

HYDROGEOLOGIC ASSESSMENT OF THE ALLIED WASTE BEDS IN THE SYRACUSE AREA

VOLUME 2 OF 2

Allied-Signal Inc.

Solvay, New York

BLASLAND & BOUCK ENGINEERS, P.C. BLASLAND, BOUCK & LEE

ENGINEERS & GEOSCIENTISTS

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ALLIED-SIGNAL INC. SOLVAY, NEW YORK

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BY

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TABLE OF CONTENTS

		PAGE							
VOLUME 1									
SECTION 1	SECTION 1 - EXECUTIVE SUMMARY								
SECTION 2	- INTRODUCTION								
2.1 C	General	7							
2.2 C	Objectives	8							
2.3 E	Background	9							
2.4 S	Solvay Process Waste Characteristics	10							
SECTION 3	8 - SITE HISTORY								
3.1 C	General History	13							
3.2 H	History of Areas F-M and OLF	15							
3.3 H	History of Waste Beds A-E	19							
3 3	3.3.1 Waste Bed A 3.3.2 Waste Bed B 3.3.3 Waste Bed C 3.3.4 Waste Beds D & E	19 20 21 22							
3.4 H	History of Waste Beds 1-8	22							
3.5 H	History of Waste Beds 9-15	23							
3 3 3	3.5.1 Waste Beds 9, 10, 11 3.5.2 Waste Bed 12 3.5.3 Waste Bed 13 3.5.4 Waste Bed 14 3.5.5 Waste Bed 15	24 25 26 27 28							
SECTION 4	- SITE CHARACTERIZATION								
4.1	General	30							
4.2	Site Reconnaissance	30							
! ! !	4.2.1 Areas F-M and OLF 4.2.2 Waste Beds A-E 4.2.3 Waste Beds 1-8 4.2.4 Waste Beds 9-11 4.2.5 Waste Beds 12-15	31 33 36 38 39							

TABLE OF CONTENTS (Continued)

		PAGE
4.3	Geology and Hydrogeology	40
i	4.3.1 Site Geology	40
	4.3.1.1 Bedrock 4.3.1.2 Glacial Geology 4.3.1.3 Post-Glacial Sediments 4.3.1.4 Geology of the Nine Mile Creek Valley 4.3.1.5 Summary of Geologic Conditions	. 41 42 44 45 53
,	4.3.2 Site Hydrogeology	55
	 4.3.2.1 Surface Water 4.3.2.2 Precipitation and Water Balance 4.3.2.3 Ground Water 4.3.2.4 Summary of Hydrogeologic Conditions 	55 64 69 81
4.4	Water Quality Results	83
	4.4.1 General 4.4.2 Surface Water 4.4.3 Ground Water 4.4.4 Summary of Water Quality	83 87 93 100
4.5	Water Quality Impact Assessment/Current & Future	102
	4.5.1 Impact of Areas F-M and OLF	102
	4.5.2 Impact of Waste Beds A-E	103
	4.5.3 Impact of Waste Beds 1-8	105
	4.5.4 Impact of Waste Beds 9-15	106
SECTION :	5 - PRELIMINARY FEASIBILITY ANALYSIS	
5.1	General	113
5.2	Existing Chloride Loadings to Onondaga Lake	114
5.3	Development of Potential Remedial Alternatives	115
5.4	Preliminary Assessment of Potential Remedial Alternatives	116
	5.4.1 General Alternatives to Address Waste Deposits	116
	5.4.1.1 The "No Action" Alternative 5.4.1.2 Cover and Vegetate Alternative 5.4.1.3 Low-Permeability Cap and Vegetate	116 117
	Alternative	120

TABLE OF CONTENTS (Continued)

