2 30'-9" to 33'-9" Dark grey-green, fine-grained granodiorite highly fractured. REC 26"/36" 72% RQD 15"/26" 58%	9-11 min/foot	No change in color	Sand lense 32'-11" to 33"-9"
			35'-9"			Run #3 33'-9" to 35'-9" Same as Run #2, less fractured. REC 20"/24" 83% RQD 15"/20" 75%	10-12 min/foot	No change in color	
			37'-9"			Run #4 35'-9" to 37'-9" Same as Run #2, less fractured. REC 22"/24" 92% RQD 15"/22" 68%	10-12 min/foot	No change in color	
						Terminated at 37'-9" in bedrock.			

CORE LOSS

CORE RECOVERY

REMARKS:

SHEET 1 OF 1

GEOLOGICAL LOG OF DRILL HOLE

MILLER ENGINEERING, INC.

PROJECT: OLIN CHEMICAL, Wilmington, MA
BORING NO. B-4
LOCATION See Plan
SURFACE ELEV.

PROJECT NO. 60321.01
BORING CO. Miller Eng'ring & Test.
DEPTH OF OVERBURDEN 22'-9"
DATE START: 6/25/86
DRILLING FOREMAN T. Gomulka
TOTAL DEPTH 27'-9"
DATE END: 6/25/86
M&T REPRESENTATIVE W. Childs
WATER DEPTH 5'1"

TYPE & SIZE OF HOLE	CORE RECOVERY %	ELEVATION	DEPTH	LOG	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION OF ROCK	DRILLING BEHAVOIR feed	DRILLING BEHAVOIR water	NOTES:
			22'-9"			Run #1 22'-9" to 27'-9" Dark grey-green, fine-grained granodiorite with thin lense quartz. Highly fractured to 24'9"; less fractured 24'-9" to 27'-9". REC 57//60" 95% RQD 28"/60" 47%	10-16 min/foot	No color change Some loss 22'-9" to 24'-9" Little loss 24'-9" to 27'-9"	
			27'-9"			Terminated at 27'-9" in bedrock.			

CORE LOSS

CORE RECOVERY

REMARKS:

SHEET 1 OF 1

GEOLOGICAL LOG OF DRILL HOLE

MILLER ENGINEERING, INC.

PROJECT: OLIN CHEMICAL, Wilmington, MA
BORING NO. B-6D
LOCATION See Plan
SURFACE ELEV.

PROJECT NO. 60321.01
BORING CO. Miller Eng'ring & Test.
DEPTH OF OVERBURDEN 14'-3"
DATE START: 6/27/86
DRILLING FOREMAN T. Gomulka
TOTAL DEPTH 19'-3"
DATE END: 6/27/86
ME&T REPRESENTATIVE W. Childs
WATER DEPTH 6"

TYPE & SIZE OF HOLE	CORE RECOVERY %	ELEVATION	DEPTH	LOG	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION OF ROCK	DRILLING feed	BEHAVOIR water	NOTES:
			10.0						
			14'-3"			Run #1 14'-3" to 19'-3" Dark grey-green, fine-grained granodiorite. little fracturing. REC 54"/60" 90% RQD 37"/54" 69%	10-12 min/foot	No change in color Little loss of water	(1) First attempt 11'-12' boulder, not included in 5' core.
			15						
			19'-3"						
			20			Terminated at 19'-3" in bedrock.			

CORE LOSS

CORE RECOVERY

REMARKS:

SHEET 1 OF 1

GEOLOGICAL LOG OF DRILL HOLE

MILLER ENGINEERING, INC.

PROJECT: OLIN CHEMICAL, Wilmington, MA
BORING NO. B-7D
LOCATION See Plan
SURFACE ELEV.

PROJECT NO. 60321.01
BORING CO. Miller Eng'ring & Test.
DEPTH OF OVERBURDEN 42'-7"
DATE START: 7/1/86
DRILLING FOREMAN T. Gomulka
TOTAL DEPTH 50'-7"
DATE END: 7/1/86
MEAT REPRESENTATIVE W. Childs
WATER DEPTH 9'

TYPE & SIZE OF HOLE	CORE RECOVERY %	ELEVATION	DEPTH	LOG	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION OF ROCK	DRILLING BEHAVOIR: feed	DRILLING BEHAVOIR: water	NOTES:
						Run #1 42'-7" to 44'-11" Dark grey-green, fine-grained, highly fractured granodiorite. REC 18"/28" 64% RQD 4"/18" 22%	12-16 min/foot	No recovery	(1) First attempt 36'-9" to 38" boulder, not included in 5' core.
			44'-11"						
			45'-6"			Run #2 44'-11" to 45'-6" Dark grey-green, fine-grained highly fractured granodiorite REC 5"/7" 71% RQD 4"/5" 80%	15 min/foot	No recovery	
			47'-7"			Run #3 45'-6" to 47'-7" Dark grey-green, fine-grained, less fractured granodiorite. REC 21"/25" 84% RQD 4"/21" 19%	14-17 min/foot	No recovery	
			50'-7"			Run #4 47'-7" to 50'-7" Dark grey-green, fine-grained, less fractured granodiorite. REC 35"/36" 97% RQD 22"/35" 63%	12 min/foot	No recovery	

CORE LOSS

CORE RECOVERY

REMARKS:

SHEET 1 OF 1

GEOLOGICAL LOG OF DRILL HOLE

MILLER ENGINEERING, INC.

PROJECT: OLIN CHEMICAL, Wilmington, MA — BORING NO. B-8 — LOCATION See Plan — SURFACE ELEV.

PROJECT NO. 60321.01 — BORING CO. Miller Eng'ring & Test. — DEPTH OF OVERBURDEN 27'-2"

DATE START: 7/19/86 — DRILLING FOREMAN T. Comulka — TOTAL DEPTH 32'-2"

DATE END: 7/21/86 — MEAT REPRESENTATIVE W. Childs — WATER DEPTH 32"

TYPE & SIZE OF HOLE	CORE RECOVERY %	ELEVATION	DEPTH	LOG	SAMPLES FOR TESTING	CLASSIFICATION AND PHYSICAL CONDITION OF ROCK	DRILLING BEHAVOIR: feed	DRILLING BEHAVOIR: water	NOTES:
			27'-2"			Run #1 27'-2" to 28'-5" Dark grey-green, fine-grained granodiorite with quartz veins, little fracturing. REC 14"/15" 93% RQD 14"/14" 100%	36 min/foot	Good recovery no change in color.	(1) Very dull coring bit accounts for very slow feed.
			28'-5"			Run #2 28'-5" to 32'-2" Dark grey-green, fine-grained granodiorite with quartz veins, little fracturing. REC 40"/45" 89% RQD 31"/40" 78%	12-15 min/foot	Good recovery No change in color	
			32'-2"			Terminated at 32'-2".			

CORE LOSS

CORE RECOVERY

REMARKS:

SHEET 1 OF 1

148 Pioneer Dr.
Leominster MA 01453
(617) 840-0391

SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St
Nashua, NH 03060
(603) 882-3601

Client OLIN CHEMICAL | Date 12/18/87 | Job No. 87-891

Location OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA

BORING NO. Type #4 BEDROCK | Ground Elev. | Date Start 11/30/87 | Date Complete 12/17/87 | Drilling Foreman P.N. | Eng./Hydrol. Geologist D.C.

Depth (ft)	Sample No.	Sample Depth (ft)	Blows 6" Penetration	Rec. Inches	Casing Blows Per ft.	Strata Change Depth	Visual Identification of Soil and/or Rock Strata
							NOTE : NX CORE from 0'0" to 50'0" CORED GROUT from 0'0" to 21'0" CORED BEDROCK from 21'0" to 50'0".
							Run #1 0'0"- 5'0" Recovery 18"/60" = 30%
5						5'0"	Run #2 0'5"- 10'0" Recovery 60"/60" = 100%
10						10'0"	Run #3 10'0"- 15'0" Recovery 60"/60" = 100%
15						15'0"	Run #4 15'0"- 20'0" Recovery 60"/60" = 100%
20						20'0"	Run #5 20'0"- 21'0" Recovery 12"/12" = 100%
						21'0"	Run #6 21'0"- 23'0" Recovery 18"/24" = 75%
						23'0"	Run #7 23'0"- 24'0" Recovery 12"/12" = 100%
25						24'0"	Run #8 24'0"- 28'0" Recovery 48"/48" = 100%
30						28'0"	Run #9 28'0"- 32'0" Recovery 30"/48" = 62.5%
						32'0"	Run #10 32'0"- 35'0" Recovery 36"/36" = 100%
35						35'0"	Run #11 35'0"- 37'0" Recovery 18"/24" = 75%
						37'0"	Run #12 37'0"- 40'0" Recovery 36"/36" = 100%
40						40'0"	

Type of Boring Casing Size: 8" NX Core

Proportion Percentages	Granular Soils (blows per ft.)		Cohesive Soils (blows per ft.)	
Trace 0 to 10%	0 to 4 Very Loose	30 to 50 Dense	0 to 2 Very Soft	8 to 15 Stiff
Some 10 to 40%	4 to 10 Loose	Over 50 Very Dense	2 to 4 Soft	15 to 30 Very Stiff
And 40 to 50%	10 to 30 Medium Dense		4 to 8 Medium Stiff	Over 30 Hard

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

148 Pioneer Dr.
Leominster, MA 01453
(617) 840-0391

SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St
Nashua, NH 03060
(603) 882-3601

Client: OLIN CHEMCIAL — Date: 12/18/87 — Job No. 87-891

Location: OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA

BORING NO. Type #4 BEDROCK — Ground Elev. — Date Start 11/30/87 — Date Complete 12/17/87 — Drilling Foreman P.N. — Eng./Hydrol. Geologist D.C.

Elev. (Depth)	Sample No.	Sample Depth (ft.)	Blows 6" Penetration	Rec. Inches	Casing Blows Per ft.	Strata Change Depth	Visual Identification of Soil and/or Rock Strata
							Run #13 40'0"- 43'0" Recovery 34"/36" = 94.%
45						43'0"	Run #14 43'0"- 48'0" Recovery 48"/60" = 80%
50						48'0"	Run #15 48'0"- 50'0" Recovery 24"/24" = 100%
55						50'0"	End of boring at 50'0" No water encountered upon completion NOTE : ROCK CORING was performed starting 12/14/87 to 12/17/87. AIR ROTARY was performed on 11/30/87 and; 1. 12" Roller bit to 18' in soil 2. 12" Roller bit 18' to 21' in bedrock 3. Set 8" Casing to 21' - drive casing with hammer to refusal. 4. Grouted inside and outside of 8" casing to surface. 80% Portland cement 20% Bentonite pellets
60							
65							
70							
75							
80							

Type of Boring — Casing Size: 8" — NX Core

Proportion Percentages	Granular Soils (blows per ft.)		Cohesive Soils (blows per ft.)	
Trace 0 to 10%	0 to 4 Very Loose	30 to 50 Dense	0 to 2 Very Soft	8 to 15 Stiff
Some 10 to 40%	4 to 10 Loose	Over 50 Very Dense	2 to 4 Soft	15 to 30 Very Stiff
And 40 to 50%	10 to 30 Medium Dense		4 to 8 Medium Stiff	Over 30 Hard

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

TEST BORING LOGS

MILLER ENGINEERING & TESTING, INC.

Project: OLIN CHEMICAL
Wilmington, MA
Project No: 60321.01
Date Start: 6/24/86
Date End: 6/25/86

Sheet ___ of ___
Boring No: 3-4
Location: See Plan
Surface Elev: ___

	Casing	Sampler
TYPE:	Hollow Stem Auger	Split Spoon
SIZE:	2 1/4" ID	1 3/8" ID
HAMMER:	---	140 pounds
FALL:	---	30 inches

Groundwater Observations

DATE	DEPTH	CASING AT	STABILIZATION PERIOD
7/1/86	5.1'	----	Overnight.

Depth	Cas bl/ft	Sample No.	Sample Depth	Pen.	Rec.	Blows/6"	Strata Change	Sample Description	Note
		S-1	0-1.5'	18"	18"	1-1-4	0.6'	S-1: Organic peat with fine sand and silt.	
		S-2	1.5-3.0'	18"	18"	7-12-16		S-2: Medium dense, fine, white gray sand.	
		S-3	3.0-4.5'	18"	14"	10-17-20	4.0'	S-3: Dense; medium to fine, brown silty sand.	
5.0'		S-4	4.5-6.0'	18"	16"	12-18-20		S-4: Same as S-3. (moist)	
		S-5	6.0-7.5'	18"	18"	13-22-49		S-5: Same as S-3. (wet)	
		S-6	7.5-9.0'	18"	18"	11-13-14	9.6'	S-6: Same as S-3. (wet)	
10.0'		S-7	9.0-10.5'	18"	18"	5-10-12		S-7: Medium dense, medium to fine, grey-white sand (wet).	
		S-8	10.5-12.0	18"	18"	6-9-11		S-8: Same as S-7. (wet)	
		S-9	12.0-13.5'	18"	6"	12-34-28	13.1'		
		S-10	13.5-14.5'	12"	12"	25-50		S-9: Very dense, medium to fine, grey silty sand w/gravel (wet).	(1)
15.0'								S-10: Same as S-9. (wet)	(2)
		S-11	15.0-15.1'	1"	0"	50/1		S-11: No recovery.	
20.0'		S-12	20.0-21.5'	18"	6"	38-50-50		S-12: Same as S-9. (wet)	
							22.9'	Terminated at 22.9'. Bedrock.	
25.0'									
30.0'									

Driller: T. Gomoulka
Helper: R. Marcoux
Inspector: B. Childs

PROPORTIONS USED: TRACE (0 - 10%), LITTLE (10 - 20%), SOME (20 - 35%), AND (35 - 50%)

COHESIVE CONSISTENCY (BLOWS/FOOT)		COHESIONLESS DENSITY (BLOWS/FOOT)	
0 - 2	VERY SOFT	0 - 4	VERY LOOSE
2 - 4	SOFT	4 - 10	LOOSE
4 - 8	MEDIUM STIFF	10 - 30	MEDIUM DENSE
8 - 15	STIFF	30 - 50	DENSE
15+	HARD	50+	VERY DENSE

Remarks:
(1) To threaded casing 300 lb. hammer at 14.5'.
(2) To 5' intervals at 15.0'.

Notes:
1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS HERE MADE.

TEST BORING LOGS

MILLER ENGINEERING & TESTING, INC.

Project: [illegible] CHEMICAL
Wilmington, MA
Project No: 60321.01
Date Start: 6/17/86
Date End: 6/17/86

Sheet ___ of ___
Boring No: [illegible]
Location: See Plan
Surface Elev: ___

	Casing	Sampler
TYPE:	Hollow Stem Auger	Split Spoon
SIZE:	2 1/4" ID	1 3/8" ID
HAMMER:	---	140 pounds
FALL:	---	30 inches

Groundwater Observations

DATE	DEPTH	CASING AT	STABILIZATION PERIOD
8/13/86	6.2'	-------	Overnight

Depth	Cas bl/ ft	Sample No.	Depth	Pen.	Rec.	Blows/6"	Strata Change	Sample Description	Note
		S-1	0-2.0'	24"	12"	5-8		S-1: Medium dense, dark brown to gray, medium to fine silty sand.	
						5-10			
		S-2	2.5'-4.0'	18"	8"	16-13		S-2: Same as S-1.	
						8			
5.0'		S-3	4.0-6.0'	24"	16"	4-2		S-3: Same as S-1. (moist)	
						6-8			
		S-4	6.0-8.0'	24"	14"	12-20		S-4: Same as S-1. (wet)	
						17-19			
	*	S-5	8.0-10.0'	24"	10"	8-11		S-5: Same as S-1. (wet)	
10.0'						13-12			
	*	S-6	10.0-12.0'	24"	24"	6-8		S-6: Same as S-1. (wet)	
						12-12			
	*	S-7	12.0-14.0'	24"	24"	12-16		S-7: Same as S-1. (wet)	
						20-21			
							14.6'		
15.0'	*	S-8	14.0-15.3'	15"	15"	22-60		S-8: Very dense, dark to light grey, medium to fine, silty sand with gravel (wet).	(1)
						50/3			
	*	S-9	16.0-17.0'	12"	12"	54-90		S-9: Same as S-8. (wet)	
	*	S-10	18.0-18.9'	9"	9"	24-100/3		S-10: Same as S-8. (wet)	
20.0'	*	S-11	19.0-20.0'	12"	6"	50-50		S-11: Same as S-8. (wet)	
	*	S-12	20.0-21.7'	19"	6"	12-34	21.0'		
							21.7'	S-12: Dense to medium dense course dark gray to brown sand with gravel (wet)	
	*	S-13	22.0-22.9'	9"	9"	75-50/3			
25.0'								S-13: Same as S-8. (wet)	
							27.4'		
30.0'								Terminated at 27.4' depth; bedrock.	(2)

Proportions used: trace (0 - 10%), little (10 - 20%), some (20 - 35%), and (35 - 50%)

Cohesive Consistency (Blows/Foot): 0 - 2 very soft; 2 - 4 soft; 4 - 8 medium stiff; 8 - 15 stiff; 15+ hard

Cohesionless Density (Blows/Foot): 0 - 4 very loose; 4 - 10 loose; 10 - 30 medium dense; 30 - 50 dense; 50+ very dense

Driller: T. Comoulka
Helper: B. Marcoux
Inspector: B. Childs

Remarks: (1) High blow count due to cobble and/or boulder.
(2) Hole terminated at 20', lost casing, moved 3'.

* Those samples starred to be used for grain size distribution.

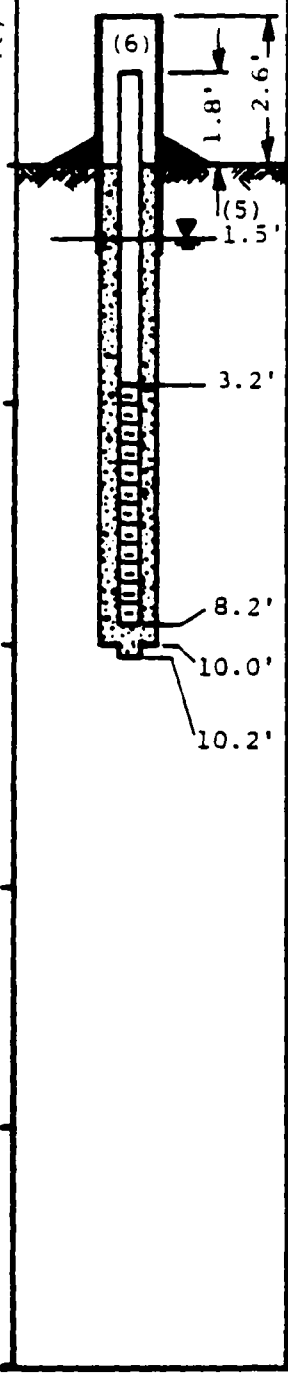
Notes:
1) The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
2) Water level readings have been made in the drill holes at times and under conditions stated on the boring logs. Fluctuations in the level of the groundwater may occur due to other factors than those present at the time measurements were made.

GROUNDWATER WELL INSTALLATION REPORT

Groundwater Well No.: 8 | Date Installed: Oct. 28, 1977

Permeability(1) : 2 x 10^{-2} cm/sec | Project No. : 77348

Well Installed by Carr-Dee Test Boring Corp. | Soils Described by R. Gardner, GEI



Elevation (ft) (2)	Depth (ft)	Split Spoon Sample No. and Location	Blows per 6" (3)	Rec. (in.) (4)	Sample Description
77.8	0	SS-1A SS-1B	1-2-7-18	12	SS-1A ~8" Fibrous peat. SS-1B ~4" Dark brown silty fine sand. Organic material and fibrous material present.
72.8	5	SS-2	25-20-20-21	11	SS-2 Slightly silty sandy gravel Particles are angular to subrounded up to 1 3/8" in size.
67.8	10	*			*Drove open-ended "A" rod with 200 lb weight. Refusal at 10.2'; 120 blows/no penetration
62.8	15				
57.8	20				
52.8	25				

Notes: (1), (2), (3), (4) See first page of Appendix A for additional information

(5) Groundwater level is the average of seven measurements taken from November 2, 1977 to May 31, 1978.

(6) On May 31, 1978 the riser pipe and slotted pervious section were lifted approximately 1.4' while removing standpipe used to conduct permeability test. The existing dimensions for the riser pipe and slotted section are given.

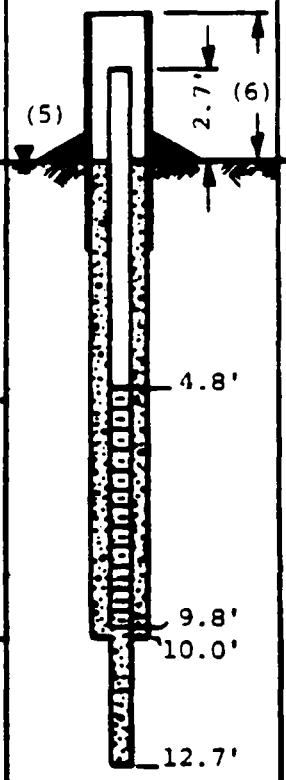
Geotechnical Engineers Inc.

GROUNDWATER WELL INSTALLATION REPORT

Groundwater Well No.: 12 | Date Installed: Nov. 2, 1977

Permeability(1) : 4×10^{-3} cm/sec | Project No. : 77348

Well Installed by Carr-Dee Test Boring Corp. | Soils Described by R. Gardner, GEI



Elevation (ft) (2)	Depth (ft)	Split Spoon Sample No. and Location	Blows per 6" (3)	Rec. (in.) (4)	Sample Description
82.0	0	SS-1A SS-1B	1-1-2-3	17	SS-1A ~8" Black sandy humus SS-1B ~9" Brown organic silty fine sand.
77.0	5	SS-2	19-30-40-34	13	SS-2 Light brown slightly silty, gravelly fine to coarse sand.
72.0	10	SS-3	33-34-29-21	9	SS-3 Gray slightly silty sandy gravel. Gravel is angular to subrounded and up to ~1 3/8" in size.
67.0	15				*Drove open-ended "A" rod with 200-lb weight. 120 blows for last 2" of penetration.
62.0	20				Recovered brownish-gray clayey, gravelly sand.
57.0	25				

Notes: (1), (2), (3), (4) See first page of Appendix A for additional information.

(5) Groundwater level is the average of seven measurements taken from November 2, 1978 to May 31, 1978.

(6) Prior to May 31, 1978, distance from ground surface to top of casing was 3.3'. Casing was removed to perform permeability test and replaced to present "stickup" of 3.6'.

Geotechnical Engineers Inc.

NEW ENGLAND POLLUTION CONTROL CO., INC.

7 EDGEWATER PLACE
EAST NORWALK, CT 06855

24 HOUR SERVICE
POLLUTION CONTROL SUPPLIES & SERVICE

- ☐ EAST NORWALK, CT 203.852-[illegible]
- ☐ NEW HAVEN, CT 203.[illegible]
- ☐ NEW LONDON, CT. 203.443-[illegible]
- ☐ NEWARK, N.J. 201.589-[illegible]
- ☐ PHILADELPHIA, PA. 215.563-[illegible]

Page _____ of _____

Date 12-23-[illegible]

Job No. _____

Job Address Olin Chemical Wilmington, Mass.

Boring No. 3 (GW13)

Fixed Datum used is _____

Ground Surface this boring is _____

DEPTH From	DEPTH To	CLASSIFICATION Be Careful and Accurate	CASING BLOWS 0-27	CASING BLOWS 28-54	SAMPLE No.	Depth	No. of 30" Blows on Spoon 1st 6"	2nd 6"	3rd 6"	4th 6"	Recovery in.	Lost Water * or Remarks
0'	12'	Fine Light Brown Sand										
12'	18'	Fine Light Brown Sand										
		Medium										
		Boulders										
18'	18'6"	Refusal										
		5" PVC Slotted Well										*After
		Installed										Sealing
												water [illegible]
												to [illegible]
												[illegible]

Ground Surface to _____ ft. used _____ casing.

Water level is _____ ft. below Ground surface _____ hrs. after completion

Water level is _____ ft. below Ground surface _____ hrs. after completion

Boring stopped by _____

Driller D. Fiorentino

Helper G. Birchard, J. [illegible]

Rig. No. 21

NEW ENGLAND POLLUTION CONTROL CO., INC.

7 EDGEWATER PLACE
EAST NORWALK, CT 06855

24 HOUR SERVICE
POLLUTION CONTROL SUPPLIES & SERVICE

- ☐ EAST NORWALK, CT 203.853-[illegible]
- ☐ NEW HAVEN, CT 203.[illegible]
- ☐ NEW LONDON, CT 203.443-[illegible]
- ☐ NEWARK, N.J. 201.589-[illegible]
- ☐ PHILADELPHIA, PA. 215.563-[illegible]

Page _____ of _____

Date December 4th, 1981

Job No. _____

Job Address [illegible] Corp. Wilmington, Mass.

Boring No 5 (GW

Fixed Datum used is _____

Ground Surface this boring is _____

DEPTH From	DEPTH To	CLASSIFICATION Be Careful and Accurate	CASING BLOWS 0-27	CASING BLOWS 28-54	SAMPLE No.	Depth	No. of 30" Blows on Spoon 1st 6"	2nd 6"	3rd 6"	4th 6"	Recovery in	Lost Water or Remarks
0'	4'	Fine to Medium Brown										
		Sand Heavily Stained										
		by Product										
4'	10'	Brown Sand Fine to										
		Medium Grade										
10'	12'	Brown Sand Fine to										
		Medium Grade, Small										
		to medium boulders										
12'	12'6"	Refusal										
		Installed 4" slotted										
		PVC pipe to 12'-6"										

Ground Surface to _____ ft. used _____ casing.

Water level is _____ ft. below Ground surface _____ hrs. after completion

Water level is _____ ft. below Ground surface _____ hrs. after completion

Boring stopped by _____

Driller D. Fiorentino

Helper G. Birchard, J. [illegible]

Rig. No. 21

BORING GW-17D

PROJECT: Olin-Wilmington	PROJECT NO: 284-10-1E00
DATE: 3/3/81	LOCATION: Wilmington, MA
DRILLING CONTRACTOR: Soil Exploration	INSPECTOR: CA Kraemer
DRILLING METHOD: 24" hollow stem augers	SAMPLING METHOD: 2" split spoon 300 lb. hammer with 24" drop
ELEVATION:	DATUM:

SAMPLE no.	SAMPLE depth	blows per 6"		DEPTH	STRATA	SOIL DESCRIPTION density, color, SOIL, admixtures, moisture, other notes, ORIGIN	WELL CONST.	REMARKS
S-1	0'-2'	1	0			very loose, brown, PEAT, little sand, wet		
		1	0					
S-2	2'-4'	7	11			medium dense, brown, SILT and fine SAND, trace clay, wet		
		15	12					
S-3	4'-6'	9	15	5		Dense, brown-gray, fine to coarse SAND, little silt, trace gravel, wet		
S-4	6'-8'	19	20					
		25	10					
S-5	8'-9.5'	15	100			very dense, gray/brown, SAND, some silts, some gravel, wet, GLACIAL TILL		
		70		10		Top of Rock, 13.0 feet		
						Run 1 13.0'-18.0', run 5.0 feet, recover 4.8 feet, 96% recovery		
				15		Run 2 18.0'-23.0', run 5.0 feet, recover 3.5, 70% recovery		
				20		Bottom of boring, 23.0 feet		
				25				
				30				
				35				

NOTES: Monitoring well installed. Cement-bentonite slurry from 13.0 to 23.0'. Tip of 5.0 foot 0.010-inch machine slotted well screen set at feet and backfilled with uniform medium sand to 7.0 feet. Cement-bent slurry from 7.0 feet to ground surface. 5-foot long 6-inch diameter pro tive steel sleeve, with locking cap, placed on top.

MALCOLM PIRNIE INC

BORING GW-18D

PROJECT: Olin-Wilmington	PROJECT NO: 284-10-1E00
DATE: 2/24/81	LOCATION: Wilmington, MA
DRILLING CONTRACTOR: Soil Exploration	INSPECTOR: CA Kraemer
DRILLING METHOD: 2½" hollow stem augers	SAMPLING METHOD: 2" split spoon 300 lb. hammer with 24" drop
ELEVATION:	DATUM:

SAMPLE no.	SAMPLE depth	blows per 6"		DEPTH	STRATA	SOIL DESCRIPTION density, color, SOIL, admixtures, moisture, other notes, ORIGIN	WELL CONSTR.	REMA
S-1	0'-2'	1	0			Very loose, brown, PEAT and SAND, moist		
S-2	2'-4'	12	15			Very dense, tan SAND, some gravel, some silt, moist		
		20	20					
S-3	4'-5'	15	31	5		Very dense, brown/gray, SAND some gravel, some silt, wet, GLACIAL TILL		
S-4	6'-8'	12	24					
		21	22					
S-5	8'-10'	30	28					
		20	20	10				
S-6	11'-13'	11	30					
		50	40					
				15				
				20		Top of rock, 19.9 feet Run 1 20.0 to 25.0 feet, run 5.0 feet recover 3.5 feet 70% recovery		
				25		Run 2 25.0'-26.0', Run 1.0 foot Recover 0.0 feet, 0% recovery		
				30		Bottom of boring, 26.0 feet		
				35				

NOTES: Monitoring well installed. Cement-bentonite slurry from 20.0' to 26.0'. Tip of 5.0 foot 0.010-inch machine slotted well screen set at 19.5feet and backfilled with medium uniform sand. Cement-bentonite slurry from 10.0 feet to ground surface. 5-foot long 6-inch diamet protective steel sleeve, with locking cap, placed on top.

BORING GW-19D

PROJECT: Olin-Wilmington	PROJECT NO: 284-10-1E00
DATE: 2/9/81	LOCATION: Wilmington, MA
DRILLING CONTRACTOR: Soil Exploration	INSPECTOR: CA Kraemer
DRILLING METHOD: 2½" hollow stem augers	SAMPLING METHOD: 2" split spoon 300 lb. hammer with 24" drop
ELEVATION:	DATUM:

SAMPLE no.	SAMPLE depth	blows per 6"		DEPTH	STRATA	SOIL DESCRIPTION (density, color, SOIL, admixtures, moisture, other notes, ORIGIN)	WELL CONST.	REMARKS
						Dense, brown, SILT and SAND, little gravel, frozen, FILL		
S-1	2'-4'	1	0			Very loose, light gray, SILT, wet, GYPSUM SLUDGE		
		0	0					
S-2	4'-6'	1	0					
		0	0	5				
S-3	6'-7.5'	1	1			Very loose, brown, SILT and SAND, some organics, wet		
S-4	7.5'-9.0'	2	2					
		2	12					
S-5	9'-10'	8	100	10		Grading to little gravel		
						Very dense brown/gray, SAND and gravel, little silt, wet, GLACIAL TILL		
S-6	11'-12.5'	12	25					
S-7	12.5'-13.3'	35	15					
		100/	.3'					
S-8	14'-14.8'	30						
		100/	.3'	15		Boulder 15'-16.1'		
						Boulder, 16.5'-17.1' and 17.1'-17.8'		
						Boulder 18'-18.8' and 19.3'-19.9'		
						Top of rock 20.0 feet		
				20		Run 1 20.0'-23.0' run 3.0 feet		
						Recover 2.0 feet, 67% recovery		
						Run 2 23.0'-24.3' Run 1.3 feet		
						Recover 0.0 feet 0% recovery		
				25		(Core barrel broke)		
						Bottom of boring 24.3 feet		
				30				
				35				

NOTES: Monitoring well installed. Cement-bentonite slurry from 20.0' to 24.3'. Tip of 5.0 foot 0.010-inch machine slotted well screen set at 19.7 feet and backfilled with medium uniform sand to 10.0 feet. Cement-bentonite slurry from 10.0 feet to ground surface. 5-foot long 6-inch protective steel sleeve, with locking cap, placed on top.

MALCOLM PIRNIE INC

TEST BORING LOGS

MILLER ENGINEERING & TESTING, INC.

Project: [illegible] CHEMICAL
Wilmington, MA
Project No: 60321.01
Date Start: 6/25/86
Date End: 6/25/86

Sheet 1 of ___
Boring No: B-5
Location: See Plan
Surface Elev: ___

	Casing	Sampler
TYPE:	Hollow Stem Auger	Split Spoon
SIZE:	2 1/4" ID	1 3/8" ID
HAMMER:	---	140 pounds
FALL:	---	30 inches

Groundwater Observations

DATE	DEPTH	CASING AT	STABILIZATION PERIOD
7/1/86	6.5'		Overnight

Depth	Cas bl/ ft	Sample No.	Depth	Pen.	Rec.	Blows/6"	Strata Change	Sample Description	Note
		S-1	0-1.5'	18"	14"	1-2-3		S-1: Loose, light brown, silty sand.	
		S-2	1.5-3.0'	18"	18"	2-2-2		S-2: Same as S-1.	
		S-3	3.0-4.5'	18"	3"	4-7-5		S-3: Same as S-1.	
5.0'		S-4	4.5-6.0'	18"	12"	6-2-1		S-4: Same as S-1.	
		S-5	6.0-7.5'	18"	12"	1/12-1		S-5: Same as S-1 with some peat. (moist)	
		S-6	7.5-9.0'	18"	2"	1/18		S-6: Same as S-1. (wet)	
10.0'		S-7	9.0-10.5'	18"	10"	8-18-17	10.0'	S-7: Dense, medium to fine, tan to light brown silty sand.	
		S-8	10.5-12.0'	18"	18"	9-15-20		S-8: Same as S-7. (wet)	
		S-9	12.0-13.5'	18"	10"	3-6-12		S-9: Same as S-7. (wet)	
15.0'		S-10	13.5-15.0'	18"	18"	3-13-18		S-10: Same as S-7. (wet)	
		S-11	15.0-16.5'	18"	16"	6-12-19	16.5'	S-11: Same as S-7 with some gravels. (wet)	
		S-12	16.5-17.5'	12"	12"	44-50		S-12: Very dense, grey, medium to fine, silty sand with gravel, trace clay.	(1)
		S-13	18.0-19.4'	16"	16"	28-33-50/4	19.4'	S-13: Same as S-12 (wet).	
20.0'									
								Terminated at 19.4' depth.	
25.0'									
30.0'									

Proportions used: Trace (0 - 10%), Little (10 - 20%), Some (20 - 35%), and (35 - 50%)

Cohesive Consistency (tons/foot)	Cohesionless Density (tons/foot)
0 - 2 very soft	0 - 4 very loose
2 - 4 soft	4 - 10 loose
4 - 8 medium stiff	10 - 30 medium dense
8 - 15 stiff	30 - 50 dense
15+ hard	50+ very dense

Driller: T. Gomoulka
Helper: B. Marcoux
Inspector: R. Childs

Remarks: (1) Pushing pebble, blow count high.

Notes:
1) The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
2) Water level readings have been made in the drill holes at times and under conditions stated on the boring log. Fluctuations in the level of the groundwater may occur due to other factors than those present at the time measurements were made.

BORING GW-22D

PROJECT: Olin-Wilmington	PROJECT NO: 284-10-1E00
DATE: 3/4/81	LOCATION: Wilmington, MA
DRILLING CONTRACTOR: Soil Exploration	INSPECTOR: CA Kraemer
DRILLING METHOD: 2¼" hollow stem augers	SAMPLING METHOD: 2" split spoon 300 lb. hammer with 24" drop
ELEVATION:	DATUM:

SAMPLE no.	SAMPLE depth	blows per 6"		DEPTH	STRATA	SOIL DESCRIPTION density, color, SOIL, admixtures, moisture, other notes, ORIGIN	WELL CONSTR.	REMAR
S-1	0'-2'	1	2			Loose, brown, SAND, trace silt, wet, MISCELLANEOUS FILL (also contains construction lumber, metal strips, and chemical products)		
		5	6					
S-2	2'-4'	6	5					
		4	4					
S-3	4'-6'	3	2					
		7	8	5				
S-4	6'-8'	8	9					
		14	28					
S-5	8'-10'	8	9					
		14	28					
S-6	10'-12'	23	26	10		Dense brown, fine SAND, little gravel, little silt, wet		
		18	21					
S-7	12'-14'	14	21					
		25	26					
S-8	14'-16'	24	25					
		19	19	15		Dense gray/brown, SAND, some silt, some gravel, moist, GLACIAL TILL		
				20				
				25				
				30				
				35		Top of Rock 36.0 feet Bottom of boring, 36.0 feet		

NOTES: Monitoring well installed. Tip of 5.0 foot 0.010-inch machine sl
well screen set at 35.0 feet and backfilled with uniform medium san
to 15.0 feet. Cement-bentonite slurry from 15.0 feet to ground surf
5-foot long 6-inch diameter protective steel sleeve, with locking c
placed on top.

TEST BORING LOGS

MILLER ENGINEERING & TESTING, INC.

Project: DEXTER CHEMICAL
Wilmington, MA
Project No: 60321.01
Date Start: 6/19/86
Date End: 6/20/86

Sheet ___ of ___
Boring No: B-3
Location: See Plan
Surface Elev: ___

	Casing	Sampler
TYPE:	Hollow Stem Auger	Split Spoon
SIZE:	2 1/4" ID	1 3/8" ID
HAMMER:	---	140 pounds
FALL:	---	30 inches

Groundwater Observations

DATE	DEPTH	CASING AT	STABILIZATION PERIOD
6/24/86	7.3'		Overnight

Depth	Casbl/ft	Sample No.	Sample Depth	Pen.	Rec.	Blows/6"	Strata Change	Sample Description	Note
		S-1	0-1.5'	18"	12"	2-7-12	2.0'	S-1: Loose, light brown, medium sand and gravel fill.	
		S-2	1.5-3.0'	18"	8"	20-8-4		S-2: Same as S-1.	
5.0'		S-3	3.0'-4.5'	18"	10"	4-1-2		S-3: Peat, fine silty sand with organics.	
		S-4	4.5-6.0'	18"	12"	1-1-1		S-4: Same as S-3.	
		S-5	6.0-7.5'	18"	6"	1-1-1	7.5'	S-5: Same as S-3 with some wood chips. (moist)	(1)
10.0'		S-6	7.5'-9.0'	18"	9"	5-4-5		S-6: Loose, dark brown, medium fine silty sand. (wet)	
		S-7	9.0-10.5'	18"	18"	5-5-16		S-7: Same as S-6. (wet)	
		S-8	10.5-11.10'	16"	16"	15-28-50/4	11.7'	S-8: Same as S-6. (More gray) (wet)	(2)
		S-9	12.0-12.11'	11"	11"	40-50/5		S-9: Very dense, grey, medium to fine silty sand with gravel (wet).	(3)
		S-10	13.5-14.5'	12"	12"	22-60		S-10: Same as S-9. (wet)	(4)
15.0'							15.0'	Terminated at 15.0' depth.	(5)
20.0'									
25.0'									
30.0'							30.9'	Terminated at 30.9' bedrock.	

Proportions used: Trace (0 - 10%), Little (10 - 20%), Some (20 - 35%), and (35 - 50%)

Cohesive Consistency (tons/foot)
0 - 2 very soft
2 - 4 soft
4 - 8 medium stiff
8 - 15 stiff
30+ hard

Cohesionless Density (tons/foot)
0 - 4 very loose
4 - 10 loose
10 - 30 medium dense
30 - 50 dense
50+ very dense

Driller: T. Gomoulka
Helper: R. Marcoux
Inspector: W. Childs

Remarks: (1) Pushing piece wood, blow count higher.
(2) (3) Pushing piece of gravel, blow count high.
(4) No samples after 15.0', OK by M. Bellotti.
(5) Boulder core 26.2'-28.0'.

Notes:
1) The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
2) Water level readings have been made in the drill holes at times and under conditions stated on the boring log. Fluctuations in the level of the groundwater may occur due to other factors than those present at the time measurements were made.

TEST BORING LOGS

MILLER ENGINEERING & TESTING, INC.

Project: OLIN CHEMICAL
Wilmington, MA
Project No: 60321.01
Date Start: 7/ 2/86
Date End: 7/10/86

Sheet ___ of ___
Boring No: B-90
Location: See Plan
Surface Elev: ___

	Casing	Sampler
TYPE:	Hollow Stem Auger	Split Spoon
SIZE:	2 1/4" ID	1 3/8" ID
HAMMER:	---	140 pounds
FALL:	---	30 inches

Groundwater Observations

DATE	DEPTH	CASING AT	STABILIZATION PERIOD
7/21/86	0.23'		Overnight

Depth	Cas bl/ft	Sample No.	Sample Depth	Pen.	Rec.	Blows/6"	Strata Change	Sample Description	Note
		S-1	0.0-9.0'	24"	24"	Weight of rod.		S-1: Peat, organics with trace silty sand. (wet)	
5.0'									
							9.0'		
10.0'		S-2	9.0-10.5'	18"	16"	10-10-12		S-2: Loose, brown to gray medium to fine silty sand. (wet)	
		S-3	10.5-12.5'	24"	24"	5-9		S-3: Same as S-2. (wet)	
						9-5			
		S-4	12.5-13.5'	12"	10"	1-2		S-4: Same as S-2. (wet)	
15.0'									(1)
20.0'		S-5	20.0-22.0'	24"	14"	7-7			
						14-26	21.5'		
								S-5: Dense, gray, medium to fine silty sand with gravel. (wet)	
25.0'		S-6	25.0-25.5'	5"	1"	65/5		S-6: Same as S-5. (wet)	
									(2) (3)
30.0'								Terminated at 29.0'.	

Proportions used: trace (0 - 10%), little (10 - 20%), some (20 - 35%), and (35 - 50%)

Driller: T. Gomoulka
Helper: R. Marcoux
Inspector: B. Childs

Cohesive Consistency (blows/foot): 0 - 2 very soft; 2 - 4 soft; 4 - 8 medium stiff; 8 - 15 stiff; 15+ hard

Cohesionless Density (blows/foot): 0 - 4 very loose; 4 - 10 loose; 10 - 30 medium dense; 30 - 50 dense; 50+ very dense

Remarks: (1) Boulder at 13.8' to 18.0'. (2) Hole moved after excessive boulders at 23.0'.
(3) Terminated on boulders at 29.0' with OK from M. Bellotti, 7/10/86

Notes: (4) Boulder core at 15.8'-18.8'.
1) The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
2) Water level readings have been made in the drill holes at times and under conditions stated on the boring logs. Fluctuations in the level of the groundwater may occur due to other factors than those present at the time measurements were made.

Sheet # ___ of

148 Pioneer Dr.
Leominster, MA 01453
(617) 840-0391

SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingal
Nashua, NH 0
(603) 882-3

Client: OLIN CHEMICAL | Date: 11/24/87 | Job No.: 87-891

Location: OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA

BORING NO. Type #3 Replacement | Ground Elev. | Date Start: 11/18/87 | Date Complete: 11/18/87 | Drilling Foreman: M.Z. | Eng./Hydrol Geologist

Depth Ft.	Sample No.	Sample Depth (ft.)	Blows 6" Penetration	Rec. Inches	Casing Blows Per ft.	Strata Change Depth	Visual Identification of Soil and/or Rock Strata
							No samples required.
5							Moist to wet, fine to medium SAND, trace inorganic silt, trace fine to medium gravel.
10							
15						15'0"	Wet fine to medium SAND, trace to so inorganic silt, trace fine to coarse gravel, trace cobbles.
20							
25							
30							
35							
40	Run #1	39'6"-	40'6"	8 min./foot		39'6"	Refusal at 39'6" with hollow stem au Run #1 CORED ROCK from 39'6" to 41'6 Recovery 14"/24" = 58.3%
		40'6"-	41'6"	10 min./foot			

Type of Boring: Casing Size: | Hollow Stem Auger Size: 4¼

Proportion Percentages	Granular Soils (blows per ft.)		Cohesive Soils (blows per ft.)	
Trace 0 to 10%	0 to 4 Very Loose	30 to 50 Dense	0 to 2 Very Soft	8 to 15 Stiff
Some 10 to 40%	4 to 10 Loose	Over 50 Very Dense	2 to 4 Soft	15 to 30 Very Stiff
And 40 to 50%	10 to 30 Medium Dense		4 to 8 Medium Stiff	Over 30 Hard

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

GW30DR Sheet # — of —

148 Pioneer Dr.
Leominster, MA 01453
(617) 840-0391

SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St
Nashua, NH 03060
(603) 882-360

Client: OLIN CHEMICAL — Date: 11/24/87 — Job No.: 87-891

Location: OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA

BORING NO.: Type #3 Replacement — Ground Elev.: — Date Start: 11/18/87 — Date Complete: 11/18/87 — Drilling Foreman: M.Z. — Eng./Hydrol. Geologist:

Depth	Sample No	Sample Depth (ft.)	Blows 6" Penetration	Rec. Inches	Casing Blows Per ft.	Strata Change Depth	Visual Identification of Soil and/or Rock Strata
	Run #1	39'6"-	40'6"	8 min./foot			Run #1 CORED ROCK from 39'6" to 41'6".
		40'6"-	41'6"	10 min./foot			Recovery 14"/24" = 58.3%
						41'6"	End of boring at 41'6"
							Water level at 7'0" upon completion
45							Set well point at 41'6"
							Well Materials;
							1 - 2" PVC end plug
							1 - 10' x 2" PVC screen
50							3 - 10' x 2" PVC riser
							1 - 5' x 2" PVC riser
							1 - protective locking casing
							1 bag - sakrete sand
							3 bags - Portland cement
55							1 pail - bentonite pellets
60							
65							
70							
75							
80							

Type of Boring: — Casing Size: — Hollow Stem Auger Size: 4¼

Proportion Percentages
Trace 0 to 10%
Some 10 to 40%
And 40 to 50%

Granular Soils (blows per ft.)
0 to 4 Very Loose
4 to 10 Loose
10 to 30 Medium Dense
30 to 50 Dense
Over 50 Very Dense

Cohesive Soils (blows per ft.)
0 to 2 Very Soft
2 to 4 Soft
4 to 8 Medium Stiff
8 to 15 Stiff
15 to 30 Very Stiff
Over 30 Hard

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

148 Pioneer Dr
Leominster, MA 01453
(617) 840-0391

SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St
Nashua, NH 03060
(603) 882-3601

Client: OLIN CORPORATION — Date: 04/18/88 — Job No: 88-238

Location: EAMES STREET, WILMINGTON, MASSACHUSETTS

BORING NO. GW-3I SHALLOW — Ground Elev — Date Start 04/12/88 — Date Complete 04/12/88 — Drilling Foreman M.Z. — Eng Hydrol Geologist M.B.

Elevation	Sample No	Sample Depth (ft.)	Blows 6" Penetration	Rec Inches	Casing Blows Per ft.	Strata Change Depth	Visual Identification of Soil and/or Rock Strata
							Dry, medium brown to orange, fine SAND, trace inorganic silt, trace root matter
5						4'0"	Moist to wet, fine SAND, trace inorganic silt.
10							
15						14'0"	Wet, fine to coarse SAND, and gravel, some inorganic silt, trace cobbles.
20						16'0"	End of boring at 16'0" Set 2" STAINLESS STEEL well point 16'0" Water level at 8'0" upon completion Well Materials; 1 - 2" end plugs 1 - 10' x 2" STAINLESS STEEL screen 1 - 5' x 2" STAINLESS STEEL riser 1 - 2' x 2" STAINLESS STEEL riser 1 - protective locking casing 2 bags-sakrete sand 8 bags-silica sand 1 pail-bentonite pellets NOTE: NO SAMPLES REQUIRED Boring 3' from B-2 Deep
25							
30							
35							
40							

Type of Boring — Casing Size: — Hollow Stem Auger Size: 6¼

Proportion Percentages	Granular Soils (blows per ft.)		Cohesive Soils (blows per ft.)	
Trace 0 to 10%	0 to 4 Very Loose	30 to 50 Dense	0 to 2 Very Soft	8 to 15 Stiff
Some 10 to 40%	4 to 10 Loose	Over 50 Very Dense	2 to 4 Soft	15 to 30 Very Stiff
And 40 to 50%	10 to 30 Medium Dense		4 to 8 Medium Stiff	Over 30 Hard

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.

Project: OLIN CHEMICAL CORPORATION
Wilmington, MA

Project No: 90718.01
Date Start:
Date End:

Sheet 1 **of** 3
Boring No: GW-37
Location:
Surface Elev:

	Casing	Sampler
Type	Flush Joint	Split Spoon
Size	4" ID	1-3/8" ID
Hammer	---	140 pounds
Fall	---	30 inches

Groundwater Observations

DATE	DEPTH	CASING AT	STABILIZATION PERIOD
	1.0'	---	Upon Completion

Depth	Cas bl/ft.	SAMPLE No.	Depth	Pen.	Rec.	Blows/6"	Strata Change	Sample Description	Notes
		S-1	0.0-2.0'	24"	4"	1-1		S-1: Black peat	
						3-4	2.0'		
		S-2	2.0-4.0'	24"	19"	6-7		S-2: Yellow-brown, medium to fine sand, trace gravel	
						7-8			
5.0'		S-3	4.0-6.0'	24"	24"	6-8		S-3: Same as S-2	
						8-9			
		S-4	6.0-8.0'	24"	18"	9-10		S-4: Same as S-2	
						11-11			
		S-5	8.0-10.0'	24"	24"	4-7		S-5: Gray-brown, fine sand	
10.0'						5-6			
		S-6	10.0-12.0'	24"	24"	7-6		S-6: Same as S-5	
						7-7			
		S-7	12.0-13.0'	12"	12"	10-10	13.0'	S-7: Same as S-5	
		S-7A	13.0-14.0'	12"	12"	19-27		S-7A: Gray-brown, fine to coarse sand, gravel and boulders	
15.0'									
		S-8	17.0-17.5'	6"	6"	55-50/0"		S-8: Same as S-7A, boulders	
								BOULDERS	
20.0'		S-9	19.0-19.5'	6"	6"	61-50/0"		S-9: Yellow-brown, coarse sand, gravel, pulverized boulders	
		S-10	21.0-21.5'	6"	6"	58-50/0"		S-10: Yellow-brown, fine to coarse sand, gravel and boulders	
25.0'		S-11	25.5-26.0'	6"	4"	28-50/6"		S-11: Gray-brown, fine to coarse sand, gravel and boulders	
							27.0'		
30.0'								Started to core at 27.0' RUN #1 27.0-32.0' RECOVERY: 56" Core Time per/foot 14:-12:-12:-12:-13:	

Driller: M. D'Ambrosio
Helper: K. Smith
Inspector:

COHESIVE CONSISTENCY (Blows/Foot)	
0 - 2	VERY SOFT
2 - 4	SOFT
4 - 8	MEDIUM STIFF
8 - 16	STIFF
16 - 30	HARD

CONGLOMERATE DENSITY (Blows/Foot)	
0 - 4	VERY LOOSE
4 - 10	LOOSE
10 - 30	MEDIUM DENSE
30 - 50	DENSE
50+	VERY DENSE

PROPORTIONS USED	
TRACE	0 - 10%
LITTLE	10 - 20%
SOME	20 - 35%
AND	35 - 50%

NOTES

See attached sheet for Monitoring Well installation

REMARKS: THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITION MAY BE GRADUAL. WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

TEST BORING LOG

MILLER ENGINEERING & TESTING, INC.

Project: OLIN CHEMICAL CORPORATION
Wilmington, MA
Project No: 90718.01
Date Start:
Date End:

Sheet 2 **of** 3
Boring No: GW-37
Location:
Surface Elev:

	Casing	Sampler
Type	Flush Joint	Split Spoon
Size	4" ID	1-3/8" ID
Hammer	---	140 pounds
Fall	---	30 inches

Groundwater Observations

DATE	DEPTH	CASING AT	STABILIZATION PERIOD

Depth	Cas bl/ft	SAMPLE No.	Depth	Pen.	Rec.	Blows/6"	Strata Change	Sample Description	Notes
							32.0'	Bedrock	
								Bottom of Exploration at 32.0'	
35.0'									
40.0'								NOTE: Made several attempts getting down through boulders. Attempt #1 augered down to 21.5' augers going at angle, due to boulders. Attempt #2 augered to 14.0' - drove casing to 23.0' used roller bit to get to 26.0' - casing at angle to much to rock core	
45.0'								NOTE: Hit boulder at 21.5' depth; boulder from 21.5 to 25.0' depth' hit another boulder or bedrock from 26.0 to 27.0' depth, using spinning shoe to get through boulders.	
50.0'									
55.0'									
60.0'									

Driller: M. D'Ambrosio
Helper: K. Smith
Inspector:

COHESIVE CONSISTENCY (Blows/Foot)
0 - 2 VERY SOFT
2 - 4 SOFT
4 - 8 MEDIUM STIFF
8 - 15 STIFF
15 - 30 HARD

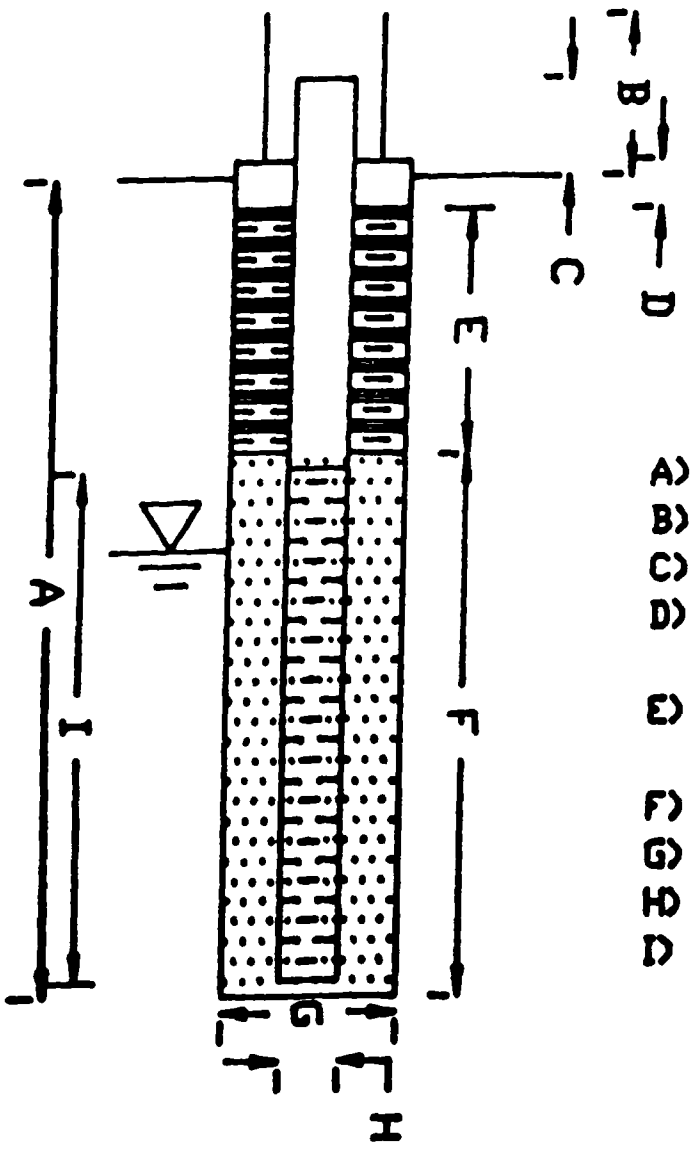
COHESIONLESS DENSITY (Blows/Foot)
0 - 4 VERY LOOSE
4 - 10 LOOSE
10 - 30 MEDIUM DENSE
30 - 50 DENSE
50+ VERY DENSE

PROPORTIONS USED
TRACE 0 - 10%
LITTLE 10 - 20%
SOME 20 - 35%
AND 35 - 50%

NOTES Note: Drilling water coming up green when coring rock, lost drilling water at 30.0'

REMARKS: THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES. TRANSITION MAY BE GRADUAL. WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

MONITORING WELL DIAGRAM



A) Borehole Depth: 29.5'
B) Cover Pipe Stickup: 2.0' ±
C) Riser Pipe Stickup: 1.5' ±
D) Concrete Seal Thickness: 1.1'
E) Bentonite Seal Thickness: 14.0'
F) Sand Pack: 15.5'
G) Borehole Diameter: 4"
H) Wellscreen Diameter: 2"
I) Wellscreen Length: 10.0'

Driller: M. D'Ambrosio
Helper: K. Smith
Inspector: _____

MILLER ENGINEERING, INC.

Project: OLIN CHEMICAL CORP.
Wilmington, MA
Project No: 90718.01
Installation Date: _____

Sheet 3 of 3
Boring No: GW-37
Well No: GW-37
Surface Elev: _____

148 Pioneer Dr.
Leominster, MA 01453
(617) 840-0391

SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St.
Nashua, NH 03060
(603) 882-3601

Client: OLIN CORPORATION — Date: 04/18/88 — Job No: 88-238

Location: EAMES STREET, WILMINGTON, MASSACHUSETTS

BORING NO.: GW-31 DEEP — Ground Elev: — Date Start: 04/11/88 — Date Complete: 04/12/88 — Drilling Foreman: M.Z. — Eng./Hydrol Geologist: M.B.

DEPTH	Sample No.	Sample Depth (ft.)	Blows 6" Penetration	Rec. Inches	Casing Blows Per ft.	Strata Change Depth	Visual Identification of Soil and/or Rock Strata
	1	0'0"- 2'0"	2-3-4-4				Loose to medium dense, dry, fine SAND, trace inorganic silt, trace root matter.
	2	2'0"- 4'0"	5-5-5-6				
5	3	4'0"- 6'0"	7-6-7-8			4'0"	Medium dense, moist to wet, fine SAND, trace inorganic silt.
	4	6'0"- 8'0"	9-10-13-14				
	5	8'0"- 10'0"	7-10-9-14				
10	6	10'0"- 12'0"	7-8-10-10				
	7	12'0"- 14'0"	7-7-9-10				
15	8	14'0"- 16'0"	25-36-31-24			14'0"	Very dense, wet, fine to coarse SAND, and gravel, some inorganic silt, trace cobbles, and boulders.
	9	16'0"- 18'0"	35-24-23-21				
	10	18'0"- 20'0"	18-28-46-51				
20	11	20'0"- 20'9"	49-120/3"				
	Run #1	22'0" to 23'0"	14	min/foot		22'0"	Refusal at 22'0" with hollow stem auger Run #1 CORED ROCK from 22'0" to 27'0" Some fractures in rock, started with water return. Had total loss of water at 23'6". Recovery 25"/60" = 41.6%
		23'0" to 24'0"	10	"			
25		24'0" to 25'0"	9	"			
		25'0" to 26'0"	10	"			
		26'0" to 27'0"	11	"			
						27'0"	End of boring at 27'0" Set 2" STAINLESS STELL well point 22'0" Water level at 7'3" upon completion Well Materials; 1 - 2" end plugs 1 - 10' x 2" STAINLESS STEEL screen 1 - 10' x 2" STAINLESS STEEL riser 1 - 2' x 2" STAINLESS STEEL riser 1 - protective locking casing 1 bag- sakrete sand 7 bags-silica sand 1 pail-bentonite pellets 1 bag -bentonite powder 3 bags-Portland cement
30							
35							
40							

Type of Boring: Casing Size: Hollow Stem Auger Size: 6¼ HSA & NX Core (2 1/8")

Proportion Percentages	Granular Soils (blows per ft.)		Cohesive Soils (blows per ft.)	
Trace 0 to 10%	0 to 4 Very Loose	30 to 50 Dense	0 to 2 Very Soft	8 to 15 Stiff
Some 10 to 40%	4 to 10 Loose	Over 50 Very Dense	2 to 4 Soft	15 to 30 Very Stiff
And 40 to 50%	10 to 30 Medium Dense		4 to 8 Medium Stiff	Over 30 Hard

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

Sheet # ___ of ___

148 Pioneer Dr.
Leominster, MA 01453
(617) 840-0391

SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St.
Nashua, NH 03060
(603) 882-3601

Client: OLIN CORPORATION | Date 04/18/88 | Job No. 88-238

Location: EAMES STREET, WILMINGTON, MASSACHUSETTS

BORING NO. GW-31 SHALLOW | Ground Elev. | Date Start 04/12/88 | Date Complete 04/12/88 | Drilling Foreman M.Z. | Eng./Hydrol. Geologist M.B.

DEPTH	Sample No.	Sample Depth (ft.)	Blows 6" Penetration	Rec. Inches	Casing Blows Per ft.	Strata Change Depth	Visual Identification of Soil and/or Rock Strata
							Dry, medium brown to orange, fine SAND, trace inorganic silt, trace root matter
5						4'0"	Moist to wet, fine SAND, trace inorganic silt.
10							
15						14'0"	Wet, fine to coarse SAND, and gravel, some inorganic silt, trace cobbles.
						16'0"	End of boring at 16'0" Set 2" STAINLESS STEEL well point 16'0" Water level at 8'0" upon completion
20							
							Well Materials; 1 - 2" end plugs 1 - 10' x 2" STAINLESS STEEL screen 1 - 5' x 2" STAINLESS STEEL riser 1 - 2' x 2" STAINLESS STEEL riser 1 - protective locking casing 2 bags-sakrete sand 8 bags-silica sand 1 pail-bentonite pellets
25							
30							NOTE: NO SAMPLES REQUIRED Boring 3' from B-2 Deep
35							
40							

Type of Boring | Casing Size: | Hollow Stem Auger Size: 6¼

Proportion Percentages	Granular Soils (blows per ft.)		Cohesive Soils (blows per ft.)	
Trace 0 to 10%	0 to 4 Very Loose	30 to 50 Dense	0 to 2 Very Soft	8 to 15 Stiff
Some 10 to 40%	4 to 10 Loose	Over 50 Very Dense	2 to 4 Soft	15 to 30 Very Stiff
And 40 to 50%	10 to 30 Medium Dense		4 to 8 Medium Stiff	Over 30 Hard

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

Sheet # ____ of ____

148 Pioneer Dr.
Leominster, MA 01453
(617) 840-0391

SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St.
Nashua, NH 03060
(603) 882-3601

Client: OLIN CORPORATION — Date: 04/18/88 — Job No.: 88-238

Location: EAMES STREET, WILMINGTON, MASSACHUSETTS

BORING NO.: GW-32 DEEP — Ground Elev.: — Date Start: 04/11/88 — Date Complete: 04/14/88 — Drilling Foreman: M.Z. — Eng./Hydrol. Geologist: M.B.

DEPTH	Sample No.	Sample Depth (ft.)	Blows 6" Penetration	Rec. Inches	Casing Blows Per ft.	Strata Change Depth	Visual Identification of Soil and/or Rock Strata
							TOPSOIL.
	1	0'6"- 2'6"	2-3-3-4			0'6"	Loose, dry, fine SAND, trace inorganic silt.
	2	2'6"- 4'6"	3-3-4-4				
5	3	4'6"- 6'6"	7-10-11-11			4'6"	Medium dense, moist to wet, fine SAND, trace inorganic silt.
	4	6'6"- 8'6"	10-11-12-13				
	5	8'6"- 10'0"	11-12-16			8'6"	Medium dense to dense, wet, fine to medium SAND, grading to fine to coarse sand, and fine gravel, trace inorganic silt.
10	6	10'0"- 12'0"	7-10-17-21				
	7	12'0"- 14'0"	12-14-16-17				
15	8	14'0"- 16'0"	43-40-24-30			14'0"	Very dense, wet, light grey to brown, fine to medium SAND, some inorganic silt, some fine to coarse gravel, trace cobbles, and boulders.
	9	16'0"- 18'0"	28-32-35-28				
	10	18'0"- 20'0"	13-12-13-20				
20	11	20'0"- 22'0"	21-16-47-20				
	12	22'0"- 24'0"	14-21-34-30			22'0"	Very dense, wet, fine to coarse SAND, and gravel, some cobbles, and inorganic silt.
25	13	24'0"-25'10"	29-38-33-120/4"			24'0"	Very dense, wet, fine SAND, some inorganic silt, trace to some fine to coarse gravel, trace cobbles & boulders.
	Run #1	26'0"-	27'0" 12	min./foot		26'0"	Refusal at 26'0" with hollow stem auger Run #1 CORED ROCK from 26'0" to 31'0" Trace to some fractures, no loss of water. Recovery 44"/60" = 73.3%
		27'0"-	28'0" 15	"			
		28'0"-	29'0" 10	"			
30		29'0"-	30'0" 9	"			
		30'0"-	31'0" 11	"			
		Well Materials;				31'0"	End of boring at 31'0" Set 2" STAINLESS STEEL well point 31'0" Water level at 7'0" upon completion
		1 - 2" end plugs					
		1 - 10' x 2"	STAINLESS STEEL	screen			
35		2 - 10' x 2"	STAINLESS STEEL	riser			
		1 - 2' x 2"	STAINLESS STEEL	riser			
		1 - protective locking casing					
		1 bag - sakrete sand					
		5 bags- silica sand					
40		1 pail- bentonite pellets					
		1 bag - bentonite powder					

Type of Boring: Casing Size: — Hollow Stem Auger Size: 6¼ HSA & NX Core (2 1/8")

Proportion Percentages

Trace 0 to 10%
Some 10 to 40%
And 40 to 50%

Granular Soils (blows per ft.)

0 to 4 Very Loose
4 to 10 Loose
10 to 30 Medium Dense
30 to 50 Dense
Over 50 Very Dense

Cohesive Soils (blows per ft.)

0 to 2 Very Soft
2 to 4 Soft
4 to 8 Medium Stiff
8 to 15 Stiff
15 to 30 Very Stiff
Over 30 Hard

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

Sheet # ____ of ____

148 Pioneer Dr.
Leominster, MA 01453
(617) 840-0391

SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St.
Nashua, NH 03060
(603) 882-3601

Client: OLIN CORPORATION | Date: 04/18/88 | Job No: 88-238

Location: EAMES STREET, WILMINGTON, MASSACHUSETTS

BORING NO.: GW-32 SHALLOW | Ground Elev | Date Start: 04/13/88 | Date Complete: 04/14/88 | Drilling Foreman: M.Z. | Eng./Hydrol. Geologist: M.B.

DEPTH	Sample No.	Sample Depth (ft.)	Blows 6" Penetration	Rec. Inches	Casing Blows Per ft.	Strata Change Depth	Visual Identification of Soil and/or Rock Strata
							TOPSOIL
						0'6"	Moist to wet, fine SAND, trace inorganic silt.
5							
10						8'6"	Wet, fine to medium SAND, grading to fine to coarse sand, and fine gravel, trace inorganic silt.
15						14'0"	Wet, fine to medium SAND, some inorganic silt, some fine to coarse gravel, trace cobbles.
						15'0"	End of boring at 15'0" Set 2" STAINLESS STEEL well point 15'0" Water level at 7'0" upon completion
20							
							Well Materils; 1 - 2" end plugs 1 - 10' x 2" STAINLESS STEEL screen 1 - 5' x 2" STAINLESS STEEL riser 1 bag - sakrete sand 7 bags - silica sand 1 pail - bentonite pellets 1 bag - Portland cement
25							
30							
35							
40							

Type of Boring: Casing Size: | Hollow Stem Auger Size: 6¼

Proportion Percentages	Granular Soils (blows per ft.)		Cohesive Soils (blows per ft.)	
Trace 0 to 10%	0 to 4 Very Loose	30 to 50 Dense	0 to 2 Very Soft	8 to 15 Stiff
Some 10 to 40%	4 to 10 Loose	Over 50 Very Dense	2 to 4 Soft	15 to 30 Very Stiff
And 40 to 50%	10 to 30 Medium Dense		4 to 8 Medium Stiff	Over 30 Hard

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ *The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual.* ■

GW30D-R Sheet # 1 of

148 Pioneer Dr.
Leominster, MA 01453
(617) 840-0391

SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls S
Nashua, NH 0306
(603) 882-36

Client: OLIN CHEMICAL | Date: 11/24/87 | Job No.: 87-891

Location: OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA

BORING NO. Type #3 Replacement | Ground Elev. | Date Start: 11/18/87 | Date Complete: 11/18/87 | Drilling Foreman: M.Z. | Eng./Hydrol. Geologist

DEPTH	Sample No.	Sample Depth (ft.)	Blows 6" Penetration	Rec. Inches	Casing Blows Per ft.	Strata Change Depth	Visual Identification of Soil and/or Rock Strata
							No samples required.
							Moist to wet, fine to medium SAND, trace inorganic silt, trace fine to medium gravel.
5							
10							
15						15'0"	Wet fine to medium SAND, trace to some inorganic silt, trace fine to coarse gravel, trace cobbles.
20							
25							
30							
35							
40	Run #1	39'6"-	40'6"	8	min./foot	39'6"	Refusal at 39'6" with hollow stem auge
		40'6"-	41'6"	10	min./foot		Run #1 CORED ROCK from 39'6" to 41'6". Recovery 14"/24" = 58 %

Type of Boring: Casing Size: Hollow Stem Auger Size: 4¼

Proportion Percentages	Granular Soils (blows per ft.)		Cohesive Soils (blows per ft.)	
Trace 0 to 10%	0 to 4 Very Loose	30 to 50 Dense	0 to 2 Very Soft	8 to 15 Stiff
Some 10 to 40%	4 to 10 Loose	Over 50 Very Dense	2 to 4 Soft	15 to 30 Very Stiff
And 40 to 50%	10 to 30 Medium Dense		4 to 8 Medium Stiff	Over 30 Hard

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

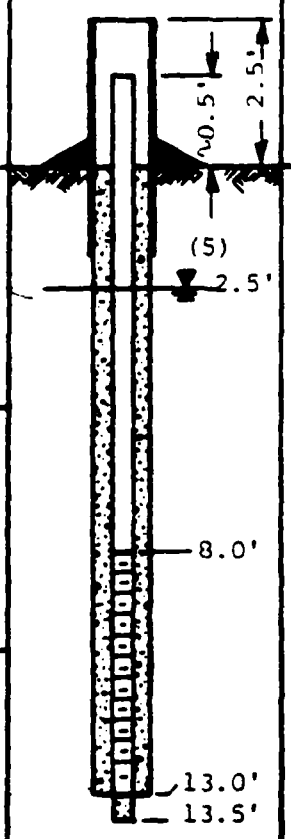
The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

GROUNDWATER WELL INSTALLATION REPORT

Groundwater Well No.: 4 | Date Installed: Oct. 31, 1977

Permeability[1] : 5×10^{-4} cm/sec | Project No. : 77348

Well Installed by Carr-Dee Test Boring Corp. | Soils Described by R. Gardner, GEI



Elevation (ft) (2)	Depth (ft)	Split Spoon Sample No. and Location	Blows per 6" (3)	Rec. (in.) (4)	Sample Description
79.8	0	SS-1	1-1-1-1	24	SS-1 ~3" Humus. ~21" Olive-brown fine sand.
		SS-2	1-5-7-8	15	SS-2 ~6" Slightly sandy humus. ~9" Olive-brown slightly silty fine sand.
74.8	5	SS-3	9-12-16-17	15	SS-3 Light olive-brown slightly silty fine to very fine sand.
69.8	10	SS-4	6-29-57-29	11	SS-4 Tan silty very fine sand.
		SS-5	160/6"	3	SS-5 Black angular rock fragments up to ~3/4" in size.
64.8	15				
59.8	20				
54.8	25				

Notes: (1), (2), (3), (4) See first page of Appendix A for additional information.
(5) Groundwater level is the average of seven measurements taken from November 2, 1977 to May 31, 1978.

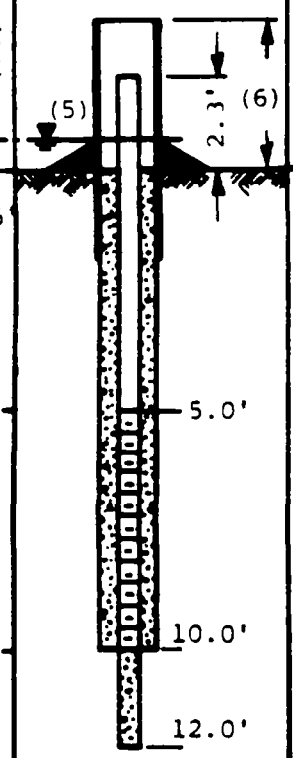
Geotechnical Engineers Inc.

GROUNDWATER WELL INSTALLATION REPORT

Groundwater Well No.: 5 | Date Installed: Oct. 31, 1977

Permeability(1) : 6. x 10^{-3} cm/sec | Project No. : 77348

Well Installed by Carr-Dee Test Boring Corp. | Soils Described by R. Gardner, GEI



Elevation (ft) (2)	Depth (ft)	Split Spoon Sample No. and Location	Blows per 6" (3)	Rec. (in.) (4)	Sample Description
76.3	0				
		SS-1	1-1-1-1	12	SS-1 Black sandy humus.
		SS-2A SS-2B	1-1-2-4	15	SS-2A ∿7" Dark gray silty fine sand; organic odor. SS-2B ∿8" Dark gray silty fine sand; no odor.
71.3	5				
		SS-3	7-8-11-12	14	SS-3 Gray-brown slightly silty fine sand.
66.3	10				
		SS-4	31-26-23-49	13	SS-4 Gray slightly silty sand and gravel. Gravel is angular to subangular up to ∿3/4" in size.
61.3	15				No refusal
56.3	20				
51.3	25				

Notes: (1), (2), (3), (4) See first page of Appendix A for additional information.

(5) Groundwater level is the average of five measurements taken from November 2, 1977 to May 31, 1978. Water was not ponded around surface casing at time of measurements.

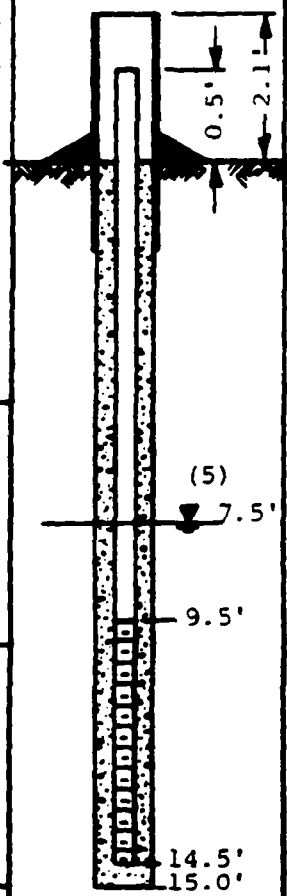
(6) Prior to May 31, 1978, distance from ground surface to top of casing was 3.4'. Casing was removed to perform permeability test and replaced to present "stickup" of 3.1'.

GROUNDWATER WELL INSTALLATION REPORT

Groundwater Well No.: 2 | Date Installed: Nov. 1, 1977

Permeability[1] : 9 x 10^{-3} cm/sec | Project No. : 77348

Well Installed by Carr-Dee Test Boring Corp. | Soils Described by R. Gardner, GEI



Elevation (ft) (2)	Depth (ft)	Split Spoon Sample No. and Location	Blows per 6" (3)	Rec. (in.) (4)	Sample Description
87.6	0				
		SS-1	1-2-2-2	13	SS-1 ~1" Humus. ~12" Black silty fine sand with roots and fibers. Slight organic odor.
		SS-2	5-8-10-10	18	
82.6	5	SS-3	8-10-13-17	17	SS-2 Yellow-tan fine sand.
		SS-4	11-13-16-18	17	SS-3 ~6" Gray fine sand. ~4" Yellow medium sand. ~7" Yellow-gray fine sand.
		SS-5	11-11-12-14	15	SS-4 Yellow-gray fine sand.
77.6	10				SS-5 Olive gray fine sand; strong odor.
		SS-6	29-37	7	SS-6 Brown gravelly fine to coarse sand.
72.6	15	*			*Refusal of chopping bit.
67.6	20				
62.6	25				

Notes: (1), (2), (3), (4) See first page of Appendix A for additional information.
(5) Groundwater level is the average of seven measurements taken from November 2, 1977 to May 31, 1978.

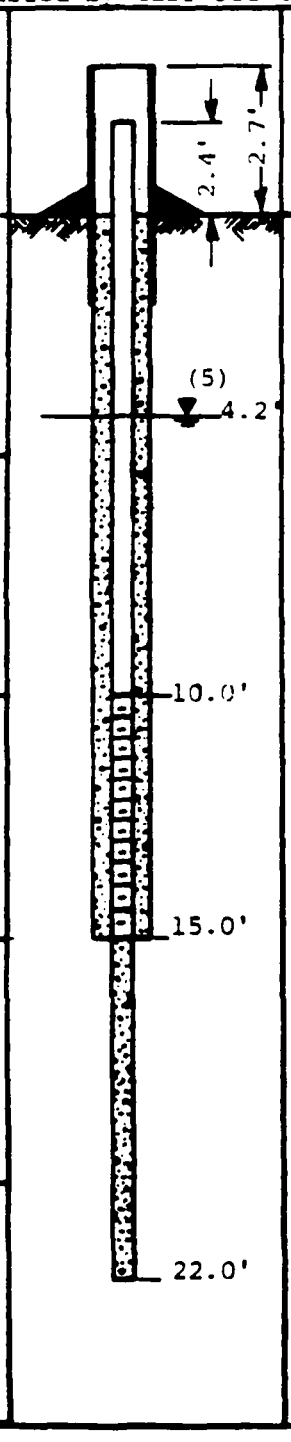
Geotechnical Engineers Inc.

GROUNDWATER WELL INSTALLATION REPORT

Groundwater Well No.: 3 | Date Installed: Nov. 1, 1977

Permeability(1) : 2×10^{-4} cm/sec | Project No. : 77348

Well Installed by Carr-Dee Test Boring Corp. | Soils Described by R. Gardner, GEI



Elevation (ft) (2)	Depth (ft)	Split Spoon Sample No. and Location	Blows per 6" (3)	Rec. (in.) (4)	Sample Description
85.4	0	SS-1A SS-1B	2-2-6-10	16	**SS-1A** ∿6" Dark gray fine sand and humus. **SS-1B** ∿10" Gray fine sand; slight odor similar to that of lagoons.
		SS-2	26-37-43	15	**SS-2** Yellow-brown fine sand; slight chemical odor.
80.4	5	SS-3	26-38-31-32	21	**SS-3** Olive-brown silty fine sand
75.4	10	SS-4A SS-4B	7-8-13-27	16	**SS-4A** ∿10" Yellow-brown fine sand; slight chemical odor. **SS-4B** ∿6" Gray and black micaceous sand and gravel. Gravel is angular to subrounded.
70.4	15	SS-5	50-40-42-41	15	**SS-5** Olive gray silty fine sandy gravel. Gravel is black and angular up to ∿1/2" in size. Trace of mica flakes.
65.4	20		*		*Drove open-ended "A" rod with 200 lb weight. Refusal at 22'; 120 blows/0.5"
60.4	25				

Notes: (1), (2), (3), (4) See first page of Appendix A for additional information.
(5) Groundwater level is the average of seven measurements taken from November 2, 1977 to May 31, 1978.

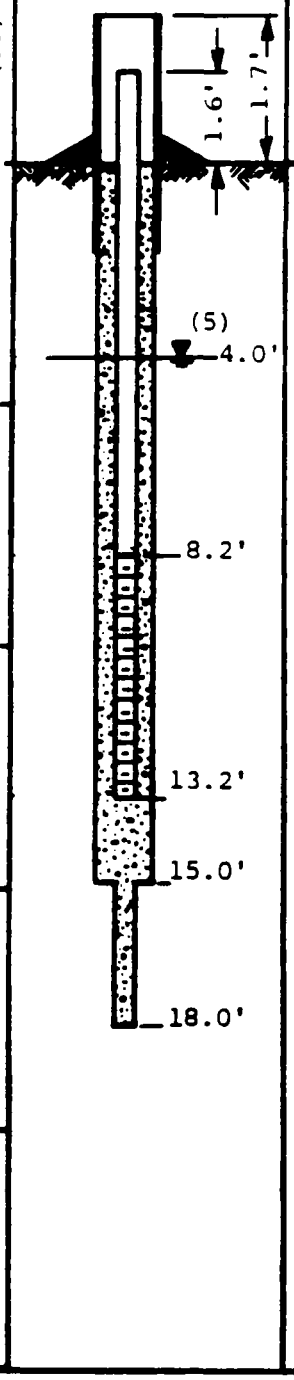
Geotechnical Engineers Inc.

GROUNDWATER WELL INSTALLATION REPORT

Groundwater Well No.: 6 | Date Installed: Oct. 28, 1977

Permeability(1) : 1×10^{-4} cm/sec | Project No. : 77348

Well Installed by Carr-Dee Test Boring Corp. | Soils Described by R. Gardner, GEI



Elevation (ft) (2)	Depth (ft)	Split Spoon Sample No. and Location	Blows per 6" (3)	Rec. (in.) (4)	Sample Description
87.2	0	SS-1	3-4-7-7	15	**SS-1** ∿10" Dark brown loamy fine sand. ∿5" White fine material in layers. Similar to that in adjacent lagoon; strong ammonia odor.
		SS-2	7-6-9-8	12	**SS-2** Dark brown loamy sand grading into black fine sand; strong odor.
82.2	5	SS-3	11-14-15-16	12	**SS-3** Yellow-brown slightly silty fine sand; strong ammonia odor.
77.2	10	SS-4	12-14-16-15	11	**SS-4** Similar to SS-3 with slight amount of gravel up to ∿¼" in size. Odor similar to that of lagoons, less ammonia odor.
72.2	15	SS-5	10-45-39-89/5"	7	**SS-5** Top - Silty fine sand. Bottom - Dark brown micaceous fine sand. Tip of spoon plugged with silty fine sand and piece of gravel ∿1 3/8" in size.
67.2	20				
62.2	25				

Notes: (1), (2), (3), (4) See first page of Appendix A for additional information.
(5) Groundwater level is the average of seven measurements taken from November 2, 1977 to May 31, 1978.

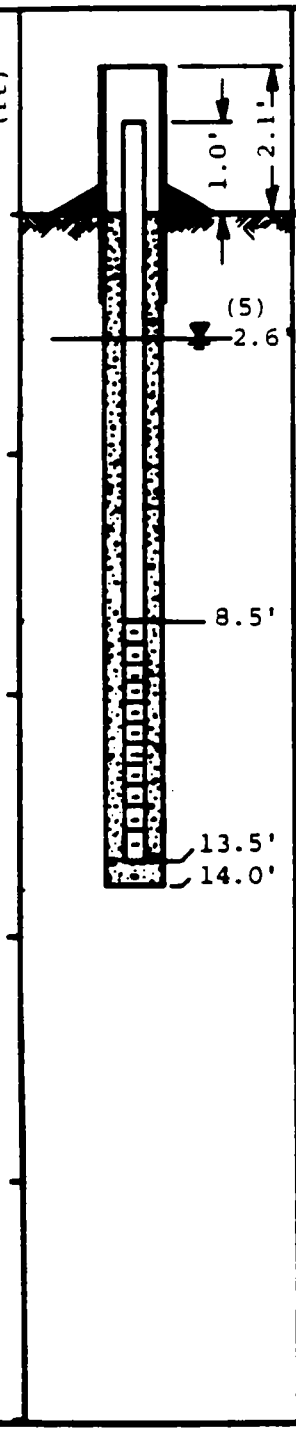
Geotechnical Engineers Inc.

GROUNDWATER WELL INSTALLATION REPORT

Groundwater Well No.: 7 | Date Installed: Oct. 27, 1977

Permeability(1) : 2×10^{-4} cm/sec | Project No. : 77348

Well Installed by Carr-Dee Test Boring Corp. | Soils Described by R. Gardner, GEI



Elevation (ft) (2)	Depth (ft)	Split Spoon Sample No. and Location	Blows per 6" (3)	Rec. (in.) (4)	Sample Description
82.7	0	SS-1	1-1-1-1	12	SS-1 Sandy peat.
77.7	5	SS-2	67-47-33-37	15	SS-2 Sand and gravel mixed with fines similar to material in lagoons. Odor similar to odor of material in lagoons.
72.7	10	SS-3	35-21-47-60/3"	14	SS-3 Similar to SS-2 except more natural fine material; strong odor.
67.7	15				*120 blows on split spoon with 140 lb weight; no penetration.
62.7	20				
57.7	25				

Notes: (1), (2), (3), (4) See first page of Appendix A for additional information
(5) Groundwater level is the average of seven measurements taken from November 2, 1977 to May 31, 1978.

Geotechnical Engineers Inc.

GW30DR

148 Pioneer Dr.
Leominster, MA 01453
(617) 840-0391

SOIL EXPLORATION CORPORATION

Geotechnical Drilling and Groundwater Monitor Wells

23 Ingalls St.
Nashua, NH 03060
(603) 882-3601

Client OLIN CHEMICAL — Date 11/24/87 — Job No. 87-891

Location OLIN CHEMICAL, EAMES STREET, WILMINGTON, MA

BORING NO. Type #3 Replacement — Ground Elev. — Date Start 11/18/87 — Date Complete 11/18/87 — Drilling Foreman M.Z. — Eng./Hydrol. Geologist

DEPTH	Sample No.	Sample Depth (ft.)	Blows 6" Penetration	Rec. Inches	Casing Blows Per ft.	Strata Change Depth	Visual Identification of Soil and/or Rock Strata
	Run #1	39'6"-	40'6" 8 min./foot				Run #1 CORED ROCK from 39'6" to 41'6".
		40'6"-	41'6" 10 min./foot				Recovery 14"/24" = 58.3%
						41'6"	End of boring at 41'6"
							Water level at 7'0" upon completion
45							Set well point at 41'6"
							Well Materials;
							1 - 2" PVC end plug
							1 - 10' x 2" PVC screen
50							3 - 10' x 2" PVC riser
							1 - 5' x 2" PVC riser
							1 - protective locking casing
							1 bag - sakrete sand
							3 bags - Portland cement
55							1 pail - bentonite pellets
60							
65							
70							
75							
80							

Type of Boring — Casing Size: — Hollow Stem Auger Size: 4¼

Proportion Percentages	Granular Soils (blows per ft.)		Cohesive Soils (blows per ft.)	
Trace 0 to 10%	0 to 4 Very Loose	30 to 50 Dense	0 to 2 Very Soft	8 to 15 Stiff
Some 10 to 40%	4 to 10 Loose	Over 50 Very Dense	2 to 4 Soft	15 to 30 Very Stiff
And 40 to 50%	10 to 30 Medium Dense		4 to 8 Medium Stiff	Over 30 Hard

Standard penetration test (SPT) = 140# hammer falling 30"
Blows are per 6" taken with an 18" long x 2" O.D. x 1 3/8" I.D. split spoon sampler unless otherwise noted.

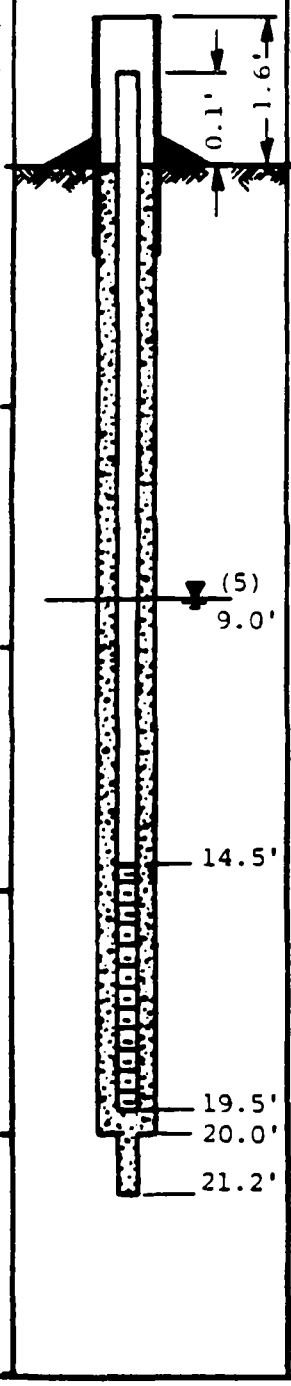
The terms and percentages used to describe soil and or rock are based on visual identification of the retrieved samples. ■ Moisture content indicated may be affected by time of year and water added during the drilling process. ■ Water levels indicated may vary with seasonal fluctuation and the degree of soil saturation when the boring was taken. ■ The stratification lines represent the approximate boundaries between soil types, the actual transitions may be gradual. ■

GROUNDWATER WELL INSTALLATION REPORT

Groundwater Well No.: 1 | Date Installed: Oct. 26, 1977

Permeability[1] : 2×10^{-2} cm/sec | Project No. : 77348

Well Installed by Carr-Dee Test Boring Corp. | Soils Described by R. Gardner, GEI



Elevation (ft) (2)	Depth (ft)	Split Spoon Sample No. and Location	Blows per 6" (3)	Rec. (in.) (4)	Sample Description
87.8	0	SS-1	2-6-7-7	17	**SS-1** ∿8" Brown sandy loam. ∿2" Light brown gravelly sand. ∿1" Black medium sand ∿6" Light brown gravelly sand.
82.8	5	SS-2	5-1-1-1	5	**SS-2** Top 5" - light brown fine to coarse sand. Lost bottom 18".
		SS-3 (overdrove 12")	1/12" 1/12" 1/12"	6	
77.8	10	SS-4	2-1-1-4	9	**SS-3** ∿2" Black organic fine sand ∿4" Light brown fine to coarse sand. **SS-4** ∿7" Gray-brown fine sand. ∿2" Black fibrous, organic medium sand.
72.8	15	SS-5	15-12-22-65	9	**SS-5** Tan-brown sandy gravel. Gravel is angular to sub-angular and up to ∿1 3/8" in size.
67.8	20	SS-6	48-44-100/2"	6	**SS-6** Coarse sand and gravel. Gravel is angular and up to ∿1 3/8" in size.
62.8	25				

Notes: (1), (2), (3), (4) See first page of Appendix A for additional information.
(5) Groundwater level is the average of six measurements taken from November 2, 1977 to May 31, 1978.

Geotechnical Engineers Inc.

GROUNDWATER WELL INSTALLATION REPORT

Groundwater Well No.: 9

Permeability(1) :

Date Installed: -

Project No. : 77348

Soils Described by R. Gardner, GEI

Elevation (ft) (2)	Depth (ft)		Split Spoon Sample No. and Location	Blows per 6" (3)	Rec. (in.) (4)	Sample Description
	0	Well Not Installed	SS-1A SS-1B	5-7-6-17	10	SS-1A ∿5" Brown loamy fine to coarse sand. Trace of gravel. SS-1B ∿5" Tan silty fine sand. Trace of medium to coarse sand, gravel and mica flakes. *Drilled rock - BX core. 100% recovery RQD = 0% Upper 12" is massive Lower 18" is very broken. Some high angle joints.
	5		*			
	10					
	15					
	20					
	25					

Notes: (1) Not applicable.
(2) Not surveyed.
(3), (4) See first page of Appendix A for additional information.

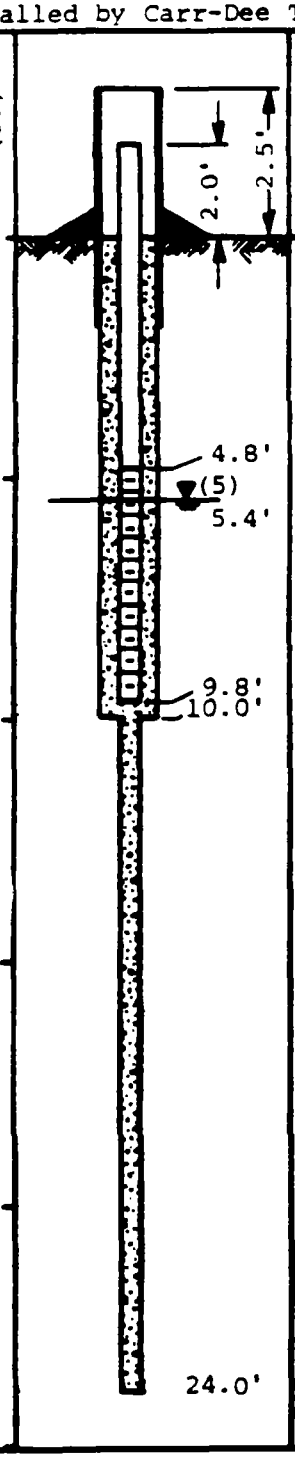
Geotechnical Engineers Inc.

GROUNDWATER WELL INSTALLATION REPORT

Groundwater Well No.: 10 | Date Installed: Nov. 2, 1977

Permeability(1) : 1. x 10^{-2} cm/sec | Project No. : 77348

Well Installed by Carr-Dee Test Boring Corp. | Soils Described by R. Gardner, GEI



Elevation (ft) (2)	Depth (ft)	Split Spoon Sample No. and Location	Blows per 6" (3)	Rec. (in.) (4)	Sample Description
87.1	0	SS-1A SS-1B	1-1-1-2	14	**SS-1A** ∿4" Black sandy humus. **SS-1B** ∿10" Orange-brown fine sand; slight organic odor.
		SS-2A SS-2B	4-6-12-20	13	
82.1	5	SS-3	40-85	8	**SS-2A** ∿6" Similar to SS-1B **SS-2B** ∿7" Similar to SS-1B except for presence of subangular gravel up to 1/2" in size.
		*			
77.1	10				**SS-3** Yellow-tan silty fine sand.
		**			*Drove open-ended "A" rod with 200-lb weight. Recovered slightly silty sand and gravel.
72.1	15				**Drove open-ended "A" rod with 200-lb weight. No refusal. Recovered silty medium to coarse sand with material similar to that in nearby lagoon.
67.1	20				
62.1	25				

Notes: (1), (2), (3), (4) See first page of Appendix A for additional information
(5) Groundwater level is the average of seven measurements taken from November 2, 1977 to May 31, 1978.

Geotechnical Engineers Inc.

TEST BORING LOGS

MILLER ENGINEERING & TESTING, INC.

Project: OLIN CHEMICAL
Wilmington, MA
Project No: 60321.01
Date Start: 7/10/86
Date End: 7/11/86

Sheet 1 of 1
Boring No: B-8
Location: See Plan
Surface Elev:

	Casing	Sampler
TYPE:	Hollow Stem Auger	Split Spoon
SIZE:	2 1/4" ID	1 3/8" ID
HAMMER:	---	140 pounds
FALL:	---	30 inches

Groundwater Observations

DATE	DEPTH	CASING AT	STABILIZATION PERIOD
7/21/86	32"	--	Upon Completion

Depth	Cas bl/ft	Sample No.	Sample Depth	Pen.	Rec.	Blows/6"	Strata Change	Sample Description	Note
		S-1	0-6.5'	18"	18"	Weight of rod.		S-1: Peat, organics with trace silt and sand. (moist)	
5.0'									
		S-2	6.5-8.0'	18"	18"	15-29-29	7.4'	S-2: Medium dense, medium brown silty sand. (moist)	
		S-3	8.0-9.5'	18"	12"	4-2-6		S-3: Same as S-2. (wet)	
10.0'									
		S-4	9.5-11.0'	18"	18"	3-5-9		S-4: Same as S-2. (wet)	
		S-5	11.0-12.5'	18"	18"	5-9-11		S-5: Same as S-2. (wet)	
		S-6	12.5-14.0'	18"	18"	4-6-9		S-6: Same as S-2. (wet)	
15.0'		S-7	14.0-15.5'	18"	18"	7-8-11		S-7: Same as S-2. (wet)	
		S-8	15.5-17.0'	18"	18"	5-8-12		S-8: Same as S-2. (wet)	
		S-9	17.0-19.5'	6"	2"	50/6-50/0	17.0'	S-9: Very dense, grey, silty sand with gravel (wet).	(1)
20.0'									
		S-10	22.0-22.0'	0"	0"	50/0		S-10: Boulder, no penetration.	
25.0'								Terminated at 27.2' on bedrock.	(2)
30.0'									(3)

Proportions used: Trace (0 - 10%), Little (10 - 20%), Some (20 - 35%), and (35 - 50%)

Cohesive Consistency (tons/foot)		Cohesionless Density (blows/foot)	
0 - 2	Very soft	0 - 4	Very loose
2 - 4	Soft	4 - 10	Loose
4 - 8	Medium stiff	10 - 30	Medium dense
8 - 15	Stiff	30 - 50	Dense
30+	Hard	50+	Very dense

Driller: M. D'Ambrosio
Helper: R. Marcoux
Inspector: B. Childs

Remarks:
(1) Pushing stone for high blow count.
(2) Hole terminated at 27.5' - lost wrench moved 2'.
(3) Hole terminated at 27.4', lost shoe, moved another 2'.

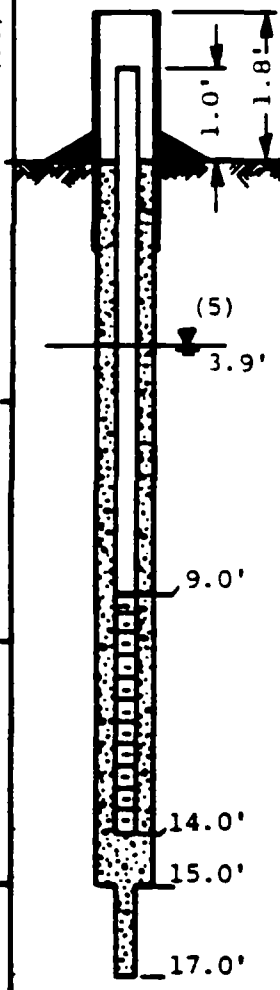
Notes:
1) The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
2) Water level readings have been made in the drill holes at times and under conditions stated on the boring logs. Fluctuations in the level of the groundwater may occur due to other factors than those present at the time measurements were made.

GROUNDWATER WELL INSTALLATION REPORT

Groundwater Well No.: 11 | Date Installed: Oct. 31, 1977

Permeability(1) : 5×10^{-4} cm/sec | Project No. : 77348

Well Installed by Carr-Dee Test Boring Corp. | Soils Described by R. Gardner, GEI



Elevation (ft) (2)	Depth (ft)	Split Spoon Sample No. and Location	Blows per 6" (3)	Rec. (in.) (4)	Sample Description
85.6	0				
		SS-1	1-2-3-3	11	SS-1 Gray-brown sand and gravel mixed with material similar to that in lagoons.
		SS-2	1/12"-1-1	4	
		SS-3	1-1	11	SS-2 Dark brown slightly sandy forest mulch.
80.6	5	SS-4	3-4-4-4	11	SS-3 Similar to SS-2.
					SS-4 Gray to olive-brown slightly silty fine sand.
75.6	10	SS-5	6-8-8-10	13	SS-5 Gray-brown slightly silty fine sand; odor similar to that in lagoons.
70.6	15	SS-6	36-45-28-34	16	SS-6 Brown silty sand and gravel. Gravel up to ∿1" in size.
					No refusal.
65.6	20				
60.6	25				

Notes: (1), (2), (3), (4) See first page of Appendix A for additional information.
(5) Groundwater level is the average of seven measurements taken from November 2, 1977 to May 31, 1978.

Geotechnical Engineers Inc.

NEW ENGLAND POLLUTION CONTROL CO., INC.

7 EDGEWATER PLACE
EAST NORWALK, CT 06855

24 HOUR SERVICE
POLLUTION CONTROL SUPPLIES & SERVICE

- ☐ EAST NORWALK, CT 203 853-[illegible]
- ☐ NEW HAVEN, CT 203 777-[illegible]
- ☐ NEW LONDON, CT. 203 443-[illegible]
- ☐ NEWARK, N.J. 201 589-[illegible]
- ☐ PHILADELPHIA, PA. 215 563-[illegible]

Page _____ of _____

Date December 7th, 1980

Job No. _____

Job Address Olin Corp. Wilmington, Mass.

Boring No. 7 (GW15

Fixed Datum used is _____

Ground Surface this boring is _____

DEPTH From	DEPTH To	CLASSIFICATION Be Careful and Accurate	CASING BLOWS 0-27	CASING BLOWS 28-54	SAMPLE No.	Depth	No. of 30" Blows on Spoon 1st 6"	2nd 6"	3rd 6"	4th 6"	Recovery In	Lost Water * or Remarks
0'	3'	Brown sand stained										
		with Product										
3'	10'	Brown sand, fine to										
		medium grade										
10'	19'	Brown sand, small to										
		medium boulder										
19'	19'6"	Refusal										
		3" PVC slotted well										
		installed										

Ground Surface to _____ ft. used _____ casing.

Water level is _____ ft. below Ground surface _____ hrs. after completion

Water level is _____ ft. below Ground surface _____ hrs. after completion

Boring stopped by _____

Driller D. Fiorentino

Helper G. Birchard, J. [illegible]

Rig. No. 21

NEW ENGLAND POLLUTION CONTROL CO., INC.

7 EDGEWATER PLACE
EAST NORWALK, CT 06855

24 HOUR SERVICE
POLLUTION CONTROL SUPPLIES & SERVICE

- ☐ EAST NORWALK, CT 203/853-[illegible]
- ☐ NEW HAVEN, CT 203/77[illegible]
- ☐ NEW LONDON, CT. 203/443-[illegible]
- ☐ NEWARK, N.J. 201/589-[illegible]
- ☐ PHILADELPHIA, PA. 215/563-[illegible]

Page _____ of _____

Job No. _____

Boring No. 11 (GW)

Date December 4th, 1980

Job Address Clin Corp. Willmington, Mass.

Fixed Datum used is _____

Ground Surface this boring is _____

DEPTH From	DEPTH To	CLASSIFICATION Be Careful and Accurate	CASING BLOWS 0-27	CASING BLOWS 28-54	SAMPLE No.	Depth	No. of 30" Blows on Spoon 1st 6"	2nd 6"	3rd 6"	4th 6"	Recovery in.	Lost Water * or Remarks
0'	8'	Light brown sand fine										
		to medium grade										
10'	14'6"	Light brown sand fine										
		to medium grade small										
		to medium boulders										
14'6"	15'	Refusal										

Ground Surface to _____ ft. used _____ casing.

Water level is _____ ft. below Ground surface _____ hrs. after completion

Water level is _____ ft. below Ground surface _____ hrs. after completion

Boring stopped by _____

Driller D. Fiorentino

Helper G. Birchard, J. Ba[illegible]

Rig. No. 21

BORING GW-17S

PROJECT: Olin-Wilmington	PROJECT NO: 284-10-1E00
DATE: 3/4/81	LOCATION: Wilmington, MA
DRILLING CONTRACTOR: Soil Exploration	INSPECTOR: CA Kraemer
DRILLING METHOD: 2¼" hollow stem augers	SAMPLING METHOD: None taken
ELEVATION:	DATUM:

SAMPLE no.	SAMPLE depth	SAMPLE blows per 6"	DEPTH	STRATA	SOIL DESCRIPTION density, color, SOIL, admixtures, moisture, other notes, ORIGIN	WELL CONST.	REMARKS
			5				
					Bottom of boring 8.0 feet		
			10				
			15				
			20				
			25				
			30				
			35				

NOTES: Monitoring well installed. Tip of 5.0 foot 0.010-inch machine slot well screen set at 8.0 feet and backfilled with medium uniform sand to 2.0 feet. Cement-bentonite slurry from 2.0 feet to ground surface 5-foot long 6-inch diameter protective steel sleeve, with locking cap placed on top.

BORING GW-1dS

PROJECT: Olin-Wilmington	PROJECT NO: 284-10-1E00
DATE: 2/25/81	LOCATION: Wilmington, MA
DRILLING CONTRACTOR: Soil Exploration	INSPECTOR: CA Kraemer
DRILLING METHOD: 2¼" hollow stem augers	SAMPLING METHOD: None taken
ELEVATION:	DATUM:

SAMPLE no.	SAMPLE depth	SAMPLE blows per 6"	DEPTH	STRATA	SOIL DESCRIPTION density, color, SOIL, admixtures, moisture, other notes, ORIGIN	WELL CONST.	REMA
			5				
			10		Bottom of boring 10.0 feet		
			15				
			20				
			25				
			30				
			35				

NOTES: Monitoring well installed. Tip of 5.0 foot 0.010-inch machine sl well screen set at 10.0 feet and backfilled with medium uniform sanc to 3.0 feet. Cement-bentonite slurry from 3.0 feet to ground surfa 5-foot long 6-inch diameter protective steel sleeve, with locking placed on top.

BORING GW-19S

PROJECT: Olin-Wilmington	PROJECT NO: 284-10-1E00
DATE: 2/12/81	LOCATION: Wilmington, MA
DRILLING CONTRACTOR: Soil Exploration	INSPECTOR: CA Kraemer
DRILLING METHOD: 2¼" hollow stem augers	SAMPLING METHOD: None taken
ELEVATION:	DATUM:

SAMPLE no.	SAMPLE depth	SAMPLE blows per 6"	DEPTH	STRATA	SOIL DESCRIPTION density, color, SOIL, admixtures, moisture, other notes, ORIGIN	WELL CONST.	REMARK
			5				
			10		Bottom of boring 10.0 feet		
			15				
			20				
			25				
			30				
			35				

NOTES: Monitoring well installed. Tip of 5.0 foot 0.010-inch machine slo well screen set at 10.0 feet and backfilled with medium uniform sand to 3.5 feet. Cement-bentonite slurry from 3.5 feet to ground surface 5-foot long 6-inch diameter protective steel sleeve, with locking ca placed on top.

MALCOLM PIRNIE INC

SHEET 1 OF 1

BORING GW-20

PROJECT: Olin-Wilmington	PROJECT NO: 284-10-1E00
DATE: 2/26/81	LOCATION: Wilmington, MA
DRILLING CONTRACTOR: Soil Exploration	INSPECTOR: CA Kraemer
DRILLING METHOD: 2½" hollow stem augers	SAMPLING METHOD: 2" split spoon 300 lb. hammer with 24" drop
ELEVATION:	DATUM:

SAMPLE no.	SAMPLE depth	blows per 6"		DEPTH	STRATA	SOIL DESCRIPTION density, color, SOIL, admixtures, moisture, other notes, ORIGIN	WELL CONST.	REMARKS
S-1	0'-2'	1	0			Top soil and roots, 0.0'-1.0 feet		
		4	12			Medium dense, brown, SAND, some gravel, trace silt, moist Grading to dense, SAND and GRAVEL trace silt		
S-2	2'-4'	25	23					
		17	15					
S-3	4'-5.5'	10	18					
		40		5		Very dense, gray/brown, SAND some silt, some gravel, moist, GLACIAL TILL		
				10				
				15		Top of Rock 15.0 feet Run 1, 15.0'-16.5' Run 15. feet Recover 1.0', 67% recovery Run 2, 16.5'-21.5' Run 5.0' Recover 3.9', 68% recovery		
				20				
						Bottom of boring 21.5 feet		
				25				
				30				
				35				

NOTES: Monitoring well installed. Cement-bentonite slurry from 15.0' to 21.5' Tip of 5.0 foot 0.010-inch machine slotted well screen set at 14.7' feet and backfilled with medium uniform sand to 8.0 feet. Ce bentonite slurry from 8.0 feet to ground surface. 5-foot long 6-inc diameter protective steel sleeve, with locking cap, placed on top.

MALCOLM PIRNIE, INC.

BORING GW-21

PROJECT: Olin-Wilmington	PROJECT NO: 284-10-1E00
DATE: 3/5/81	LOCATION: Wilmington, MA
DRILLING CONTRACTOR: Soil Exploration	INSPECTOR: CA Kraemer
DRILLING METHOD: 2½" hollow stem augers	SAMPLING METHOD: 2" split spoon 300 lb. hammer with 24" drop
ELEVATION:	DATUM:

SAMPLE no.	SAMPLE depth	blows per 6"		DEPTH	STRATA	SOIL DESCRIPTION density, color, SOIL, admixtures, moisture, other notes, ORIGIN	WELL CONST.	REMARKS
S-1	0'-2'	1	0			Very loose, dark brown, PEAT, little sand, wet		
		0	0					
S-2	2'-4'	5	6			Medium dense, brown, SAND, trace silt, wet		
		5	6					
S-3	4'-6'	9	11	5		Dense, brown/gray SAND, some SILT, some gravel, moist GLACIAL TILL		
		12	11					
				10				
				15		Top of Rock 15.0 feet Run 1, 15.0'-17.5' Run 2.5' Recover 2.5', 100% recovery Run 2, 17.5'-20.0' recover 2.0' 80% recovery		
				20		Bottom boring, 20.0 feet		
				25				
				30				
				35				

NOTES: Monitoring well installed. Cement-bentonite slurry from 15.0' to 20.0' Tip of 5.0 foot 0.010-inch machine slotted pipe well screen se at 14.5' feet and backfilled with uniform medium sand to 4.0 feet. Cement-bentonite slurry from 4.0 feet to ground surface. 5-foot long inch protective steel sleeve, with locking cap, placed on top.

BORING GW-22S

PROJECT: Olin-Wilmington	PROJECT NO: 284-10-1E00
DATE: 3/5/81	LOCATION: Wilmington, MA
DRILLING CONTRACTOR: Soil Exploration	INSPECTOR: CA Kraemer
DRILLING METHOD: 2½" hollow stem augers	SAMPLING METHOD: None taken
ELEVATION:	DATUM:

SAMPLE no.	SAMPLE depth	SAMPLE blows per 6"	DEPTH	STRATA	SOIL DESCRIPTION density, color, SOIL, admixtures, moisture, other notes, ORIGIN	WELL CONST.	REMAR
			5				
			10				
			15		Bottom of boring 15.0 feet		
			20				
			25				
			30				
			35				

NOTES: Monitoring well installed. Tip of 5.0 foot 0.010-inch machine sl
well screen set at 15.0 feet and backfilled with medium uniform sand
to 8.0 feet. Cement-bentonite slurry from 8.0 feet to ground surfac
5-foot long 6-inch diameter protective steel sleeve, with locking c
placed on top.

TEST BORING LOGS

MILLER ENGINEERING & TESTING, INC.

Project: OLIN CHEMICAL
Wilmington, MA
Project No: 60321.01
Date Start: 6/19/86
Date End: 6/19/86

Sheet [illegible] of [illegible]
Boring No: [illegible]
Location: See Plan
Surface Elev: _____

	Casing	Sampler
TYPE:	Hollow Stem Auger	Split Spoon
SIZE:	2 1/4" ID	1 3/8" ID
HAMMER:	---	140 pounds
FALL:	---	30 inches

Groundwater Observations

DATE	DEPTH	CASING AT	STABILIZATION PERIOD
6/20/86	[illegible].2'		Overnight

Depth	Cas bl/ft	Sample No.	Sample Depth	Sample Pen.	Sample Rec.	Sample Blows/6"	Strata Change	Sample Description	Note
							12.0'	Dark brown - gray, medium to fine sand.	(1)
							20.0'	Dark to light gray, medium to fine sand with gravels. (wet)	
								Terminated at 20'.	(2)

5.0' 10.0' 15.0' 20.0' 25.0' 30.0'

Proportions used: Trace (0 - 10%), Little (10 - 20%), and (20 - 35%), and (35 - 50%)

Cohesive Consistency (tons/foot)	Cohesionless Density (blows/foot)
0 - 2 very soft	0 - 4 very loose
2 - 4 soft	4 - 10 loose
4 - 8 medium stiff	10 - 30 medium dense
8 - 15 stiff	30 - 50 dense
15+ hard	50+ very dense

Driller: T. Compulka
Helper: B. Marcoux
Inspector: B. Childs

Remarks:
(1) No samples required.
(2) Hole moved after auger lost down hole at 13.0'.

Notes:
1) The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
2) Water level readings have been made in the drill holes at times and under conditions stated on the boring logs. Fluctuations in the level of the groundwater may occur due to other factors than those present at the time measurements were made.

GW 285

TEST BORING LOGS

MILLER ENGINEERING & TESTING, INC.

Project: OLIN CHEMICAL
Wilmington, MA
Project No: 60321.01
Date Start: 6/27/86
Date End: 6/27/86

Sheet 1 of 1
Boring No: B-5S
Location: See Plan
Surface Elev:

	Casing	Sampler
TYPE:	Hollow Stem Auger	
SIZE:	2 1/4" ID	
HAMMER:	---	
FALL:	---	

Groundwater Observations

DATE	DEPTH	CASING AT	STABILIZATION PERIOD
6/30/86	0.6'		Overnight

Depth	Cas bl/ft	Sample No.	Sample Depth	Sample Pen.	Sample Rec.	Sample Blows/6"	Strata Change	Sample Description	Note
							4.2'	Organic peat with trace fine sand and silt.	(1)
5.0'							12.0'	Gray, medium to fine sand and silt with gravel. (wet)	
10.0'								Terminated at 12.0'.	
15.0'									
20.0'									
25.0'									
30.0'									

Proportions used: trace (0 - 10%), little (10 - 20%), some (20 - 35%), and (35 - 50%)

Driller: T. Gomoulka
Helper: R. Marcoux
Inspector: B. Childs

Cohesive Consistency (tons/ft²)		Cohesionless Density (blows/ft)	
0 - 2	very soft	0 - 4	very loose
2 - 4	soft	4 - 10	loose
4 - 8	medium stiff	10 - 30	medium dense
8 - 15	stiff	30 - 50	dense
30+	hard	50+	very dense

Remarks: (1) *No samples required.*

Notes:
1) The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
2) Water level readings have been made in the drill holes at times and under conditions stated on the boring logs. Fluctuations in the level of the groundwater may occur due to other factors than those present at the time measurements were made.

TEST BORING LOGS

MILLER ENGINEERING & TESTING, INC.

Project: OLIN CHEMICAL
Wilmington, MA
Project No: 60321.01
Date Start: 6/26/86
Date End: 6/27/86

Sheet 1 of 1
Boring No: B-60
Location: See Plan
Surface Elev:

	Casing	Sampler
TYPE:	Hollow Stem Auger	Split Spoon
SIZE:	2 1/4" ID	1 3/8" ID
HAMMER:	---	140 pounds
FALL:	---	30 inches

Groundwater Observations

DATE	DEPTH	CASING AT	STABILIZATION PERIOD
6/27/86	0.6'	---	Overnight

Depth	Casbl/ft	Sample No.	Depth	Pen.	Rec.	Blows/6"	Strata Change	Sample Description	Note
		S-1	0-1.5'	18"	12"	1/12-7		S-1: Organic peat, trace fine sand and silt. (moist).	
		S-2	1.5-3.0'	18"	12"	2-10-12		S-2: Same as S-1. (wet)	
		S-3	3.0-4.5'	18"	12"	32-19-50	3.8'	S-3: Very dense, brown, medium to fine silty sand (wet).	
							4.2'		
5.0'		S-4	4.5-5.5'	12"	6"	40-50		S-4: Very dense, medium to fine, grey, silty sand with gravel (wet).	(1)
10.0'		S-5	10.0-10.8'	8"	4"	24-50/2		S-5: Same as S-4. (wet)	(2)
							14.3'		
15.0'								Terminated at 14.3' on bedrock.	
20.0'									
25.0'									
30.0'									(3)

PROPORTIONS USED: TRACE (0 - 10%), LITTLE (10 - 20%), SOME (20 - 35%), AND (35 - 50%)

COHESIVE CONSISTENCY (Blows/Foot)

0 - 2	VERY SOFT
2 - 4	SOFT
4 - 8	MEDIUM STIFF
8 - 15	STIFF
30+	HARD

COHESIONLESS DENSITY (Blows/Foot)

0 - 4	VERY LOOSE
4 - 10	LOOSE
10 - 30	MEDIUM DENSE
30 - 50	DENSE
50+	VERY DENSE

Driller: T. Comoulka
Helper: R. Marcoux
Inspector: B. Childs

Remarks:
(1) To threaded casing 300 ft. hammer at 6.0'.
(2) Pushing pebble, high blow count.
(3) Hole moved after excessive boulders at 14'.
(4) Boulder core at 11.0-12.0'.

Notes:
1) THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.
2) WATER LEVEL READINGS HAVE BEEN MADE IN THE DRILL HOLES AT TIMES AND UNDER CONDITIONS STATED ON THE BORING LOGS. FLUCTUATIONS IN THE LEVEL OF THE GROUNDWATER MAY OCCUR DUE TO OTHER FACTORS THAN THOSE PRESENT AT THE TIME MEASUREMENTS WERE MADE.

TEST BORING LOGS

MILLER ENGINEERING & TESTING, INC.

Project: OLIN CHEMICAL
Wilmington, MA
Project No: 60321.01
Date Start: 7/3/86
Date End: 7/3/86

Sheet 1 of 1
Boring No: B-9S
Location: See Plan
Surface Elev:

	Casing	Sampler
TYPE:	Hollow Stem Auger	Split Spoon
SIZE:	2 1/4" ID	1 3/8" ID
HAMMER:	---	140 pounds
FALL:	---	30 inches

Groundwater Observations

DATE	DEPTH	CASING AT	STABILIZATION PERIOD
7/21/86	0.22'		Overnight

Depth	Cas bl/ ft	Sample No.	Sample Depth	Sample Pen.	Sample Rec.	Sample Blows/6"	Strata Change	Sample Description	Note
								Peat, organics with trace of fine silty sand.	(1)
5.0'									
10.0'							9.0'		
								Brown to gray, medium to fine silty sand.	
							14.0'		
15.0'								Terminated at 14.0'.	
20.0'									
25.0'									
30.0'									

Proportions used: TRACE (0 - 10%), LITTLE (10 - 20%), SOME (20 - 35%), AND (35 - 50%)

COHESIVE CONSISTENCY (tons/foot)	
0 - 2	VERY SOFT
2 - 4	SOFT
4 - 8	MEDIUM STIFF
8 - 15	STIFF
30+	HARD

COHESIONLESS DENSITY (blows/foot)	
0 - 4	VERY LOOSE
4 - 10	LOOSE
10 - 30	MEDIUM DENSE
30 - 50	DENSE
50+	VERY DENSE

Driller: T. Gomoulka
Helper: R. Marcoux
Inspector: B. Childs

Remarks:
(1) No samples needed.

Notes:
1) The stratification lines represent the approximate boundary between soil types and the transition may be gradual.
2) Water level readings have been made in the drill holes at times and under conditions stated on the boring logs. Fluctuations in the level of the groundwater may occur due to other factors than those present at the time measurements were made.

