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LANDFILL HYDROGEOLOGY, NAVAL WEAPONS SUPPORT CENTER, CRANE, INDIANA

by

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Crane, Indiana

PREFACE

This report is the sixth of six studies performed by personnel of the Site Characterization Unit (SCU) Geotechnical Laboratory (GL) of the U. S. Army Engineer Waterways Experiment Station. Funding for this study was authorized by Order for Work and Services-NAVCOMPT Form 2275 (2-81) Number N0016483WR0G185 dated 17 May 1983 and amended 9 and 16 September 1983.

The field work was conducted during the periods 7 June 1983 to 11 October 1983. Data reduction was performed from October 1983 to April 1984 and report preparation was accomplished during this same period. The drilling was performed by the Exploration Group (EG), Engineering Geology and Rock Mechanics Division (EGRMD), GL, under the supervision of Mr. Joseph B. Dunbar, Engineering Geology Applications Group (EGAG) of the EGRMD. Mr. Dunbar prepared the report and Mr. Dale L. Barefoot assisted in data compilation.

The study was conducted under the direct supervision of Mr. Jerald D. Broughton, Acting Chief, SCU, and under the general supervision of Mr. John H. Shamburger, Chief, EGAG, Mr. Mark A. Vispi, Chief, EG, Dr, Don C. Banks, Chief, EGRMD, and Dr. William F. Marcuson III, Chief, GL.

Special acknowledgment is extended to Ms. Cathy Andrews and Mr. Jim Hunsicker of the Naval Weapons Support Center for their assistance during the study.

Commander and Director of WES during the conduct of the study was COL Tilford C. Creel, CE. The Technical Director was Mr. F. R. Brown.

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PART I: INTRODUCTION

Background

1. The Naval Weapons Support Center (NWSC) landfill is located in Sec 5 and 6, T4N, R4W as shown by Figure 1. The landfill was opened in 1972 for disposal of about 40,000 pounds per day of paper, wood, metal, and putrescible materials. Dumping is in cells; about 100 ft in width, 500 ft in length, and 12 to 15 ft deep; underlain by a leachate collection system with the leachate being pumped to the NWSC waste disposal facility for treatment. Locations of filled and unfilled disposal cells and battery burial sites are shown in Figure 2. The approximate limits of the NWSC landfill are defined by Highway 161, the powerline access road, the road immediately north of building 2993, and the monitoring well access road west of disposal cell 13.

2. The NWSC requested the Waterways Experiment Station (WES) to drill two borings at the landfill to define soil thickness for future cell locations. At the time of the NWSC request, the WES was involved in a hydrogeologic study of NWSC hazardous waste disposal sites where the potential existed for groundwater contamination. Previous hydrogeological work at the NWSC landfill include 24 borings drilled by the U. S. Navy in 1970 and 1971 for the original landfill plans submitted in October 1971 by Fleck, Burkart, Shropshire, Boots, Reid, and Associates Inc. of Indianapolis, Indiana. The Snell Environmental Group (SEG) of Lansing, Michigan, submitted a report in July 1976 on inadequacies and a preliminary design to correct problems and procedures at the landfill. As a result of the SEG report, 14 monitoring wells were installed at the landfill by Mumma Drilling Inc. of Washington, Indiana, sometime after 1977 and prior to 1979. A review of the hydrogeologic data from the landfill by the Indiana State Board of Health determined existing monitoring wells and soil borings were inadequate and recommended additional soil borings and monitoring wells before operational permits could be issued. Atec Associates of Indianapolis, Indiana, installed 4 monitoring wells and drilled 10 borings in November and December 1979 as a result of State Board of Health recommendations.

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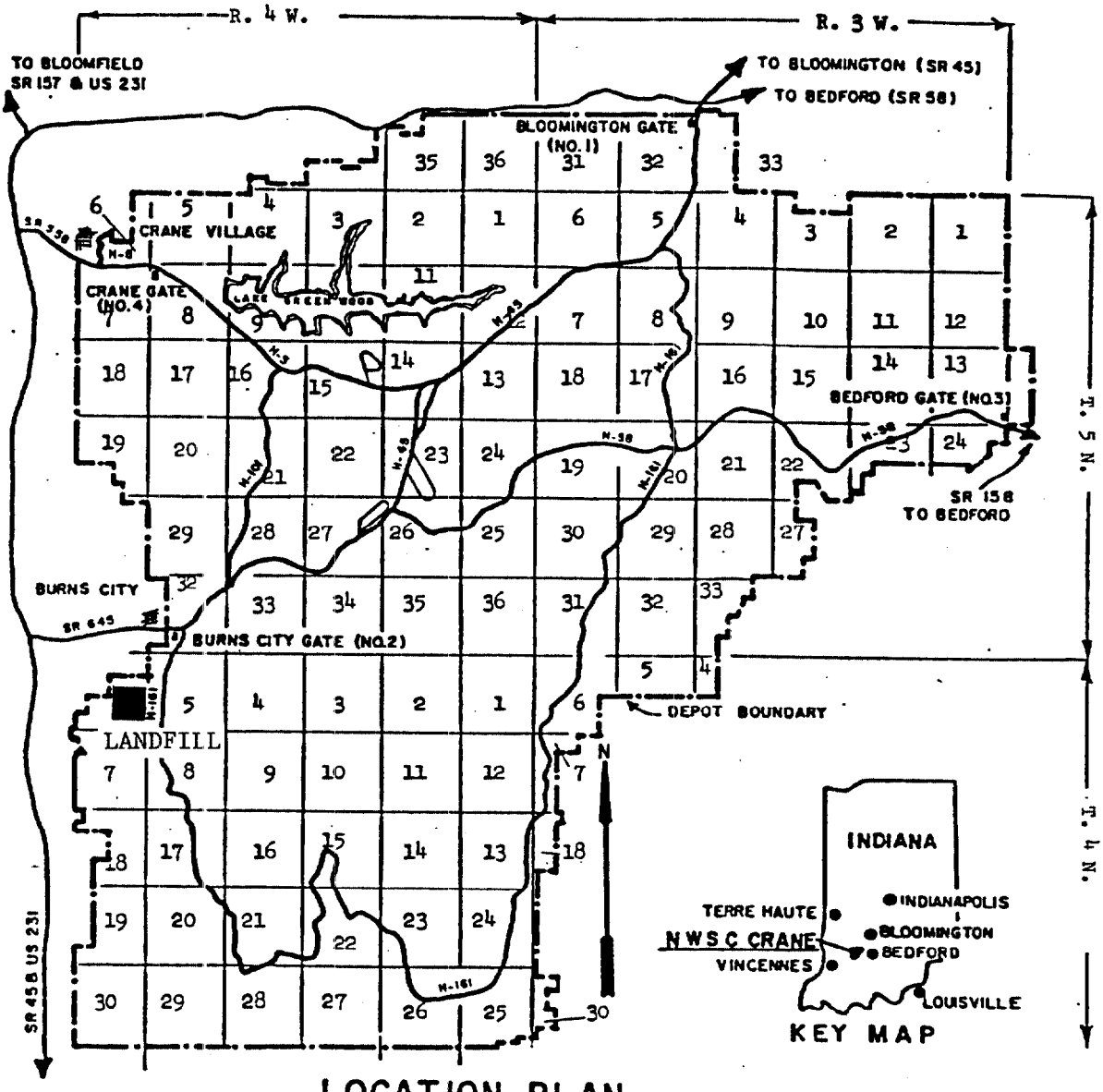

LOCATION PLAN

SCALE = GRID LINES FORM MILE SQUARES

Figure 1. Location of NWSC Landfill

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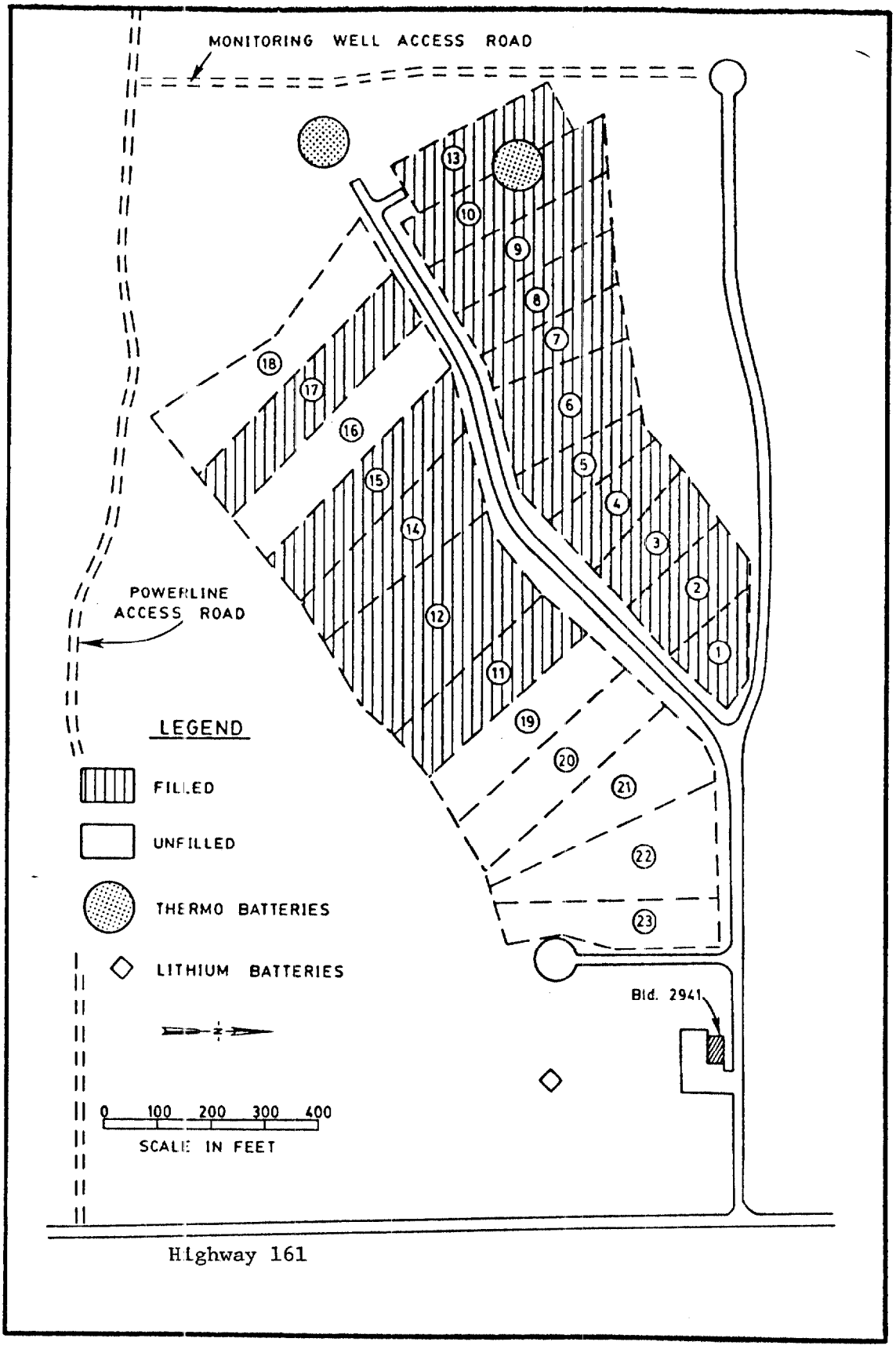

Figure 2. Landfill Cell and Battery Disposal Site Locations

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Purpose

3. The purposes of this report are to define soil thickness at the landfill between the powerline access road and cells 19 to 23 (See Figure 2) from WES and existing boring data and define the depth and flow direction of groundwater from existing well data. Activities during this study include soil and rock sampling, site reconnaissance, physical soil testing, a review of existing boring and ground-water data, and data analysis.