			PAGE
		Low-Permeability Cap, Ground-Water Cutoff Wall, and Vegetate	124
	5.4.1.5	Incorporate Sludge and Vegetate Alternative	126
	5.4.1.6	Removal and Off-Site Disposal of Wastes	128
	5.4.2 General	Alternatives to Address Ground Water	130
		The "No Action" Alternative Ground-Water Withdrawal and Treatment	130 131
5.5	Impact of Poten Loading	tial Remedial Measures on Chloride	134
5.6	Preliminary Con	clusions of the Feasibility Analysis	135
5.7	Implementation	Schedule	136
TABLES			
171223			
Table 1		aracteristics of Solvay Process Waste	
2		rracteristics of Solvay Process Waste	W+-
3 4		rea, Thickness and Volume of Solvay Proces nership of Waste Beds 1-15 and A-E and Ar	
5		to Onondaga Lake	eas i -wi
6		eek at State Fair Boulevard	
7		eek - Yearly Flow & Quality Characteristics	
8		k at Hiawatha Boulevard	
9	Harbor Broo	k - Yearly Flow & Quality Characteristics	
10		reek at Spencer Street	
11		reek - Yearly Flow & Quality Characteristics	ı
12 13		t Park Street Yearly Flow & Quality Characteristics	
14		- Yearly Flow & Quality Characteristics	
15		ydraulic Conductivity Results	
16		onductivities & Vertical Gradients in Solvay	Waste
17		Rates - Beds A-E and 1-15	
18	•	y Sampling_Parameters	
19		er Quality Results	
20		er Quality Results	
21 22		y Data - Tully Brine & Waste Bed Overflow m - Surface Water Data Points	
23	Piper Diagra	am - Ground-Water Data Points	
21		im - Additional Data Points	
25			
26		reek Flow and Ion Loading Balance	

TABLE OF CONTENTS

VOLUME	7	PAGE
	X A - FIELD METHODS	
A.1	Resistivity Survey	A-2
	A.1.1 General A.1.2 Survey Methodology A.1.3 Data Reduction A.1.4 Survey Evaluation	A-2 A-3 A-4 A-5
A.2	Boring and Well Installation Procedures	A-9
	A.2.1 Soil Sampling A.2.2 Rock Coring A.2.3 Decontamination A.2.4 Grain Size Analysis A.2.5 Well Installations	A-10 A-11 A-12 A-12 A-13
A.3	Well Development, Ground-Water Sampling and In-Situ Hydraulic Conductivity Analyses	A-14
	A.3.1 Well Development A.3.2 Ground-Water Sampling A.3.3 In-Situ Hydraulic Conductivity Analyses	A-14 A-16 A-19
A.4	Surface Water Sampling and Stream Flow Measurements	,A-21
	A.4.1 Surface Water Sampling A.4.2 Stream Flow Measurements	A-21 A-22
APPENDI	X B - RESISTIVITY DATA	
APPENDI	X C - SUBSURFACE LOGS	
APPENDI	X D - GRAIN SIZE ANALYSIS	
APPENDI	X E - SEISMIC REFRACTION INVESTIGATION	
APPENDI	X F - ANALYTICAL RESULTS	
ADDENINI	Y C - AFRIAL PHOTOGRAPHS	

TABLE OF CONTENTS (Continued)

FIGURES

Figure 1	Site Location Map
2	Chronology of Waste Disposal Area Utilization
3	Waste Beds A-E and Area F-K & M - Site Observations
4	Areas L and OLF - Site Observations
5	Waste Beds 1-8 - Site Observations
6	Waste Beds 9-11 and 12-15 - Site Observations
7	Geophysical Exploration Locations
8	Summary of Subsurface Investigations
9	Bedrock Geology
10	Geologic Cross Sections A-A' and B-B'
11	Geologic Cross Section C-C ¹
12	Top of Bedrock Contours
13	Top of Till Contours
1 4	Grain Size Distribution Curves - Till, Solvay Waste &
	Lacustrine Sediments
15	Grain Size Distribution Curves - Upper Screened Unit
16	Grain Size Distribution Curves - Lower Screened Unit
17	Chloride Ion Concentration - Onondaga Lake
18	Calcium Ion Concentration - Onondaga Lake
19	Sodium Ion Concentration - Onondaga Lake
20	Nine Mile Creek Average Concentrations
21	Harbor Brook Average Concentrations
22	Onondaga Creek Average Concentrations
23	Ley Creek Average Concentrations
24	Metro Plant Average Concentrations
25	Shallow Ground-Water Contours, December 15, 1987
26	Potentiometric Surface "Deep" Wells, December 15, 1987
27	Ground-Water and Surface Water Sampling Locations
28	Piper Diagram - Water Classification Designated by Dominant Ions
29	Piper Diagram - Surface Water Quality
30	Piper Diagram - Ground-Water Quality
31	Waste Bed Age vs. Chloride Concentration
32	Waste Bed Age vs. Sodium Concentration
33	Waste Bed Age vs. Calcium Concentration
34	Summary of Flows, Chloride Concentrations and Chloride Loading
35	Waste Bed Evaluation Program Schedule

BIBLIOGRAPHY

APPENDIX A
FIELD METHODS

APPENDIX A - FIELD METHODS

This Appendix includes a discussion of field methods employed during the Hydrogeologic Assessment of the Allied Waste Beds. Field activities included a site reconnaissance; electrical resistivity and seismic refraction surveys; soil borings; monitoring well installations; well development; in-situ hydraulic conductivity analyses; ground-water quality sampling; stream flow measurements; and surface water quality sampling.