CSA MONITORING WELL
STRATIGRAPHIC AND INSTRUMENTATION LOGS

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-36)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-4D (Page 1 of 2)
DATE COMPLETED: JUNE 21, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	REFERENCE POINT (Top of Riser)	79.23					
	GROUND SURFACE	77.5					
	SP-SAND, medium grained, brown, wet, outwash		CEMENT/ BENTONITE GROUT	1SS		8	
2.5	– saturated		2"ø PVC PIPE	2SS		14	
5.0	SP-SAND, fine to medium grained, brown, saturated			3SS		18	
	Same, except fine grained, some silt		BENTONITE PELLET SEAL	4SS		16	
7.5	SW-SAND, medium to coarse grained, trace gravel		6"ø BOREHOLE	5SS		6	
10.0				6SS		63	
	GC-GRAVEL, some sand, ice-contact deposit	66.0	SAND PACK				
12.5				7SS		41	
	BEDROCK – spoon refusal	63.5	WELL SCREEN				
15.0	END OF OVERBURDEN HOLE @ 14.2 FT. BGS						
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

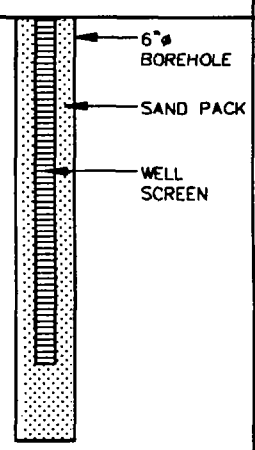
CHEMICAL ANALYSIS WATER FOUND STATIC WATER LEVEL

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L-37)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-4D (Page 2 of 2)
DATE COMPLETED: JUNE 21, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

DEPTH	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	BEDROCK INTERVAL	RUN NUMBER	CORE RECOVERY	RQD	WATER RETURN
ft BGS		ft. AMSL				%	%	%
	Overburden							
12.5								
15.0	BEDROCK(Gneiss): moderately fractured, fractures subvertical with minor weathering, fracturing/joints diminish @ 21.0 ft BGS	63.5			1	80	0	
17.5					2			
20.0								
	END OF HOLE @ 21 FT. BGS	56.5						
22.5								
25.0								
27.5								
30.0								
32.5								
35.0								
37.5								
40.0								

SCREEN DETAILS:
Screened Interval:
9.0 to 19.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
7.0 to 21.0' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

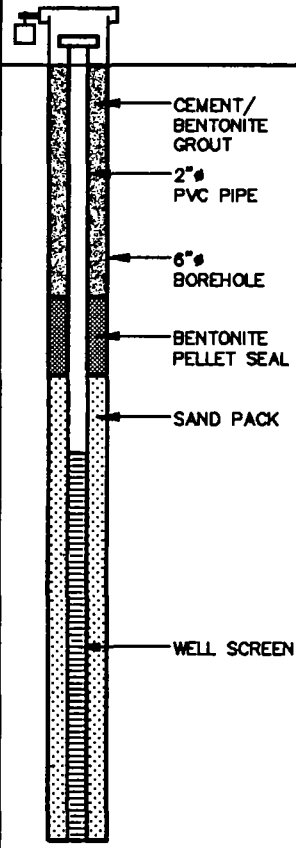
STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(L-38)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-40S
DATE COMPLETED: JULY 29, 1991
DRILLING METHOD: 4 1/4 " HSA
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	REFERENCE POINT (Top of Riser) GROUND SURFACE	88.46 86.4					
	For statigraphy see log GW-40D						
2.5							
5.0							
7.5							
10.0							
12.5							
15.0							
17.5							
20.0	END OF HOLE @ 20.0 FT. BGS	66.4					
22.5							
25.0							
27.5							
30.0							
32.5							



SCREEN DETAILS:
Screened Interval:
10.0 to 20.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
8.0 to 20.0' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

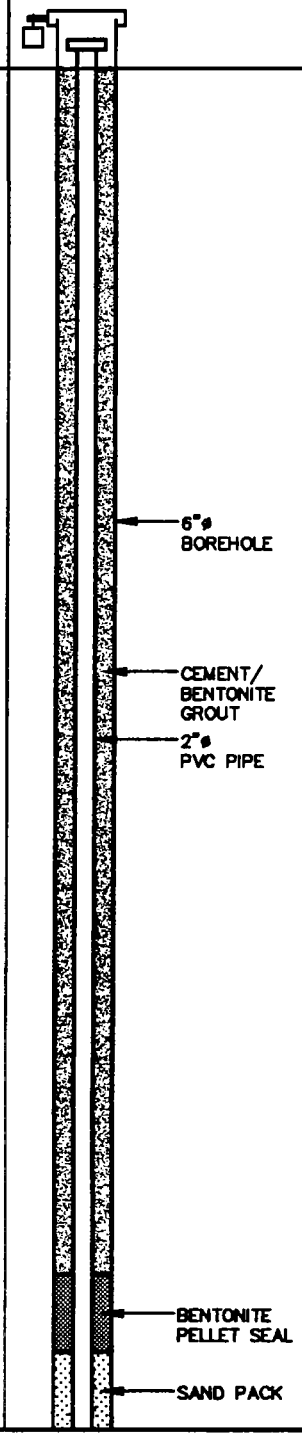
(L-39)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-40D (Page 1 of 3)
DATE COMPLETED: JULY 10, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL
	REFERENCE POINT (Top of Riser)	88.00
	GROUND SURFACE	86.4
	SP-SAND(FILL), fine to medium grained, trace gravel, yellow brown, dry	
2.5		
5.0		
		79.4
7.5	SP-SAND, fine to medium grained, dark brown, moist, outwash – saturated	
10.0		
12.5		
	SW-SAND, fine to medium grained, brown, saturated, outwash	
15.0		
17.5	ML-SILT, some fine sand, brown, outwash	68.9 68.4
	SW-SAND, fine, medium and coarse grained, brown, saturated, outwash	
20.0		
22.5		
	ML-SILT, some fine sand, brown, saturated	62.9
25.0	SW-SAND, fine to coarse grained, some fine to medium gravel, brown, saturated, ice-contact deposit	61.9
27.5		
	SW/GW-SAND and GRAVEL, fine to coarse sand, fine to medium gravel, brown, saturated, ice-contact deposit	58.4
30.0		
32.5	– coarse gravel, hard drilling to end of boring	

MONITOR INSTALLATION



SAMPLE NUMBER	STATE	'N' VALUE	PID (ppm)
1SS		14	
2SS		12	
3SS		15	
4SS		32	
5SS		42	
6SS		32	
7SS		46	
8SS		23	
9SS		10	
10SS		12	
11SS		6	
12SS		6	
13SS		56	
14SS		86	
15SS		59	
16SS		64	

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-39)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-40D (Page 2 of 3)
DATE COMPLETED: JULY 10, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
35.0			2"ø PVC PIPE	17SS		41	
37.5			SAND PACK	18SS		>100	
40.0	BEDROCK – spoon refusal	47.4					
	END OF OVERBURDEN HOLE @ 40.0 FT. BGS	46.4	WELL SCREEN				
42.5			6"ø BOREHOLE				
45.0							
47.5							
50.0							
52.5							
55.0							
57.5							
60.0							
62.5							
65.0							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

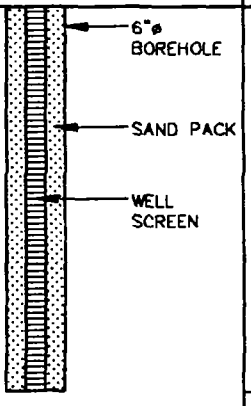
CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L-40)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-40D (Page 3 of 3)
DATE COMPLETED: JULY 26, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

DEPTH	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	BEDROCK INTERVAL	RUN NUMBER	CORE RECOVERY	RQD	WATER RETURN
ft BGS		ft. AMSL				%	%	%
	Overburden							
37.5								
40.0	BEDROCK(Gneiss), slightly to moderately fractured, fractures are slightly weathered	46.4						
42.5					1	65	40	
45.0	END OF HOLE @ 45 FT. BGS	41.4						
47.5								
50.0								
52.5								
55.0								
57.5								
60.0								
62.5								
65.0								

SCREEN DETAILS:
Screened Interval:
35.0 to 45.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
33.0 to 45.0' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

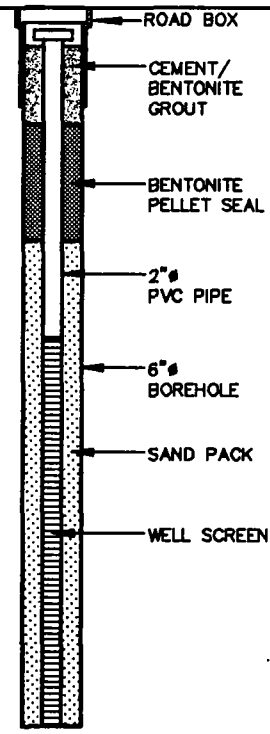
▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(L-41)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-42S
DATE COMPLETED: JUNE 21, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	REFERENCE POINT (Top of Riser)	84.16					
	GROUND SURFACE	84.5					
	For statigraphy see log GW-42D						
2.5							
5.0							
7.5							
10.0							
12.5							
15.0							
17.5							
	END OF HOLE @ 18.5 FT. BGS	66.0					
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

SCREEN DETAILS:
Screened Interval:
8.5 to 18.5' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
6.0 to 18.5' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-42)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-42D (Page 1 of 3)
DATE COMPLETED: JULY 21, 1991
DRILLING METHOD: 4 1/4 / NX
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	STATE	'N' VALUE	PID (ppm)
	REFERENCE POINT (Top of Riser)	84.16					
	GROUND SURFACE	84.4					
	GW-GRAVEL, some sand, brown, dry, ice-contact deposit		ROAD BOX	1SS	X	>100	
2.5				2SS	X	22	
	SW-SAND, some silt, brown, wet	80.4					
5.0				3SS	X	28	
7.5	SP-SAND, medium to coarse grained, trace gravel, light brown, saturated, ice-contact deposit			4SS	X	29	
				5SS	X	26	
10.0				6SS	X	17	
12.5			4"ø BOREHOLE	7SS	X	14	
			CEMENT/ BENTONITE GROUT				
15.0				8SS	X	6	
17.5			2"ø PVC PIPE	9SS	X	23	
20.0				10SS	X	11	
22.5				11SS	X	9	
	GW/SW-GRAVEL and SAND, hard drilling to end of drilling	60.9					
25.0							
27.5			BENTONITE PELLET SEAL				
30.0							
32.5			SAND PACK				

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-42)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-42D (Page 2 of 3)
DATE COMPLETED: JULY 21, 1991
DRILLING METHOD: 4 1/4 / NX
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
35.0			2"ø PVC PIPE; SAND PACK				
37.5							
40.0	BEDROCK END OF OVERBURDEN HOLE @ 39.0 FT. BGS	45.4	WELL SCREEN; 4"ø BOREHOLE	12SS	☒	>100	
42.5							
45.0							
47.5							
50.0							
52.5							
55.0							
57.5							
60.0							
62.5							
65.0							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

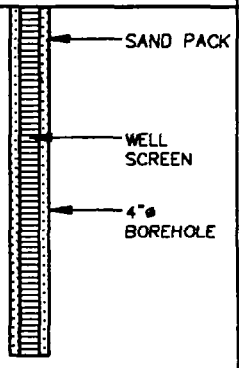
CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L-43)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-42D (Page 3 of 3)
DATE COMPLETED: JULY 21, 1991
DRILLING METHOD: 4 1/4 / NX
CRA SUPERVISOR: J.W. MICHELS

DEPTH	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	BEDROCK INTERVAL	RUN NUMBER	CORE RECOVERY	RQD	WATER RETURN
ft BGS		ft. AMSL				%	%	%
	Overburden							
37.5								
40.0	BEDROCK(Gneiss): slightly to moderately fractured, fractures are subvertical to near horizontal, little weathering on fractures	45.2			1	55	45	
42.5								
45.0	END OF HOLE @ 44 FT. BGS	40.2	SCREEN DETAILS: Screened Interval: 34.0 to 44.0' BGS Length -10.0' Diameter -2.0" Slot # 10 Material -Plastic Sand pack interval: 30.0 to 44.0' BGS Material -Coarse Sand					
47.5								
50.0								
52.5								
55.0								
57.5								
60.0								
62.5								
65.0								

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

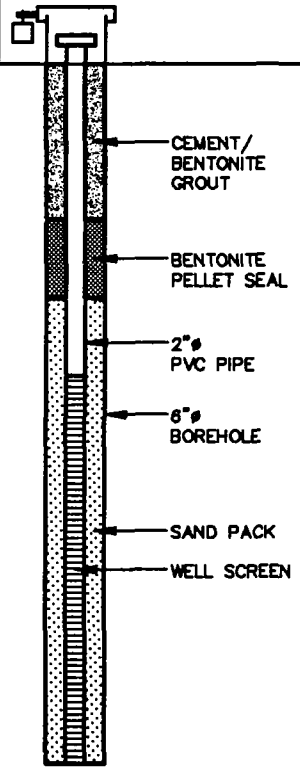
STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(L-44)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-43S
DATE COMPLETED: JUNE 24, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	REFERENCE POINT (Top of Riser)	87.36					
	GROUND SURFACE	85.6					
	For statigraphy see log GW-43D						
2.5							
5.0							
7.5							
10.0							
12.5							
15.0							
17.5							
	END OF HOLE @ 18.0 FT. BGS	67.6					
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							



SCREEN DETAILS:
Screened Interval:
8.0 to 18.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
6.0 to 18.0' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ∇ STATIC WATER LEVEL ▼

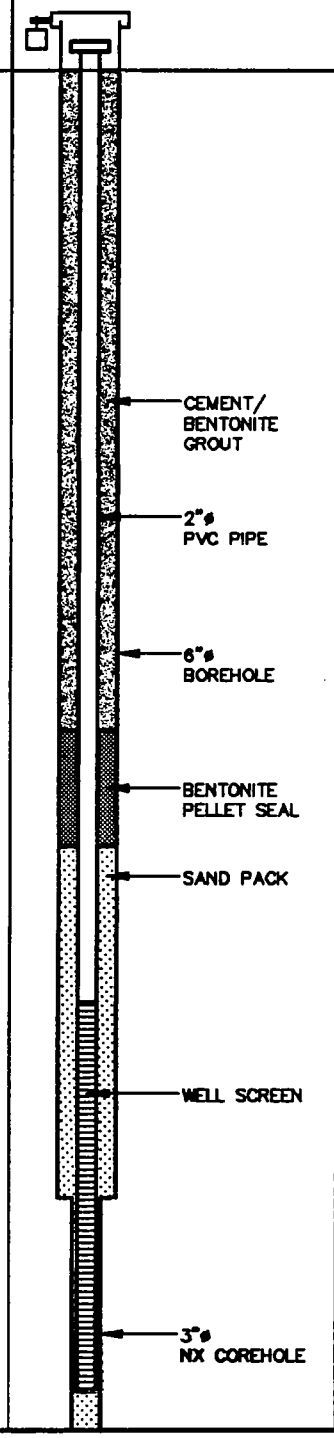
STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(L-45)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-43D (Page 1 of 2)
DATE COMPLETED: JULY 17, 1991
DRILLING METHOD: 4 1/4 / NX
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	SAMPLE NUMBER	STATE	'N' VALUE	PID (ppm)
	REFERENCE POINT (Top of Riser)	87.97				
	GROUND SURFACE	85.6				
	GW-GRAVEL, pebbles and well rounded boulders, some sand, brown, dry, ice-contact deposit		1SS		43	
2.5			2SS		46	
5.0	– saturated		3SS		80	
			4SS		80	
7.5	SW-SAND, fine to coarse grained, gravelly, brown, saturated	78.1				
	– softer		5SS		23	
10.0	Same, except trace gravel		6SS		35	
12.5			7SS		26	
15.0	GW-GRAVEL, some sand, very hard, cobbles		8SS		44	
17.5						
			9SS		13	
20.0			10SS		>100	
	– very hard					
22.5						
25.0			11SS		19	
	SW-SAND, fine to coarse grained, some gravel, some silt, dense	59.6				
27.5						
	BEDROCK – spoon refusal	56.6				
30.0	END OF OVERBURDEN HOLE @ 29.0 ft. BGS		12SS		>100	
32.5						



NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L105)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-65D (Page 1 of 4)
DATE COMPLETED: AUGUST 5, 1992
DRILLING METHOD: 4 1/4 HSA / NX / 5 7/8 WR
CRA SUPERVISOR: S. SWANSON

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
	REFERENCE ELEVATION (Top of Riser)	84.19				
	GROUND SURFACE	82.4				
	SP-SAND(FILL), some organics, trace gravel, medium grained, brown			1SS	X	17
2.5				2SS	X	28
	Same, except little gravel, little clay, moist					
5.0				3SS	X	13
	Same, except saturated					
7.5	PT-PEAT, fibrous plant material, very soft, black	75.4		4SS	X	20
				5SS	X	2
10.0	SW-SAND, trace gravel, stiff, medium to coarse grained, brown and gray	72.4	2"ø PVC PIPE			
12.5				6SS	X	22
15.0	SP-SAND, some silt, stiff, fine grained, gray	67.4				
17.5			CEMENT/ BENTONITE GROUT	7SS	X	17
20.0						
22.5			6"ø BOREHOLE	8SS	X	8
25.0						
27.5				9SS	X	27
30.0						
32.5	Same, except very fine grained					

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(L105)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-65D (Page 2 of 4)
DATE COMPLETED: AUGUST 5, 1992
DRILLING METHOD: 4 1/4 HSA / NX / 5 7/8 WR
CRA SUPERVISOR: S. SWANSON

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
35.0				10SS		17
37.5	Same, with some laminar bedding			11SS		23
40.0						
42.5			2"ø PVC PIPE	12SS		19
45.0						
47.5				13SS		22
50.0			CEMENT/ BENTONITE GROUT			
52.5				14SS		38
55.0			6"ø BOREHOLE			
57.5	Same, except fine to medium grained			15SS		23
60.0						
62.5				16SS		23
65.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L105)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-65D (Page 3 of 4)
DATE COMPLETED: AUGUST 5, 1992
DRILLING METHOD: 4 1/4 HSA / NX / 5 7/8 WR
CRA SUPERVISOR: S. SWANSON

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
67.5			CEMENT/ BENTONITE GROUT	17SS	X	26
70.0						
72.5				18SS	X	30
75.0			2"ø PVC PIPE			
77.5				19SS	X	47
80.0	SW-SAND, very stiff, fine to coarse grained, gray	2.4				
82.5	Same, except coarse grained		BENTONITE PELLET SEAL	20SS	X	>100
85.0						
87.5	SP-SAND, some silt, very stiff, fine to medium grained, gray	-5.6	6"ø BOREHOLE	21SS	X	>100
90.0						
92.5	SW-SAND, some silt, clay and weathered rock fragments, very stiff to hard, fine to coarse grained, gray and white	-10.6	SAND PACK	22SS	X	>100
95.0	BEDROCK	-13.1	WELL SCREEN			
97.5	END OF OVERBURDEN HOLE @ 95.5 FT. BGS					

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

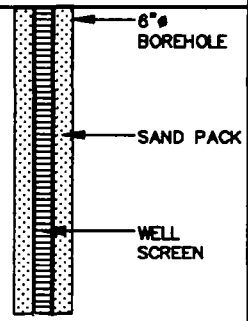
CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG
(BEDROCK)

(L106)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-65D (Page 4 of 4)
DATE COMPLETED: AUGUST 6, 1992
DRILLING METHOD: 4 1/4 HSA / NX / 5 7/8 WR
CRA SUPERVISOR: S. SWANSON

DEPTH	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	BEDROCK INTERVAL	RUN NUMBER	CORE RECOVERY	RQD	WATER RETURN
ft BGS		ft. AMSL				%	%	%
	Overburden							
95.0		-10.9						
	BEDROCK(Gneiss): light gray, medium to coarse grained, fractured				1	80	0.0	
97.5								
100.0		-15.9						
	END OF HOLE @ 100.5 FT. BGS							
102.5								
105.0								
107.5								
110.0								
112.5								
115.0								
117.5								
120.0								
122.5								

SCREEN DETAILS:
Screened Interval:
85.5 to 100.5' BGS
Length -15.0'
Diameter -2.0"
Slot # 10
Material -PVC
Sand pack interval:
83.5 to 100.5' BGS
Material -# 2 Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L108)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-66D (Page 1 of 3)
DATE COMPLETED: JULY 22, 1992
DRILLING METHOD: 4 1/4 HSA / NX / 5 7/8 WR
CRA SUPERVISOR: S. SWANSON

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
	REFERENCE ELEVATION (Top of Riser) 90.32 GROUND SURFACE 88.3					
	OL-TOPSOIL	87.8				
	SP-SAND(FILL), some silt, trace gravel, soft, light brown, dry			1SS	X	10
2.5	Same, except fine to medium grained, very stiff		CEMENT/ BENTONITE GROUT	2SS	X	10
5.0				3SS	X	45
	SW-SAND, some gravel, fine to coarse grained, gray, damp to moist	82.3		4SS	X	>100
7.5	Same, except medium to coarse grained, saturated			5SS	X	30
10.0	SW/GW-SAND and GRAVEL, medium to coarse grained, gray and brown, saturated, ice-contact deposit	78.3		6SS	X	24
12.5			6"ø BOREHOLE	7SS	X	17
15.0				8SS	X	58
17.5			2"ø PVC PIPE			
20.0				9SS	X	75
22.5						
	Same, except soft, fine to medium grained			10SS	X	25
25.0						
27.5						
	SP-SAND, very stiff, medium grained, light brown and gray, saturated	60.3 59.3		11SS	X	>100
30.0	SW/GW-SAND and GRAVEL, medium to coarse grained, light brown and gray, saturated		BENTONITE PELLET SEAL			
32.5						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L108)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-66D (Page 2 of 3)
DATE COMPLETED: JULY 22, 1992
DRILLING METHOD: 4 1/4 HSA / NX / 5 7/8 WR
CRA SUPERVISOR: S. SWANSON

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
35.0			2"ø PVC PIPE; 6"ø BOREHOLE			
37.5	Same, except gray and brown, saturated		WELL SCREEN	12SS	X	38
40.0	BEDROCK END OF OVERBURDEN HOLE @ 40.0 FT. BGS	48.3	SAND PACK			
42.5						
45.0						
47.5						
50.0						
52.5						
55.0						
57.5						
60.0						
62.5						
65.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

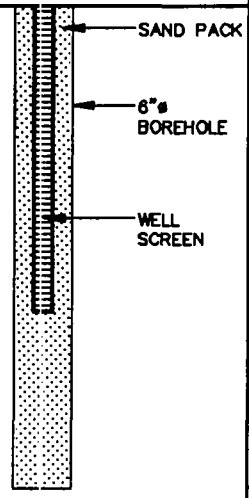
CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L109)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-66D (Page 3 of 3)
DATE COMPLETED: JULY 22, 1992
DRILLING METHOD: 4 1/4 HSA / NX / 5 7/8 WR
CRA SUPERVISOR: S. SWANSON

DEPTH	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	BEDROCK INTERVAL	RUN NUMBER	CORE RECOVERY	RQD	WATER RETURN
ft BGS		ft. AMSL				%	%	%
	Overburden							
37.5								
40.0	BEDROCK(Gneiss); metasedimentary, crystalline, fine grained, black and green, some white quartz bands, fractured, with weathered chlorite along fractures	48.3						
42.5					1	98	0.0	
45.0					2	98	0.0	
47.5	END OF HOLE @ 47.5 FT. BGS	40.8						
50.0								
52.5								
55.0								
57.5								
60.0								
62.5								
65.0								

SCREEN DETAILS:
Screened Interval: 33.0 to 43.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -PVC
Sand pack interval: 31.0 to 47.5' BGS
Material -# 2 Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

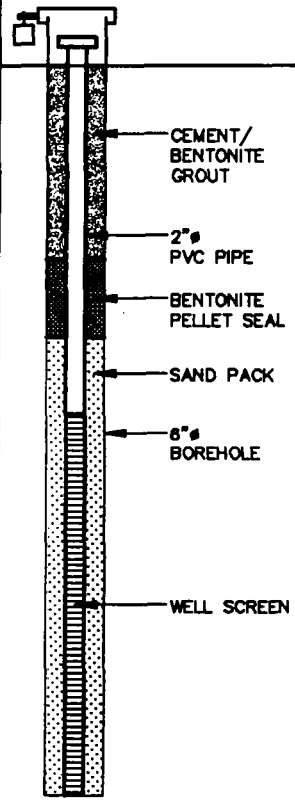
▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L110)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-66S
DATE COMPLETED: AUGUST 3, 1992
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: S. SWANSON

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
	REFERENCE ELEVATION (Top of Riser) GROUND SURFACE	90.15 88.4				
	For stratigraphy see log GW-66D					
2.5						
5.0						
7.5						
10.0						
12.5						
15.0						
17.5						
	END OF HOLE @ 19.0 FT. BGS	69.4				
20.0						
22.5						
25.0						
27.5						
30.0						
32.5						

SCREEN DETAILS:
Screened Interval:
9.0 to 19.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -PVC
Sand pack interval:
7.0 to 19.0' BGS
Material -# 2 Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L125)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-67D (Page 1 of 4)
DATE COMPLETED: NOVEMBER 2, 1992
DRILLING METHOD: 4 1/4" ID HSA / 4 7/8" ROLLER BIT
CRA SUPERVISOR: S. SWANSON

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
	REFERENCE POINT (Top of Riser)	100.39				
	GROUND SURFACE	98.2				
	OL-TOPSOIL, trace gravel, dark brown	97.7				
	SW-SAND, little gravel, little silt, very dense, tan and white, dry			1SS		50
2.5				2SS		60
5.0				3SS		>100
7.5						
			CEMENT/ BENTONITE GROUT	4SS		36
10.0				5SS		35
			5"ø BOREHOLE			
12.5	Same, except trace gravel, medium dense, medium to coarse grained, tan, moist, some iron staining			6SS		27
15.0			2"ø PVC PIPE	7SS		15
	SP-SAND, trace gravel, medium dense, fine grained, tan, moist, some iron staining	82.7				
17.5	Same, except medium grained, saturated			8SS		14
				9SS		9
20.0						
22.5						
25.0				10SS		17
			NATIVE MATERIAL			
27.5						
30.0				11SS		22
32.5						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L125)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-67D (Page 2 of 4)
DATE COMPLETED: NOVEMBER 2, 1992
DRILLING METHOD: 4 1/4" ID HSA / 4 7/8" ROLLER BIT
CRA SUPERVISOR: S. SWANSON

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
35.0				12SS	X	20
37.5						
	Some faint bedding					
40.0				13SS	X	24
42.5			5"ø BOREHOLE			
	Some faint bedding					
45.0				14SS	X	26
47.5			NATIVE MATERIAL			
	Some faint bedding					
50.0				15SS	X	26
52.5			2"ø PVC PIPE			
	Same, except fine to medium grained					
55.0				16SS	X	28
57.5						
	Same, with some silty layers, iron staining					
60.0				17SS	X	26
62.5						
65.0				18SS	X	47
	Fractured and weathered rock (@ 66.0 ft BGS)		BENTONITE PELLET SEAL			

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L147)

PROJECT NAME: OLIN (USA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-75D (Page 1 of 3)
DATE COMPLETED: MAY 6, 1993
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
	REFERENCE POINT (Top of Riser)	83.49				
	GROUND SURFACE	81.4				
	SW-SAND, fine to coarse grained, brown, outwash – saturated		ROAD BOX CONCRETE SEAL	1SS	X	19
2.5				2SS	X	22
5.0			2"ø PVC PIPE	3SS	X	16
7.5				4SS	X	25
10.0	SP/SW-SAND, interbeds, poorly graded and well graded, medium to coarse grained, brown ice contact deposits	71.4		5SS	X	17
12.5						
15.0				6SS	X	40
17.5			CEMENT/ BENTONITE GROUT			
20.0	SW-SAND, medium to coarse grained, brown	62.2				
22.5				8SS	X	32
			5"ø BOREHOLE			
25.0						
27.5						
30.0				9SS	X	24
32.5			BENTONITE PELLET SEAL			

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L147)

PROJECT NAME: OLIN (USA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-75D (Page 2 of 3)
DATE COMPLETED: MAY 6, 1993
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
35.0			BENTONITE PELLET SEAL; 2"ø PVC PIPE; SAND PACK	10SS	X	40
37.5						
40.0				11SS	X	>100
	BEDROCK – refusal	40.4	WELL SCREEN			
42.5	END OF OVERBURDEN HOLE @ 41.0 FT. BGS		5"ø BOREHOLE			
45.0						
47.5						
50.0						
52.5						
55.0						
57.5						
60.0						
62.5						
65.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L125)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-67D (Page 3 of 4)
DATE COMPLETED: NOVEMBER 2, 1992
DRILLING METHOD: 4 1/4" ID HSA / 4 7/8" ROLLER BIT
CRA SUPERVISOR: S. SWANSON

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
67.5			BENTONITE PELLET SEAL			
70.0			2"ø PVC PIPE; SAND PACK			
72.5						
75.0	Same with trace clay and silt		5"ø BOREHOLE	19SS		61
	SW-SAND(TILL), some clay, trace gravel and weathered rock, hard, medium to coarse grained, tan and gray	22.7				
77.5				20SS		>100
80.0			WELL SCREEN			
	FRACTURED BEDROCK	17.2				
82.5						
	BEDROCK	15.2				
	END OF OVERBURDEN HOLE @ 83.0 FT. BGS		4"ø HQ COREHOLE			
85.0						
87.5						
90.0						
92.5						
95.0						
97.5						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

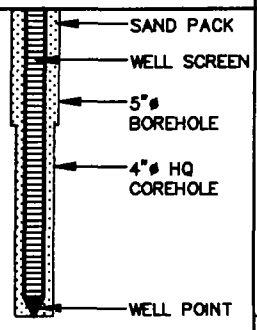
CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L126)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-67D (Page 4 of 4)
DATE COMPLETED: NOVEMBER 2, 1992
DRILLING METHOD: HQ CORE
CRA SUPERVISOR: S. SWANSON

DEPTH	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	BEDROCK INTERVAL	RUN NUMBER	CORE RECOVERY	RQD	WATER RETURN
ft BGS		ft. AMSL				%	%	%
	Overburden							
82.5		-83.0						
	BEDROCK(Gneiss): black, fine grained, irregular white and green veins (1-5mm), weakly fractured				1	75	100.0	
85.0								
87.5					2	75	100.0	
	END OF HOLE @ 88 FT. BGS	-88.0						
90.0								
92.5								
95.0								
97.5								
100.0								
102.5								
105.0								
107.5								
110.0								

SCREEN DETAILS:
Screened Interval:
72.5 to 87.5' BGS
Length -15.0'
Diameter -2.0"
Slot # 10
Material -PVC
Sand pack interval:
68.0 to 83.0' BGS
Material -# 2 Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

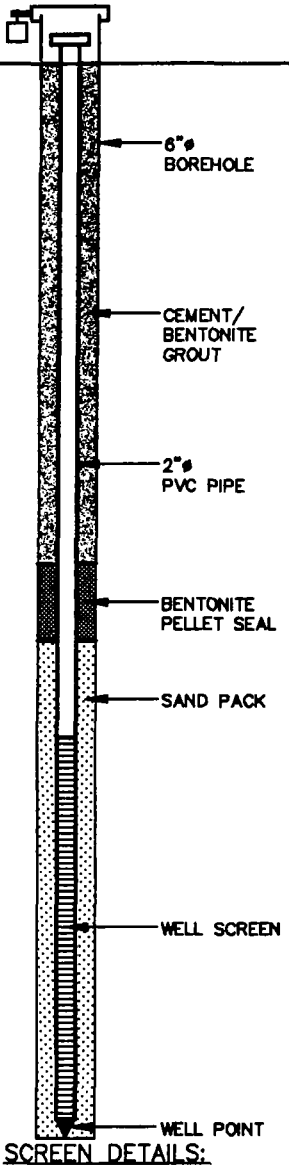
STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L127)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-67S
DATE COMPLETED: NOVEMBER 2, 1993
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: S. SWANSON

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
	REFERENCE POINT (Top of Riser) GROUND SURFACE	100.61 98.4				
	For stratigraphy see log GW-67D					
2.5			6"ø BOREHOLE			
5.0						
7.5			CEMENT/ BENTONITE GROUT			
10.0			2"ø PVC PIPE			
12.5						
15.0			BENTONITE PELLET SEAL			
17.5			SAND PACK			
20.0						
22.5			WELL SCREEN			
25.0						
27.5			WELL POINT			
	END OF HOLE @ 28.0 FT. BGS	70.4				
30.0						
32.5						



SCREEN DETAILS:
Screened Interval:
17.5 to 27.5' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -PVC
Sand pack interval:
15.0 to 28.0' BGS
Material -# 2 Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

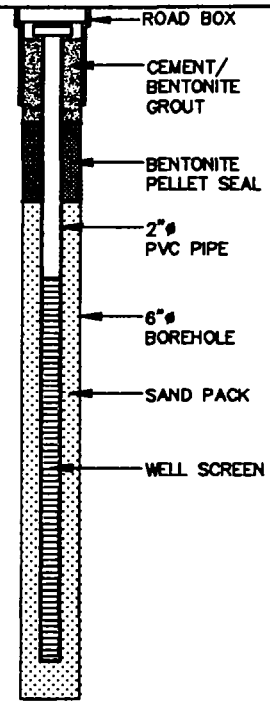
CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L111)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-68D (Page 1 of 2)
DATE COMPLETED: JULY 23, 1992
DRILLING METHOD: 4 1/4 HSA / NX / 5 7/8 WR
CRA SUPERVISOR: S. SWANSON

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
	REFERENCE ELEVATION (Top of Riser)	90.16				
	GROUND SURFACE	90.3				
	Asphalt and road base	89.7				
	SP-SAND(FILL), some silt, trace gravel, very stiff, light brown			1SS		42
2.5	Same, except some gravel, little silt and clay, very stiff, gray			2SS		63
5.0				3SS		50
	SP-SAND, some silt, some clay, trace gravel, some organic matter, very stiff, dark brown and gray			4SS		88
7.5		82.3				
	SW-SAND, some clay, some gravel, very stiff to hard, medium to coarse grained, brown and gray, moist			5SS		>100
10.0	Same, except saturated			6SS		>100
	BEDROCK	79.3				
12.5	END OF OVERBURDEN HOLE @ 11.0 FT. BGS					
15.0						
17.5						
20.0						
22.5						
25.0						
27.5						
30.0						
32.5						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

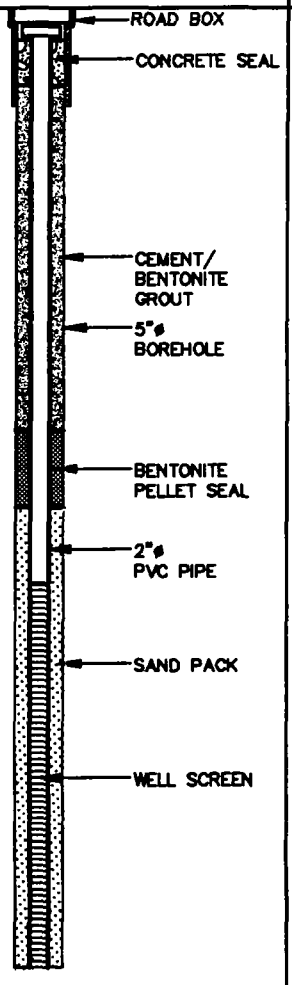
CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L142)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-73S
DATE COMPLETED: APRIL 19, 1993
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: M. JEFFREY

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
	REFERENCE POINT (Top of Riser) GROUND SURFACE	83.39 83.4				
	For straigraphy see GW-73D					
2.5						
5.0						
7.5						
10.0						
12.5						
15.0						
17.5						
20.0						
22.5						
25.0	END OF HOLE @ 25.0 FT. BGS	58.4				
27.5						
30.0						
32.5						

SCREEN DETAILS:
Screened Interval:
15.0 to 25.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -PVC
Sand pack interval:
13.0 to 25.0' BGS
Material -Medium Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L140)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-73D (Page 1 of 3)
DATE COMPLETED: APRIL 19, 1993
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: M. JEFFREY

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
	REFERENCE POINT (Top of Riser)	83.49				
	GROUND SURFACE	83.8				
	SP-SAND, some organic matter, brown, moist		ROAD BOX; CONCRETE SEAL	1SS		7
2.5	Same, with some silt			2SS		6
5.0	Same, except saturated			3SS		12
		76.4	2"ø PVC PIPE	4SS		15
7.5	SW-SAND, fine to coarse grained, tan, saturated	75.4				
	SP-SAND, some silt, brown, saturated			5SS		13
10.0				6SS		11
			5"ø BOREHOLE			
12.5						
15.0	SW-SAND, fine to coarse grained, saturated	68.4		7SS		10
17.5			CEMENT/ BENTONITE GROUT			
20.0				8SS		21
22.5						
25.0				9SS		13
27.5						
30.0				10SS		18
32.5						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(L140)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-73D (Page 2 of 3)
DATE COMPLETED: APRIL 19, 1993
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: M. JEFFREY

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
35.0	SP-SAND, some silt, brown, saturated	48.4	CEMENT/ BENTONITE GROUT	11SS	X	18
37.5						
40.0				12SS	X	14
42.5			5"ø BOREHOLE			
45.0				13SS	X	20
47.5			2"ø PVC PIPE			
50.0	SW-SAND, coarse grained, saturated – boulder	33.4	BENTONITE PELLET SEAL	14SS	X	10
52.5			SAND PACK			
55.0	SP-SAND, brown, saturated	29.4		15SS	X	
57.5	BEDROCK END OF OVERBURDEN HOLE @ 58.0 FT. BGS	25.4	WELL SCREEN			
60.0						
62.5						
65.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

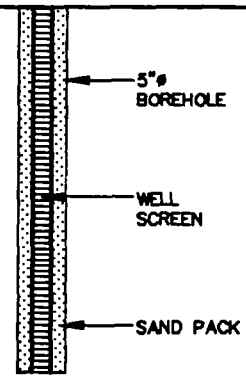
CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L141)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-73D (Page 3 of 3)
DATE COMPLETED: APRIL 14, 1993
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: M. JEFFREY

DEPTH	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	BEDROCK INTERVAL	RUN NUMBER	CORE RECOVERY	RQD	WATER RETURN
ft BGS		ft. AMSL				%	%	%
	Overburden							
57.5		25.8						
	BEDROCK(Gneiss): heavily fractured, highly weathered				1	50		
60.0								
62.5								
65.0	END OF HOLE @ 64.5 FT. BGS	19.3						
67.5								
70.0								
72.5								
75.0								
77.5								
80.0								
82.5								
85.0								

SCREEN DETAILS:
Screened Interval:
54.5 to 64.5' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -PVC
Sand pack interval:
52.0 to 64.5' BGS
Material -Medium Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(L116)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-70D (Page 2 of 2)
DATE COMPLETED: JULY 28, 1992
DRILLING METHOD: 4 1/4 HSA / NX / 5 7/8 WR
CRA SUPERVISOR: S. SWANSON

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
35.0						
37.5						
40.0				14SS	X	37
42.5			CEMENT/ BENTONITE GROUT			
45.0	SW-SAND(TILL), little gravel, brown	48.3		15SS	X	40
47.5			2"ø PVC PIPE			
50.0	Same, with some iron staining		BENTONITE PELLET SEAL	16SS	X	68
52.5			6"ø BOREHOLE			
55.0			SAND PACK			
57.5	BEDROCK END OF OVERBURDEN HOLE @ 57.0 FT. BGS	35.3	WELL SCREEN			
60.0						
62.5						
65.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

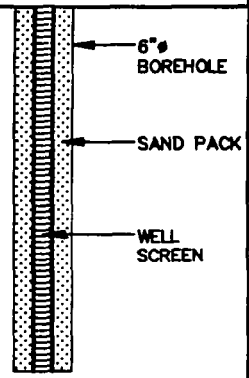
CHEMICAL ANALYSIS ⬭ WATER FOUND ∇ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG
(BEDROCK)

(L117)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-70D (Page 3 of 3)
DATE COMPLETED: JULY 22, 1992
DRILLING METHOD: 4 1/4 HSA / NX / 5 7/8 WR
CRA SUPERVISOR: S. SWANSON

DEPTH	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	BEDROCK INTERVAL	RUN NUMBER	CORE RECOVERY	RQD	WATER RETURN
ft BGS		ft. AMSL				%	%	%
	Overburden							
55.0								
57.5	BEDROCK(Gneiss): black and gray, medium to coarse grained, fractured	35.3						
60.0					1	80	0.0	0
62.5	END OF HOLE @ 62 FT. BGS	30.3	SCREEN DETAILS: Screened Interval: 52.0 to 62.0' BGS Length -10.0' Diameter -2.0" Slot # 10 Material -PVC Sand pack interval: 50.0 to 62.0' BGS Material -# 2 Sand					
65.0								
67.5								
70.0								
72.5								
75.0								
77.5								
80.0								
82.5								

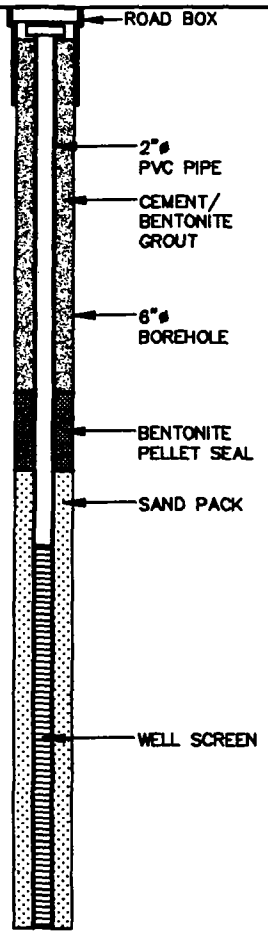
NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L118)

PROJECT NAME:	OLIN (CSA)	HOLE DESIGNATION:	GW-70S
PROJECT NO.:	3683	DATE COMPLETED:	JULY 28, 1992
CLIENT:	OLIN CORP.	DRILLING METHOD:	4 1/4" ID HSA
LOCATION:	WILMINGTON, MA.	CRA SUPERVISOR:	S. SWANSON

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
	REFERENCE ELEVATION (Top of Riser) GROUND SURFACE	*91.99* *92.2*				
	For stratigraphy see log GW-70D					
2.5						
5.0						
7.5						
10.0						
12.5						
15.0						
17.5						
20.0						
22.5						
	END OF HOLE @ 24.0 FT. BGS	*68.2*				
25.0						
27.5						
30.0						
32.5						

SCREEN DETAILS:
Screened Interval:
14.0 to 24.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -PVC
Sand pack interval:
12.0 to 24.0' BGS
Material -# 2 Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L116)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-70D (Page 1 of 2)
DATE COMPLETED: JULY 28, 1992
DRILLING METHOD: 4 1/4 HSA / NX / 5 7/8 WR
CRA SUPERVISOR: S. SWANSON

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
	REFERENCE ELEVATION (Top of Riser)	92.10				
	GROUND SURFACE	92.3				
	OL-TOPSOIL	91.8	ROAD BOX			
	SP-SAND, some silt, little clay, trace gravel, some organic material, light brown			1SS		20
2.5	SP-SAND, fine grained, tan			2SS		25
5.0	Same, with some silt, dark tan			3SS		15
7.5				4SS		26
				5SS		
10.0				6SS		
			2"ø PVC PIPE			
12.5	SW-SAND, some gravel, medium to coarse grained, light brown, saturated	80.3		7SS		30
15.0				8SS		29
	SW/GW-SAND and GRAVEL, medium to coarse grained, light brown	76.3				
17.5			CEMENT/ BENTONITE GROUT	9SS		40
20.0				10SS		45
				11SS		37
22.5			6"ø BOREHOLE	12SS		36
25.0				13SS		26
27.5	SW-SAND, some gravel, medium to coarse grained	64.8				
30.0						
32.5						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L130)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-71D (Page 1 of 3)
DATE COMPLETED: NOVEMBER 19, 1992
DRILLING METHOD: 4 1/4" ID HSA / 4 7/8" ROLLER BIT
CRA SUPERVISOR: S. SWANSON

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
	REFERENCE POINT (Top of Riser) 96.65 GROUND SURFACE 94.4					
	TOPSOIL, organic rich, black	94.2				
	SW-SAND(FILL), trace gravel, loose, medium grained, tan, dry	92.4		1SS		6
2.5	SM-SAND, some silt, loose, fine grained, tan, dry Same, except medium dense, tan and black			2SS		5
5.0	Same, with trace gravel			3SS		12
7.5			CEMENT/ BENTONITE GROUT	4SS		18
				5SS		16
10.0	SP-SAND, trace silt, medium dense, fine grained, tan, dry Same, except moist	84.4		6SS		12
12.5			5"ø BOREHOLE	7SS		>100
15.0	SW-SAND, little gravel, trace clay, medium to coarse grained, tan, saturated Same, except trace gravel, no clay, very dense	80.4		8SS		>100
17.5			2"ø PVC PIPE			
20.0				9SS		44
22.5	Same, with increased gravel content					
25.0	Same, but very hard		NATIVE MATERIAL	10SS		69
27.5						
30.0				11SS		83
32.5						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

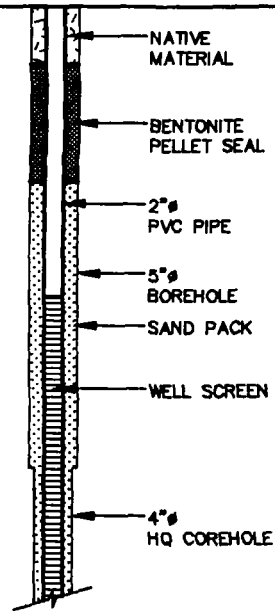
STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(L130)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-71D (Page 2 of 3)
DATE COMPLETED: NOVEMBER 19, 1992
DRILLING METHOD: 4 1/4" ID HSA / 4 7/8" ROLLER BIT
CRA SUPERVISOR: S. SWANSON

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
	SP-SAND, trace silt, very dense, fine grained, tan	60.4		12SS	X	52
35.0						
37.5						
40.0						
42.5						
45.0	BEDROCK END OF OVERBURDEN HOLE @ 44.5 FT. BGS	49.9				
47.5						
50.0						
52.5						
55.0						
57.5						
60.0						
62.5						
65.0						



NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

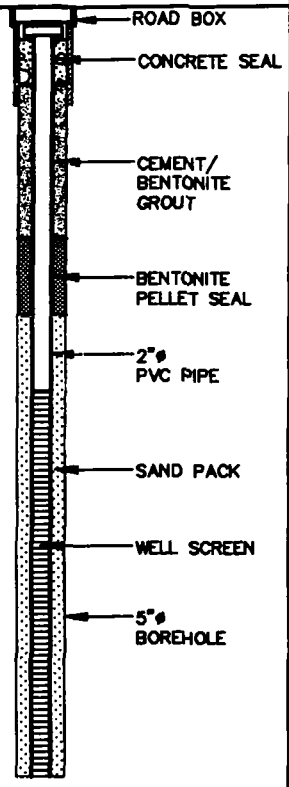
CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(L143)

PROJECT NAME: OLIN (USA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-74S
DATE COMPLETED: MARCH 25, 1993
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
	REFERENCE POINT (Top of Riser)	77.43				
	GROUND SURFACE	77.7				
	For stratigraphy see GW-74D					
2.5						
5.0						
7.5						
10.0						
12.5						
15.0						
17.5						
20.0	END OF HOLE @ 20.0 FT. BGS	57.7				
22.5						
25.0						
27.5						
30.0						
32.5						

SCREEN DETAILS:
Screened Interval:
8.0 to 20.0' BGS
Length -12.0'
Diameter -2.0"
Slot # 10
Material -PVC
Sand pack interval:
8.0 to 20.0' BGS
Material -Coarse

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L144)

PROJECT NAME: OLIN (USA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-74D (Page 1 of 2)
DATE COMPLETED: MARCH 25, 1993
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	STATE	'N' VALUE
	REFERENCE POINT (Top of Riser)	77.22				
	GROUND SURFACE	77.7				
	ASPHALT	77.0	ROAD BOX			
	SW-SAND(FILL), some gravel, brown, moist		CONCRETE SEAL	1SS	X	12
2.5				2SS	X	17
5.0				3SS	X	15
	– saturated			4SS	X	30
7.5						
	SW-SAND, some gravel, medium to coarse grained, brown, outwash	68.7	CEMENT/ BENTONITE GROUT			
10.0				5SS	X	43
12.5				6SS	X	20
15.0			2"ø PVC PIPE	7SS	X	42
17.5			BENTONITE PELLET SEAL			
20.0			5"ø BOREHOLE			
22.5			SAND PACK	8SS	X	32
25.0	BEDROCK – Gneiss, fine grained, weakly fractured	52.7	WELL SCREEN	9SS	X	>100
	END OF OVERBURDEN HOLE @ 25.0 FT. BGS					
27.5						
30.0						
32.5						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

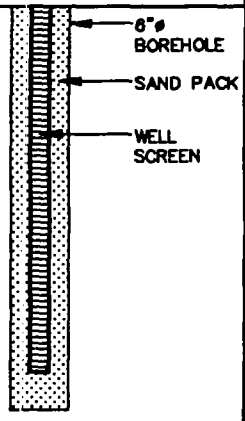
CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG
(BEDROCK)

(L112)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-68D (Page 2 of 2)
DATE COMPLETED: JULY 23, 1992
DRILLING METHOD: 4 1/4 HSA / NX / 5 7/8 WR
CRA SUPERVISOR: S. SWANSON

DEPTH	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	BEDROCK INTERVAL	RUN NUMBER	CORE RECOVERY	RQD	WATER RETURN
ft BGS		ft. AMSL				%	%	%
	Overburden							
10.0		79.3						
12.5	BEDROCK(Gneiss): black and green, fine grained, 3" white and gray quartz bands, medium grained, fractured, iron staining along fractures				1	60	0.0	0
15.0	BEDROCK(Gneiss): black and gray, medium grained, quartz banding, some mica	76.3			2		0.0	0
17.5								
	END OF HOLE @ 18 FT. BGS	72.3						
20.0								
22.5								
25.0								
27.5								
30.0								
32.5								
35.0								
37.5								

SCREEN DETAILS:
Screened Interval:
7.0 to 17.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -PVC
Sand pack interval:
5.0 to 18.0' BGS
Material -# 2 Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L128)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-68BR (Page 1 of 3)
DATE COMPLETED: DECEMBER 10, 1992
DRILLING METHOD: 4 1/4" ID HSA / 4 7/8" ROLLER BIT
CRA SUPERVISOR: M. JEFFREY

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
	REFERENCE POINT (Top of Riser)	89.83				
	GROUND SURFACE	90.2				
	For overburden stratigraphy see log GW-68D		ROAD BOX			
2.5						
5.0						
7.5						
10.0			5"ø BOREHOLE			
12.5						
15.0			CEMENT/ BENTONITE GROUT			
17.5						
20.0			4"ø PVC PIPE			
22.5						
25.0						
27.5						
30.0						
	BEDROCK	59.2				
32.5	END OF OVERBURDEN HOLE @ 31.0 FT. BGS		4"ø HQ COREHOLE			

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

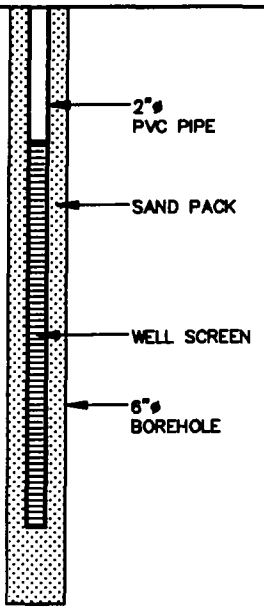
STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L113)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-69D (Page 2 of 3)
DATE COMPLETED: JULY 27, 1992
DRILLING METHOD: 4 1/4 HSA / NX / 5 7/8 WR
CRA SUPERVISOR: S. SWANSON

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
35.0			2"ø PVC PIPE	18SS	X	24
37.5	Same, with increased iron staining, product odor		SAND PACK	19SS	X	20
40.0			WELL SCREEN			
42.5	WEATHERED BEDROCK, some clay infilling, gray, product odor	48.1	6"ø BOREHOLE	20SS	X	>100
45.0	BEDROCK	46.1				
	END OF OVERBURDEN HOLE @ 45.0 FT. BGS					
47.5						
50.0						
52.5						
55.0						
57.5						
60.0						
62.5						
65.0						



SCREEN DETAILS:
Screened Interval:
36.0 to 46.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -PVC
Sand pack interval:
34.0 to 46.0' BGS
Material -# 2 Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

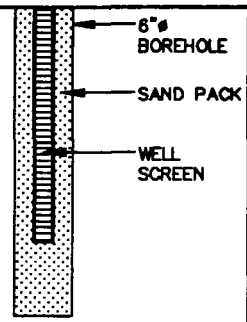
CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG
(BEDROCK)

(L114)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-69D (Page 3 of 3)
DATE COMPLETED: JULY 24, 1992
DRILLING METHOD: 4 1/4 HSA / NX / 5 7/8 WR
CRA SUPERVISOR: S. SWANSON

DEPTH	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	BEDROCK INTERVAL	RUN NUMBER	CORE RECOVERY	RQD	WATER RETURN
ft BGS		ft. AMSL				%	%	%
	Overburden							
42.5								
45.0	BEDROCK(Gneiss): black and green, fine grained, fractured	46.1			1	15	0.0	0
47.5	END OF HOLE @ 48 FT. BGS	43.1						
50.0								
52.5								
55.0								
57.5								
60.0								
62.5								
65.0								
67.5								
70.0								

SCREEN DETAILS:
Screened Interval:
36.0 to 46.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -PVC
Sand pack interval:
34.0 to 46.0' BGS
Material -# 2 Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L129)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-68BR (Page 2 of 3)
DATE COMPLETED: DECEMBER 10, 1992
DRILLING METHOD: HQ CORE
CRA SUPERVISOR: M. JEFFREY

DEPTH	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	BIENDTRERCVKAL	RNUUNMBER	CORE RECOVERY	RQD	WATER RETURN
ft BGS		ft. AMSL				%	%	%
	Overburden		4"ø PVC PIPE; CEMENT/ BENTONITE GROUT; 5"ø BOREHOLE					
30.0		59.2						
	BEDROCK – for stratigraphy see log GW-68D							
32.5								
35.0								
37.5								
40.0								
42.5								
45.0			4"ø HQ COREHOLE					
47.5								
50.0								
52.5								
55.0								
57.5								

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM – NOT MEASURED

STRATIGRAPHIC AND INSTRUMENTATION LOG
(BEDROCK)

(L129)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-68BR (Page 3 of 3)
DATE COMPLETED: DECEMBER 10, 1992
DRILLING METHOD: HQ CORE
CRA SUPERVISOR: M. JEFFREY

DEPTH	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	BIENDTRERORCVKAL	RNUUNMBER	CORE RECOVERY	RQD	WRATETURRN
ft BGS		ft. AMSL				%	%	%
60.0								
62.5								
65.0			4"ø HQ COREHOLE					
67.5								
70.0								
72.5								
75.0								
	END OF HOLE @ 76 FT. BGS	14.2						
77.5								
80.0								
82.5								
85.0								
87.5								

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM – NOT MEASURED

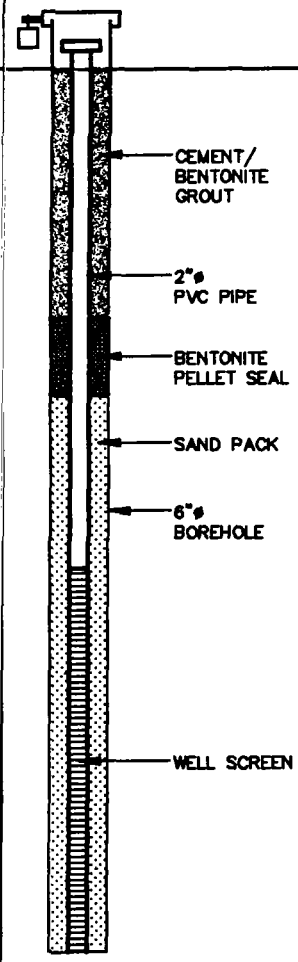
STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L115)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-69S
DATE COMPLETED: JULY 27, 1992
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: S. SWANSON

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
	REFERENCE ELEVATION (Top of Riser) GROUND SURFACE	92.28 90.9				
	For stratigraphy see log GW-69D					
2.5						
5.0						
7.5						
10.0						
12.5						
15.0						
17.5						
20.0						
22.5	END OF HOLE @ 23.0 FT. BGS	67.9				
25.0						
27.5						
30.0						
32.5						



SCREEN DETAILS:
Screened Interval:
13.0 to 23.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -PVC
Sand pack interval:
8.5 to 23.0' BGS
Material -# 2 Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

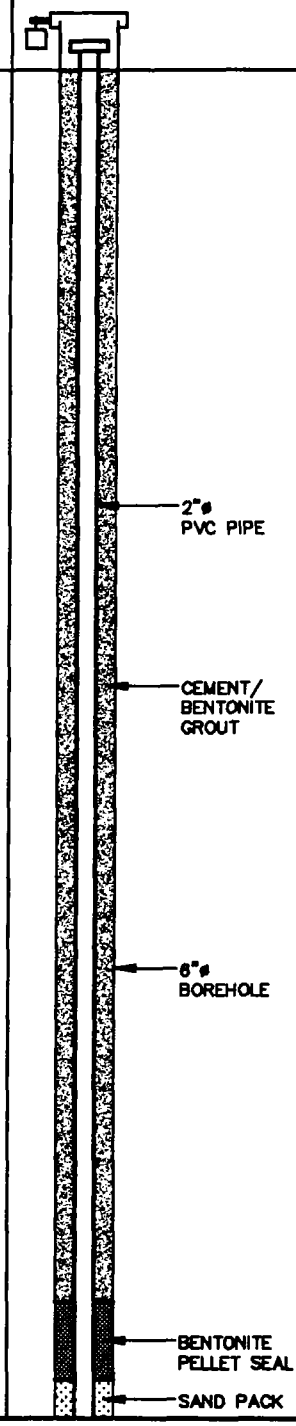
(L113)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-69D (Page 1 of 3)
DATE COMPLETED: JULY 27, 1992
DRILLING METHOD: 4 1/4 HSA / NX / 5 7/8 WR
CRA SUPERVISOR: S. SWANSON

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL
	REFERENCE ELEVATION (Top of Riser)	93.05
	GROUND SURFACE	91.1
	OL-TOPSOIL	90.8
	SP-SAND, little gravel, stiff, medium to coarse grained, light brown and tan dry	
2.5		
	Same, with some iron staining	
5.0	Same, with some silt, some clay, fine to medium grained, white, dry	
	SW-SAND, little gravel, stiff, fine to coarse grained, light brown and tan, dry	85.1
7.5		
	ML-SILT, some sand, trace gravel, very stiff, tan to white, dry	83.1 / 82.4
10.0	SW-SAND, trace gravel, stiff, medium to coarse grained, light brown and tan, dry, some iron staining	
	Same, except moist	
12.5	Same, except saturated, increased iron staining	
15.0	Same, except fine grained, tan	
	SW-SAND, trace gravel, medium to coarse grained with some fine to medium layers, tan with iron staining	
17.5		
20.0		
22.5		
25.0		
27.5		
30.0		
32.5		

MONITOR INSTALLATION



SAMPLE NUMBER	STATE	'N' VALUE
1SS	X	18
2SS	X	37
3SS	X	87
4SS	X	41
5SS	X	55
6SS	X	10
7SS	X	15
8SS	X	11
9SS	X	21
10SS	X	21
11SS	X	14
12SS	X	20
13SS	X	8
14SS	X	27
15SS	X	24
16SS	X	21
17SS	X	31

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

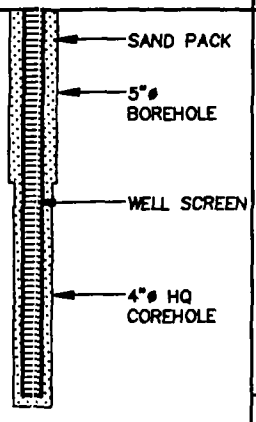
CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L131)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-71D (Page 3 of 3)
DATE COMPLETED: NOVEMBER 19, 1992
DRILLING METHOD: HQ CORE
CRA SUPERVISOR: S. SWANSON

DEPTH	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	BEDROCK INTERVAL	RUN NUMBER	CORE RECOVERY	RQD	WATER RETURN
ft BGS		ft. AMSL				%	%	%
	Overburden							
42.5								
45.0	BEDROCK(Gneiss): black and gray, fine grained, white quartz veins (1-5mm), few fractures, green mineral visible along fractures	49.9			1	90	100.0	
47.5					2	90	100.0	
50.0	END OF HOLE @ 50.3 FT. BGS	44.2						
52.5								
55.0								
57.5								
60.0								
62.5								
65.0								
67.5								
70.0								

SCREEN DETAILS:
Screened Interval:
40.0 to 50.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -PVC
Sand pack interval:
37.0 to 44.5' BGS
Material -# 2 Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L132)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-71S
DATE COMPLETED: NOVEMBER 17, 1992
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: S. SWANSON

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
	REFERENCE POINT (Top of Riser)	95.60				
	GROUND SURFACE	93.9				
	For stratigraphy see log GW-71D					
2.5			CEMENT/ BENTONITE GROUT			
5.0			BENTONITE PELLET SEAL			
7.5			2"ø PVC PIPE			
10.0						
12.5			6"ø BOREHOLE			
15.0			SAND PACK			
17.5			WELL SCREEN			
20.0						
22.5	END OF HOLE @ 23.0 FT. BGS	70.9				
25.0			SCREEN DETAILS: Screened Interval: 13.0 to 23.0' BGS Length -10.0' Diameter -2.0" Slot # 10 Material -PVC Sand pack interval: 6.0 to 23.0' BGS Material -# 2 Sand			
27.5						
30.0						
32.5						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(L133)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-72D (Page 1 of 2)
DATE COMPLETED: NOVEMBER 5, 1992
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: S. SWANSON

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
	REFERENCE POINT (Top of Riser) GROUND SURFACE	88.19 86.0				
	SW-SAND(FILL), trace gravel, medium to coarse grained, black			1SS		8
	Same, except loose, tan, dry, some iron staining					
2.5	Same, except medium dense		CEMENT/ BENTONITE GROUT	2SS		18
	Same, except dense, no iron staining					
5.0				3SS		42
	Same, except very dense		5"ø BOREHOLE			
7.5				4SS		64
	Same, except moist		BENTONITE PELLET SEAL	5SS		29
10.0	SW-SAND(TILL), little gravel, trace clay, hard, medium to coarse grained, gray, saturated	76.0	2"ø PVC PIPE	6SS		70
	Same, except little clay					
12.5			SAND PACK	7SS		43
	BEDROCK	72.0				
15.0			WELL SCREEN			
17.5	END OF OVERBURDEN HOLE @ 17.0 FT. BGS	69.0	4"ø HQ COREHOLE			
20.0						
22.5						
25.0						
27.5						
30.0						
32.5						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

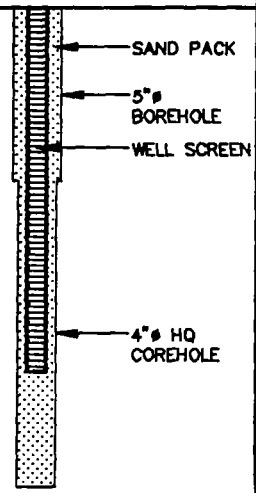
CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L134)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-72D (Page 2 of 2)
DATE COMPLETED: NOVEMBER 5, 1992
DRILLING METHOD: HQ CORE
CRA SUPERVISOR: S. SWANSON

DEPTH (ft BGS)	DESCRIPTION OF STRATA	ELEVATION (ft. AMSL)	MONITOR INSTALLATION	BEDROCK INTERVAL	RUN NUMBER	CORE RECOVERY (%)	RQD (%)	WATER RETURN (%)
	Overburen							
15.0								
17.5	BEDROCK(Gneiss): black and green, medium grained, white medium to coarse grained quartz veins (2-20mm)	69.0			1	80	100.0	
20.0								
22.5					2	90	100.0	
25.0	END OF HOLE @ 25 FT. BGS	61.0						
27.5								
30.0								
32.5								
35.0								
37.5								
40.0								
42.5								

SCREEN DETAILS:
Screened Interval:
12.0 to 22.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -PVC
Sand pack interval:
10.0 to 17.0' BGS
Material -# 2 Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

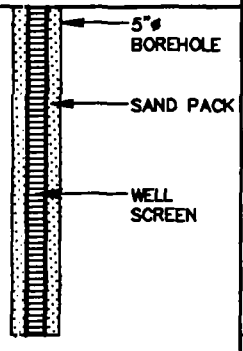
▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L148)

PROJECT NAME: OLIN (USA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-75D (Page 3 of 3)
DATE COMPLETED: MAY 6, 1993
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W. MICHELS

DEPTH	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	BIENDTRERCVKAL	RNUUMBER	CORE RECOVERY	RQD	WATER RETURN
ft BGS		ft. AMSL				%	%	%
	Overburden							
40.0								
	BEDROCK(Gneiss): fine grained to medium grained, sedimentary, weakly to moderately fractured	40.4						
42.5					1	90	80.0	
45.0								
	END OF HOLE @ 46 FT. BGS	35.4						
47.5								
50.0								
52.5								
55.0								
57.5								
60.0								
62.5								
65.0								
67.5								

SCREEN DETAILS:
Screened Interval:
36.0 to 46.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -PVC
Sand pack interval:
34.0 to 46.0' BGS
Material -Coarse

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(L-75)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-44S
DATE COMPLETED: APRIL 24, 1992
DRILLING METHOD: 4 1/4 " ID HSA
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE OVA (ppm)
	REFERENCE POINT (Top of Riser)	85.70					
	GROUND SURFACE	84.0					
	For stratigraphy see log GW-44D						
2.5			CEMENT/ BENTONITE GROUT				
5.0							
7.5			BENTONITE PELLET SEAL				
			2"ø PVC PIPE				
10.0			6"ø BOREHOLE				
12.5							
15.0			SAND PACK				
17.5			WELL SCREEN				
20.0	END OF HOLE @ 20.0 FT. BGS	64.0					
22.5			SCREEN DETAILS: Screened Interval: 10.0 to 20.0' BGS Length -10.0' Diameter -2.0" Slot # 10 Material -Plastic Sand pack interval: 8.0 to 20.0' BGS Material -Coarse Sand				
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

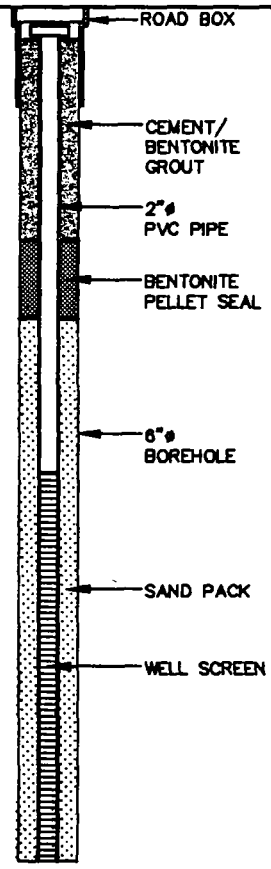
CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(L-78)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-45S
DATE COMPLETED: DECEMBER 11, 1992
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE OVA (ppm)
	REFERENCE POINT (Top of Riser)	89.43					
	GROUND SURFACE	89.9					
	For stratigraphy see log GW-45D						
2.5							
5.0							
7.5							
10.0							
12.5							
15.0							
17.5							
20.0							
22.5	END OF HOLE @ 22.0 FT. BGS	67.9					
25.0							
27.5							
30.0							
32.5							

SCREEN DETAILS:
Screened Interval:
12.0 to 22.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
8.0 to 22.0' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

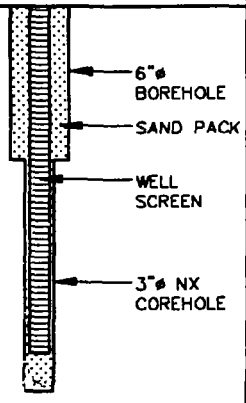
CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L-46)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-43D (Page 2 of 2)
DATE COMPLETED: JULY 18, 1991
DRILLING METHOD: 4 1/4 / NX
CRA SUPERVISOR: J.W. MICHELS

DEPTH	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	BEDROCK INTERVAL	RUN NUMBER	CORE RECOVERY	RQD	WATER RETURN
ft BGS		ft. AMSL				%	%	%
	Overburden							
27.5								
30.0	BEDROCK(Gneiss): moderately fractured, fractures are subvertical and slightly weathered	56.6			1	60	70	
32.5								
35.0	END OF HOLE @ 35 FT. BGS	50.6						
37.5								
40.0								
42.5								
45.0								
47.5								
50.0								
52.5								
55.0								

SCREEN DETAILS:
Screened Interval:
24.0 to 34.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
20.0 to 30.0' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

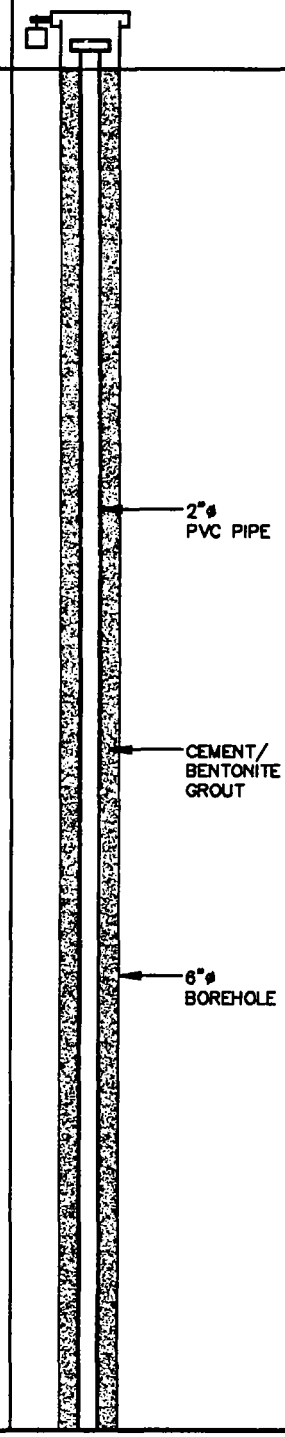
STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-73)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-44D (Page 1 of 3)
DATE COMPLETED: APRIL 24, 1992
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	SAMPLE NUMBER	STATE	'N' VALUE	OVA (ppm)
	REFERENCE POINT (Top of Riser)	83.97				
	GROUND SURFACE	83.5				
	GW-GRAVEL(FILL), fine to medium, some sand, gray, dry					
	– saturated					
2.5	GW-GRAVEL, fine to medium, some sand, gray, saturated, ice-contact deposit	81.0	1SS	X	34	
5.0	SW-SAND, fine to coarse grained, some fine gravel, brown, saturated	78.7	2SS	X	15	
7.5			3SS	X	11	
	SP-SAND, medium grained, brown	74.5	4SS	/	3	
10.0			5SS	X	34	
12.5	SW-SAND, medium to coarse grained, some gravel, brown	72.0	6SS	X	32	
15.0			7SS	X	59	
17.5						
20.0			8SS	X	91	
22.5	SW-SAND, fine to coarse grained, some gravel trace silt					
25.0			9SS	X	59	
			10SS	X	42	
27.5	GW-GRAVEL, fine, some sand, brown and black	55.5	11SS	X	36	
30.0	SW-SAND, fine grained, some silt, brown	53.5	12SS	X	18	
32.5	SP-SAND, fine to coarse grained, some gravel brown	50.5				



NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-73)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-44D (Page 2 of 3)
DATE COMPLETED: APRIL 24, 1992
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	STATE	'N' VALUE	OVA (ppm)
35.0				13SS	X	17	
				14SS	X	39	
37.5	– chemical odor						
				15SS	X	32	
40.0	– strong chemical odor						
			CEMENT/ BENTONITE GROUT	16SS	X	23	
42.5							
			6"ø BOREHOLE	17SS	X	62	
45.0							
47.5							
			2"ø PVC PIPE				
50.0							
			BENTONITE PELLET SEAL	18SS	X	54	
52.5							
			SAND PACK				
55.0							
				19SS	/		
57.5				20SS	X	>100	
		24.5					
60.0	SW-SAND, some broken weathered bedrock, green brown, product odor		WELL SCREEN				
		22.5					
	BEDROCK						
62.5	END OF OVERBURDEN HOLE @ 61.0 FT. BGS						
65.0							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

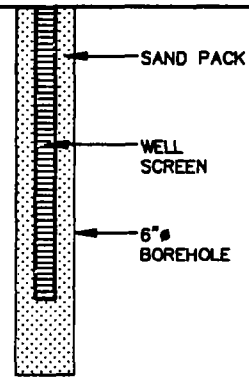
CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L-74)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-44D (Page 3 of 3)
DATE COMPLETED: APRIL 24, 1992
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

DEPTH	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	BEDROCK INTERVAL	RUN NUMBER	CORE RECOVERY	RQD	WATER RETURN
ft BGS	GROUND SURFACE	ft. AMSL 83.5				%	%	%
60.0	Overburden							
62.5	BEDROCK(Gneiss): slightly fractured, fractures are sub-vertical and slightly weathered	22.5			1	45	50	
65.0								
67.5	END OF HOLE @ 67 FT. BGS	16.5						
70.0								
72.5								
75.0								
77.5								
80.0								
82.5								
85.0								
87.5								

SCREEN DETAILS:
Screened Interval:
55.0 to 65.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
53.0 to 67.0' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-76)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-45D (Page 1 of 3)
DATE COMPLETED: DECEMBER 11, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE OVA (ppm)
	REFERENCE POINT (Top of Riser)	89.36'					
	GROUND SURFACE	89.8					
	Asphalt	89.5	ROAD BOX	1SS	X		
	SW\GW-SAND and GRAVEL, coarse, cobbles, brown, dry, ice-contact deposit						
2.5				2SS	X	89	
5.0							
7.5							
	GW\SW-SAND and GRAVEL, fine to coarse, brown, saturated, ice-contact deposit	80.8					
10.0			2"ø PVC PIPE	3SS	X	42	
12.5				4SS	X	83	
	GW-GRAVEL, fine, some medium to coarse grained sand, brown, saturated	75.8					
15.0				5SS	X	38	
17.5			CEMENT/ BENTONITE GROUT				
20.0	SW-SAND, medium to coarse grained, some fine rounded to subrounded gravel, brown,	69.8'		6SS	X	46	
22.5			6"ø BOREHOLE				
25.0				7SS	X	29	
27.5							
	Same, except fine gravel						
30.0				8SS	X	32	
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

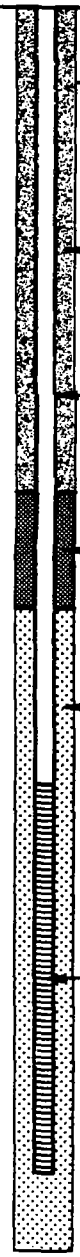
STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(L-76)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-45D (Page 2 of 3)
DATE COMPLETED: DECEMBER 11, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE OVA (ppm)
35.0			6"ø BOREHOLE	9SS		57	
37.5							
40.0			CEMENT/ BENTONITE GROUT	10SS		>100	
42.5			2"ø PVC PIPE				
45.0				11SS		85	
47.5			BENTONITE PELLET SEAL				
50.0			SAND PACK	12SS		90	
52.5							
55.0							
57.5			WELL SCREEN				
60.0	BEDROCK	29.8					
	END OF HOLE @ 60.0 FT. BGS						
62.5							
65.0							



NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

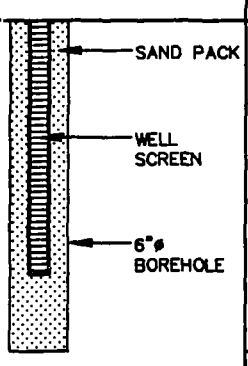
CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L-77)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-45D (Page 3 of 3)
DATE COMPLETED: DECEMBER 11, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

DEPTH	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	BEDROCK INTERVAL	RUN NUMBER	CORE RECOVERY	RQD	WATER RETURN
ft BGS		ft. AMSL				%	%	%
	Overburden							
57.5								
60.0	BEDROCK(Gneiss): moderatley to strongly fractured, fractures are sub-horizontal and sub-vertical with little weathering	29.8			1	80	0	
62.5								
	END OF HOLE @ 63.5 FT. BGS	26.3						
65.0			SCREEN DETAILS: Screened Interval: 52.5 to 62.5' BGS Length -10.0' Diameter -2.0" Slot # 10 Material -Plastic Sand pack interval: 48.0 to 64.5' BGS Material -Coarse Sand					
67.5								
70.0								
72.5								
75.0								
77.5								
80.0								
82.5								
85.0								

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

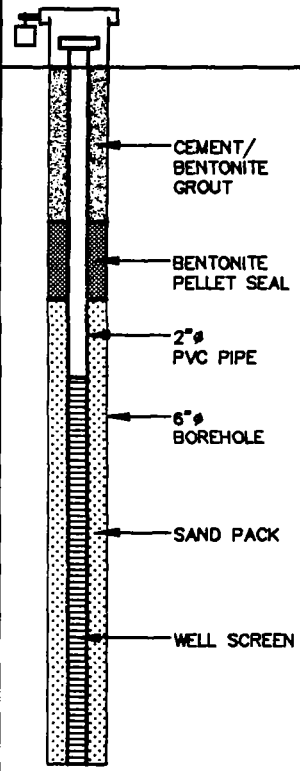
STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-79)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-46D (Page 1 of 2)
DATE COMPLETED: JANUARY 31, 1992
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE OVA (ppm)
	REFERENCE POINT (Top of Riser)	85.90					
	GROUND SURFACE	84.2					
	SP-SAND, fine grained, brown, saturated						
2.5			CEMENT/ BENTONITE GROUT	1SS	X	28	
5.0	– very hard		BENTONITE PELLET SEAL	2SS	X	>100	
7.5			2"ø PVC PIPE				
			6"ø BOREHOLE				
10.0	SC-SAND, some clay, some silt, trace gravel, dense, brown	74.2		3SS	X	>100	
12.5			SAND PACK				
	BEDROCK	71.7					
	END OF OVERBURDEN HOLE 14.0 FT. BGS						
15.0			WELL SCREEN				
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							



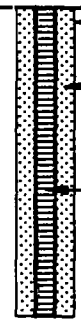
NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L-80)

PROJECT NAME:	OLIN (CSA)	HOLE DESIGNATION:	GW-46D (Page 2 of 2)
PROJECT NO.:	3683	DATE COMPLETED:	J.W. MICHELS
CLIENT:	OLIN CORP.	DRILLING METHOD:	4 1/4 / NX / 5 7/8 WR
LOCATION:	WILMINGTON, MA.	CRA SUPERVISOR:	J.W. MICHELS

DEPTH	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	BEDROCK INTERVAL	RUN NUMBER	CORE RECOVERY	RQD	WATER RETURN
ft BGS		ft. AMSL				%	%	%
	Overburden		 6"ø BOREHOLE; SAND PACK; WELL SCREEN					
12.5								
15.0	BEDROCK(Gneiss): black, moderately fractured, fractures are sub-vertical and weathered slightly	70.2			1	60	75	
17.5								
	END OF HOLE @ 18 FT. BGS	66.2	SCREEN DETAILS: Screened Interval: 8.0 to 18.0' BGS Length -10.0' Diameter -2.0" Slot # 10 Material -Plastic Sand pack interval: 6.0 to 18.0' BGS Material -Coarse Sand					
20.0								
22.5								
25.0								
27.5								
30.0								
32.5								
35.0								
37.5								
40.0								

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

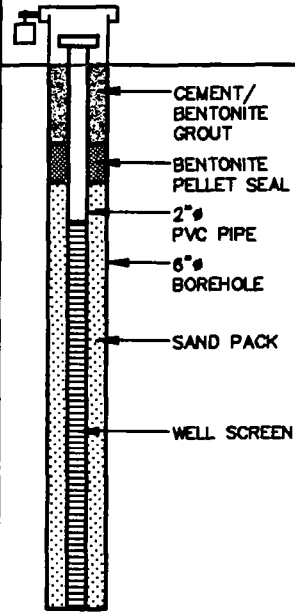
▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-47)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-47 (Page 1 of 2)
DATE COMPLETED: JUNE 27, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	REFERENCE POINT (Top of Riser)	93.18					
	GROUND SURFACE	91.6					
	SW-SAND(FILL), fine to coarse grained, trace gravel, dry			1SS	X	29	
2.5				2SS	X	>100	
	BEDROCK	88.6					
	END OF OVERBURDEN HOLE @ 4.0 FT. BGS	87.6					
5.0							
7.5							
10.0							
12.5							
15.0							
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

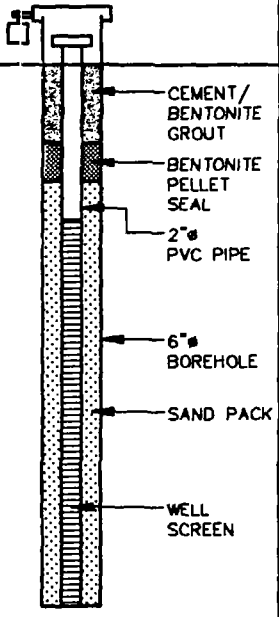
CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L-72)

PROJECT NAME: GW-47
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-47 (Page 2 of 2)
DATE COMPLETED: JULY 26, 1991
DRILLING METHOD: 4 14 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

DEPTH	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	BEDROCK INTERVAL	RUN NUMBER	CORE RECOVERY	RQD	WATER RETURN
ft BGS		ft. AMSL				%	%	%
	Overburden							
2.5								
5.0	BEDROCK(Gneiss): slightly fractured, fractures are slightly weathered and subhorizontal	87.6			1	35	30	
7.5								
10.0					2	75	60	
12.5								
15.0	END OF HOLE @ 14 FT. BGS	77.6						
17.5								
20.0								
22.5								
25.0								
27.5								
30.0								

SCREEN DETAILS:
Screened Interval:
4.0 to 14.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
3.0 to 14.0' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

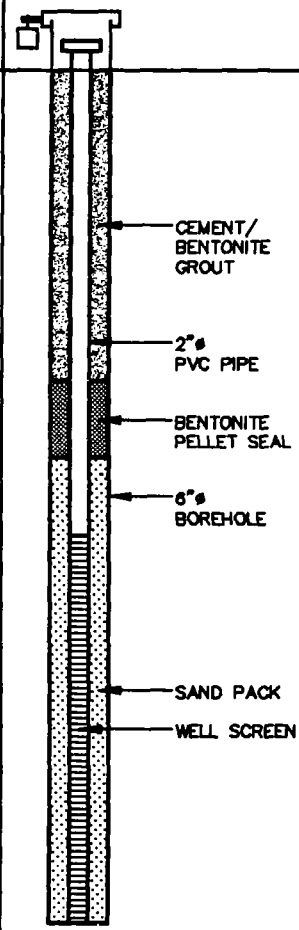
▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-48)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-48S
DATE COMPLETED: JULY 16, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	REFERENCE POINT (Top of Riser) GROUND SURFACE	91.14 88.9					
	For stratigraphy see log GW-48D						
2.5							
5.0							
7.5							
10.0							
12.5							
15.0							
17.5							
20.0							
22.5	END OF HOLE @ 22.0 FT. BGS	66.9					
25.0							
27.5							
30.0							
32.5							

SCREEN DETAILS:
Screened Interval:
12.0 to 22.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
10.0 to 22.0' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-49)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-48D (Page 1 of 3)
DATE COMPLETED: JULY 26, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	STATE	'N' VALUE	PID (ppm)
	REFERENCE POINT (Top of Riser)	90.86					
	GROUND SURFACE	89.0					
	ML/SW/GW-SILT, SAND and GRAVEL(FILL), rubble, dry			1SS	X	38	
2.5	– wood, garbage, very hard, odor			2SS	X	25	
5.0	– softer						
		82.0					
7.5	SC-SAND(FILL), some silt, some gravel, gray, moist			3SS	X	5	
10.0	– saturated			4SS	X	2	
12.5	– charcoal, wood fragments, wet to saturated		6"ø BOREHOLE	5SS	X	11	
			CEMENT/ BENTONITE GROUT	6SS	X	2	
		74.5					
15.0	SW-SAND, fine to medium grained, some silt, brown, saturated, outwash			7SS	X	15	
17.5			2"ø PVC PIPE	8SS	X	31	
		69.5					
20.0	SW/GW-SAND and GRAVEL, fine to coarse grained, angular, brown gray, ice-contact deposit			9SS	X	>100	
22.5							
		66.0					
	SM-SAND, some silt, some gravel, brown			10SS	X	24	
25.0				11SS	X	64	
27.5			BENTONITE PELLET SEAL	12SS	X	>100	
	GW-GRAVEL, some sand, brown						
30.0			SAND PACK	13SS	X	61	
		58.0					
	SW-SAND, some silt, some gravel, brown, ice-contact deposit			14SS	X	51	
32.5			WELL SCREEN				

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

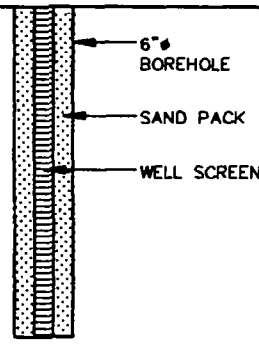
CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-49)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-48D (Page 2 of 3)
DATE COMPLETED: JULY 26, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
35.0		53.0		15SS	X	75	
37.5	BEDROCK(Gneiss): slightly to moreately fractured with subvertical fractures, slightly weathered						
	END OF OVERBURDEN HOLE @ 36.0 FT. BGS						
40.0							
42.5							
45.0							
47.5							
50.0							
52.5							
55.0							
57.5							
60.0							
62.5							
65.0							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

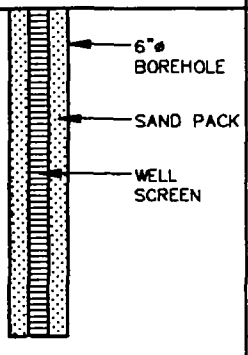
CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L-50)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-48D (Page 3 of 3)
DATE COMPLETED: JULY 16, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

DEPTH	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	BEDROCK INTERVAL	RUN NUMBER	CORE RECOVERY	RQD	WATER RETURN
ft BGS		ft. AMSL				%	%	%
	Overburden							
35.0								
	BEDROCK(Gneiss): moderate to slightly fractured, fractures slighlty weathered	53.0			1	65	50	
37.5								
40.0								
	END OF HOLE @ 41 FT. BGS	48.0						
42.5								
45.0								
47.5								
50.0								
52.5								
55.0								
57.5								
60.0								
62.5								

SCREEN DETAILS:
Screened Interval:
31.0 to 41.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
29.0 to 41.0' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

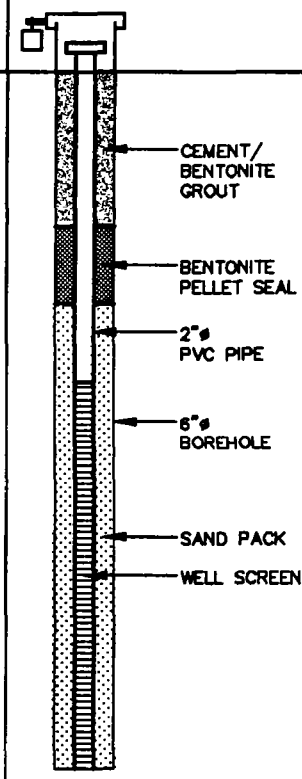
STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-81)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-49D
DATE COMPLETED: DECEMBER 14, 1992
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	STATE	'N' VALUE	OVA (ppm)
	REFERENCE POINT (Top of Riser)	81.37					
	GROUND SURFACE	79.2					
	CL-CLAY, some sand, some silt, black, product odor			1SS			
2.5				2SS			
	SP-SAND(FILL), fine grained, black, saturated, slight odor	75.2					
5.0				3SS		26	
7.5							
10.0	CL-CLAY, some sand, some gravel, black, saturated	69.2		4SS		55	
12.5				5SS		>100	
15.0				6SS			
17.5	END OF HOLE @ 18.0 FT. BGS	61.2					
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							



SCREEN DETAILS:
Screened Interval:
8.0 to 18.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
6.0 to 18.0' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

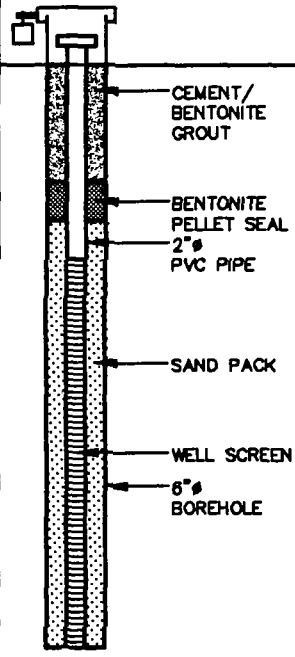
CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-51)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-50S
DATE COMPLETED: JUNE 27, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	REFERENCE POINT (Top of Riser) GROUND SURFACE	79.71 77.0					
	For stratigraphy see log GW-50D						
2.5							
5.0							
7.5							
10.0							
12.5							
15.0	END OF HOLE @ 15.0 FT. BGS	62.0					
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

SCREEN DETAILS:
Screened Interval:
5.0 to 15.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
4.0 to 15.0' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-52)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-50D (Page 1 of 3)
DATE COMPLETED: JUNE 21, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	STATE	'N' VALUE	PID (ppm)
	REFERENCE POINT (Top of Riser)	80.11					
	GROUND SURFACE	77.4					
	OL-SILT, leaves, twigs, brown, dry, outwash	76.4					
	SP-SAND, medium grained, brown black, saturated			1SS		2	
2.5				2SS		12	
	SW-SAND, coarse grained, some gravel, some silt, gray, saturated, outwash						
5.0			6"ø BOREHOLE	3SS		59	
				4SS		67	
7.5							
				5SS		40	
10.0	GW-GRAVEL, some sand, some silt, gray, saturated	67.4					
	— very hard drilling to end of boring, ice-contact deposit			6SS		53	
12.5			CEMENT/ BENTONITE GROUT	7SS		53	
15.0				8SS		19	
17.5			2"ø PVC PIPE	9SS		43	
20.0				10SS		>100	
22.5				11SS		>100	
25.0							
27.5			BENTONITE PELLET SEAL				
30.0				12SS		>100	
			SAND PACK				
32.5	GW-GRAVEL medium to coarse grained, some fine to coarse sand, hard, brown, ice-contact deposit		WELL SCREEN				

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

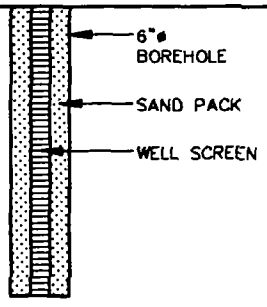
CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-52)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-50D (Page 2 of 3)
DATE COMPLETED: JUNE 21, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
35.0	BEDROCK END OF OVERBURDEN HOLE @ 35.0 FT. BGS	42.4					
37.5							
40.0							
42.5							
45.0							
47.5							
50.0							
52.5							
55.0							
57.5							
60.0							
62.5							
65.0							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

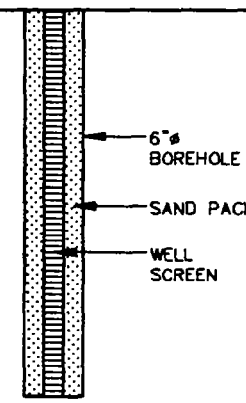
CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L-53)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-50D (Page 3 of 3)
DATE COMPLETED: JUNE 27, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

DEPTH	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	BEDROCK INTERVAL	RUN NUMBER	CORE RECOVERY	RQD	WATER RETURN
ft BGS		ft. AMSL				%	%	%
	Overburden							
32.5								
35.0	BEDROCK(Gneiss): moderately fractured, fractures are slightly weathered and subvertical	42.4						
37.5					1			
40.0	END OF HOLE @ 40 FT. BGS	37.4						
42.5								
45.0								
47.5								
50.0								
52.5								
55.0								
57.5								
60.0								

SCREEN DETAILS:
Screened Interval:
30.0 to 40.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
28.0 to 40.0' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

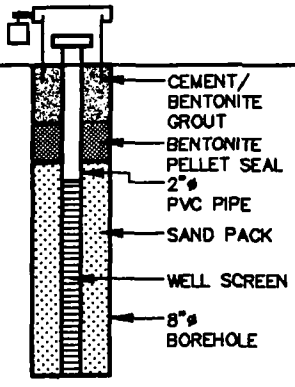
▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-54)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-51S
DATE COMPLETED: JUNE 19, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	REFERENCE POINT (Top of Riser) GROUND SURFACE	84.59' 82.9					
2.5	For statigrapghy see log GW-51D						
5.0							
7.5	END OF HOLE ● 8.0 FT. BGS	74.9					
10.0							
12.5							
15.0							
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

SCREEN DETAILS:
Screened Interval:
3.0 to 8.0' BGS
Length -5.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
2.5 to 8.0' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

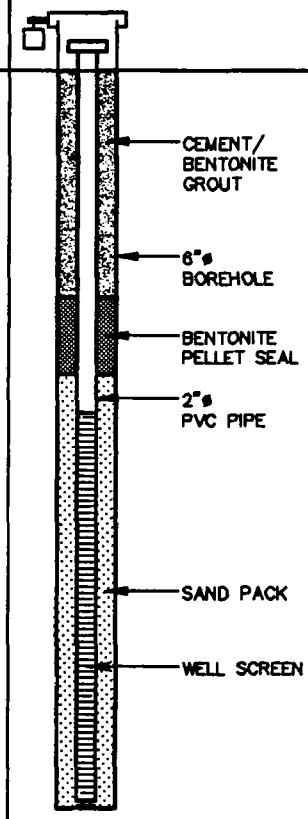
STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-55)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-51D (Page 1 of 2)
DATE COMPLETED: JUNE 20, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	REFERENCE POINT (Top of Riser)	84.52					
	GROUND SURFACE	82.8					
	SP-SAND, medium grained, red brown, dry, outwash			1SS	X	5	
2.5				2SS	X	35	
	SW-SAND, some gravel, brown, outwash						
5.0				3SS	X	68	
	– saturated			4SS	X	71	
7.5		74.8					
	GC-GRAVEL, some sand, brown, ice-contact deposits			5SS	X	82	
10.0							
12.5				6SS	X	77	
	BEDROCK – refusal	68.8					
15.0	END OF OVERBURDEN HOLE @ 14.0 FT. BGS						
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							



NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

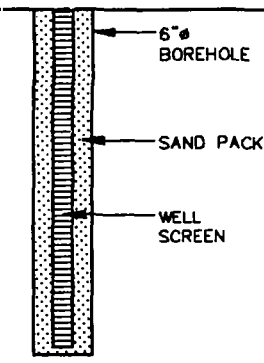
CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L-56)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-51D (Page 2 of 2)
DATE COMPLETED: JUNE 19, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

DEPTH	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	BEDROCK INTERVAL	RUN NUMBER	CORE RECOVERY	RQD	WATER RETURN
ft BGS		ft. AMSL				%	%	%
	Overburden							
12.5								
	BEDROCK(Gneiss): slightly fractured, fractures are slightly weathered and subvertical	68.8						
15.0					1	80	70	
17.5								
	END OF HOLE @ 19 FT. BGS	63.8						
20.0								
22.5								
25.0								
27.5								
30.0								
32.5								
35.0								
37.5								
40.0								

SCREEN DETAILS:
Screened Interval:
8.8 to 19.0' BGS
Length -10.2'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
7.8 to 19.0' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

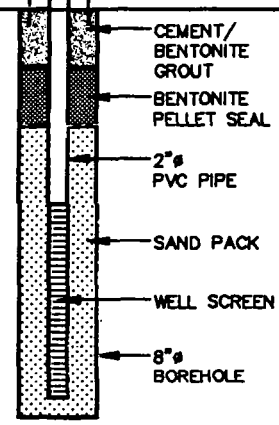
▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-57)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-52S
DATE COMPLETED: JUNE 13, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: E. HOLT

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	REFERENCE POINT (Top of Riser)	87.99					
	GROUND SURFACE	85.6					
	For stratigraphy see log MW-52D						
2.5							
5.0							
7.5							
10.0	END OF HOLE @ 10.5 FT. BGS	75.1	SCREEN DETAILS: Screened Interval: 5.0 to 10.0' BGS Length -5.0' Diameter -2.0" Slot # 10 Material -Plastic Sand pack interval: 3.0 to 10.5' BGS Material -Coarse Sand				
12.5							
15.0							
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

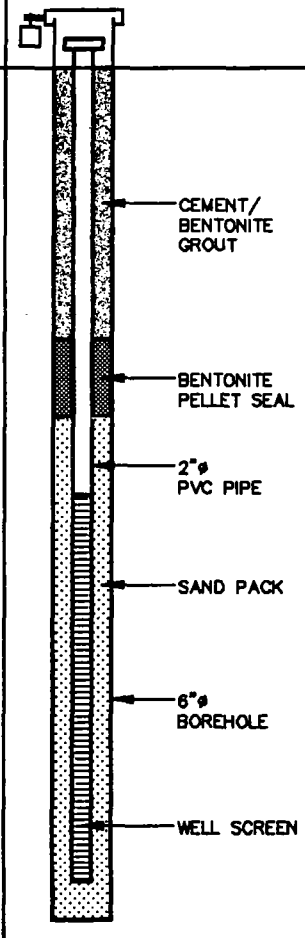
STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-58)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-52D (Page 1 of 2)
DATE COMPLETED: JUNE 13, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: E. HOLT

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	REFERENCE POINT (Top of Riser)	88.00					
	GROUND SURFACE	85.8					
	SP-SAND, fine to medium grained, trace organics, loose, light tan brown, dry			1SS		9	
2.5	Same, except little organics, tan to gray brown			2SS		30	
	Same, except no organics, tan brown, dry to moist			3SS		27	
5.0	Same, except trace silt in matrix, wet to saturated			4SS		>100	
7.5				5SS		36	
10.0	SW-SAND, fine to medium grained, some gravel, little silt, medium dense, brown, saturated, ice-contact deposit	75.8		6SS		24	
12.5	Same, except some silt, olive gray and brown			7SS		55	
15.0	BEDROCK	70.8					
	END OF OVERBURDEN HOLE @ 15.0 FT. BGS						
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							



NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

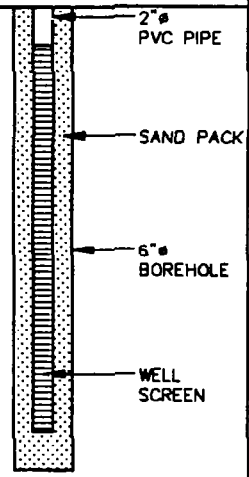
CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG
(BEDROCK)

(L-59)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-52D (Page 2 of 2)
DATE COMPLETED: JUNE 18, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

DEPTH	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	BEDROCK INTERVAL	RUN NUMBER	CORE RECOVERY	RQD	WATER RETURN
ft BGS		ft. AMSL				%	%	%
	Overburden							
12.5								
15.0	BEDROCK(Gneiss): moderately to strongly fractured, fractures decrease with depth, fractures are subvertical	70.8						
17.5					1	40	30	
20.0					2	80	75	
22.5	END OF HOLE @ 22 FT. BGS	63.8						
25.0								
27.5								
30.0								
32.5								
35.0								
37.5								
40.0								

SCREEN DETAILS:
Screened Interval:
11.0 to 21.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
9.0 to 22.0' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

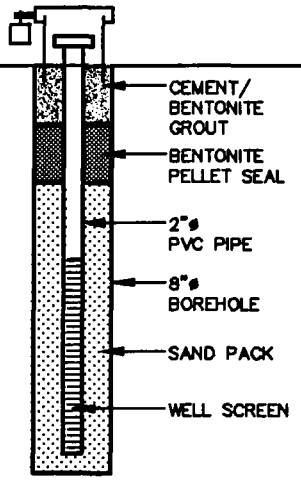
STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-60)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-53S
DATE COMPLETED: JUNE 13, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: E. HOLT

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	REFERENCE POINT (Top of Riser)	90.69					
	GROUND SURFACE	89.0					
	For stratigraphy see log GW-53D						
2.5							
5.0							
7.5							
10.0							
	END OF HOLE @ 10.5 FT. BGS	78.5					
12.5							
15.0							
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							



SCREEN DETAILS:
Screened Interval:
5.0 to 10.0' BGS
Length -5.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
3.0 to 10.5' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

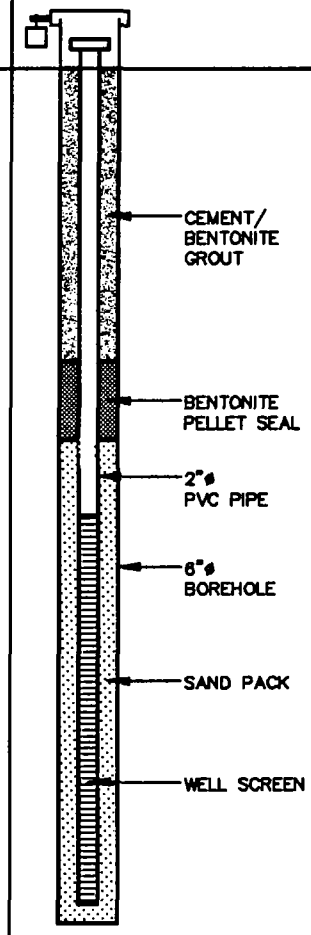
STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(L-61)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-53D
(Page 1 of 2)
DATE COMPLETED: JUNE 17, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	STATE	'N' VALUE	PID (ppm)
	REFERENCE POINT (Top of Riser)	91.88					
	GROUND SURFACE	89.3					
	SW-SAND, fine to medium grained, loose, light brown, moist, some asphalt and concrete			1SS		14	
2.5				2SS		16	
		85.3	CEMENT/ BENTONITE GROUT				
5.0	GP-GRAVEL, coarse, little coarse grained sand, dense, gray, wet, fill deposit, slight chemical odor			3SS		46	
		83.3					
7.5	SW-SAND, medium to coarse grained, little gravel, dense, light brown, outwash, saturated, slight chemical odor			4SS		84	
			BENTONITE PELLET SEAL	5SS		>100	
10.0		79.3		6SS		>100	
	GM-GRAVEL, meduim, some silt, very dense, olive green, saturated		2"ø PVC PIPE				
12.5	GP-GRAVEL, fine to coarse, some silt, loose, dense, olive green and brown, saturated, ice-contact deposit		6"ø BOREHOLE	7SS		52	
	Same, except medium to coarse gravel, gniess, micaceous, some silt, dense, saturated			8SS		>100	
15.0	BEDROCK	74.3					
	END OF OVERBURDEN HOLE @ 15.0 FT. BGS		SAND PACK				
17.5			WELL SCREEN				
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							



NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

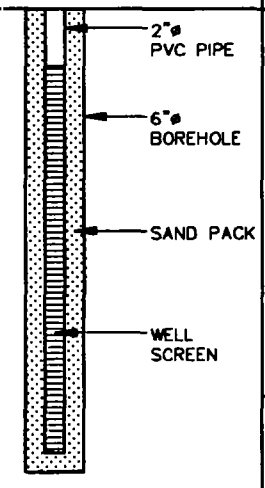
CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L-62)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-53D (Page 2 of 2)
DATE COMPLETED: JUNE 17, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.M.MICHELS

DEPTH	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	BEDROCK INTERVAL	RUN NUMBER	CORE RECOVERY	RQD	WATER RETURN
ft BGS		ft. AMSL				%	%	%
	Overburden							
12.5								
15.0	BEDROCK(Gneiss): slightly to moderately fractured, fractures are subvertical and slightly weathered	74.3						
17.5					1	70		
20.0								
22.5	END OF HOLE @ 22 FT. BGS	67.3						
25.0								
27.5								
30.0								
32.5								
35.0								
37.5								
40.0								

SCREEN DETAILS:
Screened Interval:
11.5 to 21.5' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
9.5 to 22.0' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

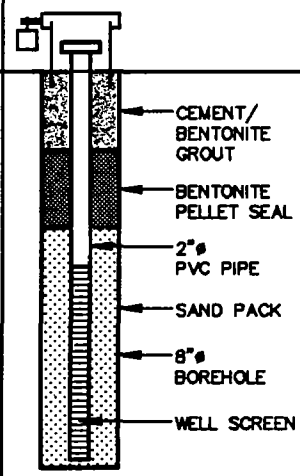
▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(L-63)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-54S
DATE COMPLETED: JUNE 13, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	REFERENCE POINT (Top of Riser) GROUND SURFACE	88.69 86.4					
	For statigraphy see log GW-54D						
2.5							
5.0							
7.5							
10.0	END OF HOLE @ 10.2 FT. BGS	76.2	SCREEN DETAILS: Screened Interval: 5.0 to 10.0' BGS Length -5.0' Diameter -2.0" Slot # 10 Material -Plastic Sand pack interval: 4.0 to 10.2' BGS Material -Coarse Sand				
12.5							
15.0							
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(L-64)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-54D (Page 1 of 2)
DATE COMPLETED: JUNE 14, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	STATE	'N' VALUE	PID (ppm)
	REFERENCE POINT (Top of Riser)	89.15					
	GROUND SURFACE	86.6					
	SP-SAND(FILL), medium grained, trace gravel, brown, moist		CEMENT/ BENTONITE GROUT	1SS		60	
2.5				2SS		39	
5.0	SW-SAND, fine to medium grained, some silt, some gravel, gray, saturated, ice-contact deposit		2"ø PVC PIPE	3SS		>100	
7.5				4SS		77	
			BENTONITE PELLET SEAL	5SS		57	
10.0	GW-GRAVEL, some sand, brown		6"ø BOREHOLE	6SS		100	
12.5			SAND PACK	7SS		83	
15.0			WELL SCREEN	8SS		>100	
	BEDROCK	71.3					
	END OF OVERBURDEN HOLE @ 15.3 FT. BGS						
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

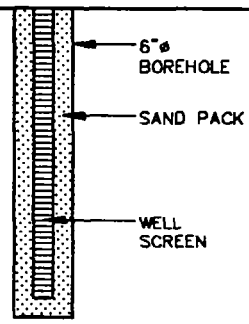
CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L-65)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-54D (Page 2 of 2)
DATE COMPLETED: JUNE 14, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

DEPTH	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	BEDROCK INTERVAL	RUN NUMBER	CORE RECOVERY	RQD	WATER RETURN
ft BGS		ft. AMSL				%	%	%
	Overburden							
15.0		71.3						
	BEDROCK(Gneiss): moderately fractured, fractures show slight weathering and decrease with depth							
17.5					1	65	60	
20.0		66.1						
	END OF HOLE @ 20.5 FT. BGS							
22.5								
25.0								
27.5								
30.0								
32.5								
35.0								
37.5								
40.0								
42.5								

SCREEN DETAILS:
Screened Interval:
10.0 to 20.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
9.0 to 20.5' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

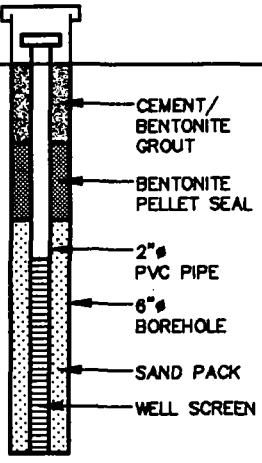
STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-66)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-55S
DATE COMPLETED: JULY 2, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	REFERENCE POINT (Top of Riser)	81.44					
	GROUND SURFACE	79.8					
	For statigraphy see log GW-55D						
2.5							
5.0							
7.5							
10.0	END OF HOLE @ 10.0 FT. BGS	69.8					
12.5							
15.0							
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							



SCREEN DETAILS:
Screened Interval:
5.0 to 10.0' BGS
Length -5.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
4.0 to 10.0' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

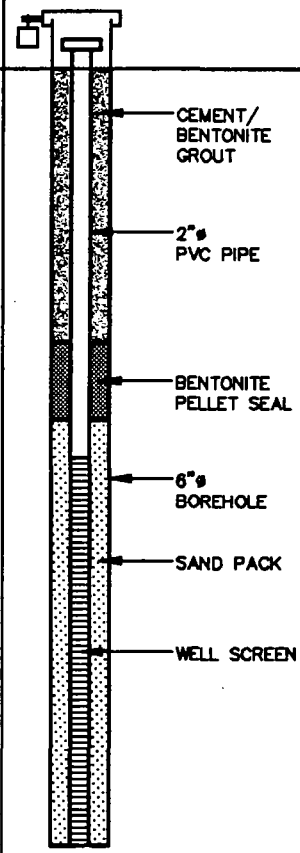
STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-67)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-55D (Page 1 of 2)
DATE COMPLETED: JULY 2, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	STATE	'N' VALUE	PID (ppm)
	REFERENCE POINT (Top of Riser)	81.73					
	GROUND SURFACE	79.7					
	SP-SAND, medium grained, brown, saturated, outwash		CEMENT/ BENTONITE GROUT	1SS	X	9	
2.5				2SS	X		
	SW-SAND, fine to coarse grained, some gravel, trace to some silt, gray, saturated, ice-contact deposit	76.2	2"ø PVC PIPE				
5.0				3SS	X	45	
7.5	– very hard		BENTONITE PELLET SEAL	4SS	X	70	
10.0	SW-SAND, fine to coarse grained, some gravel, gray, saturated		6"ø BOREHOLE	5SS	X	33	
12.5			SAND PACK				
	BEDROCK – auger refusal	65.7					
15.0	END OF OVERBURDEN HOLE @ 14.0 FT. BGS		WELL SCREEN				
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							



NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

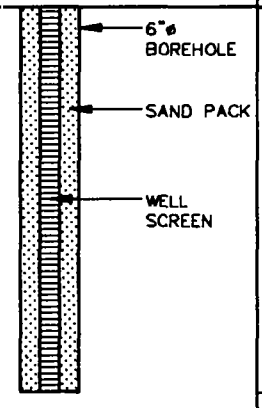
CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L-68)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-55D (Page 2 of 2)
DATE COMPLETED: JUNE 21, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

DEPTH	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	BEDROCK INTERVAL	RUN NUMBER	CORE RECOVERY	RQD	WATER RETURN
ft BGS		ft. AMSL				%	%	%
	Overburden							
12.5								
15.0	BEDROCK(Gneiss): moderately to strongly fractured, fractures are subvertical and slightly weathered	65.7			1	75	45	
17.5								
20.0	END OF HOLE @ 20 FT. BGS	59.7						
22.5								
25.0								
27.5								
30.0								
32.5								
35.0								
37.5								
40.0								

SCREEN DETAILS:
Screened Interval:
10.0 to 20.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
9.0 to 20.0' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

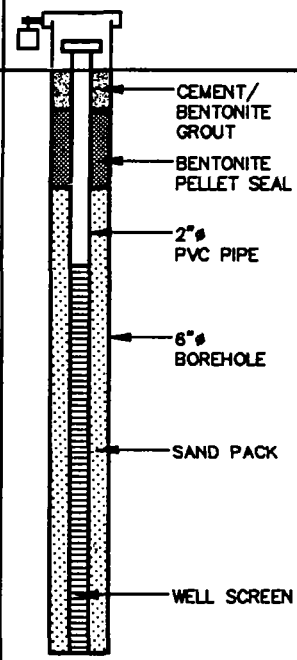
▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(L-69)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-56S
DATE COMPLETED: JULY 9, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	REFERENCE POINT (Top of Riser) GROUND SURFACE	83.01 80.6					
	For statigraphy see log GW-56D						
2.5							
5.0							
7.5							
10.0							
12.5							
15.0	END OF HOLE @ 15.0 FT. BGS	65.6					
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

SCREEN DETAILS:
Screened Interval:
5.0 to 15.0' BGS
Length -10.0'
Diameter -2.0:"
Slot # 10
Material -Plastic
Sand pack interval:
3.0 to 15.0' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(L-70)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-56D (Page 1 of 2)
DATE COMPLETED: JULY 8, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	STATE	'N' VALUE	PID (ppm)
	REFERENCE POINT (Top of Riser)	82.76					
	GROUND SURFACE	80.5					
	SP-SAND, medium grained, brown, dry, outwash			1SS		4	
2.5	SW-SAND, fine to coarse grained, some gravel, trace silt, dry, ice-contact deposit – very hard	78.2		2SS		90	
				3SS		>100	
5.0	GW-GRAVEL, some fine to medium grained sand, trace silt, gray brown, saturated, ice-deposit contact	75.5	CEMENT/ BENTONITE GROUT				
7.5			2"ø PVC PIPE	4SS		44	
10.0				5SS		59	
				6SS		25	
12.5			BENTONITE PELLET SEAL	7SS		23	
	– very hard						
15.0				8SS		85	
17.5			6"ø BOREHOLE	9SS		>100	
			SAND PACK				
20.0	BEDROCK – auger refusal	61.0					
	END OF OVERBURDEN HOLE @ 19.5 FT. BGS		WELL SCREEN				
22.5							
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

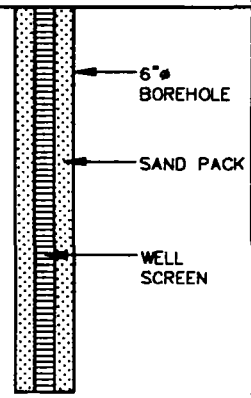
CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L-71)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-56D (Page 2 of 2)
DATE COMPLETED: JULY 8, 1991
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

DEPTH	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	BEDROCK INTERVAL	RUN NUMBER	CORE RECOVERY	RQD	WATER RETURN
ft BGS		ft. AMSL				%	%	%
	Overburden							
17.5								
20.0	BEDROCK(Gneiss): strongly fractured, fractures are highly weathered and subvertical to subhorizontal	61.0						
22.5					1	40	45	
25.0	END OF HOLE @ 25 FT. BGS	55.5						
27.5								
30.0								
32.5								
35.0								
37.5								
40.0								
42.5								
45.0								

SCREEN DETAILS:
Screened Interval:
15.0 to 25.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
13.0 to 25.0' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(L-82)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-57D (Page 1 of 2)
DATE COMPLETED: JANUARY 29, 1992
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE OVA (ppm)
	REFERENCE POINT (Top of Riser)	94.99					
	GROUND SURFACE	95.3					
	SW-SAND, fine to medium grained, some gravel, cobbles, brown, dry		ROAD BOX				
2.5				1SS		97	
			CEMENT/ BENTONITE GROUT	2SS		>100	
5.0							
7.5	Same, except fne to coarse grained, trace to some gravel			3SS		40	
10.0			2"ø PVC PIPE	4SS		37	
12.5	– moist		6"ø BOREHOLE	5SS		31	
15.0	– saturated			6SS		92	
17.5			BENTONITE PELLET SEAL	7SS		82	
20.0			SAND PACK				
	– very hard			8SS		>100	
22.5							
25.0				9SS		>100	
	BEDROCK	69.3	WELL SCREEN				
27.5	END OF OVERBURDEN HOLE @ 26.0 FT. BGS						
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

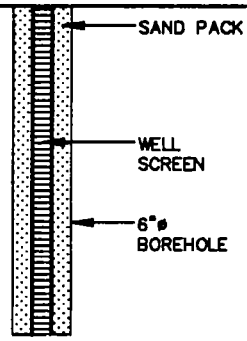
CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG
(BEDROCK)

(L-83)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-57D (Page 2 of 2)
DATE COMPLETED: JANUARY 29, 1992
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

DEPTH	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	BIENDTRERORCVKAL	RNUUNMBER	CRORECOVERY	RQD	WRATERETURN
ft BGS		ft. AMSL				%	%	%
	Overburden							
25.0								
	BEDROCK(Gneiss): slightly to heavily fractured, fractures are sub-vertical and moderately weathered	69.3			1	60	40	
27.5								
30.0								
	END OF HOLE @ 31 FT. BGS	64.3	SCREEN DETAILS: Screened Interval: 21.0 to 31.0' BGS Length -10.0' Diameter -2.0" Slot # 10 Material -Plastic Sand pack interval: 18.0 to 31.0' BGS Material -Coarse Sand					
32.5								
35.0								
37.5								
40.0								
42.5								
45.0								
47.5								
50.0								
52.5								

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(L-96)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-58D (Page 1 of 4)
DATE COMPLETED: AUGUST 3, 1992
DRILLING METHOD: 4 1/4 HSA / NX / 5 7/8 WR
CRA SUPERVISOR: S. SWANSON

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
	REFERENCE ELEVATION (Top of Riser)	98.19				
	GROUND SURFACE	96.1				
	SW-SAND, some silt, little gravel, stiff, medium grained, tan			1SS	X	20
	Same, except light tan					
2.5				2SS	X	57
5.0				3SS	X	33
	SW-SAND, trace gravel, stiff, medium to coarse grained, tan					
7.5				4SS	X	20
				5SS	X	16
10.0	Same, except orange iron stained, moist					
			2"ø PVC PIPE	6SS	X	15
12.5				7SS	X	26
	SW/GW-SAND and GRAVEL, firm, medium to coarse grained, light brown and gray, ice-contact deposit	82.1				
15.0				8SS	X	15
17.5			CEMENT/ BENTONITE GROUT	9SS	X	22
20.0				10SS	X	19
22.5				11SS	X	16
			6"ø BOREHOLE	12SS	X	19
25.0						
27.5						
	Same, with some iron staining					
30.0				13SS	X	>100
32.5						
	Same, except light brown					

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-96)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-58D (Page 2 of 4)
DATE COMPLETED: AUGUST 3, 1992
DRILLING METHOD: 4 1/4 HSA / NX / 5 7/8 WR
CRA SUPERVISOR: S. SWANSON

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
35.0				14SS	X	>100
37.5						
40.0	Same, with some clay			15SS	X	>100
42.5			2"ø PVC PIPE			
45.0				16SS	X	99
47.5						
50.0	Same, except gravel		CEMENT/ BENTONITE GROUT	17SS	X	52
52.5						
55.0	Same, except little clay			18SS	X	60
57.5			6"ø BOREHOLE			
60.0	Same, except some clay			19SS	X	38
62.5						
65.0			BENTONITE PELLET SEAL	20SS	X	24

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

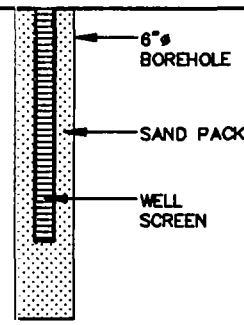
CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L103)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-64D (Page 3 of 3)
DATE COMPLETED: JULY 31, 1992
DRILLING METHOD: 4 1/4 HSA / NX / 5 7/8 WR
CRA SUPERVISOR: S. SWANSON

DEPTH	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	BEDROCK INTERVAL	RUN NUMBER	CORE RECOVERY	RQD	WATER RETURN
ft BGS		ft. AMSL				%	%	%
	Overburden							
62.5		20.6						
65.0	BEDROCK(Gneiss): gray, coarse grained, fractured				1	60	0.0	0
67.5		16.1						
	END OF HOLE @ 68 FT. BGS		SCREEN DETAILS: Screened Interval: 56.0 to 66.0' BGS Length -5.0' Diameter -2.0" Slot # 10 Material -PVC Sand pack interval: 47.0 to 68.0' BGS Material -# 2 Sand					
70.0								
72.5								
75.0								
77.5								
80.0								
82.5								
85.0								
87.5								
90.0								

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

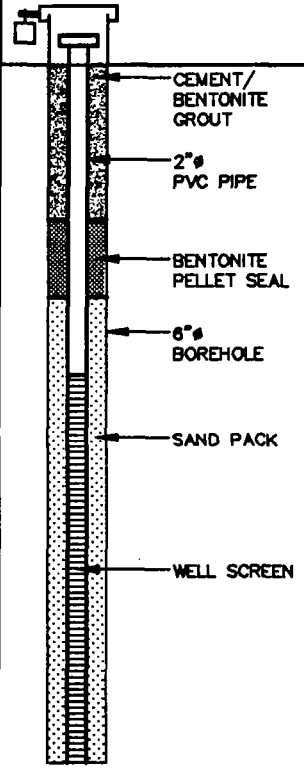
▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L107)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-65S
DATE COMPLETED: AUGUST 7, 1992
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: S. SWANSON

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
	REFERENCE ELEVATION (Top of Riser) GROUND SURFACE	84.14 82.4				
	For stratigraphy see log GW-65S					
2.5						
5.0						
7.5						
10.0						
12.5						
15.0						
17.5	END OF HOLE @ 18.0 FT. BGS	64.4				
20.0						
22.5						
25.0						
27.5						
30.0						
32.5						

SCREEN DETAILS:
Screened Interval:
8.0 to 18.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -PVC
Sand pack interval:
6.0 to 18.0' BGS
Material -# 2 Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(L123)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-62BRD (Page 3 of 6)
DATE COMPLETED: JANUARY 6, 1993
DRILLING METHOD: 4 1/4" ID HSA / 4 7/8" ROLLER BIT
CRA SUPERVISOR: M. JEFFREY

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
67.5						
70.0						
72.5						
75.0			4"ø PVC PIPE			
77.5						
80.0						
82.5			CEMENT/ BENTONITE GROUT			
85.0						
87.5			5"ø BOREHOLE			
90.0						
92.5						
95.0						
97.5						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L123)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-62BRD (Page 4 of 6)
DATE COMPLETED: JANUARY 6, 1993
DRILLING METHOD: 4 1/4" ID HSA / 4 7/8" ROLLER BIT
CRA SUPERVISOR: M. JEFFREY

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
100.0			5"ø BOREHOLE; 4"ø PVC PIPE; CEMENT/ BENTONITE GROUT			
102.5						
105.0	BEDROCK	-23.0				
	END OF OVERBURDEN HOLE @ 105 FT. BGS					
107.5			4"ø HQ COREHOLE			
110.0						
112.5						
115.0						
117.5						
120.0						
122.5						
125.0						
127.5						
130.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-96)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-58D (Page 3 of 4)
DATE COMPLETED: AUGUST 3, 1992
DRILLING METHOD: 4 1/4 HSA / NX / 5 7/8 WR
CRA SUPERVISOR: S. SWANSON

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
67.5			BENTONITE PELLET SEAL; 6"ø BOREHOLE			
70.0	SW-SAND, some clay, some gravel, light brown with iron staining, product odor	27.1	2"ø PVC PIPE; SAND PACK	21SS	X	69
72.5						
75.0	BEDROCK END OF OVERBURDEN HOLE @ 74.0 FT. BGS	22.1	WELL SCREEN			
77.5						
80.0						
82.5						
85.0						
87.5						
90.0						
92.5						
95.0						
97.5						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

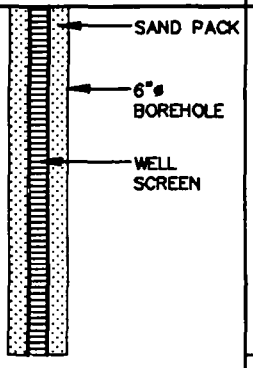
CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L-97)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-58D (Page 4 of 4)
DATE COMPLETED: AUGUST 3, 1992
DRILLING METHOD: 4 1/4" ID HSA / NX / WR
CRA SUPERVISOR: S. SWANSON

DEPTH	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	BIENDTRERORCVKAL	RNUUMBER	CORE RECOVERY	RQD	WATER RETURN
ft BGS		ft. AMSL				%	%	%
	Overburden							
72.5								
75.0	BEDROCK(Gniess): dark gray to black with some white veins, fine grained, fractured	22.1			1	90	0.0	
77.5								
80.0	END OF HOLE @ 79 FT. BGS	17.1	SCREEN DETAILS: Screened Interval: 70.0 to 80.0' BGS Length -10.0' Diameter -2.0" Slot # 10 Material -PVC Sand pack interval: 67.0 to 80.0' BGS Material -# 2 Sand					
82.5								
85.0								
87.5								
90.0								
92.5								
95.0								
97.5								
100.0								

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

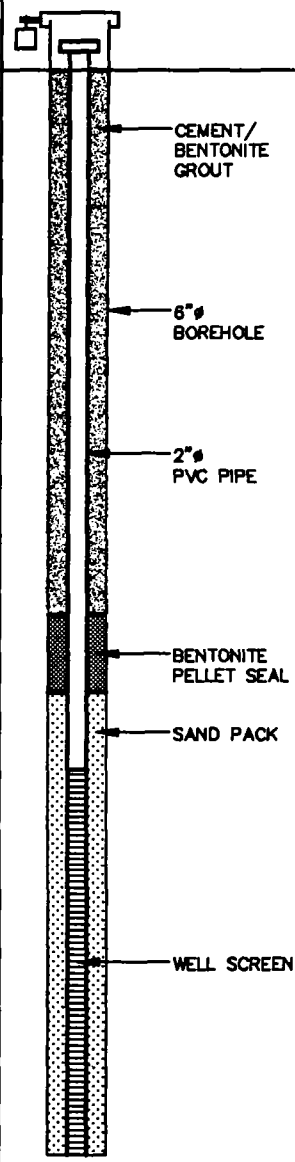
STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(L-98)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-58S
DATE COMPLETED: AUGUST 3, 1992
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: S. SWANSON

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
	REFERENCE ELEVATION (Top of Riser) GROUND SURFACE	98.21 96.0				
	For stratigraphy see log GW-58D					
2.5						
5.0						
7.5						
10.0						
12.5						
15.0						
17.5						
20.0						
22.5						
25.0						
27.5						
	END OF HOLE @ 28.0 FT. BGS	68.0				
30.0						
32.5						



SCREEN DETAILS:
Screened Interval:
18.0 to 28.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -PVC
Sand pack interval:
16.0 to 28.0' BGS
Material -# 2 Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

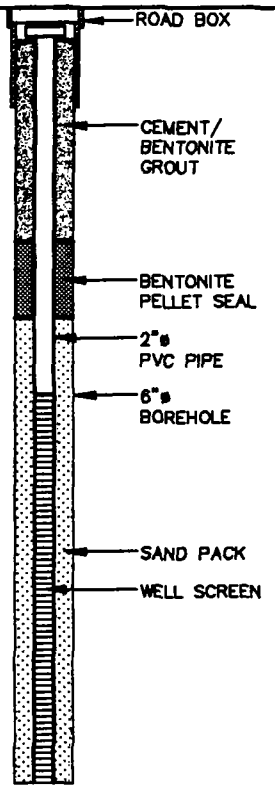
CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(L-86)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-59S
DATE COMPLETED: FEBRUARY 7, 1992
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE OVA (ppm)
	REFERENCE POINT (Top of Riser)	85.08					
	GROUND SURFACE	85.3					
	For stratigraphy see log GW-57D						
2.5							
5.0							
7.5							
10.0							
12.5							
15.0							
17.5							
20.0	END OF HOLE @ 20.0 FT. BGS	65.3					
22.5							
25.0							
27.5							
30.0							
32.5							

SCREEN DETAILS:
Screened Interval:
10.0 to 20.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
8.0 to 20.0' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-84)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-59D (Page 1 of 3)
DATE COMPLETED: FEBRUARY 7, 1992
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE OVA (ppm)
	REFERENCE POINT (Top of Riser)	85.06					
	GROUND SURFACE	85.2					
	SW-SAND, medium to coarse grained, some gravel, brown, moist		ROAD BOX				
2.5				1SS	X	33	
	GW-GRAVEL, some sand, brown, saturated	81.2					
5.0				2SS	X	>100	
7.5				3SS	X	>100	
10.0				4SS	X	>100	
	Rock fragments, very hard	74.2	2"ø PVC PIPE	5SS	X	>100	
12.5							
15.0	SW-SAND, medium to coarse grained, some gravel, brown, saturated	70.2		6SS	X	34	
17.5			CEMENT/ BENTONITE GROUT	7SS	X	37	
20.0				8SS	X	35	
22.5			6"ø BOREHOLE				
25.0				9SS	X	44	
27.5							
30.0	GW-GRAVEL, some sand	55.2		10SS	X	47	
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(L-84)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-59D (Page 2 of 3)
DATE COMPLETED: FEBRUARY 7, 1992
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	STATE	'N' VALUE	OVA (ppm)
35.0			CEMENT/ BENTONITE GROUT				
37.5			2"ø PVC PIPE				
40.0				11SS	X	44	
42.5			6"ø BOREHOLE				
45.0			BENTONITE PELLET SEAL				
47.5							
50.0			SAND PACK	12SS	X	62	
52.5							
55.0							
57.5			WELL SCREEN				
	CL-CLAY(TILL), some sand, some gravel	27.2					
60.0	BEDROCK	25.2		13SS	X		
	END OF OVERBURDEN HOLE @ 60.0 FT. BGS						
62.5							
65.0							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

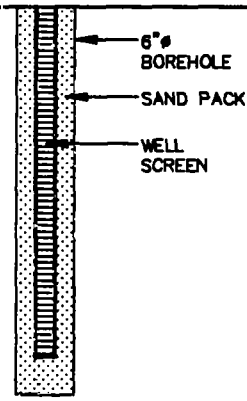
CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L-85)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-59D (Page 3 of 3)
DATE COMPLETED: FEBRUARY 7, 1992
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

DEPTH	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	BEDROCK INTERVAL	RUN NUMBER	CORE RECOVERY	RQD	WATER RETURN
ft BGS		ft. AMSL				%	%	%
	Overburden							
57.5								
60.0	BEDROCK(Gneiss): slightly to moderately fractured, fractures are sub-vertical	25.2						
62.5					1	70	60	
65.0	END OF HOLE @ 65 FT. BGS	20.2						
67.5								
70.0								
72.5								
75.0								
77.5								
80.0								
82.5								
85.0								

SCREEN DETAILS:
Screened Interval:
49.0 to 64.0' BGS
Length -15.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
47.0 to 65.0' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