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PART II: DRILLING AND SAMPLING

WES Borings

4. Two borings, WES-11-1-83 and WES-11-2-83, were drilled with a truck-mounted Failing 1500 drilling rig approximately 10 ft into rock (see Figure 3). Boring WES-11-2-83 was drilled east of Building 2993, on east side of Highway 161, to verify if soil thickness was similar to soil thickness at the landfill. Three- inch undisturbed soil samples were taken in each boring with a fixed piston sampler at a 5 ft sample interval for laboratory classification of soil samples to supplement existing soils data from the landfill. Boring advance between soil samples was with a 5-in. folding auger and boring advance in rock was with a 4x5-1/2 in. core barrel for visual examination of the rock. When drilling in rock, air was used to remove the cuttings. Borings were grouted following drilling.

Previous Borings

5. Previous landfill borings were drilled by three different drilling contractors over a 9 year period. Borings B-20 through B-34, B-40 through B-45, and B-50 through B-52 were drilled by the U. S. Navy and consist of 2-1/2 in. auger borings drilled to refusal at rock. It is unknown what type of soil samples, if any, were taken in these borings. No drilling information is available from borings 1 through 7 which were drilled by Mumma Drilling Inc. A shallow and a deep monitoring well were installed at each boring location. Borings 101 through 110 and 201 through 204 were drilled by Atec Associates with a hollow stem auger to refusal at rock. Splitspoon and shelby tube samples were taken in each boring for laboratory soil classification and testing. Monitoring wells were installed in borings 201 through 204.

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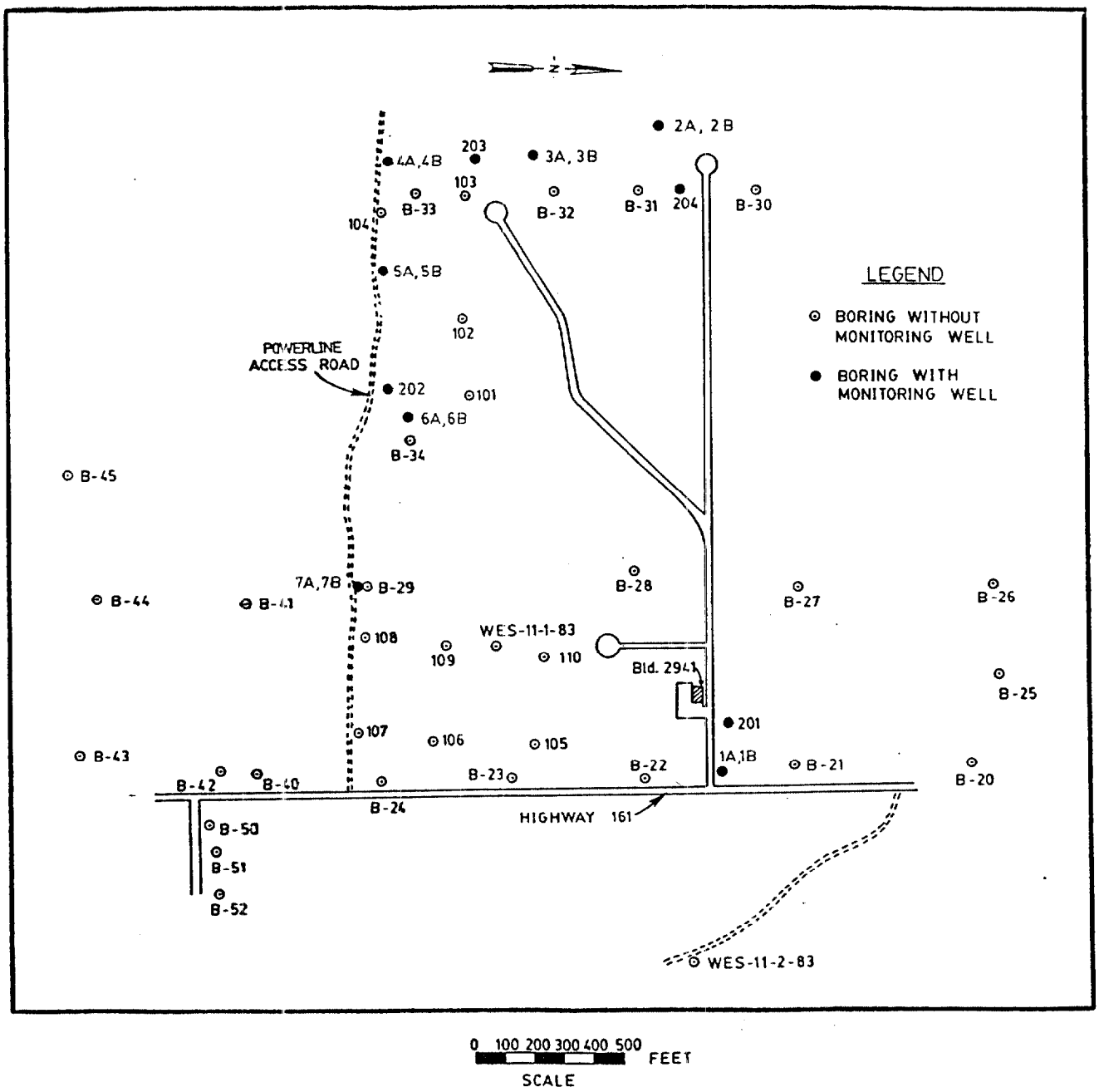

Figure 3. Landfill Boring Locations

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PART III: LANDFILL HYDROGEOLOGY

Geology

6. Soils at the landfill are generally fine-grained soils, composed of either silt (ML) or clay (CL and CH) as identified by U. S. Navy, Atec, and WES boring logs and laboratory soil tests. Soil thickness at the landfill ranges from 2 to 18 ft. Soil thickness from 40 landfill borings including 2 WES borings is presented in Table 1 and Figure 4 shows a soil thickness map for the landfill. Detailed cross sections of the landfill are presented on Public Works (PW) drawing 3746 or Naval Facilities (NAVFAC) drawing 2042329. A site reconnaissance of disposal cell 16 (cell being filled at time of WES drilling) identified a soil thickness from about 6 to 8 ft along the entire disposal cell length.

7. Rock underlying the landfill soil is Pennsylvanian age sandstone, siltstone, shale, and coal beds from the Mansfield Formation of the Raccoon Creek Group. Borings WES-11-1-83 and WES-11-2-83 were drilled 10.3 and 6.2 ft respectively into rock and encountered a weathered, very fine-grained, thinly bedded sandstone and siltstone ranging from tan to reddish brown with minor grey to dark grey shale. Underlying the soil in disposal cell 16, approximately 5 ft of thinly bedded sandstone and siltstone are exposed in the cell walls. In addition, minor 2 to 3-in. lignite seams and lenses are exposed in the rock walls. Construction of cell 16 for dumping consisted of excavating into rock approximately 15 ft (21 to 23 ft below ground surface) and backfilling with 5-7 ft of clay for an impermeable cell base. Underlying the clay base is a 2 to 3 ft thick bituminous coal bed at the lower limit of maximum excavation, approximately 20 ft below ground surface. Coal was visible in the spoil mounds flanking disposal cell 16 and was reported by landfill personnel to have come from below the clay filled cell base at the depth as indicated above. Boring data from U. S. Navy borings are presented on PW drawing 3103 or NAVFAC drawing 2002159. WES and Atec boring logs are presented in Appendix A. WES and Atec laboratory soil test data are presented in Appendix B.

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TABLE 1

Boring Number	Surface Elevation* (Ft MSL)	Soil Thickness** (Ft)	Top of Rock Elevation (Ft MSL)
B-20	713.0	6.5	706.5
B-21	713.0	10.5	702.5
B-22	711.0	9.2	701.8
B-23	711.0	10.5	700.5
B-24	707.0	9.0	698.0
B-25	711.0	10.0	701.0
B-26	709.0	6.0	706.0
B-27	711.0	7.0	704.0
B-28	701.0	5.0	706.0
B-29	706.5	7.0	699.5
B-30	692.0	10.0	682.0
B-31	681.0	10.5	670.5
B-32	683.0	4.5	678.5
B-33	684.5	10.5	674.0
B-34	683.0	7.0	676.0
B-40	698.0	10.0	688.0
B-41	702.5	9.5	693.0
B-42	699.0	10.25	688.75
B-43	699.0	8.5	690.5
B-44	693.0	8.5	684.5
B-45	691.0	9.0	682.0
B-50	702.0	16.0	686.0
B-51	704.0	16.5	687.50
B-52	706.8	15.0	691.8
101	699.0	15.5	683.50
102	695.0	18.0	667.0
103	682.5	9.1	673.4
104	688.5	15.5	673.0
105	707.5	7.0	700.5
106	709.5	12.3	697.2
107	704.0	11.2	692.8
108	706.5	12.0	694.5
109	706.5	11.0	695.5
110	703.0	10.0	693.0
201	711.0	6.9	704.1
202	683.5	6.2	677.3
203	679.0	7.0	672.0
204	685.5	7.4	678.1
WES-11-1-83	706.0	8.0	698.0
WES-11-2-83	715.0	2.0	713.0

* Surface Elevations obtained from PW drawing 3103 or ODON 7-1/2 minute Topographic Map.

** Determined by drilling refusal depth (considered top of rock)

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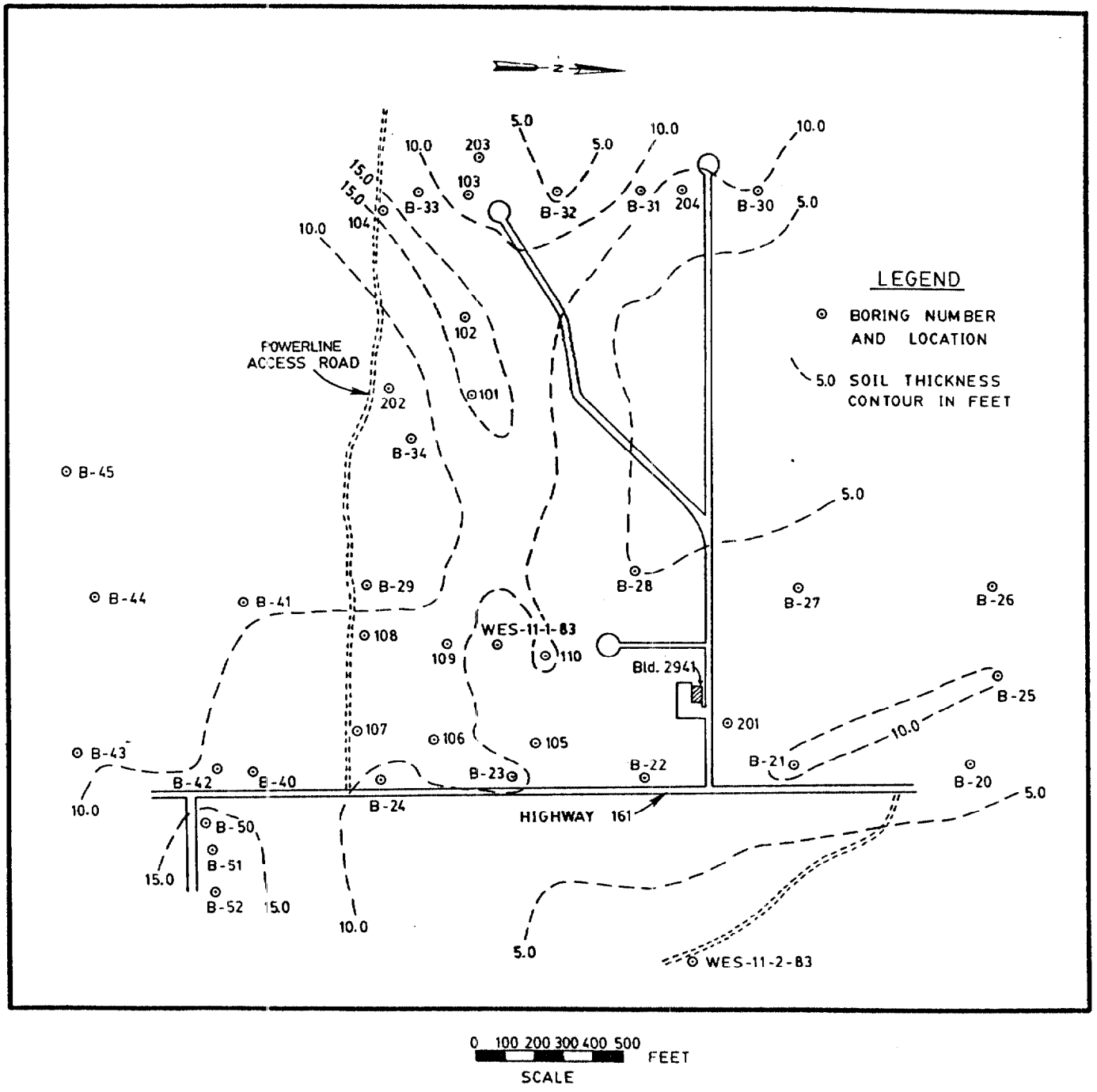

Figure 4. Landfill Soil Thickness Contour Map

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Ground Water

8. A total of 18 monitoring wells have been installed at the landfill with 11 wells in the water table in rock or soil at depths generally less than 20 ft and 7 wells in a lower rock aquifer at depths of more than 40 ft. All landfill monitoring wells are 4 in. in diameter and constructed with PVC. Available well construction data for wells 1 through 7 which contain two wells per site are presented in Figure 5 which includes total depths for each well. Monitoring wells 201 through 204 are in soil with well depths and available well construction data included in the Atec boring logs in Appendix A. Well construction is believed to consist of a 1-2 ft well screen, filter sand to within a few feet of ground surface, and a bentonite seal to surface.