Detailed field methodologies employed during this assessment were included as part of the Blasland & Bouck Engineers, P.C., "Work Plan, Hydrogeologic Assessment of the Allied Waste Beds in the Syracuse Area", March 1987. Items not discussed in the Work Plan are discussed below, as well as a review of all methodologies employed during the actual assessment. Methodologies employed during the Site Reconnaissance were discussed previously in Volume 1, Section 4.2.

A.1 Resistivity Survey

An earth resistivity survey was initiated in the early part of the Waste Bed Investigation to determine its practicality for delineating the vertical and areal extent of brine plumes associated with Waste Beds 9-15. Because of the heterogeneity of the geologic and the hydrogeologic conditions adjacent to the waste beds, the resistivity survey proved to be less useful than originally anticipated. Resistivity is a very useful tool for defining the subsurface geology in areas where the geology is relatively uniform and the data evaluation is limited to no more than three or four rock units. During the analysis of the data, it became apparent that it was going to be difficult to isolate variations in resistivity due to high saline conditions and from variations due to the nature of the subsurface material. The usefulness of the resistivity became more apparent as the resistivity data was correlated with data from soil borings, monitoring wells and excavations around the waste bed. It became clear that in some areas very low resistivity values were correlated with high concentrations of total dissolved solids, but a linear relationship between resistivity and total dissolved solids or chloride concentrations could not be established.

A.1.1 General

A resistivity survey consists of passing an electrical current between two points (electrodes) through the earth and measuring the potential difference created as the current passes through the earth materials. The resistance of the material is calculated by using Ohm's Law, R = V/I; where: R = resistance; V = potential drop; and I = current induced. In general, the measured value from a resistivity survey is apparent resistivity. In shallow surveys where penetration of

the current is through a homogeneous material, the apparent resistivity would be equivalent to the actual resistivity. In most cases which involve penetration of saturated and unsaturated materials and layered earth materials, a series of computations or graphical analyses are necessary to change apparent resistivity to actual resistivity.

The resistivity of a material increases with an increase in properties such as porosity or sand and gravel content. The resistivity decreases with an increase in water content or salinity. Some typical values for some materials which may be encountered in this survey are listed below (from Telford, 1982).

Rock Type	Resistivity Range (Ohm-m)	Resistivity Range (Ohm-ft)
Alluvium and sands	10-800	3-244
Maris	3-70	.9-21
Clays	1-100	.3-30
Unconsolidated wet clay	20	6
Consolidated shales	20-2000	6-610
Natural waters	1-100	.3-30
Saline waters, 3 percent	.15	.05
Saline waters, 20 percent	.05	.015

A.1.2 Survey Methodology

The survey "array" or layout refers to the relative positions of the current and potential electrodes. There are several arrays which can be utilized for electrical resistivity surveys. The Wenner array was chosen as the most appropriate for the survey (Figure B-1).

The Wenner array uses uniformly spaced electrodes to measure apparent resistivity. The apparent resistivity using this array is calculated by the following formula (following Ohm's Law):

$$\rho$$
 a = 2 a $\frac{V}{I}$

Where: ρ_a = apparent resistivity; a = electrode spacing; V/I = the instrument reading.

The survey combined profiling and sounding methodologies. By obtaining resistivity measurements along a traverse using the same electrode spacing at several stations, a horizontal profile is created. This method can be used to delineate the lateral extent of a contaminant plume. When several electrode spacings ("a" spacings) are used at one station, a depth sounding is formed. This is because as the probe spacing increases, so does the depth of penetration of the electrical current. The sounding method can be used to delineate the vertical variation in subsurface materials including water quality variations.

Earth resistivity was measured along nine lines in the Waste Bed 9-15 area; the lines were numbered 1 through 9 and are shown on Figure 7. At most of the numbered lines several stations were established and for these stations an alphabetic designation was assigned. At each station, the resistivity was measured for four "a" spacing (20, 40, 80 and 160 feet). For example, at line 1 there were three stations (1a, 1b, and 1c) and at each station four resistivity measurements were made.