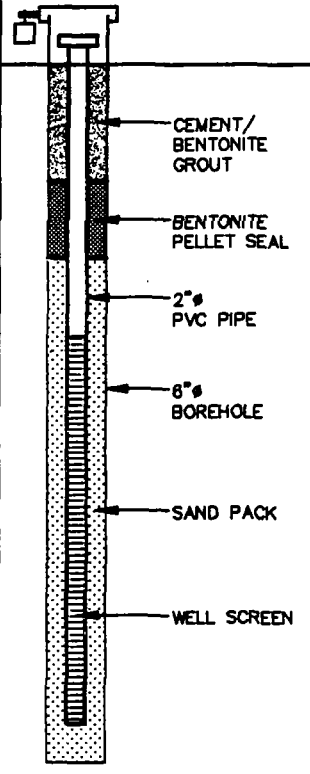
STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-88)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-60S
DATE COMPLETED: APRIL 29, 1992
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE OVA (ppm)
	REFERENCE ELEVATION (Top of Riser) GROUND SURFACE	90.48 88.9					
	For stratigraphy see log GW-60D						
2.5							
5.0							
7.5							
10.0							
12.5							
15.0							
17.5							
	END OF HOLE @ 18.0 FT. BGS	72.5					
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							



SCREEN DETAILS:
Screened Interval:
7.0 to 17.0' BGS
Length -10.0'
Dia'eter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
5.0 to 18.0' BGS
Material -Coarse Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(L-89)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-61D (Page 1 of 3)
DATE COMPLETED: APRIL 30, 1992
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	STATE	'N' VALUE	OVA (ppm)
	REFERENCE ELEVATION (Top of Riser) 83.65 GROUND SURFACE 81.5						
	Humus	81.0					
	SP-SAND, medium grained, brown – saturated			1SS		6	
2.5	SM-SAND, fine grained, some silt, brown	79.0		2SS		15	
5.0	SW-SAND, medium to coarse grained, brown	76.5		3SS		12	
7.5				4SS		9	
10.0							
	Same, except fine to medium grained		2"ø PVC PIPE				
12.5				5SS		23	
15.0	ML-SILT, some very fine sand, brown	66.5		6SS		WH	
17.5			CEMENT/ BENTONITE GROUT				
20.0	SW-SAND, fine to coarse grained, some silt, trace gravel, brown	61.5		7SS		3	
22.5			6"ø BOREHOLE				
25.0				8SS		20	
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

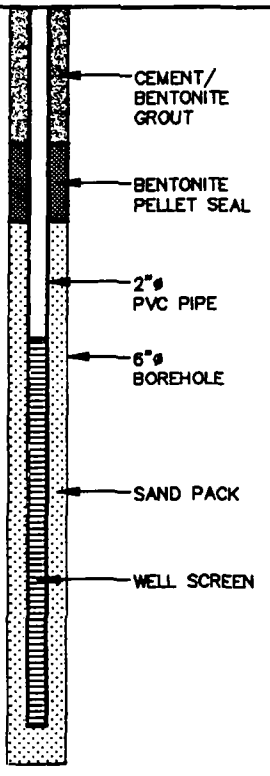
STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-89)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-61D (Page 2 of 3)
DATE COMPLETED: APRIL 30, 1992
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE OVA (ppm)
35.0							
	GW-GRAVEL, some sand, silt and clay, dense	45.5					
37.5							
40.0							
42.5							
45.0							
47.5							
	BEDROCK	33.5					
	END OF OVERBURDEN HOLE @ 48.0 FT. BGS						
50.0							
52.5							
55.0							
57.5							
60.0							
62.5							
65.0							



NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

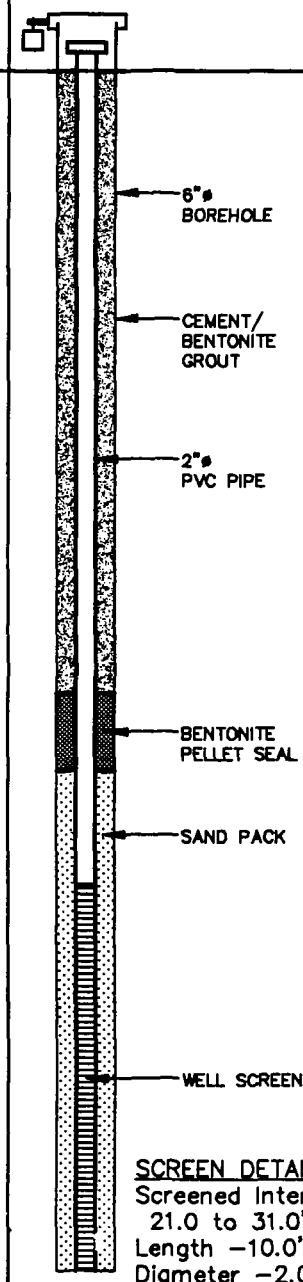
(L-87)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-60D
DATE COMPLETED: APRIL 29, 1992
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL
	REFERENCE ELEVATION (Top of Riser)	90.73
	GROUND SURFACE	88.6
	SW-SAND(FILL), leaves, mulch, black, wet	
2.5		
5.0	— black and brown humus, peat	
7.5		
	GC-GRAVEL, some clay, some sand, dense, gray, ice-contact deposit	80.6
10.0		
	— very hard	
12.5		
	SW-SAND, fine to coarse grained, brown, saturated	74.6
15.0	Same, with some silt, trace gravel, gray	
17.5		
20.0		
22.5		
25.0		
	BEDROCK	62.6
27.5		
30.0		
	END OF HOLE @ 26.0 FT. BGS	57.6
32.5		

MONITOR INSTALLATION



SCREEN DETAILS:
Screened Interval:
21.0 to 31.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
18.0 to 31.0' BGS
Material -Medium Sand

SAMPLE

NUMBER	STATE	'N' VALUE	OVA (ppm)
1SS	X	6	
2SS	X	9	
3SS	X	8	
4SS	X	16	
5SS	X	75	
6SS	X	100	
7SS	X	93	
8SS	X	>100	
9SS	X	95	
10SS	X	55	
11SS	X	55	

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(L-91)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-61S
DATE COMPLETED: APRIL 30, 1992
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE OVA (ppm)
	REFERENCE ELEVATION (Top of Riser) GROUND SURFACE	83.51 81.7					
	For stratigraphy see log GW-61D						
2.5			CEMENT/ BENTONITE GROUT				
5.0			6"ø BOREHOLE				
7.5			BENTONITE PELLET SEAL				
10.0			2"ø PVC PIPE				
12.5			SAND PACK				
15.0			WELL SCREEN				
17.5							
20.0	END OF HOLE @ 20.0 FT. BGS	61.7					
22.5			SCREEN DETAILS: Screened Interval: 10.0 to 20.0' BGS Length -10.0' Diameter -2.0" Slot # 10 Material -Plastic Sand pack interval: 8.0 to 20.0' BGS Material -Medium Sand				
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

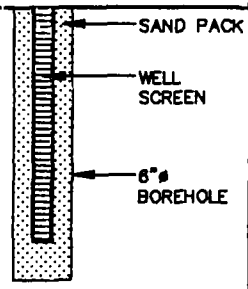
CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG
(BEDROCK)

(L-90)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-61D (Page 3 of 3)
DATE COMPLETED: APRIL 30, 1992
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

DEPTH	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	BEDROCK INTERVAL	RUN NUMBER	CORE RECOVERY	RQD	WATER RETURN
ft BGS		ft. AMSL				%	%	%
	Overburden							
47.5		33.7						
	No recovery							
50.0					1	0		
		29.7						
52.5	END OF HOLE @ 52 FT. BGS		SCREEN DETAILS: Screened Interval: 41.0 to 51.0' BGS Length -10.0' Diameter -2.0" Slot # 10 Material -Plastic Sand pack interval: 38.0 to 52.0' BGS Material -Medium Sand					
55.0								
57.5								
60.0								
62.5								
65.0								
67.5								
70.0								
72.5								
75.0								

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(L119)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-61BR (Page 1 of 4)
DATE COMPLETED: DECEMBER 17, 1992
DRILLING METHOD: 4 1/4" ID HSA / 4 7/8" ROLLER BIT
CRA SUPERVISOR: M. JEFFREY

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
	REFERENCE POINT (Top of Riser)	83.67				
	GROUND SURFACE	81.6				
	For overburden stratigraphy see log GW-61D					
2.5						
5.0						
7.5						
10.0						
12.5			4"ø PVC PIPE			
15.0						
17.5			CEMENT/ BENTONITE GROUT			
20.0						
22.5						
25.0			5"ø BOREHOLE			
27.5						
30.0						
32.5						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(L119)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-61BR (Page 2 of 4)
DATE COMPLETED: DECEMBER 17, 1992
DRILLING METHOD: 4 1/4" ID HSA / 4 7/8" ROLLER BIT
CRA SUPERVISOR: M. JEFFREY

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
35.0						
37.5						
40.0						
42.5			4"ø PVC PIPE			
45.0						
47.5						
50.0			CEMENT/ BENTONITE GROUT			
52.5						
55.0			5"ø BOREHOLE			
57.5						
60.0						
62.5						
65.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ∇ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L119)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-61BR (Page 3 of 4)
DATE COMPLETED: DECEMBER 17, 1992
DRILLING METHOD: 4 1/4" ID HSA / 4 7/8" ROLLER BIT
CRA SUPERVISOR: M. JEFFREY

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
67.5			5"ø BOREHOLE; 4"ø PVC PIPE			
70.0			CEMENT/ BENTONITE GROUT			
72.5	BEDROCK END OF OVERBURDEN HOLE @ 105 FT. BGS	9.6	4"ø HQ COREHOLE			
75.0						
77.5						
80.0						
82.5						
85.0						
87.5						
90.0						
92.5						
95.0						
97.5						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L120)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-61BR (Page 4 of 4)
DATE COMPLETED: DECEMBER 17, 1992
DRILLING METHOD: HQ CORE
CRA SUPERVISOR: M. JEFFREY

DEPTH	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	BEDROCK INTERVAL	RUN NUMBER	CORE RECOVERY	RQD	WATER RETURN
ft BGS		ft. AMSL				%	%	%
	Overburden		5"ø BOREHOLE; 4"ø PVC PIPE					
70.0								
72.5	BEDROCK – for stratigraphy see log GW-61D	9.6	CEMENT/ BENTONITE GROUT					
75.0			4"ø HQ COREHOLE					
77.5								
80.0								
82.5								
85.0								
87.5								
90.0								
92.5	END OF HOLE @ 92 FT. BGS	-10.4						
95.0								
97.5								

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

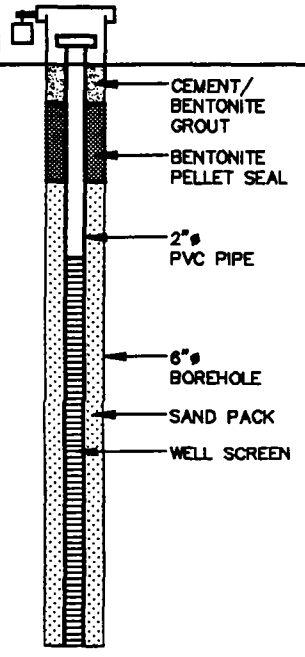
▽ WATER FOUND ▼ STATIC WATER LEVEL NM – NOT MEASURED

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-95)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-62S
DATE COMPLETED: MAY 5, 1992
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE OVA (ppm)
	REFERENCE ELEVATION (Top of Riser) GROUND SURFACE	84.61 82.3					
	For stratigraphy see log GW-62D						
2.5							
5.0							
7.5							
10.0							
12.5							
15.0	END OF HOLE @ 15.0 FT. BGS	67.3					
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

SCREEN DETAILS:
Screened Interval:
5.0 to 15.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -Plastic
Sand pack interval:
3.0 to 15.0' BGS
Material -Medium Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-92)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-62D (Page 1 of 4)
DATE COMPLETED: MAY 4, 1992
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	STATE	'N' VALUE	OVA (ppm)
	REFERENCE ELEVATION (Top of Riser)	83.84					
	GROUND SURFACE	82.4					
	Roots, organic humas, black, wet						
	SW-SAND, some silt, organic matter, black, saturated	81.4		1SS		9	
2.5				2SS		15	
5.0				3SS		25	
	SW-SAND, fine to coarse grained, some gravel brown and black			4SS		25	
7.5		74.4					
	SP-SAND, fine to medium grained, loose, brown,			5SS		9	
10.0	Same, except medium grained			6SS		8	
12.5			2"ø PVC PIPE	7SS		11	
15.0				8SS		9	
17.5			CEMENT/ BENTONITE GROUT	9SS		11	
20.0							
22.5		59.4					
	SW-SAND, fine to coarse grained, trace to some gravel, brown		6"ø BOREHOLE				
25.0				10SS		18	
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(L-92)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-62D (Page 2 of 4)
DATE COMPLETED: MAY 4, 1992
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE OVA (ppm)
35.0							
37.5							
40.0							
42.5			6"ø BOREHOLE				
45.0			CEMENT/ BENTONITE GROUT				
47.5							
50.0			2"ø PVC PIPE				
52.5							
55.0							
57.5			BENTONITE PELLET SEAL				
60.0			SAND PACK				
62.5							
65.0			WELL SCREEN				

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

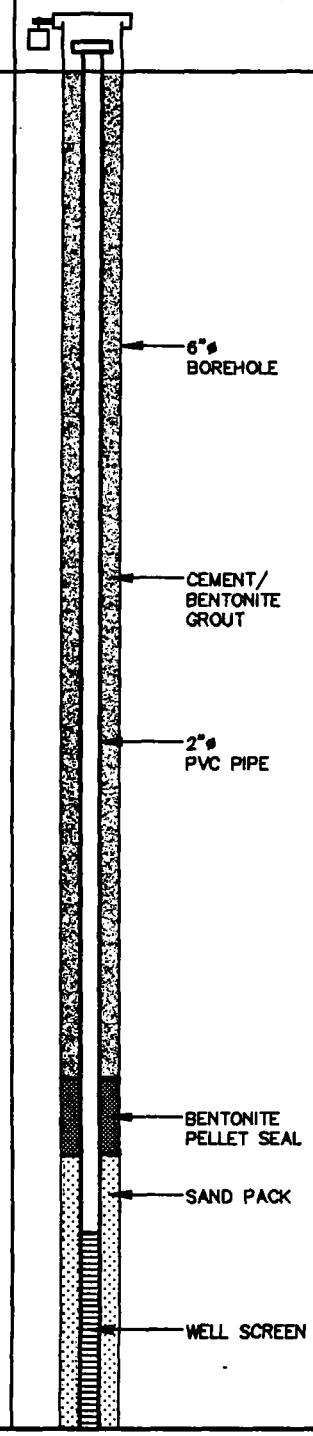
STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(L-94)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-62M (Page 1 of 2)
DATE COMPLETED: MAY 5, 1992
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE OVA (ppm)
	REFERENCE ELEVATION (Top of Riser) GROUND SURFACE	84.39 82.4					
	For stratigraphy see log GW-62D						



NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

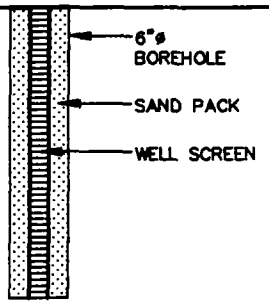
CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(L-94)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-62M (Page 2 of 2)
DATE COMPLETED: MAY 5, 1992
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE OVA (ppm)
35.0							
37.5							
40.0	END OF HOLE @ 40.0 FT. BGS	42.4	SCREEN DETAILS: Screened Interval: 30.0 to 40.0' BGS Length -10.0' Diameter -2.0" Slot # 10 Material -Plastic Sand pack interval: 28.0 to 40.0' BGS Material -Medium Sand				
42.5							
45.0							
47.5							
50.0							
52.5							
55.0							
57.5							
60.0							
62.5							
65.0							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

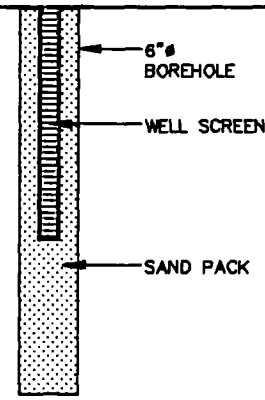
CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(L-92)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-62D (Page 3 of 4)
DATE COMPLETED: MAY 4, 1992
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE OVA (ppm)
	BEDROCK	16.4					
67.5	END OF OVERBURDEN HOLE @ 66.0 FT. BGS						
70.0							
72.5							
75.0							
77.5							
80.0							
82.5							
85.0							
87.5							
90.0							
92.5							
95.0							
97.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ∇ STATIC WATER LEVEL ▼

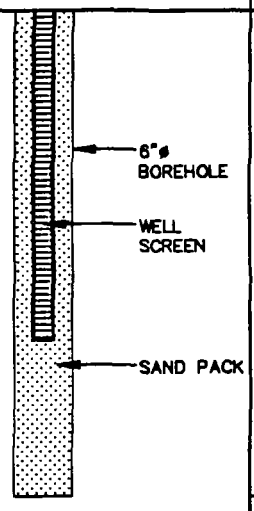
STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L-93)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-62D (Page 4 of 4)
DATE COMPLETED: MAY 4, 1992
DRILLING METHOD: 4 1/4 / NX / 5 7/8 WR
CRA SUPERVISOR: J.W. MICHELS

DEPTH (ft BGS)	DESCRIPTION OF STRATA	ELEVATION (ft. AMSL)	MONITOR INSTALLATION	BEDROCK INTERVAL	RUN NUMBER	CORE RECOVERY (%)	RQD (%)	WATER RETURN (%)
	Overburden							
65.0								
	BEDROCK – No recovery	16.4						
67.5					1	0		
70.0	BEDROCK(Quartzite): white and gray, medium grained, moderatley to heavily fractured	12.4						
72.5					2	20	30	
75.0	END OF HOLE @ 75 FT. BGS	7.4						
77.5								
80.0								
82.5								
85.0								
87.5								
90.0								
92.5								



SCREEN DETAILS:
Screened Interval:
61.0 to 71.0' BGS
Length –10.0'
Diameter –2.0"
Slot # 10
Material –Plastic
Sand pack interval:
58.0 to 75.0' BGS
Material –Medium Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM – NOT MEASURED

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L121)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-62BR (Page 1 of 4)
DATE COMPLETED: JULY 22, 1992
DRILLING METHOD: 4 1/4" ID HSA / 4 7/8" ROLLER BIT
CRA SUPERVISOR: S. SWANSON / J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
	For overburden stratigraphy see log GW-62D					
2.5						
5.0						
7.5						
10.0						
12.5			4"ø PVC PIPE			
15.0						
17.5			CEMENT/ BENTONITE GROUT			
20.0						
22.5						
25.0			5"ø BOREHOLE			
27.5						
30.0						
32.5						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ∇ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L121)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-62BR (Page 2 of 4)
DATE COMPLETED: JULY 22, 1992
DRILLING METHOD: 4 1/4" ID HSA / 4 7/8" ROLLER BIT
CRA SUPERVISOR: S. SWANSON / J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
35.0						
37.5						
40.0						
42.5			4"ø PVC PIPE			
45.0						
47.5						
50.0			CEMENT/ BENTONITE GROUT			
52.5						
55.0			5"ø BOREHOLE			
57.5						
60.0						
62.5						
65.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(L121)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-62BR (Page 3 of 4)
DATE COMPLETED: JULY 22, 1992
DRILLING METHOD: 4 1/4" ID HSA / 4 7/8" ROLLER BIT
CRA SUPERVISOR: S. SWANSON / J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
67.5						
70.0			4"ø PVC PIPE			
72.5			CEMENT/ BENTONITE GROUT			
75.0			5"ø BOREHOLE			
77.5						
80.0	BEDROCK END OF OVERBURDEN HOLE @ 80.0 FT. BGS	-80.0	3"ø NQ COREHOLE			
82.5						
85.0						
87.5						
90.0						
92.5						
95.0						
97.5						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ∇ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L122)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-62BR (Page 4 of 4)
DATE COMPLETED: JULY 22, 1992
DRILLING METHOD: NQ CORE
CRA SUPERVISOR: S. SWANSON / J.W. MICHELS

DEPTH	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	BIENDTRERCVKAL	RNUUNMBER	CORE RECOVERY	RQD	WATER RETURN
ft BGS		ft. AMSL				%	%	%
	Overburden		5"ø BOREHOLE; CEMENT/ BENTONITE GROUT; 4"ø PVC PIPE					
77.5								
80.0	BEDROCK(Gneiss): medasedimentary, black, fine grained, fractured, little iron staining, along fractures, some chlorite and talc along fractures, weathering	-80.0			1	75	0.0	
82.5					2	75	0.0	
85.0								
87.5					3	60	0.0	
90.0			3"ø NQ COREHOLE					
92.5					4	80	0.0	
95.0								
97.5					5	95	0.0	
100.0								
102.5					6	90	0.0	
105.0	END OF HOLE @ 105 FT. BGS	-105.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

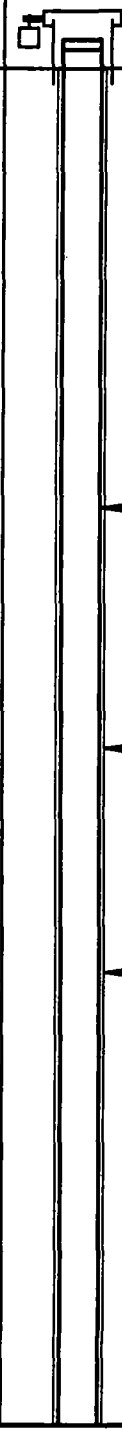
STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L123)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-62BRD (Page 1 of 6)
DATE COMPLETED: JANUARY 6, 1993
DRILLING METHOD: 4 1/4" ID HSA / 4 7/8" ROLLER BIT
CRA SUPERVISOR: M. JEFFREY

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
	REFERENCE POINT (Top of Riser)	83.66				
	GROUND SURFACE	82.0				
	For overburden stratigraphy see log GW-62D					
2.5						
5.0						
7.5						
10.0						
12.5			4"ø PVC PIPE			
15.0						
17.5			CEMENT/ BENTONITE GROUT			
20.0						
22.5						
25.0			5"ø BOREHOLE			
27.5						
30.0						
32.5						



NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(L123)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-62BRD (Page 2 of 6)
DATE COMPLETED: JANUARY 6, 1993
DRILLING METHOD: 4 1/4" ID HSA / 4 7/8" ROLLER BIT
CRA SUPERVISOR: M. JEFFREY

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
35.0						
37.5						
40.0						
42.5			4"ø PVC PIPE			
45.0						
47.5						
50.0			CEMENT/ BENTONITE GROUT			
52.5						
55.0			5"ø BOREHOLE			
57.5						
60.0						
62.5						
65.0						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (BEDROCK)

(L124)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-62BRD (Page 5 of 6)
DATE COMPLETED: JANUARY 6, 1993
DRILLING METHOD: HQ CORE
CRA SUPERVISOR: M. JEFFREY

DEPTH	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	BIT RECOVERY	RUN NUMBER	CORE RECOVERY	RQD	WATER RETURN
ft BGS		ft. AMSL				%	%	%
	Overburden		5"ø BOREHOLE					
102.5			4"ø PVC PIPE					
			CEMENT/ BENTONITE GROUT					
105.0	BEDROCK – for stratigraphy see log GW-62D	-23.0						
107.5					1	100		
110.0			4"ø HQ COREHOLE					
112.5					2	100		
115.0								
117.5					3	100		
120.0								
122.5					4	100		
125.0								
127.5					5	100		
130.0								
					6	100		

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

▽ WATER FOUND ▼ STATIC WATER LEVEL NM – NOT MEASURED

STRATIGRAPHIC AND INSTRUMENTATION LOG
(BEDROCK)

(L124)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-62BRD (Page 6 of 6)
DATE COMPLETED: JANUARY 6, 1993
DRILLING METHOD: HQ CORE
CRA SUPERVISOR: M. JEFFREY

DEPTH	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	BEDROCK INTERVAL	RUN NUMBER	CORE RECOVERY	RQD	WATER RETURN
ft BGS		ft. AMSL				%	%	%
132.5			4"ø HQ COREHOLE		6	100		
135.0								
137.5					7	100		
140.0								
142.5					8	100		
145.0	END OF HOLE @ 145 FT. BGS	-63.0						
147.5								
150.0								
152.5								
155.0								
157.5								
160.0								

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

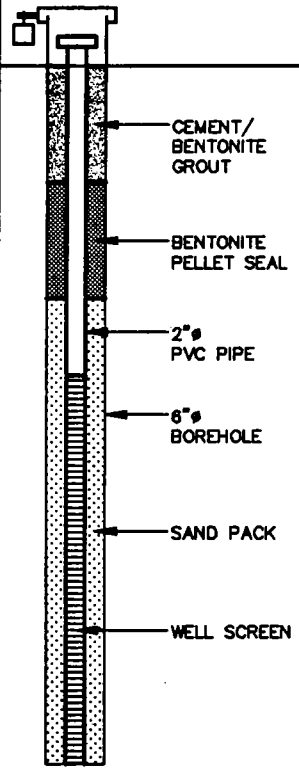
▽ WATER FOUND ▼ STATIC WATER LEVEL NM – NOT MEASURED

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L101)

PROJECT NAME:	OLIN (CSA)	HOLE DESIGNATION:	GW-63S
PROJECT NO.:	3683	DATE COMPLETED:	AUGUST 5, 1992
CLIENT:	OLIN CORP.	DRILLING METHOD:	4 1/4" ID HSA
LOCATION:	WILMINGTON, MA.	CRA SUPERVISOR:	S. SWANSON

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
	REFERENCE ELEVATION (Top of Riser) GROUND SURFACE	82.82 81.1				
	For stratigraphy see log GW-63D					
2.5						
5.0						
7.5						
10.0						
12.5						
15.0						
17.5						
	END OF HOLE @ 18.0 FT. BGS	63.1				
20.0						
22.5						
25.0						
27.5						
30.0						
32.5						



SCREEN DETAILS:
Screened Interval:
8.0 to 18.0' BGS
Length -10.0'
Diameter -2.0"
Slot # 10
Material -PVC
Sand pack interval:
6.0 to 18.0' BGS
Material -# 2 Sand

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-99)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-63D (Page 1 of 2)
DATE COMPLETED: AUGUST 5, 1992
DRILLING METHOD: 4 1/4 HSA / NX / 5 7/8 WR
CRA SUPERVISOR: S. SWANSON

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
	REFERENCE ELEVATION (Top of Riser) 83.32 GROUND SURFACE 81.1					
	SW-SAND, trace gravel, firm, fine to medium grained, tan			1SS		13
2.5				2SS		17
	Same, except saturated					
5.0				3SS		8
7.5	Same, except dark tan		CEMENT/ BENTONITE GROUT	4SS		12
10.0	Same, except little gravel			5SS		16
			6"ø BOREHOLE	6SS		15
12.5	Same, except medium to coarse grained, some iron staining			7SS		24
15.0	Same, except tan and gray			8SS		14
17.5			BENTONITE PELLET SEAL			
	SW-SAND(TILL), some clay, gravel and weathered rock fragments, very stiff, medium to coarse grained, red and tan, iron staining	62.1				
20.0				9SS		64
22.5			2"ø PVC PIPE			
25.0				10SS		49
	SW-SAND, some clay, little gravel, very stiff, fine to coarse grained, gray		SAND PACK			
27.5						
	BEDROCK	52.1	W[illegible] SCREEN			
30.0	END OF OVERBURDEN HOLE @ 29.0 FT. BGS					
32.5						

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

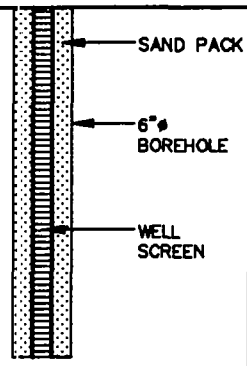
CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG
(BEDROCK)

(L100)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-63D (Page 2 of 2)
DATE COMPLETED: AUGUST 5, 1992
DRILLING METHOD: 4 1/4 HSA / NX / 5 7/8 WR
CRA SUPERVISOR: S. SWANSON

DEPTH	DESCRIPTION OF STRATA	ELEVATION	MONITOR INSTALLATION	BEDROCK INTERVAL	RUN NUMBER	CORE RECOVERY	RQD	WATER RETURN
ft BGS		ft. AMSL				%	%	%
	Overburden							
27.5								
30.0	BEDROCK(Gneiss): gray, fine to medium grained	52.1			1	80	0.0	
32.5								
35.0	END OF HOLE @ 34 FT. BGS	47.1	SCREEN DETAILS: Screened Interval: 24.0 to 34.0' BGS Length -10.0' Diameter -2.0" Slot # 10 Material -PVC Sand pack interval: 19.0 to 34.0' BGS Material -# 2 Sand					
37.5								
40.0								
42.5								
45.0								
47.5								
50.0								
52.5								
55.0								

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

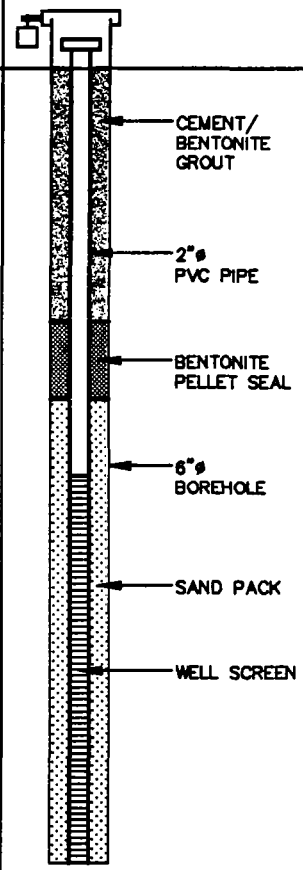
▽ WATER FOUND ▼ STATIC WATER LEVEL NM - NOT MEASURED

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L104)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: GW-64S
DATE COMPLETED: JULY 31, 1992
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: S. SWANSON

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE
	REFERENCE ELEVATION (Top of Riser) GROUND SURFACE	86.70 84.6				
2.5 5.0 7.5 10.0 12.5 15.0 17.5 20.0	For stratigraphy see log GW-64S					
22.5 25.0 27.5 30.0 32.5	END OF HOLE @ 20.5 FT. BGS	64.1	SCREEN DETAILS: Screened Interval: 10.5 to 20.5' BGS Length -10.0' Diameter -2.0" Slot # 10 Material -PVC Sand pack interval: 8.5 to 20.5' BGS Material -# 2 Sand			

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

F

APPENDIX F

HYDRAULIC CONDUCTIVITY DATA

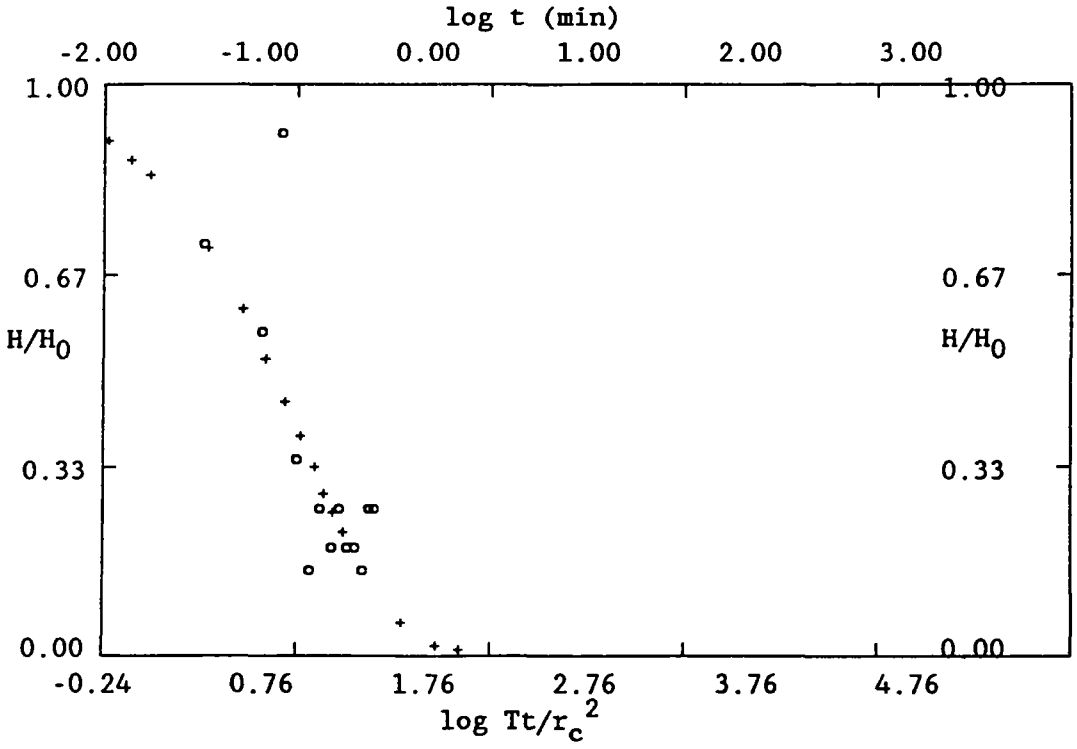
SLUG TEST HYDRAULIC CONDUCTIVITY DATA

Data for Slug Injection/Withdrawal Test

Well Name: 43DR Date of Test: 9/91
Aquifer Thickness (b): 22.000 ft
Change in Vol.of Water = 0.022 cu ft
Effective Radius of Well = 0.083 ft
Radius of Casing(rc) over Water Level Decline = 0.083 ft

Entry No.	Time(t) (min)	Head (ft)	H (ft)	H/H0
1	0.000	0.000		
2	0.017	0.460	0.460	1.000
3	0.033	0.330	0.330	0.717
4	0.067	0.260	0.260	0.565
5	0.083	0.420	0.420	0.913
6	0.100	0.160	0.160	0.348
7	0.117	0.070	0.070	0.152
8	0.133	0.120	0.120	0.261
9	0.150	0.090	0.090	0.196
10	0.167	0.120	0.120	0.261
11	0.183	0.090	0.090	0.196
12	0.200	0.090	0.090	0.196
13	0.217	0.070	0.070	0.152
14	0.233	0.120	0.120	0.261
15	0.250	0.120	0.120	0.261

GW43D RISING



o - Data

+ - Type Curve
Slug Test: alpha =-10.0

SOLUTION

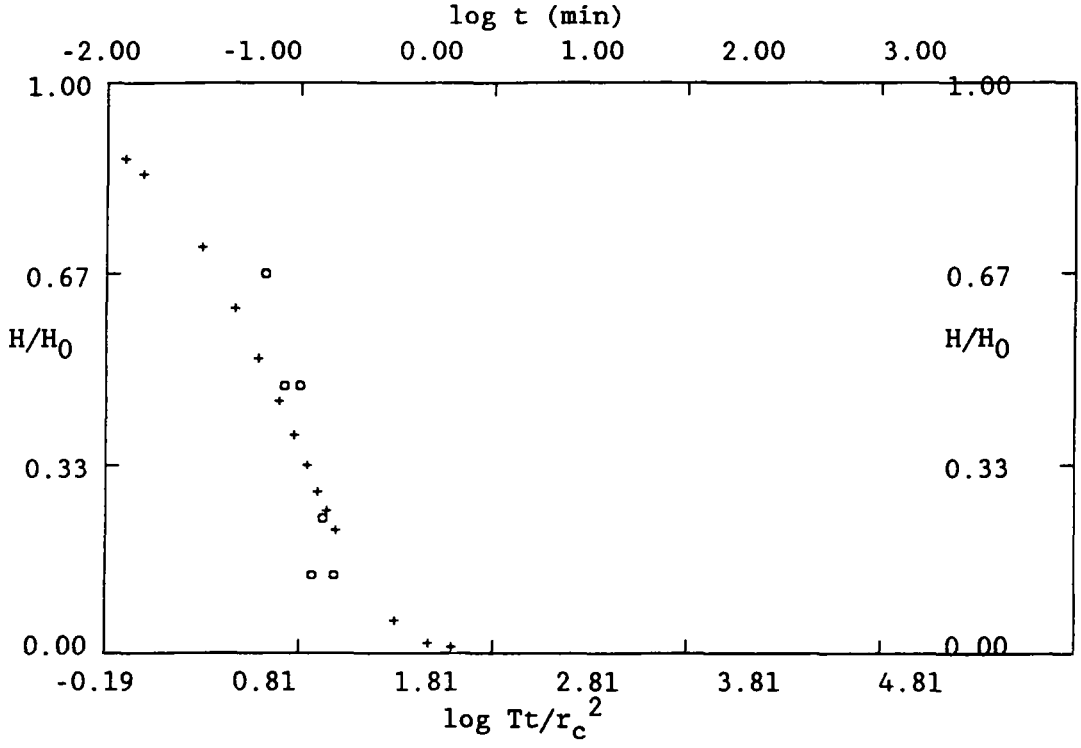
Transmissivity = 3.996E-0001 sq ft/min
Aquifer Thick. = 2.200E+0001 ft
Hydraulic Cond.= 1.816E-0002 ft/min
Storativity = 1.000E-0010

Data for Slug Injection/Withdrawal Test

Well Name: 43DF Date of Test: 9/91
Aquifer Thickness (b): 22.000 ft
Change in Vol.of Water - 0.022 cu ft
Effective Radius of Well - 0.083 ft
Radius of Casing(rc) over Water Level Decline - 0.083 ft

Entry No.	Time(t) (min)	Head (ft)	H (ft)	H/HO
********	**********	**********	**********	**********
1	0.000	0.000		
2	0.017	0.210	0.210	1.000
3	0.033	0.470	0.470	2.238
4	0.050	0.440	0.440	2.095
5	0.067	0.140	0.140	0.667
6	0.083	0.100	0.100	0.476
7	0.100	0.100	0.100	0.476
8	0.117	0.030	0.030	0.143
9	0.133	0.050	0.050	0.238
10	0.150	0.030	0.030	0.143
11	0.167	0.000	0.000	0.000

GW43D FALLING



o - Data

+ - Type Curve
Slug Test: alpha =-10.0

SOLUTION

Transmissivity = 4.484E-0001 sq ft/min
Aquifer Thick. = 2.200E+0001 ft
Hydraulic Cond.= 2.038E-0002 ft/min
Storativity = 1.000E-0010

Data for Slug Injection/Withdrawal Test

Well Name: 51DR Date of Test: 9/91
Aquifer Thickness (b): 10.000 ft
Change in Vol.of Water - 0.022 cu ft
Effective Radius of Well - 0.083 ft
Radius of Casing(rc) over Water Level Decline - 0.083 ft

Entry No.	Time(t) (min)	Head (ft)	H (ft)	H/HO
1	0.000	0.000		
2	0.017	0.550	0.550	1.000
3	0.033	0.500	0.500	0.909
4	0.050	0.550	0.550	1.000
5	0.067	0.480	0.480	0.873
6	0.083	0.500	0.500	0.909
7	0.100	0.460	0.460	0.836
8	0.117	0.480	0.480	0.873
9	0.133	0.440	0.440	0.800
10	0.150	0.480	0.480	0.873
11	0.167	0.410	0.410	0.745
12	0.183	0.460	0.460	0.836
13	0.200	0.410	0.410	0.745
14	0.217	0.440	0.440	0.800
15	0.233	0.390	0.390	0.709
16	0.250	0.440	0.440	0.800
17	0.267	0.410	0.410	0.745
18	0.283	0.370	0.370	0.673
19	0.300	0.390	0.390	0.709
20	0.317	0.370	0.370	0.673
21	0.333	0.370	0.370	0.673
22	0.350	0.370	0.370	0.673
23	0.367	0.370	0.370	0.673
24	0.383	0.340	0.340	0.618
25	0.400	0.340	0.340	0.618
26	0.417	0.340	0.340	0.618
27	0.433	0.340	0.340	0.618
28	0.450	0.320	0.320	0.582
29	0.467	0.320	0.320	0.582
30	0.483	0.300	0.300	0.545
31	0.500	0.340	0.340	0.618
32	0.517	0.300	0.300	0.545
33	0.533	0.320	0.320	0.582
34	0.550	0.270	0.270	0.491
35	0.567	0.320	0.320	0.582
36	0.583	0.270	0.270	0.491
37	0.600	0.320	0.320	0.582
38	0.617	0.250	0.250	0.455
39	0.633	0.270	0.270	0.491
40	0.650	0.270	0.270	0.491
41	0.667	0.250	0.250	0.455

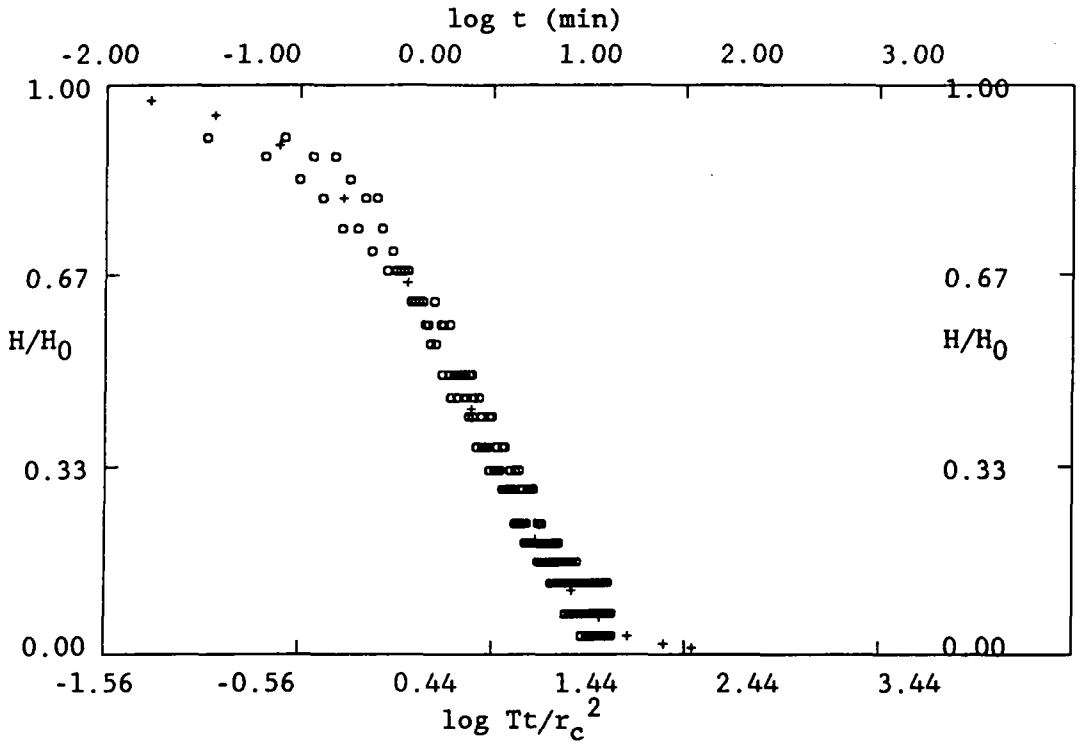
42	0.683	0.270	0.270	0.491
43	0.700	0.250	0.250	0.455
44	0.717	0.270	0.270	0.491
45	0.733	0.250	0.250	0.455
46	0.750	0.270	0.270	0.491
47	0.767	0.230	0.230	0.418
48	0.783	0.270	0.270	0.491
49	0.800	0.230	0.230	0.418
50	0.817	0.250	0.250	0.455
51	0.833	0.200	0.200	0.364
52	0.850	0.250	0.250	0.455
53	0.867	0.230	0.230	0.418
54	0.883	0.200	0.200	0.364
55	0.900	0.230	0.230	0.418
56	0.917	0.200	0.200	0.364
57	0.933	0.200	0.200	0.364
58	0.950	0.200	0.200	0.364
59	0.967	0.230	0.230	0.418
60	0.983	0.180	0.180	0.327
61	1.000	0.230	0.230	0.418
62	1.017	0.180	0.180	0.327
63	1.033	0.180	0.180	0.327
64	1.050	0.200	0.200	0.364
65	1.067	0.180	0.180	0.327
66	1.083	0.200	0.200	0.364
67	1.100	0.180	0.180	0.327
68	1.117	0.200	0.200	0.364
69	1.133	0.160	0.160	0.291
70	1.150	0.200	0.200	0.364
71	1.167	0.160	0.160	0.291
72	1.183	0.200	0.200	0.364
73	1.200	0.160	0.160	0.291
74	1.217	0.160	0.160	0.291
75	1.233	0.180	0.180	0.327
76	1.250	0.160	0.160	0.291
77	1.267	0.160	0.160	0.291
78	1.283	0.160	0.160	0.291
79	1.300	0.160	0.160	0.291
80	1.317	0.130	0.130	0.236
81	1.333	0.180	0.180	0.327
82	1.350	0.130	0.130	0.236
83	1.367	0.180	0.180	0.327
84	1.383	0.130	0.130	0.236
85	1.400	0.160	0.160	0.291
86	1.417	0.130	0.130	0.236
87	1.433	0.160	0.160	0.291
88	1.450	0.130	0.130	0.236
89	1.467	0.110	0.110	0.200
90	1.483	0.130	0.130	0.236
91	1.500	0.130	0.130	0.236
92	1.517	0.130	0.130	0.236
93	1.533	0.110	0.110	0.200
94	1.550	0.160	0.160	0.291
95	1.567	0.110	0.110	0.200
96	1.583	0.160	0.160	0.291
97	1.600	0.110	0.110	0.200
98	1.617	0.160	0.160	0.291
99	1.633	0.110	0.110	0.200
100	1.650	0.110	0.110	0.200
101	1.667	0.110	0.110	0.200

102	1.683	0.110	0.110	0.200
103	1.700	0.110	0.110	0.200
104	1.717	0.110	0.110	0.200
105	1.733	0.130	0.130	0.236
106	1.750	0.090	0.090	0.164
107	1.767	0.130	0.130	0.236
108	1.783	0.090	0.090	0.164
109	1.800	0.130	0.130	0.236
110	1.817	0.110	0.110	0.200
111	1.833	0.090	0.090	0.164
112	1.850	0.110	0.110	0.200
113	1.867	0.090	0.090	0.164
114	1.883	0.110	0.110	0.200
115	1.900	0.090	0.090	0.164
116	1.917	0.110	0.110	0.200
117	1.933	0.090	0.090	0.164
118	1.950	0.090	0.090	0.164
119	1.967	0.110	0.110	0.200
120	1.983	0.090	0.090	0.164
121	2.000	0.090	0.090	0.164
122	2.017	0.090	0.090	0.164
123	2.033	0.090	0.090	0.164
124	2.050	0.070	0.070	0.127
125	2.067	0.110	0.110	0.200
126	2.083	0.070	0.070	0.127
127	2.100	0.110	0.110	0.200
128	2.117	0.070	0.070	0.127
129	2.133	0.110	0.110	0.200
130	2.150	0.070	0.070	0.127
131	2.167	0.070	0.070	0.127
132	2.183	0.090	0.090	0.164
133	2.200	0.070	0.070	0.127
134	2.217	0.090	0.090	0.164
135	2.233	0.070	0.070	0.127
136	2.250	0.110	0.110	0.200
137	2.267	0.070	0.070	0.127
138	2.283	0.090	0.090	0.164
139	2.300	0.070	0.070	0.127
140	2.317	0.090	0.090	0.164
141	2.333	0.090	0.090	0.164
142	2.350	0.070	0.070	0.127
143	2.367	0.070	0.070	0.127
144	2.383	0.070	0.070	0.127
145	2.400	0.070	0.070	0.127
146	2.417	0.040	0.040	0.073
147	2.433	0.090	0.090	0.164
148	2.450	0.090	0.090	0.164
149	2.467	0.090	0.090	0.164
150	2.483	0.040	0.040	0.073
151	2.500	0.040	0.040	0.073
152	2.517	0.070	0.070	0.127
153	2.533	0.040	0.040	0.073
154	2.550	0.070	0.070	0.127
155	2.567	0.040	0.040	0.073
156	2.583	0.090	0.090	0.164
157	2.600	0.040	0.040	0.073
158	2.617	0.090	0.090	0.164
159	2.633	0.070	0.070	0.127
160	2.650	0.040	0.040	0.073
161	2.667	0.070	0.070	0.127

162	2.683	0.040	0.040	0.073
163	2.700	0.070	0.070	0.127
164	2.717	0.040	0.040	0.073
165	2.733	0.090	0.090	0.164
166	2.750	0.040	0.040	0.073
167	2.767	0.040	0.040	0.073
168	2.783	0.070	0.070	0.127
169	2.800	0.040	0.040	0.073
170	2.817	0.070	0.070	0.127
171	2.833	0.040	0.040	0.073
172	2.850	0.070	0.070	0.127
173	2.867	0.040	0.040	0.073
174	2.883	0.040	0.040	0.073
175	2.900	0.070	0.070	0.127
176	2.917	0.040	0.040	0.073
177	2.933	0.070	0.070	0.127
178	2.950	0.020	0.020	0.036
179	2.967	0.070	0.070	0.127
180	2.983	0.040	0.040	0.073
181	3.000	0.040	0.040	0.073
182	3.017	0.070	0.070	0.127
183	3.033	0.040	0.040	0.073
184	3.050	0.070	0.070	0.127
185	3.067	0.020	0.020	0.036
186	3.083	0.070	0.070	0.127
187	3.100	0.020	0.020	0.036
188	3.117	0.020	0.020	0.036
189	3.133	0.040	0.040	0.073
190	3.150	0.040	0.040	0.073
191	3.167	0.070	0.070	0.127
192	3.183	0.020	0.020	0.036
193	3.200	0.070	0.070	0.127
194	3.217	0.040	0.040	0.073
195	3.233	0.020	0.020	0.036
196	3.250	0.040	0.040	0.073
197	3.267	0.020	0.020	0.036
198	3.283	0.070	0.070	0.127
199	3.300	0.020	0.020	0.036
200	3.317	0.070	0.070	0.127
201	3.333	0.040	0.040	0.073
202	3.350	0.020	0.020	0.036
203	3.367	0.040	0.040	0.073
204	3.383	0.020	0.020	0.036
205	3.400	0.070	0.070	0.127
206	3.417	0.020	0.020	0.036
207	3.433	0.020	0.020	0.036
208	3.450	0.040	0.040	0.073
209	3.467	0.040	0.040	0.073
210	3.483	0.040	0.040	0.073
211	3.500	0.020	0.020	0.036
212	3.517	0.070	0.070	0.127
213	3.533	0.020	0.020	0.036
214	3.550	0.070	0.070	0.127
215	3.567	0.040	0.040	0.073
216	3.583	0.020	0.020	0.036
217	3.600	0.040	0.040	0.073
218	3.617	0.020	0.020	0.036
219	3.633	0.070	0.070	0.127
220	3.650	0.020	0.020	0.036
221	3.667	0.070	0.070	0.127

222	3.683	0.020	0.020	0.036
223	3.700	0.020	0.020	0.036
224	3.717	0.040	0.040	0.073
225	3.733	0.020	0.020	0.036
226	3.750	0.070	0.070	0.127
227	3.767	0.020	0.020	0.036
228	3.783	0.070	0.070	0.127
229	3.800	0.040	0.040	0.073
230	3.817	0.020	0.020	0.036
231	3.833	0.040	0.040	0.073
232	3.850	0.020	0.020	0.036
233	3.867	0.070	0.070	0.127
234	3.883	0.020	0.020	0.036
235	3.900	0.070	0.070	0.127
236	3.917	0.040	0.040	0.073
237	3.933	0.020	0.020	0.036
238	3.950	0.020	0.020	0.036
239	3.967	0.020	0.020	0.036
240	3.983	0.040	0.040	0.073
241	4.000	0.020	0.020	0.036
242	4.017	0.070	0.070	0.127
243	4.033	0.020	0.020	0.036
244	4.050	0.020	0.020	0.036
245	4.067	0.020	0.020	0.036
246	4.083	0.020	0.020	0.036
247	4.100	0.040	0.040	0.073
248	4.117	0.020	0.020	0.036
249	4.133	0.040	0.040	0.073
250	4.150	0.020	0.020	0.036
251	4.167	0.020	0.020	0.036
252	4.183	0.020	0.020	0.036
253	4.200	0.020	0.020	0.036
254	4.217	0.040	0.040	0.073
255	4.233	0.000	0.000	0.000

GW51D RISING



o - Data

+ - Type Curve
Slug Test: alpha = -4.0

SOLUTION

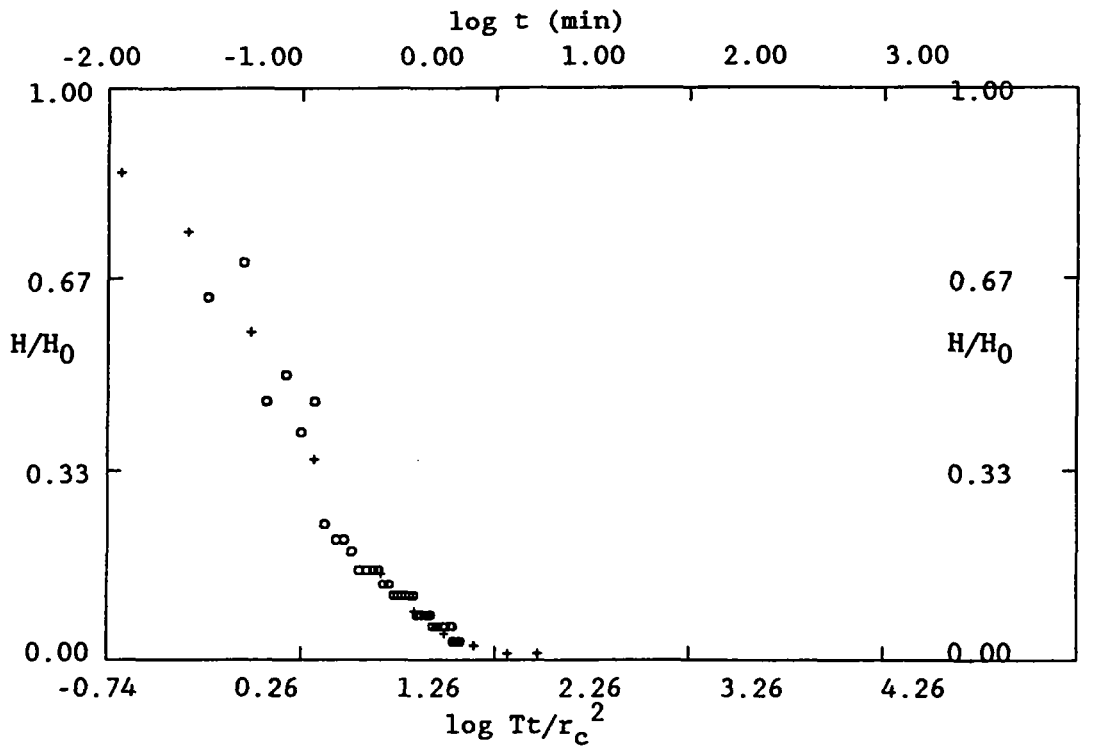
Transmissivity = 1.913E-0002 sq ft/min
Aquifer Thick. = 1.000E+0001 ft
Hydraulic Cond.= 1.913E-0003 ft/min
Storativity = 1.000E-0004

Data for Slug Injection/Withdrawal Test

Well Name: 54DF Date of Test: 9/91
Aquifer Thickness (b): 12.000 ft
Change in Vol.of Water - 0.022 cu ft
Effective Radius of Well - 0.083 ft
Radius of Casing(rc) over Water Level Decline - 0.083 ft

Entry No.	Time(t) (min)	Head (ft)	H (ft)	H/HO
1	0.000	0.000		
2	0.017	0.880	0.880	1.000
3	0.033	0.560	0.560	0.636
4	0.050	0.610	0.610	0.693
5	0.067	0.400	0.400	0.455
6	0.083	0.440	0.440	0.500
7	0.100	0.350	0.350	0.398
8	0.117	0.400	0.400	0.455
9	0.133	0.210	0.210	0.239
10	0.150	0.190	0.190	0.216
11	0.167	0.190	0.190	0.216
12	0.183	0.170	0.170	0.193
13	0.200	0.140	0.140	0.159
14	0.217	0.140	0.140	0.159
15	0.233	0.140	0.140	0.159
16	0.250	0.140	0.140	0.159
17	0.267	0.120	0.120	0.136
18	0.283	0.120	0.120	0.136
19	0.300	0.100	0.100	0.114
20	0.317	0.100	0.100	0.114
21	0.333	0.100	0.100	0.114
22	0.350	0.100	0.100	0.114
23	0.367	0.100	0.100	0.114
24	0.383	0.100	0.100	0.114
25	0.400	0.070	0.070	0.080
26	0.417	0.070	0.070	0.080
27	0.433	0.070	0.070	0.080
28	0.450	0.070	0.070	0.080
29	0.467	0.070	0.070	0.080
30	0.483	0.050	0.050	0.057
31	0.500	0.050	0.050	0.057
32	0.517	0.050	0.050	0.057
33	0.533	0.050	0.050	0.057
34	0.550	0.050	0.050	0.057
35	0.567	0.050	0.050	0.057
36	0.583	0.050	0.050	0.057
37	0.600	0.050	0.050	0.057
38	0.617	0.030	0.030	0.034
39	0.633	0.030	0.030	0.034
40	0.650	0.030	0.030	0.034
41	0.667	0.030	0.030	0.034

GW54D FALLING



o - Data

+ - Type Curve
Slug Test: alpha = -3.0

SOLUTION

Transmissivity = 1.264E-0001 sq ft/min
Aquifer Thick. = 1.200E+0001 ft
Hydraulic Cond.= 1.053E-0002 ft/min
Storativity = 1.000E-0003

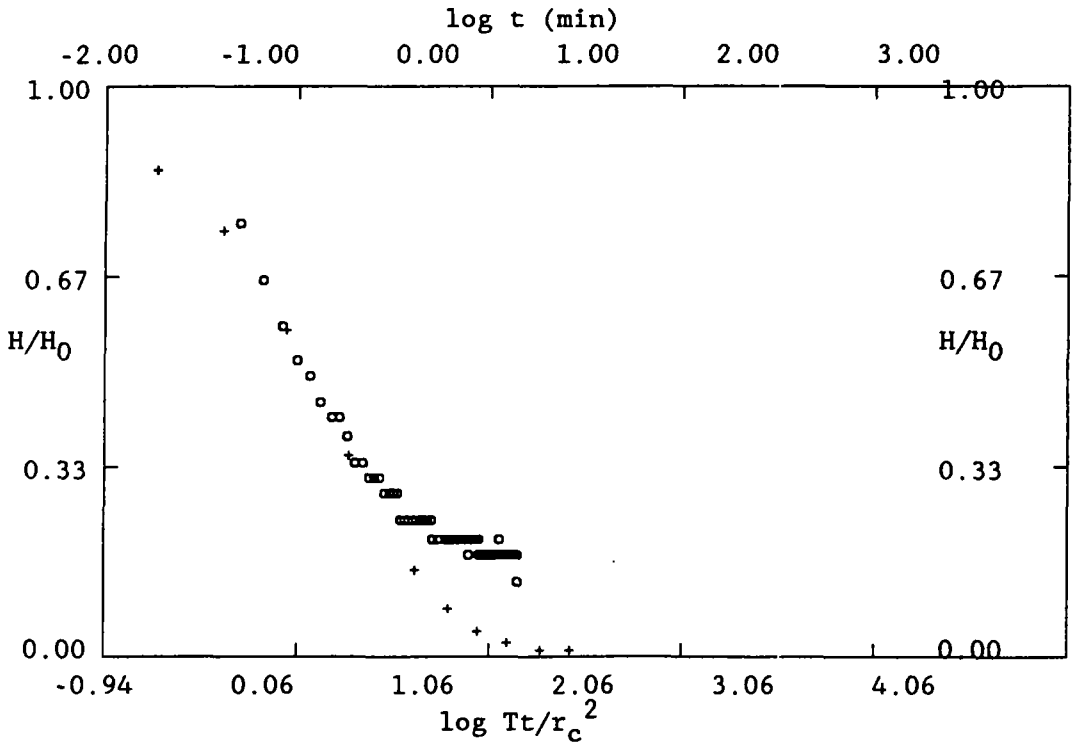
Data for Slug Injection/Withdrawal Test

Well Name: 54DR Date of Test: 9/91
Aquifer Thickness (b): 12.000 ft
Change in Vol.of Water = 0.022 cu ft
Effective Radius of Well = 0.083 ft
Radius of Casing(rc) over Water Level Decline = 0.083 ft

Entry No.	Time(t) (min)	Head (ft)	H (ft)	H/HO
1	0.000	0.000		
2	0.017	0.670	0.670	1.000
3	0.033	0.700	0.700	1.045
4	0.050	0.510	0.510	0.761
5	0.067	0.440	0.440	0.657
6	0.083	0.390	0.390	0.582
7	0.100	0.350	0.350	0.522
8	0.117	0.330	0.330	0.493
9	0.133	0.300	0.300	0.448
10	0.150	0.280	0.280	0.418
11	0.167	0.280	0.280	0.418
12	0.183	0.260	0.260	0.388
13	0.200	0.230	0.230	0.343
14	0.217	0.230	0.230	0.343
15	0.233	0.210	0.210	0.313
16	0.250	0.210	0.210	0.313
17	0.267	0.210	0.210	0.313
18	0.283	0.190	0.190	0.284
19	0.300	0.190	0.190	0.284
20	0.317	0.190	0.190	0.284
21	0.333	0.190	0.190	0.284
22	0.350	0.160	0.160	0.239
23	0.367	0.160	0.160	0.239
24	0.383	0.160	0.160	0.239
25	0.400	0.160	0.160	0.239
26	0.417	0.160	0.160	0.239
27	0.433	0.160	0.160	0.239
28	0.450	0.160	0.160	0.239
29	0.467	0.160	0.160	0.239
30	0.483	0.160	0.160	0.239
31	0.500	0.160	0.160	0.239
32	0.517	0.140	0.140	0.209
33	0.533	0.140	0.140	0.209
34	0.550	0.140	0.140	0.209
35	0.567	0.140	0.140	0.209
36	0.583	0.140	0.140	0.209
37	0.600	0.140	0.140	0.209
38	0.617	0.140	0.140	0.209
39	0.633	0.140	0.140	0.209
40	0.650	0.140	0.140	0.209
41	0.667	0.140	0.140	0.209

42	0.683	0.140	0.140	0.209
43	0.700	0.140	0.140	0.209
44	0.717	0.140	0.140	0.209
45	0.733	0.140	0.140	0.209
46	0.750	0.140	0.140	0.209
47	0.767	0.140	0.140	0.209
48	0.783	0.120	0.120	0.179
49	0.800	0.140	0.140	0.209
50	0.817	0.140	0.140	0.209
51	0.833	0.140	0.140	0.209
52	0.850	0.140	0.140	0.209
53	0.867	0.140	0.140	0.209
54	0.883	0.140	0.140	0.209
55	0.900	0.120	0.120	0.179
56	0.917	0.120	0.120	0.179
57	0.933	0.120	0.120	0.179
58	0.950	0.120	0.120	0.179
59	0.967	0.120	0.120	0.179
60	0.983	0.120	0.120	0.179
61	1.000	0.120	0.120	0.179
62	1.017	0.120	0.120	0.179
63	1.033	0.120	0.120	0.179
64	1.050	0.120	0.120	0.179
65	1.067	0.120	0.120	0.179
66	1.083	0.120	0.120	0.179
67	1.100	0.120	0.120	0.179
68	1.117	0.120	0.120	0.179
69	1.133	0.140	0.140	0.209
70	1.150	0.120	0.120	0.179
71	1.167	0.120	0.120	0.179
72	1.183	0.120	0.120	0.179
73	1.200	0.120	0.120	0.179
74	1.217	0.120	0.120	0.179
75	1.233	0.120	0.120	0.179
76	1.250	0.120	0.120	0.179
77	1.267	0.120	0.120	0.179
78	1.283	0.120	0.120	0.179
79	1.300	0.120	0.120	0.179
80	1.317	0.120	0.120	0.179
81	1.333	0.120	0.120	0.179
82	1.350	0.120	0.120	0.179
83	1.367	0.120	0.120	0.179
84	1.383	0.120	0.120	0.179
85	1.400	0.120	0.120	0.179
86	1.417	0.090	0.090	0.134

GW54D RISING



o - Data

+ - Type Curve
Slug Test: alpha = -3.0

SOLUTION

Transmissivity = 7.973E-0002 sq ft/min
Aquifer Thick. = 1.200E+0001 ft
Hydraulic Cond.= 6.644E-0003 ft/min
Storativity = 1.000E-0003

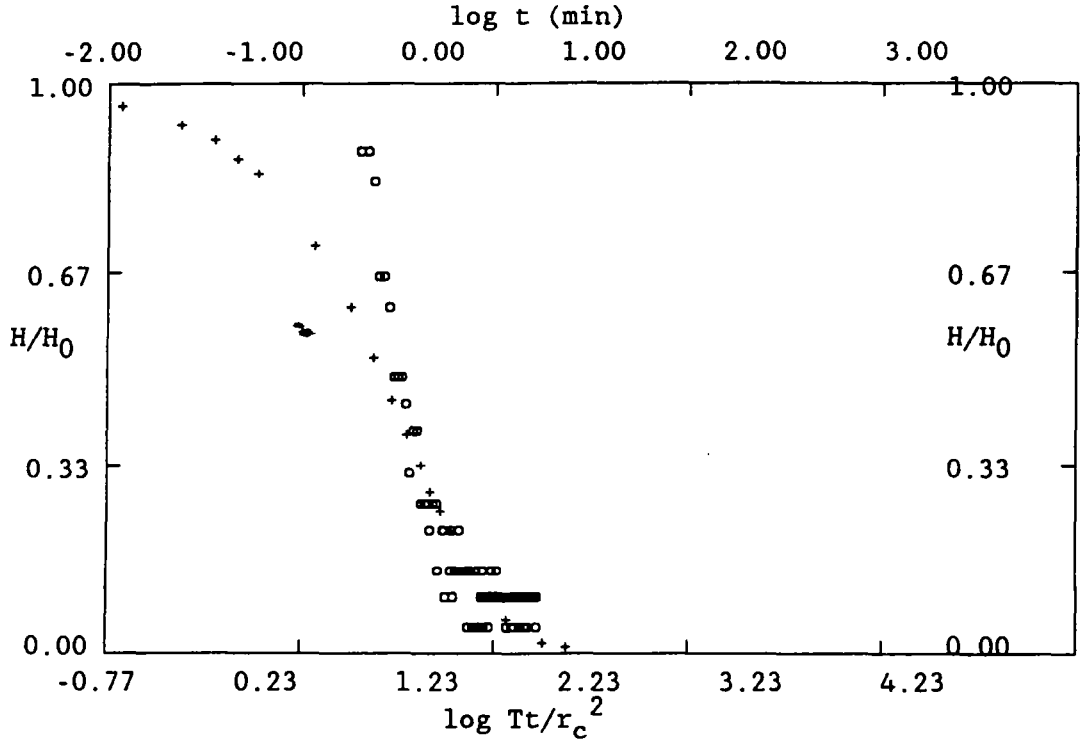
Data for Slug Injection/Withdrawal Test

Well Name: 55DF Date of Test: 9/91
Aquifer Thickness (b): 14.000 ft
Change in Vol.of Water = 0.009 cu ft
Effective Radius of Well = 0.083 ft
Radius of Casing(rc) over Water Level Decline = 0.083 ft

Entry No.	Time(t) (min)	Head (ft)	H (ft)	H/HO
1	0.000	0.000		
2	0.017	0.410	0.410	1.000
3	0.033	1.200	1.200	2.927
4	0.050	1.380	1.380	3.366
5	0.067	1.030	1.030	2.512
6	0.083	0.570	0.570	1.390
7	0.100	0.670	0.670	1.634
8	0.117	0.600	0.600	1.463
9	0.133	0.570	0.570	1.390
10	0.150	0.500	0.500	1.220
11	0.167	0.480	0.480	1.171
12	0.183	0.430	0.430	1.049
13	0.200	0.360	0.360	0.878
14	0.217	0.360	0.360	0.878
15	0.233	0.340	0.340	0.829
16	0.250	0.270	0.270	0.659
17	0.267	0.270	0.270	0.659
18	0.283	0.250	0.250	0.610
19	0.300	0.200	0.200	0.488
20	0.317	0.200	0.200	0.488
21	0.333	0.200	0.200	0.488
22	0.350	0.180	0.180	0.439
23	0.367	0.130	0.130	0.317
24	0.383	0.160	0.160	0.390
25	0.400	0.160	0.160	0.390
26	0.417	0.110	0.110	0.268
27	0.433	0.110	0.110	0.268
28	0.450	0.110	0.110	0.268
29	0.467	0.090	0.090	0.220
30	0.483	0.110	0.110	0.268
31	0.500	0.110	0.110	0.268
32	0.517	0.060	0.060	0.146
33	0.533	0.090	0.090	0.220
34	0.550	0.090	0.090	0.220
35	0.567	0.040	0.040	0.098
36	0.583	0.060	0.060	0.146
37	0.600	0.090	0.090	0.220
38	0.617	0.040	0.040	0.098
39	0.633	0.060	0.060	0.146
40	0.650	0.060	0.060	0.146
41	0.667	0.090	0.090	0.220

42	0.683	0.060	0.060	0.146
43	0.700	0.060	0.060	0.146
44	0.717	0.060	0.060	0.146
45	0.733	0.020	0.020	0.049
46	0.750	0.060	0.060	0.146
47	0.767	0.060	0.060	0.146
48	0.783	0.020	0.020	0.049
49	0.800	0.060	0.060	0.146
50	0.817	0.060	0.060	0.146
51	0.833	0.020	0.020	0.049
52	0.850	0.040	0.040	0.098
53	0.867	0.060	0.060	0.146
54	0.883	0.020	0.020	0.049
55	0.900	0.040	0.040	0.098
56	0.917	0.040	0.040	0.098
57	0.933	0.020	0.020	0.049
58	0.950	0.040	0.040	0.098
59	0.967	0.040	0.040	0.098
60	0.983	0.060	0.060	0.146
61	1.000	0.040	0.040	0.098
62	1.017	0.040	0.040	0.098
63	1.033	0.060	0.060	0.146
64	1.050	0.040	0.040	0.098
65	1.067	0.040	0.040	0.098
66	1.083	0.040	0.040	0.098
67	1.100	0.040	0.040	0.098
68	1.117	0.040	0.040	0.098
69	1.133	0.040	0.040	0.098
70	1.150	0.040	0.040	0.098
71	1.167	0.040	0.040	0.098
72	1.183	0.020	0.020	0.049
73	1.200	0.040	0.040	0.098
74	1.217	0.040	0.040	0.098
75	1.233	0.020	0.020	0.049
76	1.250	0.040	0.040	0.098
77	1.267	0.040	0.040	0.098
78	1.283	0.020	0.020	0.049
79	1.300	0.040	0.040	0.098
80	1.317	0.040	0.040	0.098
81	1.333	0.000	0.000	0.000
82	1.350	0.040	0.040	0.098
83	1.367	0.040	0.040	0.098
84	1.383	0.020	0.020	0.049
85	1.400	0.040	0.040	0.098
86	1.417	0.040	0.040	0.098
87	1.433	0.020	0.020	0.049
88	1.450	0.040	0.040	0.098
89	1.467	0.040	0.040	0.098
90	1.483	0.020	0.020	0.049
91	1.500	0.040	0.040	0.098
92	1.517	0.040	0.040	0.098
93	1.533	0.000	0.000	0.000
94	1.550	0.040	0.040	0.098
95	1.567	0.040	0.040	0.098
96	1.583	0.040	0.040	0.098
97	1.600	0.040	0.040	0.098
98	1.617	0.040	0.040	0.098
99	1.633	0.040	0.040	0.098
100	1.650	0.040	0.040	0.098
101	1.667	0.020	0.020	0.049

GW55D FALLING



o - Data

+ - Type Curve
Slug Test: alpha =-10.0

SOLUTION

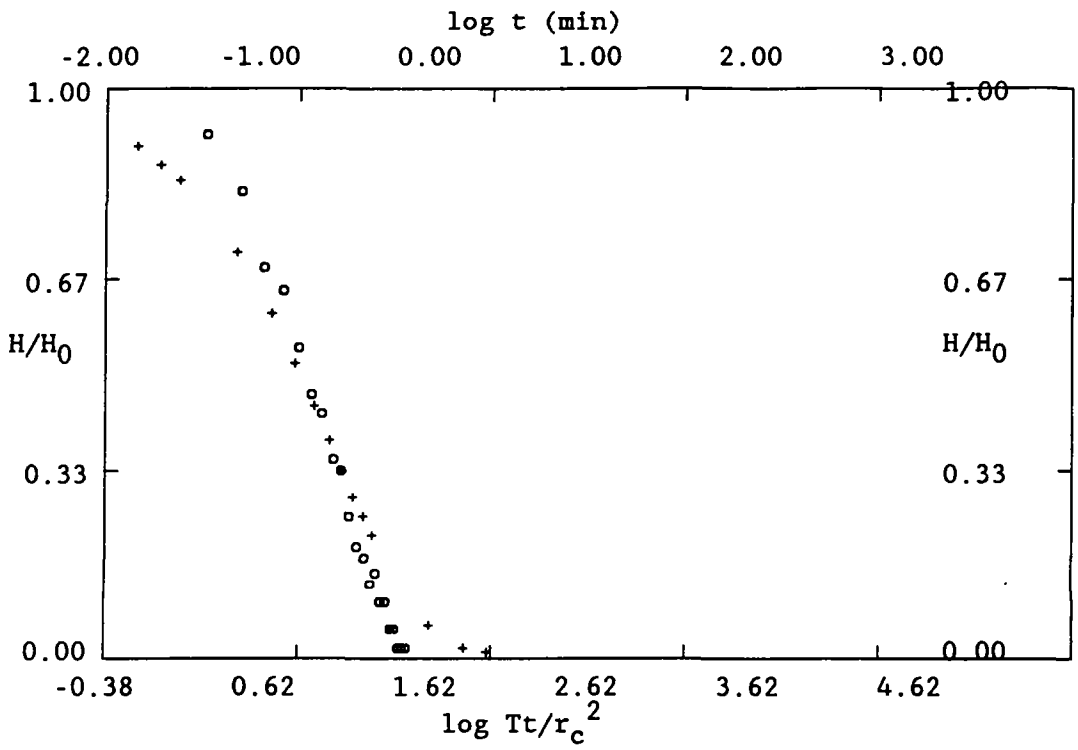
Transmissivity = 1.179E-0001 sq ft/min
Aquifer Thick. = 1.400E+0001 ft
Hydraulic Cond.= 8.424E-0003 ft/min
Storativity = 1.000E-0010

Data for Slug Injection/Withdrawal Test

Well Name: 55DR Date of Test: 9/91
Aquifer Thickness (b): 14.000 ft
Change in Vol.of Water - 0.009 cu ft
Effective Radius of Well - 0.083 ft
Radius of Casing(rc) over Water Level Decline - 0.083 ft

Entry No.	Time(t) (min)	Head (ft)	H (ft)	H/HO
1	0.000	0.000		
2	0.017	0.900	0.900	1.000
3	0.033	0.830	0.830	0.922
4	0.050	0.740	0.740	0.822
5	0.067	0.620	0.620	0.689
6	0.083	0.580	0.580	0.644
7	0.100	0.490	0.490	0.544
8	0.117	0.420	0.420	0.467
9	0.133	0.390	0.390	0.433
10	0.150	0.320	0.320	0.356
11	0.167	0.300	0.300	0.333
12	0.183	0.230	0.230	0.256
13	0.200	0.180	0.180	0.200
14	0.217	0.160	0.160	0.178
15	0.233	0.120	0.120	0.133
16	0.250	0.140	0.140	0.156
17	0.267	0.090	0.090	0.100
18	0.283	0.090	0.090	0.100
19	0.300	0.050	0.050	0.056
20	0.317	0.050	0.050	0.056
21	0.333	0.020	0.020	0.022
22	0.350	0.020	0.020	0.022
23	0.367	-0.020	0.020	0.022
24	0.383	0.000	0.000	0.000

GW55D RISING



o - Data

+ - Type Curve
Slug Test: alpha =-10.0

SOLUTION

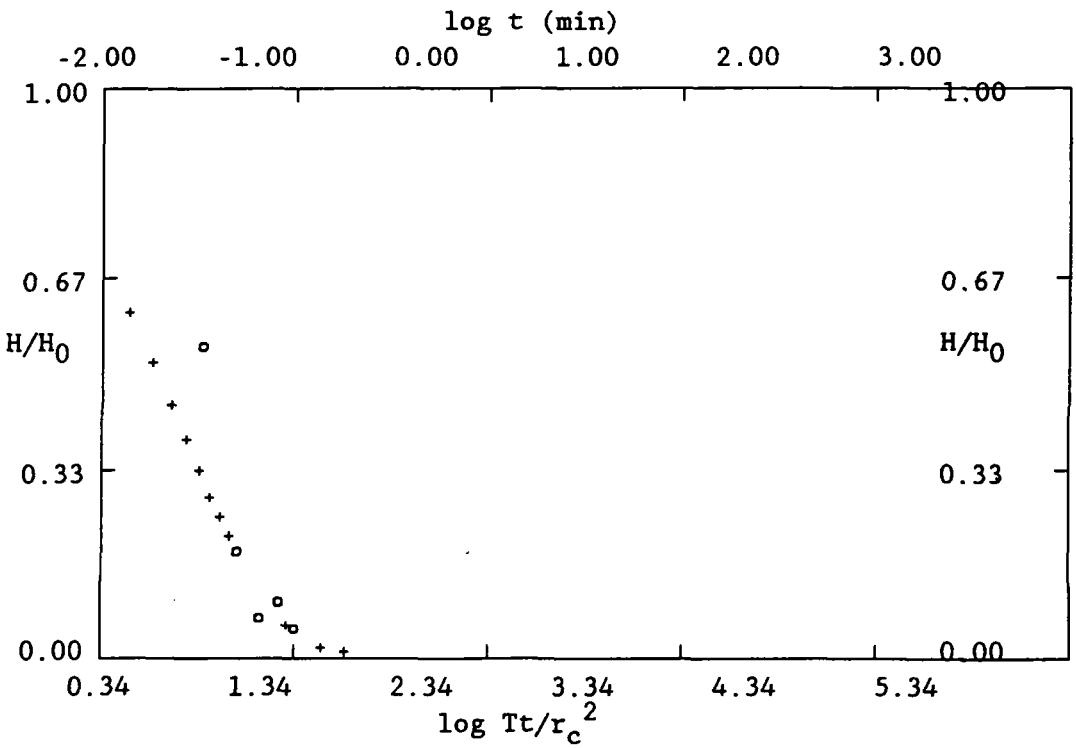
Transmissivity = 2.895E-0001 sq ft/min
Aquifer Thick. = 1.400E+0001 ft
Hydraulic Cond.= 2.068E-0002 ft/min
Storativity = 1.000E-0010

Data for Slug Injection/Withdrawal Test

Well Name: 56DF Date of Test: 9/91
Aquifer Thickness (b): 10.000 ft
Change in Vol.of Water = 0.022 cu ft
Effective Radius of Well = 0.083 ft
Radius of Casing(rc) over Water Level Decline = 0.083 ft

Entry No.	Time(t) (min)	Head (ft)	H (ft)	H/H0
1	0.000	0.000		
2	0.017	0.970	0.970	1.000
3	0.033	0.530	0.530	0.546
4	0.050	0.190	0.190	0.196
5	0.067	0.070	0.070	0.072
6	0.083	0.100	0.100	0.103
7	0.100	0.050	0.050	0.052
8	0.117	0.000	0.000	0.000

GW56D FALLING



o - Data

+ - Type Curve
Slug Test: alpha =-10.0

SOLUTION

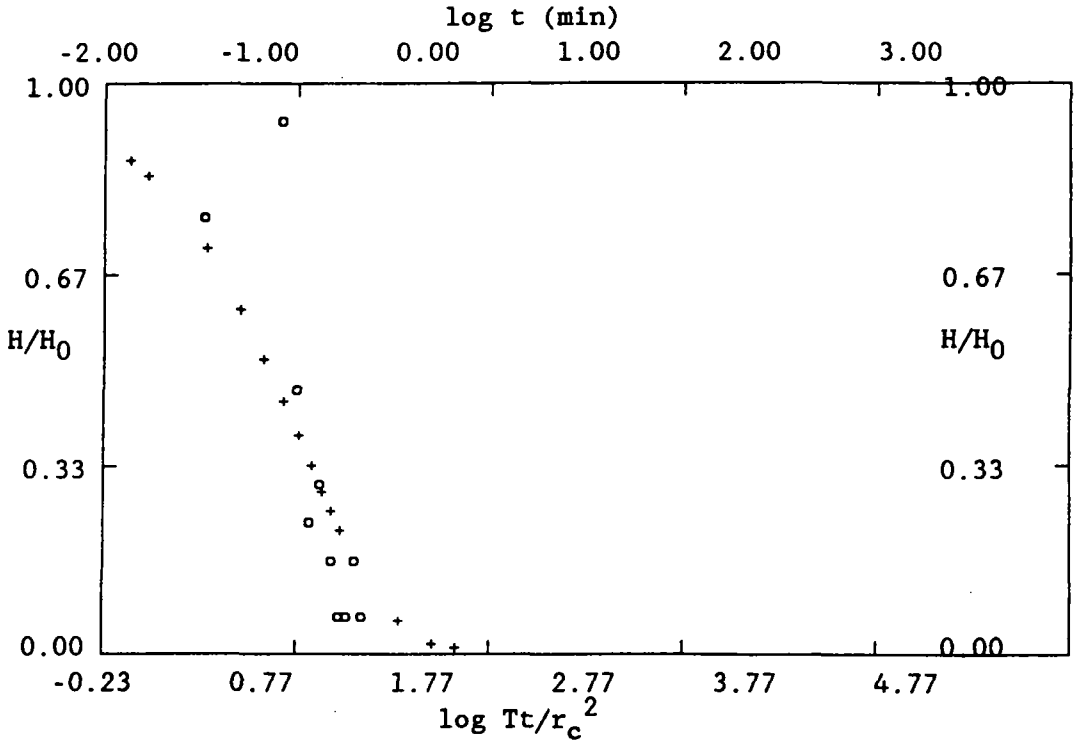
Transmissivity = 1.519E+0000 sq ft/min
Aquifer Thick. = 1.000E+0001 ft
Hydraulic Cond.= 1.519E-0001 ft/min
Storativity = 1.000E-0010

Data for Slug Injection/Withdrawal Test

Well Name: 56DR Date of Test: 9/91
Aquifer Thickness (b): 10.000 ft
Change in Vol.of Water - 0.022 cu ft
Effective Radius of Well - 0.083 ft
Radius of Casing(rc) over Water Level Decline - 0.083 ft

Entry No.	Time(t) (min)	Head (ft)	H (ft)	H/H0
1	0.000	0.000		
2	0.017	0.300	0.300	1.000
3	0.033	0.230	0.230	0.767
4	0.050	0.460	0.460	1.533
5	0.067	0.620	0.620	2.067
6	0.083	0.280	0.280	0.933
7	0.100	0.140	0.140	0.467
8	0.117	0.070	0.070	0.233
9	0.133	0.090	0.090	0.300
10	0.150	0.050	0.050	0.167
11	0.167	0.020	0.020	0.067
12	0.183	0.020	0.020	0.067
13	0.200	0.050	0.050	0.167
14	0.217	0.020	0.020	0.067
15	0.233	0.000	0.000	0.000

GW56D RISING



o - Data

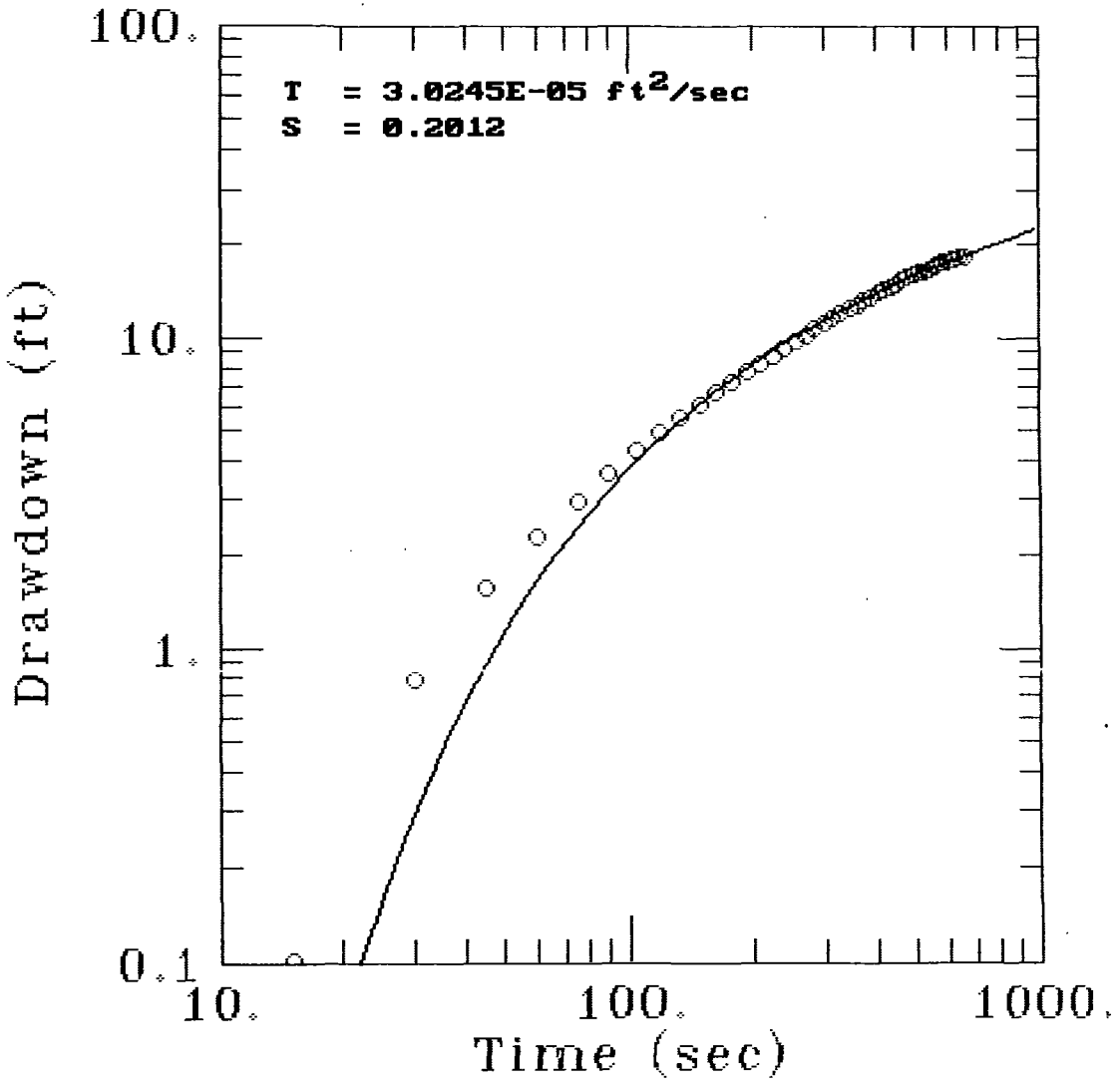
+ - Type Curve
Slug Test: alpha =-10.0

SOLUTION

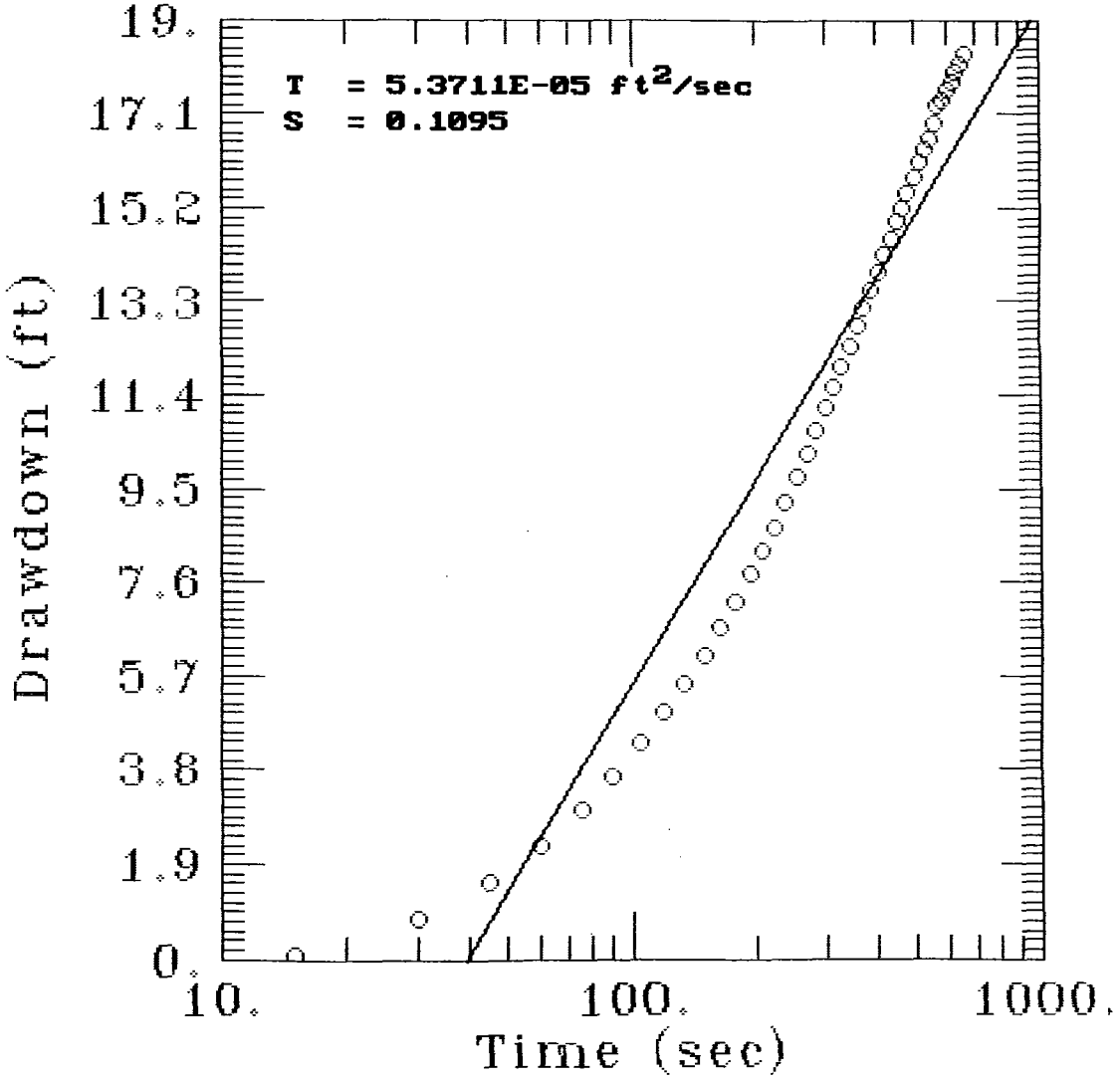
Transmissivity = 4.089E-0001 sq ft/min
Aquifer Thick. = 1.000E+0001 ft
Hydraulic Cond.= 4.089E-0002 ft/min
Storativity = 1.000E-0010

PUMPING TEST
HYDRAULIC CONDUCTIVITY DATA

GW-62BR DRAWDOWN CURVE



GW-62BR DRAWDOWN CURVE



MONITORING DATA

Saved Recorder Status

Type: 2109-10 Range: 0.00 - 23.60 feet Recorder ID: 0002

Time at Recorder: 01/21/93 15:32:39 Last Update: 12/02/92 10:32:22

Signal process: Not Applicable

Values being saved: averages

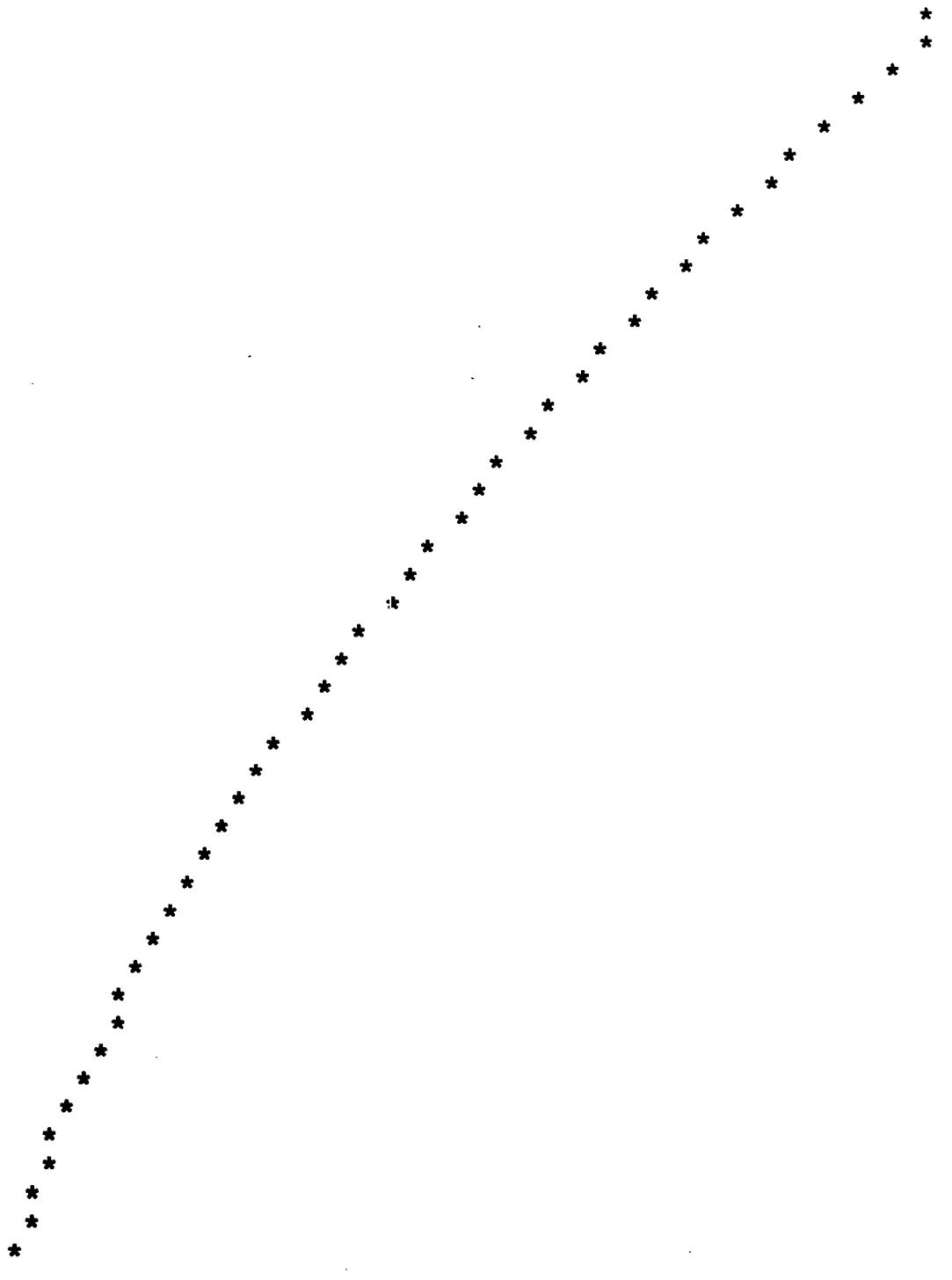
Alarm status: Low alarm @ 0.09 is OFF Upper alarm @ 23.53 is OFF

Averaging period: 00:00:15 Amount of data recorded: 00:11:30

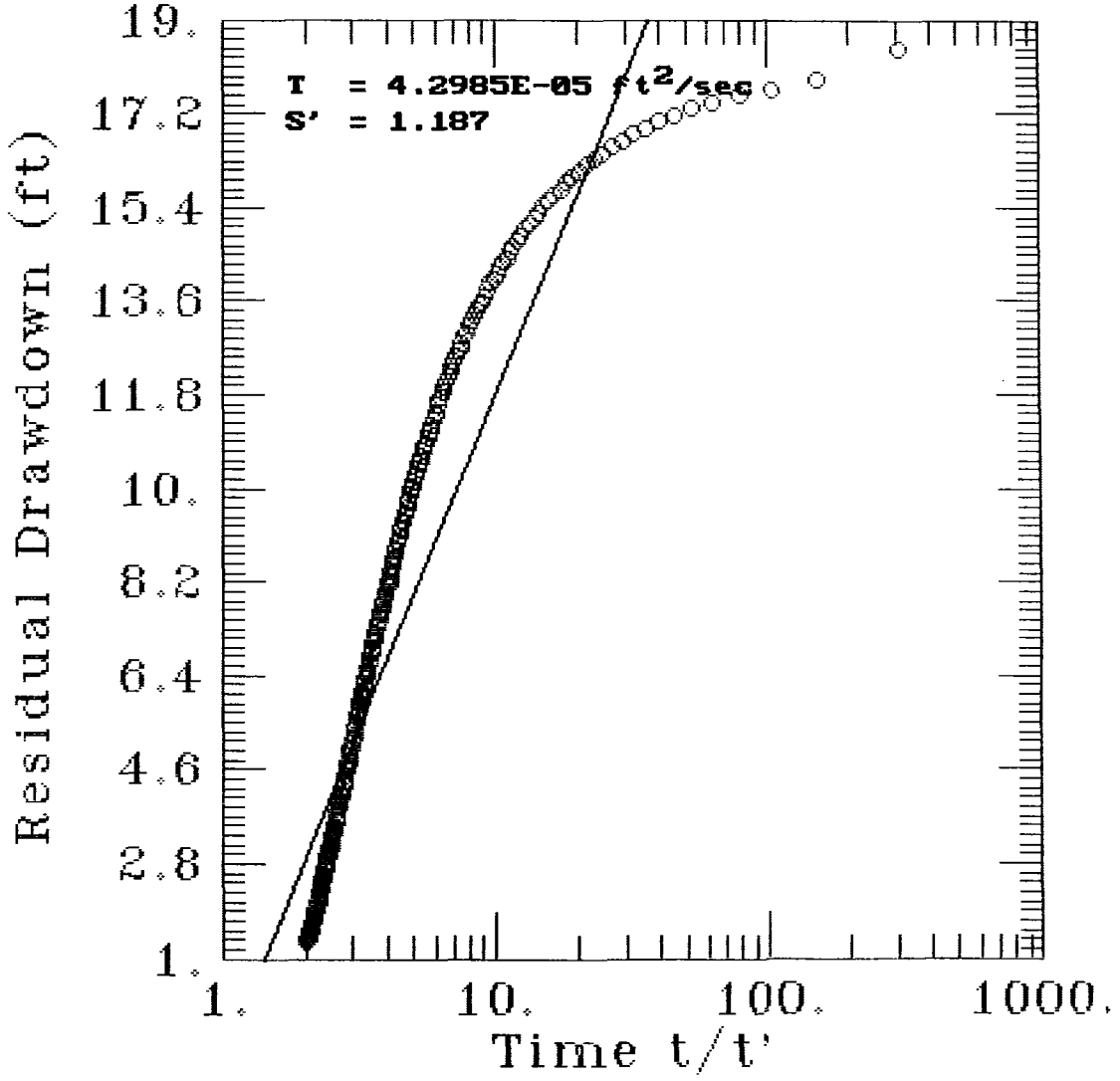
Storage Capacity: 6512 values records: 1 day 03:08:00

Output compressed by a factor of 1

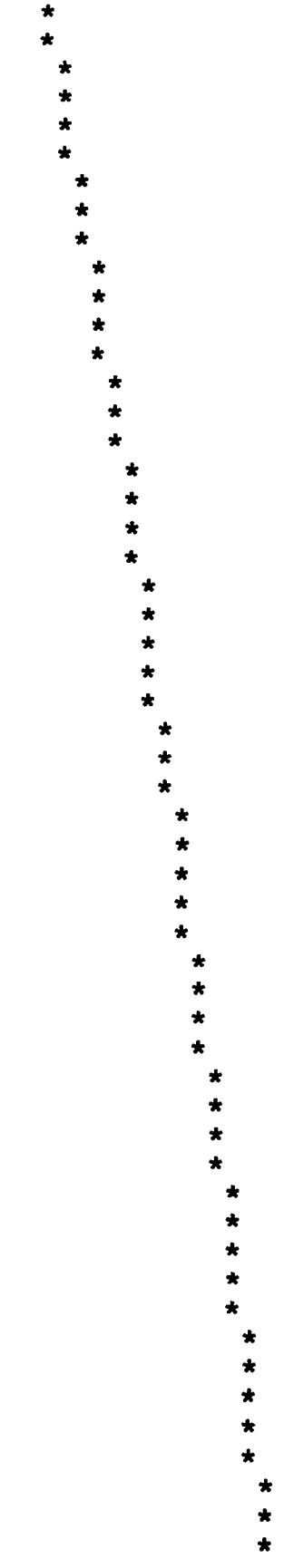
Date	Time	Avg
01/21/93	15:21:05	22.89
01/21/93	15:21:20	22.79
01/21/93	15:21:35	22.10
01/21/93	15:21:50	21.32
01/21/93	15:22:05	20.58
01/21/93	15:22:20	19.86
01/21/93	15:22:35	19.15
01/21/93	15:22:50	18.43
01/21/93	15:23:05	17.76
01/21/93	15:23:20	17.12
01/21/93	15:23:35	16.50
01/21/93	15:23:50	15.90
01/21/93	15:24:05	15.30
01/21/93	15:24:20	14.70
01/21/93	15:24:35	14.14
01/21/93	15:24:50	13.61
01/21/93	15:25:05	13.03
01/21/93	15:25:20	12.46
01/21/93	15:25:35	11.90
01/21/93	15:25:50	11.35
01/21/93	15:26:05	10.82
01/21/93	15:26:20	10.29
01/21/93	15:26:35	9.78
01/21/93	15:26:50	9.30
01/21/93	15:27:05	8.81
01/21/93	15:27:20	8.33
01/21/93	15:27:35	7.87
01/21/93	15:27:50	7.43
01/21/93	15:28:05	6.99
01/21/93	15:28:20	6.57
01/21/93	15:28:35	6.16
01/21/93	15:28:50	5.77
01/21/93	15:29:05	5.38
01/21/93	15:29:20	4.98
01/21/93	15:29:35	4.61
01/21/93	15:29:50	4.27
01/21/93	15:30:05	3.92
01/21/93	15:30:20	3.58
01/21/93	15:30:35	3.25
01/21/93	15:30:50	2.95
01/21/93	15:31:05	2.65
01/21/93	15:31:20	2.40
01/21/93	15:31:35	2.15
01/21/93	15:31:50	1.94
01/21/93	15:32:05	1.68



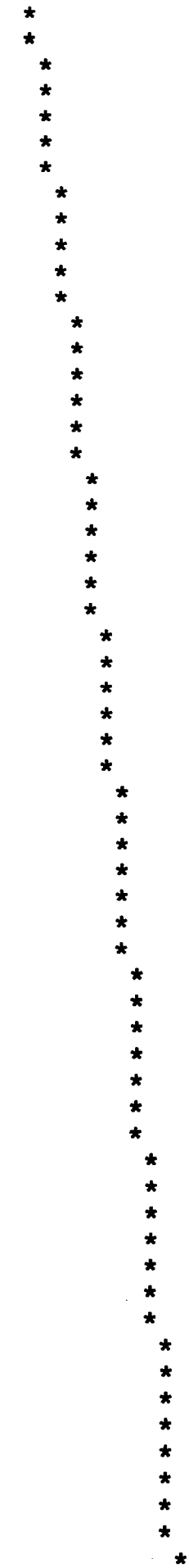
GW-62BRD RECOVERY CURVE



01/21/93	14:03:39	8.10
01/21/93	14:03:54	8.17
01/21/93	14:04:09	8.28
01/21/93	14:04:24	8.40
01/21/93	14:04:39	8.51
01/21/93	14:04:54	8.65
01/21/93	14:05:09	8.77
01/21/93	14:05:24	8.88
01/21/93	14:05:39	9.00
01/21/93	14:05:54	9.11
01/21/93	14:06:09	9.20
01/21/93	14:06:24	9.32
01/21/93	14:06:39	9.44
01/21/93	14:06:54	9.55
01/21/93	14:07:09	9.67
01/21/93	14:07:24	9.76
01/21/93	14:07:39	9.87
01/21/93	14:07:54	9.99
01/21/93	14:08:09	10.08
01/21/93	14:08:24	10.20
01/21/93	14:08:39	10.29
01/21/93	14:08:54	10.40
01/21/93	14:09:09	10.52
01/21/93	14:09:24	10.61
01/21/93	14:09:39	10.70
01/21/93	14:09:54	10.80
01/21/93	14:10:09	10.91
01/21/93	14:10:24	11.00
01/21/93	14:10:39	11.10
01/21/93	14:10:54	11.19
01/21/93	14:11:09	11.28
01/21/93	14:11:24	11.40
01/21/93	14:11:39	11.49
01/21/93	14:11:54	11.58
01/21/93	14:12:09	11.67
01/21/93	14:12:24	11.77
01/21/93	14:12:39	11.86
01/21/93	14:12:54	11.95
01/21/93	14:13:09	12.04
01/21/93	14:13:24	12.13
01/21/93	14:13:39	12.23
01/21/93	14:13:54	12.32
01/21/93	14:14:09	12.41
01/21/93	14:14:24	12.50
01/21/93	14:14:39	12.57
01/21/93	14:14:54	12.67
01/21/93	14:15:09	12.76
01/21/93	14:15:24	12.85
01/21/93	14:15:39	12.92
01/21/93	14:15:54	13.01
01/21/93	14:16:09	13.08
01/21/93	14:16:24	13.17
01/21/93	14:16:39	13.27
01/21/93	14:16:54	13.36
01/21/93	14:17:09	13.43
01/21/93	14:17:24	13.52
01/21/93	14:17:39	13.59
01/21/93	14:17:54	13.66
01/21/93	14:18:09	13.73
01/21/93	14:18:24	13.82



01/21/93	14:18:39	13.89
01/21/93	14:18:54	13.96
01/21/93	14:19:09	14.05
01/21/93	14:19:24	14.14
01/21/93	14:19:39	14.19
01/21/93	14:19:54	14.26
01/21/93	14:20:09	14.35
01/21/93	14:20:24	14.44
01/21/93	14:20:39	14.49
01/21/93	14:20:54	14.58
01/21/93	14:21:09	14.65
01/21/93	14:21:24	14.72
01/21/93	14:21:39	14.79
01/21/93	14:21:54	14.86
01/21/93	14:22:09	14.93
01/21/93	14:22:24	15.00
01/21/93	14:22:39	15.06
01/21/93	14:22:54	15.13
01/21/93	14:23:09	15.20
01/21/93	14:23:24	15.27
01/21/93	14:23:39	15.32
01/21/93	14:23:54	15.39
01/21/93	14:24:09	15.46
01/21/93	14:24:24	15.53
01/21/93	14:24:39	15.57
01/21/93	14:24:54	15.66
01/21/93	14:25:09	15.71
01/21/93	14:25:24	15.78
01/21/93	14:25:39	15.85
01/21/93	14:25:54	15.87
01/21/93	14:26:09	15.94
01/21/93	14:26:24	16.03
01/21/93	14:26:39	16.06
01/21/93	14:26:54	16.13
01/21/93	14:27:09	16.17
01/21/93	14:27:24	16.29
01/21/93	14:27:39	16.29
01/21/93	14:27:54	16.40
01/21/93	14:28:09	16.45
01/21/93	14:28:24	16.47
01/21/93	14:28:39	16.52
01/21/93	14:28:54	16.59
01/21/93	14:29:09	16.63
01/21/93	14:29:24	16.68
01/21/93	14:29:39	16.79
01/21/93	14:29:54	16.84
01/21/93	14:30:09	16.89
01/21/93	14:30:24	16.96
01/21/93	14:30:39	16.96
01/21/93	14:30:54	17.05
01/21/93	14:31:09	17.07
01/21/93	14:31:24	17.16
01/21/93	14:31:39	17.16
01/21/93	14:31:54	17.21
01/21/93	14:32:09	17.30
01/21/93	14:32:24	17.35
01/21/93	14:32:39	17.42
01/21/93	14:32:54	17.44
01/21/93	14:33:09	17.46
01/21/93	14:33:24	17.56



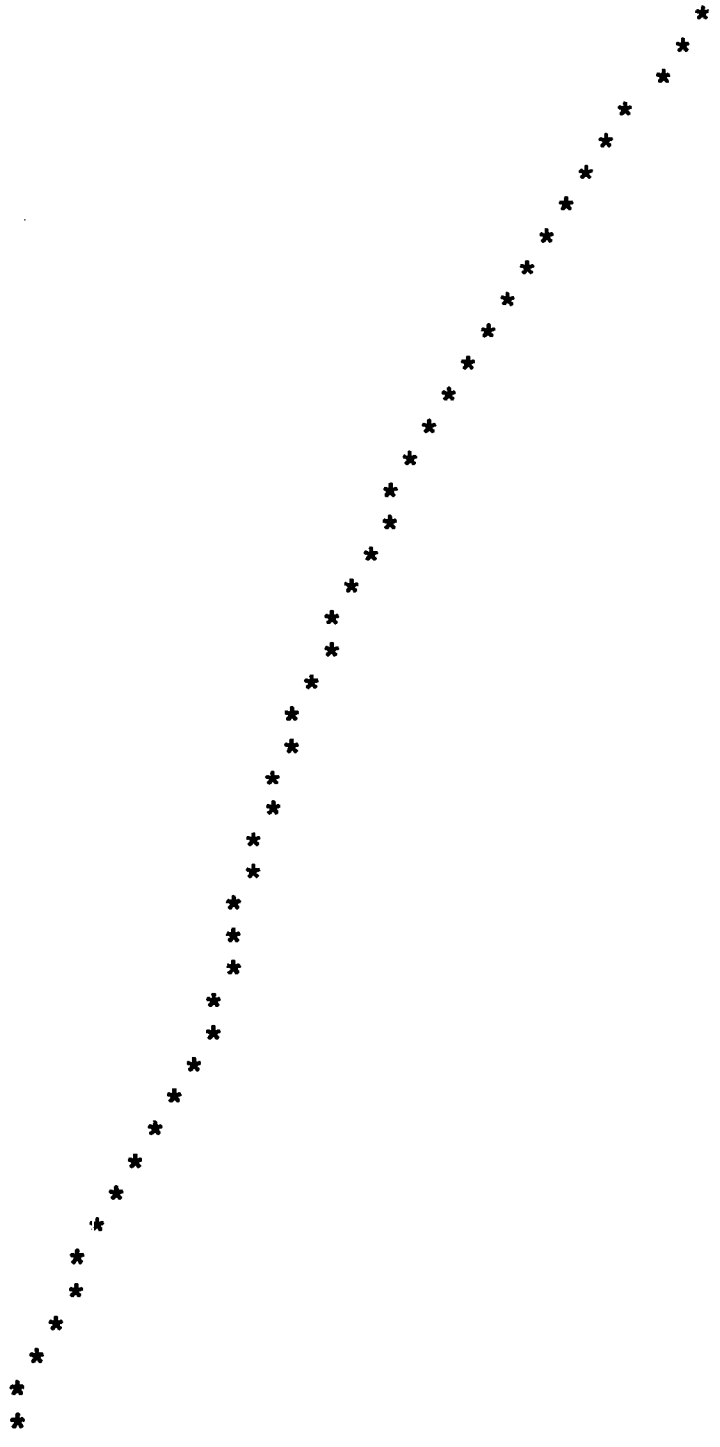
GW-62 BRL REC.
MONITORING DATA

Saved Recorder Status

Type: 2109-10 Range: 0.00 - 23.60 feet Recorder ID: 0002
Time at Recorder: 01/21/93 15:10:23 Last Update: 12/02/92 10:32:22
Signal process: Not Applicable
Values being saved: averages
Alarm status: Low alarm @ 0.09 is OFF Upper alarm @ 23.53 is OFF

Averaging period: 00:00:15 Amount of data recorded: 01:33:15
Storage Capacity: 6512 values records: 1 day 03:08:00
Output compressed by a factor of 1

Date	Time	Avg
01/21/93	13:36:54	22.72
01/21/93	13:37:09	22.59
01/21/93	13:37:24	22.03
01/21/93	13:37:39	21.48
01/21/93	13:37:54	20.99
01/21/93	13:38:09	20.53
01/21/93	13:38:24	20.07
01/21/93	13:38:39	19.63
01/21/93	13:38:54	19.19
01/21/93	13:39:09	18.80
01/21/93	13:39:24	18.36
01/21/93	13:39:39	17.99
01/21/93	13:39:54	17.65
01/21/93	13:40:09	17.28
01/21/93	13:40:24	16.93
01/21/93	13:40:39	16.61
01/21/93	13:40:54	16.26
01/21/93	13:41:09	15.92
01/21/93	13:41:24	15.62
01/21/93	13:41:39	15.32
01/21/93	13:41:54	15.02
01/21/93	13:42:09	14.72
01/21/93	13:42:24	14.46
01/21/93	13:42:39	14.21
01/21/93	13:42:54	13.98
01/21/93	13:43:09	13.75
01/21/93	13:43:24	13.54
01/21/93	13:43:39	13.33
01/21/93	13:43:54	13.13
01/21/93	13:44:09	12.94
01/21/93	13:44:24	12.78
01/21/93	13:44:39	12.62
01/21/93	13:44:54	12.48
01/21/93	13:45:09	12.39
01/21/93	13:45:24	12.13
01/21/93	13:45:39	11.77
01/21/93	13:45:54	11.37
01/21/93	13:46:09	11.00
01/21/93	13:46:24	10.66
01/21/93	13:46:39	10.34
01/21/93	13:46:54	10.01
01/21/93	13:47:09	9.69
01/21/93	13:47:24	9.39
01/21/93	13:47:39	9.09
01/21/93	13:47:54	8.81
01/21/93	13:48:09	8.54
01/21/93	13:48:24	8.28



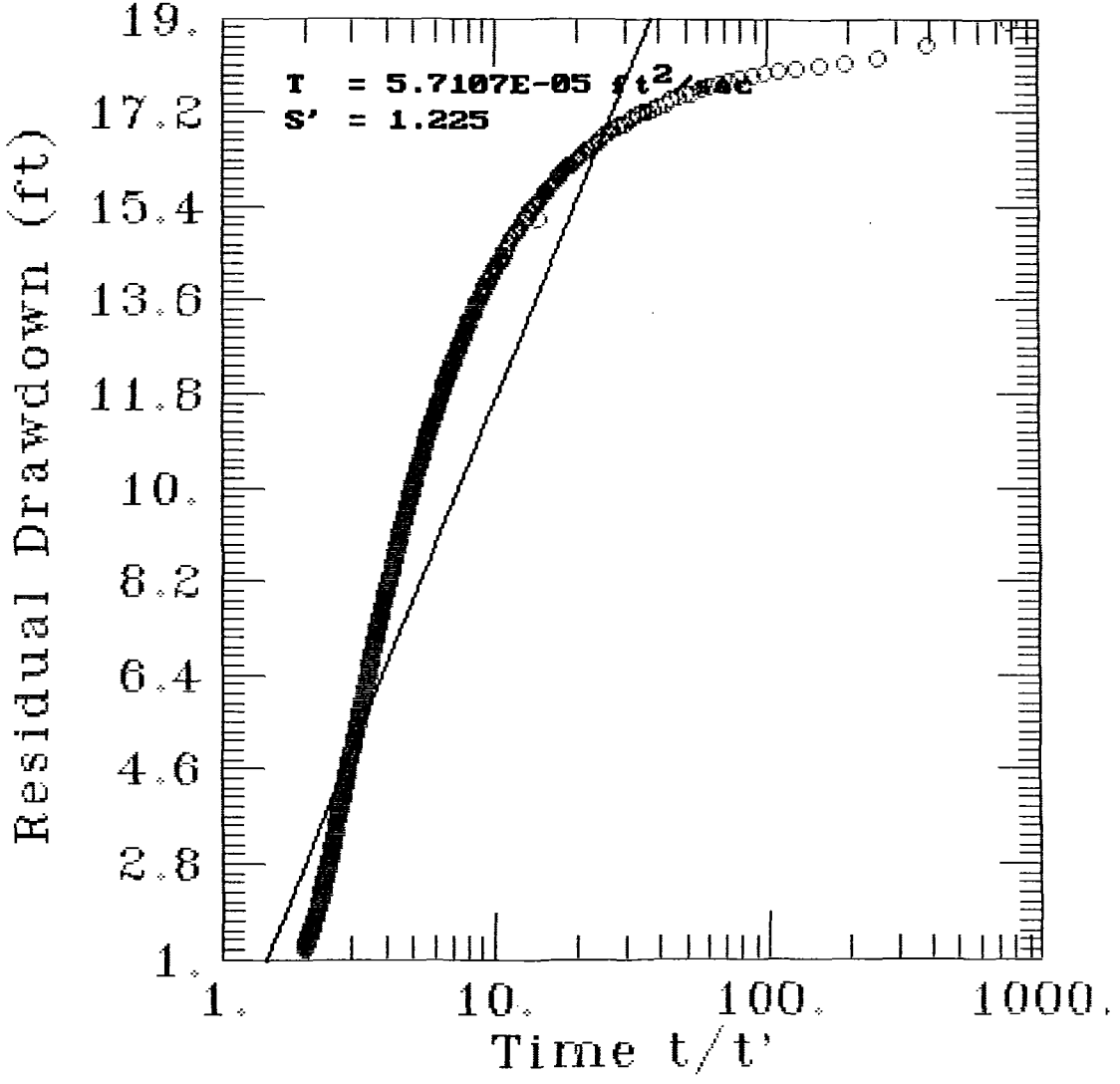
01/21/93	13:48:39	8.03
01/21/93	13:48:54	7.80
01/21/93	13:49:09	7.57
01/21/93	13:49:24	7.34
01/21/93	13:49:39	7.13
01/21/93	13:49:54	6.78
01/21/93	13:50:09	6.44
01/21/93	13:50:24	6.07
01/21/93	13:50:39	5.74
01/21/93	13:50:54	5.40
01/21/93	13:51:09	5.08
01/21/93	13:51:24	4.75
01/21/93	13:51:39	4.45
01/21/93	13:51:54	4.15
01/21/93	13:52:09	3.90
01/21/93	13:52:24	3.60
01/21/93	13:52:39	3.35
01/21/93	13:52:54	3.09
01/21/93	13:53:09	2.84
01/21/93	13:53:24	2.61
01/21/93	13:53:39	2.38
01/21/93	13:53:54	2.17
01/21/93	13:54:09	2.24
01/21/93	13:54:24	2.95
01/21/93	13:54:39	3.21
01/21/93	13:54:54	3.37
01/21/93	13:55:09	3.53
01/21/93	13:55:24	3.67
01/21/93	13:55:39	3.83
01/21/93	13:55:54	3.97
01/21/93	13:56:09	4.13
01/21/93	13:56:24	4.27
01/21/93	13:56:39	4.41
01/21/93	13:56:54	4.54
01/21/93	13:57:09	4.71
01/21/93	13:57:24	4.84
01/21/93	13:57:39	4.98
01/21/93	13:57:54	5.12
01/21/93	13:58:09	5.24
01/21/93	13:58:24	5.40
01/21/93	13:58:39	5.56
01/21/93	13:58:54	5.65
01/21/93	13:59:09	5.79
01/21/93	13:59:24	5.93
01/21/93	13:59:39	6.07
01/21/93	13:59:54	6.18
01/21/93	14:00:09	6.32
01/21/93	14:00:24	6.46
01/21/93	14:00:39	6.60
01/21/93	14:00:54	6.71
01/21/93	14:01:09	6.83
01/21/93	14:01:24	6.94
01/21/93	14:01:39	7.11
01/21/93	14:01:54	7.20
01/21/93	14:02:09	7.31
01/21/93	14:02:24	7.47
01/21/93	14:02:39	7.61
01/21/93	14:02:54	7.68
01/21/93	14:03:09	7.80
01/21/93	14:03:24	7.98

01/21/93	14:33:39	17.56
01/21/93	14:33:54	17.60
01/21/93	14:34:09	17.65
01/21/93	14:34:24	17.74
01/21/93	14:34:39	17.74
01/21/93	14:34:54	17.83
01/21/93	14:35:09	17.88
01/21/93	14:35:24	17.88
01/21/93	14:35:39	17.93
01/21/93	14:35:54	18.02
01/21/93	14:36:09	18.02
01/21/93	14:36:24	18.06
01/21/93	14:36:39	18.16
01/21/93	14:36:54	18.16
01/21/93	14:37:09	18.23
01/21/93	14:37:24	18.23
01/21/93	14:37:39	18.27
01/21/93	14:37:54	18.36
01/21/93	14:38:09	18.39
01/21/93	14:38:24	18.43
01/21/93	14:38:39	18.43
01/21/93	14:38:54	18.53
01/21/93	14:39:09	18.53
01/21/93	14:39:24	18.55
01/21/93	14:39:39	18.59
01/21/93	14:39:54	18.66
01/21/93	14:40:09	18.71
01/21/93	14:40:24	18.71
01/21/93	14:40:39	18.73
01/21/93	14:40:54	18.78
01/21/93	14:41:09	18.85
01/21/93	14:41:24	18.85
01/21/93	14:41:39	18.89
01/21/93	14:41:54	18.96
01/21/93	14:42:09	18.99
01/21/93	14:42:24	19.03
01/21/93	14:42:39	19.06
01/21/93	14:42:54	19.10
01/21/93	14:43:09	19.15
01/21/93	14:43:24	19.19
01/21/93	14:43:39	19.17
01/21/93	14:43:54	19.24
01/21/93	14:44:09	19.29
01/21/93	14:44:24	19.26
01/21/93	14:44:39	19.31
01/21/93	14:44:54	19.38
01/21/93	14:45:09	19.40
01/21/93	14:45:24	19.40
01/21/93	14:45:39	19.47
01/21/93	14:45:54	19.49
01/21/93	14:46:09	19.52
01/21/93	14:46:24	19.56
01/21/93	14:46:39	19.56
01/21/93	14:46:54	19.56
01/21/93	14:47:09	19.61
01/21/93	14:47:24	19.66
01/21/93	14:47:39	19.70
01/21/93	14:47:54	19.72
01/21/93	14:48:09	19.70
01/21/93	14:48:24	19.75

01/21/93	14:48:39	19.82
01/21/93	14:48:54	19.84
01/21/93	14:49:09	19.82
01/21/93	14:49:24	19.86
01/21/93	14:49:39	19.89
01/21/93	14:49:54	19.91
01/21/93	14:50:09	19.93
01/21/93	14:50:24	20.00
01/21/93	14:50:39	19.98
01/21/93	14:50:54	20.00
01/21/93	14:51:09	20.07
01/21/93	14:51:24	20.12
01/21/93	14:51:39	20.09
01/21/93	14:51:54	20.12
01/21/93	14:52:09	20.19
01/21/93	14:52:24	20.16
01/21/93	14:52:39	20.19
01/21/93	14:52:54	20.21
01/21/93	14:53:09	20.28
01/21/93	14:53:24	20.30
01/21/93	14:53:39	20.32
01/21/93	14:53:54	20.30
01/21/93	14:54:09	20.32
01/21/93	14:54:24	20.39
01/21/93	14:54:39	20.37
01/21/93	14:54:54	20.39
01/21/93	14:55:09	20.44
01/21/93	14:55:24	20.49
01/21/93	14:55:39	20.44
01/21/93	14:55:54	20.51
01/21/93	14:56:09	20.49
01/21/93	14:56:24	20.51
01/21/93	14:56:39	20.58
01/21/93	14:56:54	20.56
01/21/93	14:57:09	20.62
01/21/93	14:57:24	20.65
01/21/93	14:57:39	20.62
01/21/93	14:57:54	20.67
01/21/93	14:58:09	20.69
01/21/93	14:58:24	20.72
01/21/93	14:58:39	20.72
01/21/93	14:58:54	20.72
01/21/93	14:59:09	20.74
01/21/93	14:59:24	20.76
01/21/93	14:59:39	20.81
01/21/93	14:59:54	20.81
01/21/93	15:00:09	20.83
01/21/93	15:00:24	20.86
01/21/93	15:00:39	20.88
01/21/93	15:00:54	20.88
01/21/93	15:01:09	20.90
01/21/93	15:01:24	20.92
01/21/93	15:01:39	20.95
01/21/93	15:01:54	20.95
01/21/93	15:02:09	20.97
01/21/93	15:02:24	20.99
01/21/93	15:02:39	21.02
01/21/93	15:02:54	21.04
01/21/93	15:03:09	21.04
01/21/93	15:03:24	21.06