9. A rock aquifer contour map is shown in Figure 6 for monitoring wells greater than 40 ft in depth. This map shows that the ground-water flow is to the west-northwest and the piezometric surface ranges from approximately 685 ft MSL elevation (well 1A) to 645 ft MSL elevation (well 3A). Figure 7 presents a contour map for the water table, monitoring wells less than 20 ft in depth, with ground-water flow to the west and southwest, and the water table ranging from approximately 705 ft MSL elevation (well 201) to 675 ft MSL elevation (well 3B). Monitoring wells 2B and 7B in Figure 7 are dry wells. It should be noted that water levels in monitoring wells 6A and 6B are almost identical, indicating possible well construction problems with monitoring well 6A. NWSC water level measurements are presented in Appendix C.

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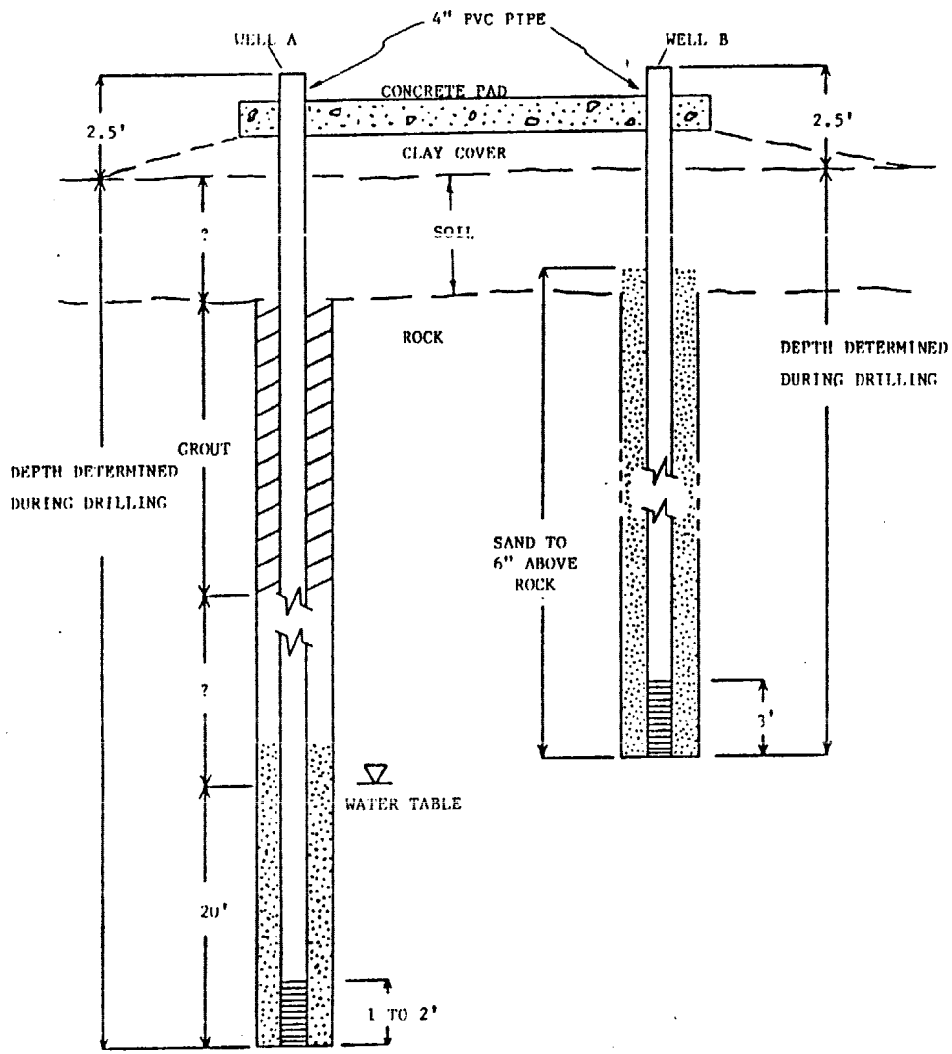

WELL NUMBER	DEPTH TO WATER	DEPTH OF WELL
1A	26.0	42.0
1B	17.0	19.0
2A	--	41.5
2B	3.8	14.0
3A	40.5	46.5
3B	2.6	10.0
4A	10.6	47.0
4B	2.5	26.5
5A	18.0	41.5
5B	1.5	17.5
6A	7.0	42.0
6B	5.0	14.5
7A	28.5	41.5
7B	--	23.0

Depths measured on 3 December 1979

Figure 5. Well Construction and Depths for Wells 1 through 7

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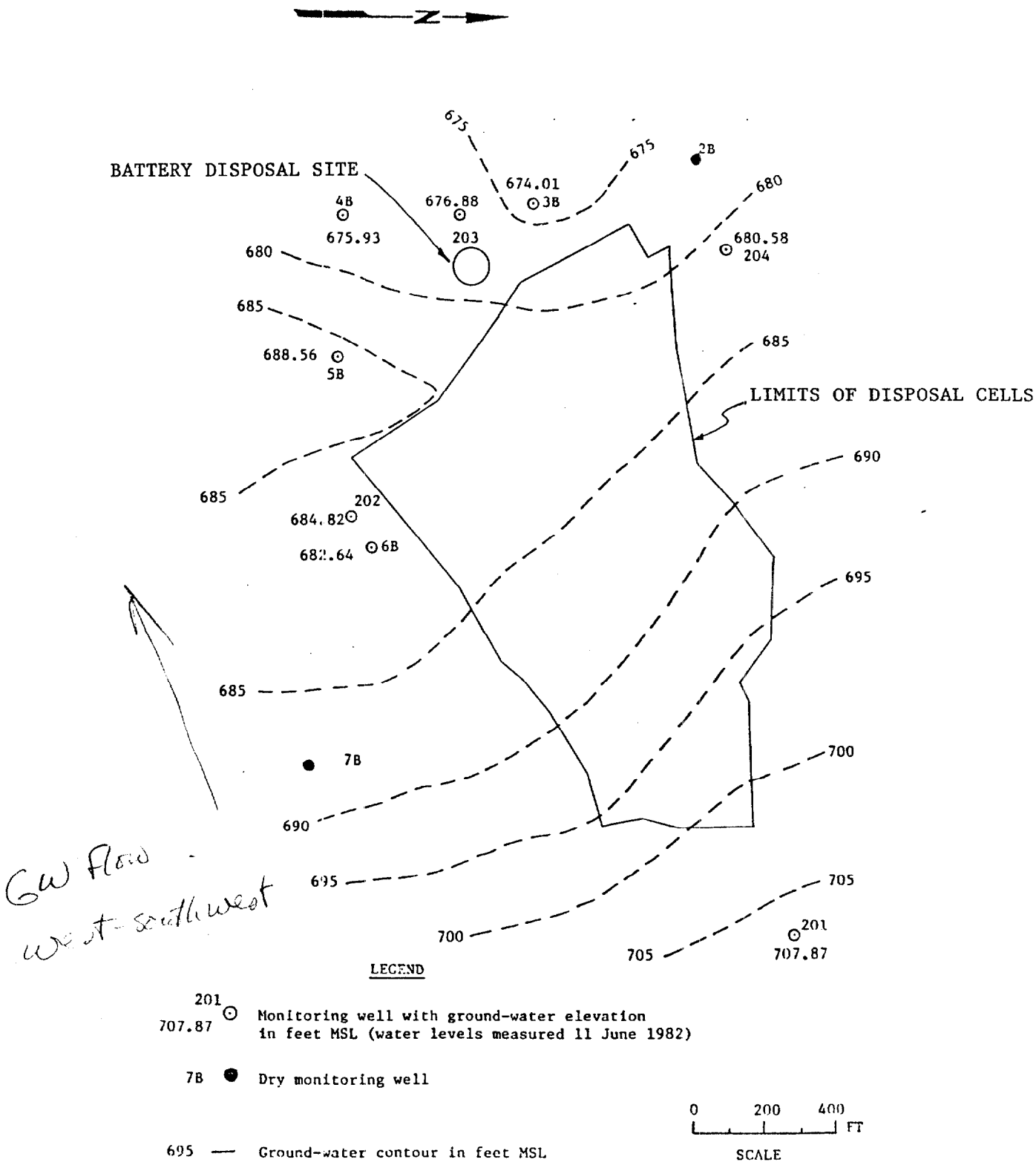

Figure 7. Landfill Ground-water Contour Map for Wells Less Than 20 ft in Depth

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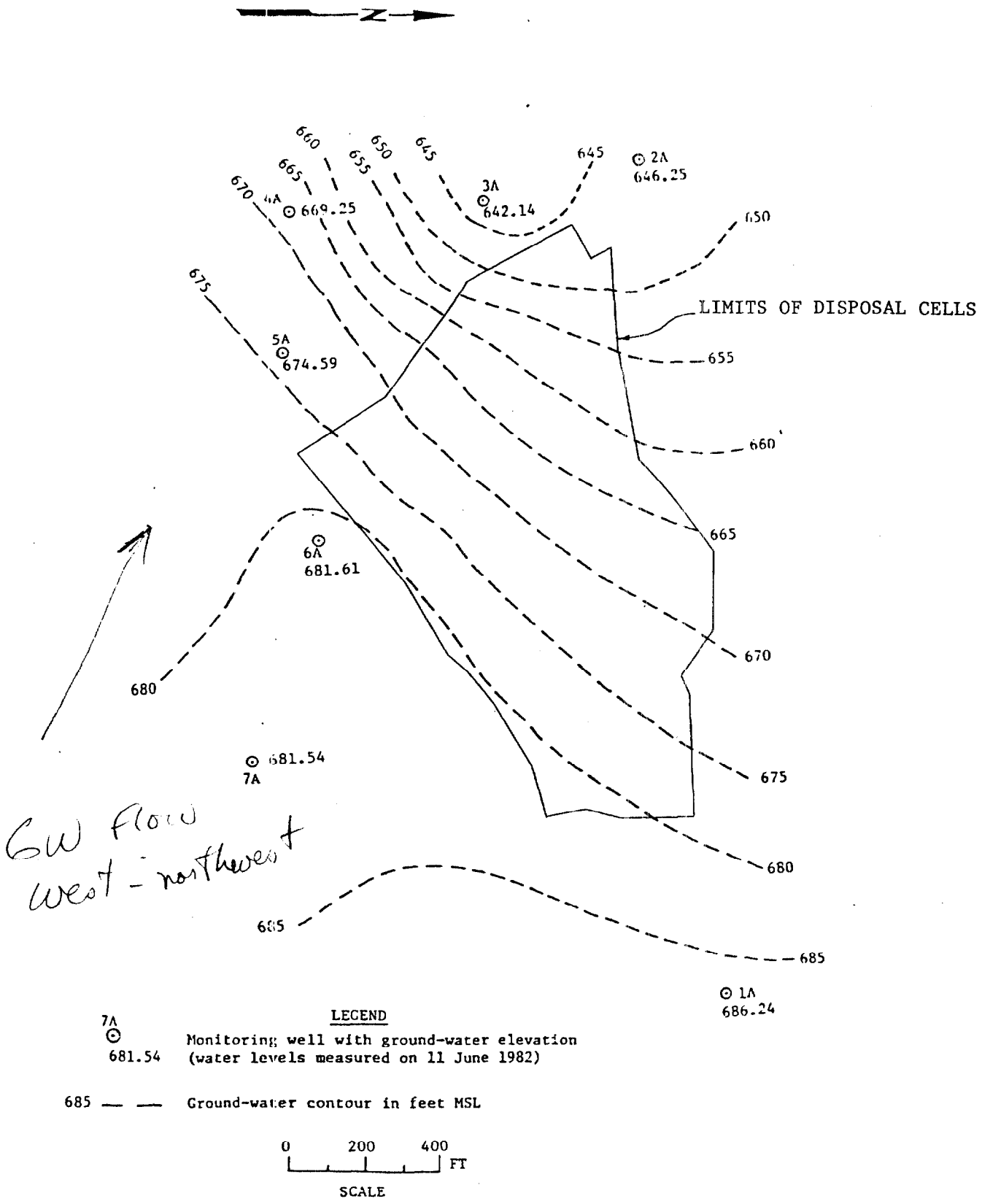