The raw and corrected data for each station is presented in Table B-1. The raw data (apparent resistivity) was recorded in a field notebook at the time the information was collected. The corrected data (corrected apparent resistivity) was computed in the office.

A.1.3 Data Reduction

The computer program used to reduce the resistivity data results in three values for resistivity. These values are apparent resistivity, fully corrected apparent resistivity and partially corrected apparent resistivity. Apparent resistivity is the true earth resistivity of a material only when one is considering a homogeneous situation. Based upon the available soil boring, well and pit excavation data in the Waste Bed area, the subsurface materials are not homogeneous; therefore, some sort of correction factor is needed to evaluate the resistivity data. The computer program assumes a two-layer case for adjusting the apparent resistivity. The full correction value of resistivity is the better value to use in an evaluation when a high electrical resistance material is encountered at depth. When low resistance materials occur at depth a full correction of the data may overcompensate, so the partially corrected apparent resistivity value is the better approximation to use in this case. The partially corrected apparent resistivity values versus depth of penetration ("a" spacing) are plotted on log-log graphs and are included as Figures B-2 through B-10.

A.1.4 Survey Evaluation

Resistivity line 1 consisted of three stations oriented east-west and was located south of Waste Beds 14 and 15. Resistivity line 2 consisted of one station to the west of line 1. The resistivity values at Stations 1a and 2 are very similar to one another (Table B-1 and Figures B-2 and B-3). There was a sharp increase in resistivity between the 20 and 40 foot "a" spacings, and then a sharp decrease in resistivity was observed between the 40 and 80 foot "a" spacings. The increase in resistivity is due to the occurrence of sands and gravels or the occurrence of bedrock. Bedrock in this area is approximately 20 feet below the surface and is the Vernon Shale Formation. Although clays usually have low values of electrical resistance, shales or siltstones can

have very high resistivity values (Telford, 1982). The subsurface materials at Stations 1b and 1c may have been more weathered than at Stations 1a and 2 so there would not be as sharp of a contrast between the overburden or till and rock interface.

Resistivity line 3 consisted of two stations and is located on the west edge of Figure 7 in the Nine Mile Creek Valley. The stations were oriented north-south and this station was placed so as to obtain representative background readings for the Nine Mile Creek Valley. Stations 3a and 3b had apparent resistivity values which were very similar to one another (Table B-1 and Figure B-4). The subsurface materials in the valley at this location are not as well defined as other areas in the valley due to the lack of boring logs available for this location. The resistivity values at the 160 foot "a" spacing are slightly higher than observed at other resistivity lines, but the values are generally low, typical of a consolidated shale. The increase in resistivity between 40 and 80 foot "a" spacings may be due to granular overburden overlying till or bedrock. The occurrence of till overlying bedrock is uncertain here. The decrease between 80 and 160 foot "a" spacings could be due to natural salinity of the bedrock, but there is no direct evidence to support this theory. The lower resistivity values could also be due to a weathered bedrock surface.

Stations 4a and 4b were located perpendicular to one another to the west of Waste Bed 14. The resistivity values at the two stations were similar, there was decrease in resistivity between the 20 and 40 foot "a" spacings and then a general increase in resistivity with increasing depth (Table B-1 and Figure B-5). The resistivity values between 20 and 40 feet are relatively low, which is due to the mounding of ground

water in this area near Bed 14. The increasing resistivity with depth is due to the occurrence of bedrock.

Resistivity line 5 was located to the east of Waste Beds 12 and 15 and consisted of 6 stations. Stations 5c, 5d and 5f were oriented north-south, while Stations 5a, 5b and 5e were oriented east-west. Resistivity values for Stations 5a, 5c and 5d indicate the same resistivity trends; those being an increase in resistivity between the 20 and 40 "a" spacings, a decrease between the 40 and 80 "a" spacings, and an increase in resistivity between the 80 and 160 "a" spacings (Table B-1 and Figure B-6). Stations 5e and 5f show the same trends in resistivity values; those being a decrease in resistivity between the 20 and 40 "a" spacings, an increase between the 40 and 80 "a" spacings, and a decrease in resistivity between the 80 and 160 "a" spacings. resistivity at Station 5b decreased in value with depth for all the "a" spacings measured. The resistivity values for all the stations were relatively low, and for the 160 foot "a" spacing the values were all similar. Soil borings which were placed nearby for the force main to Metro show that this area has highly variable subsurface conditions over relatively short distances. This is substantiated by the different trends in resistivity measured along line 5. In general, all the resistivity values are very low and this fact is likely due, in part, to the saline ground-water mounding from Waste Beds 12 and 15, and in part, due to saline ground water occurring in the Nine Mile Creek Valley.