01/21/93	15:03:39	21.06	*
01/21/93	15:03:54	21.09	*
01/21/93	15:04:09	21.11	*
01/21/93	15:04:24	21.11	*
01/21/93	15:04:39	21.13	*
01/21/93	15:04:54	21.16	*
01/21/93	15:05:09	21.16	*
01/21/93	15:05:24	21.18	*
01/21/93	15:05:39	21.18	*
01/21/93	15:05:54	21.20	*
01/21/93	15:06:09	21.22	*
01/21/93	15:06:24	21.22	*
01/21/93	15:06:39	21.25	*
01/21/93	15:06:54	21.25	*
01/21/93	15:07:09	21.27	*
01/21/93	15:07:24	21.29	*
01/21/93	15:07:39	21.29	*
01/21/93	15:07:54	21.32	*
01/21/93	15:08:09	21.32	*
01/21/93	15:08:24	21.32	*
01/21/93	15:08:39	21.34	*
01/21/93	15:08:54	21.36	*
01/21/93	15:09:09	21.36	*
01/21/93	15:09:24	21.41	*
01/21/93	15:09:39	21.41	*

GW-62BR RECOVERY CURVE



GW-62BR REC
MONITORING DATA

Saved Recorder Status

Type: 2109-10 Range: 0.00 - 23.60 feet Recorder ID: 0002
Time at Recorder: 01/21/93 18:48:42 Last Update: 12/02/92 10:32:22
Signal process: Not Applicable
Values being saved: averages
Alarm status: Low alarm @ 0.09 is OFF Upper alarm @ 23.53 is OFF

Averaging period: 00:00:15 Amount of data recorded: 03:15:15
Storage Capacity: 6512 values records: 1 day 03:08:00
Output compressed by a factor of 1

Date	Time	Avg
01/21/93	15:33:14	0.81
01/21/93	15:33:29	0.74
01/21/93	15:33:44	1.41
01/21/93	15:33:59	1.75
01/21/93	15:34:14	1.85
01/21/93	15:34:29	1.94
01/21/93	15:34:44	1.98
01/21/93	15:34:59	2.08
01/21/93	15:35:14	2.15
01/21/93	15:35:29	2.21
01/21/93	15:35:44	2.28
01/21/93	15:35:59	2.33
01/21/93	15:36:14	2.38
01/21/93	15:36:29	2.47
01/21/93	15:36:44	2.56
01/21/93	15:36:59	2.65
01/21/93	15:37:14	2.70
01/21/93	15:37:29	2.77
01/21/93	15:37:44	2.84
01/21/93	15:37:59	2.91
01/21/93	15:38:14	3.00
01/21/93	15:38:29	3.05
01/21/93	15:38:44	3.11
01/21/93	15:38:59	3.16
01/21/93	15:39:14	3.21
01/21/93	15:39:29	3.28
01/21/93	15:39:44	3.35
01/21/93	15:39:59	3.46
01/21/93	15:40:14	3.48
01/21/93	15:40:29	3.55
01/21/93	15:40:44	3.62
01/21/93	15:40:59	3.69
01/21/93	15:41:14	3.76
01/21/93	15:41:29	3.83
01/21/93	15:41:44	3.90
01/21/93	15:41:59	3.97
01/21/93	15:42:14	4.04
01/21/93	15:42:29	4.11
01/21/93	15:42:44	4.15
01/21/93	15:42:59	4.22
01/21/93	15:43:14	4.29
01/21/93	15:43:29	4.36
01/21/93	15:43:44	4.43
01/21/93	15:43:59	4.50
01/21/93	15:44:14	4.54
01/21/93	15:44:29	4.59
01/21/93	15:44:44	4.64

01/21/93	15:44:59	4.71
01/21/93	15:45:14	4.75
01/21/93	15:45:29	4.82
01/21/93	15:45:44	4.89
01/21/93	15:45:59	4.96
01/21/93	15:46:14	5.03
01/21/93	15:46:29	5.08
01/21/93	15:46:44	5.14
01/21/93	15:46:59	5.21
01/21/93	15:47:14	5.26
01/21/93	15:47:29	5.33
01/21/93	15:47:44	5.38
01/21/93	15:47:59	5.44
01/21/93	15:48:14	5.51
01/21/93	15:48:29	5.56
01/21/93	15:48:44	5.63
01/21/93	15:48:59	5.68
01/21/93	15:49:14	5.77
01/21/93	15:49:29	5.79
01/21/93	15:49:44	5.86
01/21/93	15:49:59	5.93
01/21/93	15:50:14	6.02
01/21/93	15:50:29	6.04
01/21/93	15:50:44	6.09
01/21/93	15:50:59	6.16
01/21/93	15:51:14	6.21
01/21/93	15:51:29	6.28
01/21/93	15:51:44	6.32
01/21/93	15:51:59	6.44
01/21/93	15:52:14	6.44
01/21/93	15:52:29	6.55
01/21/93	15:52:44	6.55
01/21/93	15:52:59	6.62
01/21/93	15:53:14	6.71
01/21/93	15:53:29	6.78
01/21/93	15:53:44	6.83
01/21/93	15:53:59	6.87
01/21/93	15:54:14	6.90
01/21/93	15:54:29	6.97
01/21/93	15:54:44	7.01
01/21/93	15:54:59	7.06
01/21/93	15:55:14	7.13
01/21/93	15:55:29	7.17
01/21/93	15:55:44	7.24
01/21/93	15:55:59	7.29
01/21/93	15:56:14	7.34
01/21/93	15:56:29	7.38
01/21/93	15:56:44	7.45
01/21/93	15:56:59	7.50
01/21/93	15:57:14	7.54
01/21/93	15:57:29	7.61
01/21/93	15:57:44	7.66
01/21/93	15:57:59	7.71
01/21/93	15:58:14	7.77
01/21/93	15:58:29	7.82
01/21/93	15:58:44	7.87
01/21/93	15:58:59	7.91
01/21/93	15:59:14	7.98
01/21/93	15:59:29	8.03
01/21/93	15:59:44	8.07

01/21/93	15:59:59	8.12
01/21/93	16:00:14	8.19
01/21/93	16:00:29	8.24
01/21/93	16:00:44	8.28
01/21/93	16:00:59	8.33
01/21/93	16:01:14	8.40
01/21/93	16:01:29	8.44
01/21/93	16:01:44	8.49
01/21/93	16:01:59	8.54
01/21/93	16:02:14	8.58
01/21/93	16:02:29	8.63
01/21/93	16:02:44	8.70
01/21/93	16:02:59	8.74
01/21/93	16:03:14	8.79
01/21/93	16:03:29	8.84
01/21/93	16:03:44	8.88
01/21/93	16:03:59	8.95
01/21/93	16:04:14	8.97
01/21/93	16:04:29	9.04
01/21/93	16:04:44	9.09
01/21/93	16:04:59	9.14
01/21/93	16:05:14	9.18
01/21/93	16:05:29	9.23
01/21/93	16:05:44	9.27
01/21/93	16:05:59	9.32
01/21/93	16:06:14	9.37
01/21/93	16:06:29	9.41
01/21/93	16:06:44	9.46
01/21/93	16:06:59	9.50
01/21/93	16:07:14	9.57
01/21/93	16:07:29	9.62
01/21/93	16:07:44	9.64
01/21/93	16:07:59	9.69
01/21/93	16:08:14	9.76
01/21/93	16:08:29	9.78
01/21/93	16:08:44	9.85
01/21/93	16:08:59	9.90
01/21/93	16:09:14	9.94
01/21/93	16:09:29	9.99
01/21/93	16:09:44	10.04
01/21/93	16:09:59	10.08
01/21/93	16:10:14	10.13
01/21/93	16:10:29	10.15
01/21/93	16:10:44	10.20
01/21/93	16:10:59	10.24
01/21/93	16:11:14	10.31
01/21/93	16:11:29	10.34
01/21/93	16:11:44	10.40
01/21/93	16:11:59	10.43
01/21/93	16:12:14	10.47
01/21/93	16:12:29	10.52
01/21/93	16:12:44	10.57
01/21/93	16:12:59	10.61
01/21/93	16:13:14	10.66
01/21/93	16:13:29	10.70
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01/21/93	16:13:59	10.77
01/21/93	16:14:14	10.82
01/21/93	16:14:29	10.87
01/21/93	16:14:44	10.91

01/21/93	16:14:59	10.96
01/21/93	16:15:14	11.00
01/21/93	16:15:29	11.03
01/21/93	16:15:44	11.07
01/21/93	16:15:59	11.12
01/21/93	16:16:14	11.17
01/21/93	16:16:29	11.21
01/21/93	16:16:44	11.26
01/21/93	16:16:59	11.28
01/21/93	16:17:14	11.35
01/21/93	16:17:29	11.37
01/21/93	16:17:44	11.42
01/21/93	16:17:59	11.47
01/21/93	16:18:14	11.49
01/21/93	16:18:29	11.53
01/21/93	16:18:44	11.58
01/21/93	16:18:59	11.63
01/21/93	16:19:14	11.67
01/21/93	16:19:29	11.70
01/21/93	16:19:44	11.74
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01/21/93	16:20:14	11.83
01/21/93	16:20:29	11.88
01/21/93	16:20:44	11.90
01/21/93	16:20:59	11.95
01/21/93	16:21:14	12.00
01/21/93	16:21:29	12.02
01/21/93	16:21:44	12.07
01/21/93	16:21:59	12.11
01/21/93	16:22:14	12.16
01/21/93	16:22:29	12.18
01/21/93	16:22:44	12.23
01/21/93	16:22:59	12.27
01/21/93	16:23:14	12.30
01/21/93	16:23:29	12.34
01/21/93	16:23:44	12.39
01/21/93	16:23:59	12.41
01/21/93	16:24:14	12.46
01/21/93	16:24:29	12.50
01/21/93	16:24:44	12.53
01/21/93	16:24:59	12.57
01/21/93	16:25:14	12.60
01/21/93	16:25:29	12.64
01/21/93	16:25:44	12.69
01/21/93	16:25:59	12.71
01/21/93	16:26:14	12.76
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01/21/93	16:26:44	12.83
01/21/93	16:26:59	12.87
01/21/93	16:27:14	12.90
01/21/93	16:27:29	12.94
01/21/93	16:27:44	12.97
01/21/93	16:27:59	13.01
01/21/93	16:28:14	13.03
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01/21/93	16:28:44	13.10
01/21/93	16:28:59	13.15
01/21/93	16:29:14	13.20
01/21/93	16:29:29	13.22
01/21/93	16:29:44	13.27

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01/21/93	16:30:14	13.33
01/21/93	16:30:29	13.38
01/21/93	16:30:44	13.40
01/21/93	16:30:59	13.45
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01/21/93	16:31:29	13.52
01/21/93	16:31:44	13.54
01/21/93	16:31:59	13.57
01/21/93	16:32:14	13.61
01/21/93	16:32:29	13.66
01/21/93	16:32:44	13.68
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01/21/93	16:33:29	13.77
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01/21/93	16:35:29	14.05
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01/21/93	16:35:59	14.12
01/21/93	16:36:14	14.14
01/21/93	16:36:29	14.16
01/21/93	16:36:44	14.21
01/21/93	16:36:59	14.23
01/21/93	16:37:14	14.28
01/21/93	16:37:29	14.30
01/21/93	16:37:44	14.35
01/21/93	16:37:59	14.37
01/21/93	16:38:14	14.40
01/21/93	16:38:29	14.42
01/21/93	16:38:44	14.46
01/21/93	16:38:59	14.49
01/21/93	16:39:14	14.53
01/21/93	16:39:29	14.56
01/21/93	16:39:44	14.60
01/21/93	16:39:59	14.63
01/21/93	16:40:14	14.65
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01/21/93	16:40:44	14.70
01/21/93	16:40:59	14.76
01/21/93	16:41:14	14.76
01/21/93	16:41:29	14.81
01/21/93	16:41:44	14.83
01/21/93	16:41:59	14.86
01/21/93	16:42:14	14.90
01/21/93	16:42:29	14.93
01/21/93	16:42:44	14.95
01/21/93	16:42:59	14.97
01/21/93	16:43:14	15.00
01/21/93	16:43:29	15.04
01/21/93	16:43:44	15.06
01/21/93	16:43:59	15.09
01/21/93	16:44:14	15.13
01/21/93	16:44:29	15.16
01/21/93	16:44:44	15.18

01/21/93	16:44:59	15.20	*
01/21/93	16:45:14	15.23	*
01/21/93	16:45:29	15.27	*
01/21/93	16:45:44	15.30	*
01/21/93	16:45:59	15.32	*
01/21/93	16:46:14	15.36	*
01/21/93	16:46:29	15.39	*
01/21/93	16:46:44	15.41	*
01/21/93	16:46:59	15.43	*
01/21/93	16:47:14	15.46	*
01/21/93	16:47:29	15.50	*
01/21/93	16:47:44	15.53	*
01/21/93	16:47:59	15.57	*
01/21/93	16:48:14	15.60	*
01/21/93	16:48:29	15.62	*
01/21/93	16:48:44	15.64	*
01/21/93	16:48:59	15.66	*
01/21/93	16:49:14	15.69	*
01/21/93	16:49:29	15.73	*
01/21/93	16:49:44	15.76	*
01/21/93	16:49:59	15.78	*
01/21/93	16:50:14	15.80	*
01/21/93	16:50:29	15.83	*
01/21/93	16:50:44	15.87	*
01/21/93	16:50:59	15.90	*
01/21/93	16:51:14	15.92	*
01/21/93	16:51:29	15.94	*
01/21/93	16:51:44	15.96	*
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01/21/93	16:52:14	16.01	*
01/21/93	16:52:29	16.03	*
01/21/93	16:52:44	16.06	*
01/21/93	16:52:59	16.10	*
01/21/93	16:53:14	16.13	*
01/21/93	16:53:29	16.15	*
01/21/93	16:53:44	16.17	*
01/21/93	16:53:59	16.20	*
01/21/93	16:54:14	16.24	*
01/21/93	16:54:29	16.24	*
01/21/93	16:54:44	16.29	*
01/21/93	16:54:59	16.31	*
01/21/93	16:55:14	16.33	*
01/21/93	16:55:29	16.36	*
01/21/93	16:55:44	16.38	*
01/21/93	16:55:59	16.40	*
01/21/93	16:56:14	16.43	*
01/21/93	16:56:29	16.45	*
01/21/93	16:56:44	16.50	*
01/21/93	16:56:59	16.52	*
01/21/93	16:57:14	16.54	*
01/21/93	16:57:29	16.54	*
01/21/93	16:57:44	16.56	*
01/21/93	16:57:59	16.61	*
01/21/93	16:58:14	16.61	*
01/21/93	16:58:29	16.63	*
01/21/93	16:58:44	16.68	*
01/21/93	16:58:59	16.70	*
01/21/93	16:59:14	16.73	*
01/21/93	16:59:29	16.75	*
01/21/93	16:59:44	16.77	*

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01/21/93	17:00:14	16.82
01/21/93	17:00:29	16.84
01/21/93	17:00:44	16.86
01/21/93	17:00:59	16.89
01/21/93	17:01:14	16.91
01/21/93	17:01:29	16.93
01/21/93	17:01:44	16.96
01/21/93	17:01:59	16.98
01/21/93	17:02:14	17.00
01/21/93	17:02:29	17.03
01/21/93	17:02:44	17.05
01/21/93	17:02:59	17.07
01/21/93	17:03:14	17.09
01/21/93	17:03:29	17.12
01/21/93	17:03:44	17.14
01/21/93	17:03:59	17.16
01/21/93	17:04:14	17.19
01/21/93	17:04:29	17.21
01/21/93	17:04:44	17.23
01/21/93	17:04:59	17.26
01/21/93	17:05:14	17.28
01/21/93	17:05:29	17.30
01/21/93	17:05:44	17.33
01/21/93	17:05:59	17.35
01/21/93	17:06:14	17.35
01/21/93	17:06:29	17.37
01/21/93	17:06:44	17.39
01/21/93	17:06:59	17.42
01/21/93	17:07:14	17.44
01/21/93	17:07:29	17.46
01/21/93	17:07:44	17.49
01/21/93	17:07:59	17.51
01/21/93	17:08:14	17.53
01/21/93	17:08:29	17.53
01/21/93	17:08:44	17.56
01/21/93	17:08:59	17.58
01/21/93	17:09:14	17.60
01/21/93	17:09:29	17.63
01/21/93	17:09:44	17.65
01/21/93	17:09:59	17.67
01/21/93	17:10:14	17.72
01/21/93	17:10:29	17.72
01/21/93	17:10:44	17.74
01/21/93	17:10:59	17.76
01/21/93	17:11:14	17.76
01/21/93	17:11:29	17.81
01/21/93	17:11:44	17.81
01/21/93	17:11:59	17.83
01/21/93	17:12:14	17.86
01/21/93	17:12:29	17.88
01/21/93	17:12:44	17.90
01/21/93	17:12:59	17.93
01/21/93	17:13:14	17.95
01/21/93	17:13:29	17.97
01/21/93	17:13:44	17.99
01/21/93	17:13:59	17.99
01/21/93	17:14:14	18.02
01/21/93	17:14:29	18.04
01/21/93	17:14:44	18.04

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01/21/93	17:15:29	18.13	*
01/21/93	17:15:44	18.16	*
01/21/93	17:15:59	18.13	*
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01/21/93	17:16:29	18.20	*
01/21/93	17:16:44	18.18	*
01/21/93	17:16:59	18.20	*
01/21/93	17:17:14	18.27	*
01/21/93	17:17:29	18.27	*
01/21/93	17:17:44	18.25	*
01/21/93	17:17:59	18.32	*
01/21/93	17:18:14	18.27	*
01/21/93	17:18:29	18.29	*
01/21/93	17:18:44	18.36	*
01/21/93	17:18:59	18.39	*
01/21/93	17:19:14	18.34	*
01/21/93	17:19:29	18.41	*
01/21/93	17:19:44	18.46	*
01/21/93	17:19:59	18.41	*
01/21/93	17:20:14	18.41	*
01/21/93	17:20:29	18.48	*
01/21/93	17:20:44	18.46	*
01/21/93	17:20:59	18.53	*
01/21/93	17:21:14	18.48	*
01/21/93	17:21:29	18.50	*
01/21/93	17:21:44	18.57	*
01/21/93	17:21:59	18.55	*
01/21/93	17:22:14	18.62	*
01/21/93	17:22:29	18.62	*
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01/21/93	17:26:59	18.87	*
01/21/93	17:27:14	18.94	*
01/21/93	17:27:29	18.94	*
01/21/93	17:27:44	18.96	*
01/21/93	17:27:59	18.92	*
01/21/93	17:28:14	18.94	*
01/21/93	17:28:29	19.01	*
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01/21/93	17:28:59	19.03	*
01/21/93	17:29:14	19.06	*
01/21/93	17:29:29	19.01	*
01/21/93	17:29:44	19.08	*

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01/21/93	17:30:29	19.13	*
01/21/93	17:30:44	19.13	*
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01/21/93	17:31:14	19.13	*
01/21/93	17:31:29	19.17	*
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01/21/93	17:32:14	19.22	*
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01/21/93	17:32:44	19.24	*
01/21/93	17:32:59	19.26	*
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01/21/93	17:33:29	19.29	*
01/21/93	17:33:44	19.31	*
01/21/93	17:33:59	19.33	*
01/21/93	17:34:14	19.33	*
01/21/93	17:34:29	19.36	*
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01/21/93	17:41:29	19.72	*
01/21/93	17:41:44	19.72	*
01/21/93	17:41:59	19.75	*
01/21/93	17:42:14	19.75	*
01/21/93	17:42:29	19.77	*
01/21/93	17:42:44	19.79	*
01/21/93	17:42:59	19.79	*
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01/21/93	17:43:44	19.84	*
01/21/93	17:43:59	19.84	*
01/21/93	17:44:14	19.86	*
01/21/93	17:44:29	19.86	*
01/21/93	17:44:44	19.89	*

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01/21/93	17:45:14	19.91
01/21/93	17:45:29	19.93
01/21/93	17:45:44	19.93
01/21/93	17:45:59	19.93
01/21/93	17:46:14	19.96
01/21/93	17:46:29	19.98
01/21/93	17:46:44	19.98
01/21/93	17:46:59	19.98
01/21/93	17:47:14	20.00
01/21/93	17:47:29	20.00
01/21/93	17:47:44	20.02
01/21/93	17:47:59	20.05
01/21/93	17:48:14	20.05
01/21/93	17:48:29	20.05
01/21/93	17:48:44	20.07
01/21/93	17:48:59	20.09
01/21/93	17:49:14	20.09
01/21/93	17:49:29	20.12
01/21/93	17:49:44	20.12
01/21/93	17:49:59	20.14
01/21/93	17:50:14	20.12
01/21/93	17:50:29	20.14
01/21/93	17:50:44	20.14
01/21/93	17:50:59	20.16
01/21/93	17:51:14	20.16
01/21/93	17:51:29	20.19
01/21/93	17:51:44	20.19
01/21/93	17:51:59	20.21
01/21/93	17:52:14	20.21
01/21/93	17:52:29	20.23
01/21/93	17:52:44	20.23
01/21/93	17:52:59	20.26
01/21/93	17:53:14	20.26
01/21/93	17:53:29	20.26
01/21/93	17:53:44	20.28
01/21/93	17:53:59	20.30
01/21/93	17:54:14	20.30
01/21/93	17:54:29	20.32
01/21/93	17:54:44	20.32
01/21/93	17:54:59	20.32
01/21/93	17:55:14	20.35
01/21/93	17:55:29	20.37
01/21/93	17:55:44	20.35
01/21/93	17:55:59	20.37
01/21/93	17:56:14	20.39
01/21/93	17:56:29	20.39
01/21/93	17:56:44	20.39
01/21/93	17:56:59	20.42
01/21/93	17:57:14	20.42
01/21/93	17:57:29	20.44
01/21/93	17:57:44	20.44
01/21/93	17:57:59	20.44
01/21/93	17:58:14	20.46
01/21/93	17:58:29	20.46
01/21/93	17:58:44	20.49
01/21/93	17:58:59	20.49
01/21/93	17:59:14	20.49
01/21/93	17:59:29	20.51
01/21/93	17:59:44	20.51

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01/21/93	18:00:14	20.53
01/21/93	18:00:29	20.56
01/21/93	18:00:44	20.56
01/21/93	18:00:59	20.58
01/21/93	18:01:14	20.56
01/21/93	18:01:29	20.56
01/21/93	18:01:44	20.58
01/21/93	18:01:59	20.58
01/21/93	18:02:14	20.58
01/21/93	18:02:29	20.60
01/21/93	18:02:44	20.60
01/21/93	18:02:59	20.62
01/21/93	18:03:14	20.62
01/21/93	18:03:29	20.65
01/21/93	18:03:44	20.65
01/21/93	18:03:59	20.65
01/21/93	18:04:14	20.65
01/21/93	18:04:29	20.67
01/21/93	18:04:44	20.67
01/21/93	18:04:59	20.69
01/21/93	18:05:14	20.69
01/21/93	18:05:29	20.69
01/21/93	18:05:44	20.69
01/21/93	18:05:59	20.72
01/21/93	18:06:14	20.72
01/21/93	18:06:29	20.74
01/21/93	18:06:44	20.74
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01/21/93	18:07:14	20.76
01/21/93	18:07:29	20.76
01/21/93	18:07:44	20.79
01/21/93	18:07:59	20.79
01/21/93	18:08:14	20.79
01/21/93	18:08:29	20.81
01/21/93	18:08:44	20.81
01/21/93	18:08:59	20.81
01/21/93	18:09:14	20.83
01/21/93	18:09:29	20.83
01/21/93	18:09:44	20.83
01/21/93	18:09:59	20.86
01/21/93	18:10:14	20.86
01/21/93	18:10:29	20.86
01/21/93	18:10:44	20.88
01/21/93	18:10:59	20.88
01/21/93	18:11:14	20.88
01/21/93	18:11:29	20.90
01/21/93	18:11:44	20.90
01/21/93	18:11:59	20.90
01/21/93	18:12:14	20.90
01/21/93	18:12:29	20.92
01/21/93	18:12:44	20.92
01/21/93	18:12:59	20.92
01/21/93	18:13:14	20.95
01/21/93	18:13:29	20.95
01/21/93	18:13:44	20.95
01/21/93	18:13:59	20.95
01/21/93	18:14:14	20.97
01/21/93	18:14:29	20.97
01/21/93	18:14:44	20.97

01/21/93	18:14:59	20.99
01/21/93	18:15:14	20.99
01/21/93	18:15:29	21.02
01/21/93	18:15:44	21.04
01/21/93	18:15:59	21.02
01/21/93	18:16:14	21.04
01/21/93	18:16:29	21.04
01/21/93	18:16:44	21.04
01/21/93	18:16:59	21.04
01/21/93	18:17:14	21.06
01/21/93	18:17:29	21.06
01/21/93	18:17:44	21.09
01/21/93	18:17:59	21.06
01/21/93	18:18:14	21.09
01/21/93	18:18:29	21.09
01/21/93	18:18:44	21.11
01/21/93	18:18:59	21.11
01/21/93	18:19:14	21.11
01/21/93	18:19:29	21.11
01/21/93	18:19:44	21.13
01/21/93	18:19:59	21.13
01/21/93	18:20:14	21.16
01/21/93	18:20:29	21.13
01/21/93	18:20:44	21.16
01/21/93	18:20:59	21.18
01/21/93	18:21:14	21.16
01/21/93	18:21:29	21.16
01/21/93	18:21:44	21.18
01/21/93	18:21:59	21.18
01/21/93	18:22:14	21.18
01/21/93	18:22:29	21.18
01/21/93	18:22:44	21.20
01/21/93	18:22:59	21.20
01/21/93	18:23:14	21.20
01/21/93	18:23:29	21.22
01/21/93	18:23:44	21.25
01/21/93	18:23:59	21.22
01/21/93	18:24:14	21.25
01/21/93	18:24:29	21.25
01/21/93	18:24:44	21.25
01/21/93	18:24:59	21.27
01/21/93	18:25:14	21.27
01/21/93	18:25:29	21.27
01/21/93	18:25:44	21.29
01/21/93	18:25:59	21.29
01/21/93	18:26:14	21.27
01/21/93	18:26:29	21.27
01/21/93	18:26:44	21.29
01/21/93	18:26:59	21.29
01/21/93	18:27:14	21.32
01/21/93	18:27:29	21.32
01/21/93	18:27:44	21.32
01/21/93	18:27:59	21.32
01/21/93	18:28:14	21.32
01/21/93	18:28:29	21.32
01/21/93	18:28:44	21.34
01/21/93	18:28:59	21.34
01/21/93	18:29:14	21.34
01/21/93	18:29:29	21.34
01/21/93	18:29:44	21.34

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01/21/93	18:30:29	21.39	*
01/21/93	18:30:44	21.39	*
01/21/93	18:30:59	21.39	*
01/21/93	18:31:14	21.36	*
01/21/93	18:31:29	21.41	*
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01/21/93	18:31:59	21.36	*
01/21/93	18:32:14	21.43	*
01/21/93	18:32:29	21.39	*
01/21/93	18:32:44	21.39	*
01/21/93	18:32:59	21.41	*
01/21/93	18:33:14	21.46	*
01/21/93	18:33:29	21.46	*
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01/21/93	18:34:44	21.43	*
01/21/93	18:34:59	21.48	*
01/21/93	18:35:14	21.50	
01/21/93	18:35:29	21.50	
01/21/93	18:35:44	21.46	*
01/21/93	18:35:59	21.46	*
01/21/93	18:36:14	21.46	*
01/21/93	18:36:29	21.46	*
01/21/93	18:36:44	21.50	
01/21/93	18:36:59	21.52	
01/21/93	18:37:14	21.48	*
01/21/93	18:37:29	21.52	
01/21/93	18:37:44	21.55	
01/21/93	18:37:59	21.55	
01/21/93	18:38:14	21.55	
01/21/93	18:38:29	21.55	
01/21/93	18:38:44	21.55	
01/21/93	18:38:59	21.50	
01/21/93	18:39:14	21.50	
01/21/93	18:39:29	21.50	
01/21/93	18:39:44	21.57	
01/21/93	18:39:59	21.52	
01/21/93	18:40:14	21.59	
01/21/93	18:40:29	21.52	
01/21/93	18:40:44	21.52	
01/21/93	18:40:59	21.59	
01/21/93	18:41:14	21.59	
01/21/93	18:41:29	21.59	
01/21/93	18:41:44	21.55	
01/21/93	18:41:59	21.59	
01/21/93	18:42:14	21.62	
01/21/93	18:42:29	21.62	
01/21/93	18:42:44	21.57	
01/21/93	18:42:59	21.62	
01/21/93	18:43:14	21.62	
01/21/93	18:43:29	21.59	
01/21/93	18:43:44	21.59	
01/21/93	18:43:59	21.64	
01/21/93	18:44:14	21.64	
01/21/93	18:44:29	21.59	
01/21/93	18:44:44	21.64	

01/21/93	18:44:59	21.59
01/21/93	18:45:14	21.59
01/21/93	18:45:29	21.62
01/21/93	18:45:44	21.66
01/21/93	18:45:59	21.62
01/21/93	18:46:14	21.66
01/21/93	18:46:29	21.62
01/21/93	18:46:44	21.62
01/21/93	18:46:59	21.69
01/21/93	18:47:14	21.66
01/21/93	18:47:29	21.66
01/21/93	18:47:44	21.66
01/21/93	18:47:59	21.66

GW-62M DR.D
MONITORING DATA

Saved Recorder Status

Type: 2109-10 Range: 0.00 - 23.60 feet Recorder ID: 0002
Time at Recorder: 01/21/93 12:19:17 Last Update: 12/02/92 10:32:22
Signal process: Not Applicable
Values being saved: averages
Alarm status: Low alarm @ 0.09 is OFF Upper alarm @ 23.53 is OFF

Averaging period: 00:00:10 Amount of data recorded: 00:04:50
Storage Capacity: 6512 values records: 18:05:20
Output compressed by a factor of 1

Date	Time	Avg
01/21/93	12:14:24	9.46
01/21/93	12:14:34	9.46
01/21/93	12:14:44	9.46
01/21/93	12:14:54	9.46
01/21/93	12:15:04	9.46
01/21/93	12:15:14	9.46
01/21/93	12:15:24	9.46
01/21/93	12:15:34	9.46
01/21/93	12:15:44	9.44
01/21/93	12:15:54	9.46
01/21/93	12:16:04	9.46
01/21/93	12:16:14	9.46
01/21/93	12:16:24	9.46
01/21/93	12:16:34	9.46
01/21/93	12:16:44	9.44
01/21/93	12:16:54	9.14
01/21/93	12:17:04	8.86
01/21/93	12:17:14	8.81
01/21/93	12:17:24	8.86
01/21/93	12:17:34	8.86
01/21/93	12:17:44	8.88
01/21/93	12:17:54	8.86
01/21/93	12:18:04	8.86
01/21/93	12:18:14	8.86
01/21/93	12:18:24	8.86
01/21/93	12:18:34	8.86
01/21/93	12:18:44	8.86
01/21/93	12:18:54	8.86

Saved Recorder Status

Type: 2109-10 Range: 0.00 - 23.60 feet Recorder ID: 0002
Time at Recorder: 01/21/93 13:03:59 Last Update: 12/02/92 10:32:22
Signal process: Not Applicable
Values being saved: averages
Alarm status: Low alarm @ 0.09 is OFF Upper alarm @ 23.53 is OFF

Averaging period: 00:02:00 Amount of data recorded: 00:38:00
Storage Capacity: 6512 values records: 9 days 01:04:00
Output compressed by a factor of 1

Date	Time	Avg	
01/21/93	12:25:02	8.86	*
01/21/93	12:27:02	8.88	*
01/21/93	12:29:02	8.86	*
01/21/93	12:31:02	8.86	*
01/21/93	12:33:02	8.88	*
01/21/93	12:35:02	8.86	*
01/21/93	12:37:02	8.86	*
01/21/93	12:39:02	8.86	*
01/21/93	12:41:02	8.86	*
01/21/93	12:43:02	8.84	*
01/21/93	12:45:02	8.84	*
01/21/93	12:47:02	8.84	*
01/21/93	12:49:02	8.86	*
01/21/93	12:51:02	8.88	*
01/21/93	12:53:02	8.86	*
01/21/93	12:55:02	8.88	*
01/21/93	12:57:02	8.84	*
01/21/93	12:59:02	8.86	*

GW-62M - REC
MONITORING DATA

Saved Recorder Status

Type: 2109-10 Range: 0.00 - 23.60 feet Recorder ~~ID: 0002~~
Time at Recorder: 01/21/93 13:12:45 Last Update: 12/02/92 10:32:22
Signal process: Not Applicable
Values being saved: averages
Alarm status: Low alarm @ 0.09 is OFF Upper alarm @ 23.53 is OFF

Averaging period: 00:00:01 Amount of data recorded: 00:00:50
Storage Capacity: 6512 values records: 01:48:32
Output compressed by a factor of 1

Date	Time	Avg
01/21/93	13:11:55	8.79
01/21/93	13:11:56	8.88
01/21/93	13:11:57	8.74
01/21/93	13:11:58	8.84
01/21/93	13:11:59	8.79
01/21/93	13:12:00	8.95
01/21/93	13:12:01	8.81
01/21/93	13:12:02	8.79
01/21/93	13:12:03	8.93
01/21/93	13:12:04	8.86
01/21/93	13:12:05	8.88
01/21/93	13:12:06	8.79
01/21/93	13:12:07	8.88
01/21/93	13:12:08	8.70
01/21/93	13:12:09	8.91
01/21/93	13:12:10	8.91
01/21/93	13:12:11	9.09
01/21/93	13:12:12	9.41
01/21/93	13:12:13	9.55
01/21/93	13:12:14	9.60
01/21/93	13:12:15	9.60
01/21/93	13:12:16	9.48
01/21/93	13:12:17	9.44
01/21/93	13:12:18	9.50
01/21/93	13:12:19	9.48
01/21/93	13:12:20	9.48
01/21/93	13:12:21	9.53
01/21/93	13:12:22	9.55
01/21/93	13:12:23	9.50
01/21/93	13:12:24	9.48
01/21/93	13:12:25	9.53
01/21/93	13:12:26	9.50
01/21/93	13:12:27	9.46
01/21/93	13:12:28	9.44
01/21/93	13:12:29	9.46
01/21/93	13:12:30	9.46
01/21/93	13:12:31	9.48
01/21/93	13:12:32	9.46
01/21/93	13:12:33	9.44
01/21/93	13:12:34	9.44
01/21/93	13:12:35	9.48
01/21/93	13:12:36	9.48
01/21/93	13:12:37	9.48
01/21/93	13:12:38	9.44
01/21/93	13:12:39	9.44
01/21/93	13:12:40	9.44
01/21/93	13:12:41	9.44

```
01/21/93 13:12:42  9.44                                    *
01/21/93 13:12:43  9.48                                      *
```

GW-62D DR.D
MONITORING DATA

Saved Recorder Status

Type: 2109-10 Range: 0.00 - 23.60 feet Recorder ID: 0002
Time at Recorder: 01/21/93 11:58:11 Last Update: 12/02/92 10:32:22
Signal process: Not Applicable
Values being saved: averages
Alarm status: Low alarm @ 0.09 is OFF Upper alarm @ 23.53 is OFF

Averaging period: 00:00:30 Amount of data recorded: 02:18:30
Storage Capacity: 6512 values records: 2 days 06:16:00
Output compressed by a factor of 1

Date	Time	Avg
01/21/93	09:39:32	12.62
01/21/93	09:40:02	12.62
01/21/93	09:40:32	12.62
01/21/93	09:41:02	12.09
01/21/93	09:41:32	11.81
01/21/93	09:42:02	11.79
01/21/93	09:42:32	11.79
01/21/93	09:43:02	11.79
01/21/93	09:43:32	11.83
01/21/93	09:44:02	11.79
01/21/93	09:44:32	11.79
01/21/93	09:45:02	11.81
01/21/93	09:45:32	11.77
01/21/93	09:46:02	11.83
01/21/93	09:46:32	11.81
01/21/93	09:47:02	11.81
01/21/93	09:47:32	11.81
01/21/93	09:48:02	11.79
01/21/93	09:48:32	11.79
01/21/93	09:49:02	11.79
01/21/93	09:49:32	11.79
01/21/93	09:50:02	11.79
01/21/93	09:50:32	11.81
01/21/93	09:51:02	11.79
01/21/93	09:51:32	11.79
01/21/93	09:52:02	11.81
01/21/93	09:52:32	11.79
01/21/93	09:53:02	11.77
01/21/93	09:53:32	11.79
01/21/93	09:54:02	11.79
01/21/93	09:54:32	11.81
01/21/93	09:55:02	11.81
01/21/93	09:55:32	11.81
01/21/93	09:56:02	11.81
01/21/93	09:56:32	11.79
01/21/93	09:57:02	11.79
01/21/93	09:57:32	11.83
01/21/93	09:58:02	11.79
01/21/93	09:58:32	11.77
01/21/93	09:59:02	11.81
01/21/93	09:59:32	11.79
01/21/93	10:00:02	11.79
01/21/93	10:00:32	11.79
01/21/93	10:01:02	11.83
01/21/93	10:01:32	11.79
01/21/93	10:02:02	11.83
01/21/93	10:02:32	11.79

01/21/93	10:03:02	11.81	*
01/21/93	10:03:32	11.81	*
01/21/93	10:04:02	11.79	*
01/21/93	10:04:32	11.81	*
01/21/93	10:05:02	11.79	*
01/21/93	10:05:32	11.83	*
01/21/93	10:06:02	11.79	*
01/21/93	10:06:32	11.83	*
01/21/93	10:07:02	11.77	*
01/21/93	10:07:32	11.81	*
01/21/93	10:08:02	11.83	*
01/21/93	10:08:32	11.79	*
01/21/93	10:09:02	11.81	*
01/21/93	10:09:32	11.81	*
01/21/93	10:10:02	11.81	*
01/21/93	10:10:32	11.79	*
01/21/93	10:11:02	11.79	*
01/21/93	10:11:32	11.77	*
01/21/93	10:12:02	11.79	*
01/21/93	10:12:32	11.77	*
01/21/93	10:13:02	11.79	*
01/21/93	10:13:32	11.81	*
01/21/93	10:14:02	11.79	*
01/21/93	10:14:32	11.79	*
01/21/93	10:15:02	11.81	*
01/21/93	10:15:32	11.79	*
01/21/93	10:16:02	11.79	*
01/21/93	10:16:32	11.83	*
01/21/93	10:17:02	11.81	*
01/21/93	10:17:32	11.81	*
01/21/93	10:18:02	11.81	*
01/21/93	10:18:32	11.81	*
01/21/93	10:19:02	11.81	*
01/21/93	10:19:32	11.79	*
01/21/93	10:20:02	11.83	*
01/21/93	10:20:32	11.74	*
01/21/93	10:21:02	11.81	*
01/21/93	10:21:32	11.81	*
01/21/93	10:22:02	11.79	*
01/21/93	10:22:32	11.81	*
01/21/93	10:23:02	11.81	*
01/21/93	10:23:32	11.79	*
01/21/93	10:24:02	11.79	*
01/21/93	10:24:32	11.79	*
01/21/93	10:25:02	11.81	*
01/21/93	10:25:32	11.81	*
01/21/93	10:26:02	11.81	*
01/21/93	10:26:32	11.83	*
01/21/93	10:27:02	11.81	*
01/21/93	10:27:32	11.79	*
01/21/93	10:28:02	11.81	*
01/21/93	10:28:32	11.81	*
01/21/93	10:29:02	11.86	*
01/21/93	10:29:32	11.81	*
01/21/93	10:30:02	11.83	*
01/21/93	10:30:32	11.81	*
01/21/93	10:31:02	11.81	*
01/21/93	10:31:32	11.79	*
01/21/93	10:32:02	11.83	*
01/21/93	10:32:32	11.81	*

01/21/93	10:33:02	11.83	*
01/21/93	10:33:32	11.79	*
01/21/93	10:34:02	11.86	*
01/21/93	10:34:32	11.81	*
01/21/93	10:35:02	11.79	*
01/21/93	10:35:32	11.81	*
01/21/93	10:36:02	11.83	*
01/21/93	10:36:32	11.79	*
01/21/93	10:37:02	11.81	*
01/21/93	10:37:32	11.81	*
01/21/93	10:38:02	11.79	*
01/21/93	10:38:32	11.79	*
01/21/93	10:39:02	11.79	*
01/21/93	10:39:32	11.83	*
01/21/93	10:40:02	11.81	*
01/21/93	10:40:32	11.79	*
01/21/93	10:41:02	11.83	*
01/21/93	10:41:32	11.81	*
01/21/93	10:42:02	11.81	*
01/21/93	10:42:32	11.79	*
01/21/93	10:43:02	11.81	*
01/21/93	10:43:32	11.79	*
01/21/93	10:44:02	11.81	*
01/21/93	10:44:32	11.81	*
01/21/93	10:45:02	11.83	*
01/21/93	10:45:32	11.83	*
01/21/93	10:46:02	11.81	*
01/21/93	10:46:32	11.81	*
01/21/93	10:47:02	11.81	*
01/21/93	10:47:32	11.83	*
01/21/93	10:48:02	11.81	*
01/21/93	10:48:32	11.79	*
01/21/93	10:49:02	11.86	*
01/21/93	10:49:32	11.81	*
01/21/93	10:50:02	11.83	*
01/21/93	10:50:32	11.81	*
01/21/93	10:51:02	11.86	*
01/21/93	10:51:32	11.83	*
01/21/93	10:52:02	11.86	*
01/21/93	10:52:32	11.83	*
01/21/93	10:53:02	11.81	*
01/21/93	10:53:32	11.81	*
01/21/93	10:54:02	11.83	*
01/21/93	10:54:32	11.83	*
01/21/93	10:55:02	11.83	*
01/21/93	10:55:32	11.86	*
01/21/93	10:56:02	11.86	*
01/21/93	10:56:32	11.83	*
01/21/93	10:57:02	11.86	*
01/21/93	10:57:32	11.81	*
01/21/93	10:58:02	11.86	*
01/21/93	10:58:32	11.83	*
01/21/93	10:59:02	11.83	*
01/21/93	10:59:32	11.88	*
01/21/93	11:00:02	11.83	*
01/21/93	11:00:32	11.88	*
01/21/93	11:01:02	11.88	*
01/21/93	11:01:32	11.81	*
01/21/93	11:02:02	11.83	*
01/21/93	11:02:32	11.81	*

```
01/21/93 11:03:02 11.88          *
01/21/93 11:03:32 11.83        *
01/21/93 11:04:02 11.83        *
01/21/93 11:04:32 11.86         *
01/21/93 11:05:02 11.81       *
01/21/93 11:05:32 11.77     *
01/21/93 11:06:02 11.86         *
01/21/93 11:06:32 11.88          *
01/21/93 11:07:02 11.79      *
01/21/93 11:07:32 11.86         *
01/21/93 11:08:02 11.86         *
01/21/93 11:08:32 11.81       *
01/21/93 11:09:02 11.81       *
01/21/93 11:09:32 11.81       *
01/21/93 11:10:02 11.81       *
01/21/93 11:10:32 11.83        *
01/21/93 11:11:02 11.83        *
01/21/93 11:11:32 11.86         *
01/21/93 11:12:02 11.81       *
01/21/93 11:12:32 11.86         *
01/21/93 11:13:02 11.83        *
01/21/93 11:13:32 11.79      *
01/21/93 11:14:02 11.83        *
01/21/93 11:14:32 11.81       *
01/21/93 11:15:02 11.81       *
01/21/93 11:15:32 11.88          *
01/21/93 11:16:02 11.88          *
01/21/93 11:16:32 11.79      *
01/21/93 11:17:02 11.86         *
01/21/93 11:17:32 11.83        *
01/21/93 11:18:02 11.88          *
01/21/93 11:18:32 11.83        *
01/21/93 11:19:02 11.74    *
01/21/93 11:19:32 11.93             *
01/21/93 11:20:02 11.79      *
01/21/93 11:20:32 11.83        *
01/21/93 11:21:02 11.77     *
01/21/93 11:21:32 11.81       *
01/21/93 11:22:02 11.90           *
01/21/93 11:22:32 11.88          *
01/21/93 11:23:02 11.81       *
01/21/93 11:23:32 11.77     *
01/21/93 11:24:02 11.93             *
01/21/93 11:24:32 11.79      *
01/21/93 11:25:02 11.86         *
01/21/93 11:25:32 11.83        *
01/21/93 11:26:02 11.79      *
01/21/93 11:26:32 11.86         *
01/21/93 11:27:02 11.79      *
01/21/93 11:27:32 11.81       *
01/21/93 11:28:02 11.79      *
01/21/93 11:28:32 11.83        *
01/21/93 11:29:02 11.81       *
01/21/93 11:29:32 11.90           *
01/21/93 11:30:02 11.86         *
01/21/93 11:30:32 11.93             *
01/21/93 11:31:02 11.79      *
01/21/93 11:31:32 11.70 *
01/21/93 11:32:02 11.81       *
01/21/93 11:32:32 11.88          *
```

01/21/93	11:33:02	11.86	*
01/21/93	11:33:32	11.88	*
01/21/93	11:34:02	11.88	*
01/21/93	11:34:32	11.79	*
01/21/93	11:35:02	11.74	*
01/21/93	11:35:32	11.95	*
01/21/93	11:36:02	11.86	*
01/21/93	11:36:32	11.74	*
01/21/93	11:37:02	11.79	*
01/21/93	11:37:32	11.86	*
01/21/93	11:38:02	11.93	*
01/21/93	11:38:32	11.72	*
01/21/93	11:39:02	11.81	*
01/21/93	11:39:32	12.00	*
01/21/93	11:40:02	11.70	*
01/21/93	11:40:32	11.83	*
01/21/93	11:41:02	11.88	*
01/21/93	11:41:32	11.81	*
01/21/93	11:42:02	11.81	*
01/21/93	11:42:32	11.90	*
01/21/93	11:43:02	11.77	*
01/21/93	11:43:32	11.86	*
01/21/93	11:44:02	11.72	*
01/21/93	11:44:32	11.81	*
01/21/93	11:45:02	11.83	*
01/21/93	11:45:32	11.86	*
01/21/93	11:46:02	11.83	*
01/21/93	11:46:32	11.86	*
01/21/93	11:47:02	11.86	*
01/21/93	11:47:32	11.88	*
01/21/93	11:48:02	11.86	*
01/21/93	11:48:32	11.83	*
01/21/93	11:49:02	11.77	*
01/21/93	11:49:32	11.86	*
01/21/93	11:50:02	11.81	*
01/21/93	11:50:32	11.86	*
01/21/93	11:51:02	11.86	*
01/21/93	11:51:32	11.83	*
01/21/93	11:52:02	11.81	*
01/21/93	11:52:32	11.86	*
01/21/93	11:53:02	11.81	*
01/21/93	11:53:32	11.81	*
01/21/93	11:54:02	11.83	*
01/21/93	11:54:32	11.83	*
01/21/93	11:55:02	11.83	*
01/21/93	11:55:32	11.86	*
01/21/93	11:56:02	11.83	*
01/21/93	11:56:32	11.86	*
01/21/93	11:57:02	11.81	*

MONITORING DATA
GW-62D RK

Saved Recorder Status

Type: 2109-10 Range: 0.00 - 23.60 feet Recorder ID: 0002
Time at Recorder: 01/21/93 12:07:51 Last Update: 12/02/92 10:32:22
Signal process: Not Applicable
Values being saved: averages
Alarm status: Low alarm @ 0.09 is OFF Upper alarm @ 23.53 is OFF

Averaging period: 00:00:30 Amount of data recorded: 02:28:00
Storage Capacity: 6512 values records: 2 days 06:16:00
Output compressed by a factor of 1

Date	Time	Avg
01/21/93	09:39:32	12.62
01/21/93	09:40:02	12.62
01/21/93	09:40:32	12.62
01/21/93	09:41:02	12.09
01/21/93	09:41:32	11.81
01/21/93	09:42:02	11.79
01/21/93	09:42:32	11.79
01/21/93	09:43:02	11.79
01/21/93	09:43:32	11.83
01/21/93	09:44:02	11.79
01/21/93	09:44:32	11.79
01/21/93	09:45:02	11.81
01/21/93	09:45:32	11.77
01/21/93	09:46:02	11.83
01/21/93	09:46:32	11.81
01/21/93	09:47:02	11.81
01/21/93	09:47:32	11.81
01/21/93	09:48:02	11.79
01/21/93	09:48:32	11.79
01/21/93	09:49:02	11.79
01/21/93	09:49:32	11.79
01/21/93	09:50:02	11.79
01/21/93	09:50:32	11.81
01/21/93	09:51:02	11.79
01/21/93	09:51:32	11.79
01/21/93	09:52:02	11.81
01/21/93	09:52:32	11.79
01/21/93	09:53:02	11.77
01/21/93	09:53:32	11.79
01/21/93	09:54:02	11.79
01/21/93	09:54:32	11.81
01/21/93	09:55:02	11.81
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01/21/93	09:57:02	11.79
01/21/93	09:57:32	11.83
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01/21/93	09:58:32	11.77
01/21/93	09:59:02	11.81
01/21/93	09:59:32	11.79
01/21/93	10:00:02	11.79
01/21/93	10:00:32	11.79
01/21/93	10:01:02	11.83
01/21/93	10:01:32	11.79
01/21/93	10:02:02	11.83
01/21/93	10:02:32	11.79

01/21/93	10:03:02	11.81	*
01/21/93	10:03:32	11.81	*
01/21/93	10:04:02	11.79	*
01/21/93	10:04:32	11.81	*
01/21/93	10:05:02	11.79	*
01/21/93	10:05:32	11.83	*
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01/21/93	10:30:02	11.83	*
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01/21/93	10:31:32	11.79	*
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01/21/93	10:32:32	11.81	*

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01/21/93	12:01:32	11.83
01/21/93	12:02:02	11.86
01/21/93	12:02:32	11.83

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01/21/93 12:03:02 11.83        *
01/21/93 12:03:32 11.86         *
01/21/93 12:04:02 11.86         *
01/21/93 12:04:32 11.86         *
01/21/93 12:05:02 12.55                                    *
01/21/93 12:05:32 12.64                                        *
01/21/93 12:06:02 12.64                                        *
01/21/93 12:06:32 12.67                                         *
01/21/93 12:07:02 12.67                                         *
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G

APPENDIX G

HAGER-RICHTER EM/TEMPERATURE LOGGING REPORTS

BOREHOLE GEOPHYSICAL SURVEY II
OLIN CORPORATION SITE
WILMINGTON, MASSACHUSETTS

HAGER-RICHTER
GEOSCIENCE, INC.

Consultants in Geology & Geophysics

HAGER-RICHTER
GEOSCIENCE, INC.

BOREHOLE GEOPHYSICAL SURVEY II
OLIN CORPORATION SITE
WILMINGTON, MASSACHUSETTS

Prepared for:

Conestoga-Rovers & Associates, Inc.
1801 Old Highway 8
St. Paul, MN 55112

Prepared by:

Hager-Richter Geoscience, Inc.
8 Industrial Way - D10
Salem, New Hampshire 03079

File 92G29-A
January, 1993

0. EXECUTIVE SUMMARY

Hager-Richter Geoscience, Inc. conducted borehole geophysical logging in seven monitoring wells in the vicinity of the Olin Corporation Site, Wilmington, Massachusetts in December, 1992 and January, 1993 for Conestoga-Rovers & Associates, Inc. The current logging is an extension of a borehole geophysical survey conducted near the Site by H-R for CRA in August, 1992. The objectives of the borehole logging program were to provide data on: (1) the location and depth of a conductive plume known to be present in the vicinity of the Site, and (2) the depth intervals of productive fractures intersected in three bedrock wells. Conductivity (EM39) logs were obtained for five wells, and dual temperature logs were obtained in three wells drilled into bedrock.

The results of the survey may be summarized as follows:

1. None of the five wells for which conductivity was measured for this Report exhibits zones of elevated conductivity (approximately 360 mmho/m) as were measured in the August, 1992 series and were interpreted to be within the main part of the conductive plume.

2. The conductivity data for the five wells serve to constrain better the location of the plume. Four of the wells (GW-61BR, GW-67D, GW-68BR, and GW-71D) exhibit zones of slightly elevated conductivity (10 to 25 mmho/m), and are interpreted to be located at the fringes of the conductive plume. The fifth well (GW-69D) exhibits a maximum conductivity of about 115 mmho/m at the bottom of the hole, and is located nearer the central part of the conductive plume.

3. The dual temperature logs indicate that water enters GW-62BR at or near the seal at the bottom of the PVC casing, enters GW-68BR at the bottom of the hole, and are inconclusive about where water enters GW-62BRD.

Borehole Geophysical Survey II
Olin Corporation Site
Wilmington, Massachusetts
File 92G29A January, 1993

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FIGURES

1. Site location
2. Principle of the induction log
3. Productive fracture location with dual temperature logs

PLATES

1. Site Plan
2. Conductivity logs superimposed on Site Plan

APPENDIX

Borehole Logs - in pocket

Borehole Geophysical Survey II
Olin Corporation Site
Wilmington, Massachusetts
File 92G29A January, 1993

1. INTRODUCTION

Hager-Richter Geoscience, Inc. was retained by Conestoga-Rovers & Associates, Inc. of St. Paul, Minnesota to log seven monitoring wells located in the vicinity of the Olin Corporation Site in Wilmington, Massachusetts. The Site is an inactive chemical plant located in a suburban industrial district. The location of the Site is shown in Figure 1.

The borehole logging program is part of a larger hydrogeologic investigation being conducted by CRA. The present survey is an extension of borehole geophysical logging of ten wells conducted at the Site by H-R for CRA in August, 1992.[1]

The wells and types of logs included in the present survey were:

Well #	Log Type
GW-61BR	Conductivity[2]
GW-62BR	Dual Temp (Conductivity in August '92 data set)
GW-62BRD	Dual Temp
GW-67D	Conductivity
GW-68BR	Conductivity + Dual Temp
GW-69D	Conductivity
GW-71D	Conductivity

The locations of the subject monitoring wells and the wells included in the August survey are shown on the Site Plan (Plate 1). None of the subject monitoring wells is located on the Olin Corporation property.

The objectives of the borehole logging program were to provide data on: (1) the location and depth of a conductive plume known to be present downgradient from the Olin property, and (2) the depth intervals of productive fractures intersected by three bedrock wells. Conductivity logs were obtained for five of the wells. Three of the wells were drilled into bedrock, and dual temperature logs were obtained for those wells.

---

[1] Reference: "Borehole Geophysical Survey, Olin Corporation Site, Wilmington, Massachusetts," H-R report to CRA dated August, 1992.

[2] Dual temperature logs were not run in this well because it was not accessible to the logging truck at the time of temperature logging.

Jeffrey Mann of Hager-Richter conducted the conductivity logging on December 15-17, 1992 and conducted the temperature logging on January 20, 1993. The fieldwork was coordinated with, and observed in part, by Mr. Jon Michels of CRA. Mr. Mark Jeffrey of CRA also observed a portion of the field operations. All fieldwork was conducted under Level D personal protection. Data analysis and interpretation were completed at the Hager-Richter offices. Original data and field notes reside in the Hager-Richter files and will be retained for a minimum of three years.

2. PRINCIPLES, EQUIPMENT & PROCEDURES

2.1 Conductivity Logs

2.1.1 General. The principle of the conductivity log, sometimes referred to as the electromagnetic induction log, is illustrated in Figure 2. An electric current, called an eddy current, is induced in the formation by an electric current in the transmitter coil (Tx), also called a primary coil, located near the top of the probe. The induced current produces a secondary electromagnetic field and a voltage in the receiver coil (Rx), also called a secondary or measuring coil, located near the bottom of the probe. The design of the system, including the geometry and coil characteristics, is such that the voltage in the receiver coil is proportional to the formation conductivity. In addition, the system is so designed and calibrated that the output, after processing, is the conductivity of the formation in units of millimhos per meter, mmho/m (numerically equivalent to the SI units, milliSiemens per meter, or mS/m).

The maximum distance outward from the tool to which the conductivity of the borehole material is measured is about 2 feet. The tool does not need to be immersed in water to obtain accurate data, but it cannot be used in a steel-cased hole.

2.1.2 Site Specific. All data were obtained with a Geonics EM39 logging system. This compact, portable system has a winch with a maximum depth capability of 100 meters. The electronics are battery powered. All data were recorded at intervals of 0.1 meter (approximately 4 inches) while the tool was being pulled out of the monitoring well at a rate of about 2 to 3 feet per minute. The data were recorded in digital form with a data logger, transferred to a portable computer in the field, processed in the office, and then plotted using commercially available software.

As recommended in the report for the August, 1992 data set, the conductivity logs for the current data set were run without purging the wells. One well (GW-45D) that had been logged in the August series was re-logged during the present series to ensure reproducibility. The two logs were essentially identical.

After each log was being run, the equipment was decontaminated by washing the downhole portion of the cable and the tool with Alconox soap and rinsing with distilled water.

2.2 Dual Temperature Logs

2.2.1 General. The principal of the dual temperature log is illustrated in Figure 3. Two temperature logs are run for each well to identify those fractures, or zones, that are productive. The temperature log is the first log run in each well. Water is then removed from the well, either by pumping or bailing. The amount removed depends on the diameter of the well and, to some extent, on the depth. The concept is to remove enough water to lower the water level approximately 30 to 50 feet if there is no inflow. Most wells produce at least some water during the time required to remove the water and set up the equipment to run the second temperature log. Therefore, at the time of running the second temperature log, the actual displacement of the water column is somewhat less than the 30 to 50 feet. Many wells recover completely, and the static water level is about the same for the two temperature logs. The vertical movement of water in the well causes the temperature of the water at most depths to differ from the formation temperature. Because this difference will decrease with time, the temperature should be logged again within an hour. Comparison of the two temperature logs shows where water enters the well.

2.2.2 Site Specific. The borehole logging system was a Mount Sopris Series III logging system with a depth capability of 4500 feet. The equipment is mounted in a four wheel drive pickup truck. Data are recorded in both digital and analogue form. The digital data, recorded in the field in a portable computer, were processed in the office using proprietary software and then plotted using commercially available software.

The digital temperature probe of the Series III logging system measures temperature to 0.02 °C precision. For each well, the temperatures were logged at an interval of 0.1 foot from the static water level to the bottom of the well for each well, at a logging speed of about 20 feet/minute.

After each log was completed at the Site, the equipment was decontaminated with the following procedure: each tool and the downhole portion of the cable were washed

using Alconox soap and natural sponges or cotton rags, and rinsed with distilled water.

The pumping schedule between the first and second temperature logs for each of the three bedrock wells at the Olin Site is the following:

Temperature log #1 run.
Well pumped to remove the volume of water equivalent to a column of approximately 50 feet.
Temperature log #2 run.

Monitoring well GW-62BR. The schedule for the dual temperature log was the following, where T_0 is the time of starting the pump.

TIME (min)	WATER LEVEL (feet)	COMMENT
$< T_0$		Run 1st temp log
T_0	4.5	Start pump
$T_0 + 25$	32.4	Stop pump
$T_0 + 35$	29.5	
$T_0 + 80$	18.9	
$T_0 + 173$	8.3	
$T_0 + 187$	8.0	Run 2nd temp log

The pump was set at approximately 50 feet depth. A total of 25 gallons of water was pumped from the well, equivalent to a column of about 35 to 40 feet of water.

Monitoring well GW-62BRD. The schedule for the dual temperature log was the following, where T_0 is the time of starting the pump.

TIME (min)	WATER LEVEL (feet)	COMMENT
$< T_0$		Run 1st temp log
T_0	4.6	Start pump
$T_0 + 13$	48.8	Stop pump
$T_0 + 93$	8.1	
$T_0 + 125$	7.8	Run 2nd temp log

The pump was set at approximately 50 feet depth. A total of 35 gallons of water was pumped from the well, equivalent to a column of about 50 feet of water.

Monitoring well GW-68BR. The schedule for the dual emperature log was the following, where T_0 is the time of starting the pump.

TIME (min)	WATER LEVEL (feet)	COMMENT
$< T_0$		Run 1st temp log
T_0	8.1	Start pumping
$T_0 + 60$	29.1	Stop pumping
$T_0 + 140$	13.4	Run 2nd temp log

The pump was set at approximately 30 feet depth. A total of approximately 16 gallons of water was pumped from the well, equivalent to a column of about 25 feet of water.

3. RESULTS AND DISCUSSION

3.1 General

A copy of each log is located in the Appendix (in pocket) but is not described in detail in the text. All depths are in units of feet and referenced to depth below the ground surface.

3.2 Conductivity Logs

The conductivity measured for four (GW-61BR, GW-67D, GW-68BR, and GW-71D) of the five wells included in the present data set varies from about 0 mmho/m to 25 mmho/m. The conductivity measured in the fifth well (GW-69D) was less than 10 mmho/m except for the bottom of the well, where a peak conductivity of 115 mmho/m was measured.

In Plate 2, conductivity logs for the present data set plus the August, 1992 data set are superimposed on a plan of the Olin Corp. Site to show the relationship of each well location to the conductivity profile measured in the well. None of the five wells of the

current data set exhibits as high conductivity measured six wells in the August, 1992 data set (maximum 360 mmho/m). The wells included in the current data set are located north and south of the wells included in the August, 1992 data set, and on the basis of the conductivities measured, we conclude that four of the wells (GW-61BR, GW-67D, GW-68BR, and GW-71D) are located on the fringes of the conductive plume at the Olin Corporation Site. Well GW-69D appears to be located on the flanks of the plume. We conclude, then, that the conductivity measurements of the current data set help constrain the location of the conductive plume near the Olin Corporation Site.

3.2 Dual Temperature Logs

Dual temperature logs were obtained in three wells (GW-62BR, GW-62BRD, and GW-68BR). The length of open hole in each bedrock well is limited, and the bedrock is relatively competent, evidenced by the slow rate of recharge after pumping.

For GW-62BR, the open portion of the borehole is from about 77 feet to the bottom at 110 feet. Our interpretation of the dual temperature log is that water is enters the well at 77 feet, the depth of the PVC/bedrock seal. Small amounts of water might be entering the well at about 91 and 97 feet.

For GW-62BRD, the open portion of the borehole is from 105 feet to the bottom of the well at 146 feet. The near-zero geothermal gradient measured between 85 feet and the total depth precludes using the dual temperature logging technique to obtain data on the depth of water entry. This well exhibited a very slow rate of recharge, indicating that bedrock contains no relatively large conductive fracture.

For GW-68BR, the open portion of the borehole is from 25 feet to the bottom of the well at 76 feet. Our interpretation of the dual temperature log for GW-68BR is that water entry is located at or near the bottom of the well.

4. CONCLUSIONS

On the basis of the borehole geophysical logs obtained in the vicinity of the Olin Corporation Site in Wilmington, Massachusetts during December, 1992 and January, 1993, we conclude the following:

1. None of the five wells for which conductivity was measured for this Report exhibits zones of elevated conductivity (approximately 360 mmho/m) as were measured in the August, 1992 series and were interpreted to be within the main part of the conductive plume.

2. The conductivity data for the five wells serve to constrain better the location of the plume. Four of the wells (GW-61BR, GW-67D, GW-68BR, and GW-71D) exhibit zones of slightly elevated conductivity (10 to 25 mmho/m), and are interpreted to be located at the fringes of the conductive plume. The fifth well (GW-69D) exhibits a maximum conductivity of about 115 mmho/m at the bottom of the hole, and is located nearer the central part of the conductive plume.

3. The dual temperature logs indicate that water enters GW-62BR at or near the seal at the bottom of the PVC casing, enters GW-68BR at the bottom of the hole, and are inconclusive about where water enters GW-62BRD.

Borehole Geophysical Survey II
Olin Corporation Site
Wilmington, Massachusetts
File 92G29A January, 1993

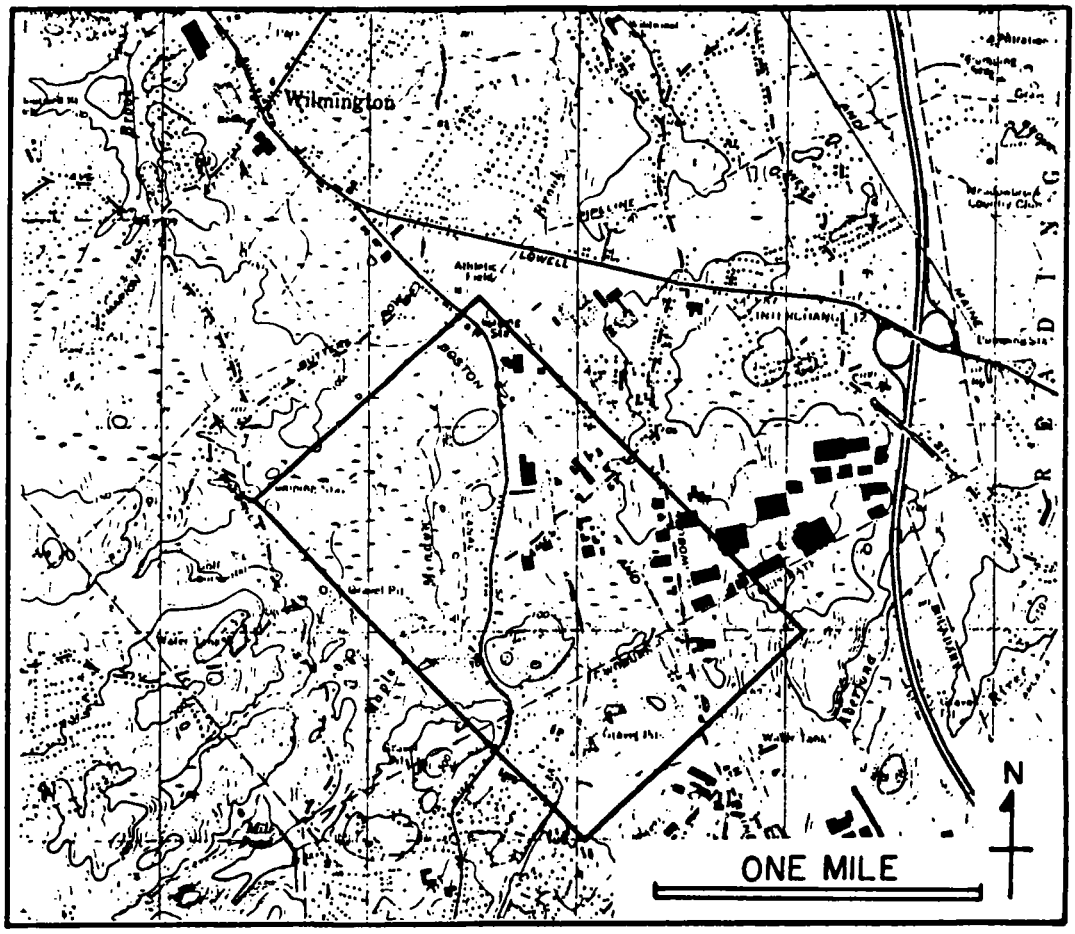

Figure 1. Site location. The box outlines the area shown in Plate 1, the Site Plan. Base map Wilmington, Mass. 7 1/2" USGS topographic quadrangle.

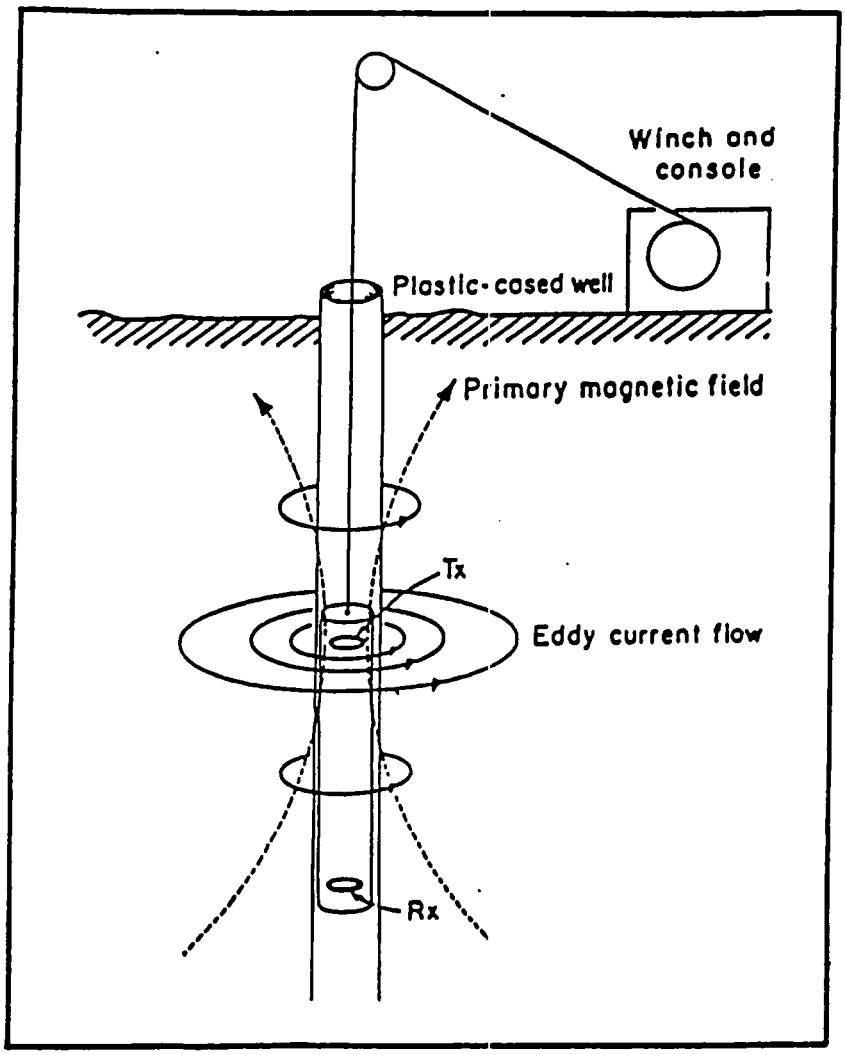

Figure 2. Principle of the induction log. Sketch by Geonics.

Borehole Geophysical Survey II
Olin Corporation Site
Wilmington, Massachusetts
File 92G29A January, 1993

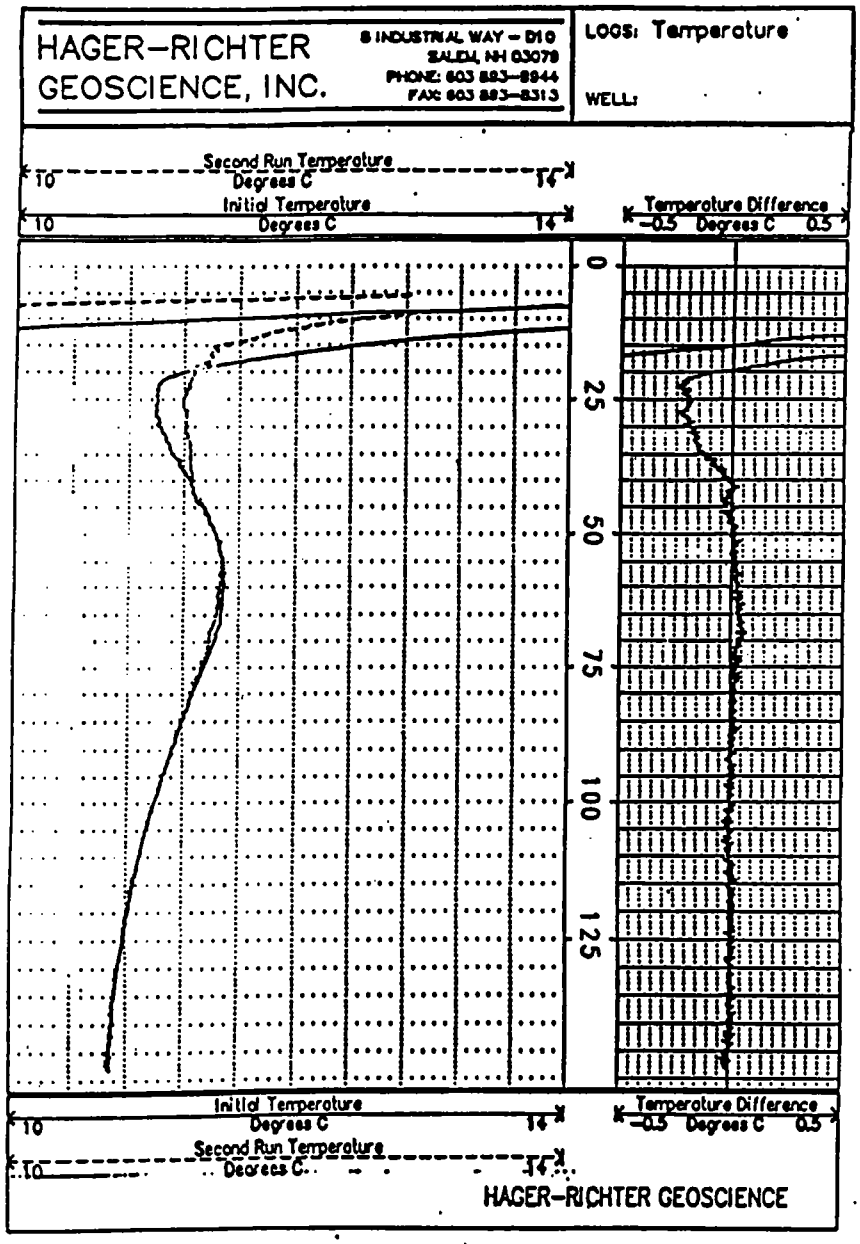

Figure 3. Productive fracture location with dual temperature logs. After running the first log, sufficient water is bailed from the well to lower the water level about 30 feet if no water entered the well. The second log was run about 30 minutes later, and the well had fully recharged. The difference log shows that most water entered the well at about 40 feet depth, and about 5 to 10% of the water entered at about 71 feet. Note that the water that entered at 40 feet was warmer than the water being displaced, and the water entering at 71 feet was colder.

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BOREHOLE GEOPHYSICAL SURVEY
OLIN CORPORATION SITE
WILMINGTON, MASSACHUSETTS

HAGER-RICHTER
GEOSCIENCE, INC.

consultants in geology & geophysics

HAGER-RICHTER
GEOSCIENCE, INC.

BOREHOLE GEOPHYSICAL SURVEY
OLIN CORPORATION SITE
WILMINGTON, MASSACHUSETTS

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File 92G29
August, 1992

Borehole Geophysical Survey
Olin Corporation Site
Wilmington, Massachusetts
File 92G29 August, 1992

0. EXECUTIVE SUMMARY

Hager-Richter Geoscience, Inc. was retained by Conestoga-Rovers & Associates, Inc. to log ten monitoring wells in the vicinity of the Olin Corporation Site, Wilmington, Massachusetts in August, 1992. The objective of the borehole logging program was to provide data on the location and depth of a conductive plume known to be present in the vicinity of the Site. Conductivity (EM39) logs were obtained for each well.

The results of the survey may be summarized as follows:

1. Six of the ten wells exhibit well defined zones of sharply elevated conductivity (uniformly about 360 mmho/m), and are interpreted to be within the main part of the conductive plume.

2. The top of the conductive plume is located at increasing depths below ground surface with increasing distance from the Site.

Borehole Geophysical Survey
Olin Corporation Site
Wilmington, Massachusetts
File 92G29 August, 1992

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2. Principle of the induction log
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1. Site Plan
2. Conductivity logs superimposed on Site Plan

APPENDIX

Borehole Logs - in pocket

Borehole Geophysical Survey
Olin Corporation Site
Wilmington, Massachusetts
File 92G29 August, 1992

1. INTRODUCTION

Hager-Richter Geoscience, Inc. was retained by Conestoga-Rovers & Associates, Inc. of St. Paul, Minnesota to log ten monitoring wells located in the vicinity of the Olin Corporation Site in Wilmington, Massachusetts. The Site is an inactive chemical plant located in a suburban industrial district. The location of the Site is shown in Figure 1.

The locations of the subject monitoring wells are shown on the Site Plan (Plate 1). Nine of the ten subject monitoring wells are located off the Olin Corporation property.

The objective of the borehole logging program was to provide data on the location and depth of a conductive plume known to be present down-gradient from the Olin property. The borehole logging program is part of a larger hydrogeologic investigation being conducted by CRA.

Jeffrey Mann of Hager-Richter conducted the fieldwork on August 11 and 12, 1992. The fieldwork was coordinated with and observed in part by Mr. Jon Michels of CRA. All fieldwork was conducted under Level D personal protection. Data analysis and interpretation were completed at the Hager-Richter offices. Original data and field notes reside in the Hager-Richter files and will be retained for a minimum of three years.

2. PRINCIPLES, EQUIPMENT & PROCEDURES

2.1 Conductivity Logs

The principle of the conductivity log, sometimes referred to as the electromagnetic induction log, is illustrated in Figure 2. An electric current, called an eddy current, is induced in the formation by an electric current in the transmitter coil (Tx), also called a primary coil, located near the top of the probe. The induced current produces a secondary electromagnetic field and a voltage in the receiver coil (Rx), also called a secondary or measuring coil, located near the bottom of the probe. The design of the system, including the geometry and coil characteristics, is such that the voltage in the receiver coil is proportional to the formation conductivity. In addition, the system is so designed and calibrated that the output, after processing, is the conductivity of the formation in units of millimhos per meter, mmho/m (numerically equivalent to the SI units, milliSiemens per meter, or mS/m).

The maximum distance outward from the tool to which the conductivity of the borehole material is measured is about 2 feet. The tool does not need to be immersed in water to obtain accurate data, but it cannot be used in a steel-cased hole.

2.2 Site Specific

All data were obtained with a Geonics EM39 logging system. This compact, portable system has a winch with a maximum depth capability of 100 meters. The electronics are battery powered. All data were recorded at intervals of 0.1 meter (approximately 4 inches) while the tool was being pulled out of the monitoring well at a rate of about 2 to 3 feet per minute.

The data were recorded in digital form with a data logger, transferred to a portable computer in the field, processed in the office, and then plotted using commercially available software.

Several logs were run more than once to ensure reproducibility. Three wells (GW-42, GW-43, and GW-45) were logged twice -- prior to and after purging the well with fresh tap water to displace possibly contaminated (more conductive) water that entered the well at

the screened interval at the bottom of the hole. Comparison of the conductivity logs run prior to and after purging the boreholes with clean tap water shows no significant difference in the data (see Appendix). The conductivity logs for the seven other wells were run after purging; however, we conclude that the purging is unnecessary and we recommend that the purging step be eliminated if additional wells are logged in the future.

As each log was being run, the equipment was decontaminated by washing the downhole portion of the cable and the tool with Alconox soap and rinsing with distilled water. After completing the logging at each well, the wash and rinse water was disposed of at the decontamination pad.

3. RESULTS AND DISCUSSION

3.1 General

A copy of each log is located in the Appendix (in pocket) but is not described in detail in the text. All depths are in units of feet and referenced to depth below the ground surface.

3.2 Conductivity Logs

The conductivity measured for the ten subject wells varies from about 0 mmho/m to 360 mmho/m in distinct zones related to the location of the wells to the Site. In Plate 2, the conductivity logs are superimposed on a plan of the Olin Corp. Site to show the relationship of well location to the conductivity measured.

Generally, the conductivity of the unsaturated zone and the "fresh" water zones for each of the monitoring wells is less than about 10 mmho/m. The conductivity of natural, fresh ground water in New England is generally a few mmho/m.

In six of the ten wells (GW-36, GW-42D, GW-43D, GW-44D, GW-45D, and GW-59D) the conductivity reaches a uniform maximum of 350-360 mmho/m for well-defined depth intervals (shown in Figure 3). The top of the zones of the highly anomalous conductivity varies in depth below ground surface from 25-32 feet near the Site to about 49

feet farther from the Site. Well GW-70D, located at a similar distance from the Site as GW59D, also exhibits a zone of elevated conductivity at a depth of about 49 feet, but the maximum conductivity measured is only 120 mmho/m, possibly indicating that the well is located off the axis of the plume.

Wells GW-58D and GW-62BR are located slightly north of the six wells with the very high conductivity, and each exhibits a narrow band of elevated conductivity (maximum 95 and 40 mmho/m, respectively) at a depth of about 72 feet below ground surface. There is an elevation change between the two wells, however, with GW-62BR at a lower elevation. Interestingly, the increase in conductivity in GW-62BR occurs at the overburden/bedrock interface. GW-62BR also shows a zone of fluctuating conductivity values between depths of about 32 and 40 feet where the values vary between -20 mmho/m and about 100 mmho/m. Such variable values and negative values over a short distance are generally attributed to the presence of metal objects, although the CRA representative indicated that no steel was left in the borehole. (The negative values for conductivity for the top few feet of each log are due to the steel in the wellhead.)

Well GW-40D, located south of the other nine wells, contains a zone of slightly elevated conductivity (approximately 20 mmho/m) between depths of about 31 and 37 feet. It appears to be located outside the main part of the conductive plume.

4. CONCLUSIONS

On the basis of the borehole geophysical logs obtained at the Olin Corporation Site in Wilmington, Massachusetts, we conclude the following:

1. Six of the ten wells exhibit well defined zones of sharply elevated conductivity (uniformly about 360 mmho/m), and are interpreted to be within the main part of the conductive plume.

2. The top of the conductive plume is located at increasing depths below ground surface with increasing distance from the Site.

Borehole Geophysical Survey
Olin Corporation Site
Wilmington, Massachusetts
File 92G29 August, 1992

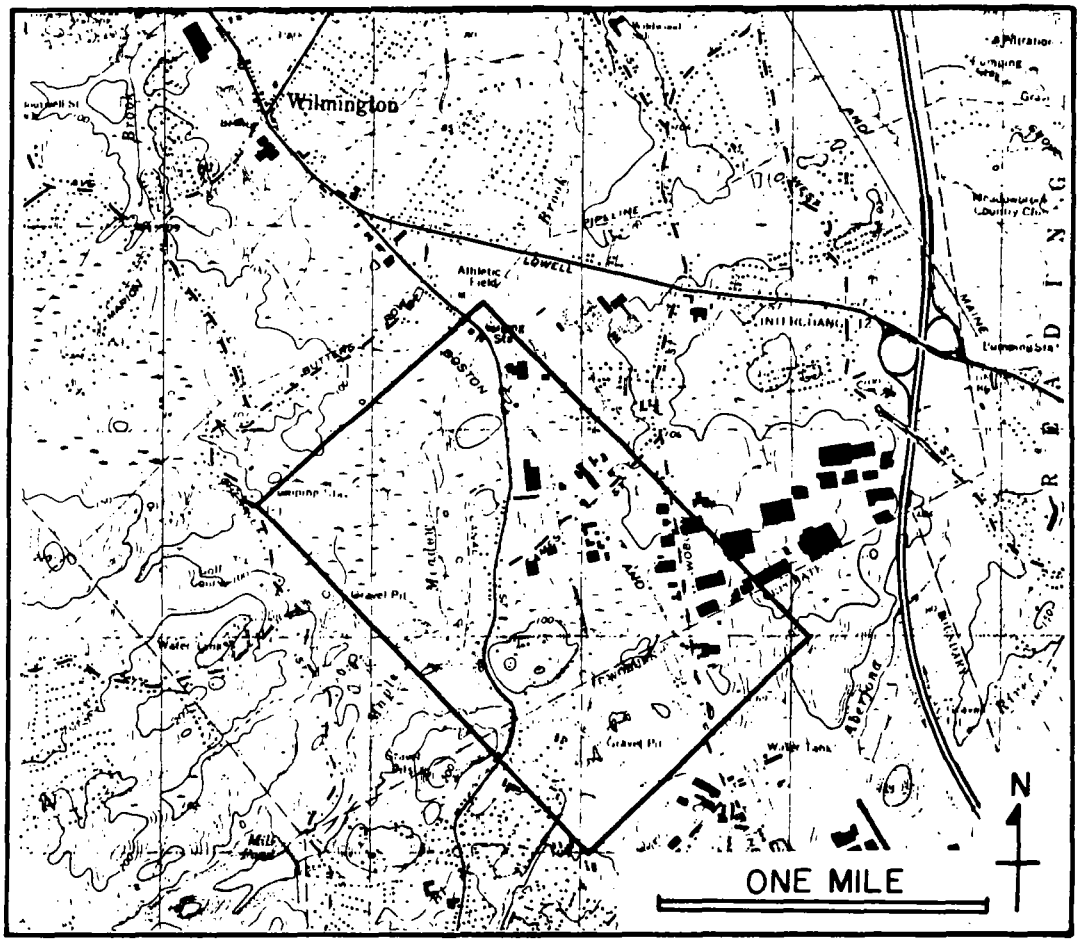

Figure 1. Site location. The box outlines the area shown in Plate 1, the Site Plan. Base map Wilmington, Mass. 7 1/2" USGS topographic quadrangle.

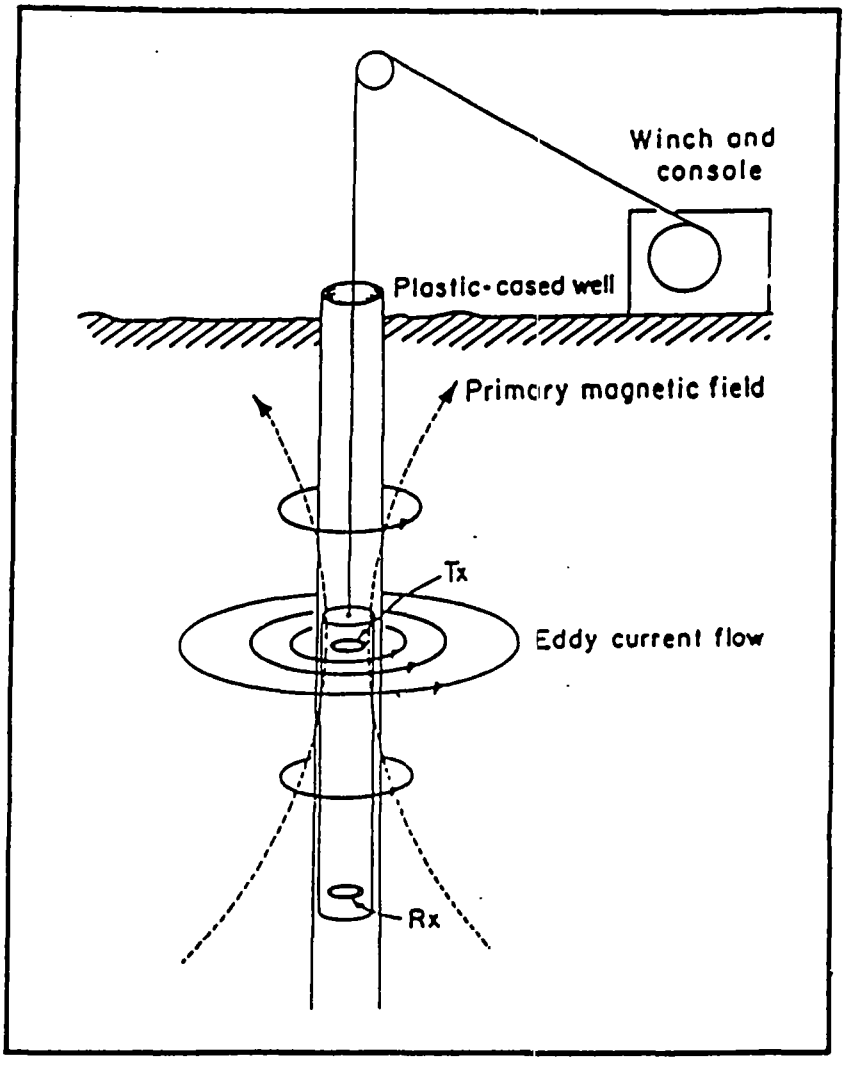

Figure 2. Principle of the induction log. Sketch provided by Geonics.

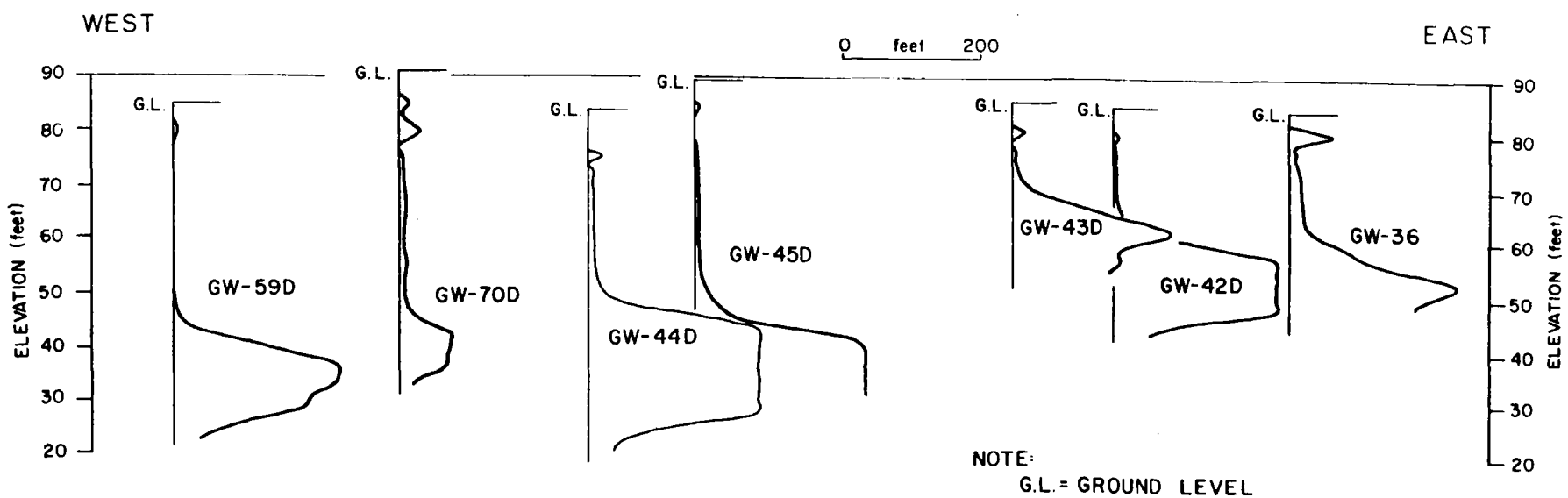

Figure 3. Conductivity profile.

H

APPENDIX H

QUALITATIVE BIOTA SURVEY/ WETLANDS DELINEATION

WETLANDS PRESERVATION INC.

Site Habitat Characterization

Olin Wilmington Facility
51 Eames Street
Wilmington, Massachusetts 01887

March 3, 1993

Revised June 11, 1993

Prepared for

OLIN CHEMICALS
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Lower River Road
Charleston, Tennessee 37310

By

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Georgetown, Massachusetts 01833

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Site Habitat Characterization
Olin Wilmington Facility
51 Eames Street
Wilmington, MA

1.0 Introduction

This report provides a detailed evaluation of the location and characteristics of the various upland and wetland habitat areas on and immediately adjacent to the property located on Eames Street in Wilmington, Massachusetts.

For the purpose of this report, the area of study includes all contiguous property at the Eames Street facility, the offsite West Ditch System located immediately to the west of the site, and a similar stream and ditch system located to the east and adjacent to the MBTA railroad track which is referred to as the East Ditch System.

Within the study area, both upland and wetland habitat classes were identified and distinct areas of upland and wetland composed of one or more habitat classes are discussed relative to their vegetative cover, hydrology, soils, wildlife use and other pertinent characteristics. The location of each of the upland and wetland areas is identified on Figure 1, Habitat Location Plan.

2.0 Site Overview

The property exhibits several past and present land use patterns which have had an impact on shaping the current condition of the site. The north portion of the site, including approximately one-third of the property area, is currently developed and contains the offices, parking area, several warehouse buildings,

industrial structures such as loading platforms, above ground holding tanks and a water treatment facility. Several concrete pads remain intact from razed process buildings. In general, this portion of the site is highly developed, however, daily activities on this portion are currently limited to facility maintenance and groundwater investigation and monitoring activities.

The central portion of the property is a wetland area which has been highly disturbed during previous tree cutting, soil excavation and stream channelization activities. Several gravel spoil piles and berms remain around a small pond and along the banks of the streams in this portion of the site. The central wetland area on the site is listed as Zone B according to the Flood Insurance Rate Map (FIRM) for Wilmington, Massachusetts, Middlesex County dated June 15, 1982. (Community Panel Numbers 250227-0002 B and 250227-0004 B). Figure 2 illustrates the FIRM for the site.

The southwest corner of the property contains a gypsum landfill which has been capped and is currently mowed periodically to restrict tree and shrub development.

The remaining south central and southeast portion of the site is mixed forested wetland and forested upland. Several old ditches, stone piles and an old foundation indicate the historic farming activities on this portion of the site. The average diameter of the forest trees in this area is 12 to 14 inches dbh (diameter at breast height). The presence of the mature red oak/white pine forest canopy indicates this portion of the site has most likely remained relatively undisturbed for 60 or more years.

3.0 Upland Habitat Evaluation

3.1 Upland Area Classification

The upland component of the property currently consists of several types of areas which are best classified according to their respective land use and vegetation cover patterns. While no one formal habitat classification system is available for disturbed sites such as this, the following descriptions best identify the current conditions of the upland habitats on the site.

- Heavily maintained/industrial - This class includes all upland areas currently or previously developed which continue to be maintained as part of an industrial facility. Characteristics of this class include all office, factory and storage buildings on the site, paved parking and driveway areas, industrial facilities such as fuel tanks, railroad tracks, concrete pads and loading platforms.
- Heavily maintained/open field - This class consists of areas on the site which have been previously altered and were heavily utilized in the past but are currently mowed periodically and maintained as open field. Included in this class are areas due south of the factory buildings on the site known as the former lagoon area and the area of the capped gypsum landfill in the southwest corner of the property.
- Upland Forest (white pine/Northern red oak/white ash stand type) - This class includes all the upland forested portions of the property. The stand type is white pine/Northern red oak/white ash according to Forest Cover Types of North America, Society of American Foresters, 1954. Variations and subtypes in species composition exist in specific areas on the site due to manmade or natural disturbances. Portions of the forested upland area are in various stages of secondary succession,

however, in general, the majority of the forested area was found to be consistent in species composition with this stand type. The primary species in the type are Eastern white pine, Northern red oak and white ash. Red maple is the chief associate while various other species may also be present in specific areas.

3.2 Upland Area Characterization

3.2.1 Upland Area A

Upland Area A is the front or north portion of the site and extends from the entrance along Eames Street to the south of the existing or former building and tank facilities. This area of the site is highly developed and contains offices, associated landscaping, industrial structures and several mature trees standing along the perimeter of the maintained area. Much of this area is paved. Upland grasses and forbs generally dominate the non-paved portions of the site here. Drainage from this area generally sheds toward the west toward Drainage Area BB and to the south toward Drainage Area AA.

The soils of Upland Area A have been obscured by impervious surfaces and building construction. These soils are classified as Urban Land and include areas of Udorthents which are heavily disturbed by cultural activities which include excavating, regrading, filling and continued maintenance. Due to the highly developed condition of this portion of the site, quantitative vegetation sampling and soil sampling was not conducted. Although this area of the site was in active chemical manufacturing for many years, current activities are limited primarily to facility maintenance and groundwater interception system.

3.2.2 Upland Area B

Upland Area B is located south of the buildings and industrial facilities on the site and is an area of open mowed field which once contained open lagoons or settling ponds. These structures have been removed, the area has been regraded and is now mowed periodically. This area is best characterized as heavily maintained/open field.

The soils of this area are heavily disturbed by historic grading activities which include excavating, regrading, filling and continued maintenance. These soils are classified as Udorthents. They are variable in composition and drainage class because soil morphology has been altered by the development activities. Additional onsite investigation would be necessary to determine the suitability of these soils for future use. The periodic mowing of this area restricts tree, sapling and shrub development and limits the plant community to grasses and forbs. Due to the season of observation, definitive identification of the herbaceous species in this area was not feasible. The past disturbances and the present maintenance schedule in this area restricts further succession toward a more natural and diverse plant community.

3.2.3 Upland Area C

Upland Area C is a capped gypsum landfill in the southwest corner of the site. This area is periodically mowed and is maintained as open field with only an herbaceous stratum with a variety of upland grasses and forbs present. Due to the season of observation, definitive identification of species in this area was not feasible. The past disturbances and the present maintenance schedule in this area restricts further succession toward more natural communities. Therefore, this area is best characterized as heavily maintained/open field. Due to the season of

observation along with the closely mowed condition of the herbaceous stratum, quantitative vegetation sampling was not conducted in this area. Similarly, due to the present land use of this area and disturbed nature of the area, soil sampling was also not conducted.

3.2.4 Upland Area D

The remaining portion of the property, including the area south of the central wetland area, an upland island centrally located on the site, and several small peripheral areas are typically forested upland. These areas are best described as successional mixed hardwood/white pine and generally corresponds to the white pine/Northern red oak/white ash stand type as described in the Forest Cover Types of North America published by the Society of American Foresters. The forest canopy is well stratified with an average tree diameter of 12" dbh. This portion of the property is relatively undisturbed. Evidence of past farming activities is found in several old foundations, stone piles and old cart paths.

The predominant soils in Upland Area D are deep, well to somewhat excessively drained gravelly loamy sand and coarse sand textures. They are deep to water table and bedrock. These soils are derived from coarse sandy glacial till parent materials. These parent materials were deposited by glacial ice with minimal transportation by water. The soils of Upland Area D are relatively undisturbed as compared to other areas of the site. These soils most closely resemble Canton series soils. Canton soils have more sand in the substratum and are less firm in the substratum than other till soils with dense basal deposits.

While glacial till materials are generally unstratified and heterogeneous in the forested upland area, the largest portion of the forested area, closest to the

town line with Woburn, does exhibit some signs of stratification and likely experienced influence from glacial meltwater. Conversely, the soils on the upland island generally possess finer textures and do not exhibit stratification. By virtue of its landscape position, the island is only moderately well to well drained as are the portions of Upland Area D to the east and west of the pond. The condition of most of the area indicates that this area has received minimal disturbance in the last 60+ years. Recent disturbance in this area appears limited to periodic use of several cart paths to access groundwater monitoring wells and the area disturbed to erect the chain link fence at the perimeter of the property.

The tree stratum in the forested areas is made up of red oak (*Quercus rubra*), black cherry (*Prunus serotina*), white oak (*Quercus alba*), red maple (*Acer rubrum*), gray birch (*Betula populifolia*), white pine (*Pinus strobus*) and pitch pine (*Pinus rigida*). The sapling stratum typically contains red oak, red maple, gray birch and white pine. The shrub stratum density is variable through much of the area with shadbush (*Amelanchier canadensis*), highbush blueberry (*Vaccinium corymbosum*), white pine, beaked hazelnut (*Corylus cornuta*), common red raspberry (*Rubus idaeus*), blackberry (*Rubus* sp.), black chokeberry (*Aronia melanocarpa*) and multiflora rose (*Rosa multiflora*) occasionally present. The herbaceous stratum typically consists of cinnamon fern (*Osmunda cinnamomea*), teaberry (*Gaultheria procumbens*), partridge berry (*Mitchella repens*), clubmoss (*Lycopodium complanatum*), common raspberry (*Rubus* sp.) and poison ivy (*Toxicodendron radicans*). Additional herbaceous species were present but unidentifiable due to the season of observation. The liana stratum is typically sparse with poison ivy, bittersweet (*Celastrus scandens*) and grape (*Vitis* sp.) present. Table 1 portrays the plant community characteristics of the forested upland island in the central

portion of this area. Figure 3 illustrates the moderately stratified nature of this forested upland and the dominance of the tree and shrub communities. Table 2 provides the plant community characteristics of the forested upland area in the southeastern corner of the property. Figure 4 illustrates the high vertical stratification of this portion of the forested upland. The generally mature even aged nature of the forest cover along with the high degree of stratification in the forest indicates that these areas have been relatively undisturbed for 60 or more years. The high degree of vertical stratification in these areas generally increases the overall wildlife habitat value of the forest.

4.0 Wetland Habitat Evaluation

4.1 Wetland Regulatory Jurisdiction and Delineation

4.1.1 Jurisdictional Wetland Regulations

The site is subject to the following wetland protection regulations: Massachusetts Wetland Protection Regulations (MWPR) 310 CMR 10.00 and the Federal Clean Water Act, Sections 401 and 404. The site currently contains wetland resource areas which are jurisdictional under all of these regulations. Jurisdictional state wetlands include Bank (310 CMR 10.54) associated with perennial and intermittent streams on the site, Land Under Water (310 CMR 10.56) associated with a pond and perennial stream on the site, and Bordering Vegetated Wetlands (BVW) (310 CMR 10.55). While these resource types are included in the state jurisdiction, all wetland areas on the site also represent federal wetland areas and fall under the jurisdiction of the Army Corps of Engineers (ACOE) under the Clean Water Act, Sections 401 and 404.

According to the FIRM for the Town of Wilmington, Massachusetts, Middlesex County, dated June 15, 1982, the property contains an area of Zone B* floodplain throughout the central portion of the site. No Zone A floodplain occurs on the site. Based on the vegetative, topographical and hydrological conditions on the site, it is anticipated that any areas of 100 year floodplain which may occur in Zone B will fall within the jurisdictional BVW boundaries and thus no jurisdictional Bordering Land Subject to Flooding (BLSF) as identified in MWPR 310 CMR 10.57 occurs on the property. Figure 2 illustrates the floodplain area designated on the Community Panel Numbers 250227-0002 B and 250227 0004 B of the FIRM for the Town of Wilmington, Massachusetts.

All upland portions of the site falling within 100 feet of the onsite or adjacent wetland boundary when the boundary delineates the edge of BVW or Bank are considered jurisdictional buffer zone area subject to regulation under the MWPR. No buffer zone is dictated for the small isolated wetland, Area DD, by state regulation.

4.1.2 Wetland Boundary Delineation

Due to the nature of the site, only slight variations were observed in the jurisdictional boundaries of the wetland areas using the respective delineation approaches in the state and federal regulations. As a result, one wetland boundary was established which encompasses the state and federal wetland jurisdictional boundary for each area. The wetland delineation placed in the

* Zone B is defined as: "Areas between limits of the 100-year flood and 500-year flood; or certain areas subject to 100-year flooding with average depths less than one (1) foot or where the contributing drainage area is less than one square mile; or areas protected by levees from the base flood."

field represents the upper limit of either the state wetland boundary based on the predominance (50% or more) of wetland indicator species, or a federal wetland boundary based on the three parameter approach as defined by the 1987 Federal Manual for Delineating Jurisdictional Wetland Areas.

The field delineation was conducted by placing consecutively numbered solid pink flags at intervals along the wetland boundary. The interval between flags is determined by the configuration of the boundary and density of vegetation. The wetland flags series used to complete the delineation are: A1-A60, B1-B23, C1-C53, D1-D118, E1-E16, F1-F6, G1-G16, H1-H20, J1-J18, S1-S16, U1-U58, V1-V13, W1-W34, X1-X28, Y1-Y29, and Z1-Z22 respectively.

Wetland flags were placed in the field according to the criteria for delineation provided in the MWPR. The flags identify the limit where 50 percent or more of the vegetation cover by stratum (tree, sapling, shrub, liana (vine) and herbaceous) is made up of wetland indicator species or according to the multi-disciplinary technical criteria utilized by the federal government for wetland delineation, whichever location was higher on the topography.

In utilizing the federal methodology, the wetland flags identify areas which exhibit evidence of hydrophytic vegetation, hydric soils and wetland hydrology.

Circular plots were utilized for the vegetation and soil sampling and plot size for each respective stratum was adjusted according to site conditions. In general, vegetation plot sizes for each stratum are as follows: tree and liana - 30 foot radius, sapling and shrub - 15 foot radius, and herbaceous 5 foot radius. Trees were sampled by measuring the dbh of each stem in the plot and the

corresponding value was then recorded on the data form. Sapling, shrub, herbaceous and liana species were sampled by calculating the percent aerial coverage of each species in the stratum. The status of plant species as wetland indicator plants was determined using the National List of Wetland Plants for Massachusetts dated May 1988.

Soil observation holes within the plot area were dug by hand using tile spade and/or dutch auger. The point of measurement of the soil surface does not include the forest duff (recognizable plant remains/fibric non-soil material per USDA format) for mineral soils. For organic soils and mineral soils with a histic epipedon (thick organic surface layer), the soil surface is the top of the uppermost organic horizon. All soil colors are based on standardized notation and color chips of the Munsell Soil Color Chart (1990 Edition) and a moist condition unless noted otherwise.

Any soil profile descriptions and vernacular are based on currently accepted terminology of the United States Department of Agriculture (USDA)/Soil Conservation Service (SCS). Color, texture, structure, consistence and other physical soil properties are based on field estimations; no laboratory tests were performed.

Hydric soil determinations are based on actual field observations of soil morphology as compared to the technical criteria and field indicators listed in the Corps of Engineers Wetlands Delineation Manual dated 1987. For hydric soil determinations, the control section is 20 inches (50 centimeters) minimally, from the soil surface. Soil drainage class determinations are based on actual field observations of soil morphology as compared to the U.S. Army Corps of Engineers -

New England Division, Guidelines For Soil Drainage Class Determination, dated 02/27/91. Soil taxonomy determinations are based on actual field observations as compared to the Keys to Taxonomic Classification of New England Soils by M.R. Cuomo and S.A.L. Pilgrim. January 1991.

4.2 Wetland Area Characterization

4.2.1 Wetland Classification

For the purpose of evaluation, the wetlands on the site were segregated into 6 drainage areas based on the overriding hydrologic characteristics. Each of these areas include one or more wetland classes based on their plant community composition and structural components. Each wetland class has been identified in the field through visual observations of hydrologic and plant community characteristics. Detailed descriptions of the wetland classes within the various drainage areas were documented at strategic observation points which provided representative samples of the wetland types present. Classification of wetland areas on the site is from Classification of Wetlands and Deep Water Habitats of the United States by Lewis M. Cowardin et. al., United States Fish and Wildlife Service.

The various wetland areas found on the site have been classified into the following wetland types:

- Forested wetland - This wetland class is characterized by woody vegetation and normally possesses an overstory of trees, and understory of young trees and shrubs and a low understory of herbaceous species. The forested wetlands on the site are considered broad leaved deciduous and, in general, red maple is the dominant tree species.
- Scrub-shrub wetland - This wetland class is dominated by woody vegetation less than 20 feet tall and includes true shrubs, young trees

and other normally taller shrubs and trees stunted due to environmental conditions, i.e. ice damage, wind damage, frequent flooding or browsing. The scrub-shrub wetlands on the site are considered broad leaved deciduous and are generally dominated by silky dogwood (*Cornus amomum*), highbush blueberry, sweet pepperbush (*Clethra alnifolia*) and glossy buckthorn (*Rhamnus frangula*).

- Emergent wetland - This wetland class is characterized by erect herbaceous species well suited for survival in very wet or inundated soil conditions. In general, the species are most commonly perennial well rooted hydrophytes. The emergent wetlands on the site are considered Palustrine persistent emergent wetlands dominated by such species as cattail (*Typha latifolia*), woolgrass (*Scirpus cyperinus*), purple loosestrife (*Lythrum salicaria*), sedge (*Carex* spp.) and reed (*Phragmites* spp.).
- Unconsolidated bottom - This wetland class includes wetland and standing water areas with at least 25% of the bottom substrate covered by particles smaller than stones (rock fragments larger than 25.4 cm (10 inches) but less than 60.4 cm (24 inches)) and <30% vegetative cover. The small pond on the site fits this description and therefore has been included under this class.
- Streambed - This class includes all the intermittent and perennial drainage channels on the site. Substrate within each streambed can vary greatly depending on local conditions. Streambeds may be scoured and unvegetated or may contain occasional pioneering annuals or perennial emergents and shrubs. The vegetation cover, however, must be too sparse to classify the area as either emergent wetland or scrub-shrub.

4.2.2 Drainage Area Descriptions

4.2.2.1 Drainage Area AA

Area AA is the primary drainage path through the property. It includes the "West Ditch" "South Ditch" and portions of the "East Ditch" systems. Area AA is considered to begin in the three distinct channels of the offsite West Ditch area and flows easterly under the abandoned railroad at a stone box culvert and onto the property. The three offsite drainage ditches generally collect water from a drainage basin which is in predominantly commercial and light industrial use. The ditch system receives water from a detention pond located west of Jewel Drive, several roof and parking lot drainages, surface runoff and from groundwater discharges. The West Ditch system is entirely manmade with flow channels along lot lines and along the adjacent railroad line. The West Ditch System flows largely in response to precipitation runoff with significant flows occurring during and immediately following storm conditions. Between storms the principle hydrologic input is groundwater which appears to maintain a small relatively constant flow within the channel once it enters the property. Water collected in the West Ditch system flows under the railroad track via a box culvert and east through the property within a well defined channel (referred to as the South Ditch System).

The West Ditch system is a principal source of surface discharge of site groundwater. The resulting interaction with surface water conditions results in formation of relatively insoluble compounds which form a low density flocculent which drifts with the stream flow and settles throughout the stream bottom in the West Ditch as well as in the remainder of Drainage Area AA. Plans to control the flocculent on the site property have been the focus of considerable study. A detailed evaluation of existing conditions of the West Ditch system was provided

in Wetlands Preservation, Inc.'s Existing Wetland Conditions, Interim Action Plan, West Ditch Precipitate report dated November 2, 1992. This report may be referred to for additional information on the emergent wetland areas within the West Ditch.

The soils within the West Ditch area are heavily disturbed by development activities along Jewell Drive and appear to have been filled and regraded. These soils are classified as Udorthents and have a wet substratum. These soils are considered hydric and most closely resemble poorly drained mineral soils. The stream channels in the lower end of the ditch are also frequently covered with flocculent from the contaminated groundwater release. This flocculent tends to readily resuspend during high runoff periods and the degree of flocculent percent is dependent upon several factors including water flow, water levels and groundwater levels.

Vegetation patterns within the West Ditch System reflect the historically disturbed nature of the area resulting from railroad and industrial development. Vegetation in the ditch system is highly variable with vegetative cover generally dominated by plant species which can tolerate a wide range of hydrologic conditions. Predominant species are purple loosestrife, cattail, Canada rush (*Juncus canadensis*), soft rush (*Juncus effusus*), sedge, common reed, glossy buckthorn and red maple. Vegetation is patchy in distribution, apparently a result of the variations in soil and hydrologic conditions. The vegetation is dominated by an herbaceous stratum throughout the central portion of each ditch with a relatively dense shrub stratum occurring along the bank. The frequency of flooding in this area limits the development of tree and shrub strata throughout most of the central portion of the ditches. The herbaceous plant community will most likely remain dominant with little change within the flooded basin. Table 3

provides details of the current plant community in a typical section of the emergent wetland in the West Ditch. The dominant herbaceous stratum throughout the central portion of this area along with the species composition identifies this area as emergent wetland. Figure 5 illustrates the percent cover by vegetation stratum and the dominance of the herbaceous stratum in the emergent wetland area.

Once on the site property, the stream, now referred to as the South Ditch, receives flow from Area BB and generally deepens and flows easterly across the site. Near the center of the property, the stream flows adjacent to a small manmade pond. A small break in the berm of the pond provides a hydrologic connection with the stream. The direction of flows to and from the pond from the stream are dependent on relative hydrostatic head in each area. The stream continues southeastward past the pond eventually merging with the third major drainage stream (Drainage Area CC) on the site near the fence along the eastern property line. Following the confluence with the flow from Area CC, the stream flows off the property into the railroad ditch along the west side of the MBTA tracks where there is a confluence with flows from Drainage Area EE, also referred to as the East Ditch. The combined flows discharge south to a 24" CMP where it continues through a series of surface and subsurface drainages along the west side of the MBTA railroad tracks to its eventual confluence with Halls Brook just west of the inlet of Halls Brook at Mishawum Lake in Woburn. Halls Brook in this area is highly degraded as a result of industrial urbanization, however, the Halls Brook system does support populations of the Mystic Valley Amphipod (*Crangonyx aberrans*), an invertebrate which is state listed as a Species of Special Concern pursuant to the Massachusetts Endangered Species Act (MGL c. 131A).

The soils in the South Ditch section of Drainage Area AA are heavily disturbed by logging, excavating, regrading and filling, especially at the margins of the current wetland boundary. These soils are classified as Udorthents and have a wet substratum.

The predominant soils inside the wetland boundary are considered hydric and closely resemble very poorly drained mineral soils. The eastern portion of Drainage Area AA, within the confines of the fence line around the parcel, is periodically inundated or ponded during cycles of high groundwater table.

A profile description (typical) for predominant soils within the wetland area reads as follows:

0"	Black (10YR 2/0), fibric plant remains, mucky peat, saturated
6"	Black (10YR 2/0), loam
12"	Gray (10YR 6/1), coarse sandy loam (gleyed)
36"	terminated, refusal (stones)

This description most closely corresponds to Scarboro series soils.

Several wetland community types exist within the South Ditch area, including emergent wetlands, scrub-shrub wetlands, a stream, a pond and wooded wetlands. Most of the stream channel has been dredged and the banks and portions of the streambed have revegetated with emergent wetland vegetation and wetland shrub species. Typically there is manna grass (*Glyceria obtusa*), woolgrass, soft rush and sedges in the herbaceous stratum. There is glossy buckthorn, gray birch and sweet pepperbush in the shrub stratum. Occasionally there is red maple, gray birch, red oak, shadbush and swamp white oak (*Quercus bicolor*) in the tree stratum along the edge of the stream.

The manmade pond is approximately 150′ by 50′ and is located centrally in the property. The pond is hydrologically connected with the stream via a small break in the berm at the southwest corner. The area immediately to the northeast and west of the pond is highly disturbed and contains several gravel berms and piles, most of which have revegetated with upland trees, shrubs and herbaceous species. The pond is well vegetated along the north edge with dense overhanging shrubs and small trees including gray birch and red maple in the tree stratum and glossy buckthorn and red chokeberry (*Aronia arbutifolia*) in the shrub stratum. There are several small open areas along the pond edges vegetated with soft rush, goldenrod (*Solidago* sp.), swamp dewberry (*Rubus hispidus*) and little bluestem (*Andropogon scoparius*) in the herbaceous stratum. Initial investigations indicate the pond as unconsolidated bottom with a mud bottom substrate. Most of the pond bottom has been subject to significant deposition of flocculent material from contaminated groundwater discharges. The pond has a vegetative cover of less than 30% and is permanently flooded. Observations during the summer of 1992 indicate extremely sparse submerged aquatic vegetation exists within the pond area. The edges of the pond are vegetated with an approximate equal percentage of species in the shrub and herbaceous strata with tree, sapling and liana strata generally nonexistent. Table 4 provides details on the plant community of the area immediately along the pond edges. Figure 6 illustrates the dominance of the shrub and herbaceous strata along the pond edge and the general absence of the tree, sapling and liana strata. The dominant species within the herbaceous and shrub strata indicate that this area, while once highly disturbed, is currently in an early successional stage of revegetation.

There is a large scrub-shrub wetland area to the north and northeast of the pond area. In this area, groundwater breakout occurs and generally flows are from the former lagoon area in a southeasterly direction to the South Ditch. There are also several small depressional areas within this scrub-shrub wetland which occasionally pond water. Typically this area contains heavily vegetated shrub thickets with many open clearings interspersed throughout. The clearings are dominated by a dense herbaceous stratum.

Historical data from aerial photography and recent field observations of remnant stumps and downed logs indicate the area east of the old lagoon area and north of the pond area was once forested but has undergone a significant change in vegetation cover. There are rotting tree stumps throughout this scrub-shrub area which show evidence of past cutting activities. While an indepth investigation has not been done, it appears the earlier forest canopy in this area died back within a relatively short period of time. The standing dead trees were subsequently cut and removed from the area. The present scrub-shrub community has become well established in the cleared or open area. Evidence of this mortality has been observed on aerial photographs dated April 13, 1981 and may be related to a variety of factors, including air or water borne contaminants from the old lagoon structure, human induced surface and ground hydrology changes, or natural causes such as gypsy moth defoliation, disease, etc. In general, this area is dominated by gray birch with red maple occasionally present in a sparse tree and sapling strata. The shrub stratum is dominated by gray birch and glossy buckthorn with common elderberry (*Sambucus canadensis*) and highbush blueberry occasionally present. The herbaceous stratum ranges from relatively sparse in the dense thicket portion of this scrub-shrub wetland to dense in the open clearings. Goldenrod, woolgrass and unidentified grasses (*Graminae* spp.) are commonly found

throughout this area with pokeweed (*Phytolacca americana*), tussock sedge (*Carex stricta*) and phragmites (*Phragmites australis*) occasionally present. False buckwheat (*Polygonum scandens*) is occasionally present in the liana stratum.

Provided in Table 5 are the results of vegetation sampling conducted within the scrub-shrub wetland area. The species composition of the tree, sapling and shrub strata are dominated by an early successional species typically found on disturbed sites. Figure 7 illustrates the high percentage of species cover in the shrub and herbaceous strata while the tree, sapling and liana strata are relatively sparse.

Also present in Drainage Area AA is a small portion of forested wetland adjacent to the fence at the east property line. This area is typically vegetated with a mature overstory with red maple dominant and white oak, gray birch, black cherry and white pine occasionally present in the tree stratum. Red maple and gray birch are found in the sapling stratum. The shrub stratum is dense at the perimeter of this area and generally sparse toward the center. Glossy buckthorn, red maple and highbush blueberry are found with shadbush occurring occasionally. No species were observed in the liana stratum. The herbaceous stratum consists of glossy buckthorn seedlings and an unidentified fern species. The vegetational composition of this area is generally evenly distributed among the tree, sapling and shrub strata with a sparse herbaceous stratum and no liana stratum present. The plant community composition is typically broad leaved deciduous. Table 6 provides results of vegetation sampling within this forested wetland area. Figure 8 illustrates the approximately equal percent coverages of tree, sapling and shrub strata, a generally sparse herbaceous stratum and a nonexistent liana stratum for the sample. The degree of stratification and dominance of the older tree and sapling species indicates this area has not undergone recent disturbances.

4.2.2.2 Drainage Area BB

Area BB is generally located west of the main site buildings and also includes a small area in the northwest corner of the site. This small drainage area begins in the northwest property corner and is joined by a second small drainage originating from a culvert at the outfall for the water treatment facility on the site. The flows through the culvert are intermittent and depend on water treatment system discharges and runoff on the site. Together, these flows form the main stream which flows south along the west property line. The lower portion of the drainage in Area BB is a dug channel. The flow in the channel continues south to a 36" culvert running under the access road midway along the west side property line on the site. A short distance below the culvert, the drainage merges with the flow in Drainage Area AA.

The soils of Wetland Area BB are heavily disturbed by historic site activities which include excavating, regrading and filling in and around the borders of the wetland. The area also historically received stormwater runoff from roofs and other impervious surfaces located on the developed (northerly) portion of the site. These soils are classified as Udorthents due to the site history.

The predominant soil condition within the wetland represents a very poorly drained organic soil. These soils have a very wet substratum and are considered hydric. A profile description (typical) for the existing unfilled wetland area reads as follows:

0"	Black (10YR 2/0), highly decomposed sapric muck
30"	Brown (7.5YR 5/3), coarse sandy loam
48"	terminated, no refusal

This description most closely corresponds to Freetown series soils.

Area BB contains several wetland classes associated with the small drainage stream flowing south through the area. The northern portion of Area BB is generally an emergent wetland at the center with a plant community dominated by cattail, meadowsweet (*Spiraea latifolia*), goldenrod and purple loosestrife. Surrounding the open marsh portion is an area of forested wetland dominated by red maple, gray birch and swamp white oak in the tree stratum; red maple in the sapling stratum; highbush blueberry, shadbush and glossy buckthorn in the shrub stratum; and cinnamon fern in the herbaceous stratum.

Associated with the middle portion of the stream in Area BB is a similar open marsh area typically vegetated with cattail, purple loosestrife, meadowsweet and goldenrod. Occasionally there is glossy buckthorn, red maple and gray birch present in the shrub stratum along the side slope/perimeter areas. The vegetation of this area is dominated by the herbaceous and shrub strata with tree, sapling and liana strata generally nonexistent. The majority of this area is an open emergent wetland system with shrub species present along the perimeter. Due to the flooding frequency in the area, the vegetation is not highly stratified and it is unlikely, due to the saturated and occasionally inundated soils, that rapid successional changes in the plant community will occur within the flooded basin. Table 7 provides details on the current plant community composition of the open wetland portion of Area BB. The dominant herbaceous stratum and the subdominant shrub stratum illustrated in Figure 9 identify this area as emergent wetland.

The plant community in the southern most portion of Area BB is typically a forested wetland dominated by gray birch with quaking aspen (*Populus tremula*) with swamp white oak also present. The sapling stratum is dominated by gray birch and the shrub stratum is predominantly glossy buckthorn with gray birch and highbush

blueberry also present. No species were observed in the liana stratum and in the herbaceous stratum there are several fern species (all were unidentified due to the season of the year) and glossy buckthorn dominant with sedges, goldenrod and swamp dewberry also present. Table 8 provides the results of the vegetation sampling in the forested wetland portion of Area BB. The species composition found in this area indicates that this area has undergone a previous disturbance and is in an early forest successional stage. Figure 10 illustrates the relative dominance of the shrub and herbaceous strata.

There is evidence of past cutting activities in this area and several large rotting stumps remain in the area. The main channel of the stream through this area is through a manmade ditch which contains flows directly to the 36" CMP at the access road along the west side property line. The southerly portion of the area also includes a remnant manmade ditch which no longer contains flowing water.

4.2.2.3 Drainage Area CC

Drainage Area CC is located south of Drainage Area AA and surface water from Area CC flows to the east eventually entering Drainage Area AA near the eastern property line. This small drainage stream begins as groundwater breakout in a large, relatively flat scrub-shrub swamp located along the western side of the property. Drainage Area CC contains two wetland types, a scrub-shrub portion along the west side property line directly south and adjacent to the main drainage stream (Drainage Area AA) on the site and a larger forested wetland complex located along the eastern portion of the drainage. Drainage Area CC extends from the west property line through the center portion of the property to the confluence with the main drainage Area AA approximately 25' east of the chain link fence at the east property line.

The predominant soils in Wetland Area CC are very poorly drained mineral soils. The western portions of Drainage Area CC have been exposed to some disturbance during past site investigations but the majority of Area CC soils are in a natural condition. Portions of the area are subject to flooding due to bank overflow from the brook and have a water table that is occasionally above the soil surface. The remainder of time the water table is at or very near the soil surface. The soils in this area most closely resemble Swansea series. Poorly drained mineral soils also constitute a significant portion of the wetland area.

The scrub-shrub area is vegetated with dense shrub thickets with occasional small open grassy areas interspersed throughout. In the thicket section, glossy buckthorn is dominant in the shrub stratum, with sweet pepperbush, gray birch seedlings and highbush blueberry also present. The herbaceous stratum is generally sparse here with cinnamon fern, sensitive fern (*Onoclea sensibilis*) and another unidentified fern species occasionally present.

In the open grassy portions of the scrub-shrub area, gray birch and glossy buckthorn are most commonly found in a sparse to medium shrub stratum with sweet pepperbush and highbush blueberry occasionally present. The herbaceous stratum is made up of little bluestem, soft rush, Canada rush and swamp dewberry, with twig rush (*Cladium marisoides*) and several unidentified grasses occasionally present. This portion of the scrub-shrub area contains several depressional areas which pond water during the winter and spring seasons. This area was disturbed during previous dredging activities in the main stream and several berms and small soil piles remain. The vegetation composition of this area is dominated by portions of dense shrub thickets along with open grassy patches scattered throughout.