Figure 6. Landfill Ground-water Contour Map for Wells Greater than 40 ft in Depth

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PART IV: CONCLUSIONS

Conclusions

10. Based on WES borings and a review of existing landfill boring and ground-water data the following conclusions are made:

(a) Soil thickness at the landfill ranges from 2 to 18 ft and is similar east of Highway 161.

(b) Ground water occurs in two aquifers, water table aquifer and a lower rock aquifer, with flow to the west and southwest for the water table aquifer and to the west-northwest for the lower rock aquifer.

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APPENDIX A: FIELD BORING LOGS

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BORING LOG
FIELD DATA

Project NWSC Landfill Site Crane, IN Date 22 June 1983
Location NWSC Landfill Job No. 441-G150.13GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El *700.0 Boring No. WES-11-1-83

SAMPLE NUMBER	DATE TAKEN	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd Press	Cont	CLASSIFICATION AND REMARKS
1	22 Jun	0.0		0.0	0.5	0.0	2.0	3" Shelby Tube	0	St	Clay (CL): grey and brown, very
1A				0.5	1.0	2.0	2.1		0	Jar	soft, moist, organic matter.
				1.0	1.5				100		
				1.5	2.0				180		
			7.0	2.0	2.5				280		Sample length: 2.1 ft.
				0.0	5.0			5" Folding Auger			Cleanout
2	22 Jun	7.0		5.0	5.5	5.0	6.0	3" Fixed Piston	180	St	Gravelly Clay (CL): brown, grey,
2A				5.5	6.0	6.0	6.1		270	Jar	very stiff, brittle, gravel is
				6.0	6.5				360		fine to medium, weathered rock.
				6.5	7.0				450		
			8.0	7.0	7.45				500		Sample length 1.1 ft.
				5.0	9.0			5" Folding Auger			Cleanout.
				9.0	10.0			5-5/8" Rock Bit			Cleanout: very hard.

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* Surface elevation from topographic map.

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-11-1-83

SAMPLE NUMBER	DATE TAKEN 1983	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
		8.0	--	10.0	11.1			3" Pitcher Sampler			Tube was damaged --
											Sandstone: brown, reddish brown,
											very fine-grained.
				--	11.3			5-5/8" Rock Bit			Cleanout.
	23 Jun			11.3	13.2	11.3	13.2	4x5½ Core Barrel		Run 1	Sandstone, siltstone and shale.
	23 Jun		18.3	13.2	18.3	13.2	18.3	4x5½ Core Barrel		Run 2	Sandstone, siltstone, and shale.
											See drilling log page three for
											details.
	24 Jun										Water level overnight: 12.5 ft.
	24 Jun										Grouted hole.

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Hole No. WES-11-1-83

DRILLING LOG	DIVISION US Navy	INSTALLATION Crane, IN	SHEET 3 OF 3 SHEETS

1. PROJECT NWSC Landfill Characterization	10. SIZE AND TYPE OF BIT 4x5½" Diamond
2. LOCATION (Coordinates or Station) NWSC Landfill	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY CEWES	12. MANUFACTURER'S DESIGNATION OF DRILL Failing
4. HOLE NO. (As shown on drawing title and file number) WES-11-1-83	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED -- ; UNDISTURBED 2
5. NAME OF DRILLER C. Drake	14. TOTAL NUMBER CORE BOXES Zero
6. DIRECTION OF HOLE [X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE: STARTED 22 Jun 83 ; COMPLETED 23 Jun 83
	17. ELEVATION TOP OF HOLE * 700.0
7. THICKNESS OF OVERBURDEN 7.0 ft	18. TOTAL CORE RECOVERY FOR BORING 100% %
8. DEPTH DRILLED INTO ROCK 11.3 ft	19. SIGNATURE OF INSPECTOR
9. TOTAL DEPTH OF HOLE 18.3 ft	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
690	10		Sandstone: brown, reddish brown, very fine-grained			
689	11		3" Pitcher Sampler			
688	12		Sandstone and siltstone (80%) Shale (20%): brown, reddish brown, grey, dark grey, very fine grained, very thinly bedded and horizontal in attitude, bedding ranges from 1/16" to 1/4" maximum, weathered, oxidized, soft.			#L Run 1 Began 8:02 Rec 1.9' End 8:16 Loss -- Time 14 min. Gain -- Drl time 14 min. Hyd press 100 PSI Water press -- RPM 75-150 Drl Action Smooth ~~Water~~ ret Brown, grey Remarks --
687	13		Run 1 RQD=31.6%	100%	--	
			Same as above. Run 2 Pitcher Sampler	100%		
686	14		fractured very fine-grained sandstone.			
685	15		Sandstone, siltstone, & shale: See above			#L Run 3 Began 8:50 Rec 4.8' End 9:10 Loss -- Time 20 min. Gain -- Drl time 20 min. Hyd press 100 PSI Water press -- RPM 75-150 Drl Action Smooth ~~Water~~ ret Brown, grey Remarks
684	16					
683	17		Sandstone: brown, reddish brown, very fine-grained, uniform, quartz sandstone, weathered.			
682	18		Run 3 RQD=37.5%	100%		
			* Surface elevation from topographic map.			

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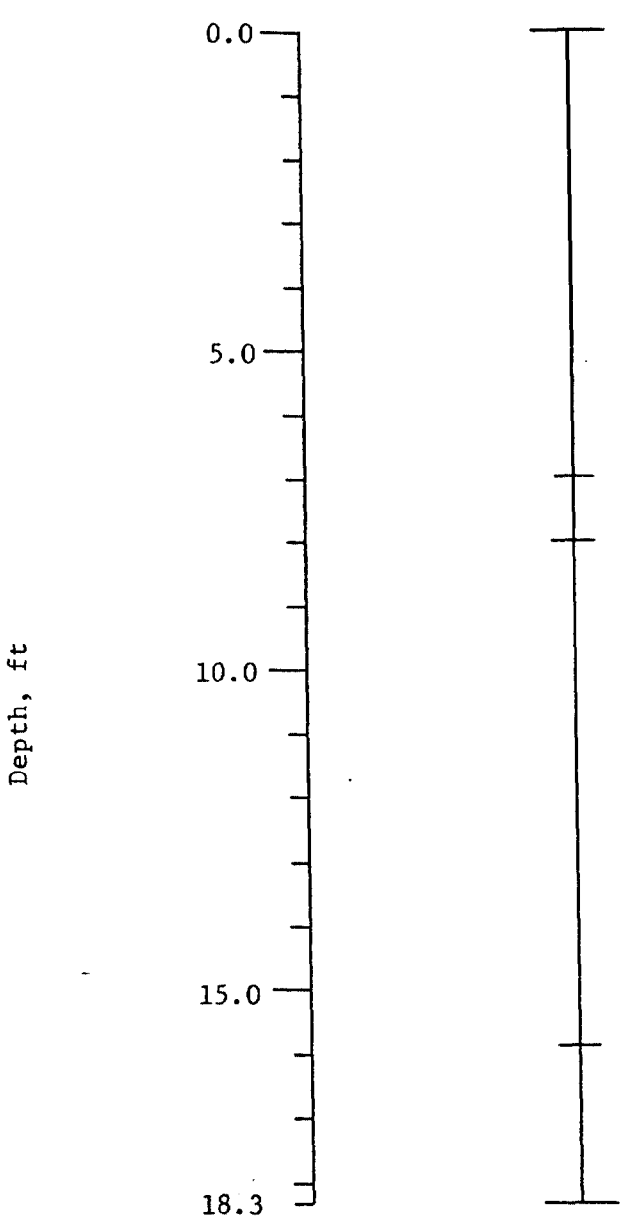
PROJECT | HOLE NO.



700.0 ft MSL

Clay(CL): grey and brown, very soft, moist, organic matter.

Gravelly clay(CL): brown, grey, very stiff, brittle, gravel is fine to medium weathered sandstone and siltstone.

Sandstone, siltstone, and shale: brown, reddish brown sandstone and siltstone (80%) thinly bedded with grey to dark grey shale (20%), bedding ranges from 1/16 to 1/4-in and horizonal in attitude, very fine-grained weathered, oxidized.

Sandstone: brown, reddish brown, very fine-grained, uniform quartz sandstone, weathered, oxidized.

NWSC, Crane, Indiana
NWSC Landfill
Lithology
Boring Number: WES-11-1-83

BORING LOG
FIELD DATA

Project NWSC Landfill Site Crane, IN Date 23 Jun 83
Location NWSC Landfill - East of Hwy 161 Job No. 441-G150.13GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El * 710.0 Boring No. WES-11-2-83

SAMPLE NUMBER	DATE TAKEN	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd Press	Cont	CLASSIFICATION AND REMARKS
1	23 Jun	0.0		0.0	0.5	0.0	1.23		50	St	Gravelly clay (CL): brown,
1A				0.5	1.0	1.23	1.43		120	Jar	reddish brown, soft to stiff,
				1.0	1.5				400		weathered, dry.
			2.0	1.5	2.0				820		Sample length: 1.43 ft.
				0.0	3.2			5-5/8" Rock Bit			Cleanout for core barrel.
	23 Jun	2.0	8.2	3.2	8.2	3.2	8.2	4"x5½" Core Barrel		Run 1	Clay, shale, siltstone, and sand-
											stone - see boring log on page 2
											for details.
	24 Jun										Water level overnight: 3.8 ft.
	24 Jun										Grouted hole.

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Sheet 1 of 2 Sheets

* Surface elevation from topographic map.