Resistivity line 6 consisted of 1 station located in the bottom of a gravel excavation to the west of Waste Bed 13. The depth of the excavation was approximately 20 feet below the surrounding ground surface. All the resistivity values were relatively low (Table B-1 and

Figure B-7). The very low resistivity occurring at the 40 foot "a" spacing is due to the saline ground-water leaching from Waste Bed 13. There was a significant increase between the 40 and 80 foot "a" spacings and a large drop in resistivity between the 80 and 160 foot "a" spacings. The increase in resistivity between the 40 and 80 foot "a" spacings is likely due to sands and gravels overlying till and/or bedrock. The increase observed here is also due to the fact that the resistivity measured for the 20 foot "a" spacing is low in comparison because of the occurrence of the water table. The sharp decrease between the 80 and 160 foot "a" spacings could be due to either weathered bedrock or an increase in salinity.

Six stations were measured at resistivity line 7. An extra "a" spacing of 10 feet was measured at each of the stations. The decrease in resistivity values between the 10 and 20 foot "a" spacings is due to the presence of the water table (Table B-1 and Figure B-8). The increases in resistivity between the 20 and 80 foot "a" spacings is due to sands and gravels intermixed in the lacustrine sediments. The decrease in resistivity between the 80 and 160 foot "a" spacings may be due to the occurrence of weathered bedrock and the increase of salinity with depth.

Resistivity line 8 consisted of seven stations and was located north of Waste Beds 9 and 10. The values for resistivity were similar for all the stations with one exception (Table B-1 and Figure B-9). At Station 8b, the resistivity increased between the 40 and 80 foot "a" spacings, whereas the resistivity decreased for the other stations. The increase may have been due to the occurrence of more sands and gravels than occurred at the other stations. The resistivity values the between 80

and 160 foot "a" spacings were very low for all the stations. There are several wells near this resistivity line which were sampled, reflecting saline ground-water conditions. Therefore, the low resistivity values observed along line 8 appear to be due to the increasing salinity with increasing depth.

Three stations were measured along resistivity line 9. This line was located to the north of Waste Beds 12 and 13 and the Conrail tracks and was oriented parallel to the tracks and lies south of Nine Mile Creek. The resistivity values were generally low, but an increase in resistivity was observed the between 40 and 160 foot "a" spacings (Table B-1 and Figure B-10). Although ground water in the area is suspected to be naturally brackish, the low porosity of the bedrock in this area has caused a rise in resistivity with depth.

A.2 Boring and Well Installation Procedures

During October and November 1987, 19 borings were advanced at eight well cluster locations and monitoring wells were installed in 16 of the completed borings. Soil samples were obtained during the advancement of the deepest boring at each well cluster location and at one additional location where a well was not installed. Two other boreholes were not used for well installations due to difficulties encountered during drilling.

Eight well clusters were installed at various locations around the waste beds (Figure 8). In general, one deep well was screened in a permeable zone near the bedrock and a shallow well was screened in a permeable zone below the potentiometric surface. At Well Cluster 5, a third well was screened from 6.9 to 11.9 feet below grade in order to determine the quality of the perched water conditions at this location. One cluster consisted of a deep well

installed during this investigation (WB-6), and a second pre-existing 6-inch steel cased shallow well located in close proximity to WB-6.

A.2.1 Soil Sampling

Eighteen of the nineteen boreholes were completed with a truck-mounted Mobile 57 drill rig with 4-1/4 inch I.D. hollow-stem augers. One borehole (WB-2) was advanced with a truck-mounted TH60 Cyclone drill rig using air rotary techniques. Soil samples obtained while using the Mobile 57 drill rig were taken in accordance with ASTM D1586-84 for split barrel sampling. A 1-3/8 inch diameter, 2 foot long (internal dimensions) split-spoon sampler driven 24 inches with a 140 pound hammer dropped 30 inches was used throughout the sampling program. In general, the first borehole within a cluster was sampled continuously to the top of bedrock or to 100 feet, whichever was encountered first. Below 100 feet and above 100 feet, at the discretion of the on-site geologist, the sampling interval was changed to 5 foot intervals.

Upon removal of the sampler from the borehole, the soil samples were described by the supervising geologist. Soil sample descriptions were recorded in bound field books in indelible ink and included: soil moisture, color, type and texture, length of recovery, blow counts, drilling and sampling equipment, and miscellaneous observations. After describing the sample, a representative portion of the sample was stored in an 8 ounce glass jar provided by the driller.