Although the area does contain open grassy portions in areas of more recent disturbance, the overall plant community makeup best characterizes the area as scrub-shrub wetland. The majority of the area was relatively recently disturbed and is in an early successional stage with the shrub and herbaceous strata dominant. The tree, sapling and liana strata are generally nonexistent. The hydrologic conditions in this area are similar to the adjacent wooded swamp and this area will most likely develop a tree and sapling overstory over time. Table 9 provides details on the current plant community composition of this wetland area. The occurrence of a dense shrub stratum interspersed with open grassy patches identifies this area as scrub-shrub wetland. Figure 11 illustrates the dominance of the shrub and herbaceous strata in representative portions of the thicket and open meadow areas within the wetland. The species composition and structural characteristics indicate past disturbance to this area and identify the wetland area as being in a relatively early successional stage.

The eastern portion of Area CC is a forested wetland and is typical of red maple swamps in New England. The tree stratum is dominated by red maple with gray birch, swamp white oak, red oak, white oak, black cherry, white pine and pitch pine also occasionally present. The average diameter of trees in the overstory, excepting gray birch, is 12" dbh. The sapling stratum is made up of red maple while the shrub stratum is dominated by glossy buckthorn and red maple with Northern arrow-wood (*Viburnum recognitum*), highbush blueberry and red chokeberry occasionally present. The predominant observed species in the herbaceous stratum were cinnamon fern and glossy buckthorn seedlings with sphagnum (*Sphagnum* sp.), royal fern (*Osmunda regalis*), wood fern (*Dryopteris* sp.) and an unidentified fern species present but in lesser numbers. No species were observed within the liana stratum during the vegetation sampling. The vegetation composition of this area

is typical of forested wetlands. The tree, shrub and herbaceous strata are the most prevalent, the sapling stratum is sparse and there were no liana observed. The average diameter of the trees is 12 inches dbh.

This gray birch/red maple stand type is typical on abandoned farm land. The birch component is generally short lived, usually dying back in 60 years or less. As is typical of most wooded swamps in New England, this community is a sere, or a step in the successional stage, and will change over time as the vegetation community matures. Table 10 provides the results of the vegetation sampling in the forested wetland portion of Drainage Area CC. The species composition found in this area indicates that the forested wetland is currently in an early to mid successional stage with generally little or no recent disturbances within the forest. Figure 12 illustrates the generally high degree of vertical stratification in the forested wetland.

4.2.2.4 Drainage Area DD

Area DD is an isolated basin which receives surface runoff during storm events from the surrounding area particularly the steep side slopes associated with the offsite landfill located to the southeast. Several hydrology indicators observed in the area including water stains on exposed rocks, rust stains on fence posts along the property line, and water stained leaves confirm that this area is inundated periodically.

The predominant soils in Wetland Area DD are very poorly drained mineral soils which are somewhat disturbed. These soils often are inundated. The soils in this area most closely resemble Swansea series. There are somewhat poorly drained and poorly drained soils found here as well.

The wetland area in Drainage Area DD is an emergent wetland dominated by herbaceous hydrophytic vegetation throughout the center portion with generally sparse tree, sapling and shrub strata along the outer perimeters. The central portion of the area is densely vegetated with purple loosestrife dominant in the herbaceous stratum with goldenrod, jewelweed (*Impatiens capensis*), sedges and soft rush also present. Occasionally there is evening primrose (*Oenothera* sp.) in the stratum. The edge areas are vegetated with black willow (*Salix nigra*) and red maple in a sparse tree stratum. Red maple forms a sparse sapling stratum along the perimeter of the area. Glossy buckthorn and common elderberry are found in the shrub stratum which is also restricted to the perimeter of the basin. There were no species observed in the liana stratum. The vegetational composition of this area is dominated by a dense herbaceous stratum with trees, sapling and shrubs occurring in approximate equal densities around the perimeter. The majority of this isolated area is an emergent wetland. Due to frequent flooding in this area, the vegetation is not highly stratified and it is unlikely due to the hydrologic conditions that rapid change in the plant community structure will occur within the flooded basin. Table 11 provides details on the current vegetation characteristics of this wetland area. Although tree, sapling and shrub strata are present, they occur in a relatively small area along the perimeter of this area. The herbaceous stratum throughout the central portion of this wetland area is composed of dominant species found in emergent wetlands. Figure 13 illustrates the overwhelming dominance of the herbaceous stratum in this area.

4.2.2.5 Drainage Area EE

Area EE has historically been referred to as the East Ditch System and is located to the east of the property along the west side of the MBTA railroad tracks. The drainage begins at a 24" culvert immediately south of the bridge over the railroad

tracks on Eames Street and extends approximately 2,100 feet south to the confluence of the main stream from the AA area which joins the drainage ditch approximately 200 feet north of a 24" culvert. The main discharge from the property continues through the south portion of the drainage ditch along the west side of the tracks and subsequently enters the 24" culvert which discharges in an open ditch approximately 400' to the south. Eventually the drainage ditch discharges into Halls Brook in Woburn.

The soils of Wetland Area EE are heavily disturbed by historic and ongoing activities related to excavation and maintenance for the railroad tracks. These soils are classified as Udorthents. Additionally, the bottom of the excavation has a wet substratum. These soils are considered hydric and most closely resemble poorly drained mineral soils, however, most of the ditch has been covered with a layer of 1" - 2" crushed aggregate.

The ditch is sparsely vegetated along its entire length with the majority of the vegetation being subject to cutting and/or spraying during maintenance of the railroad easement. Small red maple and glossy buckthorn shrub and tree sprouts occur on the west bank of the ditch. Herbaceous species observed include purple loosestrife, sedge, soft rush, several grasses and swamp dewberry. The east bank of the ditch is entirely made up of crushed stone and occasionally contains glossy buckthorn and red maple sprouts. Due to its proximity to the railroad ROW, this area is heavily maintained by vegetative cutting and/or spraying. The heavily maintained nature of this area generally restricts plant community establishment.

The inundated portion of the ditch is unvegetated with a variable sand, mud and cobble-gravel bottom. Sparse herbaceous and shrub strata are present along the

west bank of the ditch. Due to MBTA maintenance schedules, this area is anticipated to remain as a sparsely vegetated ditch and is considered to fall within the Unconsolidated Bottom wetland classification due to the bottom substrate and low percentage of plant species coverage. Table 12 provides details of the limited plant community of this area. The poor substrate and highly disturbed nature of the ditch limit the plant community to a sparse herbaceous and shrub strata. Figure 14 illustrates the dominance of the sparse herbaceous and shrub strata present in this area.

5.0 Wildlife Utilization of Site

During the wetland delineation activities and several follow-up site visits, general observations of onsite wildlife habitat characteristics were made within the various wetland upland areas. These observations included plant community composition and structure, occurrence of edge and transition zones, hydrologic characteristics, leaf litter and substrate characteristics, nesting, denning and travel corridor sites as well as actual observations of individual species using the area.

In general, the site contains a diverse mix of wetland and upland habitats. This diversity of habitat can enhance an area's overall ability to support and sustain equally diverse wildlife populations. The mosaic of dense scrub-shrub thickets interspersed among the forested wetland, and the presence of pond and stream corridors increases the available edge habitat important to many small mammals and songbirds. The changes in vertical stratification from dense wooded areas into open wet meadow, marsh and maintained upland fields provides browsing, sunning and feeding areas. During the site visits, observations of Eastern cottontail rabbits (*Sylvilagus floridanus*) and their sign such as tracks, pellets and burrows

confirms a utilization of the site by this species. Several larger animal dens were also observed on the site and may be utilized by woodchuck (*Marmota monax*), opossum (*Didelphis virginiana*) or quite likely fox (*Vulpes fulva*). Fox and raccoon (*Procyon lotor*) tracks as well as travel lanes under the chain link fence along the south property line were observed. During the site evaluation, woodchuck remains were found in Drainage Area AA and a dead opossum was observed in the upland forested area south of Drainage Area CC.

The chain link fence enclosing the entire property, while passable by smaller mammals, restricts usage of the site by larger mammals. The land use patterns of the surrounding area also limit the types of wildlife species in the area, therefore it is unlikely mammals other than those typical to urban areas such as gray squirrel (*Sciurus carolinensis*), raccoon, woodchuck, rabbit, opossum and skunk (*Mephitis mephitis*) frequent the area.

Several significant snags as well as downed hollow trees were observed in both the forested wetland and forested upland portions of the site. Cavities and burrow holes indicated use by birds, however, due to the season of observation, which was generally after the fall migration season, bird sightings were limited. Species observed during the site visits included black capped chickadees (*Parus atricapillus*), blue jays (*Cyanocitta cristata*), sparrows (unidentified) and a downy woodpecker (*Dendrocopus pubescens*). Several small songbird nests were observed in the dense thicket portions of the scrub-shrub wetland areas.

There are many areas on the site which may be important in providing reptile and amphibian habitat. The various perennial and intermittent streams, the pond and intermittently flooded areas, the variability of substrates from soft burrowable

mud to rocky crevice laden stream bottoms, and the occurrence of many downed and rotting logs and stumps in some portions of the site are physical and structural characteristics which contribute to reptile and amphibian habitat. Many of these areas are, however, impacted to varying degrees by past and current human activities on the site including vegetation control, disturbed soil conditions, flocculent sedimentation. As a result, the site appears to provide only marginal habitat for reptiles and amphibians. Various observations of amphibians were made during several visits to the site including Northern leopard frog (*Rana pipiens pipiens*) and bull frog (*Rana catesbeiana*) sightings. Given the nature of the wetland areas on the site, spring peepers (*Hyla crucifer crucifer*) and wood frogs (*Rana sylvatica*) are also likely to occur.

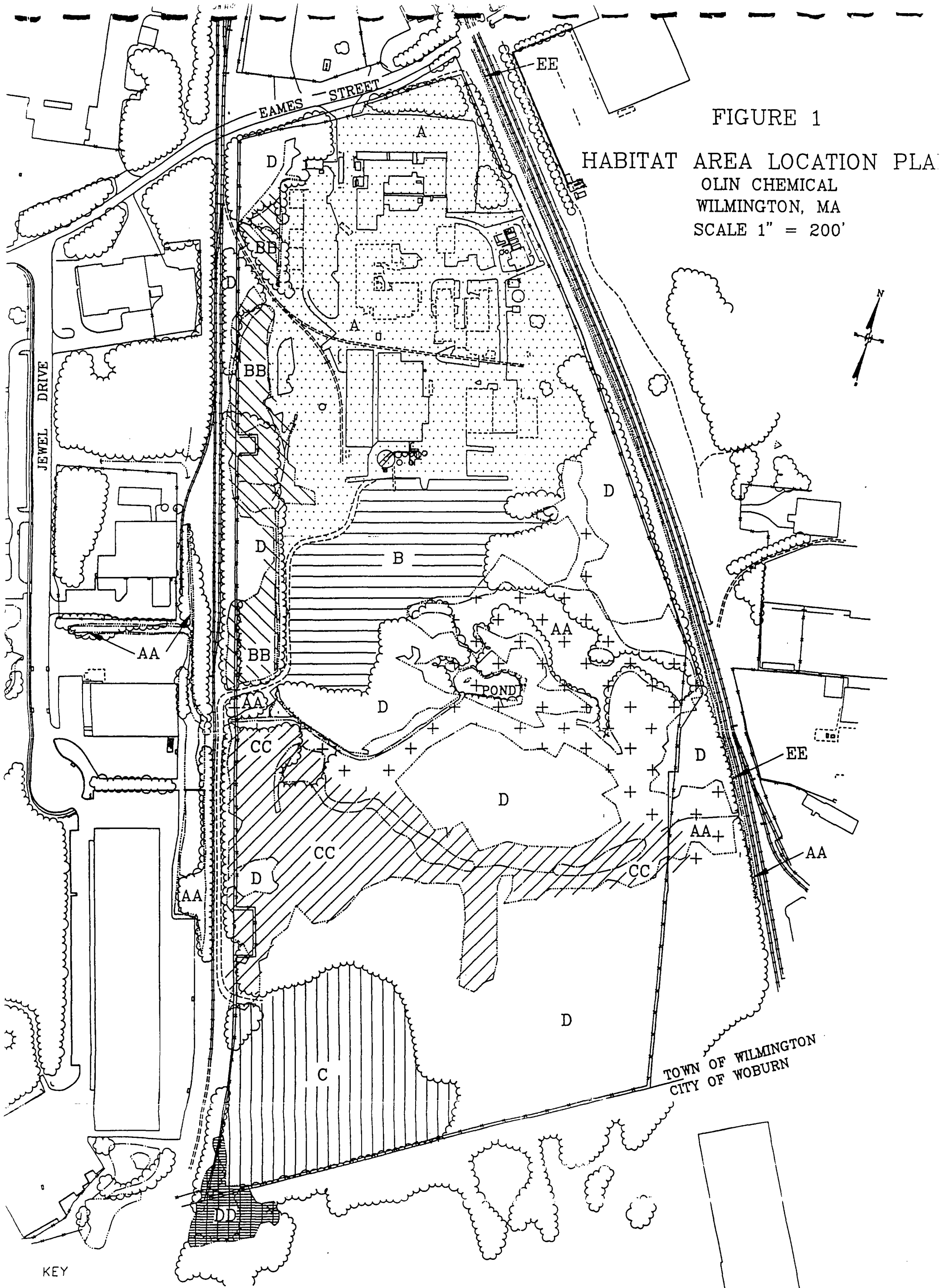
The proximity of unbroken forest cover along the south edge of the central wetland area can provide corridors between the wetland area into and beyond the buffer zone in the upland forest. The cleared forest at the interface between the landfill area and lagoon area and the forested uplands can provide important "edge" essential for a variety of small songbirds, mammals and reptiles which utilize the open field to feed and sun but which need the heavily stratified dense forest canopy cover for shelter and nesting.

Summary Perspective of Wildlife Usage

The site contains a variety of upland and wetland habitats which contain wildlife habitat characteristics such as denning, feeding, sheltering and nesting sites which are useful to a wide variety of birds, small mammals, reptiles and amphibians. The transition areas between the various upland and wetland habitats and the interspersion of individual habitat types within the upland and wetland areas are important in providing edge between the dense cover types and the open meadow and grassy portions of the various habitat areas.

The current contamination of the main drainage stream in the Drainage Area AA reduces the overall water quality of this portion of the site. While the various wetland and upland habitats adjacent to the stream currently contain useful wildlife habitat characteristics, the poor water quality and past human disruption of the area limit the habitat value of this portion of the site.

The current industrial complex on the north portion of the site limits the usefulness of this area to many small mammals and birds which require tracts of undisturbed woodland for seclusion and shelter. The existing chain link security fence erected in 1981 inhibits movement of larger mammals on and off the site thus restricting habitation of the site by these animals as well as the use of adjacent habitat types. The open paved and grassy areas on the north portion of the site may enhance sunning and feeding areas for select birds, small mammals such as rodents, squirrels and rabbits, and reptiles such as snakes.



KEY

A	HEAVILY MAINTAINED/INDUSTRIAL
B	HEAVILY MAINTAINED/OPEN FIELD – FORMER LAGOON AREA
C	HEAVILY MAINTAINED OPEN FIELD – GYPSUM DUMP
D	FORESTED UPLAND
AA	DRAINAGE AREA AA – UNCONSOLIDATED BOTTOM – POND/SCRUB–SHRUB WETLAND/FORESTED WETLAND – "SOUTH DITCH" EMERGENT WETLAND – "WEST DITCH"
BB	DRAINAGE AREA BB – EMERGENT WETLAND/SCRUB–SHRUB WETLAND/FORESTED WETLAND
CC	DRAINAGE AREA CC – SCRUB–SHRUB WETLAND/FORESTED WETLAND
DD	DRAINAGE AREA DD – EMERGENT WETLAND – ISOLATED
EE	DRAINAGE AREA EE – UNCONSOLIDATED BOTTOM – "EAST DITCH"

Figure 11

Drainage Area CC

Scrub-Shrub Component

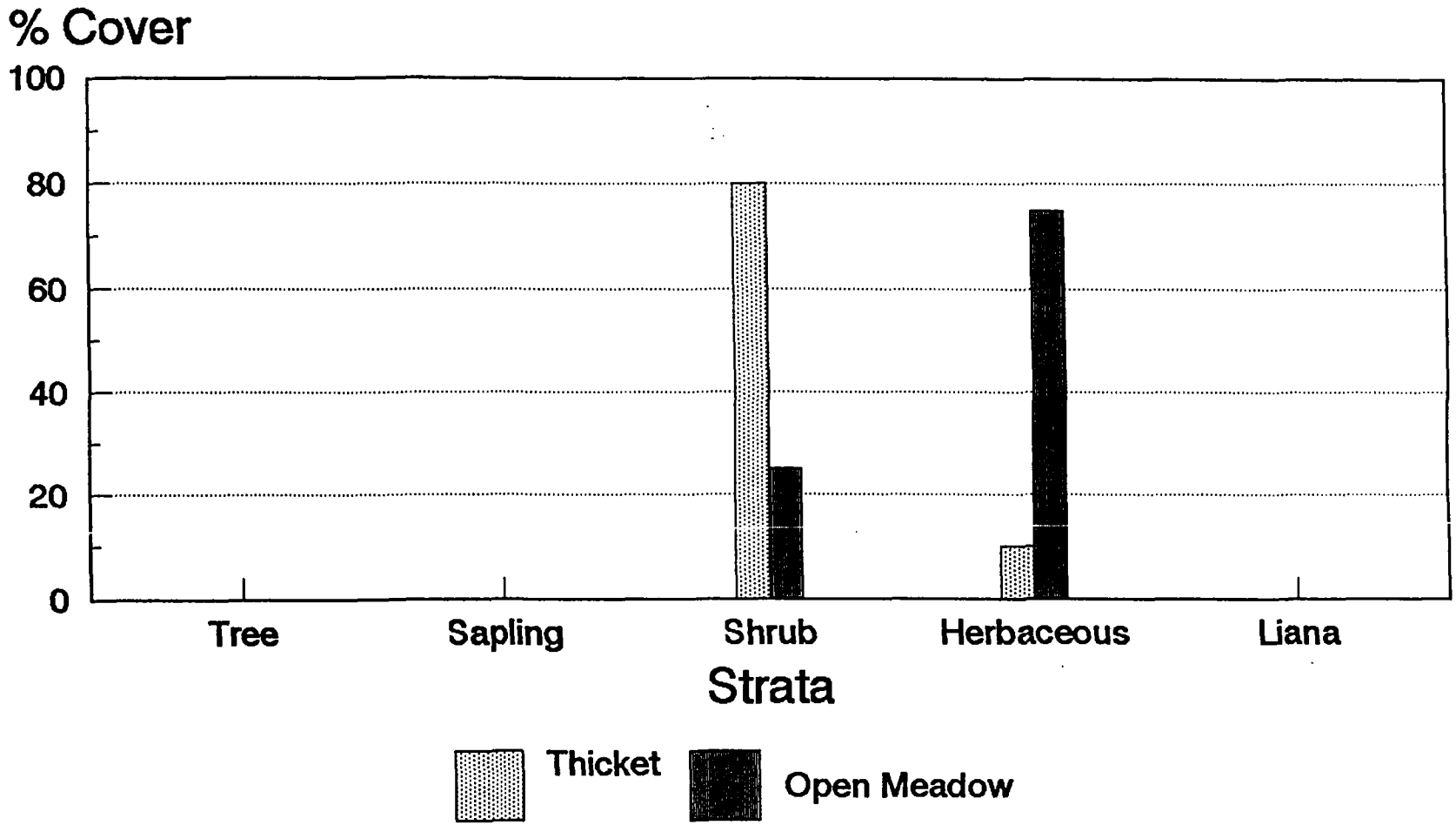


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Figure 12

Drainage Area CC

Forested Wetland Component

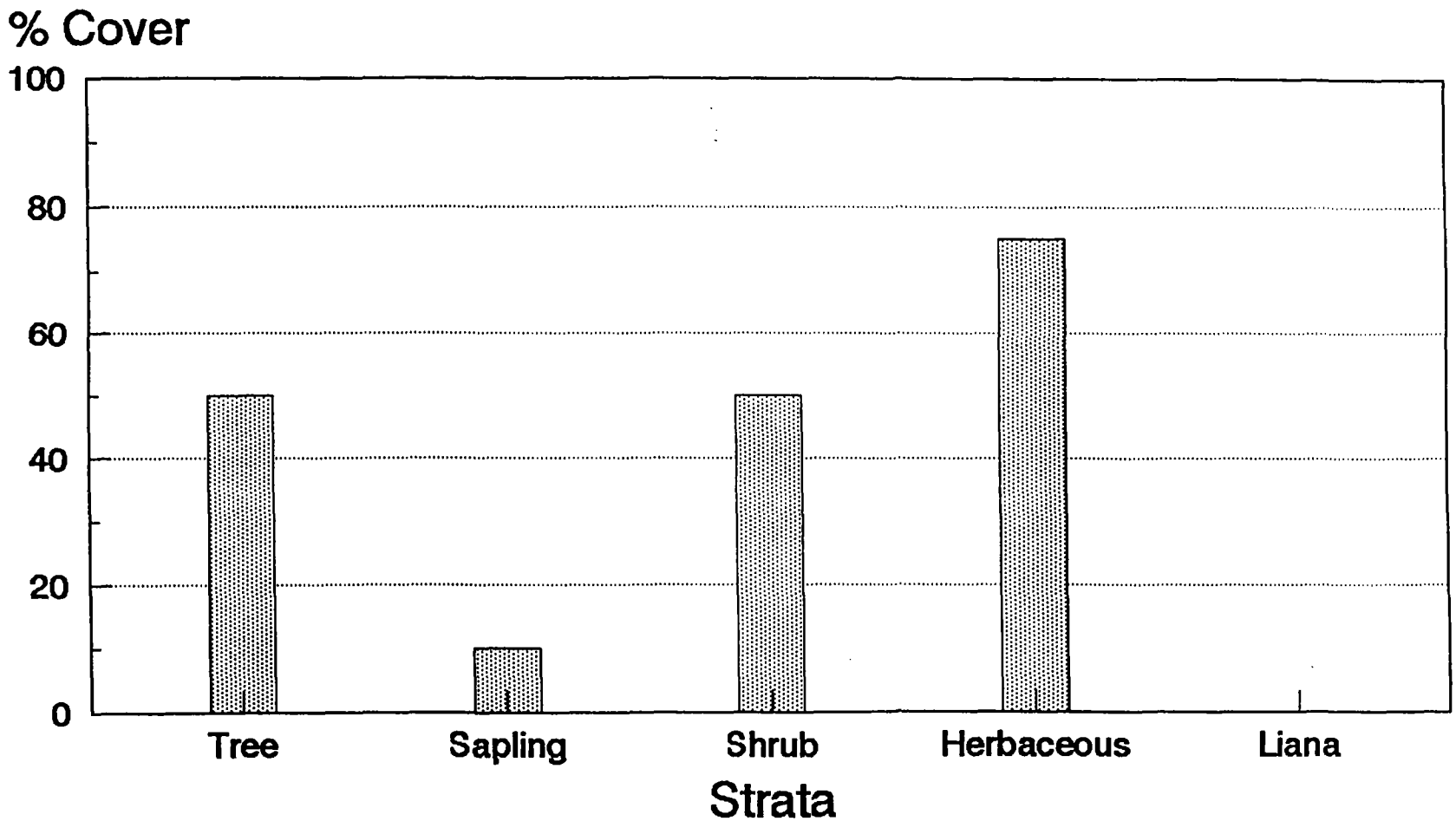

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Figure 13

Drainage Area DD

Emergent Wetland Component

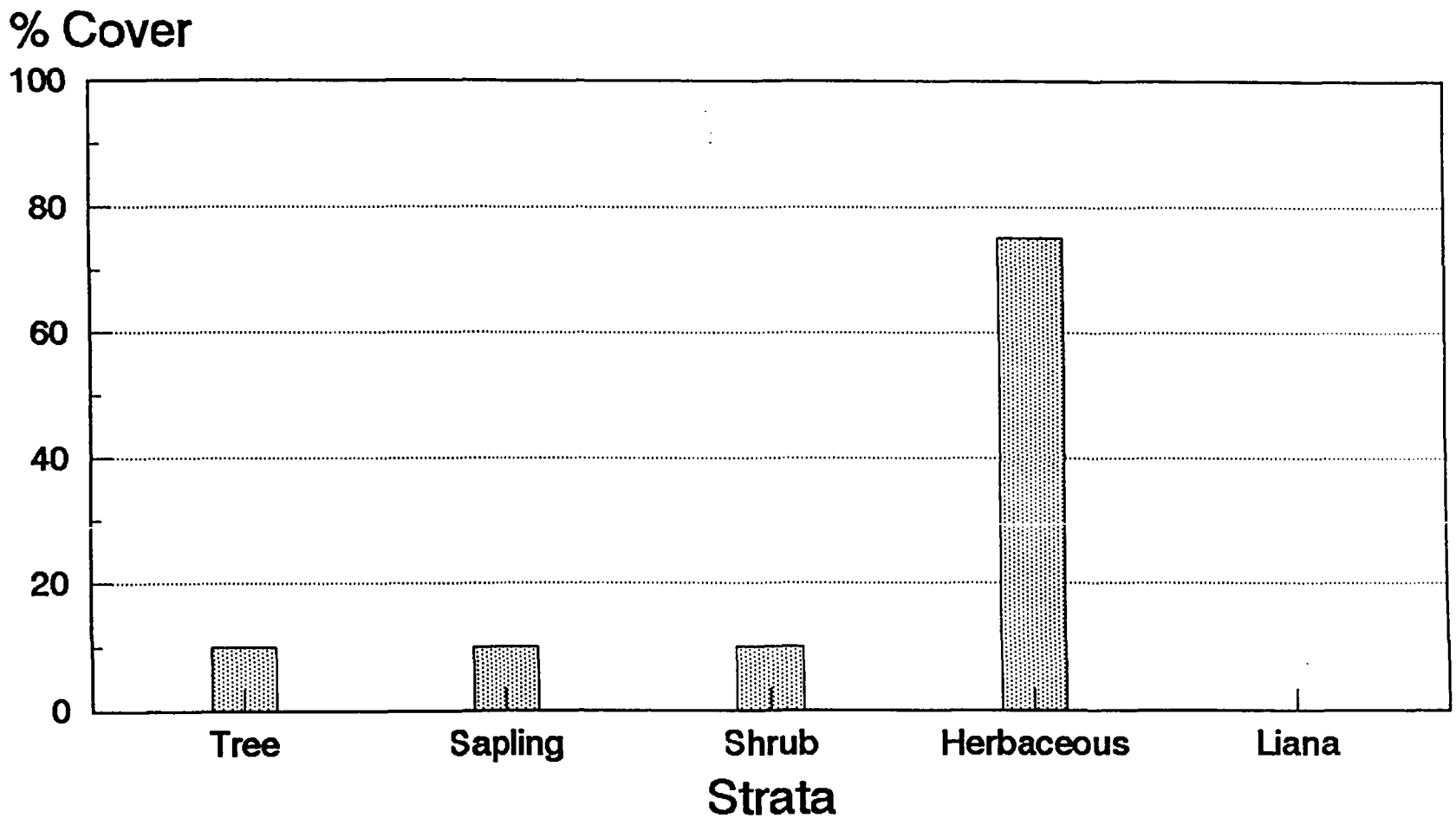

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Figure 14

Drainage Area EE

Unconsolidated Bottom Component (Ditch)

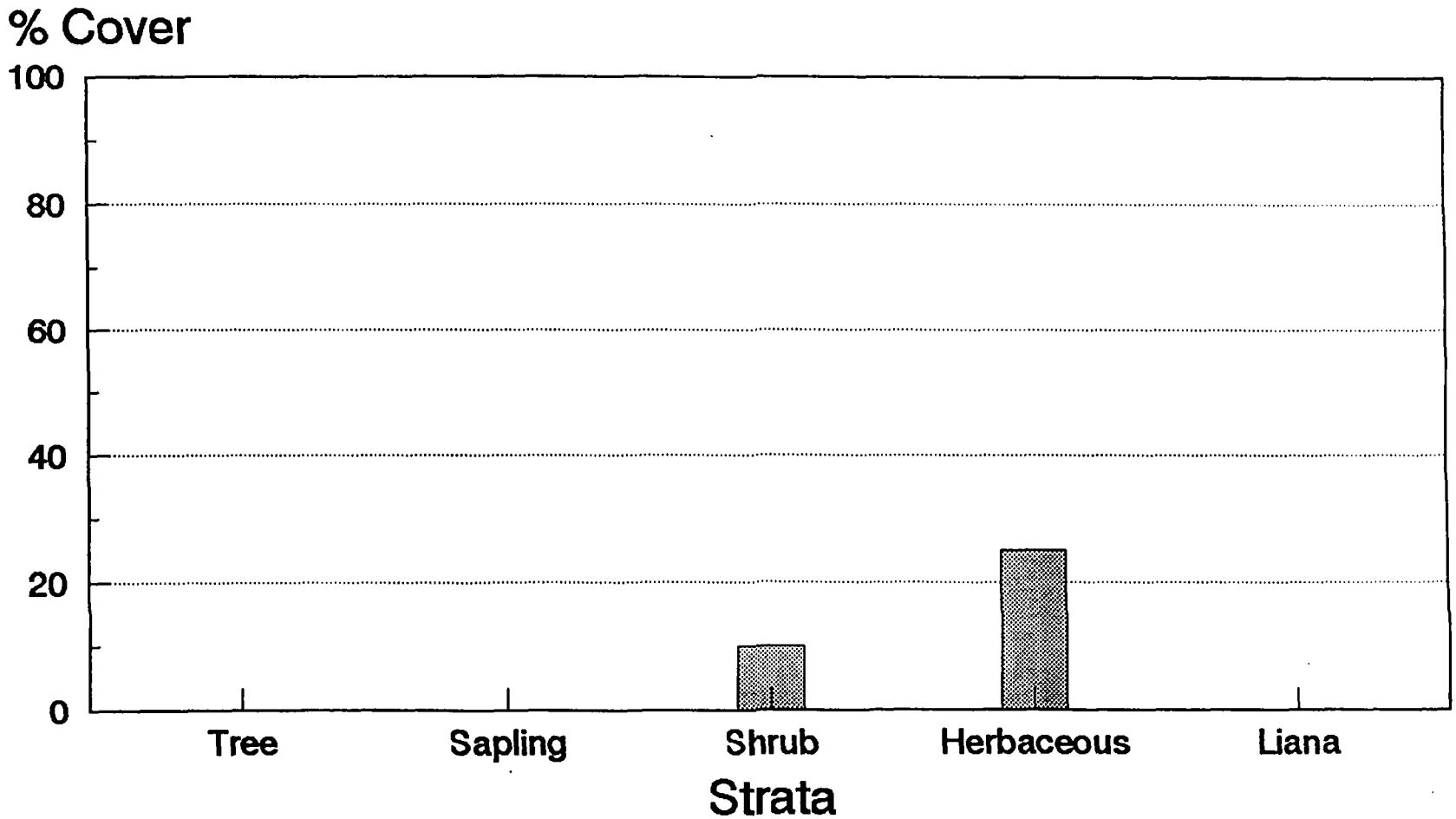

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Table 1

Plant Community Composition

Upland Area D

Forested Upland Island Component

Stratum	Scientific Name	Canopy Closure	Species Dominance	NWI Status
Tree		Dense		
white pine	(*Pinus strobus*)		D	FACU
white oak	(*Quercus alba*)		D	FACU-
black cherry	(*Prunus serotina*)		C	FACU
red maple	(*Acer rubrum*)		O	FAC
Sapling		Sparse		
black cherry	(*Prunus serotina*)		O	FACU
shadbush	(*Amelanchier canadensis*)		O	FAC
red maple	(*Acer rubrum*)		O	FAC
Shrub		Medium Dense		
glossy buckthorn	(*Rhamnus frangula*)		D	FAC
red maple	(*Acer rubrum*)		O	FAC
black cherry	(*Prunus serotina*)		O	FACU
shadbush	(*Amelanchier canadensis*)		O	FAC
Herbaceous		Sparse*		
glossy buckthorn	(*Rhamnus frangula*)		C	FAC
clubmoss	(*Lycopodium complanatum*)		O	FACU

Liana - none observed

*Note: Due to season of observation, limited species observed in herbaceous stratum.

Canopy closure - Very Dense = >80%, Dense = 75%, Medium Dense = 50%, Medium Sparse = 25%, Sparse = <10%

Species density - D = Dominant C = Common O = Occasional

Table 2

Plant Community Composition

Upland Area D

Forested Upland Component

Stratum	Scientific Name	Canopy Closure	Species Dominance	NWI Status
Tree		Dense		
white oak	(*Quercus alba*)		D	FACU-
red oak	(*Quercus rubra*)		C	FACU-
black cherry	(*Prunus serotina*)		O	FACU
Sapling		Medium Dense		
white oak	(*Quercus alba*)		D	FACU-
Shrub		Medium Dense		
red oak	(*Quercus rubra*)		C	FACU-
black cherry	(*Prunus serotina*)		C	FACU
red maple	(*Acer rubrum*)		O	FAC
highbush blueberry	(*Vaccinium corymbosum*)		O	FACW-
Herbaceous		Medium Dense*		
sheep laurel	(*Kalmia angustifolia*)		D	FAC
teaberry	(*Gaultheria procumbens*)		D	FACU
clubmoss	(*Lycopodium complanatum*)		O	FACU
black cherry	(*Prunus serotina*)		O	FACU

Liana - none observed

*Note: Due to season of observation, limited species observed in herbaceous stratum.

Canopy closure - Very Dense = >80%, Dense = 75%, Medium Dense = 50%, Medium Sparse = 25%, Sparse = <10%

Species density - D = Dominant C = Common O = Occasional

Table 3

Plant Community Composition

Drainage Area AA

Emergent Wetland Component

Stratum	Scientific Name	Canopy Closure	Species Dominance	NWI Status
Tree		Sparse		
red maple	(*Acer rubrum*)		D	FAC
Sapling		Sparse		
red maple	(*Acer rubrum*)		D	FAC
Shrub		Medium Dense		
glossy buckthorn	(*Rhamnus frangula*)		D	FAC
Herbaceous		Very Dense		
glossy buckthorn	(*Rhamnus frangula*)		D	FAC
manna grass	(*Glyceria canadensis*)		C	OBL
goldenrod	(*Solidago* sp.)		O	--
spiraea	(*Spiraea tomentosa*)		O	FACW
unidentified herbaceous			O	--

Liana - none observed

Canopy closure - Very Dense = >80%, Dense = 75%, Medium Dense = 50%, Medium Sparse = 25%, Sparse = <10%

Species density - D = Dominant C = Common O = Occasional

Table 4

Plant Community Composition

Drainage Area AA

Unconsolidated Bottom Component (Pond)

Stratum	Scientific Name	Canopy Closure	Species Dominance	NWI Status
Shrub		Medium Dense		
gray birch	(*Betula populifolia*)		C	FAC
red maple	(*Acer rubrum*)		C	FAC
Herbaceous		Medium Dense		
little bluestem	(*Andropogon scoparius*)		C	UPL
goldenrod	(*Solidago* sp.)		C	--
swamp dewberry	(*Rubus hispidus*)		C	FACW
soft rush	(*Juncus effusus*)		O	FACW+

Note: No aquatic vegetation observed due to ice cover on the pond.

Canopy closure - Very Dense = >80%, Dense = 75%, Medium Dense = 50%, Medium Sparse = 25%, Sparse = <10%

Species density - D = Dominant C = Common O = Occasional

Table 5

Plant Community Composition

Drainage Area AA

Scrub-Shrub Component

Stratum	Scientific Name	Canopy Closure	Species Dominance	NWI Status
Tree		Sparse		
gray birch	(*Betula populifolia*)		D	FAC
red maple	(*Acer rubrum*)		O	FAC
Sapling		Sparse		
gray birch	(*Betula populifolia*)		D	FAC
Shrub		Dense		
gray birch	(*Betula populifolia*)		D	FAC
glossy buckthorn	(*Rhamnus frangula*)		D	FAC
elderberry	(*Sambucus candensis*)		O	FACW-
highbush blueberry	(*Vaccinium corymbosum*)		O	FACW-
Herbaceous		Dense		
goldenrod	(*Solidago* sp.)		D	--
grasses	(*Graminae* spp.)		C	--
woolgrass	(*Scirpus cyperinus*)		C	FACW+
pokeweed	(*Phytolaca americana*)		O	FACU+
phragmites	(*Phragmites* sp.)		O	FACW
tussock sedge	(*Carex stricta*)		O	OBL
Liana				
false buckwheat	(*Polygonum scandens*)		O	FACU+

Canopy closure - Very Dense = >80%, Dense = 75%, Medium Dense = 50%, Medium Sparse = 25%, Sparse = <10%

Species density - D = Dominant C = Common O = Occasional

Table 6

Plant Community Composition

Drainage Area AA

Forested Wetland Component

Stratum	Scientific Name	Canopy Closure	Species Dominance	NWI Status
Tree		Medium Sparse		
gray birch	(*Betula populifolia*)		D	FAC
quaking aspen	(*Populus tremula*)		C	FACU
swamp white oak	(*Quercus bicolor*)		O	FACW+
Sapling		Medium Sparse		
gray birch	(*Betula populifolia*)		D	FAC
Shrub		Dense		
glossy buckthorn	(*Rhamnus frangula*)		D	FAC
gray birch	(*Betula populifolia*)		O	FAC
highbush blueberry	(*Vaccinium corymbosum*)		O	FACW-
Herbaceous		Dense		
spinulose wood fern	(*Dryopteris spinulosa*)		D	FAC+
glossy buckthorn	(*Rhamnus frangula*)		C	FAC
goldenrod	(*Solidago* sp.)		O	--
sedge	(*Carex* sp.)		O	--
lady fern	(*Athyrium thelypterioides*)		O	FAC
swamp dewberry	(*Rubus hispidus*)		O	FACW

Liana - none observed

*Note: Due to season of observation, limited species observed in herbaceous stratum.

Canopy closure - Very Dense = >80%, Dense = 75%, Medium Dense = 50%, Medium Sparse = 25%, Sparse = <10%

Species density - D = Dominant C = Common O = Occasional

Table 7

Plant Community Composition

Drainage Area BB

Emergent Wetland Component

Area along ditch - open marsh

Stratum	Scientific Name	Canopy Closure	Species Dominance	NWI Status
Shrub		Medium Dense		
glossy buckthorn	(*Rhamnus frangula*)		D	FAC
red maple	(*Acer rubrum*)		C	FAC
gray birch	(*Betula populifolia*)		O	FAC
Herbaceous		Dense		
cattail	(*Typha latifolia*)		D	OBL
purple loosestrife	(*Lythrum salicaria*)		D	FACW+
spiraea	(*Spiraea latifolia*)		C	FAC+
goldenrod	(*Solidago* sp.)		C	--

Tree, Sapling and Liana strata - none observed

Canopy closure - Very Dense = >80%, Dense = 75%, Medium Dense = 50%, Medium Sparse = 25%, Sparse = <10%

Species density - D = Dominant C = Common O = Occasional

Table 8

Plant Community Composition

Drainage Area BB

Forested Wetland Component

Stratum	Scientific Name	Canopy Closure	Species Dominance	NWI Status
Tree		Medium Dense		
red maple	(*Acer rubrum*)		D	FAC
white oak	(*Quercus alba*)		O	FACU-
gray birch	(*Betula populifolia*)		O	FAC
black cherry	(*Prunus serotina*)		O	FACU
white pine	(*Pinus strobus*)		trace	FACU
Sapling		Medium Dense		
red maple	(*Acer rubrum*)		D	FAC
gray birch	(*Betula populifolia*)		O	FAC
Shrub		Medium Dense		
glossy buckthorn	(*Rhamnus frangula*)		D	FAC
highbush blueberry	(*Vaccinium corymbosum*)		C	FACW-
red maple	(*Acer rubrum*)		C	FAC
shadbush	(*Amelanchier arbutifolia*)		trace	FACW
Herbaceous		Sparse		
glossy buckthorn	(*Rhamnus frangula*)		D	FAC
fern (unidentified)			O	--
Indian pipe	(*Monotropa uniflora*)		trace	FACU-

Liana - none observed

Canopy closure - Very Dense = >80%, Dense = 75%, Medium Dense = 50%, Medium Sparse = 25%, Sparse = <10%

Species density - D = Dominant C = Common O = Occasional

Table 9

Plant Community Composition

Drainage Area CC

Scrub-Shrub Component

Thicket Section

Stratum	Scientific Name	Canopy Closure	Species Dominance	NWI Status
Shrub		Very Dense		
glossy buckthorn	(*Rhamnus frangula*)		D	FAC
sweet pepperbush	(*Clethra alnifolia*)		C	FAC+
gray birch	(*Betula populifolia*)		C	FAC
highbush blueberry	(*Vaccinium corymbosum*)		O	FACW-
Herbaceous		Sparse		
cinnamon fern	(*Osmunda cinnamomea*)		C	FACW
fern (unidentified)			O	--
sensitive fern	(*Onoclea sensibilis*)		O	FACW

Tree, Sapling, and Liana strata - none observed

Open Meadow Section

Shrub		Sparse/ Medium		
gray birch	(*Betula populifolia*)		D	FAC
glossy buckthorn	(*Rhamnus frangula*)		D	FAC
sweet pepperbush	(*Clethra alnifolia*)		O	FAC+
highbush blueberry	(*Vaccinium corymbosum*)		O	FACW-
Herbaceous		Dense		
little bluestem	(*Andropogon scoparius*)		D	UPL
soft rush	(*Juncus effusus*)		C	FACW+
Canada rush	(*Juncus canadensis*)		C	OBL
swamp dewberry	(*Rubus hispidus*)		C	FACW
twig rush	(*Cladium marisoides*)		O	OBL

Tree, Sapling, and Liana strata - none observed

Canopy closure - Very Dense = >80%, Dense = 75%, Medium Dense = 50%, Medium Sparse = 25%, Sparse = <10%

Species density - D = Dominant C = Common O = Occasional

Table 10

Plant Community Composition

Drainage Area CC

Forested Wetland Component

Stratum	Scientific Name	Canopy Closure	Species Dominance	NWI Status
Tree		Medium Density		
red maple	(*Acer rubrum*)		D	FAC
gray birch	(*Betula populifolia*)		C	FAC
red oak	(*Quercus rubra*)		O	FACU-
pitch pine	(*Pinus rigida*)		O	FACU
white oak	(*Quercus alba*)		O	FACU-
black cherry	(*Prunus serotina*)		O	FACU
white pine	(*Pinus strobus*)		O	FACU
Sapling		Sparse		
red maple	(*Acer rubrum*)		D	FAC
Shrub		Medium Dense		
glossy buckthorn	(*Rhamnus frangula*)		D	FAC
red maple	(*Acer rubrum*)		C	FAC
Northern arrow-wood	(*Viburnum recognitum*)		O	FACW+
Herbaceous		Dense		
cinnamon fern	(*Osmunda cinnamomea*)		D	FACW
sphagnum	(*Sphagnum* sp.)		C	OBL
royal fern	(*Osmunda regalis*)		C	OBL
glossy buckthorn	(*Rhamnus frangula*)		C	FAC
wood fern	(*Dryopteris* sp.)		O	--
fern (unidentified)			O	--

Liana - none observed

Canopy closure - Very Dense = >80%, Dense = 75%, Medium Dense = 50%, Medium Sparse = 25%, Sparse = <10%

Species density - D = Dominant C = Common O = Occasional

Table 11

Plant Community Composition

Drainage Area DD

Emergent Wetland Component

Stratum	Scientific Name	Canopy Closure	Species Dominance	NWI Status
Tree		Sparse		
willow	(*Salix* sp.)		D	FACW+
red maple	(*Acer rubrum*)		C	FAC
Sapling		Sparse		
red maple	(*Acer rubrum*)		C	FAC
Shrub		Sparse		
glossy buckthorn	(*Rhamnus frangula*)		D	FAC
elderberry	(*Sambucus canadensis*)		O	FACW-
Herbaceous		Dense		
purple loosestrife	(*Lythrum salicaria*)		D	FACW+
goldenrod	(*Solidago* sp.)		C	--
jewelweed	(*Impatiens capensis*)		C	FACW
sedge	(*Carex* sp.)		C	--
soft rush	(*Juncus effusus*)		O	FACW+
evening primrose	(*Oenothera* sp.)		trace	--

Liana - none observed

Canopy closure - Very Dense = >80%, Dense = 75%, Medium Dense = 50%, Medium Sparse = 25%, Sparse = <10%

Species density - D = Dominant C = Common O = Occasional

Table 12

Plant Community Composition

Drainage Area EE

Unconsolidated Bottom Component (Ditch)

Stratum	Scientific Name	Canopy Closure	Species Dominance	NWI Status
Tree and Sapling strata - none observed				
Shrub		Sparse		
red maple	(*Acer rubrum*)		C	FAC
glossy buckthorn	(*Rhamnus frangula*)		C	FAC
Herbaceous		Medium Sparse		
purple loosestrife	(*Lythrum salicaria*)		C	FACW+
sedge	(*Carex* sp.)		C	--
soft rush	(*Juncus effusus*)		O	FACW+
grasses	(*Graminae* spp.)		O	--
swamp dewberry	(*Rubus hispidus*)		O	FACW
Liana - none observed				

Canopy closure - Very Dense = >80%, Dense = 75%, Medium Dense = 50%, Medium Sparse = 25%, Sparse = <10%

Species density - D = Dominant C = Common O = Occasional

Figure 9

Drainage Area BB

Emergent Wetland Component

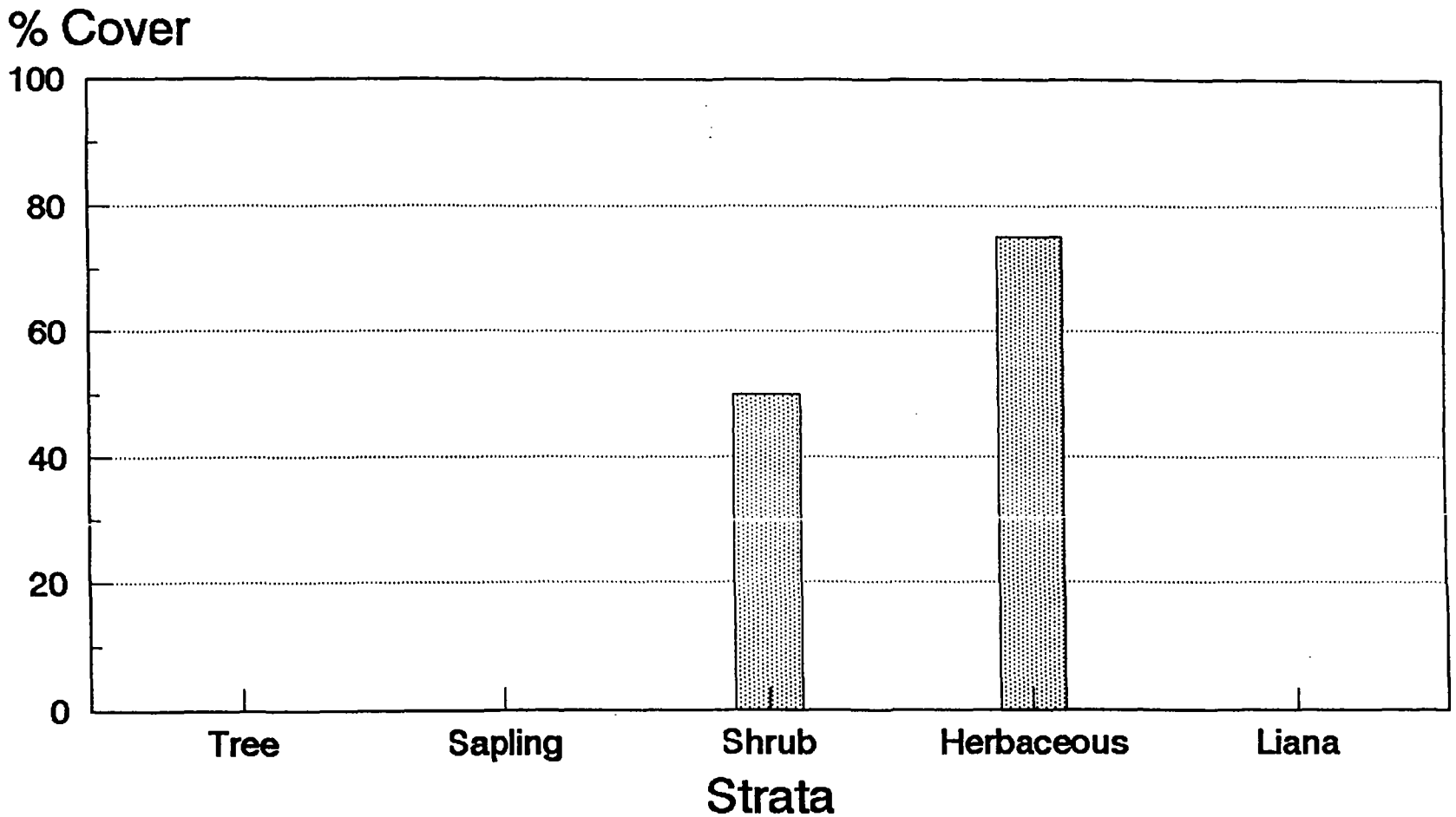

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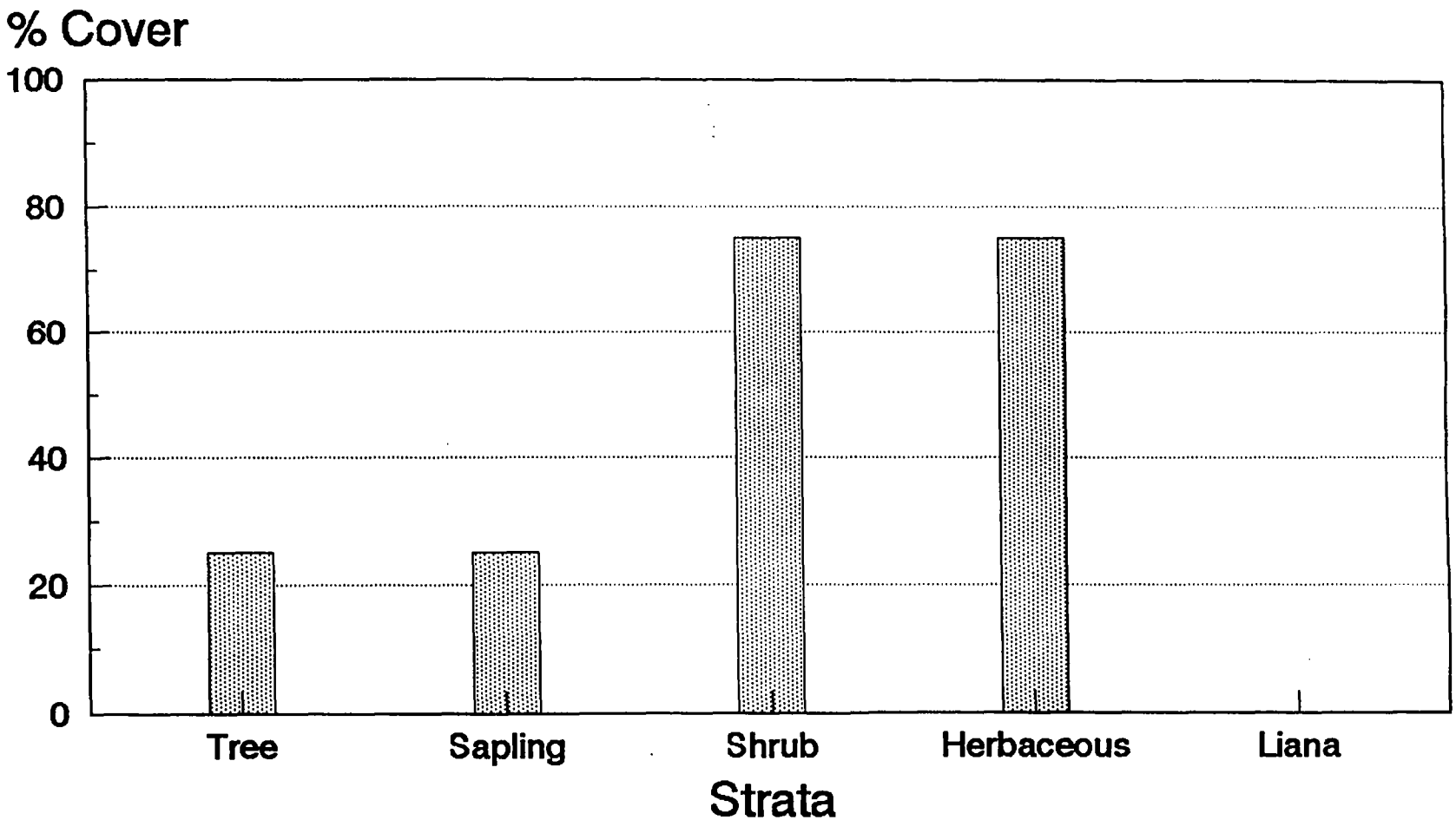
Figure 10

Wetland Area BB

Forested Wetland Component



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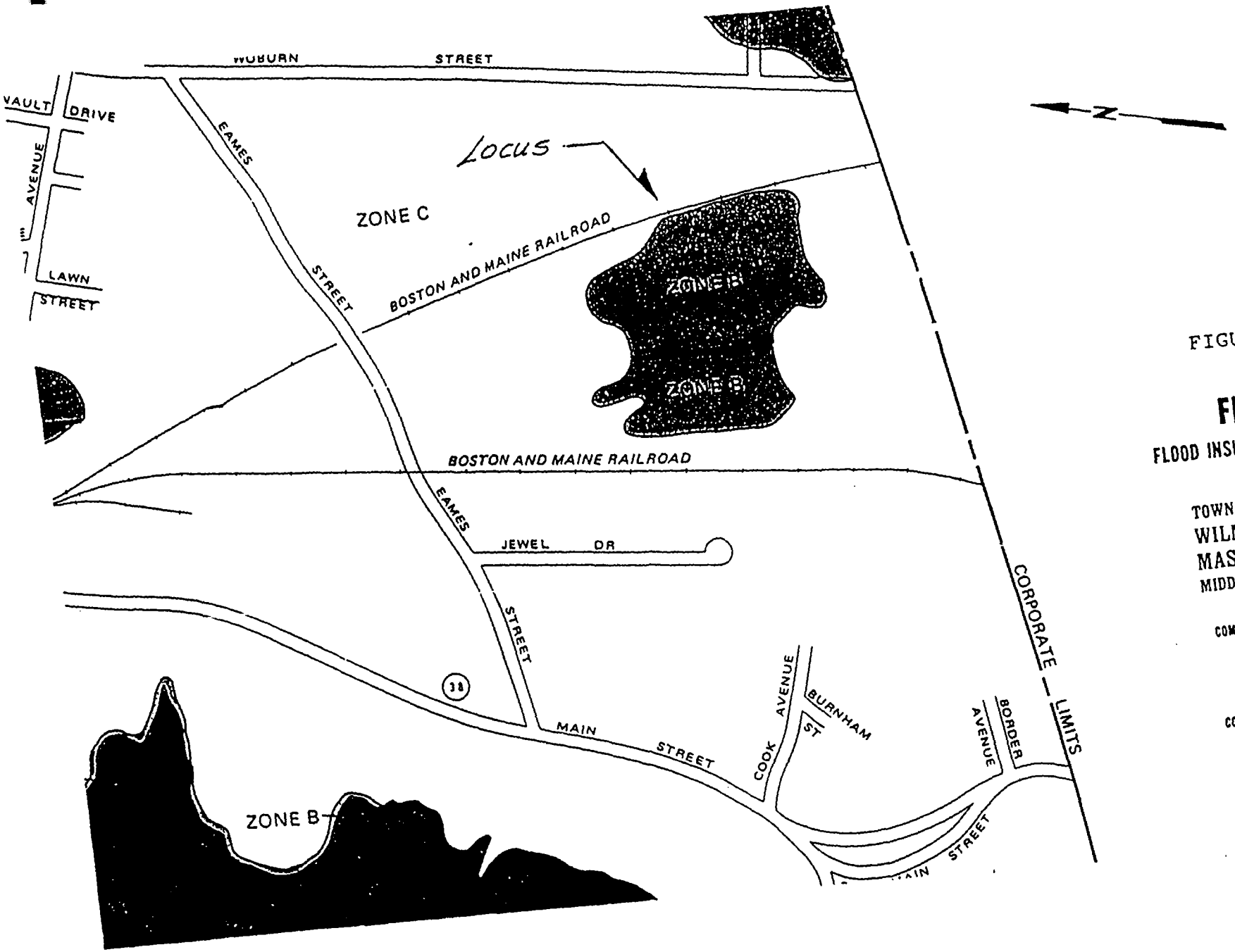

FIGURE 2

FIRM

FLOOD INSURANCE RATE MAP

TOWN OF
WILMINGTON,
MASSACHUSETTS
MIDDLESEX COUNTY

COMMUNITY-PANEL NUMBER
250227 0004 B
EFFECTIVE DATE:
JUNE 15, 1982

COMMUNITY-PANEL NUMBER
250227 0002 B
EFFECTIVE DATE:
JUNE 15, 1982

Figure 3

Upland Area D

Forested Upland Island Component

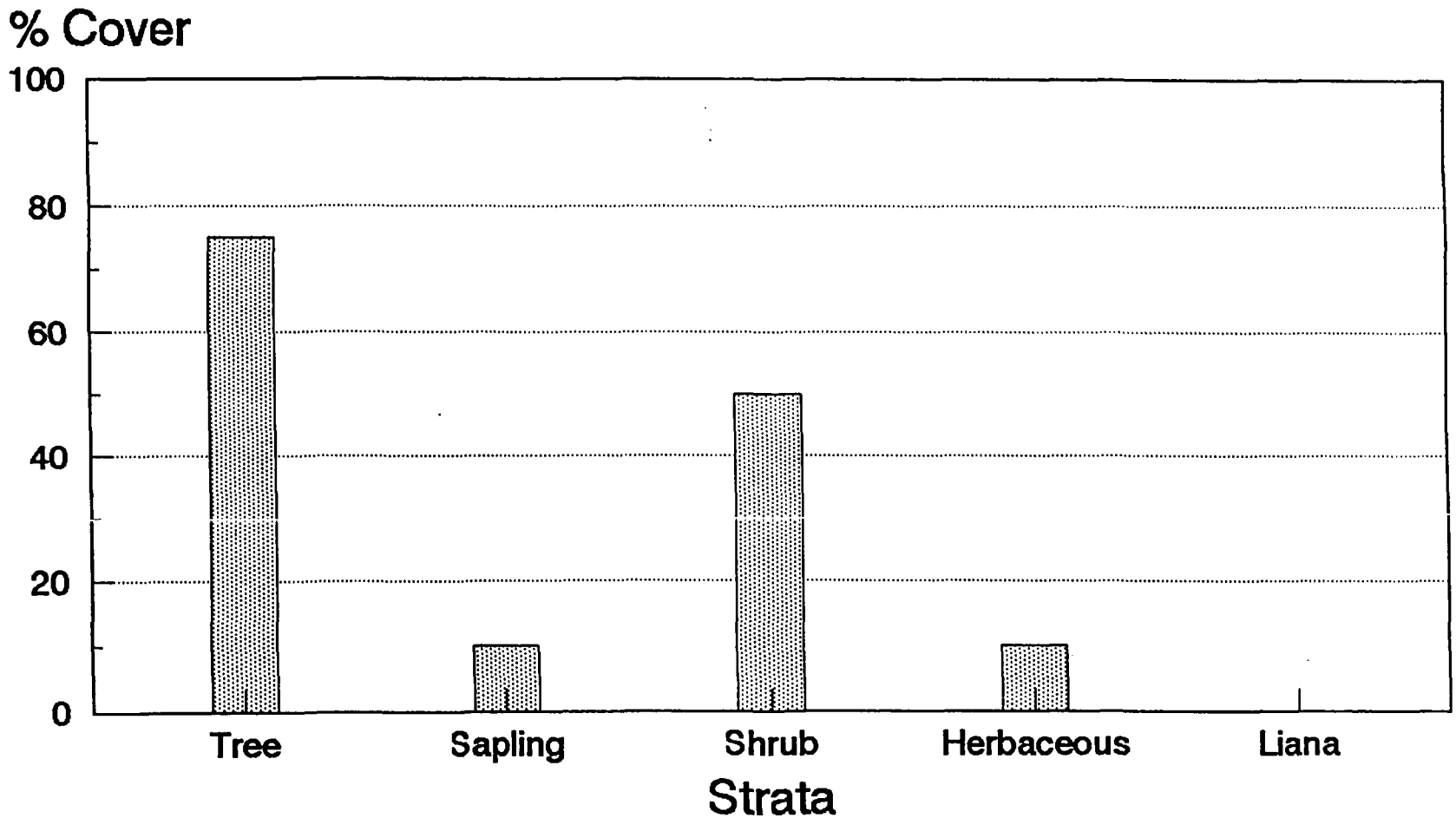

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Figure 4

Upland Area D

Forested Upland Component

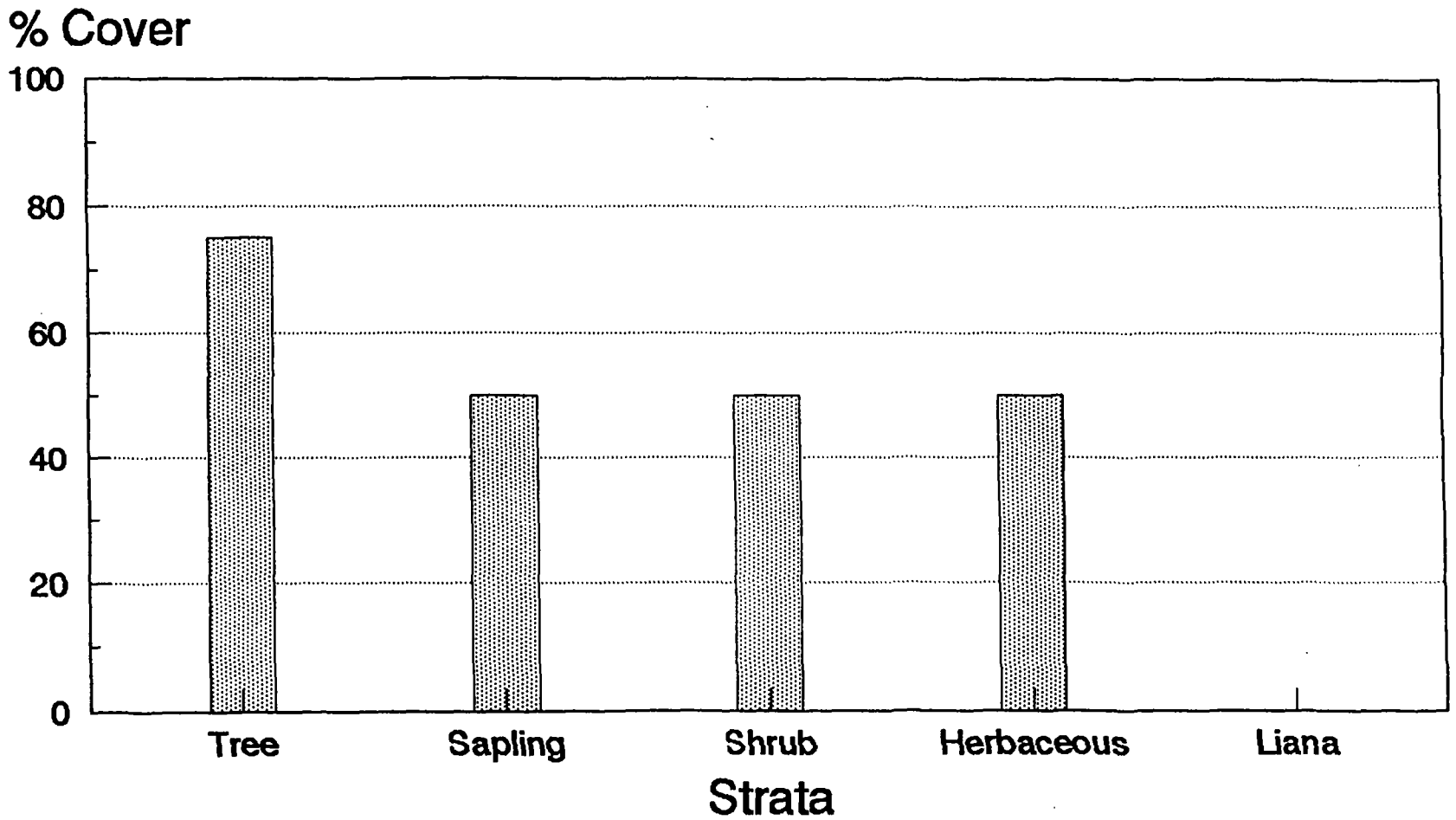

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Figure 5

Drainage Area AA

Emergent Wetland Component

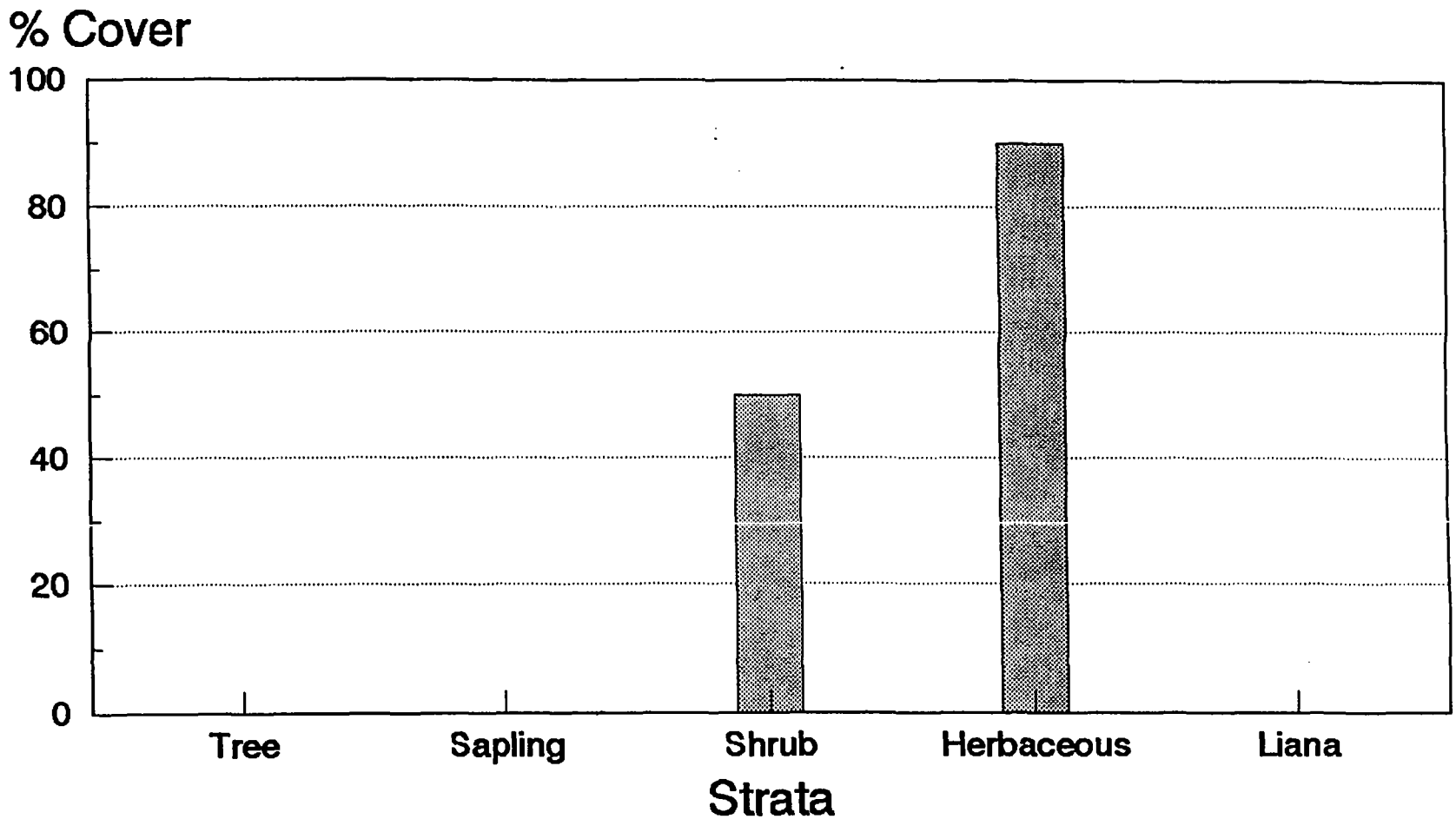

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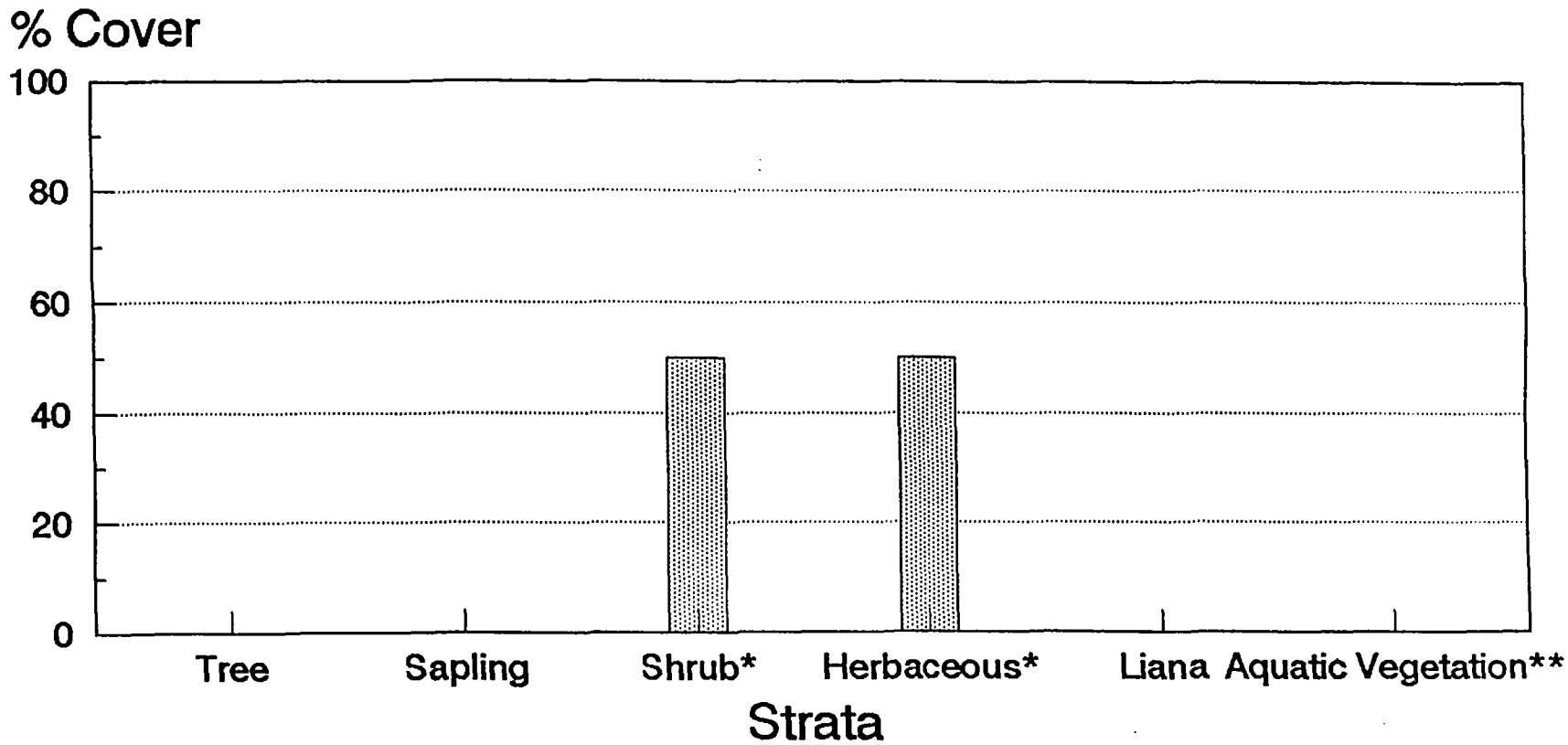
Figure 6

Drainage Area AA

Unconsolidated Bottom Component (Pond)



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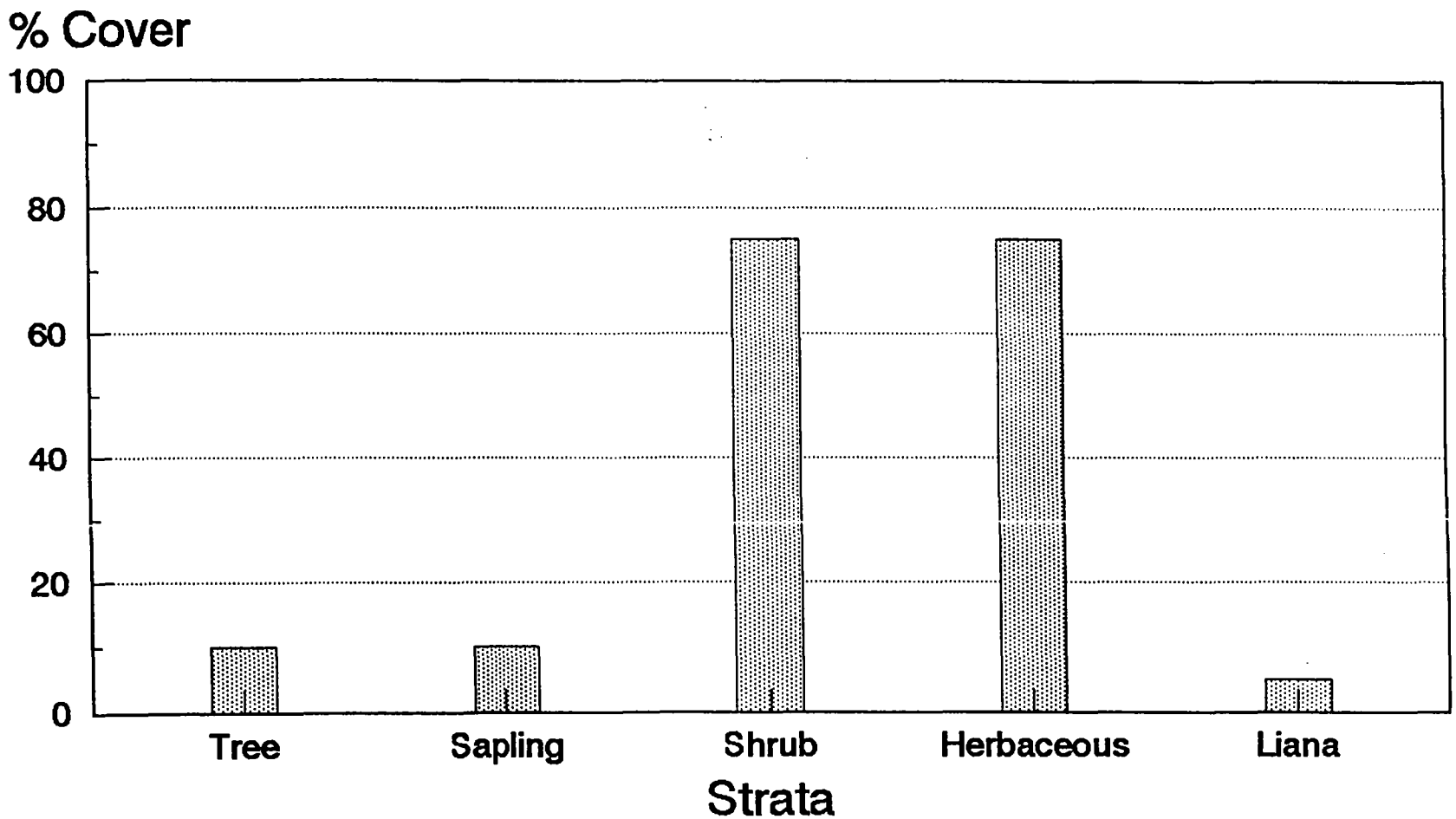
*Note: Located along pond edges only.

**Note: No aquatic vegetation observed during quantitative vegetation sampling due to ice cover on the pond. Previous observations indicated extremely sparse submerged aquatic vegetation.

Figure 7

Drainage Area AA

Scrub-Shrub Component

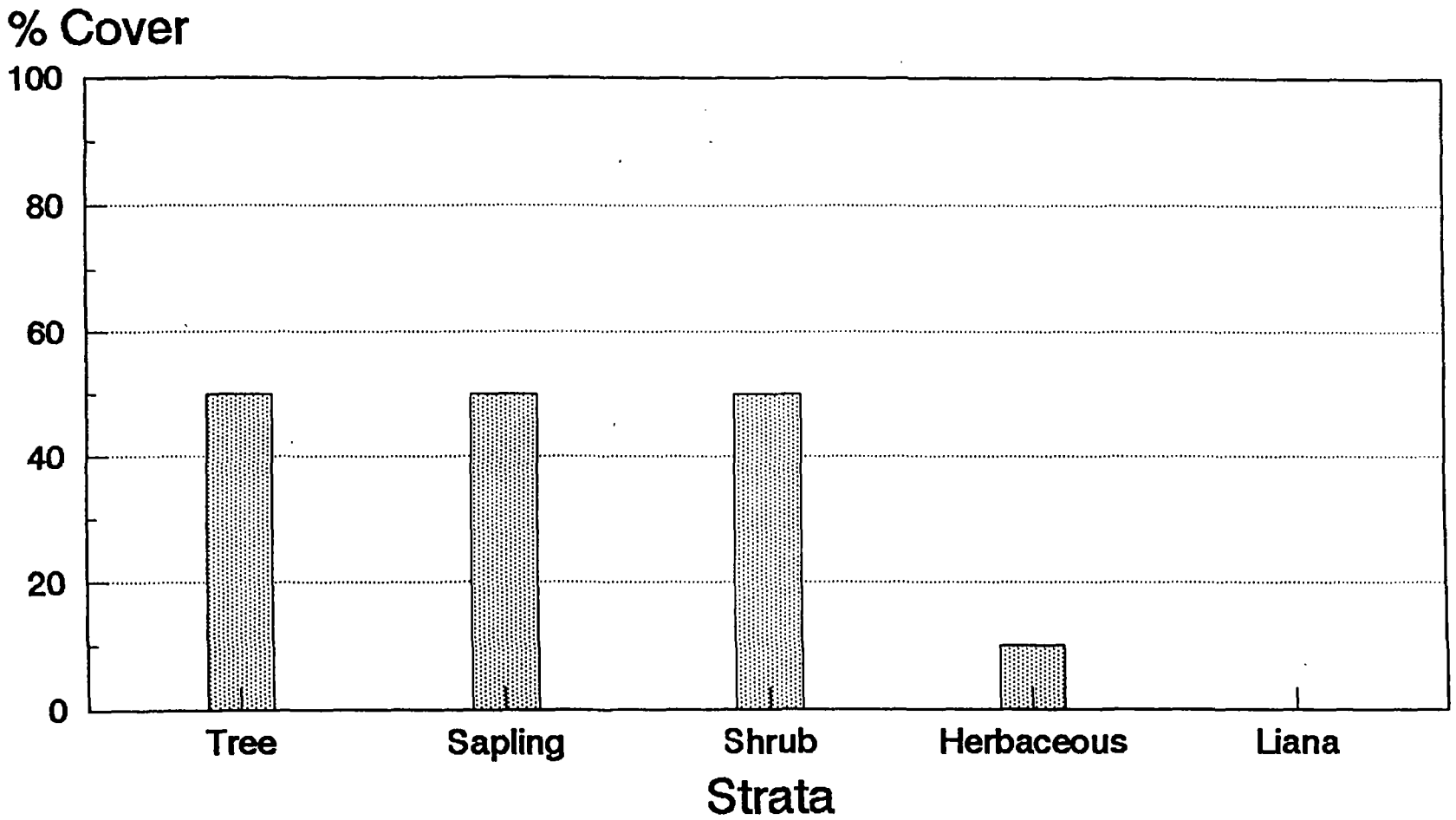


Wetlands Preservation, Inc.
1/12/93

Figure 8

Drainage Area AA

Forested Wetland Component



Wetlands Preservation, Inc.
1/12/93

APPENDIX I

BOREHOLE STRATIGRAPHIC LOGS

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-01)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-1
DATE COMPLETED: JUNE 5, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W.MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	GROUND SURFACE	85.0					
	SW-SAND(FILL), fine to coarse grained, angular, some silt, brown, dry		8"ø BOREHOLE; CEMENT/ BENTONITE GROUT	1SS	X	32	0
2.5				2SS	X	27	0
5.0				3SS	/	21	
7.5	Same, except medium to coarse grained, trace fine gravel, angular, brownish gray, slighlty moist			4SS	X	45	0
	– 1/2" silt seam, black, product odor			5SS	X	47	12
10.0				6SS	X	65	0
12.5	END OF HOLE @ 12.0 FT. BGS	73.0					
15.0							
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-02)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-2
DATE COMPLETED: JUNE 5, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W.MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	STATE	'N' VALUE	PID (ppm)
	GROUND SURFACE	86.5					
	SP-SAND(FILL), fine to coarse grained, some silt, trace gravel, brown, dry			1SS		35	0
2.5				2SS		34	0
5.0				3SS		7	0
	Same, except medium grained, no gravel		8" ø BOREHOLE	4SS		38	0
7.5	SP-SAND, medium to coarse grained, brown, dry		CEMENT/ BENTONITE GROUT	5SS		76	0
10.0				6SS		>100	0
	- saturated						
12.5	Same, except fine to coarse grained, angular, gray, saturated			7SS		>100	0
15.0				8SS		13	0
17.5	- black coarse sand, product odor (17.5 ft to 18.0 ft BGS)	68.5		9SS		45	0
	END OF HOLE @ 18.0 FT. BGS						
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-03)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-3
DATE COMPLETED: JUNE 5, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W.MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	STATE	'N' VALUE	PID (ppm)
	GROUND SURFACE	86.2					
	SP-SAND(FILL), fine to medium grained, some silt, brown, dry			1SS	X	41	0
	- trace gravel						
2.5				2SS	X	26	0
5.0			8"ø BOREHOLE	3SS	X	14	0
			CEMENT/ BENTONITE GROUT				
7.5				4SS	X	42	0
	SP-SAND, medium to coarse grained, brown, dry			5SS	X	40	0
10.0							
	- saturated			6SS	X	60	0
12.5	END OF HOLE @ 12.0 FT. BGS	74.2					
15.0							
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-04)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-4
DATE COMPLETED: JUNE 5, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W.MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	GROUND SURFACE	86.2					
	SP-SAND(FILL), fine to medium grained, some silt, brown, dry		8"ø BOREHOLE; CEMENT/ BENTONITE GROUT	1SS	X	38	0
2.5				2SS	X	45	0
5.0	Same, except medium to coarse grained, trace silt, trace gravel, slightly moist			3SS	X	75	0
7.5	– black organic seam, saturated, no odor (7.8 to 8.4 ft BGS)			4SS	X	45	0
	SW-SAND, coarse grained, angular, gray, saturated			5SS	X	31	0
10.0	END OF HOLE @ 10.0 FT. BGS	76.2					
12.5							
15.0							
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-05)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-5
DATE COMPLETED: JUNE 6, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W.MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	STATE	'N' VALUE	PID (ppm)
	GROUND SURFACE	88.1					
	SP-SAND(FILL), some silt, trace gravel, brown, dry		8"ø BOREHOLE; CEMENT/ BENTONITE GROUT	1SS	X	56	0
2.5				2SS	X	50	0
5.0				3SS	X	23	0
	SP-SAND(FILL), medium to coarse grained, angular, red brown, moist			4SS	X	22	0
7.5	– some gravel (cobbles), brown gray, saturated			5SS	X	>100	0
10.0	END OF HOLE @ 10.0 FT. BGS	78.1					
12.5							
15.0							
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(L-06)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-6
DATE COMPLETED: JUNE 6, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W.MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	GROUND SURFACE	85.3					
	SP-SAND(FILL), fine to medium grained, some silt, brown, dry		8"ø BOREHOLE; CEMENT/ BENTONITE GROUT	1SS	X	37	0
2.5				2SS	X	34	0
5.0	Same, except some gravel, trace silt, moist			3SS	X	32	0
	SP-SAND, medium to coarse grained, gray - saturated			4SS	X	30	0
7.5	END OF HOLE @ 8.0 FT. BGS	77.3					
10.0							
12.5							
15.0							
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-07)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-7
DATE COMPLETED: JUNE 6, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W.MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	STATE	'N' VALUE	PID (ppm)
	GROUND SURFACE	84.0					
	SW-SAND(FILL), fine grained brown, dry		8"ø BOREHOLE; CEMENT/ BENTONITE GROUT	1SS	X	34	0
2.5	SP-SAND, medium to coarse grained, brown, dry			2SS	X	29	0
5.0	– moist – cobbles, saturated			3SS	X	23	0
7.5				4SS	X	>100	0
	END OF HOLE @ 8.0 FT. BGS	76.0					
10.0							
12.5							
15.0							
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-08)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-8
DATE COMPLETED: JUNE 7, 1991
DRILLING METHOD: 6 1/4" ID HSA
CRA SUPERVISOR: J.W.MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	STATE	'N' VALUE	PID (ppm)
	GROUND SURFACE	84.7					
	SW-SAND, fine grained, some silt, brown, dry		11"ø BOREHOLE; CEMENT/ BENTONITE GROUT	1SS		21	0
2.5				2SS		17	0
	Same, except medium grained, gray SP-SAND, coarse grained, angular, some silt, trace gravel (cobbles), moist - saturated			3SS		14	0
5.0				4SS		>100	0
7.5	END OF HOLE @ 8.0 FT. BGS	76.7					
10.0							
12.5							
15.0							
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-09)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-9
DATE COMPLETED: JUNE 7, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W.MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	GROUND SURFACE	88.1					
	SW-SAND, some silt, trace gravel, brown, dry		8"ø BOREHOLE	1SS	X	14	0
2.5				2SS	X	15	0
	Same, except medium to coarse grained, no silt		CEMENT/ BENTONITE GROUT				
5.0	Same, except some gravel, cobbles, moist			3SS	X	6	0
7.5				4SS	X	>100	0
	– saturated						
	SW-SAND, medium to coarse grained, some gravel, saturated			5SS	X	23	0
10.0	END OF HOLE @ 10.0 FT. BGS	78.1					
12.5							
15.0							
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(L-10)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-10
DATE COMPLETED: JUNE 7, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W.MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	GROUND SURFACE	85.2					
	SP-SAND, fine grained, gray brown, dry		8"ø BOREHOLE; CEMENT/ BENTONITE GROUT	1SS	X	40	0
2.5	Same, except medium grained, gray with black stains, moist			2SS	X	30	0
5.0				3SS	X	25	
7.5	– saturated			4SS	X	>100	
	END OF HOLE @ 8.0 FT. BGS	77.2					
10.0							
12.5							
15.0							
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-11)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-11
DATE COMPLETED: JUNE 7, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W.MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	STATE	'N' VALUE	PID (ppm)
	GROUND SURFACE	88.2					
	ML-SILT(FILL), brown, dry	86.7		1SS	X	20	0
2.5	SW-SAND(FILL), medium grained, some gravel, brown, dry	84.2		2SS	X	17	0
5.0	GC-GRAVEL(FILL), medium grained, cobbles, black, dry, stringer of product, odor		8"ø BOREHOLE; CEMENT/ BENTONITE GROUT	3SS	X	>100	0
7.5				4SS	X	>100	0
				5SS	X	>100	24
10.0	SW-SAND, coarse grained, angular, saturated	78.2		6SS	X		8
12.5	END OF HOLE @ 12.0 FT. BGS	76.2					
15.0							
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(L-12)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-12
DATE COMPLETED: JUNE 10, 1991
DRILLING METHOD: 6 1/4" ID HSA
CRA SUPERVISOR: J.M. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	GROUND SURFACE	85.9					
	SP-SAND, medium grained, brown, moist		11"ø BOREHOLE; CEMENT/ BENTONITE GROUT	1SS		16	0
2.5				2SS		7	5
	SW-SAND, some gravel, hard, black						
5.0				3SS		>100	2.5
	– saturated	79.9					
	END OF HOLE @ 6.0 FT. BGS						
7.5							
10.0							
12.5							
15.0							
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(L-13)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-13
DATE COMPLETED: JUNE 10, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: E. HOLT

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	STATE	'N' VALUE	PID (ppm)
	GROUND SURFACE	91.5					
	No recovery			1SS		11	
2.5	SW-SAND, fine to medium grained, some round gravel, loose, brown dry to moist	89.5		2SS		11	
5.0	SP-SAND, medium to coarse grained, some round to subangular gravel, loose, light brown, moist		8"ø BOREHOLE; CEMENT/ BENTONITE GROUT	3SS		>100	
				4SS		>100	
7.5				5SS		>100	
10.0	GP-GRAVEL, fine to coarse grained, some medium to coarse sand, trace rock flour, loose, light brown, moist mottling otherwise dry	83.5		6SS		100	
				7SS		>100	
12.5	END OF HOLE @ 12.0 FT. BGS	79.5					
15.0							
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-14)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-14
DATE COMPLETED: JUNE 10, 1991
DRILLING METHOD: 6 1/4" ID HSA
CRA SUPERVISOR: J.W.MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	GROUND SURFACE	85.9					
	SP-SAND, medium grained, brown, dry		11" BOREHOLE; CEMENT/ BENTONITE GROUT	1SS		19	0
2.5				2SS		7	0
	– very hard, cobbles			3SS		>100	3
5.0							
	– saturated						
7.5				4SS			3
	END OF HOLE @ 9.0 FT. BGS	76.9					
10.0							
12.5							
15.0							
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-15)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-15
DATE COMPLETED: JUNE 10, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: E. HOLT

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	GROUND SURFACE	89.0					
	SW-SAND, fine to medium grained, little silt little clay, trace organics, trace gravel, loose, tan brown, dry to moist			1SS		14	
2.5	Same, with no organics, dense, moist			2SS		34	
	SP-SAND, fine to coarse grained, some subrounded to angular gravel, little rock flour, very dense, tan brown, dry to moist		8"ø BOREHOLE; CEMENT/ BENTONITE GROUT	3SS		>100	
5.0		83.0					
	GP-GRAVEL, fine to coarse grained, angular to subrounded, little rock flour, little coarse sand, very dense, tan to light brown, dry to moist			4SS		>100	
7.5	Same, except medium to coarse grained, round, some coarse sand, dense, tan brown, moist to wet			5SS		60	
10.0	END OF HOLE @ 10.0 FT. BGS	79.0					
12.5							
15.0							
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-16)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-16
DATE COMPLETED: JUNE 10, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W.MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	GROUND SURFACE	86.2					
	SP-SAND, medium grained, brown, dry		8"ø BOREHOLE; CEMENT/ BENTONITE GROUT	1SS		15	0
2.5				2SS		16	0
5.0	- black product (5.5 to 6.0 ft BGS)			3SS		5	3
7.5				4SS		41	
	END OF HOLE @ 8.0 FT. BGS	78.2					
10.0							
12.5							
15.0							
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

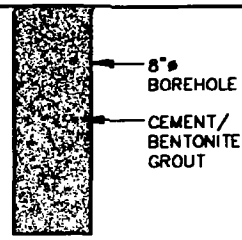
CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-17)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-17
DATE COMPLETED: JUNE 10, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: E. HOLT

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	GROUND SURFACE	86.7					
	SW-SAND, fine to medium grained, trace gravel, trace silt, medium dense, light brown, moist			1SS	X	13	
2.5	Same, except little silt, dark brown, moist to wet			2SS	X	14	
5.0				3SS	X	4	
	END OF HOLE @ 6.0 FT. BGS	80.7					
7.5							
10.0							
12.5							
15.0							
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-18)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-18
DATE COMPLETED: JUNE 10, 1991
DRILLING METHOD: 6 1/4" ID HSA
CRA SUPERVISOR: J.W.MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	GROUND SURFACE	87.0					
	SP-SAND, medium grained, brown, moist		8"ø BOREHOLE	1SS	X	20	0
2.5			CEMENT/ BENTONITE GROUT	2SS	X	22	
5.0	SW-SAND, some gravel, trace silt, brown, red and black, tar like substance, weak product odor			3SS	X	41	
	END OF HOLE @ 6.0 FT. BGS	81.0					
7.5							
10.0							
12.5							
15.0							
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-19)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-19
DATE COMPLETED: JUNE 11, 1991
DRILLING METHOD: 6 1/4" ID HSA
CRA SUPERVISOR: J.W.MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	GROUND SURFACE	88.1					
	Concrete	87.1					
2.5	SP-SAND, medium to coarse grained, some gravel, brown, dry			1SS		15	
5.0	SW-SAND, medium grained, red brown, moist		8"ø BOREHOLE; CEMENT/ BENTONITE GROUT	2SS		10	
7.5				3SS		14	
	- saturated			4SS		40	
	END OF HOLE @ 9.0 FT. BGS	79.1					
10.0							
12.5							
15.0							
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-20)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-20
DATE COMPLETED: JUNE 10, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: E. HOLT

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	GROUND SURFACE	91.6					
	Asphalt (3")			1SS		40	
2.5	SW-SAND, fine to medium grained, little pebbles, medium dense, tan brown, dry to slightly moist	89.6		2SS		35	
5.0	SP-SAND, fine to medium grained, some round gravel, dense, tan brown, dry to moist		8"ø BOREHOLE	3SS		68	
7.5	GP-GRAVEL, medium to coarse, rounded, some medium to coarse grained sand, dense, tan to orange brown, orange rust mottling, dry to moist	85.6	CEMENT/ BENTONITE GROUT	4SS		>100	
10.0	SP-SAND, medium to coarse grained, some round gravel, dense, tan brown, dry to moist	83.6		5SS		>100	
	– saturated			6SS		85	
12.5	END OF HOLE @ 12.0 FT. BGS	79.6					
15.0							
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-21)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-21
DATE COMPLETED: JUNE 10, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: E. HOLT

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	GROUND SURFACE	91.3					
	ASPHALT	91.1					
	SW-SAND, fine to medium grained, trace silt, trace clay, loose, tan brown, dry to moist			1SS		20	
2.5	– errant round quartz						
				2SS		53	
	SP-SAND, fine to coarse grained, some coarse round gravel, very dense, mottled light tan brown and brown, dry		8"ø BOREHOLE				
5.0	Same, except dry to moist			3SS		76	
			CEMENT/ BENTONITE GROUT				
7.5				4SS		100	
	SP/GW-SAND and GRAVEL, medium to fine grained, dry to moist	83.3					
	– moist			5SS		44	
10.0	GP/GW-GRAVEL, medium fine to very coarse, dense, brown, saturated, little silt and clay in matrix	81.3		6SS		56	
12.5	END OF HOLE @ 12.0 FT. BGS	79.3					
15.0							
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-22)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-22
DATE COMPLETED: JUNE 10, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: E. HOLT

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	GROUND SURFACE	91.0					
	Asphalt	90.8					
	SW-SAND, fine to medium grained, loose, brown, moist			1SS		26	
2.5	SP-SAND, fine to coarse grained, some rounded gravel, loose, brown to tan brown, moist			2SS		12	
	SW-SAND, fine to medium grained, some errant rounded gravel, very loose, brown, moist		8"ø BOREHOLE				
5.0				3SS		5	
			CEMENT/ BENTONITE GROUT				
7.5				4SS		11	
				5SS		8	
10.0	GW-GRAVEL, fine to medium, little fine sand, little clay and silt in matrix, loose, tan brown, saturated	81.0		6SS		7	
12.5	END OF HOLE @ 12.0 FT. BGS	79.0					
15.0							
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-23)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-23
DATE COMPLETED: JUNE 10, 1991
DRILLING METHOD: 6 1/4" ID HSA
CRA SUPERVISOR: J.W.MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	GROUND SURFACE	85.0					
	SP-SAND, medium grained, dry		11" BOREHOLE; CEMENT/ BENTONITE GROUT	1SS	X	11	0
	Same, except red						
2.5	– boulder			2SS	X		0
	SP-SAND, medium grained, red brown, moist						
5.0	– saturated			3SS	X	95	
	END OF HOLE @ 6.0 FT. BGS	79.0					
7.5							
10.0							
12.5							
15.0							
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(L-24)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-24
DATE COMPLETED: JUNE 10, 1991
DRILLING METHOD: 6 1/4" ID HSA
CRA SUPERVISOR: J.W.MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	GROUND SURFACE	85.4					
	SP-SAND, medium grained, red brown, dry		8" ø BOREHOLE; CEMENT/ BENTONITE GROUT	1SS	X	10	
2.5				2SS	X	25	
5.0				3SS	X	57	
	– saturated	79.4					
	END OF HOLE @ 6.0 FT. BGS						
7.5							
10.0							
12.5							
15.0							
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-25)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-25
DATE COMPLETED: JUNE 10, 1991
DRILLING METHOD: 6 1/4" ID HSA
CRA SUPERVISOR: J.W.MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	GROUND SURFACE	85.5					
	SP-SAND, medium grained, red brown, dry		8" ø BOREHOLE; CEMENT/ BENTONITE GROUT	1SS		7	0
2.5				2SS		22	0
5.0				3SS		58	0
	– saturated	79.5					
	END OF HOLE @ 6.0 FT. BGS						
7.5							
10.0							
12.5							
15.0							
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-26)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-26
DATE COMPLETED: JUNE 11, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: E. HOLT

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	GROUND SURFACE	90.6					
2.5	Cement		8"ø BOREHOLE; CEMENT/ BENTONITE GROUT				
5.0	SW-SAND, fine to medium grained, medium dense, white to tan brown, striated lower 8" with tan brown, moist	85.6		1SS	X	53	
7.5	Same, except moist to wet			2SS	X	90	
10.0	END OF HOLE @ 9.0 FT. BGS	81.6					
12.5							
15.0							
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-27)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-27
DATE COMPLETED: JUNE 11, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: E. HOLT

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	GROUND SURFACE	89.8					
	SW-SAND, fine grained, little organics, loose, tan to light brown, dry		8"ø BOREHOLE	1SS		12	
2.5	Same, except no organics, tan brown with dark mottling, dry to moist		CEMENT/ BENTONITE GROUT	2SS		14	
5.0	SW-SAND, fine to medium grained, little gravel, trace coarse sand in gravel, medium dense, dry to moist			3SS		>100	
	END OF HOLE @ 6.0 FT. BGS	83.8					
7.5							
10.0							
12.5							
15.0							
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-28)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-28
DATE COMPLETED: JUNE 11, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: E. HOLT

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	GROUND SURFACE	90.6					
	SW-SAND, medium to fine grained, loose, dark brown and black, dry to moist, chemical like odor		8"ø BOREHOLE	1SS		19	
2.5	Same, except light brown to brown, chemical like odor		CEMENT/ BENTONITE GROUT	2SS		16	
	SW-SAND, fine to medium grained, tan brown, moist, chemical like odor						
5.0	Same, slight chemical like odor			3SS		30	
7.5	SP-SAND, fine to medium grained, some silt, some angular gravel, dense, dark gray to tan brown to dark brown, wet, strong chemical like odor			4SS		26	
10.0	END OF HOLE @ 10.0 FT. BGS	80.6		5SS		>100	
12.5							
15.0							
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-29)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-29
DATE COMPLETED: JUNE 11, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W.MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	GROUND SURFACE	89.6					
	SP-SAND(FILL), medium grained, red brown, dr		8"ø BOREHOLE; CEMENT/ BENTONITE GROUT	1SS	X	20	0
2.5				2SS	X	16	0
5.0				3SS	X	29	0
				4SS	X	>100	0
7.5	SW-SAND(TILL), fine to medium grained, some silt, some gravel, brown gray, saturated	82.1		5SS	X	>100	0
10.0	END OF HOLE @ 10.0 FT. BGS	79.6					
12.5							
15.0							
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-30)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-30
DATE COMPLETED: JUNE 11, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: E. HOLT

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	GROUND SURFACE	89.5					
	SW-SAND, fine to medium griained, trace angular gravel, loose, dark brown and black, moist to dry, slight chemical odor		8" ø BOREHOLE	1SS		11	
2.5	Same, with no gravel, dark orange brown, moist, slight chemical odor			2SS		16	
	Same, except medium dense, slight chemical odor						
5.0				3SS		27	
	– slight chemical odor		CEMENT/ BENTONITE GROUT				
7.5				4SS		47	
				5SS		>100	
10.0							
12.5	END OF HOLE @ 12.0 FT. BGS	77.5					
15.0							
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-31)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-31
DATE COMPLETED: JUNE 11, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W.MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	GROUND SURFACE	88.5					
	Concrete	87.5	8"ø BOREHOLE; CEMENT/ BENTONITE GROUT				
	SP-SAND, medium grained, brown, dry			1SS	X	40	
2.5				2SS	X	12	
5.0	– moist – saturated			3SS	X	10	
7.5	END OF HOLE @ 7.0 FT. BGS	81.5					
10.0							
12.5							
15.0							
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-32)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-32
DATE COMPLETED: JUNE 11, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: J.W. MICHELS

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	STATE	'N' VALUE	PID (ppm)
	GROUND SURFACE	88.7					
	SP-SAND, medium grained, brown, dry		8"ø BOREHOLE; CEMENT/ BENTONITE GROUT	1SS	X	11	0
2.5				2SS	X	10	0
5.0				3SS	X	36	0
7.5	SW-SAND, some silt, brown, wet			4SS	X	54	0
	- saturated			5SS	X	26	0
10.0	END OF HOLE @ 10.0 FT. BGS	78.7					
12.5							
15.0							
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

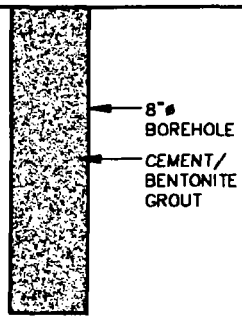
CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-33)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-33
DATE COMPLETED: JUNE 11, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: E. HOLT

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	STATE	'N' VALUE	PID (ppm)
	GROUND SURFACE	88.4					
	SW-SAND, fine to medium grained, errant angular gravel, trace silt, loose, dark brown, dry			1SS		10	
2.5				2SS		7	
	Same, except orange brown, moist						
5.0				3SS		6	
	Same, except dark orange brown, wet						
7.5				4SS		6	
	END OF HOLE @ 8.0 FT. BGS	80.4					
10.0							
12.5							
15.0							
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-34)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-34
DATE COMPLETED: JUNE 11, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: E. HOLT

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	GROUND SURFACE	88.0					
	SW-SAND, fine to medium grained, angular gravel (top 1"), loose, dark orange brown, moist		8"ø BOREHOLE; CEMENT/ BENTONITE GROUT	1SS		6	
2.5	Same, except orange brown to tan brown			2SS		10	
5.0				3SS		11	
7.5	– moist to wet			4SS		12	
	END OF HOLE @ 8.0 FT. BGS	80.0					
10.0							
12.5							
15.0							
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L-35)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-35
DATE COMPLETED: JUNE 11, 1991
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: E. HOLT

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	GROUND SURFACE	88.1					
	Asphalt	87.9	8"ø BOREHOLE; CEMENT/ BENTONITE GROUT				
	SW-SAND, fine to medium grained, trace organics, trace gravel, medium dense, dark brown to black, moist, slight chemical like odor			1SS	X	24	
2.5	Same, except no gravel or organics, dark tan brown, slight chemical odor			2SS	X	26	
5.0	Same, except light tan brown			3SS	X	31	
	Same, except tan brown to dark tan brown			4SS	X	48	
7.5	– trace fine gravel, moist to wet						
	END OF HOLE @ 8.0 FT. BGS	80.1					
10.0							
12.5							
15.0							
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(L135)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-36
DATE COMPLETED: FEBRUARY 6, 1992
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: M. JEFFREY

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	SP-SAND, medium grained, brown, dry		8"ø BOREHOLE	1SS	X		
2.5			CUTTINGS	2SS	X		
5.0	– saturated			3SS	X		
	END OF HOLE @ 6.0 FT. BGS	-6.0					
7.5							
10.0							
12.5							
15.0							
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

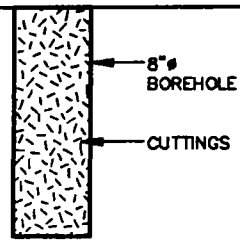
CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L136)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-37
DATE COMPLETED: FEBRUARY 6, 1992
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: M. JEFFREY

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	SP-SAND, medium grained, brown, dry			1SS			
2.5				2SS			
5.0	– saturated			3SS			
	END OF HOLE @ 6.0 FT. BGS	-6.0					
7.5							
10.0							
12.5							
15.0							
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG (OVERBURDEN)

(L137)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-38
DATE COMPLETED: FEBRUARY 6, 1992
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: M. JEFFREY

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE N VALUE	SAMPLE PID (ppm)
	SP-SAND, medium grained, brown, dry		8" ø BOREHOLE	1SS			
2.5			CUTTINGS	2SS			
	– saturated						
5.0	END OF HOLE @ 5.0 FT. BGS	-5.0					
7.5							
10.0							
12.5							
15.0							
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(L138)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-39
DATE COMPLETED: FEBRUARY 6, 1992
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: M. JEFFREY

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	SAMPLE STATE	SAMPLE 'N' VALUE	SAMPLE PID (ppm)
	SP-SAND, medium grained, brown, dry		8"ø BOREHOLE; CUTTINGS	1SS			
2.5				2SS			
5.0	– saturated			3SS			
	END OF HOLE @ 6.0 FT. BGS	-6.0					
7.5							
10.0							
12.5							
15.0							
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ◯ WATER FOUND ▽ STATIC WATER LEVEL ▼

STRATIGRAPHIC AND INSTRUMENTATION LOG
(OVERBURDEN)

(L139)

PROJECT NAME: OLIN (CSA)
PROJECT NO.: 3683
CLIENT: OLIN CORP.
LOCATION: WILMINGTON, MA.