Hole No. WES-11-2-83

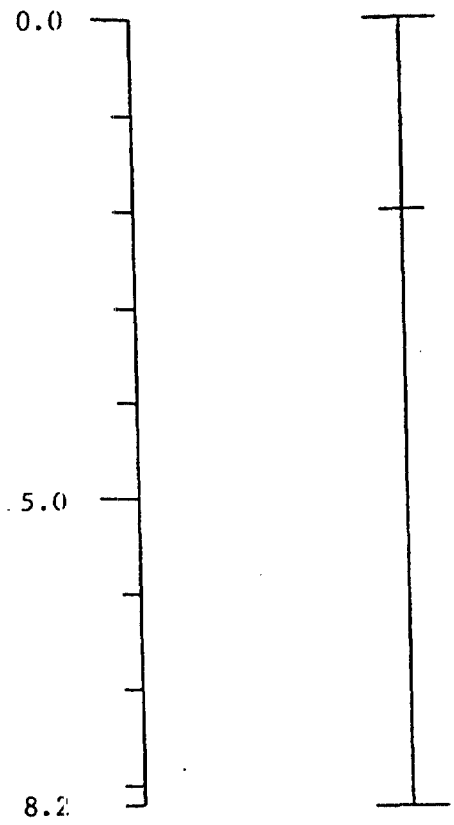
DRILLING LOG	DIVISION US Navy	INSTALLATION Crane, IN	SHEET 2 OF 2 SHEETS

1. PROJECT NWSC Landfill Characterization	10. SIZE AND TYPE OF BIT 4x5½ in.-Diamond
2. LOCATION (Coordinates or Station) NWSC Landfill	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY CEWES	12. MANUFACTURER'S DESIGNATION OF DRILL Failing 1500
4. HOLE NO. (As shown on drawing title and file number) WES-11-2-83	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED --- ; UNDISTURBED One
5. NAME OF DRILLER C. Drake	14. TOTAL NUMBER CORE BOXES Zero
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER 3.8' below ground Surf
	16. DATE HOLE: STARTED 23 Jun 83 ; COMPLETED 23 Jun 83
7. THICKNESS OF OVERBURDEN 2.0 ft	17. ELEVATION TOP OF HOLE * 710.0
8. DEPTH DRILLED INTO ROCK 6.2 ft.	18. TOTAL CORE RECOVERY FOR BORING 100% %
9. TOTAL DEPTH OF HOLE 8.2 ft.	19. SIGNATURE OF INSPECTOR

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
707.0	30					
			Sandstone: brown, very fine-grained, soft, weathered, oxidized.			23 June 1983
706.0	40		Clay: grey, soft-			
			Gravelly clay - weathered shale and sandstone - brown and grey.			
705.0	50		Clay: grey, soft.			WL -- Run 1 Began 1:52 Rec 5.0' End 2:15 Loss -- Time 23 min. Gain -- Drl time 23 min. Hyd press 100 PSI Water press -- RPM 75-150± Drl Action Smooth Water ret Brown, reddish brown Return -- --
704.0	60		Sandstone: reddish brown, brown, oxidized, weathered, very fine-grained, friable, breaks show weathering and partial filling (solution).			
			fractured			
703.0	70		Thinly bedded sandstone, siltstone and shale - brown to grey, soft.			
702.0	80		Run 1 RQD=24.0%	100%	--	
			* Surface elevation from topographic map.			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT)

PROJECT | HOLE NO.



710.0 ft MSL

Gravelly clay(CL): brown, reddish brown, soft to stiff, weathered, dry.

Sandstone: brown, reddish brown, thinly bedded with shale and siltstone, very fine-grained, weathered, oxidized.

NWSC, Crane, Indiana
NWSC Landfill
Lithology
Boring Number: WES-11-2-83

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CLIENT : U. S. Navy
BORING NO. 101
PROJECT NAME Landfill
JOB NO. D-79873 DATE 11-29-79
PROJECT LOCATION Crane, Indiana
STATION
BORING METHOD HSA
FOREMAN R. Jones
ROCK CORE DIA. in.
INSPECTOR
SHELBY TUBE O.D. in.

SOIL CLASSIFICATION SURFACE ELEVATION–	Stratum Depth, Ft.	Ground Water	Depth Scale, Ft.	SPT ** Sample No.	Blows/6 in. 3–6 in. Increments	Recovery, %	Shelby Tube No.	BORING & SAMPLING NOTES
Top soil	0.3							
Light Brown moist stiff CLAYEY SILT(ML)			5	1	4 7/8	75		
	6.5							
Light Brown dry hard CLAYEY SILT (ML)			10	2	9 18/35	100		
	14.2							
Brown dry hard CLAYEY SILT (ML) with trace fine Sand			15	3	15 14/50 0.3	100		
Bottom test boring @ 15.5'								

BORING METHOD
HSA HOLLOW STEM AUGER

GROUND WATER-
NOTED ON RODS FT.

*THESE SHELBY TUBE SAMPLES OBTAINED II
BORING DRILLED A FEW

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CLIENT U. S. Navy
BORING NO. 102
PROJECT NAME Landfill
JOB NO. D-79873
DATE 11-29-79
PROJECT LOCATION Crane, Indiana
STATION
BORING METHOD HSA
FOREMAN R. Jones
ROCK CORE DIA. in.
INSPECTOR
SHELBY TUBE O.D. in.

SOIL CLASSIFICATION SURFACE ELEVATION–	Stratum Depth, Ft.	Ground Water	Depth Scale, Ft.	SPT ** Sample No.	SPT ** Blows/6 In. 3–6 In. Increments	SPT ** Recovery, %	Shelby Tube No.	BORING & SAMPLING NOTES
Top soil	0.3							
Brown slightly moist hard SILTY CLAY (CL) with sand Seams							1	Pushed Shelby Tube from 2.0' to 4.0'
			5					
				1	14 14/23			
			10					
Black wet SILTY CLAY (CL) with trace coarse SAND	11.5 12.5							Took auger sample of Black soil from 11.5' to 12.5'
Light Gray dry hard CLAYEY SILT (ML)				2	16 38/50 0.3			
			15					
Auger refusal @ 18.0'	18.0							
Bottom test boring @ 18.0'								
			20					

BORING METHOD
HSA – HOLLOW STEM AUGER
CFA – CONTINUOUS FLIGHT AUGER

GROUND WATER NOTED ON RODS 8.5 FT.

*THESE SHELBY TUBE SAMPLES OBTAINED IN BORING DRILLED A FEW

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CLIENT: U. S. Navy
BORING NO. 103
PROJECT NAME: Landfill
JOB NO. D-79873
DATE 11-29-79
PROJECT LOCATION: Crane, Indiana
STATION
BORING METHOD: HSA
FOREMAN: R. Jones
ROCK CORE DIA. in.
INSPECTOR
SHELBY TUBE O.D. in.

SOIL CLASSIFICATION SURFACE ELEVATION–	Stratum Depth, Ft.	Ground Water	Depth Scale, Ft.	SPT ** Sample No.	SPT ** Blows/6 in. 3–6 in. Increments	SPT ** Recovery, %	Shelby Tube No.	BORING & SAMPLING NOTES
Top soil	0.3							
Brown moist soft SILTY CLAY with trace Sand						80	1	Pushed Shelby Tube from 3.0' to 5.0'
			5					
	6.5							
Gray dry hard CLAYEY SILT (ML) with coal Seams								
Auger refusal @ 9.1'	9.1			1	35/50 0.1	100		
Bottom test boring @ 9.1'			10					

BORING METHOD GROUND WATER *THESE SHELBY TUBE SAMPLES OBTAINED

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CLIENT U. S. Navy
BORING NO. 104
PROJECT NAME Landfill
JOB NO. D-79873
DATE 11-29-79
PROJECT LOCATION Crane, Indiana
STATION
BORING METHOD HSA
FOREMAN R. Jones
ROCK CORE DIA. in.
INSPECTOR
SHELBY TUBE O.D. in.

SOIL CLASSIFICATION SURFACE ELEVATION–	Stratum Depth, Ft.	Ground Water	Depth Scale, Ft.	SPT ** Sample No.	SPT ** Blows/6 in. 3–6 in. Increments	SPT ** Recovery, %	Shelby Tube No.	BORING & SAMPLING NOTES
Top soil	0.3							
Brown moist SILTY CLAY (CL)						75	1	Pushed Shelby Tube from 3.0' to 5.0'
			5					
	7.5							
Brown slightly moist very stiff CLAYEY SILT (ML)				1	12	75		
Coal	9.8				14/15			
Brown dry hard CLAYEY SILT (ML)	10.0		10					
	13.6							
Coal	13.8			2	50	100		
Gray dry hard CLAYEY SILT (ML) Auger refusal @ 15.5'	15.5		15		0.4			
Bottom test boring @ 15.5'								

BORING METHOD
HSA – HOLLOW STEM AUGER

GROUND WATER
NOTED ON RODS FT

*THESE SHELBY TUBE SAMPLES OBTAINED IN

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CLIENT U. S. Navy
BORING NO. 105
PROJECT NAME Landfill
JOB NO. D-79873
DATE 12-1-79
PROJECT LOCATION Crane, Indiana
STATION
BORING METHOD HSA
FOREMAN R. Jones
ROCK CORE DIA. in.
INSPECTOR
SHELBY TUBE O.D. in.

SOIL CLASSIFICATION SURFACE ELEVATION–	Stratum Depth, Ft.	Ground Water	Depth Scale, Ft.	SPT ** Sample No.	SPT ** Blows/6 in. 3–6 in. Increments	SPT ** Recovery, %	Shelby Tube No.	BORING & SAMPLING NOTES
Top soil	0.3							
Brown moist medium stiff SILTY CLAY						100	1	Pushed Shelby Tube from 2.0' to 4.0'
	5.0		5					
Brown dry hard CLAYEY SILT with Sandstone clay Seams Auger refusal @ 7.0'	7.0							
Bottom test boring @ 7.0'								

DRILLING METHOD GROUND WATER *THESE SHELBY TUBE SAMPLES OBTAINED IN

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CLIENT: U. S. Navy
PROJECT NAME: Landfill
PROJECT LOCATION: Crane, Indiana
BORING METHOD: HSA
ROCK CORE DIA. ____ in.
SHELBY TUBE O.D. ____ in.

BORING NO. 106
JOB NO. D-79873 DATE 12-1-79
STATION
FOREMAN R. Jones
INSPECTOR

SOIL CLASSIFICATION	Stratum Depth, Ft.	Ground Water	Depth Scale, Ft.	SPT ** Sample No.	SPT ** Blows/6 in. 3—6 in. Increments	SPT ** Recovery, %	Shelby Tube No.	BORING & SAMPLING NOTES
SURFACE ELEVATION—								
Top soil	0.3							
Brown moist medium stiff SILTY CLAY	3.0							
Brown moist very stiff CLAYEY SILT (ML)	7.9		5	1	4 8/10	100		
Gray dry hard CLAYEY SILT (ML) with Siltstone Seams			10	2	6 21/40	100		
Auger refusal @ 12.3	12.3							
Bottom test boring @ 12.3'								Boring is standing in water

SHELBY TUBE SAMPLES OBTAINED

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CLIENT: U. S. Navy
PROJECT NAME: Landfill
PROJECT LOCATION: Crane, Indiana
BORING METHOD: HSA
ROCK CORE DIA. ____ in.
SHELBY TUBE O.D. ____ in.

BORING NO. 107
JOB NO. D-79873 DATE 12-1-79
STATION
FOREMAN R. Jones
INSPECTOR

SOIL CLASSIFICATION SURFACE ELEVATION–	Stratum Depth, Ft.	Ground Water	Depth Scale, Ft.	SPT ** Sample No.	SPT ** Blows/6 in. 3–6 in. Increments	SPT ** Recovery, %	Shelby Tube No.	BORING & SAMPLING NOTES
Top soil	0.3							
Brown moist stiff SILTY CLAY	2.5							
Brown slightly moist very stiff CLAYEY SILT (ML)			5	1	8 11/13	100		
	6.5							
Brown dry hard CLAYEY SILT (ML) with Siltstone Seams			10	2	17 46/50 0.3	100		
Auger refusal @ 11. 2'	11.2							
Bottom test boring @ 11.2'								

BORING METHOD GROUND WATER *THESE SHELBY TUBE SAMPLES OBTAINED

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LIENT: U. S. Navy
ROJECT NAME: Landfill
ROJECT LOCATION: Crane, Indiana
ORING METHOD: HSA
OCK CORE DIA. ____ in.
HELBY TUBE O.D. ____ in.

BORING NO. 108
JOB NO. D-79873 DATE 12-1-79
STATION
FOREMAN R. Jones
INSPECTOR

SOIL CLASSIFICATION	Stratum Depth, Ft.	Ground Water	Depth Scale, Ft.	SPT ** Sample No.	SPT ** Blows/6 In. 3–6 In. Increments	SPT ** Recovery, %	Shelby Tube No.	BORING & SAMPLING NOTES
SURFACE ELEVATION–								
Top soil	0.3							
Brown moist CLAYEY SILT (ML)						100	1	Pushed Shelby tube from 2.0' to 4.0'
			5					
	6.0							
Brown dry hard CLAYEY SILT (ML)				1	13 33/50 0.4	100		
			10					
Auger refusal @ 12.0'	12.0							
Bottom test boring @ 12.0'								

BORING METHOD GROUND WATER *THESE SHELBY TUBE SAMPLES OBTAINED

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CLIENT U. S. Navy
BORING NO. 109
PROJECT NAME Landfill
JOB NO. D-79873
DATE 12-1-79
PROJECT LOCATION Crane, Indiana
STATION
BORING METHOD HSA
FOREMAN R. Jones
ROCK CORE DIA. in.
INSPECTOR
SHELBY TUBE O.D. in.