Boring logs developed from the field notes are included in Appendix C. Table A-1 lists complete borehole and well installation details. The original field notes are maintained on file at the offices of Blasland & Bouck Engineers, P.C.

The boring advanced with the Cyclone drill rig at well cluster WB-2 was not sampled for soils above 95 feet. Samples obtained below 95 feet in this boring were cuttings and, as such, are not of the quality of split-spoon samples. The 0-95 foot interval had been sampled during the advancement of a hollow-stem auger boring (WB-2La) previously conducted at this cluster location, which failed to reach bedrock due to difficult drilling conditions. The log developed for boring WB-2L (Appendix C) is a composite log consisting of the soil information from the auger boring above 95 feet and the air rotary cuttings below that depth.

A.2.2 Rock Coring

At six separate drilling locations, the bedrock was cored with an NX core barrel which provides for the retrieval of a nominal 2-1/8 inch rock core. Five of the six cores were obtained from well clusters and the sixth was taken from boring WB-1La. The location of WB-1L had been a proposed well cluster location, but the boring was abandoned due to the relatively shallow bedrock and the relatively low permeability of the material overlying the bedrock encountered during drilling. At three of the eight well cluster locations, bedrock was not reached by the rig set up for coring, therefore, no cores were obtained from these clusters. Examination of air rotary cuttings and a change in drilling rate were used to determine depth to bedrock at WB-2L. Depth to

bedrock was not determined at the remaining two well cluster locations, WB-1 and WB-B.

Five foot core runs were performed at four of the five coring locations with core recovery varying between 2.8 and 4.5 feet. At the fifth location where a 3.8 foot core run was performed, recovery was 2.6 feet. A description of the rock core recovered and the rate of core cutting is provided on the subsurface logs in Appendix C.

A.2.3 Decontamination

Decontamination procedures for both drill rigs were similar. The rigs were decontaminated with high pressure hot water spray systems upon mobilization to the site and after each boring at a designated decontamination area. All downhole equipment, including augers, drill rods, tremie pipes, core barrels, auger plugs, split-spoon samplers, and associated drilling equipment including pipe wrenches, hand-held hammers and other equipment were decontaminated.

Split-spoon samplers were decontaminated prior to each use at the drilling location by washing with an Alconox detergent solution and thoroughly rinsing with tap water before the next sample.

A.2.4 Grain Size Analysis

Three to four soil samples from each of the eight well clusters were selected for grain size analysis. The samples selected from each cluster were either located within the screened interval or comprised of relatively impermeable material in comparison to the overlying and underlying deposits. The samples selected for analysis are listed in Table D-1.

Standard sieve analysis was conducted on all the selected samples except those which contained only a small proportion of material coarser than a No. 200 sieve size. Any sample with 20 percent or greater fines (No. 200 sieve size) had hydrometer analyses conducted on them in addition to the sieve analysis. Grain size analysis was performed in accordance with ASTM D422. The grain size curves are included in Appendix D.

A.2.5 Well Installations

Boreholes completed as described in the previous section were utilized for the installation of ground-water monitoring wells. Once the augers were advanced to the desired depth, a string of 2-inch I.D. flush-joint PVC 0.010-inch slot screen and riser were inserted into the borehole. In general, a grade zero sand pack was then installed by manually pouring sand into the annulus, filling the interval from below to above the well screen. In some locations, collapsed natural materials were used for the entire or a portion of the sand pack dependent on local geologic conditions (Table 25).

Bentonite pellets were poured into the annulus above the sand pack to provide a seal above the well screen pack. The bentonite pellets were hydrated by the water present in the borehole annulus. Grout comprised of approximately 95 percent Type II Portland cement and 5 percent bentonite powder (dry weight) mixed with approximately 6 gallons of water per bag of cement, was used to seal the annulus around the PVC riser to the surface. The grout was mixed into a slurry and added to the annulus using a tremie pipe, such that water in the annulus is displaced from the bottom upwards and a continuous grout

seal is insured. After the grout was emplaced, a 4.2-foot long, 4-inch I.D. steel surface casing with locking cap was installed around the PVC riser and secured with a padlock.