HOLE DESIGNATION: BH-40
DATE COMPLETED: FEBRUARY 6, 1992
DRILLING METHOD: 4 1/4" ID HSA
CRA SUPERVISOR: M. JEFFREY

DEPTH ft BGS	STRATIGRAPHIC DESCRIPTION & REMARKS	ELEVATION ft AMSL	MONITOR INSTALLATION	SAMPLE NUMBER	STATE	VALUE	PID (ppm)
	SP-SAND, medium grained, brown, dry		8"ø BOREHOLE	1SS			
2.5			CUTTINGS	2SS			
5.0	– moist			3SS			
	END OF HOLE @ 6.0 FT. BGS	-6.0					
7.5							
10.0							
12.5							
15.0							
17.5							
20.0							
22.5							
25.0							
27.5							
30.0							
32.5							

NOTES: MEASURING POINT ELEVATIONS MAY CHANGE; REFER TO CURRENT ELEVATION TABLE

CHEMICAL ANALYSIS ⬭ WATER FOUND ▽ STATIC WATER LEVEL ▼

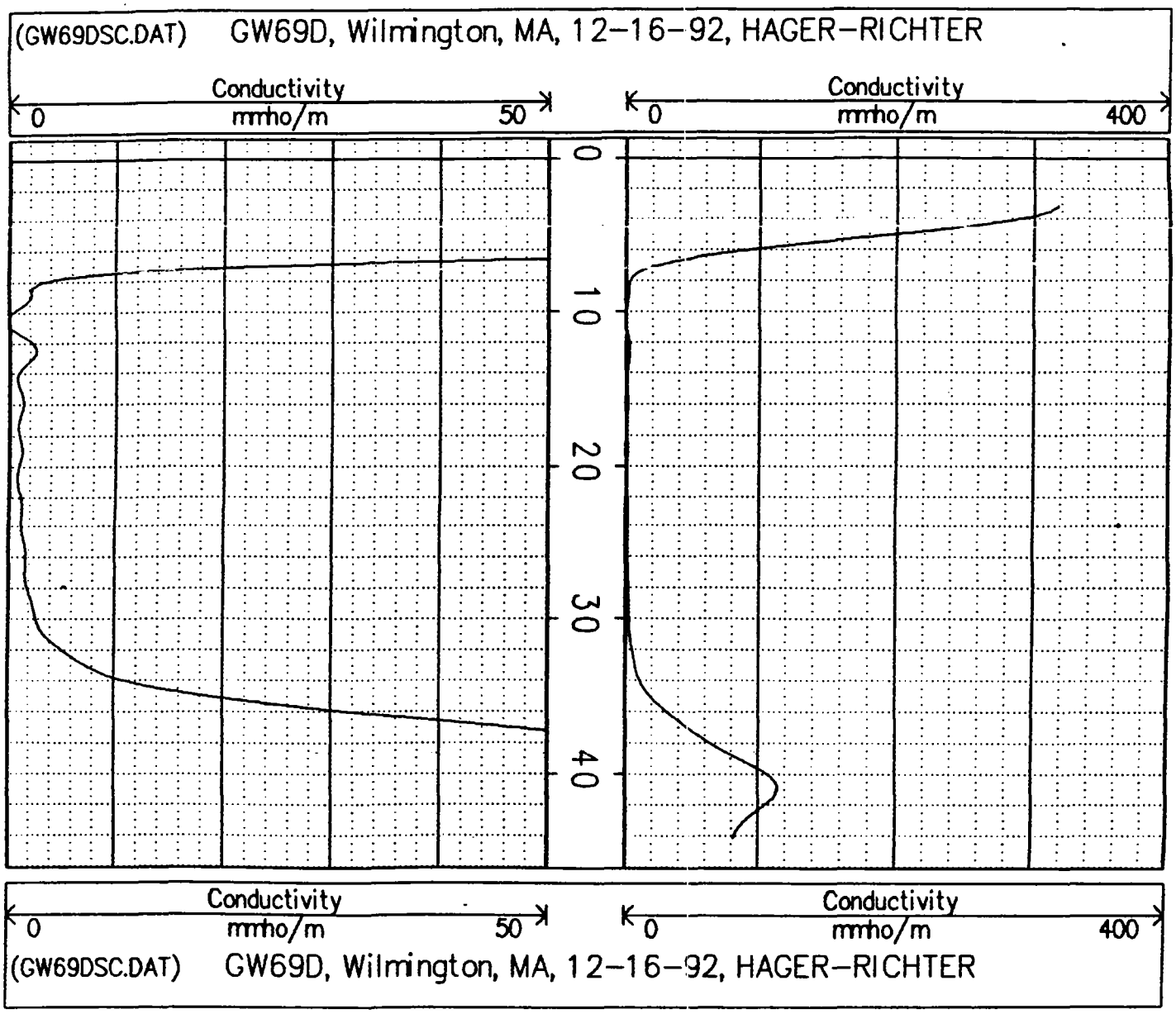
HAGER-RICHTER GEOSCIENCE, INC.
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

CONDUCTIVITY

WELL: GW69D

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR: Soils Exploration Corp.
COMMENTS:

DATE: December 16, 1992
H-R FILE #: 92G29A
ELEVATION:
LOG DATUM: Ground Level
CLIENT TD:
H-R TD: 46.3 feet
STATIC WATER LEVEL: 10.0 feet
DEPTH TO BEDROCK:



HAGER-RICHTER GEOSCIENCE, INC.
98 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

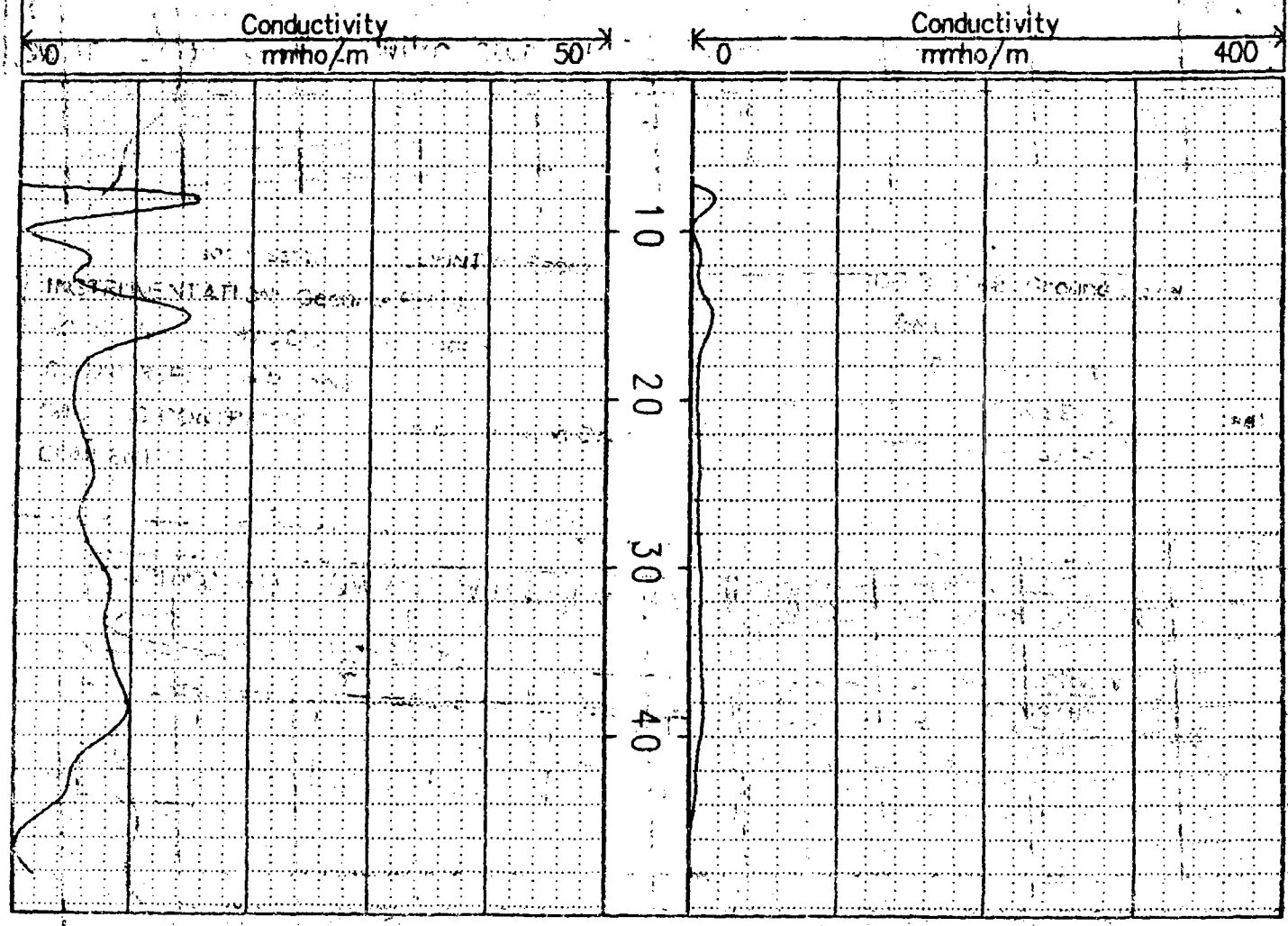
CONDUCTIVITY

WELL: GW71D

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR: Soils Exploration Corp.
COMMENTS:

DATE: December 16, 1992
H-R FILE #: 92G29A
ELEVATION:
LOG DATUM: Ground Level
CLIENT TD:
H-R TD: 50.3 feet
STATIC WATER LEVEL: 12.8 feet
DEPTH TO BEDROCK:

(GW71DSC.DAT) GW71D, Wilmington, MA, 12-16-92, HAGER-RICHTER



Conductivity
0
mmho/m
50
Conductivity
0
mmho/m
400
(GW71DSC.DAT) GW71D, Wilmington, MA, 12-16-92, HAGER-RICHTER

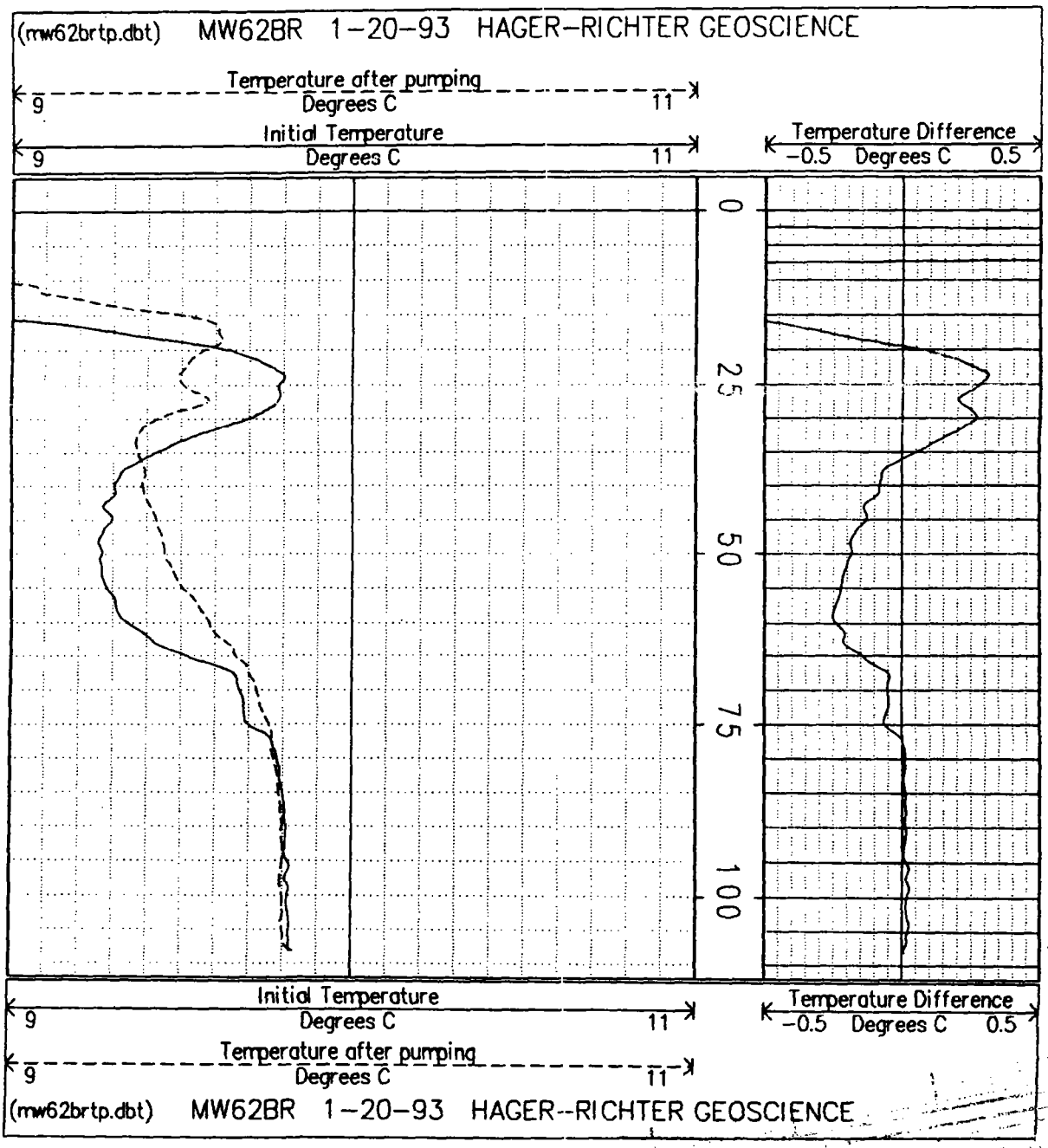
HAGER-RICHTER GEOSCIENCE, INC.
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-8944
FAX: 603 893-8313

DUAL TEMPERATURE

WELL: GW62BR

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Mt. Sopris Series III
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR: Soils Exploration Corp.
COMMENTS: 4" PVC to 80 feet

DATE: January 20, 1993
H-R FILE #: 92G29A
ELEVATION:
LOG DATUM: Ground Level
CLIENT TD:
H-R TD: 110.3 feet
STATIC WATER LEVEL: 2.1 feet
DEPTH TO BEDROCK: 75 feet



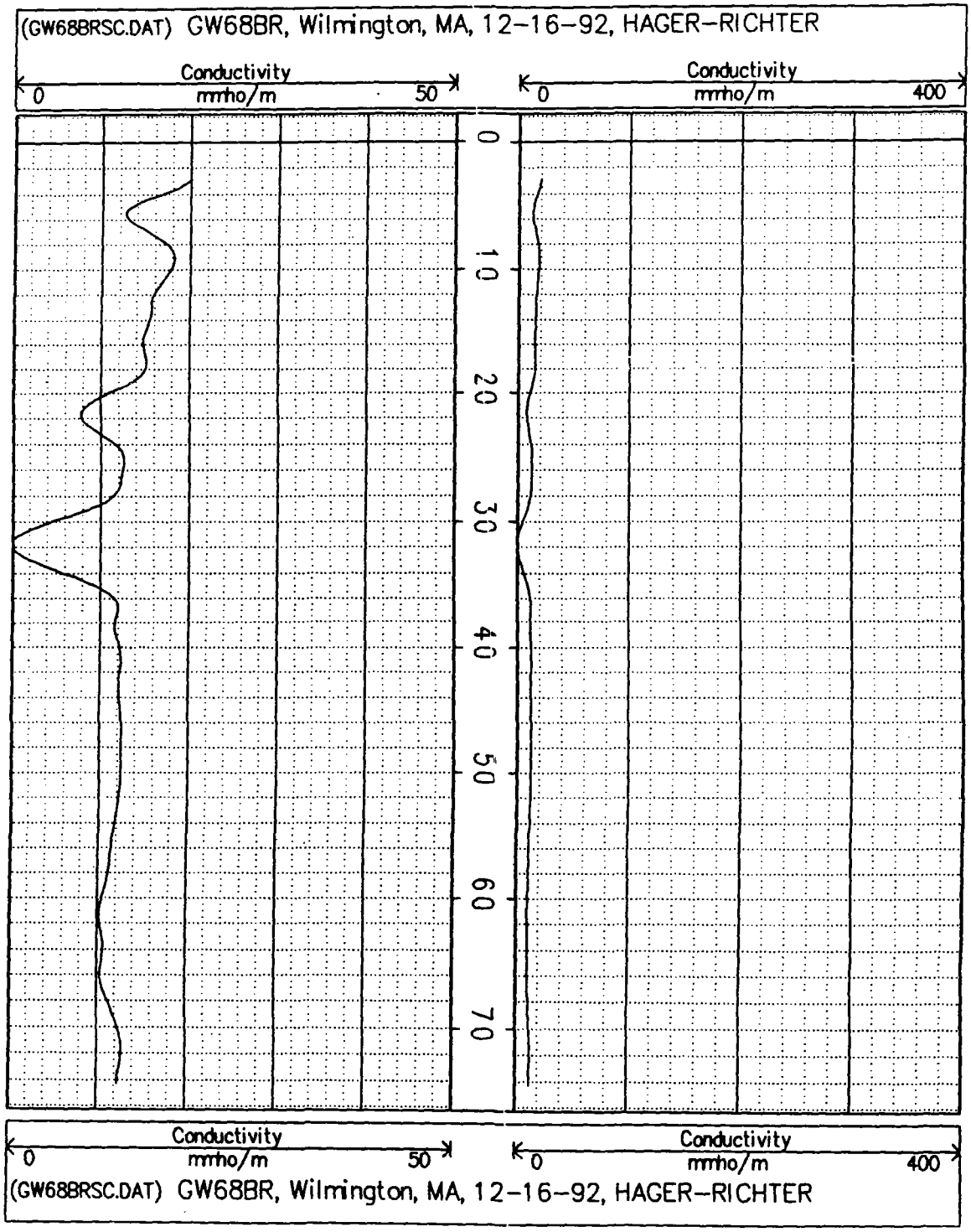
HAGER-RICHTER GEOSCIENCE, INC.
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

CONDUCTIVITY

WELL: GW68BR

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR: Soils Exploration Corp.
COMMENTS:

DATE: December 16, 1992
H-R FILE #: 92G29A
ELEVATION:
LOG DATUM: Ground Level
CLIENT TD:
H-R TD: 76.5 feet
STATIC WATER LEVEL: 18.6 feet
DEPTH TO BEDROCK: 21 feet



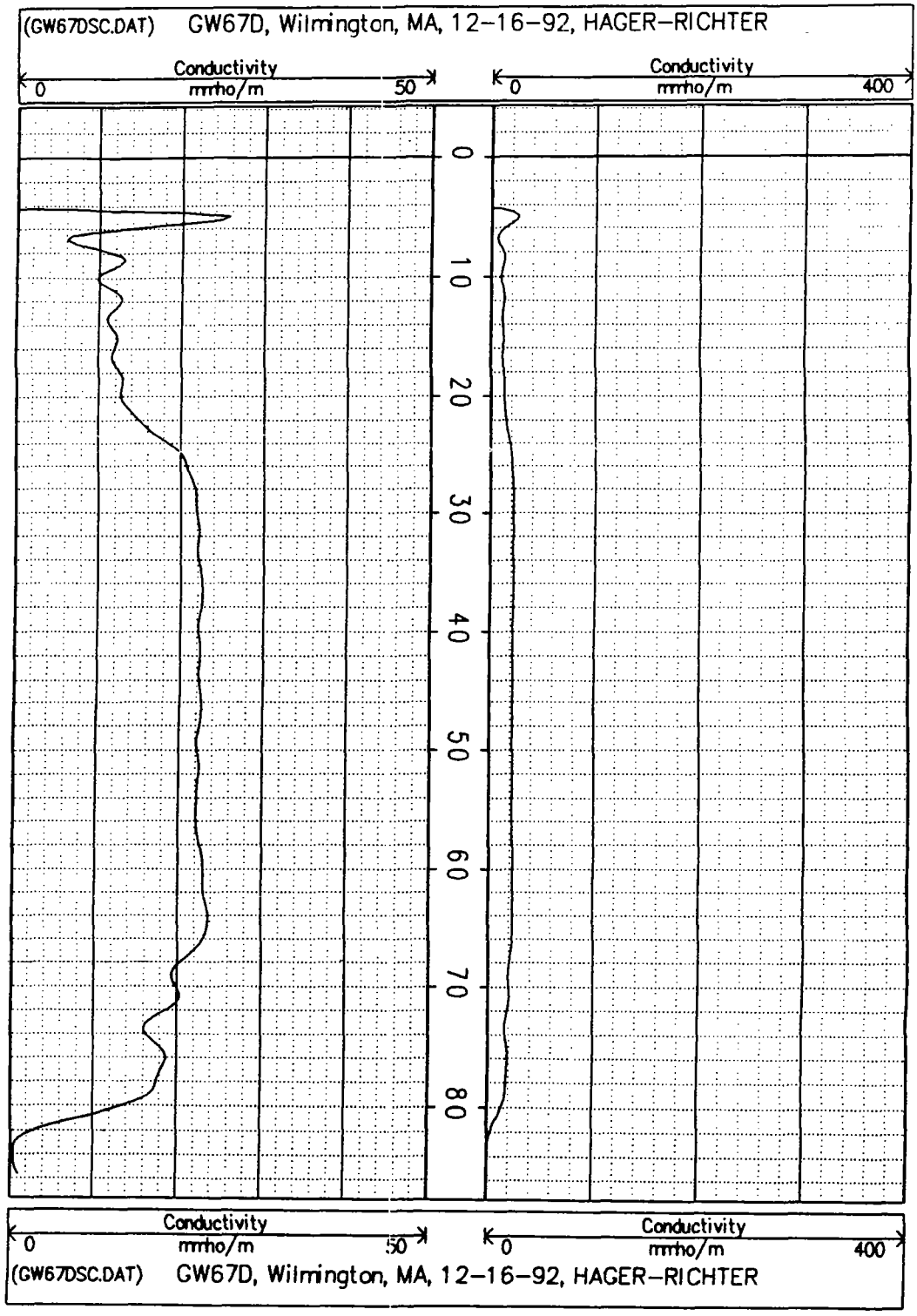
HAGER-RICHTER GEOSCIENCE, INC.
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

CONDUCTIVITY

WELL: GW67D

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR: Soils Exploration Corp.
COMMENTS:

DATE: December 16, 1992
H-R FILE #: 92G29A
ELEVATION:
LOG DATUM: Ground Level
CLIENT TD:
H-R TD: 87.8 feet
STATIC WATER LEVEL: 17.3 feet
DEPTH TO BEDROCK:



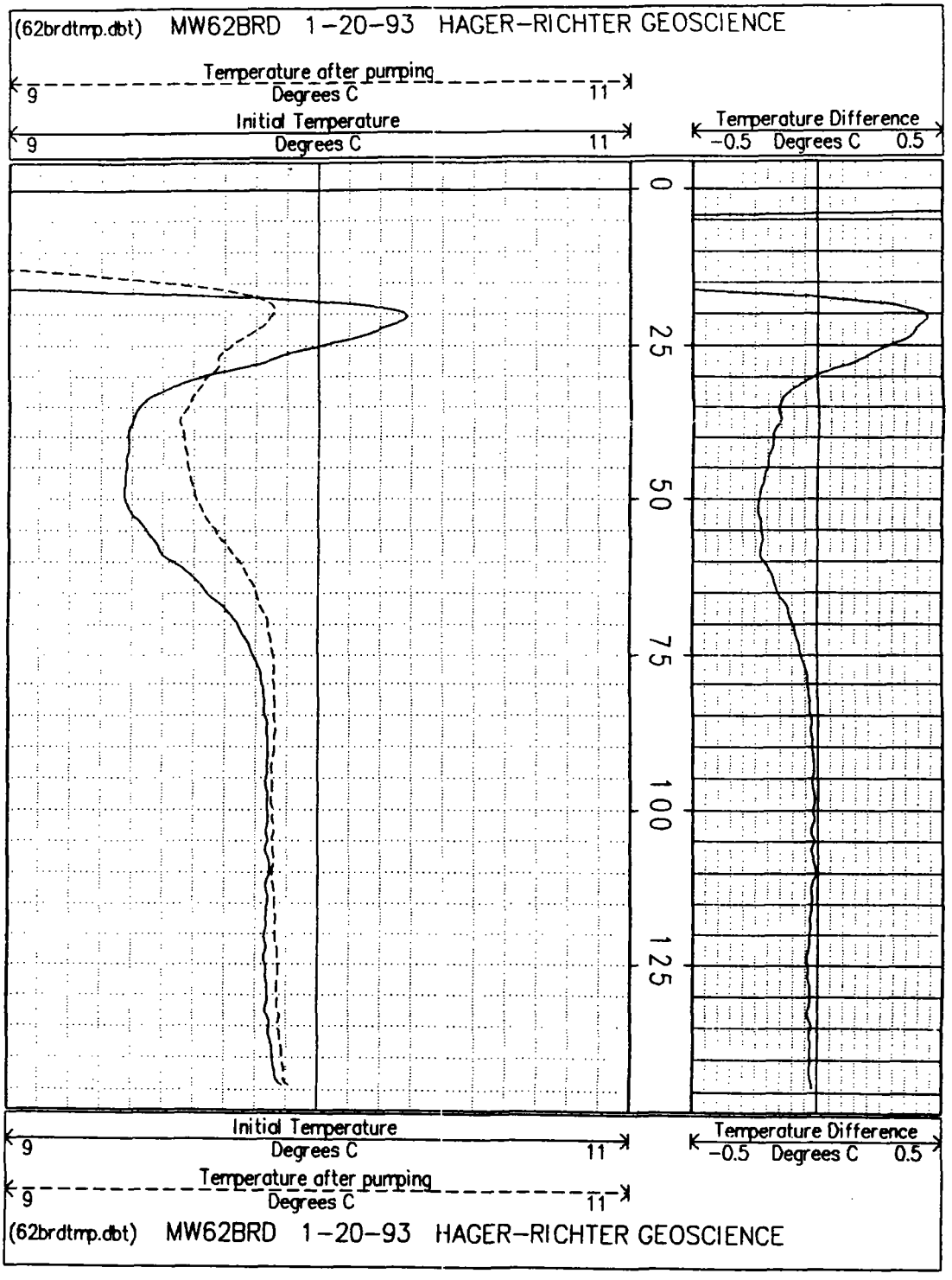
HAGER-RICHTER GEOSCIENCE, INC.
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

DUAL TEMPERATURE

WELL: GW62BRD

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Mt. Sopris Series III
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR: Soils Exploration Corp.
COMMENTS: 4" PVC to 105 feet

DATE: January 20, 1993
H-R FILE #: 92G29A
ELEVATION:
LOG DATUM: Ground Level
CLIENT TD:
H-R TD: 145.9 feet
STATIC WATER LEVEL: 2.7 feet
DEPTH TO BEDROCK: 75 feet



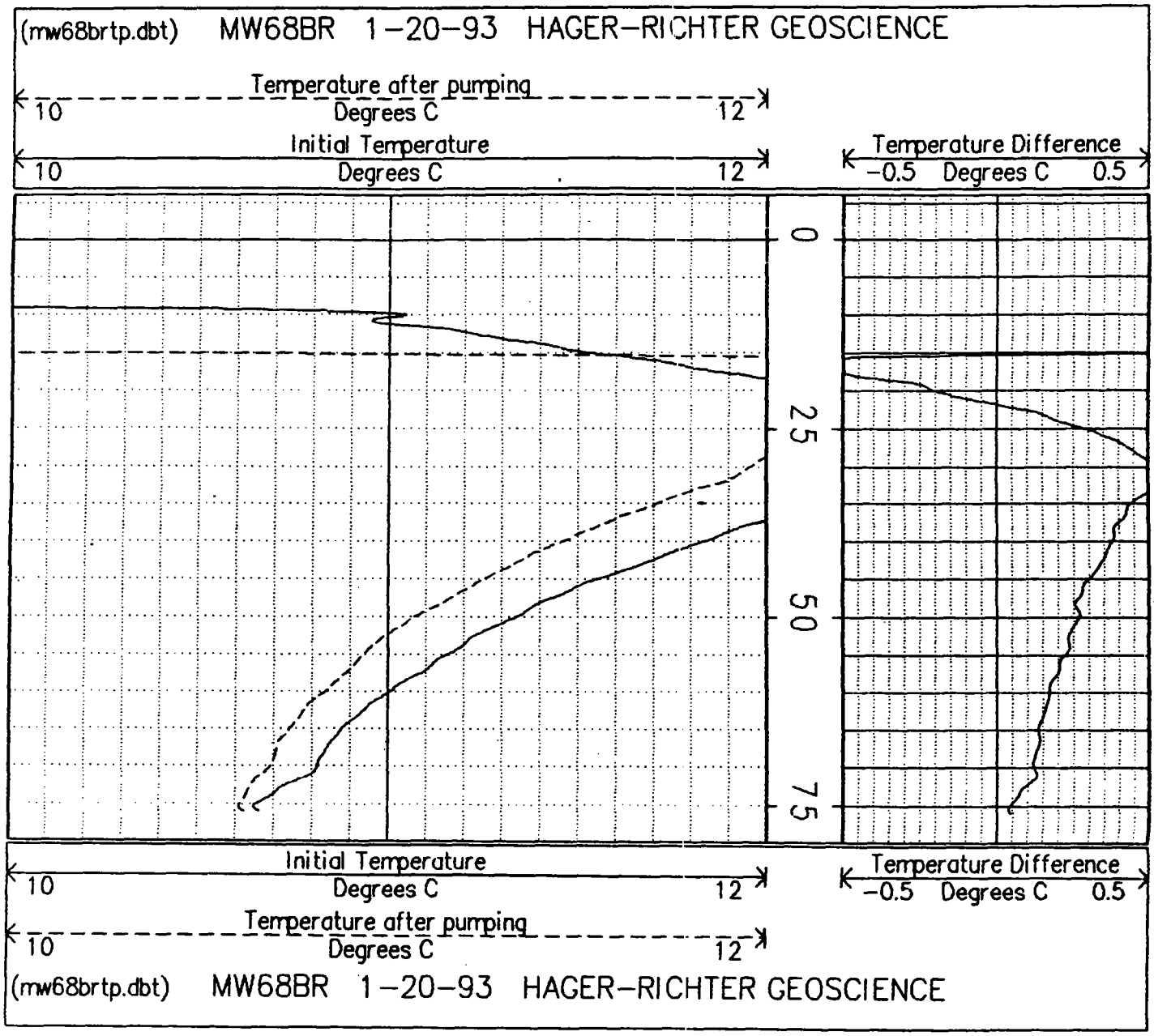
HAGER-RICHTER GEOSCIENCE, INC.
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

DUAL TEMPERATURE

WELL: GW68BR

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Mt. Sopris Series III
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR: Soils Exploration Corp.
COMMENTS: 4" PVC to 26 feet

DATE: January 20, 1993
H-R FILE #: 92G29A
ELEVATION:
LOG DATUM: Ground Level
CLIENT TD:
H-R TD: 75.7 feet
STATIC WATER LEVEL: 8.1 feet
DEPTH TO BEDROCK: 21 feet



HAGER-RICHTER GEOSCIENCE, INC.
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

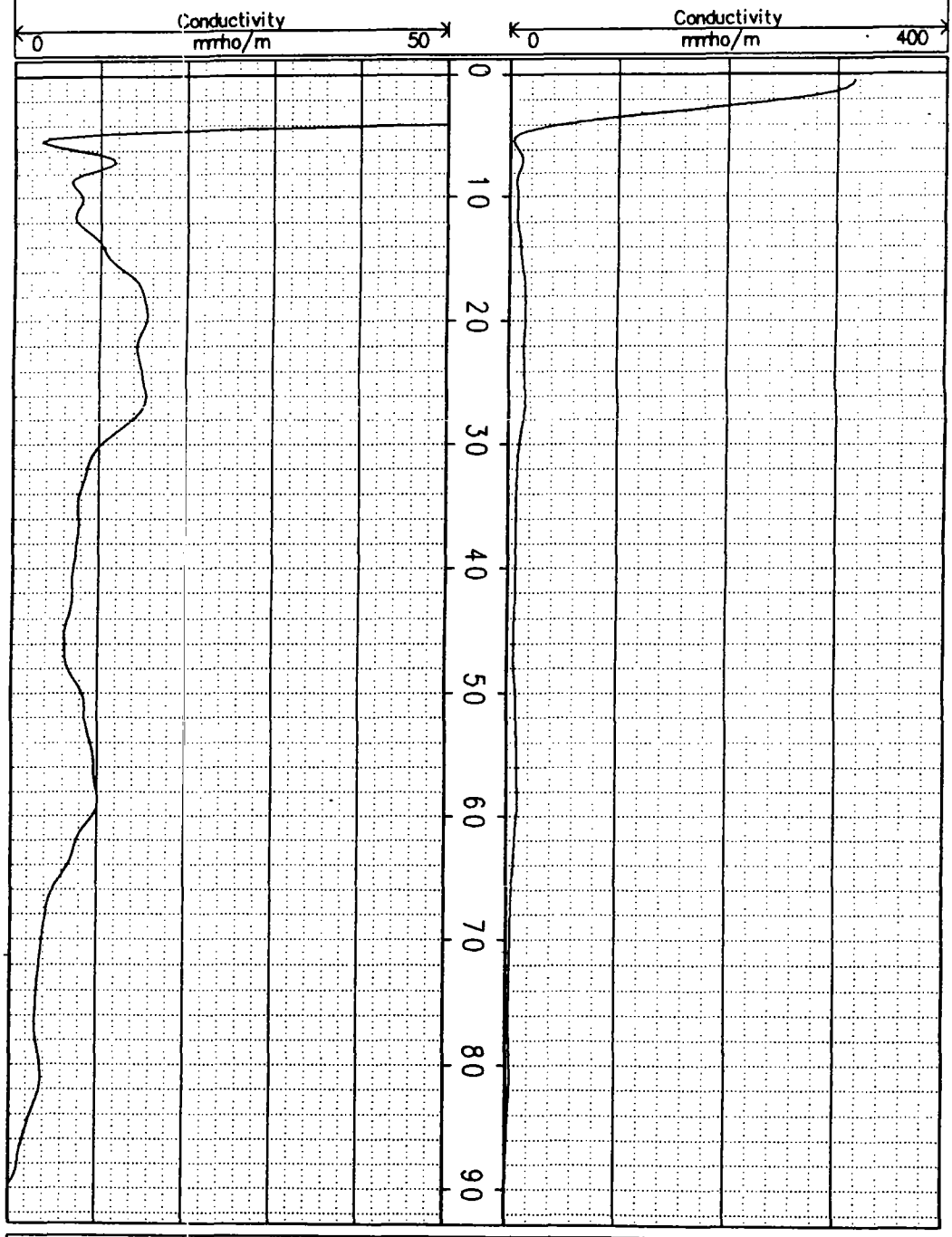
CONDUCTIVITY

WELL: GW61BR

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR: Soils Exploration Corp.
COMMENTS:

DATE: December 17, 1992
H-R FILE #: 92G29A
ELEVATION:
LOG DATUM: Ground Level
CLIENT TD:
H-R TD: 91.8 feet
STATIC WATER LEVEL: 4.7 feet
DEPTH TO BEDROCK:

(GW61BRSC.DAT) GW61BR, Wilmington, MA, 12-17-92, HAGER-RICHTER



(GW61BRSC.DAT) GW61BR, Wilmington, MA, 12-17-92, HAGER-RICHTER

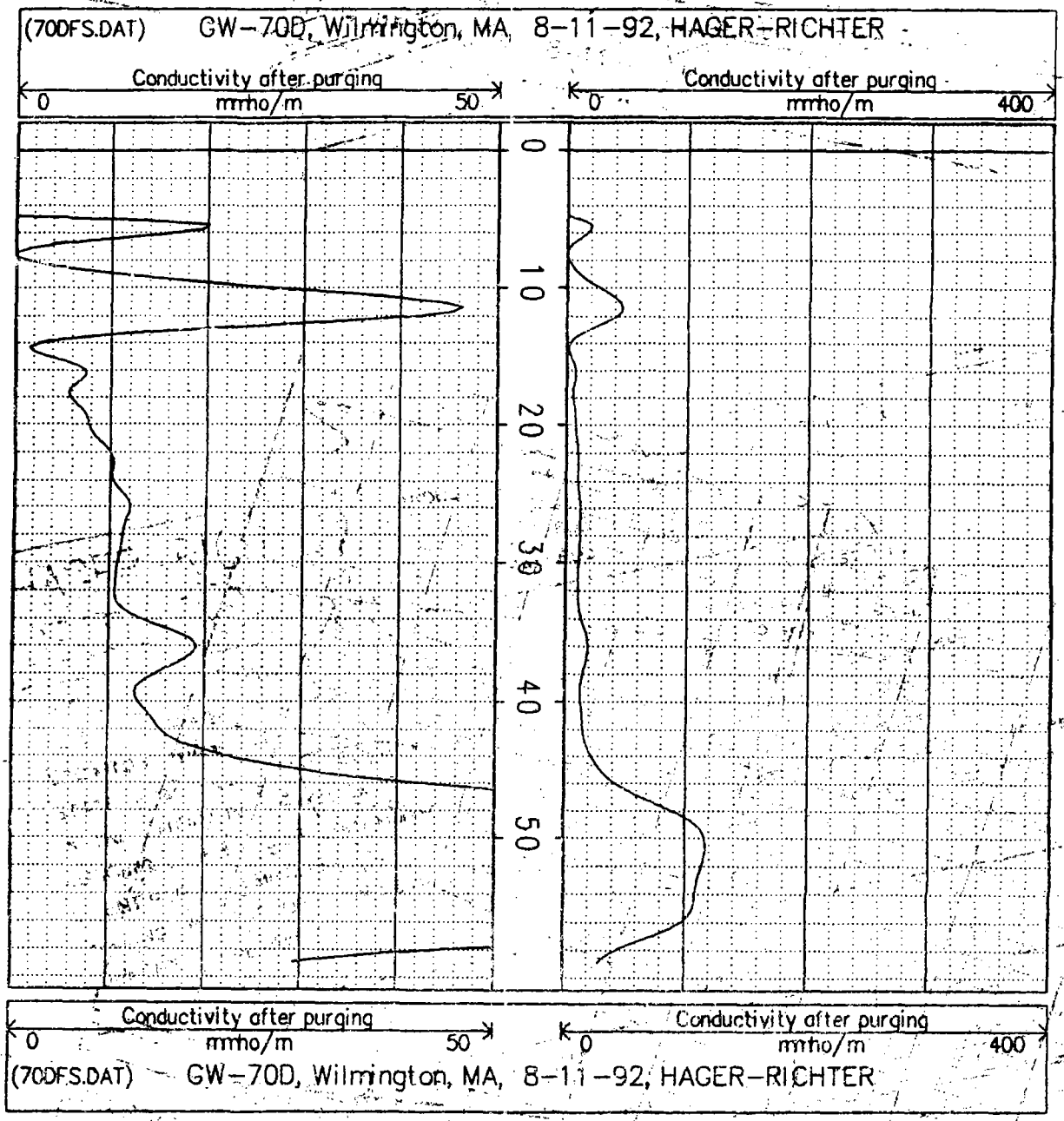
HAGER-RICHTER GEOSCIENCE, INC.
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

CONDUCTIVITY

WELL: GW-70D

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR: Soils Exploration Corp.
COMMENTS: 2 in. PVC

DATE: August 11, 1992
H-R FILE #: 92G29
ELEVATION: 92.3 feet
LOG DATUM: Ground Level
CLIENT TD: 62 feet
H-R TD: 61.08 feet
STATIC WATER LEVEL: 11.74 feet
DEPTH TO BEDROCK: approx. 57 feet



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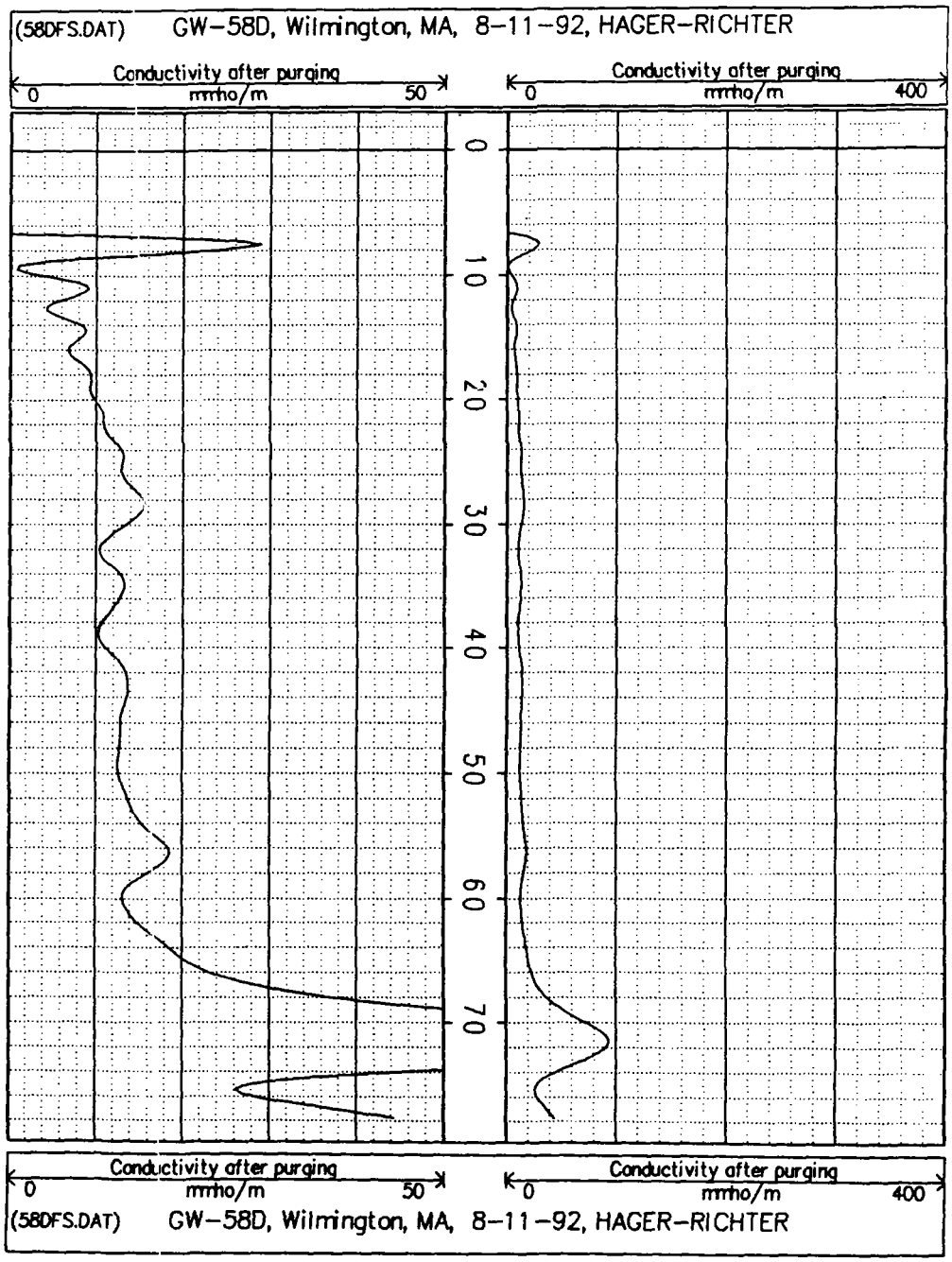
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

CONDUCTIVITY

WELL: GW-58D

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR: Soils Exploration Corp.
COMMENTS: 2 in. PVC

DATE: August 11, 1992
H-R FILE #: 92G29
ELEVATION:
LOG DATUM: Ground Level
CLIENT TD: 80 feet
H-R TD: 79.91 feet
STATIC WATER LEVEL: 17.9 feet
DEPTH TO BEDROCK: approx. 74 feet

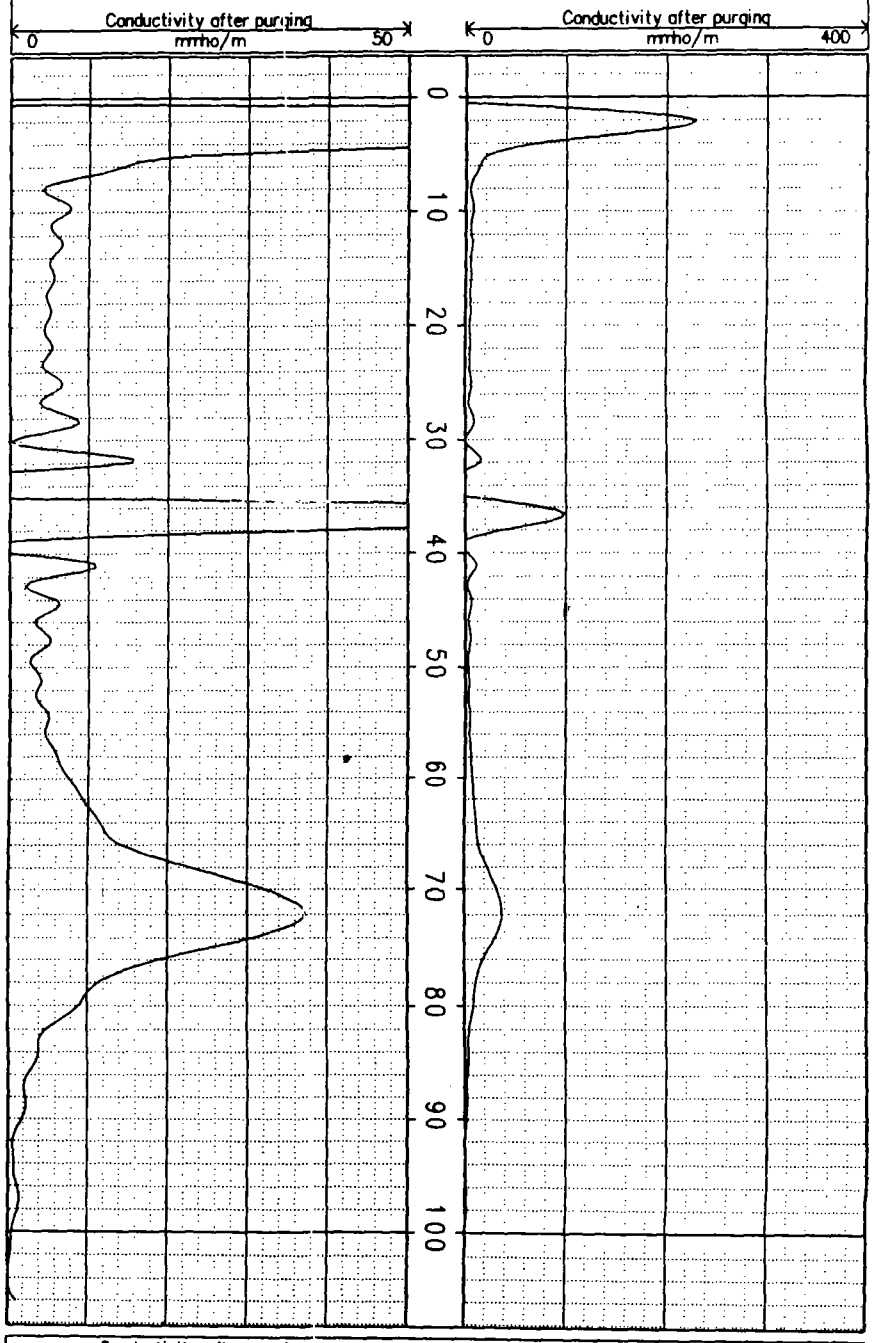


HAGER-RICHTER GEOSCIENCE, INC.	8 INDUSTRIAL WAY, UNIT D-10 C LM, NH 03079 PHONE: 603 893-9944 FAX: 603 893-8313	CONDUCTIVITY WELL: GW-62BR

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR: Soils Exploration Corp.
COMMENTS: 2 in. PVC

DATE: August 11, 1992
H-R FILE #: 92G29
ELEVATION:
LOG DATUM: Ground Level
CLIENT TD: 105 feet
H-R TD: 108.19 feet
STATIC WATER LEVEL: 3.84 feet
DEPTH TO BEDROCK: approx. 80 feet

(62BRFS.DAT) GW-62BR, Wilmington, MA, 8-11-92, HAGER-RICHTER



(62BRFS.DAT) GW-62BR, Wilmington, MA, 8-11-92, HAGER-RICHTER

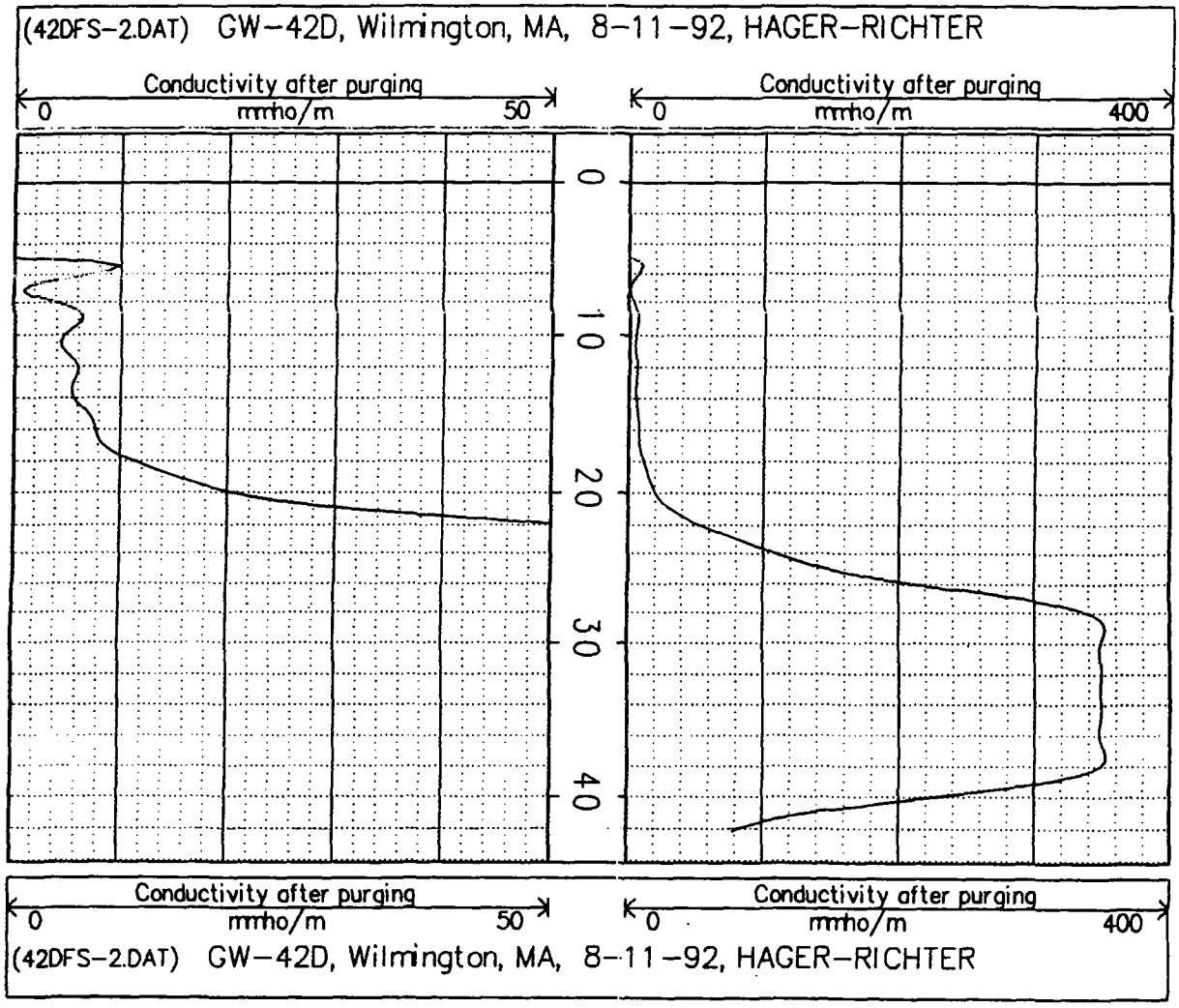
HAGER-RICHTER GEOSCIENCE, INC.
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

CONDUCTIVITY

WELL: GW-42D

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR:
COMMENTS: 2 in. PVC

DATE: August 11, 1992
H-R FILE #: 92G29
ELEVATION: 84.4 feet
LOG DATUM: Ground Level
CLIENT TD:
H-R TD: 44.36 feet
STATIC WATER LEVEL: 3.37 feet
DEPTH TO BEDROCK: 39.0 feet



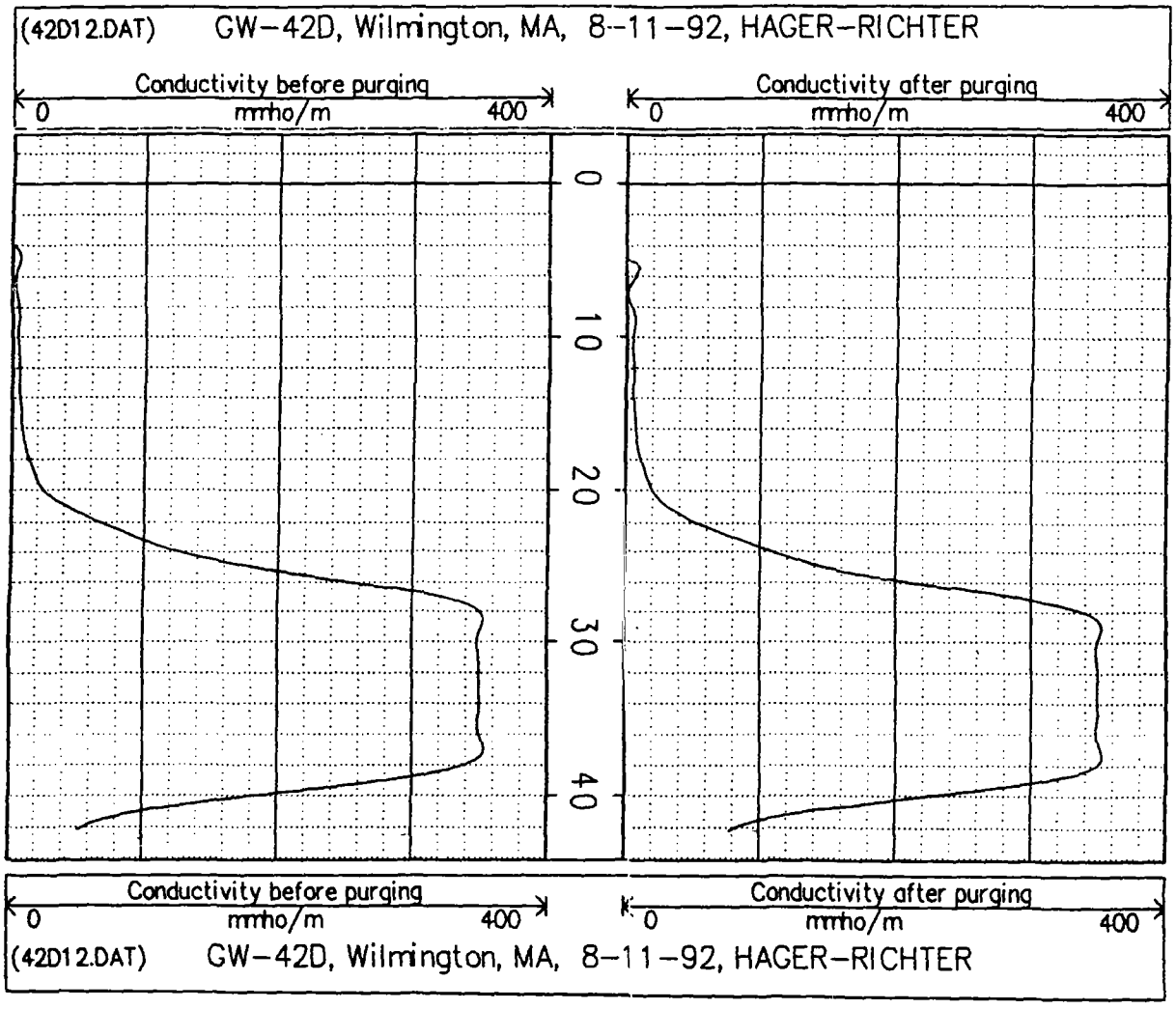
HAGER-RICHTER GEOSCIENCE, INC.
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

CONDUCTIVITY

WELL: GW-42D

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR:
COMMENTS: 2 in. PVC

DATE: August 11, 1992
H-R FILE #: 92G29
ELEVATION: 84.4 feet
LOG DATUM: Ground Level
CLIENT TD:
H-R TD: 44.36 feet
STATIC WATER LEVEL: 3.37 feet
DEPTH TO BEDROCK: 39.0 feet



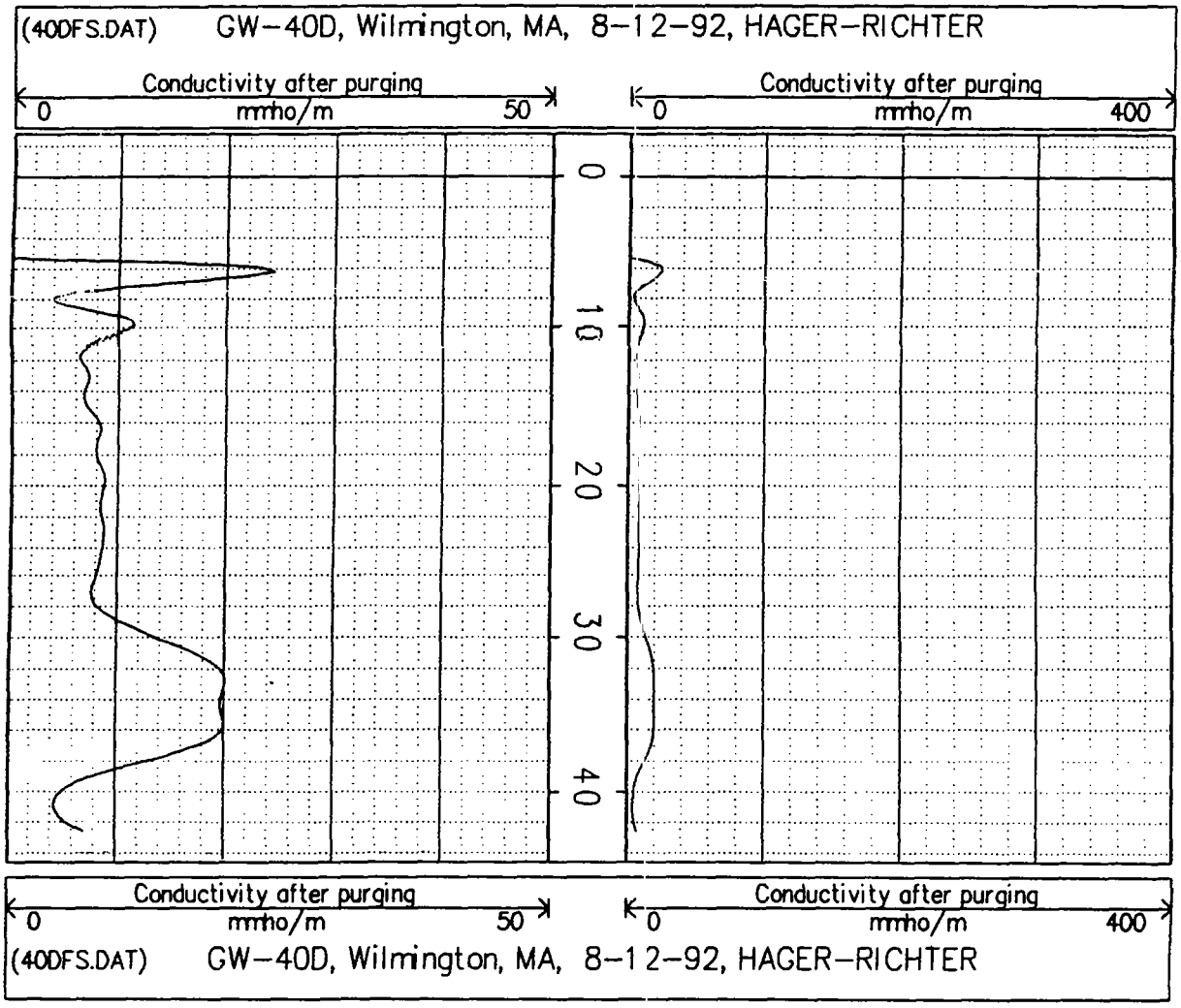
HAGER-RICHTER GEOSCIENCE, INC.
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

CONDUCTIVITY

WELL: GW-40D

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR:
COMMENTS: 2 in. PVC

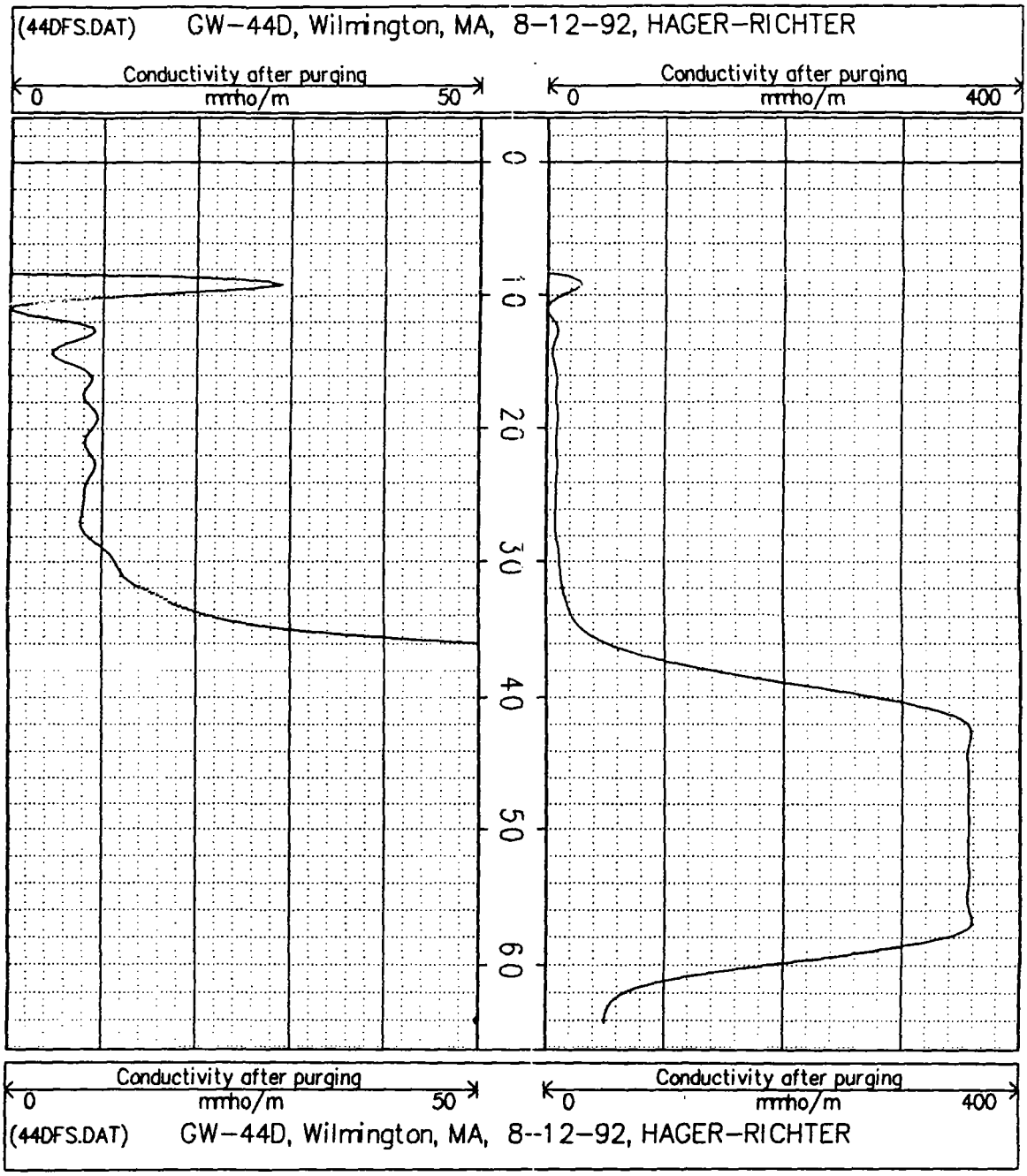
DATE: August 12, 1992
H-R FILE #: 92G29
ELEVATION: 86.4 feet
LOG DATUM: Ground Level
CLIENT TD: 45 feet
H-R TD: 44.73 feet
STATIC WATER LEVEL: 10.6 feet
DEPTH TO BEDROCK: 39.0 feet



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 Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR:
COMMENTS: 2 in. PVC

DATE: August 12, 1992
H-R FILE #: 92G29
ELEVATION: 83.5 feet
LOG DATUM: Ground Level
CLIENT TD: 67 feet
H-R TD: 66.38 feet
STATIC WATER LEVEL: 5.94 feet
DEPTH TO BEDROCK: approx. 67 feet



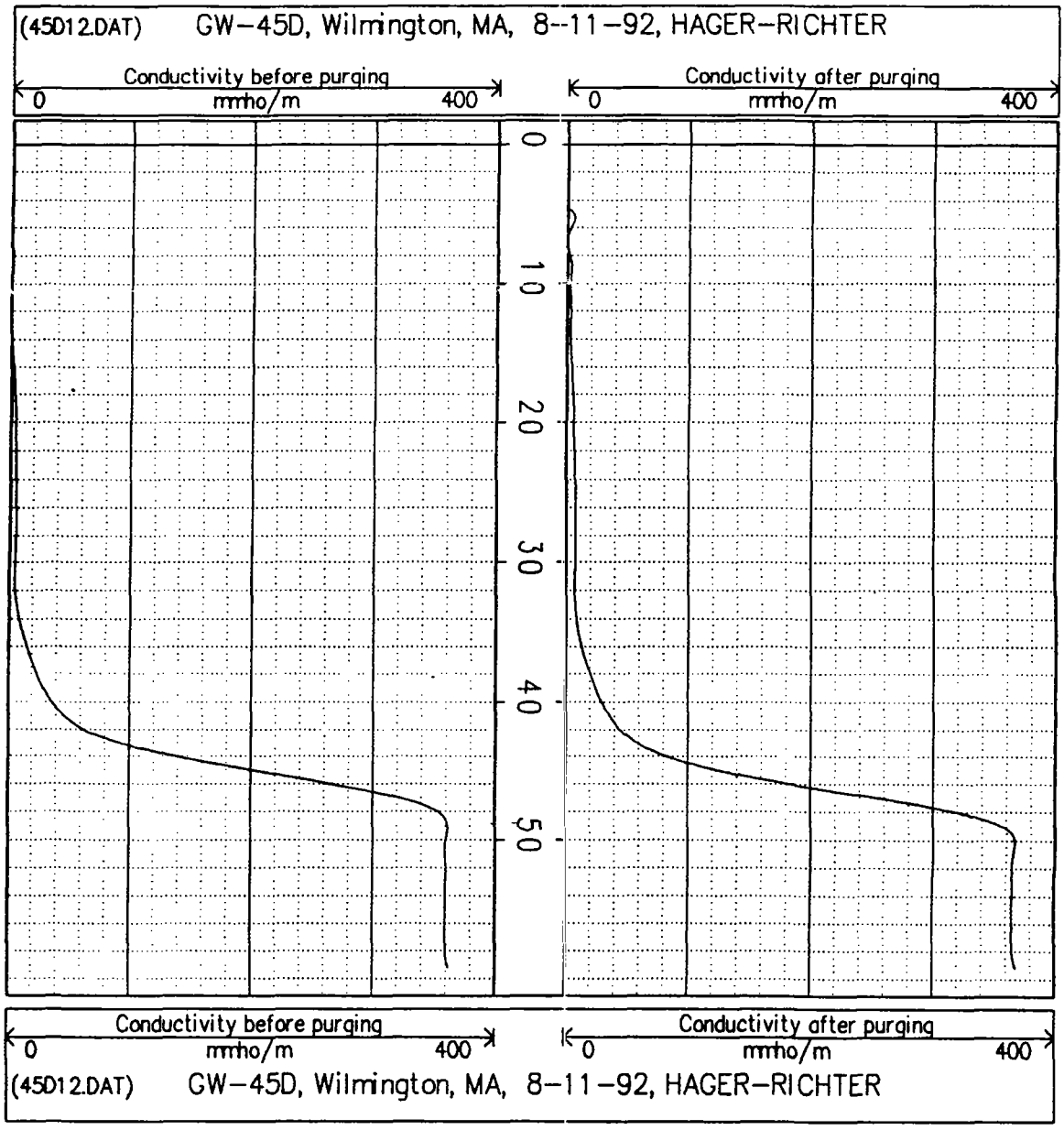
HAGER-RICHTER GEOSCIENCE, INC.
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

CONDUCTIVITY

WELL: GW-45D

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR:
COMMENTS: 2 in. PVC

DATE: August 11, 1992
H-R FILE #: 92G29
ELEVATION: 89.8 feet
LOG DATUM: Ground Level
CLIENT TD: 63.5 feet
H-R TD: 61.41 feet
STATIC WATER LEVEL: 8.90 feet
DEPTH TO BEDROCK: approx. 63 feet



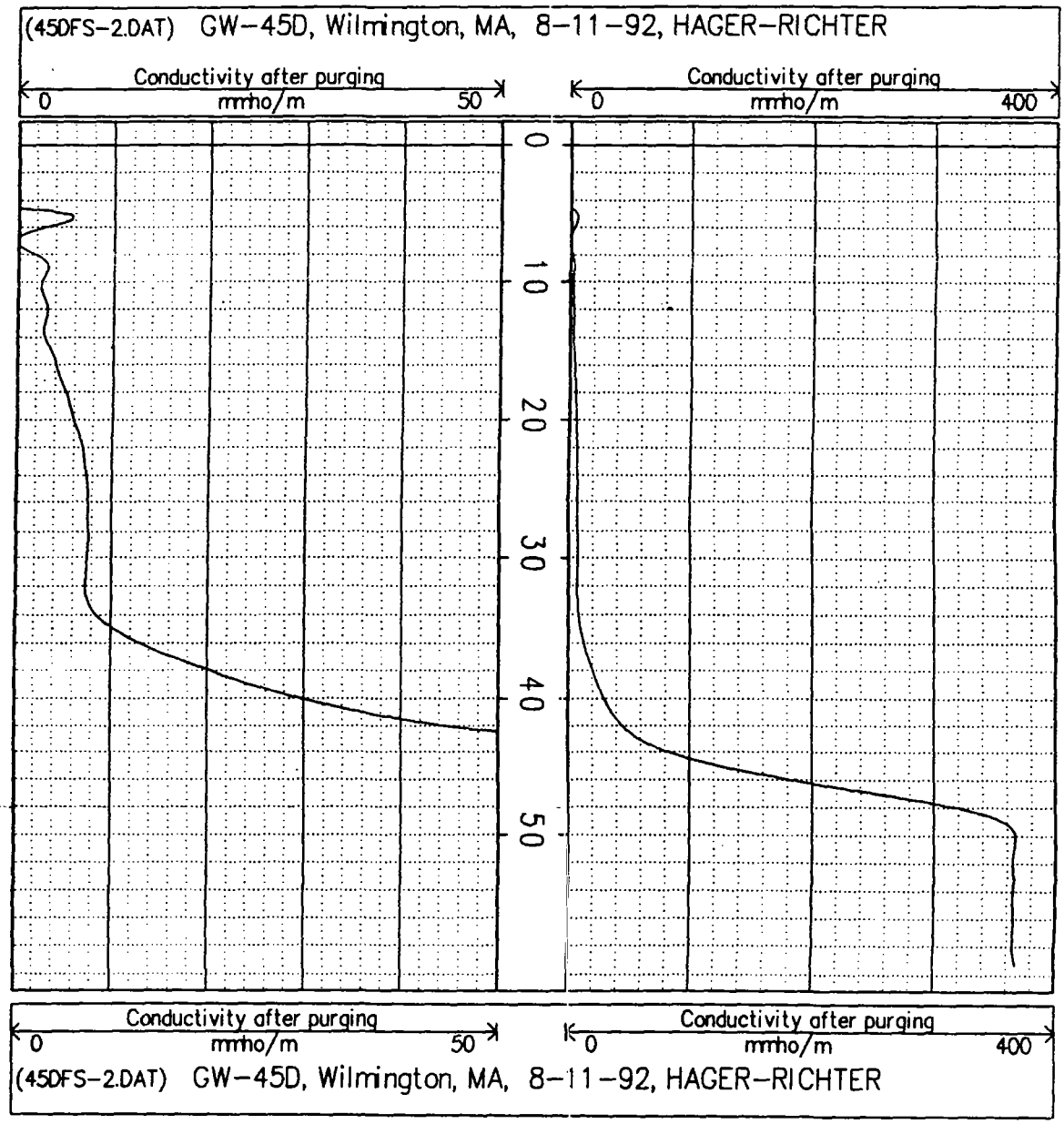
HAGER-RICHTER GEOSCIENCE, INC.
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

CONDUCTIVITY

WELL: GW-45D

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR:
COMMENTS: 2 in. PVC

DATE: August 11, 1992
H-R FILE #: 92G29
ELEVATION: 89.8 feet
LOG DATUM: Ground Level
CLIENT TD: 63.5 feet
H-R TD: 61.41 feet
STATIC WATER LEVEL: 8.90 feet
DEPTH TO BEDROCK: approx. 63 feet



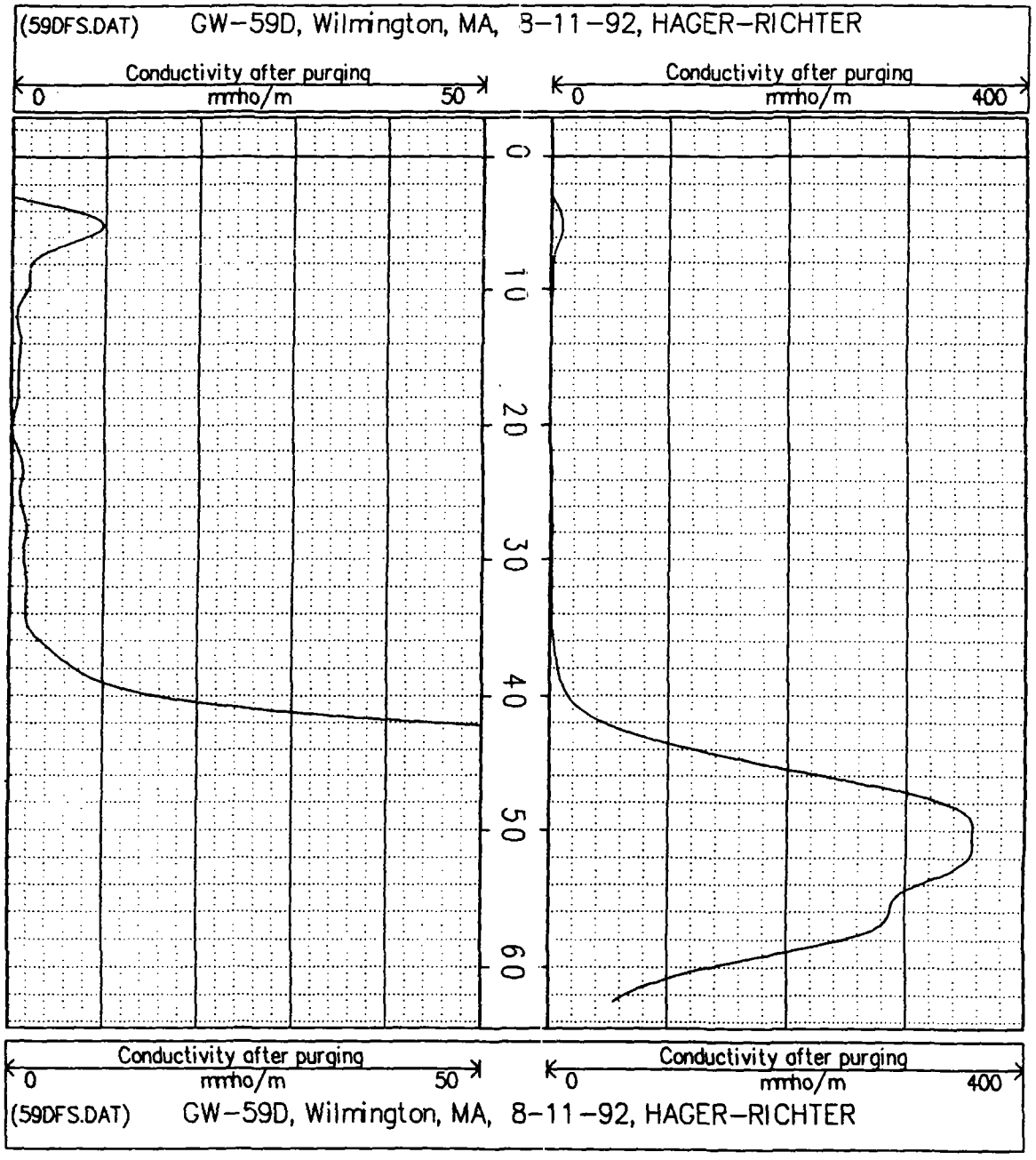
HAGER-RICHTER GEOSCIENCE, INC.
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

CONDUCTIVITY

WELL: GW-59D

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR:
COMMENTS: 2 in. PVC

DATE: August 11, 1992
H-R FILE #: 92G29
ELEVATION: 85.2 feet
LOG DATUM: Ground Level
CLIENT TD: 65 feet
H-R TD: 64.69 feet
STATIC WATER LEVEL: 4.57 feet
DEPTH TO BEDROCK: approx. 60 feet



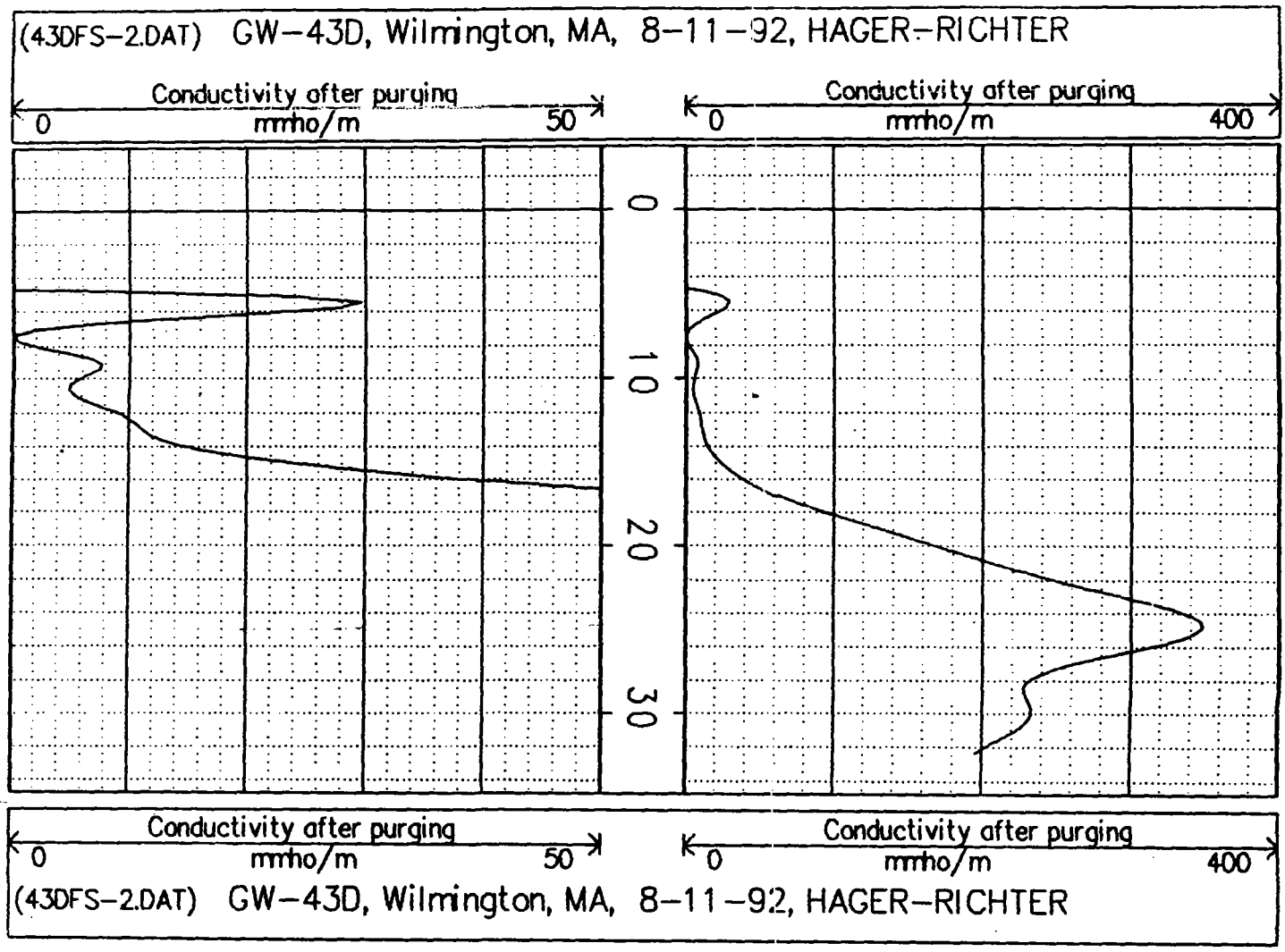
HAGER-RICHTER GEOSCIENCE, INC.
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

CONDUCTIVITY

WELL: GW-43D

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR:
COMMENTS: 2 in. PVC

DATE: August 11, 1992
H-R FILE #: 92G29
ELEVATION: 85.6 feet
LOG DATUM: Ground Level
CLIENT TD: 35 feet
H-R TD: 34.47 feet
STATIC WATER LEVEL: 7.62 feet
DEPTH TO BEDROCK: 29.0 feet



HAGER-RICHTER GEOSCIENCE, INC.

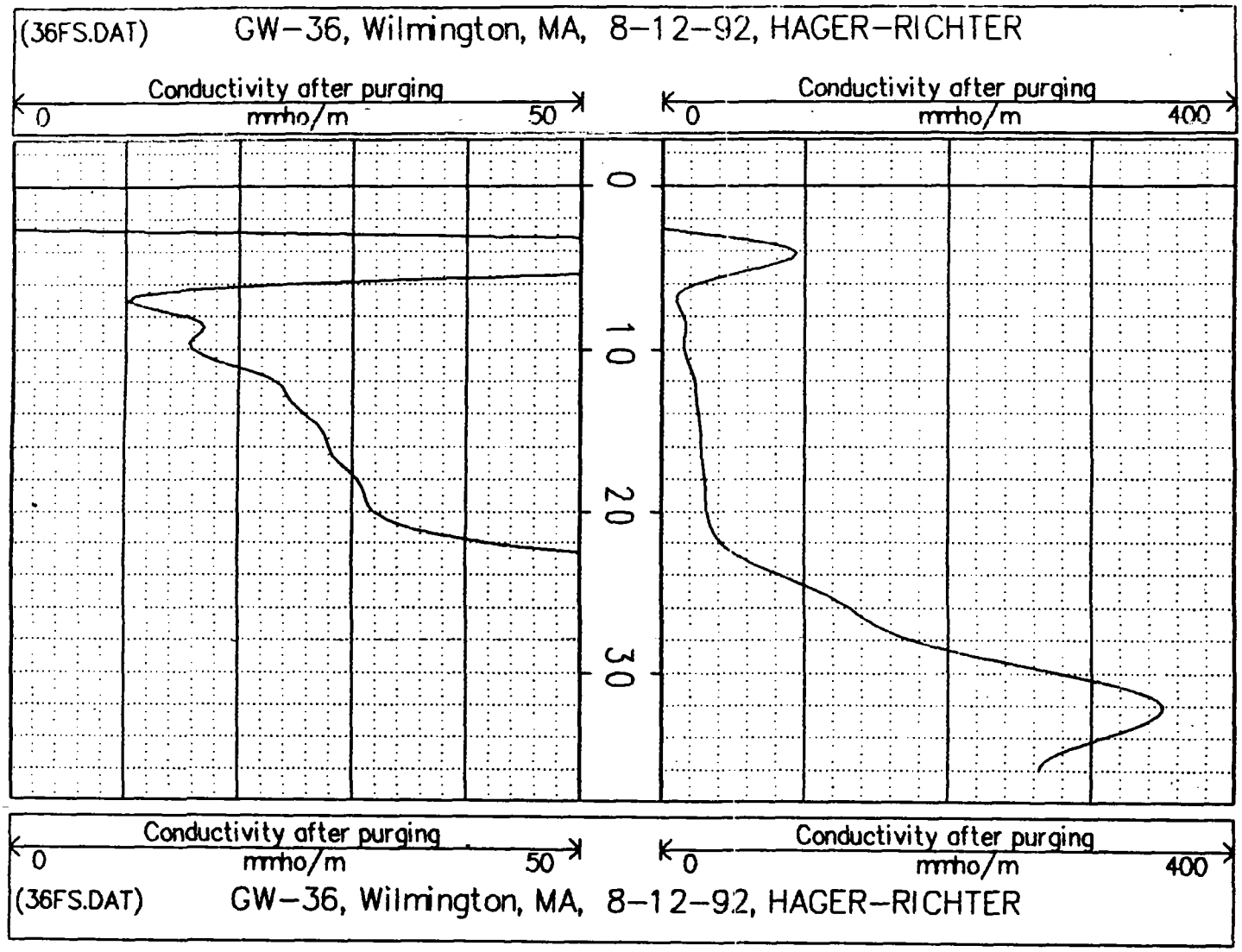
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

CONDUCTIVITY

WELL: GW-36

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR:
COMMENTS: 2 in. PVC

DATE: August 12, 1992
H-R FILE #: 92G29
ELEVATION: 84.3 feet
LOG DATUM: Ground Level
CLIENT TD: 37 feet
H-R TD: 38.09 feet
STATIC WATER LEVEL: 5.4 feet
DEPTH TO BEDROCK: 36.5 feet



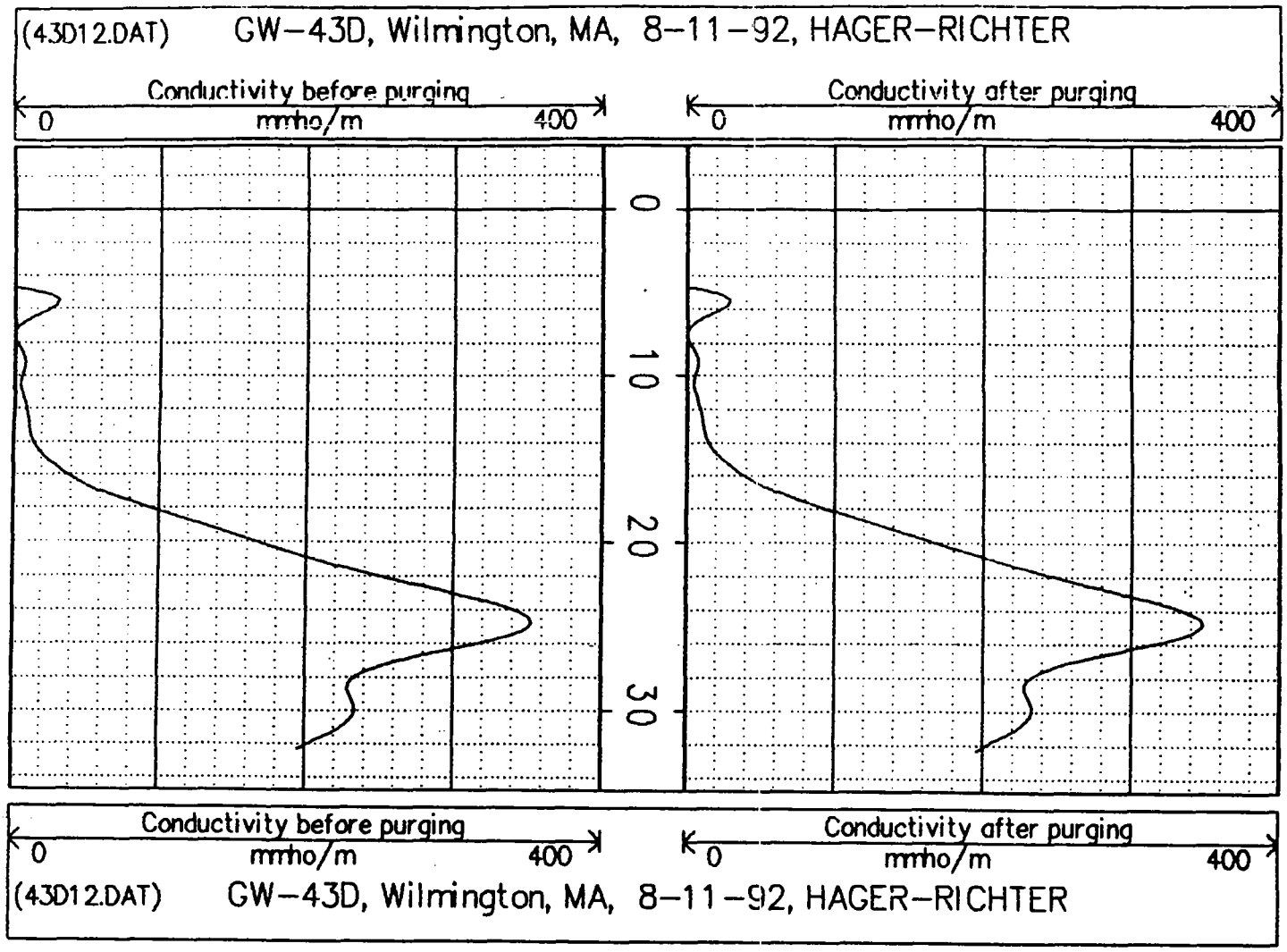
HAGER-RICHTER GEOSCIENCE, INC.
8 INDUSTRIAL WAY, UNIT D-10
SALEM, NH 03079
PHONE: 603 893-9944
FAX: 603 893-8313

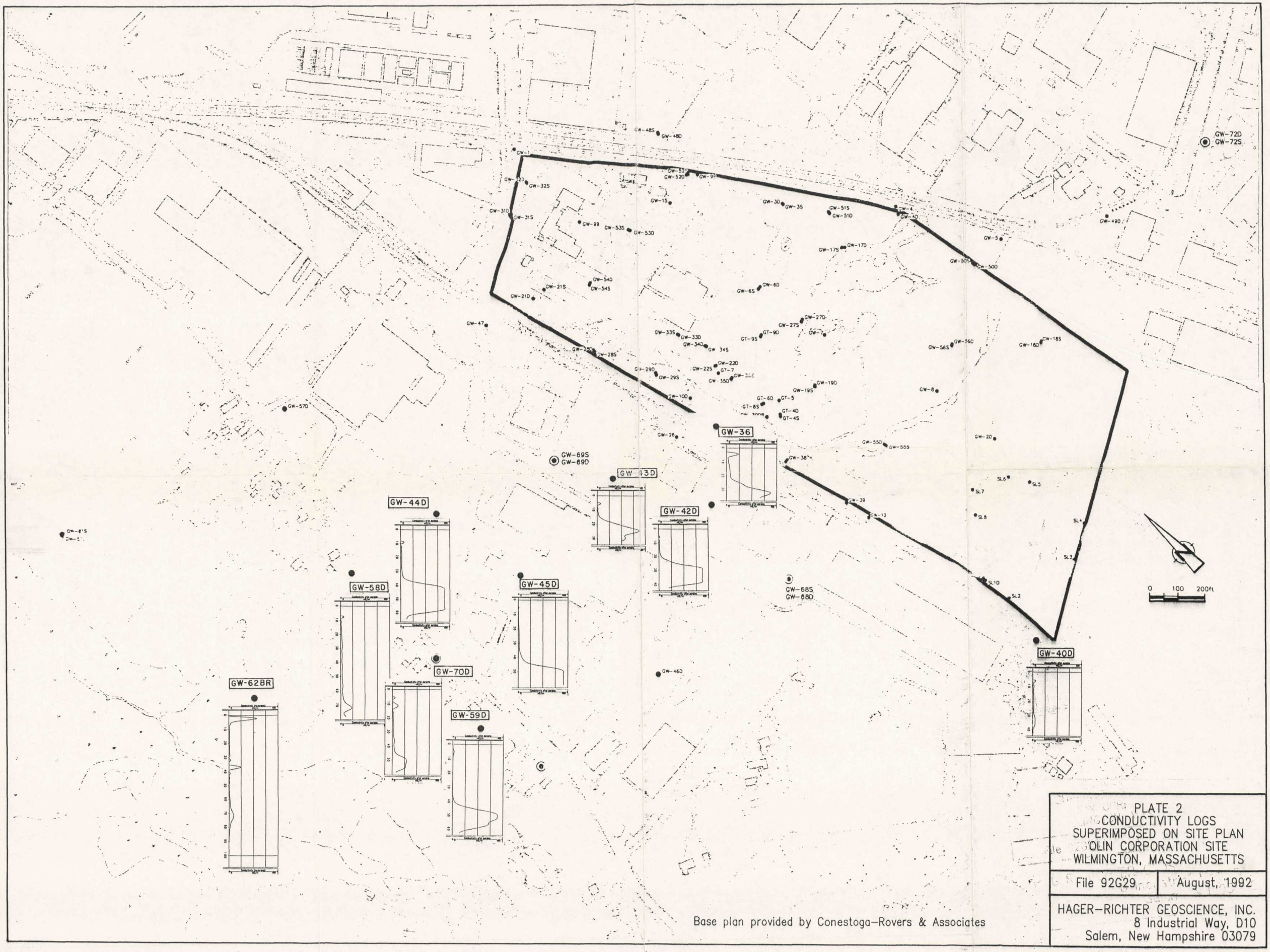
CONDUCTIVITY

WELL: GW-43D

PROJECT: Olin Corporation Site
CLIENT: Conestoga-Rovers & Associates, Inc.
LOCATION: Wilmington
STATE: Massachusetts COUNTY: Essex
INSTRUMENTATION: Geonics EM39
LOGGING GEOPHYSICIST: Jeff Mann
CLIENT REP: Jon Michels
DRILLING CONTRACTOR:
COMMENTS: 2 in. PVC

DATE: August 11, 1992
H-R FILE #: 92G29
ELEVATION: 85.6 feet
LOG DATUM: Ground Level
CLIENT TD: 35 feet
H-R TD: 34.47 feet
STATIC WATER LEVEL: 7.62 feet
DEPTH TO BEDROCK: 29.0 feet





Base plan provided by Conestoga-Rovers & Associates

PLATE 2
CONDUCTIVITY LOGS
SUPERIMPOSED ON SITE PLAN
OLIN CORPORATION SITE
WILMINGTON, MASSACHUSETTS

File 92G29	August, 1992

HAGER-RICHTER GEOSCIENCE, INC.
8 Industrial Way, D10
Salem, New Hampshire 03079

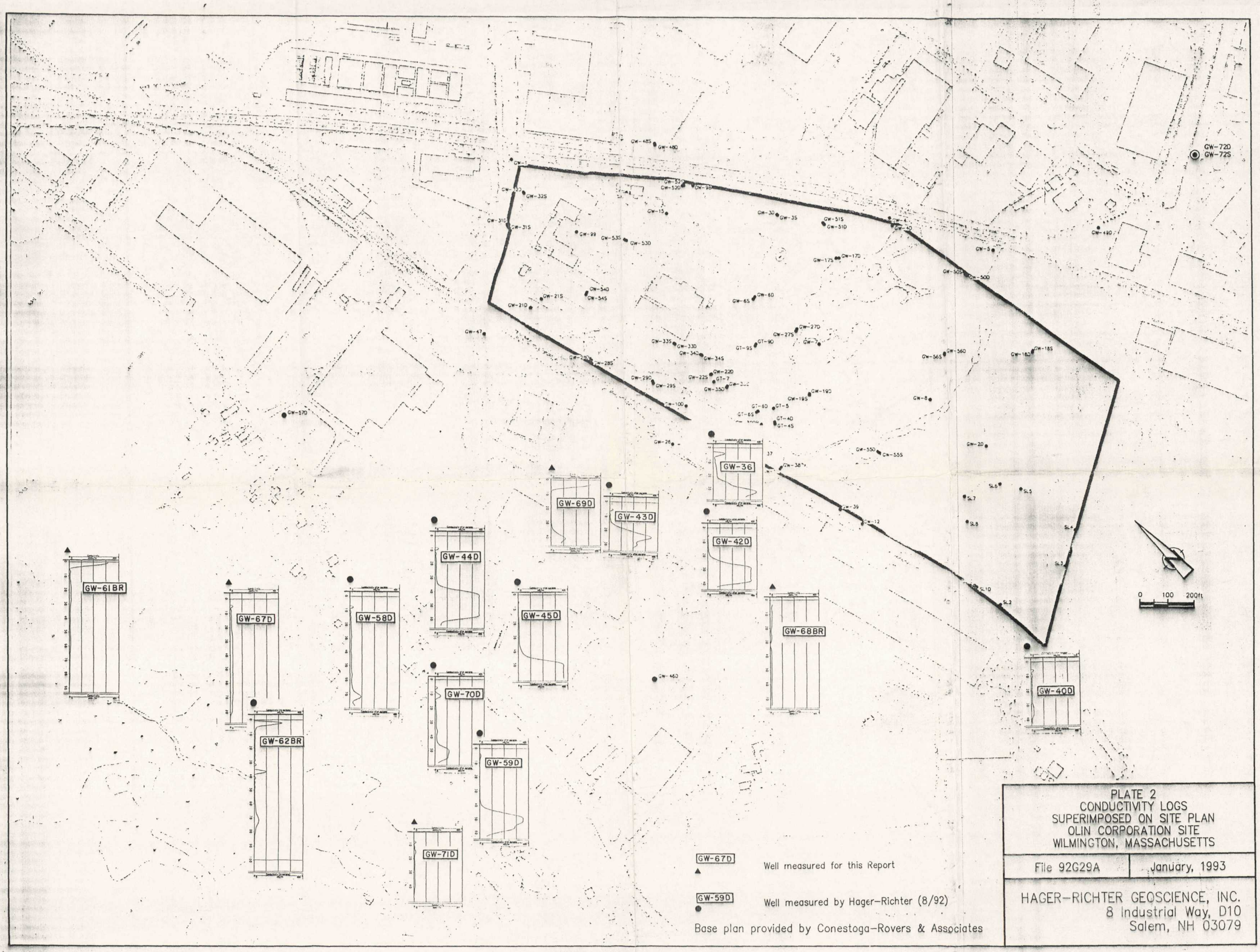
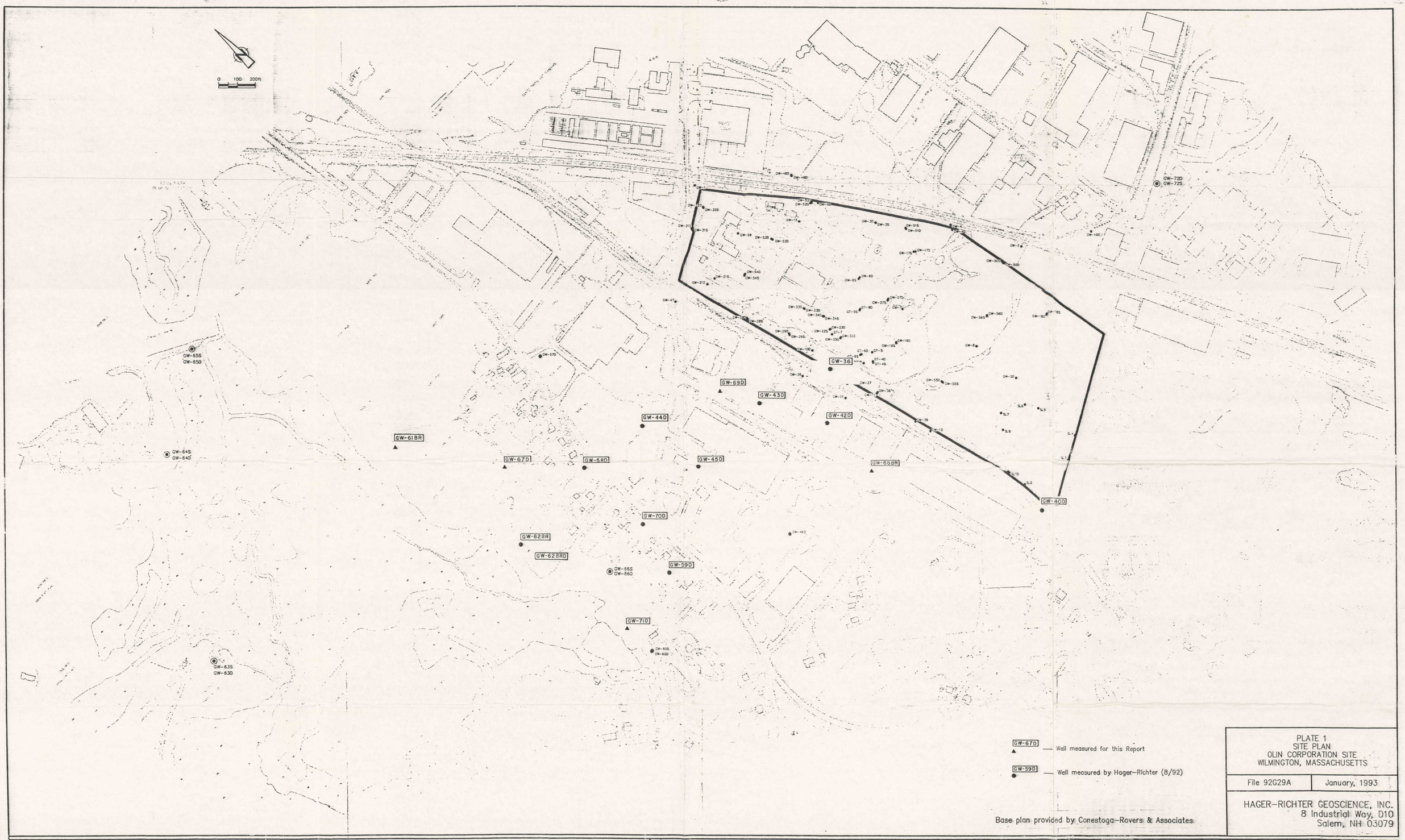


PLATE 2
CONDUCTIVITY LOGS
SUPERIMPOSED ON SITE PLAN
OLIN CORPORATION SITE
WILMINGTON, MASSACHUSETTS

File 92G29A | January, 1993

HAGER-RICHTER GEOSCIENCE, INC.
8 Industrial Way, D10
Salem, NH 03079



Base plan provided by Conestoga-Rovers & Associates

PLATE 1
SITE PLAN
OLIN CORPORATION SITE
WILMINGTON, MASSACHUSETTS

File 92G29A | January, 1993

HAGER-RICHTER GEOSCIENCE, INC.
8 Industrial Way, D10
Salem, NH 03079

LEGEND

- RAILWAY
- FENCE
- FACILITY BOUNDARY
- GW-57D EXISTING WELL LOCATION
- GW-63S PROPOSED WELL LOCATION

Nº	Revision	Date	Initial

Approved

OLIN CORPORATION

WILMINGTON FACILITY

PROPOSED WELL LOCATIONS

CRA
CONESTOGA-ROVERS & ASSOCIATES

Drawn by: DKC	Scale: 1" = 200'	Date: JULY 1992	File Nº: 45 (P-50)	Rev.Nº: –
Designed by: MJ				
Checked by: MJ	Field book:	Project Nº: 3683	Drawing Nº: 2	

Base plan provided by Conestoga-Rovers & Associates

PLATE 1
SITE PLAN
OLIN CORPORATION SITE
WILMINGTON, MASSACHUSETTS

File 92G29	August, 1992

HAGER-RICHTER GEOSCIENCE, INC.
8 Industrial Way, D10
Salem, New Hampshire 03079

LEGEND

- RAILWAY
- FENCE
- FACILITY BOUNDARY
- GW-57D EXISTING WELL LOCATION
- GW-63S PROPOSED WELL LOCATION

No.	Revision	Date	Initial

Approved

OLIN CORPORATION

WILMINGTON FACILITY

PROPOSED WELL LOCATIONS

CRA
CONESTOGA-ROVERS & ASSOCIATES

Drawn by: DKC	Scale: 1" = 200'	Date: JULY 1992	File No: 45 (P-50)	Rev. No: –
Designed by: MJ				
Checked by: MJ	Field book:	Project No: 3683	Drawing No: 2	

APPENDIX J

MAIN STREET PRIVATE WELL SAMPLING PROTOCOL AND ANALYTICAL REPORTS

3683

Olin CORPORATION
Environmental
Public
Affairs

FOR YOUR INFORMATION

Notes From Wilmington Trip
9/14/91 - 9/16/91

Home Sampling Program.
Discussions With Local Officials.

S. J. Barbee - New Haven
D. L. Cummings - Charleston
R. J. Horn - Charleston
S. G. Morrow - Charleston
T. P. O'Brien - Easton
A. D. Rheingold - Stamford
D. H. Brewer - Cleveland
L. E. Gaza - Stamford
W. H. Werfelman - Stamford

Curt M. Richards
Environmental Public Affairs

Recycled Paper -
Protecting our resources for the next generation

Client: Olin Chemical

26-Sep-91

ABB Environmental
Analytical Laboratory Services Division
Quality Control Report

000034

Laboratory Fortified Sample Matrix (LFM) Results

Volatile Organics by GC/MS Method 524.2

Water Matrix

Date of Analysis: 09-20-91
ABB Sample Number Spiked: 91259-014

Compound	Units	Spike Conc.	Sample Measured Conc.	LFM Measured Conc.	LFM % Recovery	Recovery Acceptance Range (%)~
1,1,1,2-Tetrachloroethane	ug/L	2.00		3.13	157	80-120
Ethylbenzene	ug/L	2.00		2.50	125	80-120
m+p-Xylene	ug/L	4.00		5.95	149	80-120
Bromoform	ug/L	2.00		3.39	170	80-120
o-Xylene	ug/L	2.00		2.88	144	80-120
Styrene	ug/L	2.00		2.32	116	80-120
1,1,2,2-Tetrachloroethane	ug/L	2.00		3.24	162	80-120
1,2,3-Trichloropropane	ug/L	2.00		2.68	134	80-120
Isopropylbenzene	ug/L	2.00		2.84	142	80-120
Bromobenzene	ug/L	2.00		2.63	132	80-120
2-Chlorotoluene	ug/L	2.00		3.16	158	80-120
n-Propylbenzene	ug/L	2.00		2.46	123	80-120
4-Chlorotoluene	ug/L	2.00		1.88	94	80-120
1,3,5-Trimethylbenzene	ug/L	2.00		3.06	153	80-120
tert-Butylbenzene	ug/L	2.00		2.85	143	80-120
1,2,4-Trimethylbenzene	ug/L	2.00		2.78	139	80-120
sec-Butylbenzene	ug/L	2.00		2.74	137	80-120
1,3-Dichlorobenzene	ug/L	2.00		2.36	118	80-120
p-Isopropyltoluene	ug/L	2.00		2.55	128	80-120
1,4-Dichlorobenzene	ug/L	2.00	0.19	2.13	97	80-120
1,2-Dichlorobenzene	ug/L	2.00		3.33	167	80-120
n-Butylbenzene	ug/L	2.00		1.97	98.5	80-120
1,2-Dibromo-3-chloropropane	ug/L	2.00		2.20	110	80-120
1,2,4-Trichlorobenzene	ug/L	2.00		2.21	111	80-120
Naphthalene	ug/L	2.00		1.51	75.5	80-120
Hexachlorobutadiene	ug/L	2.00		2.81	141	80-120
1,2,3-Trichlorobenzene	ug/L	2.00		2.83	142	80-120
2,4,4-Trimethyl-1-pentene	ug/L	2.00		2.59	130	80-120
2,4,4-Trimethyl-2-pentene	ug/L	2.00		2.53	127	80-120

~ These acceptance criteria are for advisory purposes only, and are not to be utilized as sample validation criteria.

ABB Environmental
Analytical Laboratory Services Division
Quality Control Report

Sample Duplicate Results

Volatile Organics by GC

Water Matrix

ABB Sample No. Duplicated: 91245014

Compound*	Units	Sample Conc.	Sample Duplicate Conc.	Average Conc.	RPD (%)	RPD Acceptance Range (%)
Methylene chloride	ug/L	0.54B	0.45B	0.49	18.0	
1,4-Dichlorobenzene	ug/L	0.19	0.14	0.16	30.0	
	ug/L					
	ug/L					
	ug/L					
	ug/L					
	ug/L					
	ug/L					
	ug/L					
	ug/L					
	ug/L					

* Only positive results have been included. The remaining compounds were below the laboratory Practical Quantitation Limits.

ABB Environmental
Analytical Laboratory Services Division
Quality Control Report

Methods, Chronology of Analysis and Method Blank Results

Semivolatile Organics by GC/MS Method 625

Water Matrix

CHRONOLOGY

ABB Sample Nos.	Date Received	Date Extracted	Date Analyzed	Dilution Factor ~	ABB Sample Nos.	Date Received	Date Extracted	Date Analyzed	Dilution Factor ~
91259009	16-Sep-91	17-Sep-91	17-Sep-91	1.0	91259015	16-Sep-91	17-Sep-91	18-Sep-91	1.0
91259010	16-Sep-91	17-Sep-91	18-Sep-91	1.0					
91259011	16-Sep-91	17-Sep-91	18-Sep-91	1.0					
91259011DUP	16-Sep-91	17-Sep-91	18-Sep-91	1.0					
91259011MS	16-Sep-91	17-Sep-91	18-Sep-91	1.0					
91259012	16-Sep-91	17-Sep-91	18-Sep-91	1.0					
91259013	16-Sep-91	17-Sep-91	18-Sep-91	1.0					
91259014	16-Sep-91	17-Sep-91	18-Sep-91	1.0					

METHOD BLANK RESULTS*

Compound	Conc. (ug/L)

* Only positive hits have been included. The remaining compounds were not detected.

~ The Dilution Factor (DF) indicates whether a sample, prepared in accordance with the analytical method protocol, was diluted prior to analysis. The Dilution Factor could also indicate that a smaller aliquot than specified in the method was utilized for sample preparation and analysis. For example, a dilution factor of 5 means that the sample was effectively diluted by a factor of 5 prior to analysis, i.e., the sample was analyzed at 20% its reported concentration.

ABB Environmental
Analytical Laboratory Services Division
Quality Control Report

Laboratory Control Sample Results

Semivolatile Organics by GC/MS

Water Matrix

Date of Extraction: 13-Sep-91
Date of Analysis: 18-Sep-91

Compound	Units	Spike Conc.	LCS Measured Conc.	LCS Dup. Measured Conc.	LCS % Recovery	LCS Dup. % Recovery	Recovery Acceptance Range (%)*	RPD (%)	RPD Acceptance Range (%)*
Phenol	ug/l	200	86.8	73.6	43.4	36.8	5-112	16	0-23
2-Chlorophenol	ug/l	200	156	149	78.0	74.5	23-134	4.6	0-29
1,4-Dichlorobenzene	ug/l	100	52.1	49.7	52.1	49.7	20-124	4.7	0-32
N-Nitroso-di-n-propylamine	ug/l	100	67.8	67.9	67.8	67.9	3-125	0.1	0-34
1,2,4-Trichlorobenzene	ug/l	100	48.9	50.5	48.9	50.5	44-142	3.2	0-28
4-Chloro-3-methylphenol	ug/l	200	150	149	75.0	74.5	22-136	0.7	0-37
Acenaphthene	ug/l	100	66.1	64.8	66.1	64.8	47-127	2.0	0-28
4-Nitrophenol	ug/l	200	53.4	44.0	26.7	22.0	D-132	19	0-47
2,4-Dinitrotoluene	ug/l	100	54.2	58.0	54.2	58.0	39-139	6.8	0-22
Pentachlorophenol	ug/l	200	184	156	92.0	78.0	14-150	16	0-42
Pyrene	ug/l	100	76.5	63.3	76.5	63.3	52-115	*19	0-18

* These limits are for advisory purposes only, and are not to be used as sample validation criteria.

ABB Environmental
Analytical Laboratory Services Division
Quality Control Report

Sample Duplicate Results

Semivolatile Organics by GC/MS

Water Matrix

ABB Sample No. Duplicated: 91259011

Compound*	Units	Sample Conc.	Sample Duplicate Conc.	Average Conc.	RPD (%)	RPD Acceptance Range (%)
No compounds detected.	ug/L					0-20
	ug/L					0-20
	ug/L					0-20
	ug/L					0-20
	ug/L					0-20
	ug/L					0-20
	ug/L					0-20
	ug/L					0-20
	ug/L					0-20
	ug/L					0-20
	ug/L					0-20

* Only positive results have been included. The remaining compounds were not detected.

ND = Not detected.

NC = Not calculated; relative percent difference is not calculated for sample results less than the PQL

Because of the large uncertainty associated with measurements made near the detection level, the acceptance range for relative percent difference for duplicate measurements at such a low concentration is 0-100%.

ABB Environmental
Analytical Laboratory Services Division
Quality Control Report

Matrix Spike/Matrix Spike Duplicate Results

Semivolatile Organics by GC/MS

Water Matrix

ABB Sample No. Spiked: 91259011

Compound	Units	Spike Conc.	Sample Conc.	MS Measured Conc.	MSD Measured Conc.	Theoretical Sample Spike Conc.	MS % Recovery	MSD % Recovery	Recovery Acceptance Range (%)	RPD (%)	Acceptance Range (%)
Phenol	ug/l	192	ND	69.3	NA	192	36.1	NA	12-89	NA	0-42
2-Chlorophenol	ug/l	192	ND	137	NA	192	71.4	NA	27-123	NA	0-40
1,4-Dichlorobenzene	ug/l	96.0	ND	67.8	NA	96	70.6	NA	36-97	NA	0-28
N-Nitroso-di-n-propylamine	ug/l	96.0	ND	80.3	NA	96	83.6	NA	41-116	NA	0-38
1,2,4-Trichlorobenzene	ug/l	96.0	ND	68.1	NA	96	70.9	NA	39-98	NA	0-28
4-Chloro-3-methylphenol	ug/l	192	ND	128	NA	192	66.7	NA	23-97	NA	0-42
Acenaphthene	ug/l	96.0	ND	80.0	NA	96	83.3	NA	46-118	NA	0-31
4-Nitrophenol	ug/l	192	ND	61.4	NA	192	32.0	NA	10-80	NA	0-50
2,4-Dinitrotoluene	ug/l	96.0	ND	72.3	NA	96	75.3	NA	24-96	NA	0-38
Pentachlorophenol	ug/l	192	ND	103	NA	192	53.6	NA	9-103	NA	0-50
Pyrene	ug/l	96.0	ND	69.2	NA	96	72.1	NA	26-127	NA	0-31

ABB Environmental
Analytical Laboratory Services Division
Quality Control Report

Methods, Chronology of Analysis and Method Blank Results

Pesticides/PCBs by GC Method 509A

Soil/Solid Matrix

CHRONOLOGY

ABB Sample Nos.	Date Received	Date Extracted	Date Analyzed	Dilution Factor~	ABB Sample Nos.	Date Received	Date Extracted	Date Analyzed	Dilution Factor~
91259009	16-Sep-91	17-Sep-91	18-Sep-91	1.0	91259015	16-Sep-91	17-Sep-91	18-Sep-91	1.0
91259010	16-Sep-91	17-Sep-91	18-Sep-91	1.0					
91259011	16-Sep-91	17-Sep-91	18-Sep-91	1.0					
91259011DUP	16-Sep-91	17-Sep-91	18-Sep-91	1.0					
91259011MS	16-Sep-91	17-Sep-91	18-Sep-91	1.0					
91259012	16-Sep-91	17-Sep-91	18-Sep-91	1.0					
91259013	16-Sep-91	17-Sep-91	18-Sep-91	1.0					
91259014	16-Sep-91	17-Sep-91	19-Sep-91	1.0					

METHOD BLANK RESULTS*

Compound	Conc. (ug/kg)
None	

* Only positive hits have been included. The remaining compounds were below the laboratory Practical Quantitation Limits.

~ The Dilution Factor (DF) indicates whether a sample, prepared in accordance with the analytical method protocol, was diluted prior to analysis. The Dilution Factor could also indicate that a smaller aliquot than specified in the method was utilized for sample preparation and analysis. For example, a dilution factor of 5 means that the sample was effectively diluted by a factor of 5 prior to analysis, i.e., the sample was analyzed at 20% its reported concentration.

ABB Environmental
Analytical Laboratory Services Division
Quality Control Report

Laboratory Control Sample Results

Pesticides/PCBs by GC

Water Matrix

Date of Extraction: 09-17-91
Date of Analysis: 09-18-91

Compound	Units	Spike Conc.	LCS Measured Conc.	LCS Dup. Measured Conc.	LCS % Recovery	LCS Dup. % Recovery	Recovery Acceptance Range (%)*	RPD (%)	RPD Acceptance Range (%)*
gamma-BHC (Lindane)	ug/l	0.2	0.149	0.168	74	84	32-127	13.0	0-23
Heptachlor	ug/l	0.2	0.156	0.178	78	89	34-111	13.0	0-20
Aldrin	ug/l	0.2	0.122	0.140	61	70	42-122	14.0	0-21
Dieldrin	ug/l	0.5	0.458	0.501	92	100	36-146	8.0	0-38
Endrin	ug/l	0.5	0.488	0.538	98	110	30-147	12.0	0-37
4,4'-DDT	ug/l	0.5	0.501	0.546	100	109	25-160	9.0	0-36

* These limits are for advisory purposes only, and are not to be utilized as sample validation criteria.

ABB Environmental
Analytical Laboratory Services Division
Quality Control Report

Sample Duplicate Results

Pesticides/PCBs by GC

Water Matrix

ABB Sample No. Duplicated: 91259011

Compound*	Units	Sample Conc.	Sample Duplicate Conc.	Average Conc.	RPD (%)	RPD Acceptance Range (%)
	ug/L	<	<			
	ug/L					
	ug/L					
	ug/L					
	ug/L					
	ug/L					
	ug/L					
	ug/L					
	ug/L					
	ug/L					
	ug/L					

* Only positive results have been included. The remaining compounds were below the laboratory Practical Quantitation Limits.

ABB Environmental
Analytical Laboratory Services Division
Quality Control Report

Matrix Spike/Matrix Spike Duplicate Results

Pesticide/PCBs by GC Method 608

Water Matrix

ABB Sample No. Spiked: _____

Compound	Units	Spike Conc.	Sample Conc.	MS Measured Conc.	MSD Measured Conc.	Theoretical Spiked Sample Conc.	MS % Recovery	MSD % Recovery	Recovery Acceptance Range (%)	RPD (%)	Acceptance Range (%)
gamma-BHC (Lindane)	ug/L	0.2	<	0.135	NA	0.2	68.0	NA	32-127	NA	0-30
Heptachlor	ug/L	0.2	<	0.143	NA	0.2	72.0	NA	34-111	NA	0-30
Aldrin	ug/L	0.2	<	0.114	NA	0.2	57.0	NA	42-122	NA	0-30
Dieldrin	ug/L	0.5	<	0.403	NA	0.5	81.0	NA	36-146	NA	0-30
Endrin	ug/L	0.5	<	0.433	NA	0.5	87.0	NA	30-147	NA	0-30
4,4'-DDT	ug/L	0.5	<	0.42	NA	0.5	84.0	NA	25-160	NA	0-30

NA = Not applicable.

ABB Environmental
Analytical Laboratory Services Division
Quality Control Report

Methods, Chronology of Analysis and Method Blank Results

Herbicides by GC Method 509B

Water Matrix

CHRONOLOGY

ABB Sample Nos.	Date Received	Date Extracted	Date Analyzed	Dilution Factor~	ABB Sample Nos.	Date Received	Date Extracted	Date Analyzed	Dilution Factor~
91259009	16-Sep-91	17-Sep-91	23-Sep-91	1.0	91259015	16-Sep-91	17-Sep-91	24-Sep-91	1.0
91259010	16-Sep-91	17-Sep-91	23-Sep-91	1.0					
91259011	16-Sep-91	17-Sep-91	24-Sep-91	1.0					
91259011DUP	16-Sep-91	17-Sep-91	24-Sep-91	1.0					
91259011MS	16-Sep-91	17-Sep-91	24-Sep-91	1.0					
91259012	16-Sep-91	17-Sep-91	24-Sep-91	1.0					
91259013	16-Sep-91	17-Sep-91	24-Sep-91	1.0					
91259014	16-Sep-91	17-Sep-91	24-Sep-91	1.0					

METHOD BLANK RESULTS*

Compound	Conc. (ug/L)

* Only positive hits have been included. The remaining compounds were below the laboratory Practical Quantitation Limits.

~ The Dilution Factor (DF) indicates whether a sample, prepared in accordance with the analytical method protocol, was diluted prior to analysis. The Dilution Factor could also indicate that a smaller aliquot than specified in the method was utilized for sample preparation and analysis. For example, a dilution factor of 5 means that the sample was effectively diluted by a factor of 5 prior to analysis, i.e., the sample was analyzed at 20% its reported concentration.

ABB Environmental
Analytical Laboratory Services Division
Quality Control Report

Laboratory Control Sample Results

Herbicides by GC Method 509B

Water Matrix

Column: DB-608
Date of Extraction: 09-17-91
Date of Analysis: 09-24-91

Compound	Units	Spike Conc.	LCS Measured Conc.	LCS Dup. Measured Conc.	LCS % Recovery	LCS Dup. % Recovery	Recovery Acceptance Range (%)*	RPD (%)	RPD Acceptance Range (%)*
2,4-D Methyl Ester	ug/l	5.0	2.14	4.00	43	36	25-125		0-50
Silvex Methyl Ester	ug/l	5.0	1.81	2.88	80	58	25-125		0-50

* These limits are for advisory purposes only, and are not to be utilized as sample validation criteria.

ABB Environmental
Analytical Laboratory Services Division
Quality Control Report

Matrix Spike/Matrix Spike Duplicate Results

Herbicides by GC Method 509B

Column: DB-608

Date of Extraction: 09-17-91

Date of Analysis: 09-24-91

Water Matrix

ABB Sample No. Spiked: 91259011

Compound	Units	Spike Conc.	Sample Conc.	MS Measured Conc.	MSD Measured Conc.	MS % Recovery	MSD % Recovery	Recovery Acceptance Range (%)*	RPD (%)	RPD Acceptance Range (%)*
2,4-D Methyl Ester	ug/L	5.0	<	4.08	NA	82.0	NA	25-125	NA	0-50
Silvex Methyl Ester	ug/L	5.0	<	3.81	NA	76.0	NA	25-125	NA	0-50

* These limits are for advisory purposes only, and are not to be utilized as sample validation criteria.

NA = Not applicable.

ABB Environmental
Analytical Laboratory Services Division
Quality Control Report

Sample Duplicate Results

Herbicides by GC Method 509B

Water Matrix

ABB Sample No. Duplicated: 91259011

Compound*	Units	Sample Conc.	Sample Duplicate Conc.	Average Conc.	RPD (%)	RPD Acceptance Range (%)
	ug/L					0-20
	ug/L					0-20

* Only positive results have been included. The remaining compounds were below the laboratory Practical Quantitation Limit.

ND = Not detected.

NC = Not calculated; relative percent difference and average concentration are not calculated for sample results less than the PQL.

Because of the large uncertainty associated with measurements made near the detection level, the acceptance range for relative percent difference for duplicate measurements at such a low concentration is 0-100%

ANALYSIS REQUEST FORM

Date Received 09-16-91
Lab Location TAN-C / METALS / BLACK (EXTRA SAMP TAN-A/MS BLACK)
Results Due
Client I.D. No. ~~37131~~ 37118

Client Information: Name Mike Bellotti
Company Olin Chemical
Mailing Addddress
Purchase Order/Job Number 9623
Where to Send Report ☑ Directly to Client ☐ ABB - Name
Analyses Requested By: Technical Project Professional
Approved By: Project Manager

☐ Solid Waste Data File
☐ Data Documentation Req'd
☐ Entered in Computer
Type of Sample Drinking H_2O ☐ SPECIAL PROCEDURE
List Any Hazards none known
☐ Filtered in Field ☑ Non-Filtered
Additional Information or Special Procedures
QC Level MADEP
*Indicator parameters - verbals due 091891
S/N 91259011 - extra sple provide for extractables MS & DUP, use this site for all MS/DUPs if possible.
Verbal due dates:
Wet Chemistry: 091991 GC: 09-20-91
Elements: 091991 GC/MS. 09-19-91

Sample Identification	Lab Numbers	Date Sampled	Sampled By	Analyses Required
DW 1	91259009	091691	K. Nelson	Drinking Water VOAs (524.2) + TMP + 2-Chloroethyl vinyl ether (MDLs) + Library Search (20 peaks); PP SVOAs (625) + Library Search (20 peaks); Ethylene dibromide (504); 1,2-Dibromo-3-chloropropane; SDWA Pesticides (509A); SDWA Herbicides (509B); NH_3^*, Cl^*, SO_4^*, Cr^{+6*}, total CN^-, F^-, NO_3, Total Coliform, Fecal Coliform, pH, TDS; TKN Priority Pollutant Metals + 5 metals GFAA - Sb, As, Cd, Pb, Se, Tl ICP - Be, Cr*, Cu, Ni, Ag, Zn, Fe, Na, Ba, Al, Mn CVAA - Hg
DW 1A (Field Duplicate)	91259010	091691	K. Nelson	Same as Above
DW 2	91259011	091691	K. Nelson	↓
DW 3	91259012	091691	K. Nelson	↓
DW 4	91259013	091691	K. Nelson	↓
DW 5	91259014	091691	K. Nelson	↓
DW 6	91259015	091691	K. Nelson	↓
Trip Blank	91259016	091691	K. Nelson	DW VOAs (524.2-MDLs) + TMP, 2-Chloroethylvinyl ether + Library Search (20 peaks)

RUSH

All sites were collected in duplicate, so additional sample is available.

ABB Environmental Services, Inc.

OH-62

logged [illegible] 091791

CHAIN OF CUSTODY RECORD

PROJECT NO.:

PROJECT NAME: OLIN CHEMICAL DOMESTIC WELL

SAMPLERS (SIGNATURE): Kim A. Nelson

STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CONTAINERS	40 ml VOA	1 l plastic	500 ml plastic	1 l Amber	250 ml plastic	1 l glass	250 ml plastic	100 ml glass	40 ml VOA	250 ml plastic	1 l amber glass	REMARKS INDICATE SOIL/WATER/AIR SEDIMENT/SLUDGE
	9/16/91	11:55			DW-1		2	1	1	1	1	4		2		1		
		11:55			DW-1A		2	1	1	1	1	4		2		1		
		14:35			DW-2		2	1	1	1	1	4		2	2	1	4	
		14:35			DW-2A		2	1	1	1	1	4		2		1		
		15:00			DW-3		2	1	1	1	1	4		2		1		
		15:00			DW-3A		2	1	1	1	1	4		2		1		
		15:25			DW-4		2	1	1	1	1	4		2		1		
		15:25			DW-4A		2	1	1	1	1	4		2		1		
		15:50			DW-5		2	1	1	1	1	4		2		1		
		15:50			DW-5A		2	1	1	1	1	4		2		1		
		16:15			DW-6		2	1	1	1	1	4		2		1		
		16:15			DW-6A		2	1	1	1	1	4		2		1		
					~~DW-7~~		~~2~~	~~1~~	~~1~~	~~1~~	~~1~~	~~4~~		~~2~~		~~1~~		NOT NEEDED
					~~DW-7A~~		~~2~~	~~1~~	~~1~~	~~1~~	~~1~~	~~4~~	~~1~~			~~1~~		

RELINQUISHED BY: (SIGNATURE)	DATE/TIME	RECEIVED BY: (SIGNATURE)	RELINQUISHED BY: (SIGNATURE)	DATE/TIME	RECEIVED BY: (SIGNATURE)
Kim A. Nelson	9/16/91 16:30	John L. Shields			
RELINQUISHED BY: (SIGNATURE)	DATE/TIME	RECEIVED BY: (SIGNATURE)	RELINQUISHED BY: (SIGNATURE)	DATE/TIME	RECEIVED BY: (SIGNATURE)
RELINQUISHED BY: (SIGNATURE)	DATE/TIME	RECEIVED FOR DISPOSAL BY: (SIGNATURE)	DATE/TIME	REMARKS	

000049

ABB Environmental Services, Inc.

OH-62

Client: OLIN CORP.

ABB Environmental
Analytical Laboratory Services Division
Quality Control Report

Sample Receiving Documentation

ABB Environmental Sample Numbers	Date Sample Received	Sample Matrix Description	Condition Upon Receipt	Chain of Custody Present	Requested Analyses	pH Checked
91259009	09-16-91	WATER	COOL + INTACT	YES	Cr^{+6}	NA
					NH_3	<2
					Cl, SO_4, NO_3, F, pH, TDS	NA
					CYANIDE	>12
					TOTAL COLIFORM	NA
					FECAL COLIFORM	NA
					METALS	<2
					VOA	
					VOA	
					SVOA, PEST, PCB, HERB	NA
91259010					Cr^{+6}	NA
					NH_3	<2
					Cl, SO_4, NO_3, F, pH, TDS	NA
					CYANIDE	>12
					TOTAL COLIFORM	NA
					FECAL COLIFORM	NA
					METALS	<2
					VOA	
					VOA	

Client: OLIN CORP.

ABB Environmental
Analytical Laboratory Services Division
Quality Control Report

Sample Receiving Documentation

ABB Environmental Sample Numbers	Date Sample Received	Sample Matrix Description	Condition Upon Receipt	Chain of Custody Present	Requested Analyses	pH Checked
91259010	09·16·91	WATER	COOL + INTACT	YES	SVOA, PEST, PCB, HERB	NA
91259011					Cr+6	NA
					NH_3	<2
					Cl, SO_4, NO_3, F, pH, TDS	NA
					CYANIDE	>12
					TOTAL COLIFORM	NA
					FECAL COLIFORM	NA
					METALS	<2
					VOA	
					VOA	
					SVOA, PEST, PCB, HERB	NA
91259012					Cr+6	NA
					NH_3	<2
					Cl, SO_4, NO_3, F, pH, TDS	NA

Client: OLIN CORP.

ABB Environmental
Analytical Laboratory Services Division
Quality Control Report

Sample Receiving Documentation

ABB Environmental Sample Numbers	Date Sample Received	Sample Matrix Description	Condition Upon Receipt	Chain of Custody Present	Requested Analyses	pH Checked
91259012	09·16·91	WATER	COOL + INTACT	YES	CYANIDE	>12
					TOTAL COLIFORM	NA
					FECAL COLIFORM	NA
					METALS	<2
					VOA	
					VOA	
					SVOA, PEST, PCB, HERB	NA
91259013					Cr^{+6}	NA
					NH_3	<2
					Cl, SO_4, NO_3, F, pH, TDS	NA
					CYANIDE	>12
					TOTAL COLIFORM	NA
					~~TOTAL COLIFORM~~	—
					FECAL COLIFORM	NA
					METALS	<2
					VOA	
					VOA	
					SVOA, PEST, PCB, HERB	NA

000052 9/17/91

Client: OLIN CORP

ABB Environmental
Analytical Laboratory Services Division
Quality Control Report

Sample Receiving Documentation

ABB Environmental Sample Numbers	Date Sample Received	Sample Matrix Description	Condition Upon Receipt	Chain of Custody Present	Requested Analyses	pH Checked
91259013	09·16·91	WATER	COOL + INTACT	YES	SVOA, PEST, PCB, HERB	NA
91259014					Cr^{+6}	NA
					NH_3	<2
					Cl, SO_4, NO_3, F, pH, TDS	NA
					CYANIDE	>12
					TOTAL COLIFORM	NA
					FECAL COLIFORM	NA
					METALS	<2
					VOA	
					VOA	
					SVOA, PEST, PCB, HERB	NA
91259015					Cr^{+6}	NA
					NH_3	<2
					Cl, SO_4, NO_3, F, pH, TDS	NA
					CYANIDE	>12
					TOTAL COLIFORM	NA
					FECAL COLIFORM	NA
					METALS	<2

000053

9.21.91

Client: OLIN CORP.

ABB Environmental
Analytical Laboratory Services Division
Quality Control Report

Sample Receiving Documentation

ABB Environmental Sample Numbers	Date Sample Received	Sample Matrix Description	Condition Upon Receipt	Chain of Custody Present	Requested Analyses	pH Checked
91255015	09.16.91	WATER	COOL + INTACT	YES	VOA	
					VOA	
					SVOA, TEST, PCB, HERB	NA
91259016					VOA	
					VOA	

9/19/91

WILM

PRIVATE WELL

Notes

Wilmington, MA Trip

9/14/91 - 9/16/91

Story Line:

- Conducting groundwater study.
- Property access problems with Altron.
- Wednesday, received data from well on Harwick property. High readings of chromium, sulfates, chlorides, & ammonia.
- Consultant immediately sought more information on Altron wells (drillers in area). Now has 3 wells with capability of 150 gallons/minute.
- Discovered 1977 Altron found "green water" at 67 feet. At 30 feet water clean.
- Discovered 5 homes not on city water system on Main Street (1000 feet from Site).
- Need to sample private wells to determine if any contamination.
- Expedited analysis - results to be available Friday/Saturday.

Residences On Private Wells:

Gennaro Grasso (508) 658-4450
885 Main Street

- Emino Cavelle - mother-in-law.
- Sophisticated well water treatment system - adjusts pH, removes iron, filters.
- Tests water couple of times a year. pH has been at 5.5.
- Two wells. Well approximately 30'deep. Well 15 - 20 'deep for outside use.
- Permission to sample Monday 9/16 @ 2:30.
- Sampled kitchen sink and outside faucet.
- Sample 4 & 4A (inside)
- Sample 5 & 5A (outside - 2nd well)

Charles Spinazola (508) 658-3296
887 Main Street

- Doesn't use residence well. Well collapsed.
- 2nd well at trailer. Use bottled water for drinking.
- Has 3 monitoring wells on property for 21E test for property transfer. All determined clean by MassEPA.
- Have CRA determine requirements for 21E?? Information on 21E public?? (Mike Bellotti)
- Permission to sample Monday 9/16 @ anytime.
- Sampled outside faucet at trailer.
- Sample 1 & 1A

Jas Montague (508) 658-2123
889 Main Street

- Michelle - granddaughter lives at resident with Traci Daston.
- Use bottled water for drinking.
- Permission to sample Monday 9/16 @ 4:00.
- Sampled kitchen sink faucet.
- Sample 6 & 6A

Michael A. Gatta (617) 933-7188
911 Main Street

- Attorney - In Trust for family.
- Rental property.
- Bob Cowers / Dave Craigie / Chuck McIssac (M.W. Carr) tenants.
- Use bottled water.
- Permission to sample Monday 9/16 @3:00.
- Sampled outside faucet. Michael Gatta observed sampling.
- Sample 3 & 3A

Marvin H. Greenberg (617) 933-7360
919 Main Street

- Attorney.
- Peter Spinazola (617) 935-0041 co-owner (Anchor Body Shop).
- Rental property.
- Diane Cote (508) 658-7450 / Mrs. Camale tenants.
- Use bottled water for drinking/cooking.
- Permission to sample Monday @2:30
- Sampled upstairs kitchen sink faucet.
- Sample 2 & 2A

Discussions With Town Officials:

Michael Ciara, Wilmington Town Manager

- Appreciated notification of activities.
- Wondered why we miss homes on first search.
- Concerned about MassDEP communication.
- Offered to help as intermediary with Altron. Had no success.
- Stated no need to communicate with other officials except Health & Conservation at this time.
- Wanted to hear results as soon as available.

Greg Erickson, Director of Health, Town of Wilmington

- Appreciated notification of activities.
- Offered any assistance that he could bring to the situation.
- Provided lead on Michael Gatta.
- Requested sampling analysis when available.

Eileen Chabot, Conservation Administrator, Wilmington Conservation Commission

- o Appreciated notification of activities.
- o Expressed delight because "Olin now keeps the Conservation Commission informed".
- o Stated it was "nice" to work with our contractor because they "did the job right" and "didn't leave the Site looking a mess when they left".

Follow-up:

- o Will travel to Wilmington Friday 9/20 to implement communication strategy.
- o Have committed to residents that I will provide a verbal communication of the results either Friday evening or Saturday morning.
- o Have committed to Town Manager to provide information as soon as available and no later then Friday.
- o Have committed to Director of Health and Conservation Administrator to communicate on Friday.
- o Have requested that Environmental Remediation communicate with MassDEP about activities.
- → o Have requested Environmental Remediation investigate Mass 21E.
- o Have been told by Legal that TOSCA Notification is not needed.
- o Have suggested that Altron response to Town Manager be discussed at Site Team meeting Thursday 9/19.

ABB
ASEA BROWN BOVERI

RECEIVED
SEP 27 1991
MICHAEL J. BELLOTTI
WICM
~~CHA~~ ANALYSIS
ABB

September 26, 1991

Mr. Michael Bellotti
Olin Chemicals
PO Box 248
Lower River Road
Charleston, TN

FILE COPY

Subject: Domestic Well Analysis

Enclosed ar the Reports of Analysis for the six Domestic Wells Sampled on September 16, 1991. During our data review it was noted that the Surrogate Recovery for two wells did not meet our QC criteria. Consequently, we are re-extracting and rerunning these samples. Additionally a computer file corruption has made it impossible to report the surrogate recovery for another sample. This sample will be re-run with the other samples. In all cases no herbicides were detected. We will report the results of these re-runs as soon as they are available.

If you have any questions, please do not hesitate to call me.

Sincerely,

ABB Environmental Services, Inc.

Bill

Willard C. Warren, Director
Analytical Laboratory Services

cc: R. Rozene
D. Cameron

ABB Environmental Services, Inc.