SOIL CLASSIFICATION SURFACE ELEVATION–	Stratum Depth, Ft.	Ground Water	Depth Scale, Ft.	SPT ** Sample No.	SPT ** Blows/6 in. 3–6 in. Increments	SPT ** Recovery, %	Shelby Tube No.	BORING & SAMPLING NOTES
Top soil	0.3							
Brown moist soft SILTY CLAY	3.0							
Light Brown slightly moist stiff CLAYEY SILT (ML)	6.5		5	1	3 8/10	100		
Light Brown and Gray dry hard CLAYEY SILT (ML) with Siltstone Seams			10	2	17/50 0.4	100		
Auger refusal @ 11.0'	11.0							
Bottom test boring @ 11.0'								

BORING METHOD GROUND WATER

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CLIENT U. S. Navy
BORING NO. 110
PROJECT NAME Landfill
JOB NO. D-79873
DATE 12-1-79
PROJECT LOCATION Crane, Indiana
STATION
BORING METHOD HSA
FOREMAN R. Jones
ROCK CORE DIA. in.
INSPECTOR
SHELBY TUBE O.D. in.

SOIL CLASSIFICATION SURFACE ELEVATION–	Stratum Depth, Ft.	Ground Water	Depth Scale, Ft.	SPT ** Sample No.	SPT ** Blows/6 in. 3–6 in. Increments	SPT ** Recovery, %	Shelby Tube No.	BORING & SAMPLING NOTES
Top soil	0.3							
Brown slightly moist very stiff CLAYEY SILT (ML)				1	7 10/15	100		
	5.5		5					
Light Gray hard CLAYEY SILT(ML) with Weathered Siltstone Seams								
Auger refusal @ 10.0'	10.0		10	2	50 0.5	100		
Bottom test boring @ 10.0'								

BORING METHOD
HSA – HOLLOW STEM AUGER
CFA – CONTINUOUS FLIGHT AUGER

GROUND WATER
NOTED ON RODS ____ FT.
____ DAYS

*THESE SHELBY TUBE SAMPLES OBTAINED
BORING _____ DRILLED A FI

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CLIENT: U. S. Navy
BORING NO. 201
PROJECT NAME: Landfill
JOB NO. D-79873 DATE 11-25-79
PROJECT LOCATION: Crane, Indiana
STATION
BORING METHOD: HSA
FOREMAN: R. Jones
ROCK CORE DIA. in.
INSPECTOR
SHELBY TUBE O.D. in.

SOIL CLASSIFICATION SURFACE ELEVATION–	Stratum Depth, Ft.	Ground Water	Depth Scale, Ft.	SPT ** Sample No.	SPT ** Blows/6 in. 3–6 in. Increments	SPT ** Recovery, %	Shelby Tube No.	BORING & SAMPLING NOTES
Top soil	0.3							
Brown slightly moist very stiff CLAYEY SILT (ML)								Sandstone ledge 6.3' to 6.4'
				1	4 8/10	50		Back filled with gravel and set Bentonite Seal
			5					
Auger refusal @ 6.9'	6.9							Set Observation well to 6.9'
Bottom test boring @ 6.9'								
			10					

BORING METHOD
HSA – HOLLOW STEM AUGER
CFA – CONTINUOUS FLIGHT AUGER

GROUND WATER
NOTED ON RODS ____ FT.

*THESE SHELBY TUBE SAMPLES OBTAINED IN

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CLIENT: U. S. Navy
BORING NO.: 202
PROJECT NAME: Landfill
JOB NO.: D-79873
DATE: 11-29-79
PROJECT LOCATION: Crane, Indiana
STATION:
BORING METHOD: HSA
FOREMAN: R. Jones
ROCK CORE DIA. ____ in.
INSPECTOR:
SHELBY TUBE O.D. ____ in.

SOIL CLASSIFICATION SURFACE ELEVATION–	Stratum Depth, Ft.	Ground Water	Depth Scale, Ft.	SPT ** Sample No.	SPT ** Blows/6 in. 3–6 in. Increments	SPT ** Recovery, %	Shelby Tube No.	BORING & SAMPLING NOTES
Top soil								
Brown moist SILTY CLAY (CL)	3.7					40	1	Pushed Shelby Tube from 3.0' to 3.9'
Brown dry hard CLAYEY SILT with trace fine to medium Sand			5					
Auger refusal @ 6.2'	6.2							Set Observation well to 6.2' with Bentonite Seal
Bottom test boring @ 6.2'								

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CLIENT: U. S. Navy
BORING NO. 203
PROJECT NAME: Landfill
JOB NO. D-79873
DATE 11-29-79
PROJECT LOCATION: Crane, Indiana
STATION
BORING METHOD: HSA
FOREMAN: R. Jones
ROCK CORE DIA. in.
INSPECTOR
SHELBY TUBE O.D. in.

SOIL CLASSIFICATION SURFACE ELEVATION–	Stratum Depth, Ft.	Ground Water	Depth Scale, Ft.	SPT ** Sample No.	SPT ** Blows/6 in. 3–6 in. Increments	SPT ** Recovery, %	Shelby Tube No.	BORING & SAMPLING NOTES
Top soil	0.3							
Brown moist stiff SILTY CLAY			5				1	Pushed Shelby Tube from 3.0' to 5.0'
								Set Observation well to 7.0'
Auger refusal @ 7.0'	7.0							
Bottom test boring @ 7.0'								

BORING METHOD GROUND WATER *THESE SHELBY TUBE SAMPLES OBTAINED IN

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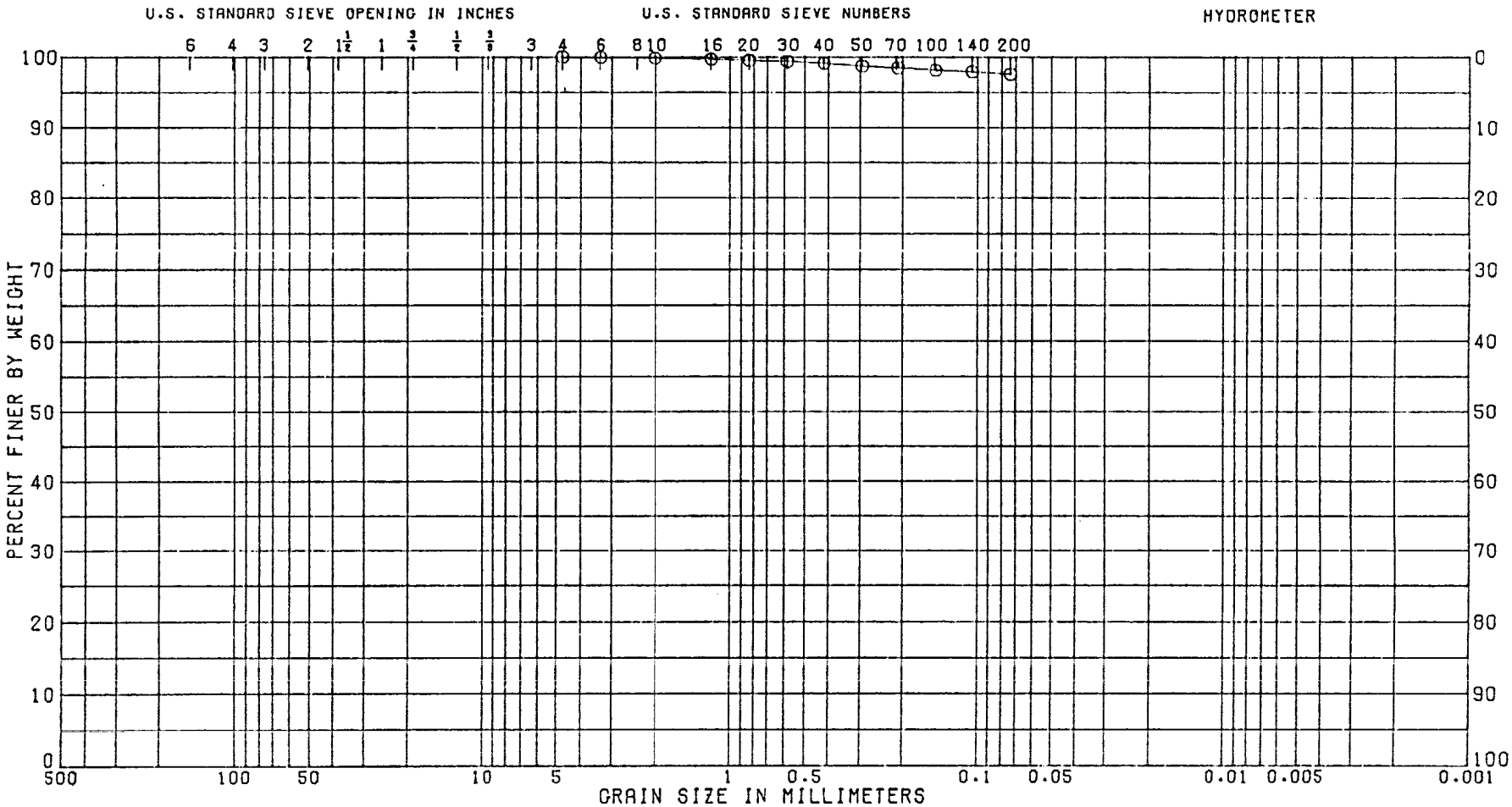
CLIENT : U. S. Navy
BORING NO. 204
PROJECT NAME Landfill
JOB NO. D-79873 DATE 12-1-79
PROJECT LOCATION Crane, Indiana
STATION
BORING METHOD HSA
FOREMAN R. Jones
ROCK CORE DIA. in.
INSPECTOR
SHELBY TUBE O.D. in.

SOIL CLASSIFICATION SURFACE ELEVATION–	Stratum Depth, Ft.	Ground Water	Depth Scale, Ft.	SPT ** Sample No.	SPT ** Blows/6 in. 3–6 in. Increments	SPT ** Recovery, %	Shelby Tube No.	BORING & SAMPLING NOTES
Topsoil .								
Brown moist soft SILTY CLAY						100	1	Could only push tube 18" 3.0' 4.5'
	5.0		5					
Brown dry hard CLAYEY SILT with Sandstone Seams								
Auger refusal @ 7.4'	7.4							Set Observation well to 7.4'
Bottom test boring @ 7.4'								