At all cluster well locations, the steel protective casing was installed such that the protective casing for the shallower well had a stick-up greater than the stick-up for the deeper well. This allowed immediate differentiation of wells within a cluster based on the casing stick-up height. After the grout in the annulus cured, sufficient grout was added to the annulus to compensate for settlement and a cement surface cap was placed around the protective pipe to encourage drainage away from the completed borehole. The complete well installation details are compiled in Table 25 and are shown on the subsurface logs in Appendix C.

A.3 Well Development, Ground-Water and In-Situe Hydraulic Conductivity Analyses

A.3.1 Well Development

The sixteen monitoring wells installed during the hydrogeologic investigation were developed during November 12-25, 1987 by Blasland & Bouck personnel. The wells were developed to remove fine grained soils from and around the well pack to promote a hydrologic interconnection between the aquifer and the well. Two methods of well development were used at the site: air-lift and bailing.

The air-lift method involved the use of a double coaxial tubing and foot valve setup powered by compressed air. The inner coaxial tube was a one-half inch diameter PVC hose, with slots cut into the bottom two

foot section which was inserted into the outer coaxial one-inch diameter PVC hose. A foot valve attached to the outer one-inch diameter hose allowed water to enter the annulus between the one-inch and one-half inch diameter hoses. The upper end of the one-half inch diameter hose was attached to a 60 cubic feet per minute air compressor which was used to force air down into the hose and out through the slots cut in the bottom. As a result, the air under pressure forced the water in the annulus between the two coaxial tubes up through the annulus to the surface. The foot valve prevented backflow of water or air into the well itself.

As the water was being pushed upwards, the tubing was raised and lowered inside of the well such that the foot valve acted like a surge block. In this manner, water is forced out into the formation, then pulled back into the well in an attempt to draw fine sediment from the sand pack into the well, where it could be pumped out. The deeper wells were generally developed by this method, as is shown in Table A-1.

Development by bailing involved removing water from the well using a two-inch diameter stainless steel bottom-loading bailer attached to a length of new polypropylene rope. The bailer was raised and lowered in a surging motion in an attempt to pull fine sediment out of the sand pack into the well bore, where it was removed by bailing. In general, the shallower wells were developed in this manner, as indicated in Table A-1.

All of the wells were initially very turbid due to suspended fines in the well. Each well was developed until there was no further noticeable decrease in the suspended load with continued development. If this analytical sample was taken after the well recharged enough to obtain a sample. The deep wells were purged with a stainless steel top-loading bailer and a stainless steel bottom-loading bailer was used to purge the shallow wells. The last approximately one-half to one well volume of water was removed from the deep wells using the bottom-loading stainless steel bailer, which was subsequently used to obtain the analytical sample.

Two of the five pre-existing wells, DW-101 and MS-104.1, are located on property in the vicinity of the Crucible Steel, Inc., Solid Waste Management Facility near the State Fair parking area. These wells were evacuated, under Blasland & Bouck supervision, by an engineering firm which conducted the Part 366 Application for Crucible. Well MS-104.1 was evacuated and sampled using a dedicated bailer. Well DW-101 was sampled using a hand-operated pump. Blasland & Bouck personnel controlled the samples once the sample was removed from the well.

Three of the five previously existing wells, P-1, P-2 and Metro 1, were evacuated using a submersible pump. At least three well volumes were evacuated from each of the wells, then the pump was removed from the well.

All analytical samples were obtained from wells using a stainless steel bailer, except for wells MS-104.1 and DW-101, as discussed above. The analyses conducted for this investigation required that three one-pint plastic sample bottles be filled for each sample. Two bottles were prepared with acid, one each of nitric and sulfuric acid for sample preservation, and the third bottle contained no preservative. A one-half gallon plastic bottle was also supplied by the lab for each sample.

point was reached before removal of five well volumes, additional water was removed such that all wells had a minimum of five well volumes evacuated. In all but two cases, the wells failed to become relatively sediment-free. Fourteen of the sixteen wells installed and developed contained some proportion of gray-brown fines at the completion of the development process. A list of the well volumes removed, the methods used, and physical appearance of the water at the completion of development is included in Table A-1.

After development of each well, the equipment used for the development was decontaminated prior to developing the next well. Decontamination entailed flushing the coaxial tubing and foot valve set up thoroughly with tap water, both inside and out. Decontamination of the bailer was accomplished by the same methods as described in Section A.3.2 under Ground-Water Sampling. New polypropylene rope was used for each well which was bailed.

A.3.2 Ground-Water Sampling

Ground-water sampling was conducted from December 9-21, 1987 by Blasland & Bouck personnel. All sixteen of the wells installed as part of Blasland & Bouck's hydrogeologic investigation were sampled, in addition to five previously existing wells.