Analytical Laboratory
340 County Road
Post Office Box 720
Westbrook, Maine 04092

Telephone (207) 874-2400
Fax (207) 775-4029

ABB ENVIRONMENTAL, INC.
ANALYTICAL LABORATORY SERVICES
340 COUNTY ROAD NO. 5
P. O. BOX 720
WESTBROOK, ME 04092
(207)874-2400/FAX(207)775-4029

OLIN CHEMICAL
ATTN: MIKE BELLOTTI
LOWER RIVER RD BOX 248
CHARLESTON, TN 37310

REPORT OF ANALYSIS 9/26/91
REFERENCE NUMBER 11963
PAGE 1

CLIENT SAMPLE ID	DW1	DW1A	
ABB SAMPLE ID	91259009	91259010	
DATE RECEIVED	9/16/91	9/16/91	UNITS
COLIFORMS, FECAL	< 1	< 1	/100 ML
COLIFORMS, TOTAL	< 1	< 1	/100 ML
PH (LABORATORY)	6.7	6.1	
RESIDUE, FILTERABLE (TDS)	120	120	MG/L
SODIUM, TOTAL	17	17	MG/L
BARIUM, TOTAL	< 0.005	< 0.005	MG/L
IRON, TOTAL	1.2	1.2	MG/L
MANGANESE, TOTAL	0.72	0.72	MG/L
ALUMINUM, TOTAL	< 0.10	< 0.10	MG/L
CHROMIUM, HEXAVALENT	< 0.010	< 0.010	MG/L
ARSENIC, TOTAL	< 0.005	< 0.005	MG/L
BERYLLIUM, TOTAL	< 0.015	< 0.015	MG/L
CADMIUM, TOTAL	< 0.002	< 0.002	MG/L
CHROMIUM, TOTAL	< 0.015	< 0.015	MG/L
COPPER, TOTAL	0.039	0.036	MG/L
LEAD, TOTAL	< 0.005	< 0.005	MG/L
THALLIUM, TOTAL	< 0.005	< 0.005	MG/L
NICKEL, TOTAL	< 0.040	< 0.040	MG/L
SILVER, TOTAL	< 0.015	< 0.015	MG/L
ZINC, TOTAL	< 0.025	< 0.025	MG/L
ANTIMONY, TOTAL	< 0.005	< 0.005	MG/L
SELENIUM, TOTAL	< 0.005	< 0.005	MG/L
MERCURY, TOTAL	< 0.20	< 0.20	UG/L
CHLORIDE	21	21	MG/L
CYANIDE, TOTAL	< 20	< 20	UG/L
FLUORIDE	< 0.20	< 0.20	MG/L
AMMONIA, AS N	< 0.10	< 0.10	MG/L
NITROGEN, TOTAL KJELDAHL	< 0.10	0.18	MG/L
NITRATE, AS N	0.29	0.26	MG/L
SULFATE	16	16	MG/L
ETHYLENE DIBROMIDE			
ETHYLENE DIBROMIDE	< 0.2	< 0.2	UG/L
1,2-DIBROMO-3-CHLOROPROPANE			
1,2-DIBROMO-3-CHLOROPROPANE	< 0.5	< 0.5	UG/L
PESTICIDES & PCB'S SURROGATE RECOVERY			
2,4,5,6-TETRACHLORO-META-XYLENE	140	110	%
PRIMARY DRINKING WATER STANDARDS PEST.			
ENDRIN	< 1	< 1	UG/L
LINDANE	< 1	< 1	UG/L
METHOXYCHLOR	< 1	< 1	UG/L

OLIN CHEMICAL
ATTN: MIKE BELLOTTI
LOWER RIVER RD BOX 248
CHARLESTON, TN 37310

REPORT OF ANALYSIS 9/26/91
REFERENCE NUMBER 11963
PAGE 2

CLIENT SAMPLE ID	DW1		DW1A		
ABB SAMPLE ID	91259009		91259010		
DATE RECEIVED	9/16/91		9/16/91		UNITS
PRIMARY DRINKING WATER STANDARDS PEST. (CONT)					
TOXAPHENE	<	1	<	1	UG/L
DRINKING WATER SURROGATE RECOVERY - PEST					
2,4,5,6-TETRACHLORO-META-XYLENE		100		95	%
PRIMARY DRINKING WATER STANDARDS HERB.					
2,4-D	<	10	<	10	UG/L
2,4,5-TP(SILVEX)	<	1	<	1	UG/L
DRINKING WATER SURROGATE RECOVERY - HERB					
2,4-DB		26		30	%
DRINKING WATER VOLATILES					
BENZENE	<	0.08	<	0.08	UG/L
BROMOBENZENE	<	0.05	<	0.05	UG/L
BROMOCHLOROMETHANE	<	0.16	<	0.16	UG/L
BROMODICHLOROMETHANE	<	0.21	<	0.21	UG/L
BROMOFORM	<	0.17	<	0.17	UG/L
BROMOMETHANE	<	0.16	<	0.16	UG/L
N-BUTYLBENZENE	<	0.08	<	0.08	UG/L
SEC-BUTYLBENZENE	<	0.05	<	0.05	UG/L
TERT-BUTYLBENZENE	<	0.06	<	0.06	UG/L
CARBON TETRACHLORIDE	<	0.12	<	0.12	UG/L
CHLOROBENZENE	<	0.05	<	0.05	UG/L
CHLOROETHANE	<	0.13	<	0.13	UG/L
CHLOROFORM	<	0.16	<	0.16	UG/L
CHLOROMETHANE	<	0.18	<	0.18	UG/L
2-CHLOROTOLUENE	<	0.11	<	0.11	UG/L
4-CHLOROTOLUENE	<	0.1	<	0.1	UG/L
DIBROMOCHLOROMETHANE	<	0.19	<	0.19	UG/L
1,2-DIBROMO-3-CHLOROPROPANE	<	0.85	<	0.85	UG/L
1,2-DIBROMOETHANE	<	0.11	<	0.11	UG/L
DIBROMOMETHANE	<	0.18	<	0.18	UG/L
1,2-DICHLOROBENZENE	<	0.1	<	0.1	UG/L
1,3-DICHLOROBENZENE	<	0.1	<	0.1	UG/L
1,4-DICHLOROBENZENE	<	0.1	<	0.1	UG/L
DICHLORODIFLUOROMETHANE	<	0.21	<	0.21	UG/L
1,1-DICHLOROETHANE	<	0.11	<	0.11	UG/L
1,2-DICHLOROETHANE	<	0.1	<	0.1	UG/L
1,1-DICHLOROETHENE	<	0.19	<	0.19	UG/L
CIS-1,2-DICHLOROETHENE	<	0.22	<	0.22	UG/L
TRANS-1,2-DICHLOROETHENE	<	0.2	<	0.2	UG/L
1,2-DICHLOROPROPANE	<	0.12	<	0.12	UG/L
1,3-DICHLOROPROPANE	<	0.14	<	0.14	UG/L
2,2-DICHLOROPROPANE	<	0.27	<	0.27	UG/L
1,1-DICHLOROPROPENE	<	0.12	<	0.12	UG/L
CIS-1,3-DICHLOROPROPENE	<	0.14	<	0.14	UG/L
TRANS-1,3-DICHLOROPROPENE	<	0.11	<	0.11	UG/L
ETHYLBENZENE	<	0.1	<	0.1	UG/L
HEXACHLOROBUTADIENE	JB	0.10	<	0.12	UG/L
ISOPROPYLBENZENE	<	0.04	<	0.04	UG/L
4-ISOPROPYLTOLUENE	<	0.08	<	0.08	UG/L
METHYLENE CHLORIDE	B	1.2	B	0.87	UG/L
NAPHTHALENE	JB	0.05	JB	0.05	UG/L
N-PROPYLBENZENE	<	0.07	<	0.07	UG/L
STYRENE	<	0.12	<	0.12	UG/L
1,1,1,2-TETRACHLOROETHANE	<	0.11	<	0.11	UG/L
1,1,2,2-TETRACHLOROETHANE	<	0.17	<	0.17	UG/L

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CLIENT SAMPLE ID	DW1		DW1A		
ABB SAMPLE ID	91259009		91259010		
DATE RECEIVED	9/16/91		9/16/91		UNITS
DRINKING WATER VOLATILES			(CONT)		
TETRACHLOROETHENE	<	0.04	<	0.04	UG/L
TOLUENE	<	0.13	<	0.13	UG/L
1,2,3-TRICHLOROBENZENE	<	0.11	<	0.11	UG/L
1,2,4-TRICHLOROBENZENE	<	0.06	<	0.06	UG/L
1,1,1-TRICHLOROETHANE	<	0.1	<	0.1	UG/L
1,1,2-TRICHLOROETHANE	<	0.2	<	0.2	UG/L
TRICHLOROETHENE	<	0.1	<	0.1	UG/L
TRICHLOROFLUOROMETHANE	<	0.13	<	0.13	UG/L
1,2,3-TRICHLOROPROPANE	<	0.18	<	0.18	UG/L
1,2,4-TRIMETHYLBENZENE	<	0.08	<	0.08	UG/L
1,3,5-TRIMETHYLBENZENE	JB	0.02	<	0.07	UG/L
VINYL CHLORIDE	<	0.25	<	0.25	UG/L
O-XYLENE	<	0.16	<	0.16	UG/L
M-XYLENE / P-XYLENE	<	0.22	<	0.22	UG/L
VOLATILE SURROGATE RECOVERY					
P-BROMOFLUOROBENZENE		71		76	%
1,2-DICHLOROBENZENE-D4	**	44	**	42	%
SEMIVOLATILE ORGANIC PRIORITY POLLUTANTS					
BENZO(B)FLUORANTHENE	<	10	<	10	UG/L
BENZO(K)FLUORANTHENE	<	10	<	10	UG/L
CHRYSENE	<	10	<	10	UG/L
BENZO(A)ANTHRACENE	<	10	<	10	UG/L
ANTHRACENE	<	10	<	10	UG/L
PHENANTHRENE	<	10	<	10	UG/L
ACENAPHTHYLENE	<	10	<	10	UG/L
ACENAPHTHENE	<	10	<	10	UG/L
BENZO(A)PYRENE	<	10	<	10	UG/L
BIS(2-CHLOROETHYL)ETHER	<	10	<	10	UG/L
BIS(2-CHLOROETHOXY)METHANE	<	10	<	10	UG/L
BIS(2-CHLOROISOPROPYL)ETHER	<	10	<	10	UG/L
BUTYL BENZYL PHTHALATE	<	10	<	10	UG/L
DIETHYLPHTHALATE	<	10	<	10	UG/L
DIMETHYLPHTHALATE	<	10	<	10	UG/L
FLUORANTHENE	<	10	<	10	UG/L
FLUORENE	<	10	<	10	UG/L
HEXACHLOROCYCLOPENTADIENE	<	10	<	10	UG/L
HEXACHLOROBUTADIENE	<	10	<	10	UG/L
HEXACHLOROETHANE	<	10	<	10	UG/L
INDENO(1,2,3-CD)PYRENE	<	10	<	10	UG/L
ISOPHORONE	<	10	<	10	UG/L
N-NITROSODI-N-PROPYLAMINE	<	10	<	10	UG/L
N-NITROSODIPHENYLAMINE	<	10	<	10	UG/L
N-NITROSODIMETHYLAMINE	<	10	<	10	UG/L
NITROBENZENE	<	10	<	10	UG/L
4-CHLORO-3-METHYLPHENOL	<	10	<	10	UG/L
PYRENE	<	10	<	10	UG/L
BENZO(GHI)PERYLENE	<	10	<	10	UG/L
1,2-DICHLOROBENZENE	<	10	<	10	UG/L
1,2,4-TRICHLOROBENZENE	<	10	<	10	UG/L
DIBENZO(A,H)ANTHRACENE	<	10	<	10	UG/L
1,3-DICHLOROBENZENE	<	10	<	10	UG/L
1,4-DICHLOROBENZENE	<	10	<	10	UG/L
2-CHLORONAPHTHALENE	<	10	<	10	UG/L
2-CHLOROPHENOL	<	10	<	10	UG/L
2-NITROPHENOL	<	10	<	10	UG/L
DI-N-OCTYLPHTHALATE	<	10	<	10	UG/L
2,4-DICHLOROPHENOL	<	10	<	10	UG/L
2,4-DIMETHYLPHENOL	<	10	<	10	UG/L

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CLIENT SAMPLE ID	DW1	DW1A	
ABB SAMPLE ID	91259009	91259010	
DATE RECEIVED	9/16/91	9/16/91	UNITS
SEMIVOLATILE ORGANIC PRIORITY POLLUTANTS (CONT)			
2,4-DINITROTOLUENE	< 10	< 10	UG/L
2,4-DINITROPHENOL	< 50	< 50	UG/L
2,4,6-TRICHLOROPHENOL	< 10	< 10	UG/L
2,6-DINITROTOLUENE	< 10	< 10	UG/L
3,3-DICHLOROBENZIDINE	< 20	< 20	UG/L
4-BROMOPHENYL PHENYL ETHER	< 10	< 10	UG/L
4-CHLOROPHENYL PHENYL ETHER	< 10	< 10	UG/L
4-NITROPHENOL	< 50	< 50	UG/L
2-METHYL-4,6-DINITROPHENOL	< 50	< 50	UG/L
PHENOL	< 10	< 10	UG/L
NAPHTHALENE	< 10	< 10	UG/L
PENTACHLOROPHENOL	< 50	< 50	UG/L
BIS(2-ETHYLHEXYL)PHTHALATE	< 10	< 10	UG/L
DI-N-BUTYLPHTHALATE	< 10	< 10	UG/L
BENZIDINE	< 50	< 50	UG/L
HEXACHLOROBENZENE	< 10	< 10	UG/L
1,2-DIPHENYLDRAZINE	< 10	< 10	UG/L
SEMIVOLATILE SURROGATE RECOVERY			
2-FLUOROPHENOL	43	37	%
PHENOL-D5	25	22	%
NITROBENZENE-D5	74	72	%
2-FLUOROBIPHENYL	83	80	%
2,4,6-TRIBROMOPHENOL	70	59	%
TERPHENYL-D14	74	78	%

SIGNATURE Laura J O'Meara
RELEASED BY LAURA J O'MEARA
CLIENT AUTHORIZATION 1

J = Indicates an estimated value. The analyte was detected in the sample at a concentration greater than the measured detection limit but less than the laboratory's Practical Quantitation Level.

B = Analyte was detected in the laboratory method blank analyzed concurrently with the samples.

Please refer to the Quality Control Report for method blank compound concentrations.

** Surrogate recovery does not meet internal QC criteria. Insufficient sample remained for reanalysis.

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CLIENT SAMPLE ID		DW2	
ABB SAMPLE ID		91259011	
DATE RECEIVED		9/16/91	UNITS
COLIFORM, FECAL		2	/100 ML
COLIFORM, TOTAL		12	/100 ML
PH (LABORATORY)		6.5	
RESIDUE, FILTERABLE (TDS)		140	MG/L
SODIUM, TOTAL		20	MG/L
BARIUM, TOTAL		0.022	MG/L
IRON, TOTAL		0.48	MG/L
MANGANESE, TOTAL		0.97	MG/L
ALUMINUM, TOTAL	<	0.10	MG/L
CHROMIUM, HEXAVALENT	<	0.010	MG/L
ARSENIC, TOTAL	<	0.005	MG/L
BERYLLIUM, TOTAL	<	0.015	MG/L
CADMIUM, TOTAL	<	0.002	MG/L
CHROMIUM, TOTAL	<	0.015	MG/L
COPPER, TOTAL		0.040	MG/L
LEAD, TOTAL	<	0.005	MG/L
THALLIUM, TOTAL	<	0.005	MG/L
NICKEL, TOTAL	<	0.040	MG/L
SILVER, TOTAL	<	0.015	MG/L
ZINC, TOTAL	<	0.025	MG/L
ANTIMONY, TOTAL	≠ <	0.005	MG/L
SELENIUM, TOTAL	<	0.005	MG/L
MERCURY, TOTAL	<	0.20	UG/L
CHLORIDE		42	MG/L
CYANIDE, TOTAL	<	20	UG/L
FLUORIDE	<	0.20	MG/L
AMMONIA, AS N		0.32	MG/L
NITROGEN, TOTAL KJELDAHL		0.27	MG/L
NITRATE, AS N	*	0.19	MG/L
SULFATE		13	MG/L
ETHYLENE DIBROMIDE			
ETHYLENE DIBROMIDE	<	0.2	UG/L
1,2-DIBROMO-3-CHLOROPROPANE			
1,2-DIBROMO-3-CHLOROPROPANE	<	0.5	UG/L
PESTICIDES & PCB'S SURROGATE RECOVERY			
2,4,5,6-TETRACHLORO-META-XYLENE		110	%
PRIMARY DRINKING WATER STANDARDS PEST.			
ENDRIN	<	1	UG/L
LINDANE	<	1	UG/L
METHOXYCHLOR	<	1	UG/L

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CLIENT SAMPLE ID		DW2	
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PRIMARY DRINKING WATER STANDARDS PEST. (CONT)			
TOXAPHENE	<	1	UG/L
DRINKING WATER SURROGATE RECOVERY - PEST			
2,4,5,6-TETRACHLORO-META-XYLENE		110	%
PRIMARY DRINKING WATER STANDARDS HERB.			
2,4-D	<	10	UG/L
2,4,5-TP(SILVEX)	<	1	UG/L
DRINKING WATER SURROGATE RECOVERY - HERB			
2,4-DB		39	%
DRINKING WATER VOLATILES			
BENZENE	<	0.08	UG/L
BROMOBENZENE	<	0.05	UG/L
BROMOCHLOROMETHANE	<	0.16	UG/L
BROMODICHLOROMETHANE	<	0.21	UG/L
BROMOFORM	<	0.17	UG/L
BROMOMETHANE	<	0.16	UG/L
N-BUTYLBENZENE	<	0.08	UG/L
SEC-BUTYLBENZENE	<	0.05	UG/L
TERT-BUTYLBENZENE	<	0.06	UG/L
CARBON TETRACHLORIDE	<	0.12	UG/L
CHLOROBENZENE	<	0.05	UG/L
CHLOROETHANE	<	0.13	UG/L
CHLOROFORM	<	0.16	UG/L
CHLOROMETHANE	<	0.18	UG/L
2-CHLOROTOLUENE	<	0.11	UG/L
4-CHLOROTOLUENE	<	0.1	UG/L
DIBROMOCHLOROMETHANE	<	0.19	UG/L
1,2-DIBROMO-3-CHLOROPROPANE	<	0.85	UG/L
1,2-DIBROMOETHANE	<	0.11	UG/L
DIBROMOMETHANE	<	0.18	UG/L
1,2-DICHLOROBENZENE	<	0.1	UG/L
1,3-DICHLOROBENZENE	<	0.1	UG/L
1,4-DICHLOROBENZENE	<	0.1	UG/L
DICHLORODIFLUOROMETHANE	<	0.21	UG/L
1,1-DICHLOROETHANE	<	0.11	UG/L
1,2-DICHLOROETHANE	<	0.1	UG/L
1,1-DICHLOROETHENE	<	0.19	UG/L
CIS-1,2-DICHLOROETHENE	<	0.22	UG/L
TRANS-1,2-DICHLOROETHENE	<	0.2	UG/L
1,2-DICHLOROPROPANE	<	0.12	UG/L
1,3-DICHLOROPROPANE	<	0.14	UG/L
2,2-DICHLOROPROPANE	<	0.27	UG/L
1,1-DICHLOROPROPENE	<	0.12	UG/L
CIS-1,3-DICHLOROPROPENE	<	0.14	UG/L
TRANS-1,3-DICHLOROPROPENE	<	0.11	UG/L
ETHYLBENZENE	<	0.1	UG/L
HEXACHLOROBUTADIENE	<	0.12	UG/L
ISOPROPYLBENZENE	<	0.04	UG/L
4-ISOPROPYLTOLUENE	<	0.08	UG/L
METHYLENE CHLORIDE	B	0.44	UG/L
NAPHTHALENE	<	0.21	UG/L
N-PROPYLBENZENE	<	0.07	UG/L
STYRENE	<	0.12	UG/L
1,1,1,2-TETRACHLOROETHANE	<	0.11	UG/L
1,1,2,2-TETRACHLOROETHANE	<	0.17	UG/L

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DRINKING WATER VOLATILES (CONT)

TETRACHLOROETHENE	<	0.04	UG/L
TOLUENE	<	0.13	UG/L
1,2,3-TRICHLOROBENZENE	<	0.11	UG/L
1,2,4-TRICHLOROBENZENE	<	0.06	UG/L
1,1,1-TRICHLOROETHANE	<	0.1	UG/L
1,1,2-TRICHLOROETHANE	<	0.2	UG/L
TRICHLOROETHENE	<	0.1	UG/L
TRICHLOROFLUOROMETHANE	<	0.13	UG/L
1,2,3-TRICHLOROPROPANE	<	0.18	UG/L
1,2,4-TRIMETHYLBENZENE	<	0.08	UG/L
1,3,5-TRIMETHYLBENZENE	<	0.07	UG/L
VINYL CHLORIDE	<	0.25	UG/L
O-XYLENE	<	0.16	UG/L
M-XYLENE / P-XYLENE	<	0.22	UG/L

VOLATILE SURROGATE RECOVERY

P-BROMOFLUOROBENZENE	77	%
1,2-DICHLOROBENZENE-D4	84	%

SEMIVOLATILE ORGANIC PRIORITY POLLUTANTS

BENZO(B)FLUORANTHENE	<	10	UG/L
BENZO(K)FLUORANTHENE	<	10	UG/L
CHRYSENE	<	10	UG/L
BENZO(A)ANTHRACENE	<	10	UG/L
ANTHRACENE	<	10	UG/L
PHENANTHRENE	<	10	UG/L
ACENAPHTHYLENE	<	10	UG/L
ACENAPHTHENE	<	10	UG/L
BENZO(A)PYRENE	<	10	UG/L
BIS(2-CHLOROETHYL)ETHER	<	10	UG/L
BIS(2-CHLOROETHOXY)METHANE	<	10	UG/L
BIS(2-CHLOROISOPROPYL)ETHER	<	10	UG/L
BUTYL BENZYL PHTHALATE	<	10	UG/L
DIETHYLPHTHALATE	<	10	UG/L
DIMETHYLPHTHALATE	<	10	UG/L
FLUORANTHENE	<	10	UG/L
FLUORENE	<	10	UG/L
HEXACHLOROCYCLOPENTADIENE	<	10	UG/L
HEXACHLOROBUTADIENE	<	10	UG/L
HEXACHLOROETHANE	<	10	UG/L
INDENO(1,2,3-CD)PYRENE	<	10	UG/L
ISOPHORONE	<	10	UG/L
N-NITROSODI-N-PROPYLAMINE	<	10	UG/L
N-NITROSODIPHENYLAMINE	<	10	UG/L
N-NITROSODIMETHYLAMINE	<	10	UG/L
NITROBENZENE	<	10	UG/L
4-CHLORO-3-METHYLPHENOL	<	10	UG/L
PYRENE	<	10	UG/L
BENZO(GHI)PERYLENE	<	10	UG/L
1,2-DICHLOROBENZENE	<	10	UG/L
1,2,4-TRICHLOROBENZENE	<	10	UG/L
DIBENZO(A,H)ANTHRACENE	<	10	UG/L
1,3-DICHLOROBENZENE	<	10	UG/L
1,4-DICHLOROBENZENE	<	10	UG/L
2-CHLORONAPHTHALENE	<	10	UG/L
2-CHLOROPHENOL	<	10	UG/L
2-NITROPHENOL	<	10	UG/L
DI-N-OCTYLPHTHALATE	<	10	UG/L
2,4-DICHLOROPHENOL	<	10	UG/L
2,4-DIMETHYLPHENOL	<	10	UG/L

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SEMIVOLATILE ORGANIC PRIORITY POLLUTANTS (CONT)

2,4-DINITROTOLUENE	<	10	UG/L
2,4-DINITROPHENOL	<	50	UG/L
2,4,6-TRICHLOROPHENOL	<	10	UG/L
2,6-DINITROTOLUENE	<	10	UG/L
3,3-DICHLOROBENZIDINE	<	20	UG/L
4-BROMOPHENYL PHENYL ETHER	<	10	UG/L
4-CHLOROPHENYL PHENYL ETHER	<	10	UG/L
4-NITROPHENOL	<	50	UG/L
2-METHYL-4,6-DINITROPHENOL	<	50	UG/L
PHENOL	<	10	UG/L
NAPHTHALENE	<	10	UG/L
PENTACHLOROPHENOL	<	50	UG/L
BIS(2-ETHYLHEXYL)PHTHALATE	<	10	UG/L
DI-N-BUTYLPHTHALATE	<	10	UG/L
BENZIDINE	<	50	UG/L
HEXACHLOROBENZENE	<	10	UG/L
1,2-DIPHENYLHRAZINE	<	10	UG/L

SEMIVOLATILE SURROGATE RECOVERY

2-FLUOROPHENOL	39	%
PHENOL-D5	22	%
NITROBENZENE-D5	77	%
2-FLUOROBIPHENYL	80	%
2,4,6-TRIBROMOPHENOL	64	%
TERPHENYL-D14	75	%

SIGNATURE Laura J. O'Meara
RELEASED BY LAURA J O'MEARA
CLIENT AUTHORIZATION 2

* The reported value is the mean of two or more replicate analyses of the sample. The precision of the replicate analyses is outside the laboratory's acceptance range for this parameter. Sample homogeneity may be a factor.

\# Matrix spike recovery is outside the laboratory's specified acceptance range indicating potential sample matrix interference and potential bias of reported value for this parameter.

B = Analyte was detected in the laboratory method blank analyzed concurrently with the samples.

Please refer to the Quality Control Report for method blank compound concentrations.

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CLIENT SAMPLE ID		DW3	
ABB SAMPLE ID		91259012	
DATE RECEIVED		9/16/91	UNITS
COLIFORMS, FECAL	<	1	/100 ML
COLIFORMS, TOTAL	<	1	/100 ML
PH (LABORATORY)		6.2	
RESIDUE, FILTERABLE (TDS)		150	MG/L
SODIUM, TOTAL		31	MG/L
BARIUM, TOTAL		0.007	MG/L
IRON, TOTAL		0.64	MG/L
MANGANESE, TOTAL		0.16	MG/L
ALUMINUM, TOTAL	<	0.10	MG/L
CHROMIUM, HEXAVALENT	<	0.010	MG/L
ARSENIC, TOTAL	<	0.005	MG/L
BERYLLIUM, TOTAL	<	0.015	MG/L
CADMIUM, TOTAL	<	0.002	MG/L
CHROMIUM, TOTAL	<	0.015	MG/L
COPPER, TOTAL		0.032	MG/L
LEAD, TOTAL	<	0.005	MG/L
THALLIUM, TOTAL	<	0.005	MG/L
NICKEL, TOTAL	<	0.040	MG/L
SILVER, TOTAL	<	0.015	MG/L
ZINC, TOTAL		0.14	MG/L
ANTIMONY, TOTAL	<	0.005	MG/L
SELENIUM, TOTAL	<	0.005	MG/L
MERCURY, TOTAL	<	0.20	UG/L
CHLORIDE		56	MG/L
CYANIDE, TOTAL	<	20	UG/L
FLUORIDE	<	0.20	MG/L
AMMONIA, AS N	<	0.10	MG/L
NITROGEN, TOTAL KJELDAHL		0.12	MG/L
NITRATE, AS N		0.29	MG/L
SULFATE		16	MG/L

ETHYLENE DIBROMIDE

ETHYLENE DIBROMIDE	<	0.2	UG/L

1,2-DIBROMO-3-CHLOROPROPANE

1,2-DIBROMO-3-CHLOROPROPANE	<	0.5	UG/L

PESTICIDES & PCB'S SURROGATE RECOVERY

2,4,5,6-TETRACHLORO-META-XYLENE		78	%

PRIMARY DRINKING WATER STANDARDS PEST.

ENDRIN	<	1	UG/L
LINDANE	<	1	UG/L
METHOXYCHLOR	<	1	UG/L

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CHARLESTON, TN 37310

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CLIENT SAMPLE ID	DW3		
ABB SAMPLE ID	91259012		
DATE RECEIVED	9/16/91		UNITS
PRIMARY DRINKING WATER STANDARDS PEST. (CONT)			
TOXAPHENE	<	1	UG/L
DRINKING WATER SURROGATE RECOVERY - PEST			
2,4,5,6-TETRACHLORO-META-XYLENE		100	%
PRIMARY DRINKING WATER STANDARDS HERB.			
2,4-D	<	10	UG/L
2,4,5-TP(SILVEX)	<	1	UG/L
DRINKING WATER SURROGATE RECOVERY - HERB			
2,4-DB	@	14	%
DRINKING WATER VOLATILES			
BENZENE	<	0.08	UG/L
BROMOBENZENE	<	0.05	UG/L
BROMOCHLOROMETHANE	<	0.16	UG/L
BROMODICHLOROMETHANE	<	0.21	UG/L
BROMOFORM	<	0.17	UG/L
BROMOMETHANE	<	0.16	UG/L
N-BUTYLBENZENE	<	0.08	UG/L
SEC-BUTYLBENZENE	<	0.05	UG/L
TERT-BUTYLBENZENE	<	0.06	UG/L
CARBON TETRACHLORIDE	<	0.12	UG/L
CHLOROBENZENE	<	0.05	UG/L
CHLOROETHANE	<	0.13	UG/L
CHLOROFORM	<	0.16	UG/L
CHLOROMETHANE	<	0.18	UG/L
2-CHLOROTOLUENE	<	0.11	UG/L
4-CHLOROTOLUENE	<	0.1	UG/L
DIBROMOCHLOROMETHANE	<	0.19	UG/L
1,2-DIBROMO-3-CHLOROPROPANE	<	0.85	UG/L
1,2-DIBROMOETHANE	<	0.11	UG/L
DIBROMOMETHANE	<	0.18	UG/L
1,2-DICHLOROBENZENE	<	0.1	UG/L
1,3-DICHLOROBENZENE	<	0.1	UG/L
1,4-DICHLOROBENZENE	<	0.1	UG/L
DICHLORODIFLUOROMETHANE	<	0.21	UG/L
1,1-DICHLOROETHANE	<	0.11	UG/L
1,2-DICHLOROETHANE	<	0.1	UG/L
1,1-DICHLOROETHENE	<	0.19	UG/L
CIS-1,2-DICHLOROETHENE	<	0.22	UG/L
TRANS-1,2-DICHLOROETHENE	<	0.2	UG/L
1,2-DICHLOROPROPANE	<	0.12	UG/L
1,3-DICHLOROPROPANE	<	0.14	UG/L
2,2-DICHLOROPROPANE	<	0.27	UG/L
1,1-DICHLOROPROPENE	<	0.12	UG/L
CIS-1,3-DICHLOROPROPENE	<	0.14	UG/L
TRANS-1,3-DICHLOROPROPENE	<	0.11	UG/L
ETHYLBENZENE	<	0.1	UG/L
HEXACHLOROBUTADIENE	<	0.12	UG/L
ISOPROPYLBENZENE	<	0.04	UG/L
4-ISOPROPYLTOLUENE	<	0.08	UG/L
METHYLENE CHLORIDE	B	0.71	UG/L
NAPHTHALENE	<	0.21	UG/L
N-PROPYLBENZENE	<	0.07	UG/L
STYRENE	<	0.12	UG/L
1,1,1,2-TETRACHLOROETHANE	<	0.11	UG/L
1,1,2,2-TETRACHLOROETHANE	<	0.17	UG/L

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CLIENT SAMPLE ID		DW3	
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DRINKING WATER VOLATILES			(CONT)
TETRACHLOROETHENE	<	0.04	UG/L
TOLUENE	<	0.13	UG/L
1,2,3-TRICHLOROBENZENE	<	0.11	UG/L
1,2,4-TRICHLOROBENZENE	<	0.06	UG/L
1,1,1-TRICHLOROETHANE	<	0.1	UG/L
1,1,2-TRICHLOROETHANE	<	0.2	UG/L
TRICHLOROETHENE	<	0.1	UG/L
TRICHLOROFLUOROMETHANE	<	0.13	UG/L
1,2,3-TRICHLOROPROPANE	<	0.18	UG/L
1,2,4-TRIMETHYLBENZENE	<	0.08	UG/L
1,3,5-TRIMETHYLBENZENE	<	0.07	UG/L
VINYL CHLORIDE	<	0.25	UG/L
O-XYLENE	<	0.16	UG/L
M-XYLENE / P-XYLENE	<	0.22	UG/L
VOLATILE SURROGATE RECOVERY			
P-BROMOFLUOROBENZENE		90	%
1,2-DICHLOROBENZENE-D4		72	%
SEMIVOLATILE ORGANIC PRIORITY POLLUTANTS			
BENZO(B)FLUORANTHENE	<	10	UG/L
BENZO(K)FLUORANTHENE	<	10	UG/L
CHRYSENE	<	10	UG/L
BENZO(A)ANTHRACENE	<	10	UG/L
ANTHRACENE	<	10	UG/L
PHENANTHRENE	<	10	UG/L
ACENAPHTHYLENE	<	10	UG/L
ACENAPHTHENE	<	10	UG/L
BENZO(A)PYRENE	<	10	UG/L
BIS(2-CHLOROETHYL)ETHER	<	10	UG/L
BIS(2-CHLOROETHOXY)METHANE	<	10	UG/L
BIS(2-CHLOROISOPROPYL)ETHER	<	10	UG/L
BUTYL BENZYL PHTHALATE	<	10	UG/L
DIETHYLPHTHALATE	<	10	UG/L
DIMETHYLPHTHALATE	<	10	UG/L
FLUORANTHENE	<	10	UG/L
FLUORENE	<	10	UG/L
HEXACHLOROCYCLOPENTADIENE	<	10	UG/L
HEXACHLOROBUTADIENE	<	10	UG/L
HEXACHLOROETHANE	<	10	UG/L
INDENO(1,2,3-CD)PYRENE	<	10	UG/L
ISOPHORONE	<	10	UG/L
N-NITROSODI-N-PROPYLAMINE	<	10	UG/L
N-NITROSODIPHENYLAMINE	<	10	UG/L
N-NITROSODIMETHYLAMINE	<	10	UG/L
NITROBENZENE	<	10	UG/L
4-CHLORO-3-METHYLPHENOL	<	10	UG/L
PYRENE	<	10	UG/L
BENZO(GHI)PERYLENE	<	10	UG/L
1,2-DICHLOROBENZENE	<	10	UG/L
1,2,4-TRICHLOROBENZENE	<	10	UG/L
DIBENZO(A,H)ANTHRACENE	<	10	UG/L
1,3-DICHLOROBENZENE	<	10	UG/L
1,4-DICHLOROBENZENE	<	10	UG/L
2-CHLORONAPHTHALENE	<	10	UG/L
2-CHLOROPHENOL	<	10	UG/L
2-NITROPHENOL	<	10	UG/L
DI-N-OCTYLPHTHALATE	<	10	UG/L
2,4-DICHLOROPHENOL	<	10	UG/L
2,4-DIMETHYLPHENOL	<	10	UG/L

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SEMIVOLATILE ORGANIC PRIORITY POLLUTANTS (CONT)

2,4-DINITROTOLUENE	<	10	UG/L
2,4-DINITROPHENOL	<	50	UG/L
2,4,6-TRICHLOROPHENOL	<	10	UG/L
2,6-DINITROTOLUENE	<	10	UG/L
3,3-DICHLOROBENZIDINE	<	20	UG/L
4-BROMOPHENYL PHENYL ETHER	<	10	UG/L
4-CHLOROPHENYL PHENYL ETHER	<	10	UG/L
4-NITROPHENOL	<	50	UG/L
2-METHYL-4,6-DINITROPHENOL	<	50	UG/L
PHENOL	<	10	UG/L
NAPHTHALENE	<	10	UG/L
PENTACHLOROPHENOL	<	50	UG/L
BIS(2-ETHYLHEXYL)PHTHALATE	<	10	UG/L
DI-N-BUTYLPHTHALATE	<	10	UG/L
BENZIDINE	<	50	UG/L
HEXACHLOROBENZENE	<	10	UG/L
1,2-DIPHENYLDRAZINE	<	10	UG/L

SEMIVOLATILE SURROGATE RECOVERY

2-FLUOROPHENOL	49	%
PHENOL-D5	31	%
NITROBENZENE-D5	77	%
2-FLUOROBIPHENYL	77	%
2,4,6-TRIBROMOPHENOL	78	%
TERPHENYL-D14	75	%

SIGNATURE Laura J. O'Meara
RELEASED BY LAURA J O'MEARA
CLIENT AUTHORIZATION 3

B = Analyte was detected in the laboratory method blank analyzed concurrently with the samples.

Please refer to the Quality Control Report for method blank compound concentrations.

@ Surrogate recovery does not meet internal QC criteria. Sample will be reextracted and reported at a later date.

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CLIENT SAMPLE ID	DW4	
ABB SAMPLE ID	91259013	
DATE RECEIVED	9/16/91	UNITS
COLIFORMS, FECAL	< 1	/100 ML
COLIFORMS, TOTAL	< 1	/100 ML
PH (LABORATORY)	7.3	
RESIDUE, FILTERABLE (TDS)	140	MG/L
SODIUM, TOTAL	21	MG/L
BARIUM, TOTAL	0.006	MG/L
IRON, TOTAL	0.43	MG/L
MANGANESE, TOTAL	0.38	MG/L
ALUMINUM, TOTAL	< 0.10	MG/L
CHROMIUM, HEXAVALENT	< 0.010	MG/L
ARSENIC, TOTAL	< 0.005	MG/L
BERYLLIUM, TOTAL	< 0.015	MG/L
CADMIUM, TOTAL	< 0.002	MG/L
CHROMIUM, TOTAL	< 0.015	MG/L
COPPER, TOTAL	< 0.025	MG/L
LEAD, TOTAL	0.005	MG/L
THALLIUM, TOTAL	< 0.005	MG/L
NICKEL, TOTAL	< 0.040	MG/L
SILVER, TOTAL	< 0.015	MG/L
ZINC, TOTAL	< 0.025	MG/L
ANTIMONY, TOTAL	< 0.005	MG/L
SELENIUM, TOTAL	< 0.005	MG/L
MERCURY, TOTAL	< 0.20	UG/L
CHLORIDE	34	MG/L
CYANIDE, TOTAL	< 20	UG/L
FLUORIDE	< 0.20	MG/L
AMMONIA, AS N	0.54	MG/L
NITROGEN, TOTAL KJELDAHL	0.72	MG/L
NITRATE, AS N	0.22	MG/L
SULFATE	18	MG/L
ETHYLENE DIBROMIDE		
ETHYLENE DIBROMIDE	< 0.2	UG/L
1,2-DIBROMO-3-CHLOROPROPANE		
1,2-DIBROMO-3-CHLOROPROPANE	< 0.5	UG/L
PESTICIDES & PCB'S SURROGATE RECOVERY		
2,4,5,6-TETRACHLORO-META-XYLENE	140	%
PRIMARY DRINKING WATER STANDARDS PEST.		
ENDRIN	< 1	UG/L
LINDANE	< 1	UG/L
METHOXYCHLOR	< 1	UG/L

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CLIENT SAMPLE ID		DW4	
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PRIMARY DRINKING WATER STANDARDS PEST. (CONT)			
TOXAPHENE	<	1	UG/L
DRINKING WATER SURROGATE RECOVERY - PEST			
2,4,5,6-TETRACHLORO-META-XYLENE		60	%
PRIMARY DRINKING WATER STANDARDS HERB.			
2,4-D	<	10	UG/L
2,4,5-TP(SILVEX)	<	1	UG/L
DRINKING WATER SURROGATE RECOVERY - HERB			
2,4-DB		***	%
DRINKING WATER VOLATILES			
BENZENE	<	0.08	UG/L
BROMOBENZENE	<	0.05	UG/L
BROMOCHLOROMETHANE	<	0.16	UG/L
BROMODICHLOROMETHANE	<	0.21	UG/L
BROMOFORM	<	0.17	UG/L
BROMOMETHANE	<	0.16	UG/L
N-BUTYLBENZENE	<	0.08	UG/L
SEC-BUTYLBENZENE	<	0.05	UG/L
TERT-BUTYLBENZENE	<	0.06	UG/L
CARBON TETRACHLORIDE	<	0.12	UG/L
CHLOROBENZENE	<	0.05	UG/L
CHLOROETHANE	<	0.13	UG/L
CHLOROFORM	<	0.16	UG/L
CHLOROMETHANE	<	0.18	UG/L
2-CHLOROTOLUENE	<	0.11	UG/L
4-CHLOROTOLUENE	<	0.1	UG/L
DIBROMOCHLOROMETHANE	<	0.19	UG/L
1,2-DIBROMO-3-CHLOROPROPANE	<	0.85	UG/L
1,2-DIBROMOETHANE	<	0.11	UG/L
DIBROMOMETHANE	<	0.18	UG/L
1,2-DICHLOROBENZENE	<	0.1	UG/L
1,3-DICHLOROBENZENE	<	0.1	UG/L
1,4-DICHLOROBENZENE	<	0.1	UG/L
DICHLORODIFLUOROMETHANE	<	0.21	UG/L
1,1-DICHLOROETHANE	<	0.11	UG/L
1,2-DICHLOROETHANE	<	0.1	UG/L
1,1-DICHLOROETHENE	<	0.19	UG/L
CIS-1,2-DICHLOROETHENE	<	0.22	UG/L
TRANS-1,2-DICHLOROETHENE	<	0.2	UG/L
1,2-DICHLOROPROPANE	<	0.12	UG/L
1,3-DICHLOROPROPANE	<	0.14	UG/L
2,2-DICHLOROPROPANE	<	0.27	UG/L
1,1-DICHLOROPROPENE	<	0.12	UG/L
CIS-1,3-DICHLOROPROPENE	<	0.14	UG/L
TRANS-1,3-DICHLOROPROPENE	<	0.11	UG/L
ETHYLBENZENE	<	0.1	UG/L
HEXACHLOROBUTADIENE	<	0.12	UG/L
ISOPROPYLBENZENE	<	0.04	UG/L
4-ISOPROPYLTOLUENE	<	0.08	UG/L
METHYLENE CHLORIDE	B	0.48	UG/L
NAPHTHALENE	<	0.21	UG/L
N-PROPYLBENZENE	<	0.07	UG/L
STYRENE	<	0.12	UG/L
1,1,1,2-TETRACHLOROETHANE	<	0.11	UG/L
1,1,2,2-TETRACHLOROETHANE	<	0.17	UG/L

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CLIENT SAMPLE ID	DW4	
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DRINKING WATER VOLATILES		(CONT)
TETRACHLOROETHENE	< 0.04	UG/L
TOLUENE	< 0.13	UG/L
1,2,3-TRICHLOROBENZENE	< 0.11	UG/L
1,2,4-TRICHLOROBENZENE	< 0.06	UG/L
1,1,1-TRICHLOROETHANE	< 0.1	UG/L
1,1,2-TRICHLOROETHANE	< 0.2	UG/L
TRICHLOROETHENE	< 0.1	UG/L
TRICHLOROFLUOROMETHANE	< 0.13	UG/L
1,2,3-TRICHLOROPROPANE	< 0.18	UG/L
1,2,4-TRIMETHYLBENZENE	< 0.08	UG/L
1,3,5-TRIMETHYLBENZENE	< 0.07	UG/L
VINYL CHLORIDE	< 0.25	UG/L
O-XYLENE	< 0.16	UG/L
M-XYLENE / P-XYLENE	< 0.22	UG/L
VOLATILE SURROGATE RECOVERY		
P-BROMOFLUOROBENZENE	89	%
1,2-DICHLOROBENZENE-D4	77	%
SEMIVOLATILE ORGANIC PRIORITY POLLUTANTS		
BENZO(B)FLUORANTHENE	< 10	UG/L
BENZO(K)FLUORANTHENE	< 10	UG/L
CHRYSENE	< 10	UG/L
BENZO(A)ANTHRACENE	< 10	UG/L
ANTHRACENE	< 10	UG/L
PHENANTHRENE	< 10	UG/L
ACENAPHTHYLENE	< 10	UG/L
ACENAPHTHENE	< 10	UG/L
BENZO(A)PYRENE	< 10	UG/L
BIS(2-CHLOROETHYL)ETHER	< 10	UG/L
BIS(2-CHLOROETHOXY)METHANE	< 10	UG/L
BIS(2-CHLOROISOPROPYL)ETHER	< 10	UG/L
BUTYL BENZYL PHTHALATE	< 10	UG/L
DIETHYLPHTHALATE	< 10	UG/L
DIMETHYLPHTHALATE	< 10	UG/L
FLUORANTHENE	< 10	UG/L
FLUORENE	< 10	UG/L
HEXACHLOROCYCLOPENTADIENE	< 10	UG/L
HEXACHLOROBUTADIENE	< 10	UG/L
HEXACHLOROETHANE	< 10	UG/L
INDENO(1,2,3-CD)PYRENE	< 10	UG/L
ISOPHORONE	< 10	UG/L
N-NITROSODI-N-PROPYLAMINE	< 10	UG/L
N-NITROSODIPHENYLAMINE	< 10	UG/L
N-NITROSODIMETHYLAMINE	< 10	UG/L
NITROBENZENE	< 10	UG/L
4-CHLORO-3-METHYLPHENOL	< 10	UG/L
PYRENE	< 10	UG/L
BENZO(GHI)PERYLENE	< 10	UG/L
1,2-DICHLOROBENZENE	< 10	UG/L
1,2,4-TRICHLOROBENZENE	< 10	UG/L
DIBENZO(A,H)ANTHRACENE	< 10	UG/L
1,3-DICHLOROBENZENE	< 10	UG/L
1,4-DICHLOROBENZENE	< 10	UG/L
2-CHLORONAPHTHALENE	< 10	UG/L
2-CHLOROPHENOL	< 10	UG/L
2-NITROPHENOL	< 10	UG/L
DI-N-OCTYLPHTHALATE	< 10	UG/L
2,4-DICHLOROPHENOL	< 10	UG/L
2,4-DIMETHYLPHENOL	< 10	UG/L

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SEMIVOLATILE ORGANIC PRIORITY POLLUTANTS (CONT)

2,4-DINITROTOLUENE	<	10	UG/L
2,4-DINITROPHENOL	<	50	UG/L
2,4,6-TRICHLOROPHENOL	<	10	UG/L
2,6-DINITROTOLUENE	<	10	UG/L
3,3-DICHLOROBENZIDINE	<	20	UG/L
4-BROMOPHENYL PHENYL ETHER	<	10	UG/L
4-CHLOROPHENYL PHENYL ETHER	<	10	UG/L
4-NITROPHENOL	<	50	UG/L
2-METHYL-4,6-DINITROPHENOL	<	50	UG/L
PHENOL	<	10	UG/L
NAPHTHALENE	<	10	UG/L
PENTACHLOROPHENOL	<	50	UG/L
BIS(2-ETHYLHEXYL)PHTHALATE	<	10	UG/L
DI-N-BUTYLPHTHALATE	<	10	UG/L
BENZIDINE	<	50	UG/L
HEXACHLOROBENZENE	<	10	UG/L
1,2-DIPHENYLHRAZINE	<	10	UG/L

SEMIVOLATILE SURROGATE RECOVERY

2-FLUOROPHENOL	40	%
PHENOL-D5	28	%
NITROBENZENE-D5	77	%
2-FLUOROBIPHENYL	85	%
2,4,6-TRIBROMOPHENOL	84	%
TERPHENYL-D14	85	%

SIGNATURE Laura J. O'Meara
RELEASED BY LAURA J O'MEARA
CLIENT AUTHORIZATION 4

B = Analyte was detected in the laboratory method blank analyzed concurrently with the samples.

Please refer to the Quality Control Report for method blank compound concentrations.

*** Unable to calculate surrogate recovery due to computer file corruption; sample will be reanalyzed and reported at a later date.

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CLIENT SAMPLE ID		DW5	
ABB SAMPLE ID		91259014	
DATE RECEIVED		9/16/91	UNITS
COLIFORMS, FECAL	<	1	/100 ML
COLIFORMS, TOTAL	<	1	/100 ML
PH (LABORATORY)		6.6	
RESIDUE, FILTERABLE (TDS)		140	MG/L
SODIUM, TOTAL		32	MG/L
BARIUM, TOTAL		0.022	MG/L
IRON, TOTAL		1.5	MG/L
MANGANESE, TOTAL		0.84	MG/L
ALUMINUM, TOTAL	<	0.10	MG/L
CHROMIUM, HEXAVALENT	<	0.010	MG/L
ARSENIC, TOTAL	<	0.005	MG/L
BERYLLIUM, TOTAL	<	0.015	MG/L
CADMIUM, TOTAL	<	0.002	MG/L
CHROMIUM, TOTAL	<	0.015	MG/L
COPPER, TOTAL	<	0.025	MG/L
LEAD, TOTAL	<	0.005	MG/L
THALLIUM, TOTAL	<	0.005	MG/L
NICKEL, TOTAL	<	0.040	MG/L
SILVER, TOTAL	<	0.015	MG/L
ZINC, TOTAL		0.054	MG/L
ANTIMONY, TOTAL	<	0.005	MG/L
SELENIUM, TOTAL	<	0.005	MG/L
MERCURY, TOTAL	<	0.20	UG/L
CHLORIDE		28	MG/L
CYANIDE, TOTAL	<	20	UG/L
FLUORIDE	<	0.20	MG/L
AMMONIA, AS N		7.6	MG/L
NITROGEN, TOTAL KJELDAHL		7.6	MG/L
NITRATE, AS N		1.4	MG/L
SULFATE		16	MG/L

ETHYLENE DIBROMIDE

ETHYLENE DIBROMIDE	<	0.2	UG/L

1,2-DIBROMO-3-CHLOROPROPANE

1,2-DIBROMO-3-CHLOROPROPANE	<	0.5	UG/L

PESTICIDES & PCB'S SURROGATE RECOVERY

2,4,5,6-TETRACHLORO-META-XYLENE		140	%

PRIMARY DRINKING WATER STANDARDS PEST.

ENDRIN	<	1	UG/L
LINDANE	<	1	UG/L
METHOXYCHLOR	<	1	UG/L

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CHARLESTON, TN 37310

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CLIENT SAMPLE ID		DW5	
ABB SAMPLE ID		91259014	
DATE RECEIVED		9/16/91	UNITS
PRIMARY DRINKING WATER STANDARDS PEST. (CONT)			
TOXAPHENE	<	1	UG/L
DRINKING WATER SURROGATE RECOVERY - PEST			
2,4,5,6-TETRACHLORO-META-XYLENE		110	%
PRIMARY DRINKING WATER STANDARDS HERB.			
2,4-D	<	10	UG/L
2,4,5-TP(SILVEX)	<	1	UG/L
DRINKING WATER SURROGATE RECOVERY - HERB			
2,4-DB		110	%
DRINKING WATER VOLATILES			
BENZENE	<	0.08	UG/L
BROMOBENZENE	<	0.05	UG/L
BROMOCHLOROMETHANE	<	0.16	UG/L
BROMODICHLOROMETHANE	<	0.21	UG/L
BROMOFORM	<	0.17	UG/L
BROMOMETHANE	<	0.16	UG/L
N-BUTYLBENZENE	<	0.08	UG/L
SEC-BUTYLBENZENE	<	0.05	UG/L
TERT-BUTYLBENZENE	<	0.06	UG/L
CARBON TETRACHLORIDE	<	0.12	UG/L
CHLOROBENZENE	<	0.05	UG/L
CHLOROETHANE	<	0.13	UG/L
CHLOROFORM	<	0.16	UG/L
CHLOROMETHANE	<	0.18	UG/L
2-CHLOROTOLUENE	<	0.11	UG/L
4-CHLOROTOLUENE	<	0.1	UG/L
DIBROMOCHLOROMETHANE	<	0.19	UG/L
1,2-DIBROMO-3-CHLOROPROPANE	<	0.85	UG/L
1,2-DIBROMOETHANE	<	0.11	UG/L
DIBROMOMETHANE	<	0.18	UG/L
1,2-DICHLOROBENZENE	<	0.1	UG/L
1,3-DICHLOROBENZENE	<	0.1	UG/L
1,4-DICHLOROBENZENE		0.19	UG/L
DICHLORODIFLUOROMETHANE	<	0.21	UG/L
1,1-DICHLOROETHANE	<	0.11	UG/L
1,2-DICHLOROETHANE	<	0.1	UG/L
1,1-DICHLOROETHENE	<	0.19	UG/L
CIS-1,2-DICHLOROETHENE	<	0.22	UG/L
TRANS-1,2-DICHLOROETHENE	<	0.2	UG/L
1,2-DICHLOROPROPANE	<	0.12	UG/L
1,3-DICHLOROPROPANE	<	0.14	UG/L
2,2-DICHLOROPROPANE	<	0.27	UG/L
1,1-DICHLOROPROPENE	<	0.12	UG/L
CIS-1,3-DICHLOROPROPENE	<	0.14	UG/L
TRANS-1,3-DICHLOROPROPENE	<	0.11	UG/L
ETHYLBENZENE	<	0.1	UG/L
HEXACHLOROBUTADIENE	<	0.12	UG/L
ISOPROPYLBENZENE	<	0.04	UG/L
4-ISOPROPYLTOLUENE	<	0.08	UG/L
METHYLENE CHLORIDE	B	0.54	UG/L
NAPHTHALENE	<	0.21	UG/L
N-PROPYLBENZENE	<	0.07	UG/L
STYRENE	<	0.12	UG/L
1,1,1,2-TETRACHLOROETHANE	<	0.11	UG/L
1,1,2,2-TETRACHLOROETHANE	<	0.17	UG/L

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DRINKING WATER VOLATILES			(CONT)
TETRACHLOROETHENE	<	0.04	UG/L
TOLUENE	<	0.13	UG/L
1,2,3-TRICHLOROBENZENE	<	0.11	UG/L
1,2,4-TRICHLOROBENZENE	<	0.06	UG/L
1,1,1-TRICHLOROETHANE	<	0.1	UG/L
1,1,2-TRICHLOROETHANE	<	0.2	UG/L
TRICHLOROETHENE	<	0.1	UG/L
TRICHLOROFLUOROMETHANE	<	0.13	UG/L
1,2,3-TRICHLOROPROPANE	<	0.18	UG/L
1,2,4-TRIMETHYLBENZENE	<	0.08	UG/L
1,3,5-TRIMETHYLBENZENE	<	0.07	UG/L
VINYL CHLORIDE	<	0.25	UG/L
O-XYLENE	<	0.16	UG/L
M-XYLENE / P-XYLENE	<	0.22	UG/L
VOLATILE SURROGATE RECOVERY			
P-BROMOFLUOROBENZENE		89	%
1,2-DICHLOROBENZENE-D4		79	%
SEMIVOLATILE ORGANIC PRIORITY POLLUTANTS			
BENZO(B)FLUORANTHENE	<	10	UG/L
BENZO(K)FLUORANTHENE	<	10	UG/L
CHRYSENE	<	10	UG/L
BENZO(A)ANTHRACENE	<	10	UG/L
ANTHRACENE	<	10	UG/L
PHENANTHRENE	<	10	UG/L
ACENAPHTHYLENE	<	10	UG/L
ACENAPHTHENE	<	10	UG/L
BENZO(A)PYRENE	<	10	UG/L
BIS(2-CHLOROETHYL)ETHER	<	10	UG/L
BIS(2-CHLOROETHOXY)METHANE	<	10	UG/L
BIS(2-CHLOROISOPROPYL)ETHER	<	10	UG/L
BUTYL BENZYL PHTHALATE	<	10	UG/L
DIETHYLPHTHALATE	<	10	UG/L
DIMETHYLPHTHALATE	<	10	UG/L
FLUORANTHENE	<	10	UG/L
FLUORENE	<	10	UG/L
HEXACHLOROCYCLOPENTADIENE	<	10	UG/L
HEXACHLOROBUTADIENE	<	10	UG/L
HEXACHLOROETHANE	<	10	UG/L
INDENO(1,2,3-CD)PYRENE	<	10	UG/L
ISOPHORONE	<	10	UG/L
N-NITROSODI-N-PROPYLAMINE	<	10	UG/L
N-NITROSODIPHENYLAMINE	<	10	UG/L
N-NITROSODIMETHYLAMINE	<	10	UG/L
NITROBENZENE	<	10	UG/L
4-CHLORO-3-METHYLPHENOL	<	10	UG/L
PYRENE	<	10	UG/L
BENZO(GHI)PERYLENE	<	10	UG/L
1,2-DICHLOROBENZENE	<	10	UG/L
1,2,4-TRICHLOROBENZENE	<	10	UG/L
DIBENZO(A,H)ANTHRACENE	<	10	UG/L
1,3-DICHLOROBENZENE	<	10	UG/L
1,4-DICHLOROBENZENE	<	10	UG/L
2-CHLORONAPHTHALENE	<	10	UG/L
2-CHLOROPHENOL	<	10	UG/L
2-NITROPHENOL	<	10	UG/L
DI-N-OCTYLPHTHALATE	<	10	UG/L
2,4-DICHLOROPHENOL	<	10	UG/L
2,4-DIMETHYLPHENOL	<	10	UG/L

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SEMIVOLATILE ORGANIC PRIORITY POLLUTANTS (CONT)

2,4-DINITROTOLUENE	<	10	UG/L
2,4-DINITROPHENOL	<	50	UG/L
2,4,6-TRICHLOROPHENOL	<	10	UG/L
2,6-DINITROTOLUENE	<	10	UG/L
3,3-DICHLOROBENZIDINE	<	20	UG/L
4-BROMOPHENYL PHENYL ETHER	<	10	UG/L
4-CHLOROPHENYL PHENYL ETHER	<	10	UG/L
4-NITROPHENOL	<	50	UG/L
2-METHYL-4,6-DINITROPHENOL	<	50	UG/L
PHENOL	<	10	UG/L
NAPHTHALENE	<	10	UG/L
PENTACHLOROPHENOL	<	50	UG/L
BIS(2-ETHYLHEXYL)PHTHALATE	<	10	UG/L
DI-N-BUTYLPHTHALATE	<	10	UG/L
BENZIDINE	<	50	UG/L
HEXACHLOROBENZENE	<	10	UG/L
1,2-DIPHENYLHRAZINE	<	10	UG/L

SEMIVOLATILE SURROGATE RECOVERY

2-FLUOROPHENOL	34	%
PHENOL-D5	23	%
NITROBENZENE-D5	60	%
2-FLUOROBIPHENYL	75	%
2,4,6-TRIBROMOPHENOL	65	%
TERPHENYL-D14	66	%

SIGNATURE Laura J O'Meara
RELEASED BY LAURA J O'MEARA
CLIENT AUTHORIZATION 5

B = Analyte was detected in the laboratory method blank analyzed concurrently with the samples.

Please refer to the Quality Control Report for method blank compound concentrations.

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CLIENT SAMPLE ID		DW6	
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COLIFORMS, FECAL	<	1	/100 ML
COLIFORMS, TOTAL	<	1	/100 ML
PH (LABORATORY)		6.1	
RESIDUE, FILTERABLE (TDS)		120	MG/L
SODIUM, TOTAL		20	MG/L
BARIUM, TOTAL	<	0.005	MG/L
IRON, TOTAL		0.52	MG/L
MANGANESE, TOTAL		0.19	MG/L
ALUMINUM, TOTAL	<	0.10	MG/L
CHROMIUM, HEXAVALENT	<	0.010	MG/L
ARSENIC, TOTAL	<	0.005	MG/L
BERYLLIUM, TOTAL	<	0.015	MG/L
CADMIUM, TOTAL	<	0.002	MG/L
CHROMIUM, TOTAL	<	0.015	MG/L
COPPER, TOTAL		0.042	MG/L
LEAD, TOTAL	<	0.005	MG/L
THALLIUM, TOTAL	<	0.005	MG/L
NICKEL, TOTAL	<	0.040	MG/L
SILVER, TOTAL	<	0.015	MG/L
ZINC, TOTAL	<	0.025	MG/L
ANTIMONY, TOTAL	<	0.005	MG/L
SELENIUM, TOTAL	<	0.005	MG/L
MERCURY, TOTAL	<	0.20	UG/L
CHLORIDE		38	MG/L
CYANIDE, TOTAL	<	20	UG/L
FLUORIDE	<	0.20	MG/L
AMMONIA, AS N		0.37	MG/L
NITROGEN, TOTAL KJELDAHL		0.41	MG/L
NITRATE, AS N	*	0.28	MG/L
SULFATE		16	MG/L

ETHYLENE DIBROMIDE

ETHYLENE DIBROMIDE	<	0.2	UG/L

1,2-DIBROMO-3-CHLOROPROPANE

1,2-DIBROMO-3-CHLOROPROPANE	<	0.5	UG/L

PESTICIDES & PCB'S SURROGATE RECOVERY

2,4,5,6-TETRACHLORO-META-XYLENE		92	%

PRIMARY DRINKING WATER STANDARDS PEST.

ENDRIN	<	1	UG/L
LINDANE	<	1	UG/L
METHOXYCHLOR	<	1	UG/L

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CLIENT SAMPLE ID		DW6	
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PRIMARY DRINKING WATER STANDARDS PEST. (CONT)			
TOXAPHENE	<	1	UG/L
DRINKING WATER SURROGATE RECOVERY - PEST			
2,4,5,6-TETRACHLORO-META-XYLENE		96	%
PRIMARY DRINKING WATER STANDARDS HERB.			
2,4-D	<	10	UG/L
2,4,5-TP(SILVEX)	<	1	UG/L
DRINKING WATER SURROGATE RECOVERY - HERB			
2,4-DB	@	16	%
DRINKING WATER VOLATILES			
BENZENE	<	0.08	UG/L
BROMOBENZENE	<	0.05	UG/L
BROMOCHLOROMETHANE	<	0.16	UG/L
BROMODICHLOROMETHANE	<	0.21	UG/L
BROMOFORM	<	0.17	UG/L
BROMOMETHANE	<	0.16	UG/L
N-BUTYLBENZENE	<	0.08	UG/L
SEC-BUTYLBENZENE	<	0.05	UG/L
TERT-BUTYLBENZENE	<	0.06	UG/L
CARBON TETRACHLORIDE	<	0.12	UG/L
CHLOROBENZENE	<	0.05	UG/L
CHLOROETHANE	<	0.13	UG/L
CHLOROFORM	<	0.16	UG/L
CHLOROMETHANE	<	0.18	UG/L
2-CHLOROTOLUENE	<	0.11	UG/L
4-CHLOROTOLUENE	<	0.1	UG/L
DIBROMOCHLOROMETHANE	<	0.19	UG/L
1,2-DIBROMO-3-CHLOROPROPANE	<	0.85	UG/L
1,2-DIBROMOETHANE	<	0.11	UG/L
DIBROMOMETHANE	<	0.18	UG/L
1,2-DICHLOROBENZENE	<	0.1	UG/L
1,3-DICHLOROBENZENE	<	0.1	UG/L
1,4-DICHLOROBENZENE	<	0.1	UG/L
DICHLORODIFLUOROMETHANE	<	0.21	UG/L
1,1-DICHLOROETHANE	<	0.11	UG/L
1,2-DICHLOROETHANE	<	0.1	UG/L
1,1-DICHLOROETHENE	<	0.19	UG/L
CIS-1,2-DICHLOROETHENE	<	0.22	UG/L
TRANS-1,2-DICHLOROETHENE	<	0.2	UG/L
1,2-DICHLOROPROPANE	<	0.12	UG/L
1,3-DICHLOROPROPANE	<	0.14	UG/L
2,2-DICHLOROPROPANE	<	0.27	UG/L
1,1-DICHLOROPROPENE	<	0.12	UG/L
CIS-1,3-DICHLOROPROPENE	<	0.14	UG/L
TRANS-1,3-DICHLOROPROPENE	<	0.11	UG/L
ETHYLBENZENE	<	0.1	UG/L
HEXACHLOROBUTADIENE	<	0.12	UG/L
ISOPROPYLBENZENE	<	0.04	UG/L
4-ISOPROPYLTOLUENE	<	0.08	UG/L
METHYLENE CHLORIDE	B	0.55	UG/L
NAPHTHALENE	<	0.21	UG/L
N-PROPYLBENZENE	<	0.07	UG/L
STYRENE	<	0.12	UG/L
1,1,1,2-TETRACHLOROETHANE	<	0.11	UG/L
1,1,2,2-TETRACHLOROETHANE	<	0.17	UG/L

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DATE RECEIVED		9/16/91	UNITS
DRINKING WATER VOLATILES			(CONT)
TETRACHLOROETHENE	<	0.04	UG/L
TOLUENE	<	0.13	UG/L
1,2,3-TRICHLOROBENZENE	<	0.11	UG/L
1,2,4-TRICHLOROBENZENE	<	0.06	UG/L
1,1,1-TRICHLOROETHANE	<	0.1	UG/L
1,1,2-TRICHLOROETHANE	<	0.2	UG/L
TRICHLOROETHENE	<	0.1	UG/L
TRICHLOROFLUOROMETHANE	<	0.13	UG/L
1,2,3-TRICHLOROPROPANE	<	0.18	UG/L
1,2,4-TRIMETHYLBENZENE	<	0.08	UG/L
1,3,5-TRIMETHYLBENZENE	<	0.07	UG/L
VINYL CHLORIDE	<	0.25	UG/L
O-XYLENE	<	0.16	UG/L
M-XYLENE / P-XYLENE	<	0.22	UG/L
VOLATILE SURROGATE RECOVERY			
P-BROMOFLUOROBENZENE		83	%
1,2-DICHLOROBENZENE-D4	**	60	%
SEMIVOLATILE ORGANIC PRIORITY POLLUTANTS			
BENZO(B)FLUORANTHENE	<	10	UG/L
BENZO(K)FLUORANTHENE	<	10	UG/L
CHRYSENE	<	10	UG/L
BENZO(A)ANTHRACENE	<	10	UG/L
ANTHRACENE	<	10	UG/L
PHENANTHRENE	<	10	UG/L
ACENAPHTHYLENE	<	10	UG/L
ACENAPHTHENE	<	10	UG/L
BENZO(A)PYRENE	<	10	UG/L
BIS(2-CHLOROETHYL)ETHER	<	10	UG/L
BIS(2-CHLOROETHOXY)METHANE	<	10	UG/L
BIS(2-CHLOROISOPROPYL)ETHER	<	10	UG/L
BUTYL BENZYL PHTHALATE	<	10	UG/L
DIETHYLPHTHALATE	<	10	UG/L
DIMETHYLPHTHALATE	<	10	UG/L
FLUORANTHENE	<	10	UG/L
FLUORENE	<	10	UG/L
HEXACHLOROCYCLOPENTADIENE	<	10	UG/L
HEXACHLOROBUTADIENE	<	10	UG/L
HEXACHLOROETHANE	<	10	UG/L
INDENO(1,2,3-CD)PYRENE	<	10	UG/L
ISOPHORONE	<	10	UG/L
N-NITROSODI-N-PROPYLAMINE	<	10	UG/L
N-NITROSODIPHENYLAMINE	<	10	UG/L
N-NITROSODIMETHYLAMINE	<	10	UG/L
NITROBENZENE	<	10	UG/L
4-CHLORO-3-METHYLPHENOL	<	10	UG/L
PYRENE	<	10	UG/L
BENZO(GHI)PERYLENE	<	10	UG/L
1,2-DICHLOROBENZENE	<	10	UG/L
1,2,4-TRICHLOROBENZENE	<	10	UG/L
DIBENZO(A,H)ANTHRACENE	<	10	UG/L
1,3-DICHLOROBENZENE	<	10	UG/L
1,4-DICHLOROBENZENE	<	10	UG/L
2-CHLORONAPHTHALENE	<	10	UG/L
2-CHLOROPHENOL	<	10	UG/L
2-NITROPHENOL	<	10	UG/L
DI-N-OCTYLPHTHALATE	<	10	UG/L
2,4-DICHLOROPHENOL	<	10	UG/L
2,4-DIMETHYLPHENOL	<	10	UG/L

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SEMIVOLATILE ORGANIC PRIORITY POLLUTANTS (CONT)

2,4-DINITROTOLUENE	<	10	UG/L
2,4-DINITROPHENOL	<	50	UG/L
2,4,6-TRICHLOROPHENOL	<	10	UG/L
2,6-DINITROTOLUENE	<	10	UG/L
3,3-DICHLOROBENZIDINE	<	20	UG/L
4-BROMOPHENYL PHENYL ETHER	<	10	UG/L
4-CHLOROPHENYL PHENYL ETHER	<	10	UG/L
4-NITROPHENOL	<	50	UG/L
2-METHYL-4,6-DINITROPHENOL	<	50	UG/L
PHENOL	<	10	UG/L
NAPHTHALENE	<	10	UG/L
PENTACHLOROPHENOL	<	50	UG/L
BIS(2-ETHYLHEXYL)PHTHALATE	<	10	UG/L
DI-N-BUTYLPHTHALATE	<	10	UG/L
BENZIDINE	<	50	UG/L
HEXACHLOROBENZENE	<	10	UG/L
1,2-DIPHENYLDRAZINE	<	10	UG/L

SEMIVOLATILE SURROGATE RECOVERY

2-FLUOROPHENOL	41	%
PHENOL-D5	28	%
NITROBENZENE-D5	74	%
2-FLUOROBIPHENYL	82	%
2,4,6-TRIBROMOPHENOL	74	%
TERPHENYL-D14	78	%

SIGNATURE Laura J O'Meara
RELEASED BY LAURA J O'MEARA
CLIENT AUTHORIZATION 6

B = Analyte was detected in the laboratory method blank analyzed concurrently with the samples.

Please refer to the Quality Control Report for method blank compound concentrations.

* The reported value is the mean of two or more replicate analyses of the sample. The precision of the replicate analyses is outside the laboratory's acceptance range for this parameter. Sample homogeneity may be a factor.

** Surrogate recovery does not meet internal QC criteria. Insufficient sample remained for reanalysis.

@ Surrogate recovery does not meet internal QC criteria. Sample will be reextracted and reported at a later date.

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CLIENT SAMPLE ID	TRIP BLK		
ABB SAMPLE ID	91259016		
DATE RECEIVED	9/16/91		UNITS
DRINKING WATER VOLATILES			
BENZENE	<	0.08	UG/L
BROMOBENZENE	<	0.05	UG/L
BROMOCHLOROMETHANE	<	0.16	UG/L
BROMODICHLOROMETHANE	<	0.21	UG/L
BROMOFORM	<	0.17	UG/L
BROMOMETHANE	<	0.16	UG/L
N-BUTYLBENZENE	<	0.08	UG/L
SEC-BUTYLBENZENE	<	0.05	UG/L
TERT-BUTYLBENZENE	<	0.06	UG/L
CARBON TETRACHLORIDE	<	0.12	UG/L
CHLOROBENZENE	<	0.05	UG/L
CHLOROETHANE	<	0.13	UG/L
CHLOROFORM	<	0.16	UG/L
CHLOROMETHANE	<	0.18	UG/L
2-CHLOROTOLUENE	<	0.11	UG/L
4-CHLOROTOLUENE	<	0.1	UG/L
DIBROMOCHLOROMETHANE	<	0.19	UG/L
1,2-DIBROMO-3-CHLOROPROPANE	<	0.85	UG/L
1,2-DIBROMOETHANE	<	0.11	UG/L
DIBROMOMETHANE	<	0.18	UG/L
1,2-DICHLOROBENZENE	<	0.1	UG/L
1,3-DICHLOROBENZENE	<	0.1	UG/L
1,4-DICHLOROBENZENE	<	0.1	UG/L
DICHLORODIFLUOROMETHANE	<	0.21	UG/L
1,1-DICHLOROETHANE	<	0.11	UG/L
1,2-DICHLOROETHANE	<	0.1	UG/L
1,1-DICHLOROETHENE	<	0.19	UG/L
CIS-1,2-DICHLOROETHENE	<	0.22	UG/L
TRANS-1,2-DICHLOROETHENE	<	0.2	UG/L
1,2-DICHLOROPROPANE	<	0.12	UG/L
1,3-DICHLOROPROPANE	<	0.14	UG/L
2,2-DICHLOROPROPANE	<	0.27	UG/L
1,1-DICHLOROPROPENE	<	0.12	UG/L
CIS-1,3-DICHLOROPROPENE	<	0.14	UG/L
TRANS-1,3-DICHLOROPROPENE	<	0.11	UG/L
ETHYLBENZENE	<	0.1	UG/L
HEXACHLOROBUTADIENE	<	0.12	UG/L
ISOPROPYLBENZENE	<	0.04	UG/L
4-ISOPROPYLTOLUENE	<	0.08	UG/L
METHYLENE CHLORIDE	B	0.82	UG/L
NAPHTHALENE	<	0.21	UG/L
N-PROPYLBENZENE	<	0.07	UG/L
STYRENE	<	0.12	UG/L
1,1,1,2-TETRACHLOROETHANE	<	0.11	UG/L
1,1,2,2-TETRACHLOROETHANE	<	0.17	UG/L

OLIN CHEMICAL
ATTN: MIKE BELLOTTI
LOWER RIVER RD BOX 248
CHARLESTON, TN 37310

REPORT OF ANALYSIS 9/26/91
REFERENCE NUMBER 11969
PAGE 2

CLIENT SAMPLE ID	TRIP BLK	
ABB SAMPLE ID	91259016	
DATE RECEIVED	9/16/91	UNITS
DRINKING WATER VOLATILES		(CONT)
TETRACHLOROETHENE	< 0.04	UG/L
TOLUENE	0.14	UG/L
1,2,3-TRICHLOROBENZENE	< 0.11	UG/L
1,2,4-TRICHLOROBENZENE	< 0.06	UG/L
1,1,1-TRICHLOROETHANE	< 0.1	UG/L
1,1,2-TRICHLOROETHANE	< 0.2	UG/L
TRICHLOROETHENE	< 0.1	UG/L
TRICHLOROFLUOROMETHANE	< 0.13	UG/L
1,2,3-TRICHLOROPROPANE	< 0.18	UG/L
1,2,4-TRIMETHYLBENZENE	< 0.08	UG/L
1,3,5-TRIMETHYLBENZENE	< 0.07	UG/L
VINYL CHLORIDE	< 0.25	UG/L
O-XYLENE	< 0.16	UG/L
M-XYLENE / P-XYLENE	< 0.22	UG/L
VOLATILE SURROGATE RECOVERY		
P-BROMOFLUOROBENZENE	92	%
1,2-DICHLOROBENZENE-D4	106	%

SIGNATURE Laura J O'Meara
RELEASED BY LAURA J O'MEARA
CLIENT AUTHORIZATION 7

detected in the laboratory method blank analyzed
.ly with the samples.

refer to the Quality Control Report for method blank compound
.trations.

CHAIN OF CUSTODY RECORD

PROJECT NO.

PROJECT NAME: OLIN CHEMICAL DOMESTIC WELL

SAMPLERS (SIGNATURE): Kim A. Nelson

STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CONTAINERS	40 ml VOA	1 L Plastic	500 ml Plastic	1 L Amber	250 ml Plastic	1 L glass	250 ml Plastic Sulfuric Acid	100 ml glass Sulfuric Acid	40 ml VOA	250 ml plastic	1 L amber glass	REMARKS INDICATE SOIL/WATER/AIR SEDIMENT/SLUDGE
	9/16/91	1155			DW-1		2	1	1	1	1	4		2		1		
		1155			DW-1A		2	1	1	1	1	4		2		1		
		1435			DW-2		2	1	1	1	1	4		2	2	1	4	
		1435			DW-2A		2	1	1	1	1	4		2		1		
		1500			DW-3		2	1	1	1	1	4		2		1		
		1500			DW-3A		2	1	1	1	1	4		2		1		
		1525			DW-4		2	1	1	1	1	4		2		1		
		1525			DW-4A		2	1	1	1	1	4		2		1		
		1550			DW-5		2	1	1	1	1	4		2		1		
		1550			DW-5A		2	1	1	1	1	4		2		1		
		1615			DW-6		2	1	1	1	1	4		2		1		
		1615			DW-6A		2	1	1	1	1	4		2		1		
					~~DW-7~~		~~2~~	~~1~~	~~1~~	~~1~~	~~1~~	~~4~~		~~2~~		~~1~~		NOT NEEDED
					~~DW-7A~~		~~2~~	~~1~~	~~1~~	~~1~~	~~1~~	~~4~~				~~1~~		

RELINQUISHED BY: (SIGNATURE)	DATE/TIME	RECEIVED BY: (SIGNATURE)	RELINQUISHED BY: (SIGNATURE)	DATE/TIME	RECEIVED BY: (SIGNATURE)
Kim A. Nelson	9/16/91 1630	John L. Shields			
RELINQUISHED BY: (SIGNATURE)	DATE/TIME	RECEIVED BY: (SIGNATURE)	RELINQUISHED BY: (SIGNATURE)	DATE/TIME	RECEIVED BY: (SIGNATURE)
RELINQUISHED BY: (SIGNATURE)	DATE/TIME	RECEIVED FOR DISPOSAL BY: (SIGNATURE)	DATE/TIME	REMARKS	

ABB Environmental Services, Inc.

OH-62

ABB Environmental Services, Inc.
Analytical Laboratory
Westbrook, Maine

GENERAL CHEMICAL ANALYSES - AQUEOUS MATRIX

PARAMETER	*METHOD*	*PQL*
Acidity	305.1	10 mg/L
Alkalinity-Manual Titrimetric	310.1	20 mg/L
Bicarbonate, Carbonate (see pH & alkalinity)	calc.	mg/L
Biochemical Oxygen Demand-Carbonaceous	405.1	6 mg/L
Biochemical Oxygen Demand-Total	405.1	6 mg/L
Chemical Oxygen Demand-Manual Colorimetric	410.4	15 mg/L
Chloride-Automated Ferricyanide	325.2	2 mg/L
Chlorine, Total Residual	330.5	0.1 mg/L
Coliform, Fecal	APHA 909C	1/100 mL
Coliform, Total	APHA 909A	1/100 mL
Color, True	110.2	5 PTCO
Color, Apparent	110.2	5 PTCO
Corrosivity-NACE Standard TM-01-69	1110	10 mpy
Cyanide, Total-Spectrophotometric	335.2	20 ug/L
Cyanide, Amenable-Spectrophotometric	335.1	20 ug/L
Dissolved Oxygen(Laboratory)-Membrane Electrode	360.1	1 mg/L
Fluoride, Potentiometric ISE	340.2	0.2 mg/L
Fluoride with distillation, Potentiometric ISE	340.1/340.2	0.2 mg/L
Hardness, Total-Manual Titrimetric	130.2	5 mg/L
Ignitability-Flash Point (closed cup)	1010	25 Degrees Celsius
MBAS, Extraction-Colorimetric	425.1	0.04 mg/L
Ammonia-Nitrogen-Automated Phenate	350.1	0.1 mg/L
Organic Nitrogen-Auto. Block Digest.,Spectro.	350.1/351.2	0.1 mg/L
Total Kjeldahl Nitrogen-Auto Block Digest,Spect	351.2	0.1 mg/L
Nitrate+Nitrite-Automated Cadmium Reduction	353.2	0.05 mg/L
Nitrate-Automated Cadmium Red./Diazotization	353.2/354.1	0.05 mg/L
Nitrite-Automated Diazotization	354.1	0.05 mg/L
Oil & Grease-Total Recoverable, Gravimetric	413.1	5 mg/L
Oil & Grease-Total Recoverable, Infrared	413.2	1.5 mg/L
Oil & Grease-Hydrocarbons,Grav./Solvent Extract	APHA 503E	5 mg/L
pH (Laboratory)	150.1	—
Phenolics, Total Recoverable-Manual 4AAP	420.1	5 ug/L
Phosphate,Total-Auto Ascorbic Acid/Block Digestion	365.4	0.1 mg/L
Phosphate, Ortho-Auto. Ascorbic Acid	365.1	0.05 mg/L
Silica-Manual Molybdosilicate	370.1	1 mg/L
Solids-Nonfilterable Residue (TSS)	160.2	4 mg/L
Solids-Volatile Nonfilterable Residue (VSS)	160.2/160.4	10 mg/L

PQL = Practical Quantitation Limit represents the normally obtainable measurement level achieved by the laboratory und routine laboratory conditions for a variety of sample matrices. Sample-specific reporting limits may vary from the labor as a result sample matrix and compound concentration.

ABB Environmental Services, Inc.
Analytical Laboratory
Westbrook, Maine

GENERAL CHEMICAL ANALYSES - AQUEOUS MATRIX

PARAMETER	*METHOD*	*PQL*
Solids-Filterable Residue (TDS),Gravimetric 180	160.1	10 mg/L
Solids-Volatile Filterable Residue (VDS)	160.1/160.4	10 mg/L
Solids-Settleable Solids (SS)	160.5	0.2 mL/L
Solids-Total Solids	160.3	10 mg/L
Specific Conductance-Wheatstone Bridge	120.1	umhos/cm
Sulfate-Turbidimetric	375.4	1 mg/L
Sulfite-Titrimetric	377.1	3 mg/L
Sulfide-Iodometric	376.1	1 mg/L
Sulfide-Monier-Williams	40CFR-425	0.5 mg/L
Sulfide-Reactive	7.3.4.1	
Tannin/Lignin-Colorimetric	APHA 513	1 mg/L
Total Organic Carbon-Oxidation	415.1	1 mg/L
Total Inorganic Carbon	415.1	1 mg/L
Total Organic Halogen	9020	mg/L
Total Petroleum Hydrocarbons-Extraction, IR	418.1	1 mg/L
Turbidity	180.1	1 NTU

PQL = Practical Quantitation Limit represents the normally obtainable measurement level achieved by the laboratory und routine laboratory conditions for a variety of sample matrices. Sample-specific reporting limits may vary from the labor as a result sample matrix and compound concentration.

ABB Environmental Services, Inc.
Analytical Laboratory
Westbrook, Maine

ELEMENTAL ANALYSES - AQUEOUS MATRIX

PARAMETER	*METHOD*	*PQL*
Aluminum-ICP	200.7/6010	0.100 mg/L
Antimony-Furnace AA	204.2/7041	0.005 mg/L
Arsenic-Furnace AA	206.2/7060	0.005 mg/L
Barium-ICP	200.7/6010	0.005 mg/L
Beryllium-ICP	200.7/6010	0.015 mg/L
Boron-ICP	200.7/6010	0.025 mg/L
Cadmium-Furnace AA	213.2	0.002 mg/L
Calcium-ICP	200.7/6010	0.025 mg/L
Chromium-ICP	200.7/6010	0.015 mg/L
Chromium, Hexavalent-Colorimetric	7196	0.010 mg/L
Cobalt-ICP	200.7/6010	0.015 mg/L
Copper-ICP	200.7/6010	0.025 mg/L
Gold-ICP	200.7/6010	0.100 mg/L
Iron-ICP	200.7/6010	0.025 mg/L
Lead-ICP	200.7/6010	0.100 mg/L
Lead-Furnace AA	239.2/7421	0.005 mg/L
Magnesium-ICP	200.7/6010	0.050 mg/L
Manganese-ICP	200.7/6010	0.010 mg/L
Mercury-CVAA	245.1/7470	0.20 ug/L
Molybdenum-ICP	200.7/6010	0.020 mg/L
Nickel-ICP	200.7/6010	0.040 mg/L
Platinum-Furnace AA	255.2	0.005 mg/L
Potassium-Flame AA	258.1	0.025 mg/L
Potassium-ICP	200.7/6010	0.500 mg/L
Selenium-Furnace AA	270.2/7740	0.005 mg/L
Silver-ICP	200.7/6010	0.015 mg/L
Sodium-ICP	200.7/6010	0.050 mg/L
Thallium-Furnace AA	279.2/7841	0.005 mg/L
Tin-ICP	200.7/6010	0.100 mg/L
Titanium-ICP	200.7/6010	0.100 mg/L
Vanadium-ICP	200.7/6010	0.025 mg/L
Zinc-ICP	200.7/6010	0.025 mg/L

PQL = Practical Quantitation Limit represents the normally obtainable measurement level achieved by the laboratory under practical routine laboratory conditions for a variety of sample matrices. Sample-specific reporting limits may vary from the laboratory PQL as a result of sample matrix and compound concentration.

ICP = Inductively Coupled Plasma

AA = Atomic Absorption

ABB Environmental Services, Inc.
Analytical Laboratory
Westbrook, Maine

ANALYTICAL METHOD INFORMATION

PARAMETER: ETHYLENE DIBROMIDE/1,2-DIBROMO-3-CHLOROPROPANE

METHOD: GC/ECD

MATRIX: AQUEOUS

Compound	*Practical Quantitation Limit (PQL) (ug/L)*
Ethylene dibromide	0.2
1,2-Dibromo-3-chloropropane	0.5

PQL = Practical Quantitation Limit represents the normally obtainable measurement level achieved by the laboratory under practical and routine laboratory conditions for a variety of sample matrices. Sample-specific reporting limits may vary from the standard PQL as a result of sample matrix and compound concentrations.

ABB Environmental Services, Inc.
Analytical Laboratory
Westbrook, Maine

ANALYTICAL METHOD INFORMATION
PARAMETER: SDWA PESTICIDES
METHOD: 608
MATRIX: AQUEOUS

COMPOUND	*PQL (ug/L)*
Endrin	1
Lindane	1
Methoxychlor	1
Toxaphene	1

PARAMETER: SDWA HERBICIDES
METHOD: SM509B
MATRIX: AQUEOUS

COMPOUND	*PQL (ug/L)*
2,4-D	10
2,4,5-TP (Silvex)	1

PQL = Practical Quantitation Limit represents the normally obtainable measurement level achieved by the laboratory under practical and routine laboratory conditions for a variety of sample matrices. Sample-specific reporting limits may vary from the standard PQL as a result of sample matrix and compound concentration.

ABB Environmental Services, Inc.
Analytical Laboratory
Westbrook, Maine

ANALYTICAL METHOD INFORMATION
PARAMETER: DRINKING WATER VOLATILE ORGANICS
METHOD: 524.2
MATRIX: AQUEOUS

Compound	*Minimum Detection Limit (MDL) (ug/L)*
Benzene	0.08
Bromobenzene	0.05
Bromochloromethane	0.16
Bromodichloromethane	0.21
Bromoform	0.17
Bromomethane	0.16
n-Butylbenzene	0.08
sec-Butylbenzene	0.05
tert-Butylbenzene	0.06
Carbon tetrachloride	0.12
Chlorobenzene	0.05
Chloroethane	0.13
Chloroform	0.16
Chloromethane	0.18
2-Chlorotoluene	0.11
4-Chlorotoluene	0.10
Dibromochloromethane	0.19
1,2-Dibromo-3-chloropropane	0.85
1,2-Dibromoethane	0.11
Dibromomethane	0.18
1,2-Dichlorobenzene	0.10
1,3-Dichlorobenzene	0.10
1,4-Dichlorobenzene	0.10
Dichlorodifluoromethane	0.21
1,1-Dichloroethane	0.11
1,2-Dichloroethane	0.10
1,1-Dichloroethene	0.19
cis-1,2-Dichloroethene	0.22
trans-1,2-Dichloroethene	0.20
1,2-Dichloropropane	0.12
1,3-Dichloropropane	0.14
2,2-Dichloropropane	0.27
1,1-Dichloropropene	0.12
cis-1,3-Dichloropropene	0.14
trans-1,3-Dichloropropene	0.11
Ethylbenzene	0.10

MDL = The Minimum Detection Limit is the minimum concentration of a substance that can be identified, measured, and reported with 99% confidence that the analyte concentration is greater than zero.

ABB Environmental Services, Inc.
Analytical Laboratory
Westbrook, Maine

ANALYTICAL METHOD INFORMATION
PARAMETER: DRINKING WATER VOLATILE ORGANICS
METHOD: 524.2
MATRIX: AQUEOUS

Compound	*Minimum Detection Limit (MDL) (ug/L)*
Hexachlorobutadiene	0.12
Isopropylbenzene	0.04
4-Isopropyltoluene	0.08
Methylene chloride	0.24
Naphthalene	0.21
n-Propylbenzene	0.07
Styrene	0.12
1,1,1,2-Tetrachloroethane	0.11
1,1,2,2-Tetrachloroethane	0.17
Tetrachloroethene	0.04
Toluene	0.13
1,2,3-Trichlorobenzene	0.11
1,2,4-Trichlorobenzene	0.06
1,1,1-Trichloroethane	0.10
1,1,2-Trichloroethane	0.20
Trichloroethene	0.10
Trichlorofluoromethane	0.13
1,2,3-Trichloropropane	0.18
1,2,4-Trimethylbenzene	0.08
1,3,5-Trimethylbenzene	0.07
Vinyl chloride	0.25
o-Xylene	0.16
m-Xylene	0.22
p-Xylene	0.22

MDL = The Minimum Detection Limit is the minimum concentration of a substance that can be identified, measured, and reported with 99% confidence that the analyte concentration is greater than zero.

ABB Environmental Services, Inc.
Analytical Laboratory
Westbrook, Maine

ANALYTICAL METHOD INFORMATION
PARAMETER: SEMIVOLATILE PRIORITY POLLUTANT VOLATILE ORGANICS
METHOD: 625/8270
MATRIX: AQUEOUS

Compound	*Practical Quantitation Limit (PQL) (ug/L)*
Benzo(B)Fluoranthene	10
Benzo(K)Fluoranthene	10
Chrysene	10
Benzo(A)Anthracene	10
Anthracene	10
Phenanthrene	10
Acenaphthylene	10
Acenaphthene	10
Benzo(A)Pyrene	10
Bis(2-Chloroethyl)Ether	10
Bis(2-Chloroethoxy)Methane	10
Bis(2-Chloroisopropyl)Ether	10
Butyl Benzyl Phthalate	10
Diethylphthalate	10
Dimethylphthalate	10
Fluoranthene	10
Fluorene	10
Hexachlorocyclopentadiene	10
Hexachlorobutadiene	10
Hexachloroethane	10
Indeno(1,2,2-CD)Pyrene	10
Isophorone	10
N-Nitrosodi-n-Propylamine	10
N-Nitrosodiphenylamine	10
N-Nitrosodimethylamine	10
Nitrobenzene	10
4-Chloro-3-methylphenol	10
Pyrene	10
Benzo(GHI)perylene	10

PQL = Practical Quantitation Limit represents the normally obtainable measurement level achieved by the laboratory under practical and routine laboratory conditions for a variety of sample matrices. Sample-specific reporting limits may vary from the standard PQL as a result of sample matrix and compound concentrations.

ABB Environmental Services, Inc.
Analytical Laboratory
Westbrook, Maine

ANALYTICAL METHOD INFORMATION
PARAMETER: SEMIVOLATILE PRIORITY POLLUTANT VOLATILE ORGANICS
METHOD: 625/8270
MATRIX: AQUEOUS

Compound	*Practical Quantitation Limit (PQL) (ug/L)*
1,2-Dichlorobenzene	10
1,2,4-Trichlorobenzene	10
Dibenzo(A,H)Anthracene	10
1,3-Dichlorobenzene	10
1,4-Dichlorobenzene	10
2-Chloronaphthalene	10
2-Chlorophenol	10
2-Nitrophenol	10
Di-n-octylphthalate	10
2,4-Dichlorophenol	10
2,4-Dimethylphenol	10
2,4-Dinitrotoluene	10
2,4-Dinitrophenol	50
2,4,6-Trichlorophenol	10
2,6-Dinitrotoluene	10
3,3-Dichlorobenzidine	20
4-Bromophenyl Phenyl Ether	10
4-Chlorophenyl Phenyl Ether	10
4-Nitrophenol	50
2-Methyl-4,6-Dinitrophenol	50
Phenol	10
Naphthalene	10
Pentachlorophenol	50
Bis(2-Ethylhexyl)Phthalate	10
Di-n-Butylphthalate	10
Benzidine	50
Hexachlorobenzene	10
1,2-Diphenyldrazine	10

PQL = Practical Quantitation Limit represents the normally obtainable measurement level achieved by the laboratory under practical and routine laboratory conditions for a variety of sample matrices. Sample-specific reporting limits may vary from the standard PQL as a result of sample matrix and compound concentrations.

REFERENCE GUIDE TO LABORATORY REPORT OF ANALYSIS

The attached Report of Analysis summarizes the analytical results for your drinking water sample. The ABB-ES Laboratory reports results using industry-accepted protocols as well as some unique reporting protocols that are designed to present a comprehensive Report of Analysis.

All sample results are reported in concentration units of ug/L (micrograms per liter) or mg/L (milligrams per liter). These units are used to express the concentration of a particular substance in a solution. One milligram per liter (1 mg/L) is equivalent to one thousand micrograms per liter (1000 mg/L); therefore, a solution with a concentration of 5 mg/L is more concentrated than a solution with a concentration of 5 ug/L.

After the Volatile Organic and Semivolatile Organic results, there is a section entitled Volatile Surrogate Recovery and Semivolatile Surrogate Recovery, respectively. Surrogates are organic compounds which are similar to analytes of interest in chemical composition, extraction, and chromatography, but which are not normally found in environmental samples. These compounds are spiked into all blanks, standards, samples and spiked samples prior to analysis. Percent recoveries are calculated for each surrogate. The surrogate compounds act as a means to measure the efficiency of the sample extraction and analysis.

The US Environmental Protection Agency has outlined certain criteria that the ABB-ES Laboratory uses for reporting sample concentrations. These criteria dictate the detection limits that laboratories should use for reporting sample results. The ABB-ES Laboratory conducts Method Detection Limit (MDL) studies and Instrument Detection Limit (IDL) studies on a regular basis. The MDL and IDL studies enable us to determine the limitations of analytical procedures as well as instrumentation. An MDL is defined as:

> "The minimum concentration of a substance that can be identified, measured, and reported with 99% confidence that the analyte concentration is greater than zero."

An IDL is defined as:

> "The smallest signal above background noise that an instrument can detect at a 99% confidence level."

Method Detection Limit or Instrument Detection Limit concentrations are then multiplied by a factor of 3 (three) to 10 (ten) to determine what the Practical Quantitation Limit (PQL) is for a particular analysis. A PQL is defined as:

> "The lowest level that can be reliably determined within specified limits of precision and accuracy during routine laboratory operating conditions."

REFERENCE GUIDE TO LABORATORY REPORT OF ANALYSIS

All parameters on this Report of Analysis are reported based upon PQLs except for the Volatile Organic Analysis results. The Volatile Organic Analysis results are reported based upon MDLs so that ABB-ES reporting limits comply with Massachusetts Department of Environmental Protection drinking water limits. If a result is reported with a "<" sign, then the compound was not detected in the sample above the PQL or, in the case of Volatile Organics, the MDL.

As part of the standard operating procedures of the ABB-ES Laboratory, contaminant-free water is analyzed as a sample concurrently with a set of samples. This reagent-free water sample is called a method blank. A "B" notation signifies that the compound reported was also detected in its corresponding method blank. There are certain compounds that occur as common laboratory contaminants that may be detected in the method blank. It is standard policy for the laboratory to reanalyze a sample if a compound that is not a common laboratory contaminant is detected in the method blank.

For Volatile Organic and Semivolatile Organic analyses, it is common for most laboratories to report values that are below the PQL. These values are notated with a "J". The "J" notation signifies that the parameter was detected and that the value reported is an estimated value because it is below the PQL.

The ABB-ES Laboratory will notate other sample results based upon Quality Control criteria to which the laboratory adheres. Non-standard quality control results are notated on the Report of Analysis. This notation will give a brief explanation of the impact of these quality control results on the actual sample results.

ABB

ASEA BROWN BOVERI

US PRIMARY AND SECONDARY DRINKING WATER REGULATIONS

PARAMETER	*PRIMARY MCL (mg/L)*	*SECONDARY MCL (mg/L)*
Arsenic, total	0.05	
Barium, total	1	
Benzene	0.005	
gamma-BHC (Lindane)	0.0004	
Bromobenzene	U	
Bromochloromethane	U	
Bromodichloromethane	*	
Bromoform	*	
Bromomethane	U	
n-Butylbenzene	U	
sec-Butylbenzene	U	
tert-Butylbenzene	U	
Cadmium, total	0.010	
Carbon tetrachloride	0.005	
Chloride	U	250
Chlorobenzene	U	
Chloroethane	U	
Chloroform	*	
Chloromethane	U	
2-Chlorotoluene	U	
4-Chlorotoluene	U	
Chromium, total	0.05	
Chromium, hexavalent	0.05	
Coliform, fecal	1/100 mL	
Coliform, total	1/100 mL	
Color		15 color units
Copper, total		1
Corrosivity		noncorrosive
2,4-D	0.1	
1,2-Dibromo-3-chloropropane	U	
Dibromochloromethane	*	
1,2-Dibromoethane	U	
Dibromomethane	U	
1,2-Dichlorobenzene	U	
1,3-Dichlorobenzene	U	

MCL = Maximum Contaminant Level

U = Unregulated parameter.

Reference list: USEPA, "Fact Sheet, Drinking Water Regulations Under the Safe Drinking Water Act," February 1989. SDWA = Safe Drinking Water Act.

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US PRIMARY AND SECONDARY DRINKING WATER REGULATIONS

PARAMETER	*PRIMARY MCL (mg/L)*	*SECONDARY MCL (mg/L)*
1,4-Dichlorobenzene	0.075	
Dichlorodifluoromethane	U	
1,1-Dichloroethane	U	
1,2-Dichloroethane	0.005	
1,1-Dichloroethene	0.007	
cis-1,2-Dichloroethene	U	
trans-1,2-Dichloroethene	U	
1,2-Dichloropropane	U	
1,3-Dichloropropane	U	
2,2-Dichloropropane	U	
1,1-Dichloropropene	U	
cis-1,3-Dichloropropene	U	
trans-1,3-Dichloropropene	U	
Endrin	0.0002	
Ethylbenzene	U	
Fluoride, soluble	4.0	2.0
Hexachlorobutadiene	U	
Iron, total	U	0.3
Isopropylbenzene	U	
4-Isopropyltoluene	U	
Langelier saturation index	U	
Lead, total	0.05	
Manganese, total	U	0.05
Mercury, total	0.002	
Methoxychlor	0.1	
Methylene chloride	U	
Naphthalene	U	
Nitrate, (as N)	10	
Odor		3 TON
pH		6.5-8.5
n-Propylbenzene	U	
Radioactivity, total alpha	15 pCi/L	
Radioactivity, total beta	4 mrem	
Radium 226, total	5 pCi/L	
Radium, 228	5 pCi/L	

MCL = Maximum Contaminant Level

U = Unregulated parameter.

Reference list: USEPA, "Fact Sheet, Drinking Water Regulations Under the Safe Drinking Water Act," February 1989. SDWA = Safe Drinking Water Act.

US PRIMARY AND SECONDARY DRINKING WATER REGULATIONS

PARAMETER	*PRIMARY MCL (mg/L)*	*SECONDARY MCL (mg/L)*
Selenium, total	0.01	
Silver, total	0.05	
Sodium, total	20.0	
Styrene	U	
Sulfate (as SO4)		250
Surfactants		2
1,1,1,2-Tetrachloroethane	U	
1,1,2,2-Tetrachloroethane	U	
Tetrachloroethene	U	
Toluene	U	
Total dissolved solids (TDS)		500
Toxaphene	0.005	
2,4,5-TP (Silvex)	0.01	
1,2,3-Trichlorobenzene	U	
1,2,4-Trichlorobenzene	U	
1,1,1-Trichloroethane	0.20	
1,1,2-Trichloroethane	U	
Trichloroethene	0.005	
Trichlorofluoromethane	U	
1,2,3-Trichloropropane	U	
Trihalomethanes (chloroform, bromoform,	0.10	
bromodichloromethane, dibromochloromethane) *		
1,2,4-Trimethylbenzene	U	
1,3,5-Trimethylbenzene	U	
Turbidity	1-5 ntu	
Vinyl chloride	0.002	
m-Xylene	U	
o-Xylene	U	
p-Xylene	U	
Zinc, total		5

MCL = Maximum Contaminant Level

U = Unregulated parameter.

Reference list: USEPA, "Fact Sheet, Drinking Water Regulations Under the Safe Drinking Water Act," February 1989. SDWA = Safe Drinking Water Act.

ABB Environmental Services, Inc.
Analytical Laboratory
Westbrook, Maine

GENERAL CHEMICAL ANALYSES - AQUEOUS MATRIX

PARAMETER	*METHOD*	*PQL*
Acidity	305.1	10 mg/L
Alkalinity-Manual Titrimetric	310.1	20 mg/L
Bicarbonate, Carbonate (see pH & alkalinity)	calc.	mg/L
Biochemical Oxygen Demand-Carbonaceous	405.1	6 mg/L
Biochemical Oxygen Demand-Total	405.1	6 mg/L
Chemical Oxygen Demand-Manual Colorimetric	410.4	15 mg/L
Chloride-Automated Ferricyanide	325.2	2 mg/L
Chlorine, Total Residual	330.5	0.1 mg/L
Coliform, Fecal	APHA 909C	1/100 mL
Coliform, Total	APHA 909A	1/100 mL
Color, True	110.2	5 PTCO
Color, Apparent	110.2	5 PTCO
Corrosivity-NACE Standard TM-01-69	1110	10 mpy
Cyanide, Total-Spectrophotometric	335.2	20 ug/L
Cyanide, Amenable-Spectrophotometric	335.1	20 ug/L
Dissolved Oxygen(Laboratory)-Membrane Electrode	360.1	1 mg/L
Fluoride, Potentiometric ISE	340.2	0.2 mg/L
Fluoride with distillation, Potentiometric ISE	340.1/340.2	0.2 mg/L
Hardness, Total-Manual Titrimetric	130.2	5 mg/L
Ignitability-Flash Point (closed cup)	1010	25 Degrees Celsius
MBAS, Extraction-Colorimetric	425.1	0.04 mg/L
Ammonia-Nitrogen-Automated Phenate	350.1	0.1 mg/L
Organic Nitrogen-Auto. Block Digest.,Spectro.	350.1/351.2	0.1 mg/L
Total Kjeldahl Nitrogen-Auto Block Digest,Spect	351.2	0.1 mg/L
Nitrate+Nitrite-Automated Cadmium Reduction	353.2	0.05 mg/L
Nitrate-Automated Cadmium Red./Diazotization	353.2/354.1	0.05 mg/L
Nitrite-Automated Diazotization	354.1	0.05 mg/L
Oil & Grease-Total Recoverable, Gravimetric	413.1	5 mg/L
Oil & Grease-Total Recoverable, Infrared	413.2	1.5 mg/L
Oil & Grease-Hydrocarbons,Grav./Solvent Extract	APHA 503E	5 mg/L
pH (Laboratory)	150.1	—
Phenolics, Total Recoverable-Manual 4AAP	420.1	5 ug/L
Phosphate,Total-Auto Ascorbic Acid/Block Digestion	365.4	0.1 mg/L
Phosphate, Ortho-Auto. Ascorbic Acid	365.1	0.05 mg/L
Silica-Manual Molybdosilicate	370.1	1 mg/L
Solids-Nonfilterable Residue (TSS)	160.2	4 mg/L
Solids-Volatile Nonfilterable Residue (VSS)	160.2/160.4	10 mg/L

PQL = Practical Quantitation Limit represents the normally obtainable measurement level achieved by the laboratory und routine laboratory conditions for a variety of sample matrices. Sample-specific reporting limits may vary from the labor as a result sample matrix and compound concentration.

ABB Environmental Services, Inc.
Analytical Laboratory
Westbrook, Maine

GENERAL CHEMICAL ANALYSES - AQUEOUS MATRIX

PARAMETER	*METHOD*	*PQL*
Solids-Filterable Residue (TDS),Gravimetric 180	160.1	10 mg/L
Solids-Volatile Filterable Residue (VDS)	160.1/160.4	10 mg/L
Solids-Settleable Solids (SS)	160.5	0.2 mL/L
Solids-Total Solids	160.3	10 mg/L
Specific Conductance-Wheatstone Bridge	120.1	umhos/cm
Sulfate-Turbidimetric	375.4	1 mg/L
Sulfite-Titrimetric	377.1	3 mg/L
Sulfide-Iodometric	376.1	1 mg/L
Sulfide-Monier-Williams	40CFR-425	0.5 mg/L
Sulfide-Reactive	7.3.4.1	
Tannin/Lignin-Colorimetric	APHA 513	1 mg/L
Total Organic Carbon-Oxidation	415.1	1 mg/L
Total Inorganic Carbon	415.1	1 mg/L
Total Organic Halogen	9020	mg/L
Total Petroleum Hydrocarbons-Extraction, IR	418.1	1 mg/L
Turbidity	180.1	1 NTU

PQL = Practical Quantitation Limit represents the normally obtainable measurement level achieved by the laboratory und routine laboratory conditions for a variety of sample matrices. Sample-specific reporting limits may vary from the labor as a result sample matrix and compound concentration.

ABB Environmental Services, Inc.
Analytical Laboratory
Westbrook, Maine

ELEMENTAL ANALYSES - AQUEOUS MATRIX

PARAMETER	*METHOD*	*PQL*
Aluminum-ICP	200.7/6010	0.100 mg/L
Antimony-Furnace AA	204.2/7041	0.005 mg/L
Arsenic-Furnace AA	206.2/7060	0.005 mg/L
Barium-ICP	200.7/6010	0.005 mg/L
Beryllium-ICP	200.7/6010	0.015 mg/L
Boron-ICP	200.7/6010	0.025 mg/L
Cadmium-Furnace AA	213.2	0.002 mg/L
Calcium-ICP	200.7/6010	0.025 mg/L
Chromium-ICP	200.7/6010	0.015 mg/L
Chromium, Hexavalent-Colorimetric	7196	0.010 mg/L
Cobalt-ICP	200.7/6010	0.015 mg/L
Copper-ICP	200.7/6010	0.025 mg/L
Gold-ICP	200.7/6010	0.100 mg/L
Iron-ICP	200.7/6010	0.025 mg/L
Lead-ICP	200.7/6010	0.100 mg/L
Lead-Furnace AA	239.2/7421	0.005 mg/L
Magnesium-ICP	200.7/6010	0.050 mg/L
Manganese-ICP	200.7/6010	0.010 mg/L
Mercury-CVAA	245.1/7470	0.20 ug/L
Molybdenum-ICP	200.7/6010	0.020 mg/L
Nickel-ICP	200.7/6010	0.040 mg/L
Platinum-Furnace AA	255.2	0.005 mg/L
Potassium-Flame AA	258.1	0.025 mg/L
Potassium-ICP	200.7/6010	0.500 mg/L
Selenium-Furnace AA	270.2/7740	0.005 mg/L
Silver-ICP	200.7/6010	0.015 mg/L
Sodium-ICP	200.7/6010	0.050 mg/L
Thallium-Furnace AA	279.2/7841	0.005 mg/L
Tin-ICP	200.7/6010	0.100 mg/L
Titanium-ICP	200.7/6010	0.100 mg/L
Vanadium-ICP	200.7/6010	0.025 mg/L
Zinc-ICP	200.7/6010	0.025 mg/L

PQL = Practical Quantitation Limit represents the normally obtainable measurement level achieved by the laboratory under practical routine laboratory conditions for a variety of sample matrices. Sample-specific reporting limits may vary from the laboratory PQL as a result of sample matrix and compound concentration.

ICP = Inductively Coupled Plasma

AA = Atomic Absorption

ABB Environmental Services, Inc.
Analytical Laboratory
Westbrook, Maine

ANALYTICAL METHOD INFORMATION

PARAMETER: ETHYLENE DIBROMIDE/1,2-DIBROMO-3-CHLOROPROPANE

METHOD: GC/ECD

MATRIX: AQUEOUS

Compound	*Practical Quantitation Limit (PQL) (ug/L)*
Ethylene dibromide	0.2
1,2-Dibromo-3-chloropropane	0.5

PQL = Practical Quantitation Limit represents the normally obtainable measurement level achieved by the laboratory under practical and routine laboratory conditions for a variety of sample matrices. Sample-specific reporting limits may vary from the standard PQL as a result of sample matrix and compound concentrations.

ABB Environmental Services, Inc.
Analytical Laboratory
Westbrook, Maine

ANALYTICAL METHOD INFORMATION
PARAMETER: SDWA PESTICIDES
METHOD: 608
MATRIX: AQUEOUS

COMPOUND	*PQL (ug/L)*
Endrin	1
Lindane	1
Methoxychlor	1
Toxaphene	1

PARAMETER: SDWA HERBICIDES
METHOD: SM509B
MATRIX: AQUEOUS

COMPOUND	*PQL (ug/L)*
2,4-D	10
2,4,5-TP (Silvex)	1

PQL = Practical Quantitation Limit represents the normally obtainable measurement level achieved by the laboratory under practical and routine laboratory conditions for a variety of sample matrices. Sample-specific reporting limits may vary from the standard PQL as a result of sample matrix and compound concentration.

ABB Environmental Services, Inc.
Analytical Laboratory
Westbrook, Maine

ANALYTICAL METHOD INFORMATION
PARAMETER: DRINKING WATER VOLATILE ORGANICS
METHOD: 524.2
MATRIX: AQUEOUS

Compound	*Minimum Detection Limit (MDL) (ug/L)*
Benzene	0.08
Bromobenzene	0.05
Bromochloromethane	0.16
Bromodichloromethane	0.21
Bromoform	0.17
Bromomethane	0.16
n-Butylbenzene	0.08
sec-Butylbenzene	0.05
tert-Butylbenzene	0.06
Carbon tetrachloride	0.12
Chlorobenzene	0.05
Chloroethane	0.13
Chloroform	0.16
Chloromethane	0.18
2-Chlorotoluene	0.11
4-Chlorotoluene	0.10
Dibromochloromethane	0.19
1,2-Dibromo-3-chloropropane	0.85
1,2-Dibromoethane	0.11
Dibromomethane	0.18
1,2-Dichlorobenzene	0.10
1,3-Dichlorobenzene	0.10
1,4-Dichlorobenzene	0.10
Dichlorodifluoromethane	0.21
1,1-Dichloroethane	0.11
1,2-Dichloroethane	0.10
1,1-Dichloroethene	0.19
cis-1,2-Dichloroethene	0.22
trans-1,2-Dichloroethene	0.20
1,2-Dichloropropane	0.12
1,3-Dichloropropane	0.14
2,2-Dichloropropane	0.27
1,1-Dichloropropene	0.12
cis-1,3-Dichloropropene	0.14
trans-1,3-Dichloropropene	0.11
Ethylbenzene	0.10

MDL = The Minimum Detection Limit is the minimum concentration of a substance that can be identified, measured, and reported with 99% confidence that the analyte concentration is greater than zero.

ABB Environmental Services, Inc.
Analytical Laboratory
Westbrook, Maine

ANALYTICAL METHOD INFORMATION
PARAMETER: DRINKING WATER VOLATILE ORGANICS
METHOD: 524.2
MATRIX: AQUEOUS

Compound	*Minimum Detection Limit (MDL) (ug/L)*
Hexachlorobutadiene	0.12
Isopropylbenzene	0.04
4-Isopropyltoluene	0.08
Methylene chloride	0.24
Naphthalene	0.21
n-Propylbenzene	0.07
Styrene	0.12
1,1,1,2-Tetrachloroethane	0.11
1,1,2,2-Tetrachloroethane	0.17
Tetrachloroethene	0.04
Toluene	0.13
1,2,3-Trichlorobenzene	0.11
1,2,4-Trichlorobenzene	0.06
1,1,1-Trichloroethane	0.10
1,1,2-Trichloroethane	0.20
Trichloroethene	0.10
Trichlorofluoromethane	0.13
1,2,3-Trichloropropane	0.18
1,2,4-Trimethylbenzene	0.08
1,3,5-Trimethylbenzene	0.07
Vinyl chloride	0.25
o-Xylene	0.16
m-Xylene	0.22
p-Xylene	0.22

MDL = The Minimum Detection Limit is the minimum concentration of a substance that can be identified, measured, and reported with 99% confidence that the analyte concentration is greater than zero.

ABB Environmental Services, Inc.
Analytical Laboratory
Westbrook, Maine

ANALYTICAL METHOD INFORMATION
PARAMETER: SEMIVOLATILE PRIORITY POLLUTANT VOLATILE ORGANIC
METHOD: 625/8270
MATRIX: AQUEOUS

Compound	*Practical Quantitation Limit (PQL) (ug/L)*
Benzo(B)Fluoranthene	10
Benzo(K)Fluoranthene	10
Chrysene	10
Benzo(A)Anthracene	10
Anthracene	10
Phenanthrene	10
Acenaphthylene	10
Acenaphthene	10
Benzo(A)Pyrene	10
Bis(2-Chloroethyl)Ether	10
Bis(2-Chloroethoxy)Methane	10
Bis(2-Chloroisopropyl)Ether	10
Butyl Benzyl Phthalate	10
Diethylphthalate	10
Dimethylphthalate	10
Fluoranthene	10
Fluorene	10
Hexachlorocyclopentadiene	10
Hexachlorobutadiene	10
Hexachloroethane	10
Indeno(1,2,2-CD)Pyrene	10
Isophorone	10
N-Nitrosodi-n-Propylamine	10
N-Nitrosodiphenylamine	10
N-Nitrosodimethylamine	10
Nitrobenzene	10
4-Chloro-3-methylphenol	10
Pyrene	10
Benzo(GHI)perylene	10

PQL = Practical Quantitation Limit represents the normally obtainable measurement level achieved by the laboratory under practical and routine laboratory conditions for a variety of sample matrices. Sample-specific reporting limits may vary from the standard PQL as a result of sample matrix and compound concentrations.

ABB Environmental Services, Inc.
Analytical Laboratory
Westbrook, Maine

ANALYTICAL METHOD INFORMATION
PARAMETER: SEMIVOLATILE PRIORITY POLLUTANT VOLATILE ORGANICS
METHOD: 625/8270
MATRIX: AQUEOUS

Compound	*Practical Quantitation Limit (PQL) (ug/L)*
1,2-Dichlorobenzene	10
1,2,4-Trichlorobenzene	10
Dibenzo(A,H)Anthracene	10
1,3-Dichlorobenzene	10
1,4-Dichlorobenzene	10
2-Chloronaphthalene	10
2-Chlorophenol	10
2-Nitrophenol	10
Di-n-octylphthalate	10
2,4-Dichlorophenol	10
2,4-Dimethylphenol	10
2,4-Dinitrotoluene	10
2,4-Dinitrophenol	50
2,4,6-Trichlorophenol	10
2,6-Dinitrotoluene	10
3,3-Dichlorobenzidine	20
4-Bromophenyl Phenyl Ether	10
4-Chlorophenyl Phenyl Ether	10
4-Nitrophenol	50
2-Methyl-4,6-Dinitrophenol	50
Phenol	10
Naphthalene	10
Pentachlorophenol	50
Bis(2-Ethylhexyl)Phthalate	10
Di-n-Butylphthalate	10
Benzidine	50
Hexachlorobenzene	10
1,2-Diphenyldrazine	10

PQL = Practical Quantitation Limit represents the normally obtainable measurement level achieved by the laboratory under practical and routine laboratory conditions for a variety of sample matrices. Sample-specific reporting limits may vary from the standard PQL as a result of sample matrix and compound concentrations.

REFERENCE GUIDE TO LABORATORY REPORT OF ANALYSIS

The attached Report of Analysis summarizes the analytical results for your drinking water sample. The ABB-ES Laboratory reports results using industry-accepted protocols as well as some unique reporting protocols that are designed to present a comprehensive Report of Analysis.

All sample results are reported in concentration units of ug/L (micrograms per liter) or mg/L (milligrams per liter). These units are used to express the concentration of a particular substance in a solution. One milligram per liter (1 mg/L) is equivalent to one thousand micrograms per liter (1000 mg/L); therefore, a solution with a concentration of 5 mg/L is more concentrated than a solution with a concentration of 5 ug/L.

After the Volatile Organic and Semivolatile Organic results, there is a section entitled Volatile Surrogate Recovery and Semivolatile Surrogate Recovery, respectively. Surrogates are organic compounds which are similar to analytes of interest in chemical composition, extraction, and chromatography, but which are not normally found in environmental samples. These compounds are spiked into all blanks, standards, samples and spiked samples prior to analysis. Percent recoveries are calculated for each surrogate. The surrogate compounds act as a means to measure the efficiency of the sample extraction and analysis.

The US Environmental Protection Agency has outlined certain criteria that the ABB-ES Laboratory uses for reporting sample concentrations. These criteria dictate the detection limits that laboratories should use for reporting sample results. The ABB-ES Laboratory conducts Method Detection Limit (MDL) studies and Instrument Detection Limit (IDL) studies on a regular basis. The MDL and IDL studies enable us to determine the limitations of analytical procedures as well as instrumentation. An MDL is defined as:

> "The minimum concentration of a substance that can be identified, measured, and reported with 99% confidence that the analyte concentration is greater than zero."

An IDL is defined as:

> "The smallest signal above background noise that an instrument can detect at a 99% confidence level."

Method Detection Limit or Instrument Detection Limit concentrations are then multiplied by a factor of 3 (three) to 10 (ten) to determine what the Practical Quantitation Limit (PQL) is for a particular analysis. A PQL is defined as:

> "The lowest level that can be reliably determined within specified limits of precision and accuracy during routine laboratory operating conditions."

REFERENCE GUIDE TO LABORATORY REPORT OF ANALYSIS

All parameters on this Report of Analysis are reported based upon PQLs except for the Volatile Organic Analysis results. The Volatile Organic Analysis results are reported based upon MDLs so that ABB-ES reporting limits comply with Massachusetts Department of Environmental Protection drinking water limits. If a result is reported with a " < " sign, then the compound was not detected in the sample above the PQL or, in the case of Volatile Organics, the MDL.

As part of the standard operating procedures of the ABB-ES Laboratory, contaminant-free water is analyzed as a sample concurrently with a set of samples. This reagent-free water sample is called a method blank. A "B" notation signifies that the compound reported was also detected in its corresponding method blank. There are certain compounds that occur as common laboratory contaminants that may be detected in the method blank. It is standard policy for the laboratory to reanalyze a sample if a compound that is not a common laboratory contaminant is detected in the method blank.

For Volatile Organic and Semivolatile Organic analyses, it is common for most laboratories to report values that are below the PQL. These values are notated with a "J". The "J" notation signifies that the parameter was detected and that the value reported is an estimated value because it is below the PQL.

The ABB-ES Laboratory will notate other sample results based upon Quality Control criteria to which the laboratory adheres. Non-standard quality control results are notated on the Report of Analysis. This notation will give a brief explanation of the impact of these quality control results on the actual sample results.

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US PRIMARY AND SECONDARY DRINKING WATER REGULATIONS

PARAMETER	*PRIMARY MCL (mg/L)*	*SECONDARY MCL (mg/L)*
Arsenic, total	0.05	
Barium, total	1	
Benzene	0.005	
gamma-BHC (Lindane)	0.0004	
Bromobenzene	U	
Bromochloromethane	U	
Bromodichloromethane	*	
Bromoform	*	
Bromomethane	U	
n-Butylbenzene	U	
sec-Butylbenzene	U	
tert-Butylbenzene	U	
Cadmium, total	0.010	
Carbon tetrachloride	0.005	
Chloride	U	250
Chlorobenzene	U	
Chloroethane	U	
Chloroform	*	
Chloromethane	U	
2-Chlorotoluene	U	
4-Chlorotoluene	U	
Chromium, total	0.05	
Chromium, hexavalent	0.05	
Coliform, fecal	1/100 mL	
Coliform, total	1/100 mL	
Color		15 color units
Copper, total		1
Corrosivity		noncorrosive
2,4-D	0.1	
1,2-Dibromo-3-chloropropane	U	
Dibromochloromethane	*	
1,2-Dibromoethane	U	
Dibromomethane	U	
1,2-Dichlorobenzene	U	
1,3-Dichlorobenzene	U	

MCL = Maximum Contaminant Level

U = Unregulated parameter.

Reference list: USEPA, "Fact Sheet, Drinking Water Regulations Under the Safe Drinking Water Act," February 1989. SDWA = Safe Drinking Water Act.

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US PRIMARY AND SECONDARY DRINKING WATER REGULATIONS

PARAMETER	*PRIMARY MCL (mg/L)*	*SECONDARY MCL (mg/L)*
1,4-Dichlorobenzene	0.075	
Dichlorodifluoromethane	U	
1,1-Dichloroethane	U	
1,2-Dichloroethane	0.005	
1,1-Dichloroethene	0.007	
cis-1,2-Dichloroethene	U	
trans-1,2-Dichloroethene	U	
1,2-Dichloropropane	U	
1,3-Dichloropropane	U	
2,2-Dichloropropane	U	
1,1-Dichloropropene	U	
cis-1,3-Dichloropropene	U	
trans-1,3-Dichloropropene	U	
Endrin	0.0002	
Ethylbenzene	U	
Fluoride, soluble	4.0	2.0
Hexachlorobutadiene	U	
Iron, total	U	0.3
Isopropylbenzene	U	
4-Isopropyltoluene	U	
Langelier saturation index	U	
Lead, total	0.05	
Manganese, total	U	0.05
Mercury, total	0.002	
Methoxychlor	0.1	
Methylene chloride	U	
Naphthalene	U	
Nitrate, (as N)	10	
Odor		3 TON
pH		6.5-8.5
n-Propylbenzene	U	
Radioactivity, total alpha	15 pCi/L	
Radioactivity, total beta	4 mrem	
Radium 226, total	5 pCi/L	
Radium, 228	5 pCi/L	

MCL = Maximum Contaminant Level

U = Unregulated parameter.

Reference list: USEPA, "Fact Sheet, Drinking Water Regulations Under the Safe Drinking Water Act," February 1989. SDWA = Safe Drinking Water Act.

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US PRIMARY AND SECONDARY DRINKING WATER REGULATIONS

PARAMETER	*PRIMARY MCL (mg/L)*	*SECONDARY MCL (mg/L)*
Selenium, total	0.01	
Silver, total	0.05	
Sodium, total	20.0	
Styrene	U	
Sulfate (as SO4)		250
Surfactants		2
1,1,1,2-Tetrachloroethane	U	
1,1,2,2-Tetrachloroethane	U	
Tetrachloroethene	U	
Toluene	U	
Total dissolved solids (TDS)		500
Toxaphene	0.005	
2,4,5-TP (Silvex)	0.01	
1,2,3-Trichlorobenzene	U	
1,2,4-Trichlorobenzene	U	
1,1,1-Trichloroethane	0.20	
1,1,2-Trichloroethane	U	
Trichloroethene	0.005	
Trichlorofluoromethane	U	
1,2,3-Trichloropropane	U	
Trihalomethanes (chloroform, bromoform,	0.10	
bromodichloromethane, dibromochloromethane) *		
1,2,4-Trimethylbenzene	U	
1,3,5-Trimethylbenzene	U	
Turbidity	1-5 ntu	
Vinyl chloride	0.002	
m-Xylene	U	
o-Xylene	U	
p-Xylene	U	
Zinc, total		5

MCL = Maximum Contaminant Level

U = Unregulated parameter.

Reference list: USEPA, "Fact Sheet, Drinking Water Regulations Under the Safe Drinking Water Act," February 1989. SDWA = Safe Drinking Water Act.

ANALYSIS REQUEST FORM

Date Received [illegible]
Lab Location [illegible]
Results Due [illegible]
Client I.D. No. [illegible] 27115

☐ Solid Waste Data File
☐ Data Documentation Req'd
☐ Entered in Computer

Type of Sample [illegible]
List Any Hazards [illegible]

SPECIAL PROCEDURE ☐

☐ Filtered in Field ☑ Non-Filtered

Additional Information or Special Procedures
[illegible] MADEP
[illegible] parameters [illegible]
[illegible]
[illegible] DUP [illegible]
[illegible] dates
[illegible] 041991 [illegible]
[illegible] 041991 [illegible]/MS [illegible]

Client Information: Name [illegible]
Company [illegible]
Mailing Adddress

Purchase Order/Job Number [illegible]

Where to Send Report ☑ Directly to Client
☐ ABB - Name

Analyses Requested By: Technical Project Professional

Approved By: Project Manager

Sample Identification	Lab Numbers	Date Sampled	Sampled By	Analyses Required
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
				[illegible] VOA [illegible]
				[illegible] pH, TDS, TKN, [illegible] Metals [illegible]
				[illegible] Cd, [illegible] Tl [illegible] Ni, Ag, Zn, [illegible] Al, Mn [illegible]
				VOA [illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	↓
[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	
[illegible]	[illegible]	[illegible]	[illegible]	↓
[illegible]	[illegible]	[illegible]	[illegible]	LW VOA (524.2 - ML) [illegible]

RUSH

[illegible]

OH-62

ABB Environmental Services, Inc.