BORING METHOD GROUND WATER *THESE SHELBY TUBE SAMPLES OBTAINED

APPENDIX B: LABORATORY SOIL TEST RESULTS

WORKING DRAFT



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

LL	PL	PI	GS	NAT W.%
40	18	22		

CLASSIFICATION

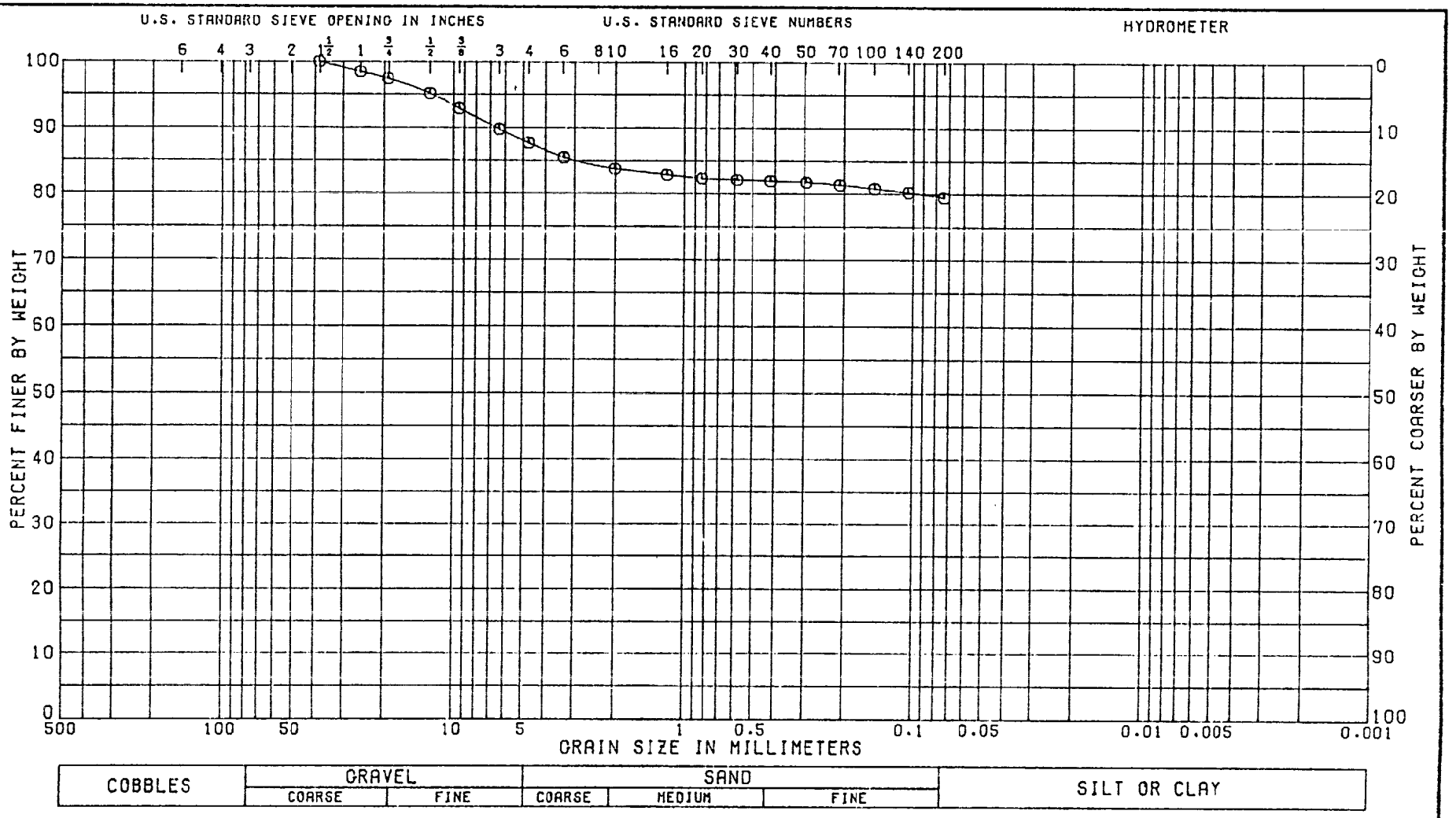
CLAY (CL), BROWN

GRADATION CURVE

PROJECT CRANE NAVAL WEAPONS SUPPORT CENTER

BORING NO. WES-11-1-83 SAMPLE NO. 1

DEPTH/ELEV 0.0-2.0 DATE 15 DEC 83



LL	PL	PI	GS	NAT W.%	
50	19	31			

CLASSIFICATION

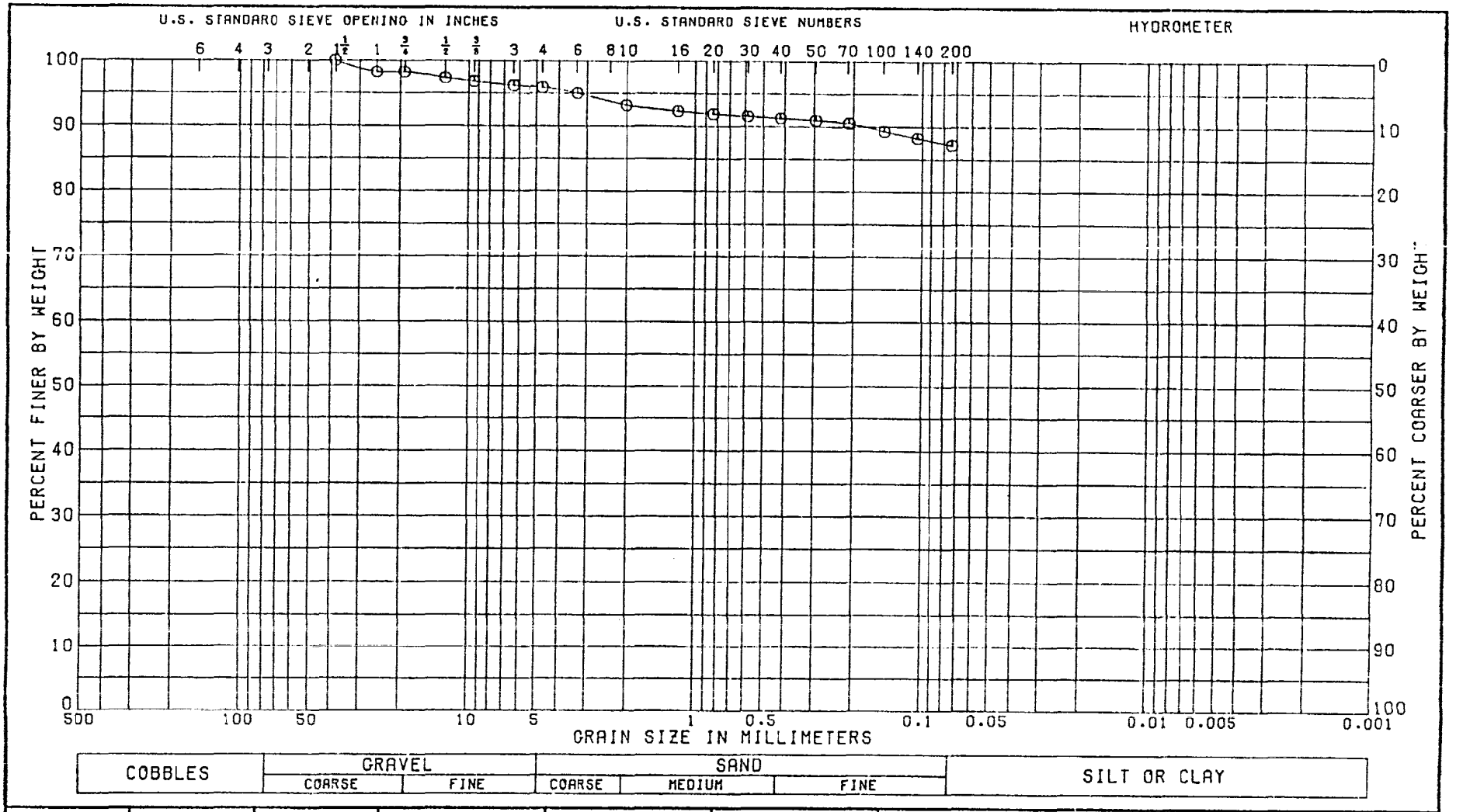
SANDY CLAY (CH), TAN

GRADATION CURVE

PROJECT CRANE NAVAL WEAPONS SUPPORT CENTER

BORING NO. WES-11-1-83 SAMPLE NO. 2

DEPTH/ELEV 5.0-6.0 DATE 15 DEC 83



LL 54	PL 18	PI 36	GS	NAT W.%	

CLASSIFICATION

SANDY CLAY (CH), BROWN

GRADATION CURVE

PROJECT CRANE NAVAL WEAPONS SUPPORT CENTER

BORING NO. WES-11-2-83 SAMPLE NO. 1

DEPTH/ELEV 0.0-1.23 DATE 15 DEC 83

ATEC ASSOCIATES, INC.
5150 East 65th Street
Indianapolis, Indiana 46220

U. S. DEPARTMENT OF THE NAVY
Geological Investigation and
Well installation - sanitary
Landfill - Crane, Indiana

PERMEABILITY AND CATION EXCHANGE TEST RESULTS

BORING	SAMPLE	DEPTH	MOISTURE CONTENT	DRY DENSITY	RATE OF PERMEABILITY (CM/SCC)	CATION EXCHANGE CAPACITY (MEG/100G)
102	1	3'-4.5'	24.4	103.9	8.9 x 10-8	7.8
103	1	3'-5'	20.9	108.9	2.1 x 10-8	10.5
104	1	3'-5'	19.3	107.7	4.8 x 10-8	7.9
105	1	2'-4'	23.1	98.5	4.8 x 10-8	8.4
108	1	2'-4'	24.4	99.1	1.9 x 10-8	10.2
202	1	3'-3.9'	24.0	100.9	8.7 x 10-8	13.1
203	1	3'-5'	17.1	126.3	2.6 x 10-8	9.6
204	1	3'-4.5'	18.3	106.5	Less than* 10-7 *No bleeding noted in 11-days	12.3

30 East 86th Street
Indianapolis, Indiana 46220

U. S. DEPARTMENT OF THE NAVY
Geological Investigation and
Well installation - sanitary
Landfill - Crane, Indiana

SIEVE ANALYSIS

(% passing)

RING	SAMPLE	DEPTH	1"	3/4"	1/2"	3/8"	#4	#8	#16	#30	#50	#100	#200
1	1	3.5' - 5'	--	--	--	100	99	99	98	97	96	92	82.6
1	2	8.5' - 10'	--	--	--	100	94	90	87	85	84	84	82.8
1	3A	13.5' - 15'	--	--	--	--	100	99	99	98	97	95	92.1
1	3B	13.5' - 15'	--	--	--	100	96	92	85	80	75	69	62.3
2	Auger	11.5' - 12.5'	-	--	--	100	99	96	93	90	89	85	75.9
2	1	8.5' - 10'	100	91	84	84	78	73	69	66	63	55	40.9
2	2	13.5 - 15'	--	--	--	--	--	--	100	99.4	99.4	99.4	99.3
3	1	8.5' - 10'	--	--	--	--	--	--	--	--	--	100	99.9
4	1	8.5' - 10'	--	--	--	--	100	99	97	95	94	92	91.6
4	2A	13.5 - 15'	--	--	--	100	94	79	71	64	61	55	49.5
4	2B	13.5'- 15'	--	--	--	--	--	100	99	99	99	99	98.3
6	1	3.5'- 5'	--	--	--	--	100	99	98	98	98	96	94.7
6	2	8.5'- 10'	--	--	100	98	91	86	84	82	82	81	80.7
7	1	3.5'-5'	--	--	100	98	95	93	92	91	90	90	88.6
7	2	8.5'-10'	--	--	--	100	99	96	92	89	87	85	83.6
8	1	8.5'-10'	--	--	100	98	88	83	79	76	75	73	71.6
9	1	3.5'-5'	--	--	--	--	100	99	98	97	97	95	91.3
9	2	8.5'-10'	--	100	92	89	81	75	73	71	70	69	68.2

TEC ASSOCIAT INC.

U.S. NAVY - CRANE, INC.

SIEVE ANALYSIS

							(% passing)						
RING	SAMPLE	DEPTH	1"	3/4"	1/2"	3/8"	#4	#8	#16	#30	#50	#100	#200
.0	1	3.5'-5'	--	--	--	100	99	97	94	91	89	88	86.3
.0	2	8.5'-10'	--	100	98	92	92	79	76	73	72	69	67.2
1	1	3.5'-5'	--	--	--	100	98	96	93	91	90	89	87.7

APPENDIX C: GROUND-WATER ELEVATIONS

WORKING DRAFT

Ground-Water Elevations

NWSC Landfill

Well Number: 1A

Top of Pipe Elevation: 713.57 ft MSL

Bottom of Well Elevation: 672.32 ft MSL

Date	Depth to Water (ft)	Elevation (ft msl)	Remarks
25 Jun 81*	27.16	686.41	
19 Aug 81	28.5	685.07	
17 Sep 81	26.75	686.82	
6 Dec 81	26.83	686.74	
11 Jun 82	27.33	686.24	
22 Sep 82	26.00	687.57	
20 Oct 82	27.00	686.57	
14 Dec 82	27.00	686.57	
21 May 83	27.05	686.52	
17 Jul 83	25.38	688.19	

* All measurements by NWSC

Ground-Water Elevations

NWSC Landfill

Well Number: 1B

Top of Pipe Elevation: 713.62 ft MSL

Bottom of Well Elevation: 694.32 ft MSL

Date	Depth to Water (ft)	Elevation (ft msl)	Remarks
25 Jun 81*	19.19	694.43	
19 Aug 81	19.00	694.62	
17 Sep 81	--	--	Dry
6 Dec 81	--	--	Dry
11 Jun 82	19.50	694.12	Dry
22 Sep 82	20.00	693.62	Dry
20 Oct 82	19.67	693.95	Dry
14 Dec 82	19.50	694.12	Dry
21 May 83	17.30	696.32	
17 Jul 83	18.12	695.50	

* All measurements by NWSC

Ground-Water Elevations

NWSC Landfill

Well Number: 2A

Top of Pipe Elevation: 671.56 ft MSL

Bottom of Well Elevation: 629.86 ft MSL

Date	Depth to Water (ft)	Elevation (ft msl)	Remarks
25 Jun 81*	25.75	645.81	
19 Aug 81	25.08	646.48	
17 Sep 81	25.13	646.43	
6 Dec 81	25.58	645.98	
11 Jun 82	25.10	646.46	
22 Sep 82	25.00	646.56	
20 Oct 82	25.17	646.39	
14 Dec 82	25.00	646.56	
21 May 83	25.6	645.96	
17 Jul 83	23.71	647.85	

* All measurements by NWSC

Ground-Water Elevations

NWSC Landfill

Well Number: 2B

Top of Pipe Elevation: 671.78 ft MSL

Bottom of Well Elevation: 657.68 ft MSL

Date	Depth to Water (ft)	Elevation (ft msl)	Remarks
25 Jun 81*	13.75	658.03	
19 Aug 81	14.17	657.61	Dry
17 Sep 81	--	--	Dry
6 Dec 81	--	--	Dry
11 Jun 82	14.80	656.98	Dry
22 Sep 82	14.88	656.90	Dry
20 Oct 82	14.67	657.11	Dry
14 Dec 82	15.00	656.78	Dry
21 May 83	--	--	Dry
17 Jul 83	13.38	658.40	

* All measurements by NWSC

Ground-Water Elevations

NWSC Landfill

Well Number: 3A

Top of Pipe Elevation: 677.64 ft MSL

Bottom of Well Elevation: 631.39 ft MSL

Date	Depth to Water (ft)	Elevation (ft msl)	Remarks
25 Jun 81*	39.16	638.48	
19 Aug 81	38.58	639.06	
17 Sep 81	38.79	638.85	
6 Dec 81	38.42	639.22	
11 Jun 82	35.50	642.14	
22 Sep 82	31.50	646.14	
20 Oct 82	35.83	641.81	
14 Dec 82	37.00	640.64	
21 May 83	39.70	637.94	
17 Jul 83	32.60	645.04	

* All measurements by NWSC

Ground-Water Elevations

NWSC Landfill

Well Number: 3B

Top of Pipe Elevation: 677.91 ft MSL

Bottom of Well Elevation: 667.11 ft MSL

Date	Depth to Water (ft)	Elevation (ft msl)	Remarks
25 Jun 81*	8.58	669.33	
19 Aug 81	6.04	671.87	
17 Sep 81	6.54	671.37	
6 Dec 81	3.75	674.16	
11 Jun 82	3.9	674.01	
22 Sep 82	5.33	672.58	
20 Oct 82	8.50	669.41	
14 Dec 82	2.50	675.41	
21 May 83	2.80	675.11	
17 Jul 83	4.92	672.99	

* All measurements by NWSC

Ground-Water Elevations

NWSC Landfill

Well Number: 4A

Top of Pipe Elevation: 687.95 ft MSL

Bottom of Well Elevation: 640.45 ft MSL

Date	Depth to Water (ft)	Elevation (ft msl)	Remarks
25 Jun 81*	24.00	663.95	
19 Aug 81	19.04	668.91	
17 Sep 81	18.75	669.20	
6 Dec 81	24.08	663.87	
11 Jun 82	18.7	669.25	
22 Sep 82	20.00	667.95	
20 Oct 82	20.33	667.62	
14 Dec 82	19.92	668.03	
21 May 83	14.7	673.25	
17 Jul 83	25.00	662.95	

* All measurements by NWSC

Ground-Water Elevations

NWSC Landfill

Well Number: 4B

Top of Pipe Elevation: 687.93 ft MSL

Bottom of Well Elevation: 661.03 ft MSL

Date	Depth to Water (ft)	Elevation (ft msl)	Remarks
25 Jun 81*	21.25	666.68	
19 Aug 81	17.33	670.60	
17 Sep 81	17.46	670.47	
6 Dec 81	13.67	674.26	
11 Jun 82	12.0	675.93	
22 Sep 82	15.25	672.68	
20 Oct 82	13.25	674.68	
14 Dec 82	3.33	684.60	
21 May 83	3.00	684.93	
17 Jul 83	13.33	674.60	

* All measurements by NWSC

Ground-Water Elevations

NWSC Landfill

Well Number: 5A

Top of Pipe Elevation: 693.69 ft MSL

Bottom of Well Elevation: 651.69 ft MSL

Date	Depth to Water (ft)	Elevation (ft msl)	Remarks
25 Jun 81*	19.08	674.61	
19 Aug 81	18.17	675.52	
17 Sep 81	18.79	674.90	
6 Dec 81	19.25	674.44	
11 Jun 82	19.10	674.59	
22 Sep 82	19.50	674.19	
20 Oct 82	19.25	674.44	
14 Dec 82	18.75	674.94	
21 May 83	19.30	674.39	
17 Jul 83	17.85	675.84	

* All measurements by NWSC

Ground-Water Elevations

NWSC Landfill

Well Number: 5B

Top of Pipe Elevation: 693.66 ft MSL

Bottom of Well Elevation: 675.86 ft MSL

Date	Depth to Water (ft)	Elevation (ft msl)	Remarks
25 Jun 81*	3.33	690.33	
19 Aug 81	3.08	690.58	
17 Sep 81	4.04	689.62	
6 Dec 81	5.17	688.49	
11 Jun 82	5.1	688.56	
22 Sep 82	6.50	687.16	
20 Oct 82	8.83	684.83	
14 Dec 82	7.00	686.66	
21 May 83	2.1	691.56	
17 Jul 83	5.85	687.81	

* All measurements by NWSC

Ground-Water Elevations

NWSC Landfill

Well Number: 6A

Top of Pipe Elevation: 688.51 ft MSL

Bottom of Well Elevation: 646.21 ft MSL

Date	Depth to Water (ft)	Elevation (ft msl)	Remarks
25 Jun 81*	6.42	682.09	
19 Aug 81	6.96	681.55	
17 Sep 81	7.63	680.88	
6 Dec 81	8.08	680.43	
11 Jun 82	6.90	681.61	
22 Sep 82	7.00	681.51	
20 Oct 82	6.50	682.01	
14 Dec 82	6.83	681.68	
21 May 83	6.70	681.81	
17 Jul 83	5.38	683.13	

* All measurements by NWSC

Ground-Water Elevations

NWSC Landfill

Well Number: 6B

Top of Pipe Elevation: 688.64 ft MSL

Bottom of Well Elevation: 673.74 ft MSL

Date	Depth to Water (ft)	Elevation (ft msl)	Remarks
25 Jun 81*	6.25	682.39	
19 Aug 81	7.04	681.60	
17 Sep 81	7.60	681.04	
6 Dec 81	6.83	681.81	
11 Jun 82	6.00	682.64	
22 Sep 82	7.00	681.64	
20 Oct 82	6.17	682.47	
14 Dec 82	5.08	683.56	
21 May 83	5.10	683.54	
17 Jul 83	5.92	682.72	

* All measurements by NWSC

Ground-Water Elevations

NWSC Landfill

Well Number: 7A

Top of Pipe Elevation: 711.04 ft MSL

Bottom of Well Elevation: 669.04 ft MSL

Date	Depth to Water (ft)	Elevation (ft msl)	Remarks
25 Jun 81*	28.75	682.29	
19 Aug 81	28.63	682.41	
17 Sep 81	28.83	682.21	
6 Dec 81	29.50	681.54	
11 Jun 82	29.50	681.54	
22 Sep 82	29.50	681.54	
20 Oct 82	29.00	682.04	
14 Dec 82	28.42	682.62	
21 May 83	29.30	681.74	
17 Jul 83	27.27	683.77	

* All measurements by NWSC

Ground-Water Elevations

NWSC Landfill

Well Number: 7B

Top of Pipe Elevation: 711.11 ft MSL

Bottom of Well Elevation: 681.31 ft MSL

Date	Depth to Water (ft)	Elevation (ft msl)	Remarks
25 Jun 81*	23.58	687.53	
19 Aug 81	24.08	687.03	
17 Sep 81	--	--	Dry
6 Dec 81	--	--	Dry
11 Jun 82	24.30	686.81	
22 Sep 82	24.00	687.11	
20 Oct 82	24.50	686.61	
14 Dec 82	24.33	686.78	
21 May 83	--	--	Dry
17 Jul 83	23.00	688.11	

* All measurements by NWSC

Ground-Water Elevations

NWSC Landfill

Well Number: 201

Top of Pipe Elevation: 714.82 ft MSL

Bottom of Well Elevation: 704.12 ft MSL

Date	Depth to Water (ft)	Elevation (ft msl)	Remarks
25 Jun 81*	7.75	707.07	
19 Aug 81	3.25	711.57	
17 Sep 81	8.25	706.57	
6 Dec 81	--	--	Dry
11 Jun 82	7.00	707.82	
22 Sep 82	7.00	707.82	
20 Oct 82	5.67	709.15	
14 Dec 82	4.00	710.82	
21 May 83	9.90	704.92	
14 Jul 83	5.71	709.11	

* All measurements by NWSC

Ground-Water Elevations

NWSC Landfill

Well Number: 202

Top of Pipe Elevation: 688.72 ft MSL

Bottom of Well Elevation: 680.62 ft MSL

Date	Depth to Water (ft)	Elevation (ft msl)	Remarks
25 Jun 81*	6.67	682.05	
19 Aug 81	5.50	683.22	
17 Sep 81	5.63	683.09	
6 Dec 81	5.25	683.47	
11 Jun 82	4.50	684.22	
22 Sep 82	6.00	682.72	
20 Oct 82	6.25	682.47	
14 Dec 82	5.08	683.64	
21 May 83	3.30	685.42	
14 Jul 83	5.75	682.97	

* All measurements by NWSC

Ground-Water Elevations

NWSC Landfill

Well Number: 203

Top of Pipe Elevation: 684.38 ft MSL

Bottom of Well Elevation: 672.38 ft MSL

Date	Depth to Water (ft)	Elevation (ft msl)	Remarks
25 Jun 81*	9.33	675.05	
19 Aug 81	8.83	675.55	
17 Sep 81	9.04	675.34	
6 Dec 81	7.50	676.88	
11 Jun 82	7.50	676.88	
22 Sep 82	8.00	676.38	
20 Oct 82	8.75	675.63	
14 Dec 82	7.00	677.38	
21 May 83	7.00	677.38	
17 Jul 83	7.54	676.84	

* All measurements by NWSC

Ground-Water Elevations

NWSC Landfill

Well Number: 204

Top of Pipe Elevation: 686.38 ft MSL

Bottom of Well Elevation: 676.38 ft MSL

Date	Depth to Water (ft)	Elevation (ft msl)	Remarks
25 Jun 81*	8.58	677.80	
19 Aug 81	7.46	678.92	
17 Sep 81	7.54	678.84	
6 Dec 81	4.58	681.80	
11 Jun 82	5.80	680.58	
22 Sep 82	6.50	679.88	
20 Oct 82	8.50	677.88	
14 Dec 82	5.00	681.38	
21 May 83	4.70	681.68	
17 Jul 83	5.71	680.67	

* All measurements by NWSC