Page 1 of 1

Client: Olin Chemical, Sample Numbers: 91259009-016

ANALYSIS AND QUALITY CONTROL DOCUMENTATION

Prepared By:

ABB ENVIRONMENTAL
ANALYTICAL LABORATORY SERVICES DIVISION
PORTLAND, MAINE

26-Sep-91

Reviewed and Approved by: Julie Ricardi
Laboratory Quality Assurance: Julie Ricardi

ABB Environmental
Analytical Laboratory Services Division
Quality Control Report

MA DEP QC REPORT

MA DEP QC Report documentation consists of the following components for specific types of analyses:

Section	Type of Documentation
INORGANIC ANALYSES FOR METALS	
o	METHODS AND CHRONOLOGY OF ANALYSIS
o	METHOD BLANK AND LABORATORY CONTROL SAMPLE RESULTS
o	DUPLICATE AND MATRIX SPIKE/MATRIX SPIKE DUPLICATE RESULTS
o	SUMMARY REPORT
INORGANIC ANALYSES FOR NON-METALS	
o	METHODS AND CHRONOLOGY OF ANALYSIS
o	METHOD BLANK AND LABORATORY CONTROL SAMPLE RESULTS
o	DUPLICATE AND MATRIX SPIKE/MATRIX SPIKE DUPLICATE RESULTS
o	SUMMARY REPORT
ORGANIC ANALYSES BY GC	
o	METHODS, CHRONOLOGY OF ANALYSIS AND METHOD BLANK RESULTS
o	LABORATORY CONTROL SAMPLE RESULTS
o	SAMPLE DUPLICATE RESULTS
o	MATRIX SPIKE RESULTS
ORGANIC ANALYSES BY GC/MS	
o	METHODS, CHRONOLOGY OF ANALYSIS AND METHOD BLANK RESULTS
o	LABORATORY CONTROL SAMPLE RESULTS
o	SAMPLE DUPLICATE RESULTS
o	MATRIX SPIKE RESULTS

ABB Environmental
Analytical Laboratory Services Division
Quality Control Report

MA DEP QC REPORT

MA DEP QC Report documentation consists of the following components for specific types of analyses:

Section	Type of Documentation
CHAIN OF CUSTODY	
	o ANALYSIS REQUEST FORMS
	o CHAIN OF CUSTODY RECORDS
	o SAMPLE RECEIVING DOCUMENTATION
	o CORRESPONDENCE

ABB Environmental
Analytical Laboratory Services Division
Quality Control Report

Methods and Chronology of Analysis

METHODS OF ANALYSIS			CHRONOLOGY OF ANALYSES				
Parameter	Method No.	Description	ABB Environmental Sample Nos.	Date Sample Received	Date of Sample Chemical Preparation	Date of Instrument Analysis	Dilution Factor *
Aluminum	200.7	Atomic Emission, Inductively Coupled Plasma	91259009	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259010	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259011	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259012	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259013	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259014	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259015	16-Sep-91	17-Sep-91	18-Sep-91	1.0
Barium	200.7	Atomic Emission, Inductively Coupled Plasma	91259009	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259010	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259011	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259012	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259013	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259014	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259015	16-Sep-91	17-Sep-91	18-Sep-91	1.0
Beryllium	200.7	Atomic Emission, Inductively Coupled Plasma	91259009	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259010	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259011	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259012	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259013	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259014	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259015	16-Sep-91	17-Sep-91	18-Sep-91	1.0
Chromium	200.7	Atomic Emission, Inductively Coupled Plasma	91259009	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259010	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259011	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259012	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259013	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259014	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259015	16-Sep-91	17-Sep-91	18-Sep-91	1.0

ABB Environmental
Analytical Laboratory Services Division
Quality Control Report

Methods and Chronology of Analysis

METHODS OF ANALYSIS			CHRONOLOGY OF ANALYSES				
Parameter	Method No.	Description	ABB Environmental Sample Nos.	Date Sample Received	Date of Sample Chemical Preparation	Date of Instrument Analysis	Dilution Factor *
Copper	200.7	Atomic Emission, Inductively Coupled Plasma	91259009	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259010	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259011	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259012	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259013	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259014	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259015	16-Sep-91	17-Sep-91	18-Sep-91	1.0
Iron	200.7	Atomic Emission, Inductively Coupled Plasma	91259009	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259010	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259011	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259012	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259013	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259014	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259015	16-Sep-91	17-Sep-91	18-Sep-91	1.0
Manganese	200.7	Atomic Emission, Inductively Coupled Plasma	91259009	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259010	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259011	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259012	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259013	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259014	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259015	16-Sep-91	17-Sep-91	18-Sep-91	1.0
Nickel	200.7	Atomic Emission, Inductively Coupled Plasma	91259009	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259010	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259011	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259012	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259013	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259014	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259015	16-Sep-91	17-Sep-91	18-Sep-91	1.0

ABB Environmental
Analytical Laboratory Services Division
Quality Control Report

Methods and Chronology of Analysis

METHODS OF ANALYSIS			CHRONOLOGY OF ANALYSES				
Parameter	Method No.	Description	ABB Environmental Sample Nos.	Date Sample Received	Date of Sample Chemical Preparation	Date of Instrument Analysis	Dilution Factor *
Silver	200.7	Atomic Emission, Inductively Coupled Plasma	91259009	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259010	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259011	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259012	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259013	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259014	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259015	16-Sep-91	17-Sep-91	18-Sep-91	1.0
Sodium	200.7	Atomic Emission, Inductively Coupled Plasma	91259009	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259010	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259011	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259012	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259013	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259014	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259015	16-Sep-91	17-Sep-91	18-Sep-91	1.0
Zinc	200.7	Atomic Emission, Inductively Coupled Plasma	91259009	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259010	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259011	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259012	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259013	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259014	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259015	16-Sep-91	17-Sep-91	18-Sep-91	1.0
Antimony	204.2	Atomic Absorption, Graphite Furnace	91259009	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259010	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259011	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259012	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259013	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259014	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259015	16-Sep-91	17-Sep-91	18-Sep-91	1.0

ABB Environmental
Analytical Laboratory Services Division
Quality Control Report

Methods and Chronology of Analysis

METHODS OF ANALYSIS			CHRONOLOGY OF ANALYSES				
Parameter	Method No.	Description	ABB Environmental Sample Nos.	Date Sample Received	Date of Sample Chemical Preparation	Date of Instrument Analysis	Dilution Factor *
Arsenic	206.2	Atomic Absorption, Graphite Furnace	91259009	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259010	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259011	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259012	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259013	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259014	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259015	16-Sep-91	17-Sep-91	18-Sep-91	1.0
Cadmium	213.2	Atomic Absorption, Graphite Furnace	91259009	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259010	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259011	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259012	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259013	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259014	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259015	16-Sep-91	17-Sep-91	18-Sep-91	1.0
Lead	239.2	Atomic Absorption, Graphite Furnace	91259009	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259010	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259011	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259012	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259013	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259014	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259015	16-Sep-91	17-Sep-91	17-Sep-91	1.0
Selenium	270.2	Atomic Absorption, Graphite Furnace	91259009	16-Sep-91	17-Sep-91	19-Sep-91	1.0
			91259010	16-Sep-91	17-Sep-91	19-Sep-91	1.0
			91259011	16-Sep-91	17-Sep-91	19-Sep-91	1.0
			91259012	16-Sep-91	17-Sep-91	19-Sep-91	1.0
			91259013	16-Sep-91	17-Sep-91	19-Sep-91	1.0
			91259014	16-Sep-91	17-Sep-91	19-Sep-91	1.0
			91259015	16-Sep-91	17-Sep-91	19-Sep-91	1.0

ABB Environmental
Analytical Laboratory Services Division
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Methods and Chronology of Analysis

METHODS OF ANALYSIS			CHRONOLOGY OF ANALYSES				
Parameter	Method No.	Description	ABB Environmental Sample Nos.	Date Sample Received	Date of Sample Chemical Preparation	Date of Instrument Analysis	Dilution Factor *
Thallium	279.2	Atomic Absorption, Graphite Furnace	91259009	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259010	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259011	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259012	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259013	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259014	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259015	16-Sep-91	17-Sep-91	17-Sep-91	1.0
Mercury	245.1	Atomic Absorption, Manual Cold Vapor	91259009	16-Sep-91	18-Sep-91	18-Sep-91	1.0
			91259010	16-Sep-91	18-Sep-91	18-Sep-91	1.0
			91259011	16-Sep-91	18-Sep-91	18-Sep-91	1.0
			91259012	16-Sep-91	18-Sep-91	18-Sep-91	1.0
			91259013	16-Sep-91	18-Sep-91	18-Sep-91	1.0
			91259014	16-Sep-91	18-Sep-91	18-Sep-91	1.0
			91259015	16-Sep-91	18-Sep-91	18-Sep-91	1.0

Notes:
Unless otherwise indicated, analytical methods are from (1) "Methods of Chemical Analysis of Water and Wastes," EPA-600/4-79-020, Revised March, 1983, or (2) "Test Methods for Evaluating Solid Wastes," EPA SW-846, Revised November, 1986.

*The Dilution Factor (DF) indicates whether a sample, prepared in accordance with the analytical method protocol, was diluted prior to analysis. The Dilution Factor could also indicate that a smaller aliquot than specified in the method was utilized for sample preparation and analysis. For example, a dilution factor of 5 means that the sample was effectively diluted by a factor of 5 prior to analysis, i.e., the sample was analyzed at 20% its reported concentration.

ABB Environmental
Analytical Laboratory Services Division
Quality Control Report

Method Blank and Laboratory Control Sample Results

			METHOD BLANK RESULTS						LABORATORY CONTROL SAMPLE RESULTS					
Parameter	Date of Prep	Date of Analysis	Units		Concentration Measured in Blank		Acceptance Range	Practical Quantitation Level*	Units	True Value	Measured Value	Percent Recovered	Acceptance Range (%)	Acceptance Range (mg/kg)
Aluminum	17-Sep-91	18-Sep-91	mg/L	<	0.10	<	0.10	0.10	mg/L	3.00	2.88	96.0	80-120	
	17-Sep-91	18-Sep-91	mg/L	<	0.10	<	0.10	0.10	mg/L	3.00	2.94	98.0	80-120	
Barium	17-Sep-91	19-Sep-91	mg/L	<	0.005	<	0.005	0.005						
	17-Sep-91	19-Sep-91	mg/L	<	0.005	<	0.005	0.005						
	17-Sep-91	18-Sep-91							mg/L	0.300	0.294	98.0	80-120	
	17-Sep-91	18-Sep-91							mg/L	0.300	0.295	98.3	80-120	
Beryllium	17-Sep-91	18-Sep-91	mg/L	<	0.015	<	0.015	0.015	mg/L	0.100	0.093	93.0	80-120	
	17-Sep-91	18-Sep-91	mg/L	<	0.015	<	0.015	0.015	mg/L	0.100	0.095	95.0	80-120	
Chromium	17-Sep-91	18-Sep-91	mg/L	<	0.015	<	0.015	0.015	mg/L	0.300	0.300	100	80-120	
	17-Sep-91	18-Sep-91	mg/L	<	0.015	<	0.015	0.015	mg/L	0.300	0.309	103	80-120	
Copper	17-Sep-91	18-Sep-91	mg/L	<	0.025	<	0.025	0.025	mg/L	0.300	0.285	95.0	80-120	
	17-Sep-91	18-Sep-91	mg/L	<	0.025	<	0.025	0.025	mg/L	0.300	0.296	98.7	80-120	
Iron	17-Sep-91	18-Sep-91	mg/L	<	0.025	<	0.050	0.025	mg/L	12.5	12.4	99.2	80-120	
	17-Sep-91	18-Sep-91	mg/L	<	0.025	<	0.050	0.025	mg/L	12.5	12.5	100	80-120	
Manganese	17-Sep-91	18-Sep-91	mg/L	<	0.010	<	0.010	0.010	mg/L	0.200	0.195	97.5	80-120	
	17-Sep-91	18-Sep-91	mg/L	<	0.010	<	0.010	0.010	mg/L	0.200	0.197	98.5	80-120	
Nickel	17-Sep-91	18-Sep-91	mg/L	<	0.040	<	0.040	0.040	mg/L	0.300	0.296	98.7	80-120	
	17-Sep-91	18-Sep-91	mg/L	<	0.040	<	0.040	0.040	mg/L	0.300	0.297	99.0	80-120	
Silver	17-Sep-91	18-Sep-91	mg/L	<	0.015	<	0.015	0.015	mg/L	0.300	0.300	100	80-120	
	17-Sep-91	18-Sep-91	mg/L	<	0.015	<	0.015	0.015	mg/L	0.300	0.300	100	80-120	
Sodium	17-Sep-91	18-Sep-91	mg/L	<	0.050	<	0.200	0.050	mg/L	2.50	2.40	96.0	80-120	
	17-Sep-91	18-Sep-91	mg/L	<	0.050	<	0.200	0.050	mg/L	2.50	2.45	98.0	80-120	
Zinc	17-Sep-91	18-Sep-91	mg/L	<	0.025	<	0.025	0.025	mg/L	0.300	0.296	98.7	80-120	
	17-Sep-91	18-Sep-91	mg/L	<	0.025	<	0.025	0.025	mg/L	0.300	0.299	99.7	80-120	
Antimony	17-Sep-91	18-Sep-91	mg/L	<	0.005	<	0.005	0.005	mg/L	0.020	0.023	115	80-120	
	17-Sep-91	18-Sep-91							mg/L	0.020	0.023	115	80-120	
Arsenic	17-Sep-91	18-Sep-91	mg/L	<	0.005	<	0.005	0.005	mg/L	0.020	0.022	110	80-120	
	17-Sep-91	19-Sep-91							mg/L	0.020	0.022	110	80-120	

ABB Environmental
Analytical Laboratory Services Division
Quality Control Report

Method Blank and Laboratory Control Sample Results

			METHOD BLANK RESULTS					LABORATORY CONTROL SAMPLE RESULTS					
Parameter	Date of Prep	Date of Analysis	Units		Concentration Measured in Blank		Acceptance Range	Practical Quantitation Level*	Units	True Value	Measured Value	Percent Recovered	Acceptance Range (%)	Acceptance Range (mg/kg)
Cadmium	17-Sep-91	18-Sep-91	mg/L	<	0.002	<	0.002	0.002	mg/L	0.010	0.011	110	80-120	
	17-Sep-91	18-Sep-91							mg/L	0.010	0.011	110	80-120	
Lead	17-Sep-91	17-Sep-91	mg/L	<	0.005	<	0.005	0.005	mg/L	0.020	0.022	110	80-120	
	17-Sep-91	17-Sep-91	mg/L	<	0.005	<	0.005	0.005	mg/L	0.020	0.020	100	80-120	
Selenium	17-Sep-91	19-Sep-91	mg/L	<	0.005	<	0.005	0.005	mg/L	0.010	0.010	100	80-120	
	17-Sep-91	19-Sep-91							mg/L	0.010	0.010	100	80-120	
Thallium	17-Sep-91	17-Sep-91	mg/L	<	0.005	<	0.005	0.005	mg/L	0.010	0.009	90.0	80-120	
	17-Sep-91	17-Sep-91							mg/L	0.010	0.009	90.0	80-120	
Mercury	18-Sep-91	18-Sep-91	ug/L	<	0.20	<	0.20	0.20	ug/L	2.00	1.70	85.0	80-120	
	18-Sep-91	18-Sep-91	ug/L	<	0.20	<	0.20	0.20	ug/L	2.00	1.65	82.5	80-120	

* Practical quantitation level is the lowest concentration measurable for samples with normal chemical and physical composition during routine laboratory operations.

DATA QUALITY COMMENTS:
Results of all quality control measurements are within the laboratory and method specified acceptance range except as noted.

ABB Environmental
Analytical Laboratory Services Division
Quality Control Report

Duplicate and Matrix Spike/Matrix Spike Duplicate Results

		DUPLICATE RESULTS						MATRIX SPIKE/MATRIX SPIKE DUPLICATE RESULTS										
	ABB		Sample				Acceptance		Concentration or Quantity				Matrix Spike Recovery (%)					
Parameter	Environmental Sample No.	Units	Measurement Rep 1	Rep 2	Mean Conc	RPD (%)	Range for RPD (%)	Units	Sample Only	Spike Added	Sample +Spike Dup 1	Sample +Spike Dup 2	Sample +Spike Dup 1	Sample +Spike Dup 2	Acceptance Range (%)	RPD (%)	Acceptance Range (%)
Aluminum	91259011	mg/L	<0.100	<0.100	<0.100	NC	0-20	mg/L	<0.100	3.00	2.92	NA	97.3	NA	80-120	NA	0-20
Barium	91259011	mg/L	0.022	0.021	0.022	4.7	0-20	mg/L	0.022	0.300	0.319	NA	99.0	NA	80-120	NA	0-20
Beryllium	91259011	mg/L	<0.015	<0.015	<0.015	NC	0-20	mg/L	<0.015	0.100	0.091	NA	91.0	NA	80-120	NA	0-20
Chromium	91259011	mg/L	<0.015	<0.015	<0.015	NC	0-20	mg/L	<0.015	0.300	0.288	NA	96.0	NA	80-120	NA	0-20
Copper	91259011	mg/L	0.038	0.043	0.041	12	0-100	mg/L	0.041	0.300	0.334	NA	97.7	NA	80-120	NA	0-20
Iron	91259011	mg/L	0.483	0.478	0.481	1.0	0-20	mg/L	0.481	12.5	12.6	NA	97.0	NA	80-120	NA	0-20
Manganese	91259011	mg/L	0.977	0.967	0.972	1.0	0-20	mg/L	0.972	0.200	1.17	NA	99.0	NA	80-120	NA	0-20
Nickel	91259011	mg/L	<0.040	<0.040	<0.040	NC	0-20	mg/L	<0.040	0.300	0.303	NA	101	NA	80-120	NA	0-20
Silver	91259011	mg/L	<0.015	<0.015	<0.015	NC	0-20	mg/L	<0.015	0.300	0.292	NA	97.3	NA	80-120	NA	0-20
Sodium	91259011	mg/L	20.2	20.3	20.3	0.5	0-20	mg/L	20.3	2.50	22.8	NA	100	NA	80-120	NA	0-20
Zinc	91259011	mg/L	<0.025	<0.025	<0.025	NC	0-20	mg/L	<0.025	0.300	0.306	NA	102	NA	80-120	NA	0-20
Antimony	91259011	mg/L	<0.005	<0.005	<0.005	NC	0-20	mg/L	<0.005	0.020	0.028	NA	140	NA	80-120	NA	0-20
Arsenic	91259011	mg/L	<0.005	<0.005	<0.005	NC	0-20	mg/L	<0.005	0.020	0.023	NA	115	NA	80-120	NA	0-20
Cadmium	91259011	mg/L	<0.002	<0.002	<0.002	NC	0-20	mg/L	<0.002	0.010	0.011	NA	110	NA	80-120	NA	0-20
Lead	91259011	mg/L	<0.005	<0.005	<0.005	NC	0-20	mg/L	<0.005	0.020	0.020	NA	100	NA	80-120	NA	0-20
Selenium	91259011	mg/L	<0.005	<0.005	<0.005	NC	0-20	mg/L	<0.005	0.010	0.012	NA	120	NA	80-120	NA	0-20
Thallium	91259011	mg/L	<0.005	<0.005	<0.005	NC	0-20	mg/L	<0.005	0.010	0.010	NA	100	NA	80-120	NA	0-20
Mercury	91259011	ug/L	<0.20	<0.20	<0.20	NC	0-20	ug/L	<0.20	2.00	1.95	NA	97.5	NA	80-120	NA	0-20

RPD = Relative percent difference, which is the absolute value of the difference between two duplicate results divided by the mean concentration then multiplied by 100%.

NA = Not applicable.

NC = Relative percent difference cannot be calculated for sample results less than the PQL.

Because of the large uncertainty (i.e., 33% or greater) associated with measurements made near the detection level, the acceptance range for relative

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Duplicate and Matrix Spike/Matrix Spike Duplicate Results

		DUPLICATE RESULTS						*MATRIX SPIKE/MATRIX SPIKE DUPLICATE RESULTS*									
	ABB		Sample				Acceptance		Concentration or Quantity				Matrix Spike Recovery (%)				
	Environmental		Measurement		Mean		Range	Units	Sample	Spike	Sample	Sample	Sample	Sample	Acceptance	RPD	Acceptance
Parameter	Sample No.	Units	Rep 1	Rep 2	Conc	RPD (%)	for RPD (%)		Only	Added	+Spike Dup 1	+Spike Dup 2	+Spike Dup 1	+Spike Dup 2	Range (%)	(%)	Range (%)

percent difference for duplicate measurements at such low concentrations is 0-100%.

DATA QUALITY COMMENTS:
Results of all quality control measurements are within the laboratory or contract specified acceptance range except as noted.

* Matrix spike recovery is outside the laboratory's specified acceptance range indicating potential sample matrix interference and potential bias of reported value for this parameter.

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Summary Report

Inorganic Laboratory Summary Report

All sample analyses for elements referenced by this Quality Control Report were routine and were conducted in accordance with appropriate analytical protocols and laboratory standard operating procedures except as noted.

ABB Environmental Sample No. 91259011
Parameter: Antimony
Description of Problem/Summary of Laboratory Actions: The antimony matrix spike recovery for this sample is 140%, which is outside the laboratory's acceptance range of 80%-120%. This may indicate the presence of a sample matrix interference and a potential bias of the reported value for this parameter.

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Methods and Chronology of Analysis

METHODS OF ANALYSIS			CHRONOLOGY OF ANALYSES				
Parameter	Method No.	Description	ABB Environmental Sample Nos.	Date Sample Received	Date of Sample Chemical Preparation	Date of Instrument Analysis	Dilution Factor *
Chloride	325.2	Colorimetric, Automated Ferricyanide	91259009	16-Sep-91	18-Sep-91	18-Sep-91	1.0
			91259010	16-Sep-91	18-Sep-91	18-Sep-91	1.0
			91259011	16-Sep-91	18-Sep-91	18-Sep-91	1.0
			91259012	16-Sep-91	18-Sep-91	18-Sep-91	1.0
			91259013	16-Sep-91	18-Sep-91	18-Sep-91	1.0
			91259014	16-Sep-91	18-Sep-91	18-Sep-91	1.0
			91259015	16-Sep-91	18-Sep-91	18-Sep-91	1.0
Coliform, Fecal	~APHA 909C	Membrane Filter, M-FC medium	91259009	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259010	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259011	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259012	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259013	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259014	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259015	16-Sep-91	17-Sep-91	18-Sep-91	1.0
Coliform, Total	~APHA 909A	Membrane Filter, M-Endo medium	91259009	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259010	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259011	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259012	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259013	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259014	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259015	16-Sep-91	17-Sep-91	18-Sep-91	1.0
Chromium, Hexavalent	7196	Colorimetric	91259009	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259010	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259011	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259012	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259013	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259014	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259015	16-Sep-91	17-Sep-91	17-Sep-91	1.0

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Methods and Chronology of Analysis

	METHODS OF ANALYSIS		CHRONOLOGY OF ANALYSES				
Parameter	Method No.	Description	ABB Environmental Sample Nos.	Date Sample Received	Date of Sample Chemical Preparation	Date of Instrument Analysis	Dilution Factor *
Cyanide, Total	335.2	Spectrophotometric, Manual	91259009	16-Sep-91	17-Sep-91	19-Sep-91	1.0
			91259010	16-Sep-91	17-Sep-91	19-Sep-91	1.0
			91259011	16-Sep-91	17-Sep-91	19-Sep-91	1.0
			91259012	16-Sep-91	17-Sep-91	19-Sep-91	1.0
			91259013	16-Sep-91	17-Sep-91	19-Sep-91	1.0
			91259014	16-Sep-91	17-Sep-91	19-Sep-91	1.0
			91259015	16-Sep-91	17-Sep-91	19-Sep-91	1.0
Fluoride	340.2	Potentiometric, Ion Selective Electrode	91259009	16-Sep-91	18-Sep-91	18-Sep-91	1.0
			91259010	16-Sep-91	18-Sep-91	18-Sep-91	1.0
			91259011	16-Sep-91	18-Sep-91	18-Sep-91	1.0
			91259012	16-Sep-91	18-Sep-91	18-Sep-91	1.0
			91259013	16-Sep-91	18-Sep-91	18-Sep-91	1.0
			91259014	16-Sep-91	18-Sep-91	18-Sep-91	1.0
			91259015	16-Sep-91	18-Sep-91	18-Sep-91	1.0
Ammonia-Nitrogen	350.1	Colorimetric, Automated Phenate	91259009	16-Sep-91	18-Sep-91	18-Sep-91	1.0
			91259010	16-Sep-91	18-Sep-91	18-Sep-91	1.0
			91259011	16-Sep-91	18-Sep-91	18-Sep-91	1.0
			91259012	16-Sep-91	18-Sep-91	18-Sep-91	1.0
			91259013	16-Sep-91	18-Sep-91	18-Sep-91	1.0
			91259014	16-Sep-91	18-Sep-91	18-Sep-91	1.0
			91259015	16-Sep-91	18-Sep-91	18-Sep-91	1.0
TKN -Total Kjeldahl Nitrogen	351.2	Colorimetric, Automated Block Digestor	91259009	16-Sep-91	18-Sep-91	19-Sep-91	1.0
			91259010	16-Sep-91	18-Sep-91	19-Sep-91	1.0
			91259011	16-Sep-91	18-Sep-91	19-Sep-91	1.0
			91259012	16-Sep-91	18-Sep-91	19-Sep-91	1.0
			91259013	16-Sep-91	18-Sep-91	19-Sep-91	1.0
			91259014	16-Sep-91	18-Sep-91	19-Sep-91	1.0
			91259015	16-Sep-91	18-Sep-91	19-Sep-91	1.0

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Parameter	Method No.	Description	ABB Environmental Sample Nos.	Date Sample Received	Date of Sample Chemical Preparation	Date of Instrument Analysis	Dilution Factor *
	METHODS OF ANALYSIS		*CHRONOLOGY OF ANALYSES*				
Nitrate+Nitrite-Nitrogen	353.2	Colorimetric, Automated Cadmium Reduction	91259009	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259010	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259011	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259012	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259013	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259014	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259015	16-Sep-91	17-Sep-91	17-Sep-91	1.0
Nitrate-Nitrogen	353.2/354.1	Calculation from Nitrate+Nitrite, Nitrite	91259009	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259010	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259011	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259012	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259013	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259014	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259015	16-Sep-91	17-Sep-91	17-Sep-91	1.0
Nitrite-Nitrogen	354.1	Colorimetric, Automated	91259009	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259010	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259011	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259012	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259013	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259014	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259015	16-Sep-91	17-Sep-91	17-Sep-91	1.0
pH (Laboratory)	150.1	Electrometric	91259009	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259010	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259011	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259012	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259013	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259014	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259015	16-Sep-91	17-Sep-91	17-Sep-91	1.0

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Methods and Chronology of Analysis

METHODS OF ANALYSIS			CHRONOLOGY OF ANALYSES				
Parameter	Method No.	Description	ABB Environmental Sample Nos.	Date Sample Received	Date of Sample Chemical Preparation	Date of Instrument Analysis	Dilution Factor *
TDS -Filterable Residue	160.1	Gravimetric, 180C	91259009	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259010	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259011	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259012	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259013	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259014	16-Sep-91	17-Sep-91	18-Sep-91	1.0
			91259015	16-Sep-91	17-Sep-91	18-Sep-91	1.0
Sulfate	375.4	Turbidimetric	91259009	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259010	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259011	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259012	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259013	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259014	16-Sep-91	17-Sep-91	17-Sep-91	1.0
			91259015	16-Sep-91	17-Sep-91	17-Sep-91	1.0

Notes:
Unless otherwise indicated, analytical methods are from (1) "Methods of Chemical Analysis of Water and Wastes," EPA 600/4-79-020, Revised March, 1983, or (2) "Test Methods for Evaluating Solid Wastes," EPA SW-846, Revised November, 1986.

NA = Not applicable.

~ APHA = Standard Methods for the Examination of Water and Wastewater, American Public Health Association, 16th edition, 1985.

*The Dilution Factor (DF) indicates whether a sample, prepared in accordance with the analytical method protocol, was diluted prior to analysis. The Dilution Factor could also indicate that a smaller aliquot than specified in the method was utilized for sample preparation and analysis. For example, a dilution factor of 5 means that the sample was effectively diluted by a factor of 5 prior to analysis, i.e., the sample was analyzed at 20% its reported concentration.

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Method Blank and Laboratory Control Sample Results

			METHOD BLANK RESULTS						LABORATORY CONTROL SAMPLE RESULTS						
Parameter	Date of Prep*	Date of Analysis*	Units		Conc. Measured in Blank		Acceptance Range	Practical Quantitation Level**	Units	True Value	Measured Value	Percent Recovered	Acceptance Range (%)	Acceptance Range (mg/kg)	Acceptance Range (%)
Chloride	18-Sep-91	18-Sep-91	mg/L	<	2.0	<	2.0	2.0	mg/L	62.5	69.8	112	80-120		
	18-Sep-91	18-Sep-91	mg/L	<	2.0	<	2.0	2.0	mg/L	62.5	70.7	113	80-120		
Coliform, Fecal	17-Sep-91	18-Sep-91	col/100 mL	<	1.0	<	1.0	1.0							
Coliform, Total	17-Sep-91	18-Sep-91	col/100 mL	<	1.0	<	1.0	1.0							
Chromium, Hexavalent	17-Sep-91	17-Sep-91	mg/L	<	0.010	<	0.010	0.010	mg/L	0.043	0.040	93.0	80-120		
Cyanide, Total	17-Sep-91	19-Sep-91	ug/L	<	20	<	20	20	ug	10.5	9.34	89.0	80-120		
Fluoride	18-Sep-91	18-Sep-91	mg/L	<	0.20	<	0.20	0.20	mg/L	1.00	0.96	96.0	80-120		
	18-Sep-91	18-Sep-91							mg/L	0.80	0.78	97.5	80-120		
Ammonia-Nitrogen	18-Sep-91	18-Sep-91	mg/L	<	0.10	<	0.10	0.10	mg/L	1.50	1.57	105	80-120		
	18-Sep-91	18-Sep-91	mg/L	<	0.10	<	0.10	0.10	mg/L	1.50	1.49	99.3	80-120		
TKN -Total Kjeldahl Nitrogen	18-Sep-91	19-Sep-91	mg/L	<	0.10	<	0.10	0.10	mg/L	1.25	1.29	103	80-120		
	18-Sep-91	19-Sep-91	mg/L	<	0.10	<	0.10	0.10	mg/L	1.25	1.19	95.2	80-120		
Nitrate+Nitrite-Nitrogen	17-Sep-91	17-Sep-91	mg/L	<	0.050	<	0.050	0.050	mg/L	1.20	1.22	102	80-120		
	17-Sep-91	17-Sep-91	mg/L	<	0.050	<	0.050	0.050	mg/L	1.20	1.26	105	80-120		
	17-Sep-91	17-Sep-91	mg/L	<	0.050	<	0.050	0.050	mg/L	1.20	1.26	105	80-120		
Nitrate-Nitrogen	17-Sep-91	17-Sep-91	mg/L	<	0.050	<	0.050	0.050	mg/L	1.20	1.22	102	80-120		
	17-Sep-91	17-Sep-91	mg/L	<	0.050	<	0.050	0.050	mg/L	1.20	1.26	105	80-120		
	17-Sep-91	17-Sep-91	mg/L	<	0.050	<	0.050	0.050	mg/L	1.20	1.26	105	80-120		
Nitrite-Nitrogen	17-Sep-91	17-Sep-91	mg/L	<	0.050	<	0.050	0.050	mg/L	1.00	0.918	91.8	80-120		
	17-Sep-91	17-Sep-91	mg/L	<	0.050	<	0.050	0.050	mg/L	1.00	0.978	97.8	80-120		
TDS -Filterable Residue	17-Sep-91	18-Sep-91	mg/L	<	10	<	10	10	mg/L	746	727	97.5	80-120		
	17-Sep-91	18-Sep-91	mg/L	<	10	<	10	10							
	17-Sep-91	18-Sep-91	mg/L	<	10	<	10	10							
	17-Sep-91	18-Sep-91	mg/L	<	10	<	10	10							
Sulfate	17-Sep-91	17-Sep-91	mg/L	<	1.0	<	1.0	1.0	mg	1.25	1.24	99.2	80-120		
									mg	1.25	1.21	96.8	80-120		

* Date is indicated if sample preparation/analysis was performed on more than one day for a parameter. If no date is given, all samples, method blanks and laboratory control samples were prepared and analyzed as indicated on the Chronology Form.

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Method Blank and Laboratory Control Sample Results

			METHOD BLANK RESULTS				LABORATORY CONTROL SAMPLE RESULTS						
Parameter	Date of Prep*	Date of Analysis*	Units	Conc. Measured in Blank	Acceptance Range	Practical Quantitation Level**	Units	True Value	Measured Value	Percent Recovered	Acceptance Range (%)	Acceptance Range (mg/kg)	Acceptance Range (%)

** Practical quantitation level is the lowest concentration measurable for samples with normal chemical and physical composition during routine laboratory operations.

DATA QUALITY COMMENTS:
Results of all quality control measurements are within the laboratory and method specified acceptance range except as noted.

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ABB Environmental Analytical Services Division Quality Control Report

Duplicate and Matrix Spike/Matrix Spike Duplicate Results

		DUPLICATE RESULTS						*MATRIX SPIKE/MATRIX SPIKE DUPLICATE RESULTS*									
	ABB		Sample				Acceptance		Concentration or Quantity				Matrix Spike Recovery (%)				
	Environmental		Measurements		Mean		Range	Units	Sample	Spike	Sample	Sample	Sample	Sample	Acceptance	RPD	Acceptance
Parameter	Sample No.	Units	Rep 1	Rep 2	Conc	RPD (%)	for RPD (%)		Only	Added	+Spike Dup 1	+Spike Dup 2	+Spike Dup 1	+Spike Dup 2	Range (%)	(%)	Range (%)
Chloride	91259011	mg/L	42.2	42.0	42.1	0.5	0-20	mg/L	33.7	12.5	47.7	47.6	112	111	80-120	0.7	0-20
Chromium, VI	91259011	mg/L	<0.010	<0.010	<0.010	NC	0-20										
	91259013							mg/L	<0.010	0.086	0.074	NA	86.0	NA	80-120	NA	0-20
Cyanide, Total	91259011	ug/L	<20	<20	<20	NC	0-20	ug/L	<20	105	115	NA	110	NA	80-120	NA	0-20
Fluoride	91259011	mg/L	<0.20	<0.20	<0.20	NC	0-20	mg	<0.020	0.200	0.193	NA	96.5	NA	80-120	NA	0-20
Ammonia	91259011	mg/L	0.323	0.313	0.318	3.1	0-20	mg/L	0.310	1.25	1.52	NA	96.8	NA	80-120	NA	0-20
TKN	91259011	mg/L	0.277	0.257	0.267	7.5	0-20	mg/L	0.267	1.25	1.53	NA	101	NA	80-120	NA	0-20
Nitrate+Nitrite	91259011	mg/L	0.208	0.164	0.186	24 *	0-20	mg/L	0.167	1.20	1.44	NA	106	NA	80-120	NA	0-20
	91259015	mg/L	0.422	0.130	0.276	106 *	0-20										
Nitrate	91259011	mg/L	0.208	0.164	0.186	24 *	0-20	mg/L	0.167	1.20	1.44	NA	106	NA	80-120	NA	0-20
	91259015	mg/L	0.422	0.130	0.276	106 *	0-20										
Nitrite	91259011	mg/L	<0.050	<0.050	<0.050	NC	0-20	mg/L	<0.050	0.250	0.205	NA	82.0	NA	80-120	NA	0-20
pH (Laboratory)	91259011		6.46	6.48	6.47	0.3	0-20										
TDS	91259011	mg/L	143	138	141	3.6	0-20										
Sulfate	91259011							mg	0.67	0.50	1.15	NA	96.0	NA	80-120	NA	0-20

RPD = Relative percent difference, which is the absolute value of the difference between two replicate results divided by the mean concentration then multiplied by 100%.

NC = Relative percent difference cannot be calculated for sample results less than the PQL.

NA = Not applicable.

Because of the large uncertainty (i.e., 33% or greater) associated with measurements made near the detection level, the acceptance range for relative percent difference for duplicate measurements at such low concentrations is 0-100%.

DATA QUALITY COMMENTS:
Results of all quality control measurements are within the laboratory or contract specified acceptance range except as noted.

ABB Environmental
Analytical Services Division
Quality Control Report

Duplicate and Matrix Spike/Matrix Spike Duplicate Results

		DUPLICATE RESULTS						*MATRIX SPIKE/MATRIX SPIKE DUPLICATE RESULTS*									
	ABB		Sample				Acceptance		Concentration or Quantity				Matrix Spike Recovery (%)				
	Environmental		Measurements		Mean		Range	Units	Sample	Spike	Sample	Sample	Sample	Sample	Acceptance	RPD	Acceptance
Parameter	Sample No.	Units	Rep 1	Rep 2	Conc	RPD (%)	for RPD (%)		Only	Added	+Spike Dup 1	+Spike Dup 2	+Spike Dup 1	+Spike Dup 2	Range (%)	(%)	Range (%)

* Precision of replicate analysis as measured by RPD is outside the laboratory's acceptance range for this parameter. Sample homogeneity may be a factor.

Client: Olin Chemical

25-Sep-91

ABB Environmental
Analytical Laboratory Services Division
Quality Control Report

Summary Report

Inorganic Laboratory Summary Report

All sample analyses for wet chemistry referenced by this Quality Control Report were routine and were conducted in accordance with appropriate analytical protocols and laboratory standard operating procedures except as noted.

ABB Environmental Sample No. 91259011,91259015
Parameter: Nitrate+Nitrite
Description of Problem/Summary of Laboratory Actions: The RPD for the duplicate analysis of these samples is outside of laboratory accepted criteria. All of the Laboratory Control Standards (LCS) and method blanks run concurrently with these samples are within acceptable laboratory criteria. The analyte concentration, determined in these samples, is close to the intrument's PQL, sample homogeneity is a potential factor.

ABB Environmental Sample No. 91259011,91259015
Parameter: Nitrate
Description of Problem/Summary of Laboratory Actions: The RPD for the duplicate analysis of these samples is outside of laboratory accepted criteria. All of the Laboratory Control Standards (LCS) and method blanks run concurrently with these samples are within acceptable laboratory criteria. The analyte concentration, determined in these samples, is close to the intrument's PQL, sample homogeneity is a potential factor.

ABB Environmental
Analytical Laboratory Services Division
Quality Control Report

Methods, Chronology of Analysis and Method Blank Results

Microextractables by GC Method 504

Water Matrix

CHRONOLOGY

ABB Sample Nos.	Date Received	Date Analyzed		ABB Sample Nos.	Date Received	Date Analyzed
91259009	16-Sep-91	20-Sep-91				
91259010	16-Sep-91	20-Sep-91				
91259011	16-Sep-91	21-Sep-91				
91259012	16-Sep-91	21-Sep-91				
91259013	16-Sep-91	21-Sep-91				
91259013DUP	16-Sep-91	21-Sep-91				
91259014	16-Sep-91	21-Sep-91				
91259015	16-Sep-91	21-Sep-91				
91259015MS	16-Sep-91	21-Sep-91				

METHOD BLANK RESULTS*

Compound		Conc. (ug/L)

* Only positive hits have been included.
The remaining compounds were below the Laboratory Practical Quantitation limits.

Client: Olin Chemical

25-Sep-91

ABB Environmental
Analytical Laboratory Services Division
Quality Control Report

Laboratory Control Sample Results

Microextractables by GC Method 504

Water Matrix

Date of Extraction: 19-Sep-91
Date of Analysis: 21-Sep-91

Compound	Units	Spike Conc.	LCS Measured Conc.	LCS Dup. Measured Conc.	LCS % Recovery	LCS Dup. % Recovery	Recovery Acceptance Range (%)*	RPD (%)	RPD Acceptance Range (%)*
Ethylene Dibromide (EDB)	ug/L	0.500	0.283	0.378	56.6	75.6	25-125	29	0-50
1,2-Dibromo-3-chloropropane (DBCP)	ug/L	0.500	0.414	0.435	82.8	87.0	25-125	4.9	0-50

* These limits are for advisory purposes only, and are not to be utilized as sample validation criteria.

ABB Environmental
Analytical Laboratory Services Division
Quality Control Report

Sample Duplicate Results

Microextractables by GC Method 504

Water Matrix

ABB Sample No. Duplicated: 91259013

Compound*	Units	Sample Conc.	Sample Duplicate Conc.	Average Conc.	RPD (%)	RPD Acceptance Range (%)
No compounds detected.	ug/L					0-20
	ug/L					0-20

* Only positive results have been included. The remaining compounds were below the laboratory Practical Quantitation Limit.

ND = Not detected.

NC = Not calculated; relative percent difference and average concentration are not calculated for sample results less than the PQL.

Because of the large uncertainty associated with measurements made near the detection level, the acceptance range for relative percent difference for duplicate measurements at such a low concentration is 0-100%

ABB Environmental
Analytical Laboratory Services Division
Quality Control Report

Matrix Spike/Matrix Spike Duplicate Results

Microextractables by GC Method 504

Water Matrix

ABB Sample No. Spiked: 91259015

Compound	Units	Spike Conc.	Sample Conc.	MS Measured Conc.	MSD Measured Conc.	MS % Recovery	MSD % Recovery	Recovery Acceptance Range (%)*	RPD (%)	RPD Acceptance Range (%)*
Ethylene Dibromide (EDB)	ug/L	0.200	ND	0.148	NA	74.0	NA	25-125	NA	0-50
1,2-Dibromo-3-chloropropane (DBCP)	ug/L	0.200	ND	0.192	NA	96.0	NA	25-125	NA	0-50

* These limits are for advisory purposes only, and are not to be utilized as sample validation criteria.

ND = Not detected.
NA = Not applicable.

ABB Environmental
Analytical Laboratory Services Division
Quality Control Report

Methods, Chronology of Analysis and Method Blank Results

Volatile Analysis by GC/MS Method 524.2

Water Matrix

CHRONOLOGY

ABB Sample Nos.	Date Received	Date Analyzed	Dilution Factor ~	ABB Sample Nos.	Date Received	Date Analyzed	Dilution Factor ~
91259-014	16-Sep-91	20-Sep-91	1.0				
91259-014MS	16-Sep-91	20-Sep-91	1.0				
91259-011	16-Sep-91	20-Sep-91	1.0				
91259-012	16-Sep-91	20-Sep-91	1.0				
91259-013	16-Sep-91	20-Sep-91	1.0				
91259-014DUP	16-Sep-91	21-Sep-91	1.0				
91259-015	16-Sep-91	21-Sep-91	1.0				
91259-016	16-Sep-91	21-Sep-91	1.0				

METHOD BLANK RESULTS*

Compound	Conc. (ug/L)
Methylene chloride	0.11J
Ethylbenzene	0.03J
Napthalene	0.15J
Hexachlorobutadiene	0.05J

* Only positive hits have been included. The remaining compounds were not detected.

~ The Dilution Factor (DF) indicates whether a sample, prepared in accordance with the analytical method protocol, was diluted prior to analysis. The Dilution Factor could also indicate that a smaller aliquot than specified in the method was utilized for sample preparation and analysis. For example, a dilution factor of 5 means that the sample was effectively diluted by a factor of 5 prior to analysis, i.e., the sample was analyzed at 20% its reported concentration.

ABB Environmental
Analytical Laboratory Services Division
Quality Control Report

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Methods, Chronology of Analysis and Method Blank Results

Volatile Analysis by GC/MS Method 524.2

Water Matrix

CHRONOLOGY

ABB Sample Nos.	Date Received	Date Analyzed	Dilution Factor ~	ABB Sample Nos.	Date Received	Date Analyzed	Dilution Factor ~
91259009	16-Sep-91	18-Sep-91	1.0				
91259010	16-Sep-91	18-Sep-91	1.0				

METHOD BLANK RESULTS*

Compound	Conc. (ug/L)
Methylene chloride	0.19J
1,3,5-Trimethylbenzene	0.05J
sec-Butylbenzene	0.05
1,2,4-Trichlorobenzene	0.14
Naphthalene	0.15J
Hexachlorobutadiene	0.13

* Only positive hits have been included. The remaining compounds were not detected.

~ The Dilution Factor (DF) indicates whether a sample, prepared in accordance with the analytical method protocol, was diluted prior to analysis. The Dilution Factor could also indicate that a smaller aliquot than specified in the method was utilized for sample preparation and analysis. For example, a dilution factor of 5 means that the sample was effectively diluted by a factor of 5 prior to analysis, i.e., the sample was analyzed at 20% its reported concentration.

ABB Environmental
Analytical Laboratory Services Division
Quality Control Report

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Laboratory Fortified Blank (LFB) Results

Volatile Organics by GC/MS Method 524.2

Water Matrix

Date of Analysis: 18-Sep-91

Compound	Units	Spike Conc.	LFB Measured Conc.	LFB % Recovery	Recovery Acceptance Range (%)
Dichlorodifluoromethane	ug/L	0.50	3.18	636	80-120
Chloromethane	ug/L	0.50	0.44	88.0	80-120
Vinyl Chloride	ug/L	0.50	0.60	120	80-120
Bromomethane	ug/L	0.50	0.70	140	80-120
Chloroethane	ug/L	0.50	0.64	128	80-120
Trichlorofluoromethane	ug/L	0.50	0.82	164	80-120
1,1-Dichloroethene	ug/L	0.50	0.68	136	80-120
Methylene Chloride	ug/L	0.50	2.82	564	80-120
trans-1,2-Dichloroethene	ug/L	0.50	0.62	124	80-120
1,1-Dichloroethane	ug/L	0.50	0.63	126	80-120
cis-1,2-Dichloroethene	ug/L	0.50	0.59	118	80-120
2,2-Dichloropropane	ug/L	0.50	0.83	166	80-120
Chloroform	ug/L	0.50	0.68	136	80-120
Bromochloromethane	ug/L	0.50	0.50	100	80-120
1,1,1-Trichloroethane	ug/L	0.50	0.76	152	80-120
1,2-Dichloroethane	ug/L	0.50	0.46	92.0	80-120
1,1-Dichloropropene	ug/L	0.50	0.71	142	80-120
Carbon Tetrachloride	ug/L	0.50	0.71	142	80-120
Benzene	ug/L	0.50	0.66	132	80-120
1,2-Dichloropropane	ug/L	0.50	0.54	108	80-120
Trichloroethene	ug/L	0.50	0.71	142	80-120
Dibromomethane	ug/L	0.50	0.45	90.0	80-120
Bromodichloromethane	ug/L	0.50	0.59	118	80-120
cis-1,3-Dichloropropene	ug/L	0.80	0.82	103	80-120
Toluene	ug/L	0.50	0.64	128	80-120
trans-1,3-Dichloropropene	ug/L	0.20	0.14	70.0	80-120
1,1,2-Trichloroethane	ug/L	0.50	0.42	84.0	80-120
1,3-Dichloropropane	ug/L	0.50	0.46	92.0	80-120
Dibromochloromethane	ug/L	0.50	0.53	106	80-120
Tetrachloroethene	ug/L	0.50	0.75	150	80-120
1,2-Dibromoethane	ug/L	0.50	0.35	70.0	80-120
Chlorobenzene	ug/L	0.50	0.55	110	80-120
1,1,1,2-Tetrachloroethane	ug/L	0.50	0.59	118	80-120
Ethylbenzene	ug/L	0.50	0.60	120	80-120
m+p-Xylene	ug/L	1.00	1.25	125	80-120

ABB Environmental
Analytical Laboratory Services Division
Quality Control Report

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Laboratory Fortified Blank (LFB) Results

Volatile Organics by GC/MS Method 524.2

Water Matrix

Date of Analysis: 18-Sep-91

Compound	Units	Spike Conc.	LFB Measured Conc.	LFB % Recovery	Recovery Acceptance Range (%)
Bromoform	ug/L	0.50	0.46	92.0	80-120
o-Xylene	ug/L	0.50	0.64	128	80-120
Styrene	ug/L	0.50	0.50	100	80-120
1,1,2,2-Tetrachloroethane	ug/L	0.50	0.42	84.0	80-120
1,2,3-Trichloropropane	ug/L	0.50	1.20	240	80-120
Isopropylbenzene	ug/L	0.50	0.55	110	80-120
Bromobenzene	ug/L	0.50	0.43	86.0	80-120
2-Chlorotoluene	ug/L	0.50	0.65	130	80-120
n-Propylbenzene	ug/L	0.50	0.51	102	80-120
4-Chlorotoluene	ug/L	0.50	0.44	88.0	80-120
1,3,5-Trimethylbenzene	ug/L	0.50	0.90	180	80-120
tert-Butylbenzene	ug/L	0.50	0.79	158	80-120
1,2,4-Trimethylbenzene	ug/L	0.50	0.50	100	80-120
sec-Butylbenzene	ug/L	0.50	0.57	114	80-120
1,3-Dichlorobenzene	ug/L	0.50	0.52	104	80-120
p-Isopropyltoluene	ug/L	0.50	0.51	102	80-120
1,4-Dichlorobenzene	ug/L	0.50	0.53	106	80-120
1,2-Dichlorobenzene	ug/L	0.50	0.54	108	80-120
n-Butylbenzene	ug/L	0.50	0.46	92.0	80-120
1,2-Dibromo-3-chloropropane	ug/L	0.50	0.67	134	80-120
1,2,4-Trichlorobenzene	ug/L	0.50	1.10	220	80-120
Naphthalene	ug/L	0.50	1.04	208	80-120
Hexachlorobutadiene	ug/L	0.50	1.27	254	80-120
1,2,3-Trichlorobenzene	ug/L	0.50	1.24	248	80-120
2,4,4-Trimethyl-1-pentene	ug/L	0.50	0.69	138	80-120
2,4,4-Trimethyl-2-pentene	ug/L	0.50	0.61	122	80-120

Client: Olin Chemical

26-Sep-91

ABB Environmental
Analytical Laboratory Services Division
Quality Control Report

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Laboratory Fortified Blank (LFB) Results

Volatile Organics by GC/MS Method 524.2

Water Matrix

Date of Analysis: 09-20-91

Compound	Units	Spike Conc.	LFB Measured Conc.	LFB % Recovery	Recovery Acceptance Range (%)
Dichlorodifluoromethane	ug/L	0.50	0.19	38	80-120
Chloromethane	ug/L	0.50	0.46	92	80-120
Vinyl Chloride	ug/L	0.50	0.37	74	80-120
Bromomethane	ug/L	0.50	0.67	134	80-120
Chloroethane	ug/L	0.50	0.65	130	80-120
Trichlorofluoromethane	ug/L	0.50	0.84	168	80-120
1,1-Dichloroethene	ug/L	0.50	0.69	138	80-120
Methylene Chloride	ug/L	0.50	2.14	428	80-120
trans-1,2-Dichloroethene	ug/L	0.50	0.68	136	80-120
1,1-Dichloroethane	ug/L	0.50	0.59	118	80-120
cis-1,2-Dichloroethene	ug/L	0.50	0.62	124	80-120
2,2-Dichloropropane	ug/L	0.50	0.65	130	80-120
Chloroform	ug/L	0.50	0.67	134	80-120
Bromochloromethane	ug/L	0.50	0.59	118	80-120
1,1,1-Trichloroethane	ug/L	0.50	0.72	144	80-120
1,2-Dichloroethane	ug/L	0.50	0.52	104	80-120
1,1-Dichloropropene	ug/L	0.50	0.67	134	80-120
Carbon Tetrachloride	ug/L	0.50	0.70	140	80-120
Benzene	ug/L	0.50	0.63	126	80-120
1,2-Dichloropropane	ug/L	0.50	0.57	114	80-120
Trichloroethene	ug/L	0.50	0.62	124	80-120
Dibromomethane	ug/L	0.50	0.58	116	80-120
Bromodichloromethane	ug/L	0.50	0.62	124	80-120
cis-1,3-Dichloropropene	ug/L	0.80	0.79	98.75	80-120
Toluene	ug/L	0.50	0.78	156	80-120
trans-1,3-Dichloropropene	ug/L	0.20	0.19	95	80-120
1,1,2-Trichloroethane	ug/L	0.50	0.65	130	80-120
1,3-Dichloropropane	ug/L	0.50	0.58	116	80-120
Dibromochloromethane	ug/L	0.50	0.65	130	80-120
Tetrachloroethene	ug/L	0.50	0.69	138	80-120
1,2-Dibromoethane	ug/L	0.50	0.60	120	80-120
Chlorobenzene	ug/L	0.50	0.57	114	80-120
1,1,1,2-Tetrachloroethane	ug/L	0.50	0.62	124	80-120

Client: Olin Chemical

26-Sep-91

ABB Environmental
Analytical Laboratory Services Division
Quality Control Report

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Laboratory Fortified Blank (LFB) Results

Volatile Organics by GC/MS Method 524.2

Water Matrix

Date of Analysis: 09-20-91

Compound	Units	Spike Conc.	LFB Measured Conc.	LFB % Recovery	Recovery Acceptance Range (%)
Ethylbenzene	ug/L	0.50	0.62	124	80-120
m+p-Xylene	ug/L	1.00	1.21	121	80-120
Bromoform	ug/L	0.50	0.63	126	80-120
o-Xylene	ug/L	0.50	0.65	130	80-120
Styrene	ug/L	0.50	0.54	108	80-120
1,1,2,2-Tetrachloroethane	ug/L	0.50	0.71	142	80-120
1,2,3-Trichloropropane	ug/L	0.50	1.81	362	80-120
Isopropylbenzene	ug/L	0.50	0.63	126	80-120
Bromobenzene	ug/L	0.50	0.59	118	80-120
2-Chlorotoluene	ug/L	0.50	0.58	116	80-120
n-Propylbenzene	ug/L	0.50	0.54	108	80-120
4-Chlorotoluene	ug/L	0.50	0.57	114	80-120
1,3,5-Trimethylbenzene	ug/L	0.50	0.58	116	80-120
tert-Butylbenzene	ug/L	0.50	0.66	132	80-120
1,2,4-Trimethylbenzene	ug/L	0.50	0.60	120	80-120
sec-Butylbenzene	ug/L	0.50	0.57	114	80-120
1,3-Dichlorobenzene	ug/L	0.50	0.60	120	80-120
p-Isopropyltoluene	ug/L	0.50	0.57	114	80-120
1,4-Dichlorobenzene	ug/L	0.50	0.50	100	80-120
1,2-Dichlorobenzene	ug/L	0.50	0.63	126	80-120
n-Butylbenzene	ug/L	0.50	0.43	86	80-120
1,2-Dibromo-3-chloropropane	ug/L	0.50	0.83	166	80-120
1,2,4-Trichlorobenzene	ug/L	0.50	0.98	196	80-120
Naphthalene	ug/L	0.50	2.43	486	80-120
Hexachlorobutadiene	ug/L	0.50	0.95	190	80-120
1,2,3-Trichlorobenzene	ug/L	0.50	1.21	242	80-120
2,4,4-Trimethyl-1 pentene	ug/L	0.5	0.77	154	80-120
2,4,4-Trimethyl-2 pentene	ug/L	0.5	0.81	162	80-120

ABB Environmental
Analytical Laboratory Services Division
Quality Control Report

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Laboratory Fortified Sample Matrix (LFM) Results

Volatile Organics by GC/MS Method 524.2

Water Matrix

Date of Analysis: 09-20-91
ABB Sample Number Spiked: 91259-014

Compound	Units	Spike Conc.	Sample Measured Conc.	LFM Measured Conc.	LFM % Recovery	Recovery Acceptance Range (%)~
Dichlorodifluoromethane	ug/L	2.00		1.67	83.5	80-120
Chloromethane	ug/L	2.00		1.45	72.5	80-120
Vinyl Chloride	ug/L	2.00		3.37	169	80-120
Bromomethane	ug/L	2.00		3.15	158	80-120
Chloroethane	ug/L	2.00		3.07	154	80-120
Trichlorofluoromethane	ug/L	2.00		3.40	170	80-120
1,1-Dichloroethene	ug/L	2.00		2.99	150	80-120
Methylene Chloride	ug/L	2.00	0.54B	4.16	208	80-120
trans-1,2-Dichloroethene	ug/L	2.00		3.05	153	80-120
1,1-Dichloroethane	ug/L	2.00		2.94	147	80-120
cis-1,2-Dichloroethene	ug/L	2.00		2.71	136	80-120
2,2-Dichloropropane	ug/L	2.00		2.90	145	80-120
Chloroform	ug/L	2.00		3.00	150	80-120
Bromochloromethane	ug/L	2.00		3.17	159	80-120
1,1,1-Trichloroethane	ug/L	2.00		2.95	148	80-120
1,2-Dichloroethane	ug/L	2.00		3.20	160	80-120
1,1-Dichloropropene	ug/L	2.00		3.00	150	80-120
Carbon Tetrachloride	ug/L	2.00		3.06	153	80-120
Benzene	ug/L	2.00		2.75	138	80-120
1,2-Dichloropropane	ug/L	2.00		2.93	147	80-120
Trichloroethene	ug/L	2.00		2.92	146	80-120
Dibromomethane	ug/L	2.00		3.16	158	80-120
Bromodichloromethane	ug/L	2.00		3.21	161	80-120
cis-1,3-Dichloropropene	ug/L	3.20		4.59	143	80-120
Toluene	ug/L	2.00		2.86	143	80-120
trans-1,3-Dichloropropene	ug/L	0.80		1.24	155	80-120
1,1,2-Trichloroethane	ug/L	2.00		3.04	152	80-120
1,3-Dichloropropane	ug/L	2.00		3.03	152	80-120
Dibromochloromethane	ug/L	2.00		3.39	170	80-120
Tetrachloroethene	ug/L	2.00		2.69	135	80-120
1,2-Dibromoethane	ug/L	2.00		2.84	142	80-120
Chlorobenzene	ug/L	2.00		2.78	139	80-120

K

APPENDIX K

CONTAMINANT FATE AND TRANSPORT SUMMARY

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K.1.0 CONTAMINANT FATE AND TRANSPORT

Facility-related chemicals have been detected in groundwater, surface water, sediment, surface soil and subsurface soil samples.

The potential chemical migration pathways which exist at the Facility include:

- groundwater flow;
- surface water runoff;
- atmospheric dispersion from surface soils; and
- tracking of surface soils/sediments.

Section K.1.1 presents a general description of the physical and chemical properties of the Facility-related chemicals and the influence of these properties on their fate and transport. The chemical migration potential for each of the identified pathways are evaluated in Sections K.1.2 through K.1.5. Section K.1.6 presents a discussion of the probable behavior and environmental fate of the primary chemical constituents at the Site.

K.1.1 PHYSICAL AND CHEMICAL PROPERTIES OF FACILITY-RELATED COMPOUNDS

Contaminant mobility, a factor in contaminant migration, depends upon the physical and chemical properties of both the contaminants

and the media in which they are identified. Properties which affect contaminant mobility include, but are not limited to, solubility, liquid density, vapor pressure and chemical affinity. The partitioning of chemicals between media is controlled by a variety of factors such as absorption, volatilization, solubility and chemical affinity.

Chemicals released to a soil medium may be adsorbed by the soil until the adsorptive capacity of the soil is reached. Under continued release(s) of the chemicals, the chemicals may migrate both horizontally and vertically, expanding the area of contaminated soils as the adsorptive capacity of the soil in the vicinity of the release is attained. Similarly, infiltration of precipitation or release(s) of other chemicals may cause the initial chemical to migrate at a rate primarily controlled by the adsorptive capacity of the soil and by the solubility of the initial chemical in the transport media.

Chemicals which have migrated to the groundwater may solubilize in the groundwater to the aqueous solubility limit of the chemical. The solubilized chemical may migrate with the groundwater and sorb onto adjacent soils. Under continued migration to the groundwater from the soils above the water table, the extent of groundwater contamination may expand as the adsorptive capacity of the soils beneath the water table in the vicinity of the release is attained.

When chemicals migrate from soils above the water table to the groundwater at a rate greater than the solubility capacity of the groundwater, the migration of the excess chemicals will result in a separate non-aqueous phase liquid (NAPL). The migration of NAPL is governed

primarily by its density. If the chemical's density is less than one, it will tend to float on the surface of the groundwater and may migrate horizontally in the direction of groundwater flow. If the chemical's density is greater than one, it may tend to migrate vertically downward until a low-permeability geologic unit is encountered, at which point the chemical may tend to migrate horizontally in the direction of the surficial slope of the geologic unit. The extent of chemical migration, above or below the water table, may expand as the sorption capacity of the respective geologic unit is attained.

The physical and chemical properties of the Site-related chemicals detected in the different media at the Site are presented in Table K.1. The chemical properties include molecular weight, aqueous solubility, vapor pressure, Henry's law constant, sorption coefficient and specific density. Table K.2 presents descriptive ranges of values for chemical and physical properties and their relation to chemical transport. Table K.2 also lists examples of Site-related chemicals which exhibit these characteristics.

The molecular weight of a compound is useful for many calculations including weight/volume unit conversions; molar volume determinations and estimating Henry's law constants.

Aqueous solubility is an important factor in estimating a chemical's fate and transport in groundwater and surface water. Compounds with high aqueous solubilities have a tendency to desorb from soils and sediment; are less likely to volatilize from water; and, are susceptible to biodegradation. Compounds with a high solubility will generally enter the

TABLE K.1

CHEMICAL PROPERTIES OF SITE-RELATED PARAMETERS
WILMINGTON FACILITY

	Formula Weight (*g/mole*)	*Aqueous Solubility at 25°C* (*mg/L*)	*Vapor Pressure at 25°C* (*mm Hg*)	*Henry's Law Constant at 25°C* (*atm-m^3/mol*)	K_{oc}	*Specific Density*
Volatile Organic Compounds						
Acetone	58	1.00E+06	2.70E+02	2.06E-05	2.2	0.7899
2-Butanone	72.11	2.06E+05	1.00E+02	4.66E-05	1.23	0.805
2-Hexanone	100.2	3.50E+04	3.80E+00	1.75E-03	134.9	0.8113
Toluene	92	5.15E+02	2.81E+01	6.66E-03	300	0.8669
2,4,4-Trimethyl-1-pentene	112.2	NA	7.75E+01	NA	NA	0.7150
2,4,4-Trimethyl-2-pentene	112.2	NA	7.75E+01	NA	NA	0.724
Semi-Volatile Organic Compounds						
N-Nitrosodiphenylamine	198	4.00E+01	1.00E-01	6.60E-04	830-1830	1.23
N-Nitrosodipropylamine	130.2	9.90E+03	8.60E-02	1.47E-06	129	0.916
Phenol	94.1	9.30E+04	3.50E-01	2.70E-07	26.9	1.06
Phthalate Esters						
Bis(2-ethylhexyl)Phthalate	391	2.85E-01	6.20E-08	1.10E-05	100000	0.9861
Butyl Benzylphthalate	312	2.69E+00	8.60E-06	1.30E-06	68-347	1.12
Di-n-Butylphthalate	278	1.30E+01	1.00E-05	2.82E-07	170000	1.047
Di-n-Octylphthalate	391	3.00E-01	1.40E-04	1.41E-12	980000000	0.99
PAHs						
Indeno (1,2,3-cd)Pyrene	276	5.30E-04	1.00E-10	6.86E-08	1600000	NA
Benzo(b) Fluoranthene	252	1.40E-02	5.00E-07	1.19E-05	550000	NA
Benzo(a) Anthracene	228	9.00E-03	2.20E-08	1.10E-06	200000	1.274
Benzo(a) Pyrene	252	1.20E-03	5.60E-09	4.90E-07	5500000	1.351
Chrysene	228	1.80E-03	6.30E-09	1.05E-06	200000	1.274
Inorganics						
Aluminum	27	NA	NA	NA	NA	2.702
Ammonia	17	5.30E+05	7.60E+03	1.60E-05	3.1	NA
Calcium	40	NA	NA	NA	NA	NA
Chloride	53.5	NA	NA	NA	NA	1.0
Chromium III	52	NA	NA	NA	NA	1.01
Chromium VI	52	NA	NA	NA	NA	1.01
Copper	63.5	NA	NA	NA	NA	NA
Iron	55.8	NA	NA	NA	NA	NA
Manganese	55	NA	NA	NA	NA	1.01
Potassium	39.1	NA	NA	NA	NA	NA
Sodium	23.0	NA	NA	NA	NA	NA
Sulphate	132	NA	NA	NA	NA	1.0
Zinc	65.4	NA	NA	NA	NA	NA

References:

Montgomery, John H. and Linda M. Welkom "Groundwater Chemicals Desk Reference", Michigan, 1990.
"USEPA Superfund Public Health Evaluation Manual", October 1986, EPA/540/1-86/060.
Howard H. Philip, "Handbook of Environmental Fate and Exposure Data for Organic Chemicals, Volume II, Solvents", Michigan.

TABLE K.2

DESCRIPTIVE RANGES FOR PHYSICAL AND CHEMICAL PROPERTIES
OF SITE-RELATED CHEMICALS
WILMINGTON FACILITY

Property	*Description*	*Units*	*Descriptive Ranges*	*Examples of Site Contaminants*
Liquid density	The density of a chemical in its pure liquid form, relative to water.	D (g/cm^3)	<1 -- less dense than water	acetone, 2-hexanone, 2-butanone N-Nitrosodipropylamine 2,4,4-Trimethylpentene
			> 1 -- more dense than water	BBP, chrysene, phenol, PAHs
Aqueous solubility	The amount of a chemical at equilibrium that will be dissolved in pure water.	mg/L	high -- soluble in water (>100)	acetone, ammonia, toluene N-Nitrosodipropylamine 2-butanone, 2-hexanone, phenol
			low -- insoluble in water (<1)	BEHP, PAHs
Vapor Pressure	The partial pressure of a vapor at equilibrium with the chemical in its pure state; describes the tendency of a chemical to evaporate.	Vp (mm Hg)	high -- volatile (>16)	VOCs
			low -- nonvolatile ($<10^{-4}$)	SVOCs
Partitioning between air and water	The proportion of a chemical at equilibrium in the vapor phase in the space above an aqueous solution of the chemical; describes the tendency of a chemical to transfer between air and water.	Henry's law constant, H (atm m^3/mol)	$<10^{-7}$ -- nonvolatile	indeno(1,2,3-cd) pyrene
			10^{-7} to 10^{-5} -- low volatility	phthalates benzo (b) fluoranthene benzo (a) anthracene benzo (a) pyrene, chrysene phenol

TABLE K.2

DESCRIPTIVE RANGES FOR PHYSICAL AND CHEMICAL PROPERTIES
OF SITE-RELATED CHEMICALS
WILMINGTON FACILITY

Property	*Description*	*Units*	*Descriptive Ranges*	*Examples of Site Contaminants*
			10^{-5} to 10^{-3} -- moderate volatility	acetone N-Nitrosodiphenylamine 2-butanone, 2-hexanone
			$>10^{-3}$ -- high volatility	toluene
Partitioning between organic matter and water	The proportion of a chemical at equilibrium sorbed to organic material in a water-soil or water-sediment system; more strongly sorbed chemicals tend to be less mobile	K_{oc} (ml/g)	0 to 50 -- very high mobility	acetone, ammonia 2-Butanone, Phenol
			50 to 100 -- high mobility	
			100 to 500 -- moderate mobility	toluene, 2-hexanone N-Nitrosodipropylamine
			500 to 2,000 -- low mobility	N-Nitrosodiphenylamine
			2,000 to 20,000 -- slight mobility	BBP
			>20,000 -- immobile	Di-n-octyl phthalate, benzo(a) pyrene benzo (b) fluoranthene benzo (a) anthracene chrysene indeno (1,2,3-cd) pyrene BEHP DBP DOP

groundwater more readily than relatively less soluble compounds. Aqueous solubility is affected by temperature, pH and other dissolved constituents. Site-related volatile organic compounds have aqueous solubilities ranging from 515 mg/L Toluene to 1.00×10^6 mg/L for Acetone. Semi-volatile organic compounds detected at the Site have relatively low solubilities ranging from 0.00053 mg/L to 40.0 mg/L.

The sorption coefficient (K_{OC}) indicates the tendency of a compound to partition between particles containing organic carbon and water. The sorption coefficient is inversely related to aqueous solubility such that a compound that binds strongly to organic carbon will have a low solubility. Compounds that adsorb onto organic materials in an aquifer are retarded in their movement in groundwater such that the compound migrates at a linear velocity less than the groundwater flow velocity.

Generally, volatile organic compounds have relatively low K_{OC} values ranging from 2.2 (Acetone) to 300 (Toluene). Semi-volatile compounds generally have a much higher adsorption capacity with K_{OC} values ranging from 68 (butyl benzylphthalate) to 9.8×10^8 (di-n-octylphthalate).

The specific density of a compound is equivalent to the density of the substance relative to the density of water. Hydrophobic (low aqueous solubility) compounds with a specific density greater than one will generally tend to sink through the water table as dense non-aqueous phase liquids. Hydrophobic compounds with a specific density less than one will generally tend to float on the water table. Hydrophilic compounds (high

aqueous solubility) behave differently. Acetone, for example, with a specific density of 0.790 does not float on water because it is highly soluble in water. Therefore, the solubility of a substance must be considered in conjunction with the specific density of a compound.

The vapor pressure of a compound provides a semi-quantitative rate at which volatilization will occur from soil and/or water to the atmosphere and/or soil gas. Generally, the Site-related volatile organic compounds have relatively high vapor pressures ranging from 28.1 mm Hg (Toluene) to 270 mm Hg (Acetone). The Site-related semi-volatile organic compounds generally have low vapor pressures and a low potential for volatilization with values ranging from 1.00×10^{-10} mm Hg (indeno(1,2,3-cd)pyrene) to 0.1 mm Hg (N-Nitrosodiphenylamine).

Henry's law constants provide an indication of the relative volatility of a compound (see Table K.2) and its tendency to evaporate from water. Henry's law constants are greatest for volatile organic compounds detected at the Site, all of which are greater than 10^{-5} atm m^3/mol. Site-related semi-volatile organic compounds generally have lower Henry's law constant values.

K.1.2 CHEMICAL MIGRATION VIA GROUNDWATER FLOW

The analytical results for groundwater samples collected from the Site monitoring wells indicate that chemical migration is occurring via the overburden groundwater flow system. Site-related chemicals have

been detected in the overburden groundwater at locations downgradient of the former acid pits/lagoons/Lake Poly area.

K.1.3 CHEMICAL MIGRATION VIA SURFACE WATER RUNOFF

Chemical migration by surface water runoff is primarily restricted to chemicals present in surficial soils and sediments in drainage ditches. Seepage of groundwater to the ground surface, as identified immediately west of the Facility, can also contribute chemicals for potential transport via surface water runoff. Migration may occur by physical transport of the soils or by dissolution.

K.1.4 CHEMICAL MIGRATION VIA ATMOSPHERIC DISPERSION

Atmospheric dispersion of chemicals at the Site is primarily restricted to chemicals present in surficial soils. The chemicals may be released to the atmosphere by volatilization and/or by atmospheric entrainment of chemicals adsorbed onto particulate matter. Once released, the chemicals may be transported by the wind. Chemicals in the atmosphere may be broken down by photochemical reaction with hydroxyl radicals, direct photolysis or may be returned to the surface by gravitational settling or scavenging by rainfall.

K.1.5 CHEMICAL MIGRATION VIA INADVERTENT TRACKING

Tracking of chemicals at the Site could potentially be caused by workers or wildlife walking across surface soils containing Site-related chemicals or by vehicular traffic through the Site. As the areas with elevated chemical concentrations in the surface soils are relatively limited, this potential migration route is considered to be insignificant.

K.1.6 ENVIRONMENTAL FATE

The basic physical and chemical properties of all detected Site-related organic constituents are presented in Table K.1.

The probable behavior and environmental fate of all constituents can be assessed to some extent by evaluating the physical and chemical properties of the constituent. The mobility and persistence of these constituents are of primary importance in this evaluation. Mobility is the potential for a chemical to migrate away from the Site. Persistence is a measure of how long a chemical will remain in the environment. Factors that affect the mobility and persistence of Site-related constituents include, but are not limited to:

1) physical properties,
2) chemical properties,
3) moisture levels,
4) microbial environment,

5) water chemistry, and

6) pH.

The water solubility is the maximum concentration of a compound that can dissolve in water at a specific temperature and pH. Compounds with high solubilities generally exhibit increased mobility.

Vapor pressure and Henry's Law Constants provide an indication of the volatility of a compound. High vapor pressures and Henry's constants indicate a greater tendency for a compound to volatilize. Compounds with high Henry's constants and high vapor pressures generally do not persist in surface water or surface soil environments.

The organic carbon partitioning coefficient (K_{OC}) indicates the tendency of a compound to be adsorbed to organic matter in soils or sediments. High K_{OC} values generally indicate lower mobility.

The general degree to which these chemical properties affect the environmental fate of Site-related constituents is summarized in Table K.2.

The chemical fate and transport of the significant Site-related parameters are discussed in the following subsections. The Site-related parameters have been grouped into the following categories to facilitate the discussion:

1. Volatile Organic Compounds

Acetone
2-Butanone
2-Hexanone
Toluene
2,4,4-Trimethyl-1-Pentene
2,4,4-Trimethyl-2-Pentene

2. Semi-Volatile Organic Compounds

N-Nitrosodiphenylamine
N-Nitrosodipropylamine
Phenol

Phthalate Esters
Bis(2-ethylhexyl) phthalate
Butyl Benzylphthalate
Di-n-Butylphthalate
Di-n-Octylphthalate

Polycyclic Aromatic Hydrocarbons (PAHs)
Benzo(b) Fluoranthene
Benzo(a) Anthracene
Benzo(a) Pyrene
Chrysene
Indeno (1,2,3-cd) Pyrene

3. Inorganics

Aluminum
Ammonia
Calcium
Chloride
Chromium III
Chromium VI
Iron
Copper
Manganese
Potassium
Sodium
Sulphate
Zinc

The physical description and primary uses of the primary Site-related compounds are presented in Table K.3.

The chemical fate and transport of the primary Site-related compounds are summarized in Table K.4.

K.1.6.1 Volatile Organic Compounds

K.1.6.1.1 Acetone

The chemical fate and transport mechanisms for Acetone is characterized by a high vapor pressure of 270 mm Hg and a high Henry's

TABLE K.3

CHEMICAL IDENTITY OF PRIMARY SITE-RELATED COMPOUNDS
WILMINGTON FACILITY

Chemical Group	*CAS Registry Number*	*Formula*	*Physical Description*	*Primary Uses*
Volatile Organic Compounds				
Acetone	67-64-1	C_3H_6O	Colorless, volatile liquid with a sweet fragrant odor.	Paint, varnish and lacquer solvent.
2-Butanone	78-93-3	C_4H_8O	Colorless liquid with a sweet mint-like odour	Solvent for coatings industry
2-Hexanone	591-78-6	$C_6H_{12}O$	Colorless liquid	Solvent and denaturant
Toluene	108-88-3	C_6H_6-CH_3	Colorless, water-white liquid with odor.	Solvent for paints and coatings, aviation fuel, gas exhaust.
2,4,4-Trimethyl-1-pentene	107-39-1	C_8H_{16}	Colorless liquid	Organic synthesis, motor fuel synthesis, particularly isooctane, peroxide reactions
2,4,4-Trimethyl-2-pentene	107-40-4	C_8H_{16}	Colorless liquid	Organic Synthesis
Semi-Volatile Organic Compounds				
N-Nitrosodiphenylamine	86-30-6	$C_{12}H_{10}N_2O$	Green platy or dark blue crystals.	Rubber processing.
N-Nitrosodipropylamine	621-64-7	$C_6H_{14}N_2O$	yellow to gold colored liquid	Research Chemical
Phenol	108-95-2	C_6H_6O	White crystals or light pink liquid which slowly turns brown on exposure to air. Sweet tarry odor.	Used in resins, adhesives, iron and steel, aluminum, leather and rubber industries.
Phthalate Esters				
Bis(2-ethylhexyl) Phthalate	117-81-7	$C_{24}H_{38}O_4$	Colorless, oily liquid with a very faint odor.	Plasticizer; in vacuum pumps.
Butyl Benzylphthalate	85-68-7	$C_{19}H_{20}O_4$	Clear, oily liquid.	Plasticizer for PVC.
Di-n-Butylphthalate	84-74-2	$C_{16}H_{22}O_4$	Colorless, oily liquid with mild aromatic odor.	Plasticizer, insect repellant, organic synthesis.
Di-n-Octylphthalate	117-84-0	$C_{24}H_{38}O_4$	Clear, viscous liquid with slight odor.	Plasticizer for PVC.
PAHs				
Indeno(1,2,3-cd)Pyrene	193-39-5	$C_{22}H_{12}$	Solid.	Derived from coal gasification.
Benzo(b) Fluoranthene	205-99-2	$C_{20}H_{12}$	Solid.	Research chemical.
Benzo(a) Anthracene	56-55-3	$C_{18}H_{12}$	Colorless leaflets or plates with a greenish-yellow fluorescence.	Research chemical.
Benzo(a) Pyrene	50-32-8	$C_{20}H_{12}$	Odorless, yellow crystals.	Research chemical.
Chrysene	218-01-9	$C_{18}H_{12}$	Orthorhombic plates exhibiting strong fluorescence under ultraviolet light.	Organic Synthesis.

TABLE K.3

CHEMICAL IDENTITY OF PRIMARY SITE-RELATED COMPOUNDS
WILMINGTON FACILITY

Chemical Group	*CAS Registry Number*	*Formula*	*Physical Description*	*Primary Uses*
Inorganics				
Aluminum	7429-90-5	Al	Tin white, with bluish tint	
Ammonia	7664-41-7	NH_3	Colorless, gas at room temperature	
Calcium	7440-70-2	Ca	moderately soft, silver-white crystalline metal	
Chloride		Cl^-		
Chromium III		Cr	Steel gray, solid	
Chromium VI		Cr	Steel gray, solid	
Copper	7440-50-8	Cu	Distinctive reddish color, ductile	
Iron	7439-89-6	Fe	Silver-white malleable metal	
Manganese	7439-96-5	Mn	Silver in color, solid	
Potassium	7440-09-7	K	soft, silvery metal	
Sodium	7440-23-5	Na	Soft, silvery white solid	
Sulphate		SO_4^{2-}		
Zinc	7440-66-6	Zn	Shiny white metal with bluish-gray luster	

TABLE K.4

CHEMICAL FATE AND TRANSPORT OF PRIMARY SITE-RELATED COMPOUNDS
WILMINGTON FACILITY

Chemical Group	*Compound*	*Air*	*Soil*	*Surface Water*	*Groundwater*
Volatile Organic Compounds	Acetone	- acetone will photochemically react with hydroxyl radicals (half-life 22 days) - direct photolysis	- volatilize and leach into the ground and probably biodegrade (VP=270 mm Hg) - evidence suggests biodegradation is fairly rapid - does not adsorb appreciably to soil (Koc=2.2)	- rapid volatilization to atmosphere (HC = 2.06×10^{-5} atm•m^3/mol)	- moderate to high mobility
	2-Butanone	- volatalize rapidly from soil or water - once in air, will primarily exist in the vapor phase - will undergo photolysis and photochemical reactions with hydroxyl radicals (half-life 2.3 days)	- volatilize rapidly from soil or water - will leach to groundwater due to low adsorption tendencies (K_{OC} = 1.23)	- rapid volatilization to atmosphere (HC = 4.7E - 05 atm•m^3/mol)	- moderate to high mobility
	2-Hexanone	- subject to direct photolysis (half-life 15 hours) - reacts with hydroxyl radicals (half life 16 to 17 hours)	removal from soil via direct photolysis, volatilization or aerobic biodegradation - low adsorption tendencies and leaches to groundwater (K_{OC} = 135)	- rapid volatilization to atmosphere (HC = 1.75E-03 atm•m3/mol) (half-life 15 - 33 hours)	- moderate to high mobility
	Toluene	- primarily vapor phase - photochemical reaction with hydroxyl radicals (half-life 13 hours) - no direct photolysis - scavenged by rainfall	- rapid volatilization to atmosphere and vadose zone (VP=28.1 mmHg) - moderate adsorption (Koc=300) and leaches to groundwater - rapid biodegradation	- rapid volatilization to atmosphere (HC=6.66×10^{-3}atm•m^3/mol) (half-life 5 to 6 hours) - rapid biodegradation - sediment adsorption and bioconcentration are insignificant	- moderate to high mobility - rapid biodegradation
	2,4,4-Trimethyl-1-pentene 2,4,4-Trimethyl-2-pentene	- primarily vapor phase	- no available data to predict fate and transport in soil	- no available data to predict fate and transport in surface water	
Semi-Volatile Organic Compounds	N-Nitrosodiphenylamine	- primarily in vapor phase - adsorbs sunlight, suggesting direct photolysis in a sunlit environment - react with hydroxyl radicals (half-life 7 hours)	- low mobility in soil - leaching to groundwater is not significant (Koc=830 to 1830) - rapid biodegradation	- volatilization will be slow but significant (HC=6.6×10^{-4}atm•m^3/mol) - rapid biodegradation	- low mobility

TABLE K.4

CHEMICAL FATE AND TRANSPORT OF PRIMARY SITE-RELATED COMPOUNDS
WILMINGTON FACILITY

Chemical Group	*Compound*	*Air*	*Soil*	*Surface Water*	*Groundwater*
Semi-Volatile Organic Compounds Cont'd.	N-Nitrosodipropylamine	- rapidly degraded by photolysis and photochemical reaction with hydroxyl radicals	- high water solubility and low K_{oc} (K_{oc} = 129) - leaching to groundwater can potentially be significant - low adsorption capacity	- rapid photolysis - photolysis half-life is approximately 2.5 hours	- moderate mobility
	Phenol	- primarily in vapor phase - slow volatilization from soils and/or water	- rapid biodegradation (half-life 2 - 5 days) - degradation rates will be much slower under anaerobic conditions than aerobic conditions - low adsorption tendencies and leaches to groundwater (K_{oc} = 27)	- rapid biodegradation under aerobic conditions - evaporation, hydrolysis, adsorption to sediment or bioconcentration in aquatic organisms are not significant removal process	- high mobility
Phthalate Esters	Bis(2-ethylhexyl) phthalate	- primarily adsorbed to particulate matter - transported long distances by particulate dispersion - scavenged by rainfall	- volatilization to atmosphere and vadose zone is insignificant ($VP=6.2 \times 10^{-8}$mmHG) - very strong tendency for soil adsorption ($Koc=1 \times 10^{5}$) - leaching to groundwater is not significant - some biodegradation in soil may occur	- volatilization to atmosphere is insignificant ($HC=1.1 \times 10^{-5}$stm.m^3/mol) - rapid biodegradation in surface waters (half-life 2 to 3 weeks) - significant sediment adsorption - bioconcentration in aquatic organisms is significant	- insignificant mobility in groundwater - biodegradation may occur but is insignificant under anaerobic conditions
	Di-n-Butylphthalate	- primarily adsorbed to particulate matter - gravitational settling and scavenged by rainfall - vapor phase di-n-butylphthalate will photochemically react with hydroxyl radicals (half-life 18 hours)	- volatilization to atmosphere and vadose zone is insignificant ($VP=1.0 \times 10^{-5}$mmHg) - very strong tendency of soil adsorption ($Koc=1.7 \times 10^{5}$) - leaching to groundwater is not significant - slow biodegradation	- volatilization to atmosphere is insignificant ($HC=2.82 \times 10^{-7}$atm•m^3/mol) - rapid biodegradation (half-life 2 to 17 days) - moderate adsorption to sediment - slight aquatic bioconcentration offset by its rapid metabolism	- low mobility - transport may be due to formation of water soluble complex with fluvial acid - fate in groundwater is unknown although biodegradation may occur anaerobically

TABLE K.4

CHEMICAL FATE AND TRANSPORT OF PRIMARY SITE-RELATED COMPOUNDS
WILMINGTON FACILITY

Chemical Group	*Compound*	*Air*	*Soil*	*Surface Water*	*Groundwater*
Phthalate Esters Cont'd.	Butyl Benzyl Phthalate	- volatilization to atmosphere is not significant (half-life 1 to 5 days)	- volatilization will not be significant ($VP=8.6x10^{-6}$ mm Hg)) - biotic degradation will not be significant - biodegradation is significant - expected to adsorb and not to leach extensively (Kov=68.347)	- volatilization will not be significant ($HC=1.30x10^{-6}$ atm•m^3/mol) - rapid biodegradation (half-life 2 days)	- biodegradation may occur anaerobically
Polycyclic Aromatic Hydrocarbons (PAHs)	- Benzo(a) anthracene - Benzo(a) pyrene - Benzo(b) fluoranthene - Chrysene - Indeno (1,2,3-cd) pyrene	- present in the gaseous phase or sorbed to particulates - can undergo photochemical oxidation with the formation of nitrated PAHs, phenols and other compounds - atmospheric half-lives are generally less than 30 days	- Koc values range from 10^5 to 10^6 which indicates very strong tendencies to be adsorbed to sediments or soils - evidence suggests microbial degradation is fairly rapid in contrast to photolysis and volatilization - half-life reported for benzo(a)pyrene in soil is 420 to 480 days	- tend to be removed from the water column by volatilization, adsorption to particulates or sediments, biodegradation or bioaccumulation into aquatic organisms - limited volatilization from water (HC - ranges from 10^{-5} to 10^{-8}) - adsorb strongly onto suspended particulates	- low mobility
Inorganics	Aluminum	- atmospheric transformations are not expected to occur during transport - does not degrade in air	- Aluminum is found in the soil complexed with other electron rich species such as fluoride, sulfate, and phosphate - absorption of aluminum out of clay surfaces affects aluminum mobility in soil - decreasing pH results in an increase in mobility of aluminum - does not degrade	- concentrations of dissolved aluminum in water vary with pH levels and the humic derived acid content of the water - absorbs to suspended solids in surface water - no biodegradation	

TABLE K.4

CHEMICAL FATE AND TRANSPORT OF PRIMARY SITE-RELATED COMPOUNDS
WILMINGTON FACILITY

Chemical Group	*Compound*	*Air*	*Soil*	*Surface Water*	*Groundwater*
Inorganics Cont'd.	Ammonia	- removal from air by rain or snow washout is dominant fate process - absorption by surface water - half-life estimated to be a few days	- adsorption occurs in most moist or dry soils - some volatilization to the atmosphere (VP=7600 mm Hg) - nitrification by microbial activity - taken up by plants and other organisms	- volatilizes to the atmosphere - volatilization will increase with increasing pH and temperature - adsorbs to sediment and suspended organic material (Kov=3.1)	
	Calcium		- governs the soluble stage of trace elements in soil	- behaviour in general is governed by the availability of the more soluble calcium-containing solids and by solution and gas-phase equilibria that involve carbon dioxide species, or by the availability of sulphur in the form of sulphate	
	Chromium	- primarily removed from the atmosphere by fallout and precipitation - chromium particles may remain airborne for long periods of time - may be transported long distances	- may be transported to atmosphere in the form of aerosol - runoff and leaching may transport chromium from soil to surface waters and groundwaters - half-life of chromium in soils may be several years	- volatilization to atmosphere is insignificant - most Chromium III will precipitate in sediments - most Chromium IV will be present in soluble form	
	Copper	- released in the form of particulate matter or adsorbed to particulates - removed by gravitational settling, dry deposition, washout by rain, and rainout (scrubbing action below clouds) - removal rate and distance travelled from the source will depend on source characteristics, particle size and wind velocity	- strongly adsorb and remains in the upper few centimeters of soil - adsorption of copper to soil is influenced by pH, organic matter and ionic strength of the soil	- present in natural waters to Cu (II) - complexed or tightly bound to organic matter - subject to sedimentation	

TABLE K.4

CHEMICAL FATE AND TRANSPORT OF PRIMARY SITE-RELATED COMPOUNDS
WILMINGTON FACILITY

Chemical Group	*Compound*	*Air*	*Soil*	*Surface Water*	*Groundwater*
Inorganics Cont'd.	Iron	- released in the form of particulate matter or adsorbed to particulate matter	- oxidizing and alkaline conditions promote the precipitation of Fe whereas acid and reducing conditions promote the solution of the compounds - often complexes with organic ligands	- chemical behaviour and solubility in water depend strongly on the oxidation intensity in the system and pH	
	Manganese	- manganese containing particles are mainly removed from the atmosphere by gravitational settling - the half-life of airborne particles is usually on the order of days	- adsorption to soil depends on pH and EH, and the organic composition of the soil	- solubility is a factor of the specific chemical form present pH of surface water will affect solubility - binds to suspended particles and sediments - subject to microbial activity	
	Manganese	- exist in air as suspended particulate matter - removed by gravitational settling, dry deposition, washout by rain and rainout	- adsorption to soils and sediments is influenced by the organic composition and the carbon exchange capacity of the soil	- solubility is controlled or affected by the pH, Eh (oxidation - reduction potential) and the characteristics of available amins.	
	Potassium		- essential element for both plants and animals - liberated with greater difficulty from silicate-minerals and exhibits a strong tendency to be reincorporated into solid weathering products, especially certain dry minerals		

law constant of 2.06×10^{-5} atm•m^3/mol. As indicated by these values, Acetone will volatilize rapidly from soil, surface water and groundwater.

In the atmosphere, Acetone will be lost by photolysis and reaction with photochemically produced hydroxyl radicals. Half-life estimates from these combined processes is 22 days. Being miscible in water, wash out by rain should be an important removal process.

Soil adsorption is relatively low for Acetone as indicated by a low K_{OC} value of 2.2. Thus, groundwater leaching is a major transport process for Acetone. Sediment adsorption and aquatic bioconcentration is negligible for Acetone.

K.1.6.1.2 <u>Toluene</u>

Toluene has a relatively high vapor pressure of 28.1 mg Hg and a relatively high Henry's law constant of 6.66×10^{-3} atm·m^3/mol. Volatilization of Toluene from surface soil, surface water and groundwater to the atmosphere is the primary transport mechanism for this compound. Under typical conditions, the rate of volatilization from the surface soil to air is within 24 hours. Depending on whether the water is static or turbulent, the rate of volatilization for surface water is 1 to 16 days or 5 to 6 hours, respectively.

In the atmosphere, Toluene exists primarily in the vapor phase and will undergo photochemical reactions with hydroxyl radicals, with

a half-life of approximately 13 hours. Toluene is not subjected to direct photolysis. It is generally persistent in the atmosphere due to the high emission rate associated with vehicular traffic.

In groundwater, the rate of Toluene transport is dependent on the degree of adsorption to soil. Toluene has a relatively low K_{OC} value of 300 which indicates that Toluene will be moderately adsorbed to soils rich in organic matter, but will readily leached from soils with low organic content.

Biodegradation of Toluene is rapid in soil and also in shallow groundwater.

The principle fate mechanisms for Toluene is rapid volatilization from surface soils and biodegradation in subsurface soil and groundwater.

K.1.6.1.3 <u>2-Butanone</u>

2-Butanone or Methyl Ethyl Ketone is produced commercially for use as a solvent especially in the coatings industry. Natural sources include volcanos, forest fires, by-product of biodegradation and it is a natural component of food.

Environmental Fate

Due to its high vapour pressure of 100 mm Hg at 25°C, volatilization from soil or water will be rapid. Once in the air, it will exist primarily in the gas phase. Predominant removal processes include photolysis and photochemical reactions with hydroxyl radicals (half-life 2.3 days).

2-Butanone is highly soluble in water but once released to water, volatilization into the atmosphere is expected to be rapid as indicated by its high vapour pressure and moderate Henry's Law Constant. The estimated half-lives in rivers and lakes is 3 and 12 days, respectively. Biodegradation is slow in both fresh and salt water. Hydrolysis, photo-oxidation, adsorption to sediments and bioconcentration are not significant removal processes.

If 2-Butanone is released to soils, it will partially evaporate into the atmosphere from near-surface soil and may leach into groundwater. Based on its low estimated K_{OC} value of 1.23, 2-Butanone will be expected to exhibit very high mobility in soil and thus, may leach to the groundwater.

K.1.6.1.4 2-Hexanone

2-Hexanone or Methyl Isobutyl Ketone is commercially produced for use as a solvent and denaturant with a wide variety of applications in a large number of industries. Such industries include rare

metal extractors and manufacturers of coatings (i.e. lacquers, varnishes, paints), pharmaceuticals, pesticides, rubber processing chemicals, and adhesives.

Environmental Fate

In the air, 2-Hexanone will be subject to direct photolysis (half-life 15 hours) and reaction with hydroxyl radicals (half-life 16 to 17 hours). In photochemical smog conditions, 2-Hexanone may also react with nitrogen oxides.

Based on its high Henry's Law Constant value of 1.75×10^{-3} atm•m^3/mol, the primary removal mechanism from water is expected to be volatilization (half-life 15 to 33 hours). 2-Hexanone is not expected to undergo chemical oxidation or hydrolysis, bioaccumulate in aquatic organisms or adsorb significantly to suspended solids or sediments in water.

If released to soil, 2-Hexanone may be removed by direct photolysis on soil surfaces, volatilization or aerobic biodegradation. The low estimated K_{OC} value of 135 indicates that 2-Hexanone would be highly mobile in soils and would not adsorb significantly to soils or sediments.

K.1.6.1.5 2,4,4-Trimethylpentene

Two isomers of 2,4,4-Trimethylpentene, namely 2,4,4-Trimethyl-1-Pentene and 2,4,4-Trimethyl-2-Pentene which are colorless liquids, were reported on Site. Known uses of both compounds include organic synthesis, with 2,4,4-Trimethyl-1-Pentene utilized in the production of motor fuel particularly isooctane.

The atmospheric fate and transport mechanisms for the two isomers of 2,4,4-Trimethylpentene is characterized by a high vapor pressure of 77.5 mm Hg at 38°C. This indicates potentially significant volatility from soil, surface water and groundwater.

There are no available data found regarding water solubility but these compounds are known to be soluble in organic solvents such as benzene and chloroform.

Soil adsorption cannot be predicted due to the lack of available K_{OC} values in literature.

K.1.6.2 Semi-volatile Organic Compounds

K.1.6.2.1 N-Nitrosodiphenylamine

N-Nitrosodiphenylamine has been produced commercially in the United States since 1945. It was primarily used as a

vulcanization retardant in the rubber-processing industry and as an intermediate in the manufacture of p-nitrosodiphenylamine. Retardants are chemicals that prevent premature vulcanization of rubber compounds during certain rubber-processing steps such as mixing and calendering. Evidence also suggests the production of N-Nitrosodiphenylamine by microorganisms in the environment.

Environmental Fate

N-Nitrosodiphenylamine has a vapor pressure of 0.1 mm Hg at 25° C and thus, it should exist almost entirely in the vapor phase in the atmosphere. In air, the main degradation pathways include photodecomposition as well as chemical reactions with hydroxyl radicals in the atmosphere.

Solubility in water is 40 mg/L. Volatilization and microbial degradation are two major environmental fate processes in water. Volatilization from water will be slow but should be a significant transport process as indicated by its Henry's Law Constant of 6.6×10^{-4} atm•m^3/mol. A biodegradability test was conducted on N-Nitrosodiphenylamine at levels of 5 and 10 ppm, and using domestic waste water as the microbial inoculum. After a 7-day period, 87% degradation was achieved in the original inoculum of 5 ppm and 47% degradation was achieved in the original inoculum of 10 ppm. After the second 7-day period, 100% degradation was achieved in the original culture of 5 ppm and 63% degradation was achieved in the original culture of 10 ppm. This demonstrated that N-Nitrosodiphenylamine was degradable (1).

The (log Kow) logarithm of n-octanol/water coefficient for N-Nitrosodiphenylamine was estimated to range from 2.57 to 3.13, indicating a low potential for bioaccumulation. A continuous 14-day exposure study of bluegill sunfish with a mean water concentration of 9.21 ppb resulted in an experimental bioconcentration factor of 217 for N-Nitrosodiphenylamine. The half-life of N-Nitrosodiphenylamine in fish was found to be less than 1 day when the fish were placed in a pollutant-free environment after the exposure period. The relatively low experimental bioconcentration potential and short half-life of N-Nitrosodiphenylamine indicated that biomagnification in the aquatic food chain was not a major environmental fate process.

The soil sorption coefficient (K_{OC}) for N-Nitrosodiphenylamine was estimated to range from 830 to 1830 which is indicative of low mobility in soil or sediment. Thus, significant leaching is not expected to occur in most types of soils and/or sediments. The major degradation pathway for N-Nitrosodiphenylamine in soil is microbial degradation.

K.1.6.2.2 <u>N-Nitrosodipropylamine</u>

N-Nitrosodipropylamine is not produced commercially and it is solely used as a research chemical.

The atmospheric fate and transport mechanisms for N-nitrosodipropylamine is characterized by a low estimated vapor pressure of 0.086 mm Hg at 20C and a Henry's Law Constant of 1.47E-06 atm•m^3/mol at 20°C. These values are indicative of low volatility from soil, surface water and groundwater.

In the atmosphere, N-Nitrosodipropylamine vapor would be rapidly degraded by photolysis and photochemical reaction with hydroxyl radicals.

The predominant removal process form water for N-Nitrosodipropylamine is photolysis and microbial degradation. In lake surface water, photolytic half-life for N-Nitrosodipropylamine is approximately 2.5 hours with N-propylamine as a major by-product. Without sunlight, microbial degradation, although expected to be a slow process, is the primary removal pathway.

As indicated by an estimated K_{OC} value of 129 and a high water solubility of 9.894 mg/L, soil adsorption is relatively low. Thus, groundwater leaching is a major transport process for N-Nitrosodipropylamine.

K.1.6.2.3 <u>Phenols</u>

Phenol is commercially produced in large quantities due to its wide range of applications in resins, adhesives, iron and steel,

Aluminum, leather and rubber industries. It is also found in cigarette smoke and vehicular exhaust as well as disinfectants and medicinal products. Natural sources include animal wastes and as decomposition product of organic wastes.

Environmental Fate

Volatilization is not expected to be rapid for Phenol due to its low vapour pressure and Henry's Law Constant. However, if Phenol is released into the atmosphere, it will exist predominantly in the vapor phase. Predominant removal process is photodegradation and photochemical reaction with hydroxyl radicals (half-life 0.61 days).

If Phenol is released to water, the primary removal process will be biodegradation which will generally be rapid under aerobic conditions in comparison to anaerobic conditions. Acclimation of resident microorganisms is rapid under aerobic conditions and may take a few weeks under anaerobic conditions. Evaporation, hydrolysis, adsorption to sediment or bioconcentration in aquatic organisms are not significant removal processes for Phenol.

Based on the reported and estimated K_{OC} value of 27, Phenol will be expected to exhibit high to very high mobility in soil, and therefore, may leach to groundwater. Biodegradation of Phenol in soil will be rapid (2 to 5 days) and will also occur in the subsurface soils. Degradation rates will be much slower under anaerobic conditions than under aerobic conditions.

K.1.6.2.4 Phthalate Esters

The phthalate esters are used in virtually every major product such as construction, automotive, household products, apparels, toys and medical products. This results in wide occurrence of phthalate esters in the environment. Phthalate esters are used as plasticizers for polvinyl and cellulosic resins, primarily in polyvinyl chloride (PVC). The most commonly produced plasticizers are bis(2-ethylhexyl) phthalate (BEHP), di-n-butyl phthalate (DBP), di-n-octyl phthalate (DOP) and butyl benzyl phthalate (BBP). The physical and chemical constants for phthalate esters are summarized in Table K.1.

Because of its high efficiency and stability, BEHP has been used in large quantities as a plasticizer for polyvinyl chloride (PVC) and other polymers. As a result of its common use, BEHP may be found in common goods such as upholstery material, hospital sheeting, shower curtains, food packaging materials and various plastic products used daily by the general public. Pursuant to the banning of PCBs in dielectric fluids for transformers and capacitors, BEHP was selected by many manufacturers as the preferred material for dielectric fluids. BEHP is currently still used in the transformer and capacitor industry.

Environmental Fate

Atmospheric levels of phthalate esters are caused by volatilization during the manufacture and waste disposal of plastic products. Phthalate esters have high boiling points ranging from 230°C to 386°C and low vapor pressures ranging from 1.4×10^{-4} to 6.2×10^{-8} mm Hg at 25°C. This indicates a strong affinity to adhere to atmospheric particulate matter especially organic matter and soot. A significant removal process from the atmosphere is by rain washout. Direct photolysis and photoxidation are atmospheric processes that might occur but to a very limited extent.

In the presence of a direct pollution source, the extent of contamination in water systems by phthalate esters is influenced by the compound's water solubility. The water solubility for phthalate esters ranges from a minimum value of 285 ppb to a maximum value of 13000 ppb (13 ppm). Table K.1 presents the solubilities of diesters in water compiled from a number of sources. As expected, the length of alkyl side chains affect water solubilities of phthalate esters. Due to the larger alkyl side chains of BEHP its water solubility is considerably lower than the shorter alkyl-side chain phthalates such as DBP. Therefore, the apparently low water solubility will limit the amount of BEHP entering this media and BEHP will generally exhibit decreased mobility in aqueous system as demonstrated in previous sections.

Biodegradation in aquatic systems is quite rapid with a half-life of 2-3 weeks following a period of acclimation.

Primary removal of phthalate esters from water systems is through adsorption to suspended matter and sediments as indicated by the high organic carbon partitioning coefficient (K_{OC}). The K_{OC} values for phthalate esters range from 68 to 980,000,000. As discussed earlier, a high K_{OC} generally indicates an increased likelihood for the chemical to bind to soil or sediment rather than to remain in water. Thus, phthalate esters have significantly high K_{OC} values which is indicative of lower mobility.

The Henry's Law constants for phthalate esters range from 1.1×10^{-5} to 1.41×10^{-12} atm•m3/mol. This is indicative of the extent of chemical partitioning between air and water at equilibrium. Due to the low Henry's Law Constants for phthalate esters, its volatilization to the atmosphere from water is likely to be negligible. This is true even under conditions, such as aeration, conducive to contaminant evaporation. For BEHP, evaporation and hydrolysis are not significant aquatic processes.

The phthalate esters, including BEHP, have a strong affinity for soil solids, including organic, humic fraction of soil. Both the mineral and organic fraction of solid soil particles tend to bind BEHP and other phthalates.

Degradation of phthalates in soil is mediated by a wide variety of microorganisms capable of metabolizing phthalates to simpler molecules. Several microorganisms including the saprophytic bacterium Serratia, Penicillium lilacinuns and Enterobacter erogenous, have been shown to degrade BEHP. Serratia can use the compound as a sole source of carbon and energy.

The rates of degradation, appear to increase with decreasing alkyl chain length. Biodegradability of BEHP is less biodegradable than short (less than 6 carbons) carbon-chain length phthalate esters but more biodegradable than several other long-carbon chain phthalates (i.e. >7 carbons). Microbial transformation of phthalate esters undoubtedly accounts for the major part of their biodegradation in the environment. Phthalates are biodegraded in water, sludge and soil under aerobic conditions. The degradation of BEHP in soil occurs under aerobic conditions, but only slowly, if at all under anaerobic conditions. Studies with ^{14}C-carbonyl-labeled BEHP in aerobic freshwater hydrosoil yielded a degradation half-life of approximately 14 days.

"Phthalate esters are being broken down continually in the environment. Thus, current environmental levels must reflect an equilibrium between amounts released in the environment and those removed. However, the amounts in any environmental compartment for example silt, lakes, air and so forth, must represent varying levels of equilibria as the phthalate concentrations normalize. In aquatic environments, dialkyl phthalates have been shown to exist in the fatty surface layer of water and it seems likely that this renders them more liable to environmental degradation as many aquatic plants and animals live in this energy-rich zone. However at high concentrations, phthalates may still be degraded and furthermore degradation maybe complete."

Presence as a Laboratory Contaminant

BEHP is a common laboratory contaminant. Many studies have shown commercial organic solvents to be contaminated with BEHP. Various investigators have noted the general contamination of laboratory supplies, solvents, and reagents with BEHP to the extent that the detection limit for BEHP in investigative samples is determined by the reagent-laboratory blank.

Due to ambient conditions within the laboratory setting, BEHP contamination of investigative samples is a common occurrence. Based on this fact, BEHP concentrations determined in investigative samples must be carefully scrutinized for validation purposes. If BEHP is detected in an investigative sample and a laboratory blank, the concentration in the investigative sample must exceed the concentration found within the blank by a factor of 10 to be considered present (i.e. multiply concentration found in laboratory blank sample by 10 to determine detection limit for investigative sample).

K.1.6.2.5 Polycyclic Aromatic Hydrocarbons (PAHs)

Polycyclic Aromatic Hydrocarbons (PAHs) are a group of chemicals formed during the incomplete combustion of virtually all forms of organic materials. The combustion of fuels in cars and in furnaces produces PAHs. Waste incinerators produce PAHs. Natural sources include volcanoes, forest fires, crude oil and shale oil. PAHs can also be found in substances such

as crude oil, coal tar pitch, creosote, road and roofing tar. A major source of exposure for humans is cigarette smoking, both active and passive. Therefore, PAHs are ubiquitous in the environment and the increasing levels found in the environment parallel industrial and urban development. Note the impact of urban sources (furnace fuels and vehicle exhaust, for example) on the PAH levels in surface soils as presented in Table K.5.

Chemical Identity

The following PAHs are considered as a group in this review of the chemical and physical properties of PAHs.

- benzo(a)anthracene
- benzo(a)pyrene
- benzo(b)fluoranthene
- chrysene
- indeno(1,2,3-cd)pyrene

Tables K.1 to K.3 summarize the physical and chemical properties of the above listed chemicals.

As pure chemicals, PAHs generally exist as colorless, white or pale yellow-green solids. Most PAHs do not occur alone in the environment, rather they are found as mixtures of two or more PAHs. The PAHs listed above are not commercially produced in the U.S. nor are there any known uses for them except as research chemical.

TABLE K.5

BACKGROUND SOIL CONCENTRATIONS OF POLYCYCLIC AROMATIC HYDROCARBONS (PAHs)

	Concentration (µg/kg)		
Compound	*Rural Soil*	*Agricultural Soil*	*Urban Soil*
Acenaphthene	1.7	6	
Acenaphthylene		5	
Anthracene		11-13	
Benzo(a)anthracene	5-20	56-110	169-59,000
Benzo(a)pyrene	2-1,300	4.6-900	165-220
Benzo(b)fluoranthene	20-30	58-220	15,000-62,000
Benzo(e)pyrene		53-130	60-14,000
Benzo(g,h,i)perylene	10-70	66	900-47,000
Benzo(k)fluoranthene	10-110	58-250	300-26,000
Chrysene	38.3	78-120	251-640
Fluoranthene	0.3-40	120-210	200-166,000
Fluorene		9.7	
Indeno (1,2,3-cd)pyrene	10-15	63-100	8,000-61,000
Phenanthrene	30	48-140	
Pyrene	1-19.7	99-150	145-147,000

Sources:
IARC (1973)
White and Vanderslice (1980)
Windsor and Hites (1979)
Edwards (1983)
Butler et al. (1984)
Vogt et al. (1987)
Jones et al. (1987)

Environmental Fate

Some of the transport and partitioning characteristics of the PAHs are roughly correlated to their molecular weights. The Site-related PAHs are considered high molecular weight compounds ranging from 228 g/mol to 278 g/mol.

In air, PAHs are present in the gaseous phase or sorbed to particulates. The atmospheric residence time and transport distance depend on the size of the particles to which PAHs are adsorbed. That is, the larger the particulate size, the shorter the residence time and transport distance. PAHs can undergo photochemical oxidation with the formation of nitrated PAHs, Phenols, and other compounds. Atmospheric half lives are generally less than 30 days.

PAH compounds tend to be removed from the water column by volatilization to the atmosphere, adsorption to particulates or sediments, biodegradation or bioaccumulation into aquatic organisms. The high molecular weight PAHs have Henry's Law Constants in the range of 10^{-5} to 10^{-8} (refer to Table K.1) which indicates very limited volatilization from water. Half-lives for volatilization of benzo(a)anthracene and benzo(a)pyrene (high molecular weight PAHs) from water have been estimated to be greater than 100 hours.

High molecular weight PAHs have K_{OC} values that range from 10^5 to 10^6 which indicates strong tendencies to adsorb to organic carbon. Due to their low water solubilities, PAHs are primarily found adsorbed to

sediments or soils. Adsorption of PAHs is a function of organic carbon content and particle size. The environmental fate of PAHs is described by USEPA in the document "Ambient Water Quality Criteria for Polynuclear Aromatic Hydrocarbons" which states:

> "PAH will adsorb strongly onto suspended particulates and biota and their (PAH) transport will be determined largely by the hydrogeologic condition of the aquatic system. PAH dissolved in the water column will probably undergo direct photolysis at a rapid rate. The ultimate fate of those which accumulate in the sediment is believed to be biodegradation and biotransformation by benthic organisms (USEPA, 1979).

This is restated in the USEPA document "Health Effects Assessment for Polycyclic Aromatic Hydrocarbons (PAHs)" which states:

> "The predominant mechanism that is likely to dictate the fate of most PAHs in aquatic media is sorption to particulate matter and subsequent sedimentation and microbial degradation."

Since PAHs are most likely to stay in the sediment or soil, microbial degradation is the most likely ultimate environmental fate in contrast to photolysis and volatilization. Compounds with four cyclic rings or less are most amenable to microbial degradation. Benzo(a)pyrene (five cyclic rings) has a half life in soil inoculated with bacteria of less than eight days. The half-life reported for benzo(a)pyrene in soil reported in Superfund

Public Health Evaluation Manual (SPHEM, 1986) is 420 to 480 days but there is no reference to the microbial content in the soil.

K.1.6.3 Inorganics

The final group of Site-related constituents includes a variety of inorganics which are typified by the following metals:

- Aluminum (Al)
- Ammonia (NH_3)
- Calcium (Ca)
- Chloride (Cl^-)
- Chromium III (Cr III)
- Chromium VI (Cr VI)
- Copper (Cu)
- Iron (Fe)
- Manganese (Mn)
- Potassium (K)
- Sodium (Na)
- Sulphate (SO_4^{2-})
- Zinc (Zn)

The following sections will present a literature review of the properties of these metals. The goals of this review will be to determine and evaluate the properties of these metals in the environment that are important in determining the environmental fate.

K.1.6.3.1 Aluminum (Al)

The largest source of particle-borne Aluminum is the flux of dust from ores and rock materials in the earth's surface. The sources of this dust are both natural processes, such as weathering of aluminosilicate crystal material and human activity, such as mining and agriculture. Aluminum has only one oxidation state (+3). Because of its reactivity, Aluminum is not found as a free metal in nature. It is found in the atmosphere mainly as aluminosilicates associated with particulate matter. However, because Aluminum can exist in only one oxidation state in the environment, atmospheric transformations are not expected to occur during transport. Aluminum is found in the soil complexed with other electron-rich species such as fluoride, sulphate, and phosphate. Soil characteristics which effect Aluminum mobility are pH and organic content. When pH of soil is decreased, possibly due to acid rain, Aluminum becomes more soluble. Aluminum will adsorb to organic matter in soils and therefore reduce mobility.

K.1.6.3.2 Ammonia

Ammonia is a naturally-occurring compound which is a key intermediate in the nitrogen cycle. The commercial synthesis of Ammonia is thought to contribute less than 5% to the total global Ammonia budget. Because of its significance in natural cycles, Ammonia has a

background concentration in most environmental media. When Ammonia is found at a local concentration that is higher than these background levels, it is usually a result of man's influence. In determining the environmental fate of Ammonia, several factors should be considered. Ammonia is the most abundant basic gas in the environment. An acid-base reaction between water and Ammonia occurs, such that the dominant form of Ammonia in water at environmentally significant pHs, is the Ammonium ion (NH_4^+). Ammonia is a key intermediate in the nitrogen cycle which is tied to the other important biological cycles (i.e. sulfur cycle or carbon cycle).

Ammonia may be released to the atmosphere by volatilization from the following sources:

- decaying organic matter;
- animal livestock excreta;
- fertilization of soil;
- venting of gas, leaks, or spills during commercial synthesis, production, or transportation;
- sewage or wastewater effluent;
- burning of coal, wood, and other natural products; and
- volcanic eruptions.

Ammonia may be released to water through the following:

- effluent from sewage treatment plants;
- effluent from industrial processes;

- runoff from fertilized fields; and
- runoff from areas of concentrated livestock.

Ammonia may be released to soils by:

- natural or synthetic fertilizer application;
- a result of livestock excrement;
- decay of organic material from dead plants and animals; and
- the natural fixation of atmospheric nitrogen.

In the atmosphere, Ammonia can be removed by rain or snow washout. This seems to be the dominant fate process. Ammonia can also be removed from the atmosphere through the direct adsorption by surface waters in areas where local atmospheric concentration is high. The reaction with acidic substances, such as H_2SO_4, HCl or HNO_3; produced in high concentrations from anthropogenic activity produces Ammonium aerosols which can undergo dry or wet deposition. The gas phase reaction of Ammonia with photochemically produced hydroxyl radicals is thought to contribute about 10% to the overall atmospheric removal process. The best estimate of the atmospheric half-life of Ammonia is a few days.

In soil, Ammonia may either volatilize to the atmosphere, adsorb to soil, or undergo microbial transformation to nitrate or nitrate anions. Uptake by plants can also be a significant fate process. Adsorption of Ammonia occurs in most moist or dry soils, and Ammonia is predominantly, but not exclusively, held as the Ammonium ion. Generally

adsorption will increase with increasing organic content of the soil, and will decrease with increasing pH.

In water, Ammonia volatilizes to the atmosphere. This process is highly pH-dependent, and can also depend on other factors such as temperature and wind speed, and atmospheric concentrations. Adsorption of Ammonia to sediment and suspended organic matter can be important under proper conditions. Adsorption to sediment should increase with increasing organic content, increased metal ion content, and decreasing pH. Ammonia in water can be removed by the microbial processes of nitrification and denitrification which would produce ionic nitrogen compounds, and from these, elemental nitrogen. The ionic nitrogen compounds formed from the aerobic processes of nitrification, NO_2^- and NO_3^-, can then leach through the sediment or be taken up by aquatic plants or other organisms.

K.1.6.3.3 Calcium (Ca)

Calcium is the most abundant of the alkaline-earth metals and is a major constituent of many rock minerals. It is an essential element for plant and animal life forms and is a major component of the solutes in most natural waters. Calcium has only one oxidation state, Ca^{2+}. Its behaviour in natural aqueous system is generally governed by the availability of the more soluble calcium-containing solids and by solution and gas-phase equilibria that involve carbon dioxide species, or by the availability of sulphur in the form of sulphate.

The usual dissolved form of calcium can be simply represented as the Ca^{2+}. In natural waters, the most common complexes of calcium are with hydroxide and carbonate ions. The pH of the surface water will directly affect which complexes are most dominant. Equilibria involving carbonates are a major factor in limiting the solubility of calcium in most natural waters.

Solutions of most soils contain an excess of Ca^{2+}, which in many soils constitutes more than 90 percent of the total cation concentration. Ca^{2+} is, therefore, the most important cation in governing the soluble stage of trace elements in soils. The transport of dissolved elements such as calcium may take place through the soil solution (diffusion) and also with the moving soil solution (mass flow, leaching).

K.1.6.3.4 Chloride and Sulphate

Chlorides and sulphates are commonly present in soil and sediment. They are negligible compounds in soil that developed in a humid climate, but in soils of arid climatic zones they can be the dominant controls of the behavior of trace elements. Sulphates of heavy metals are also readily available to plants, and their occurrence in soils has practical importance in agriculture. Chlorides as the most soluble salts occur only in soils of arid or semi-arid climatic zones.

Once in the water, chloride ions do not significantly enter into oxidation or reduction reactions, form any important solute complexes

with other ions unless chloride concentration is extremely high, do not form salts of low solubility, are not significantly adsorbed on mineral surfaces and play few vital biochemical roles. Chloride ions moved with the water through most soils tested with less retardation or loss. Chloride forms ion pairs or complex ions with some of the cations present in natural waters, but these complexes are not strong enough to be of significance in water chemistry.

K.1.6.3.5 Chromium (Cr)

Chromium (Cr) is a naturally occurring element found in continental crust, volcanic dust and gases. Chromium metal is a steel-gray solid and is primarily used in the steel and metallurgical industries. Chromium is also used in the following industries:

- refractory brick,
- metal finishing,
- manufacture of pigments,
- leather tanning,
- wood treatment, and
- water treatment

Society's use of this metal causes larger amounts of chromium to be emitted into the environment than from natural processes.

Chemical Identity

The physical and chemical properties of chromium are presented in Table K.1. Chromium has an atomic weight of 51.996 g/mole. Chromium and its salts have various solubilities in water.

Environmental Fate

Chromium occurs naturally in the Earth's crust but the majority of chromium which exists in the environment is a direct result of human activity. Chromium is released to the environment as follows:

Chromium (III) 61%	*Chromium (VI)* 32%
• coal/oil combustion	• chemical manufacture
• steel production	• plating
	• metal production

Chromium is removed from the atmosphere by fallout and precipitation. There are no known chromium compounds that can volatilize from water and thus transport of chromium from the water to the atmosphere is minimal.

Most of the chromium (III) is expected to precipitate in sediments. Limited amounts of Cr (III) remains in solution as soluble complexes. Cr (VI) may be transported over a significant distance but will eventually be reduced to Cr (III) by the organic matter in the water. The

residence time of chromium in lakewater is estimated to be between 4.6 and 18 years.

In soil, chromium will usually exist as $Cr_2O_3.nH_2O$ since the organic matter in the soil will convert soluble chromate to insoluble Cr_2O_3.

Speciation

In natural waters, at a neutral pH, chromium can exist in the aqueous phase at levels up to 500 ppb before $Cr(OH)_3(s)$ begins to precipitate.

K.1.6.3.6 Copper (Cu)

Copper and its compounds are naturally present in the earth's crust, primarily found as sulphides and oxides. Metallic Copper is prepared by smelting and electrolytic refining.

Copper is released to the atmosphere in the form of particulate matter or adsorbed to particulate matter. It is removed by gravitational settling (bulk deposition), dry deposition (inertial impaction characterized by a deposition velocity), washout by rain (attachment to droplets within clouds), and rainout (scrubbing action below clouds). The removal rate and distance travelled from the source will depend on source characteristics, particle size, and wind velocity. Gravitational settling governs

the removal of large particles (>5 μm), whereas smaller particles are removed by the other forms of dry and wet deposition.

In natural waters, Copper is predominantly in its Cu(II) state. Most of it is complexed or tightly bound to organic matter; little is present in the free (hydrated) or readily exchangeable form. The chemical conditions in most natural waters are such that, even at relatively high copper concentrations, these processes will reduce the free [Cu(II)] concentrations to extremely low values. Sediment is an important sink and reservoir for copper.

Most copper deposited in soil from the atmosphere, agricultural use, solid waste and sludge disposal will be strongly adsorbed and remain in the upper few centimeters of soil. Sandy soils with low pH have the greatest potential for leaching. In most temperate soil, the pH, organic matter, and ionic strength of the soil solutions are the key factors affecting adsorption.

K.1.6.3.7 Iron (Fe)

Iron (Fe) is widely distributed in the earth's crust and is a major component of the core. Most ores are complex oxides, which are reduced in a blast furnace. Iron, or more precisely its carbon alloy, steel, is the backbone of modern civilization, with total production exceeding that of all other metals combined.

Iron compounds, both ferrous (+2) and ferric (+3) have generally low solutibilities in water. The major exceptions are the halides and nitrates. The chemical behaviour of iron and its solubility in water depend strongly on the oxidation intensity in the system in which it occurs; pH is a strong influence as well.

In soils, the general rules governing the mobilization and fixation of Fe are that oxidizing and alkaline conditions promote the precipitation of Fe, whereas acid and reducing conditions promote the solution of Fe compounds. The released Fe readily precipitates as oxides and hydroxides, but it substitutes for Mg and Al in other minerals and often complexes with organic ligands. The content of soluble Fe in soils is extremely low in comparison with the total Fe content. The soluble Fe level reaches a minimum in the alkaline pH range and a maximum in very acidic soils. When soils are waterlogged, the reduction of Fe^{3+} to Fe^{2+} takes place and is reflected in an increase in Fe solubility

K.1.6.3.8 Manganese (Mn)

Manganese is an abundant element comprising about 0.1% of the earth's crust. Above-average exposures to manganese are most likely to occur in or near a factory or a waste site that releases significant amounts of manganese dust into the air. Manganese is also released into the air by combustion of leaded gasoline.

Manganese may exist in air as suspended particulate matter and are mainly removed from the atmosphere by gravitational settling. Removal by washout mechanisms such as rain may also occur, but is less important in removing manganese from the atmosphere than dry deposition.

The tendency of soluble manganese compounds to adsorb to soils and sediments depends mainly on the carbon exchange capacity and the organic composition of the soil. Soil adsorption contents for Mn(+2) span five orders of magnitude, ranging from 0.2 to 10,000 mL/g, increasing as a function of the organic content and the ion exchange capacity of the soil. Thus, adsorption may be highly variable.

The chemical fate and transport of manganese in water is controlled by the solubility of the specific chemical form present, which in turn is determined by pH, Eh (oxidation-reduction potential), and the characteristics of available anions. The metal may exist in water in any of four oxidation states (2+, 3+, 4+ or 7+). Divalent manganese (Mn^{+2}) predominates in most waters with pH of 4 to 7, but may become oxidized at pH greater than 8 or 9. The principal anion associated with Mn(+2) in water is usually carbonate (CO_3^{-2}), and the concentration of manganese is limited by the relatively low solubility (65 mg/L) of $MnCO_3$. Manganese is often transported in rivers as suspended sediments.

K.1.6.3.9 Potassium (K)

The crustal abundance of Potassium (K) is 2.59 percent. Potassium metal is used in organic syntheses. Several compounds have medicinal uses. KCl is used in fertilizer and plant nutrients, pharmaceuticals, photography, and spectroscopy and as a salt substitute, laboratory reagent, buffer, and food additive.

Potassium is known to behave differently than Sodium in natural systems. Sodium tends to remain in solution rather persistently once it has been liberated from silicate-numeral structures. Potassium, on the other hand, is liberated with greater difficulty from silicate-minerals and exhibits a strong tendency to be reincorporated into solid weathering products, especially certain clay minerals.

Potassium is an essential element for both plants and animals. Maintenance of optimum soil fertility entails providing a supply of available Potassium. The element is present in plant material and is lost from agricultural soil by crop harvesting and removal as well as by leaching and runoff acting on organic residues.

Potassium ions assimilated by plants become available for re-solution when the plants mature and die, or when leaves and other parts are shed at the end of the growing season. In the natural recycling that occurs in forests and grasslands; this Potassium is leached into the soil by rains during the dormant season or made available by the gradual decay of the organic material.

K.1.6.3.10 Sodium (Na)

In the United States, soda ash (technical grade Na_2Co_3) is the major Sodium compound produced. Natural soda ash is produced by electrolysis of sea water or lake brines. Sodium compounds are among the highest tonnage industrial chemicals. Major industrial uses of Sodium compounds include manufacturing Sodium glasses and detergents, bleaching pulp, paper, and textiles; and treating water. Sodium is the most familiar alkali metal, it is soft at ordinary temperatures and so reactive with water and oxygen it is stored under oxygen-free liquids such as kerosene. Practically all of its compounds are water soluble. Generally, the chemistry of the anion dominates the chemical behaviour and industrial use.

When Sodium has been brought into solution, it tends to remain in that status. There are no important precipitation reactions that can maintain low Sodium concentrations in water, in the way that carbonate precipitation controls calcium concentrations. Sodium is retained by adsorption on mineral surfaces, especially by minerals having high cation capacities such as clays.

K.1.6.3.11 Zinc (Zn)

Zinc is widely distributed in nature, consisting of 0.027 percent (by weight) of the earth's crust (Merck 1983), but it is usually not

found free in nature. The primary sources of Zinc in the environment are related to metallurgic wastes from smelter and refining operations. Releases to surface and groundwater are probably the greatest source of ambient Zinc. Zinc is not volatilized to any significant extent, but is primarily deposited on sediments as a result of discharge from industrial operations and weathering processes.

Zinc is released to the atmosphere as dust and fumes from Zinc production facilities. Total releases of Zinc to air account for only a small portion of the total environmental release. Volatilization does not appear to be an important process for Zinc. No estimate for the atmospheric lifetime of Zinc is available at this time. Atmospheric emissions of Zinc, consisting primarily of Zinc sorbed to submicron particulate matter and the oxide of Zinc are expected to be short-lived, due to surface deposition (EPA 1980).

In aquatic environments, sorption of Zinc is its dominant fate. Zinc partitions to sediments or suspended solids in surface waters through sorption onto hydrous iron and manganese oxides, clay minerals and organic material.

Zinc is likely to be strongly sorbed in soil. The mobility of Zinc in soil depends on the solubility of the speciated forms of the compound and on soil properties such as sorption potential, pH and salinity. No information specifically related to transformation and degradation in soil was identified in the available literature; however, chemical speciation of Zinc in soil is probably affected by the same factors affecting its fate in water.

REFERENCES

Agency for Toxic Substances and Disease Registry, U.S. Public Health Service. "Toxicological Profile for Aluminum". February 15, 1991.

Agency for Toxic Substances and Disease Registry, U.S. Public Health Service. "Toxicological Profile for Chromium". January 16, 1988.

Agency for Toxic Substances and Disease Registry, U.S. Public Health Service. "Toxicological Profile for Copper". February 16, 1990.

Agency for Toxic Substances and Disease Registry, U.S. Public Health Service. "Toxicological Profile for Di(2-ethylhexyl)Phthalate". January 1988.

Agency for Toxic Substances and Disease Registry, U.S. Public Health Service. "Toxicological Profile for Manganese". February 15, 1991.

Agency for Toxic Substances and Disease Registry, U.S. Public Health Service. "Toxicological Profile for N-Nitrosodiphenylamine". February 18, 1992.

Agency for Toxic Substances and Disease Registry, U.S. Public Health Service. "Toxicological Profile for N-Nitrosodi-n-propylamine". April 14, 1989.

Agency for Toxic Substances and Disease Registry, U.S. Public Health Service. "Toxicological Profile for Polycyclic Aromatic Hydrocarbons". February 16, 1990.

Agency for Toxic Substances and Disease Registry, U.S. Public Health Service. "Toxicological Profile for Toluene". April 14, 1989.

Agency for Toxic Substances and Disease Registry, U.S. Public Health Service. "Toxicological Profile for Zinc". April 14, 1989.

Carson, Bonnie L., Ellis III Harry V., McCann, Joy L., "Toxicology and Biological Monitoring of Metals in Humans", Lewis Publishers Inc. 1986.

Hem, John D., "Study and Interpretation of the Chemical Characteristics of Natural Water", U.S. Geological Survey Water - Supply Paper 2254. 1986.

Howard, Philip H., "Handbook of Environmental Fate and Exposure Data for Organic Chemicals", Volume I, Lewis Publishers, Inc. 1989.

Howard, Philip H., "Handbook of Environmental Fate and Exposure Data for Organic Chemicals", Volume II, Lewis Publishers, Inc. 1990.

Kabata-Pendias, Alina and Pendias, Henryk. "Trace Elements in Soils and Plants", CRC Press, Inc. 1984.

Mellan, Ibert, "Industrial Plasticizers", Pergamon Press, New York. 1963.

Montgomery, J., Welkom, L., "Groundwater Chemicals Desk References," Lewis Publishers. 1990.

Page, B. Denis, "An Overview of Analytical Methods for Phthalate Esters in Foods", in Abstracts of Papers, 193rd ACS National Meeting, American Chemical Society. 1987.

USEPA "Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses". February 1988.

Woodward, Kevin N., "Phthalate Ester: Toxicity and Metabolism: Volume II, CRC Press Inc., Florida. 1988.