The wells installed during the course of this study were evacuated and sampled with a decontaminated stainless steel bailer attached to a new length of polypropylene rope. With the exception of Well WB-BL, a minimum of three well volumes were evacuated from the well prior to obtaining a sample for analysis. During purging of WB-BL, the well bailed dry after removing approximately two well volumes. The

Samples were obtained by carefully lowering the bailer into the well and then pouring the sample directly into the one-half gallon bottle and the unpreserved pint bottle. The sample in the one-half gallon bottom was filtered prior to acidification.

Sample filtration was performed with a Masterflex peristaltic pump which pushed the sample through a 0.45 micron filter. manufactured by Gelman Sciences (Product No. 12123, 0.45 micron filter) and QED Environmental Systems, Inc. (Product No. FF8000) were used during this investigation dependent on availability of the filters. A new filter was used for each sample, and filtration was accomplished by pumping the sample from the one-half gallon plastic bottle through silicone tubing, through the filter and directly into the sample bottle. The silicone tubing was decontaminated prior to each filtration by thoroughly rinsing the outside of the tubing with tap water, then pumping approximately one-half gallon of tap water through the tubing, followed by a thorough rinse with distilled water and pumping approximately 1 quart of distilled water through the tubing. All sample bottles were then placed in a cooler with ice to maintain a cool temperature. The samples were delivered to the analytical laboratory on a daily basis at the completion of the field day. Chain-of-custody procedures were followed for all samples collected and are included in Appendix F.

Sampling equipment used to evacuate and sample each of the monitoring wells was decontaminated between sampling events. The bailers were washed with an Alconox/water detergent solution, rinsed with tap water, then distilled water, sprayed with methanol, and then rinsed again with distilled water. A new length of polypropylene rope

was used for each well. The submersible pump, hose, and power cords used for three wells were rinsed with tap water and the pump was inserted into a five foot long 4-inch I.D. PVC container, and at least twenty gallons of tap water was pumped through the pump.

Specific conductance, pH and temperature were all monitored on-site. After the laboratory bottles were filled, a bailer-full of ground water was poured into a clean glass or plastic container and each of the parameters were measured. The probes and thermometer used to measure these parameters were cleaned with distilled water after each use.

A.3.3 In-Situ Hydraulic Conductivity Analyses

In-situ hydraulic conductivity tests were performed on seven wells during December 1987. The tests were performed by the "slug test" method, whereby a "slug" of sufficient volume is rapidly placed into or removed from the well causing a pertabation in the static water level. Based on the slug's volume, it is possible to determine the theoretical maximum water level change in the well due to the insertion or removal of the slug. The recovery to the static level is monitored. The type and rate of recovery is indicative of the hydraulic conductivity of the screened interval of the tested well.

Slug tests were performed on Wells WB-2U, 4L, 5M, 5L, 6, BU and BL. The results of the tests are given in Table 15. These tests were performed using a length of 1-1/4 inch PVC pipe filled with cement. Three lengths, one 5 feet long and the other two 2.5 feet long, all which had dips and rings on either end, were utilized as the slugs. Depending on the anticipated hydraulic characteristics of the screened

interval, an appropriate combination of slug lengths could be utilized for each well, varying from 2.5 to 10 feet in 2.5 foot intervals. The volume of the slugs were calculated by measuring the slug's cross-sectional area and multiplying by the length.

During the conduct of the slug tests, the static water level was measured prior to placing the slug in the wells. The slug was rapidly placed in the well and successive water level measurements made at preselected time intervals until complete recovery occurred. In the wells tested for this Assessment, this usually occurred within a matter of minutes. If the recovery was too fast to record, the slug was removed and another slug added to a maximum of 10 feet. This procedure was then repeated. Once the water level stabilized to the static water level with the appropriate length of slug in the well, the slug was rapidly removed. Again, the recovery of the water level to the static level was monitored at preselected intervals. Most wells recovered very quickly, with three recovering within 20–25 seconds and one recovering within approximately 45 minutes.

The type and rate of the water level recovery after slug removal was used to determine a value of the screened interval horizontal hydraulic conductivity. This was done using a computer program by Weyer and Horwood-Brown that uses Hvorselv's formulae. The determined values of hydraulic conductivity are given in Table 15.

A.4 Surface Water Sampling and Stream Flow Measurements

A.4.1 Surface Water Sampling

Surface water sampling was conducted during the period of December 3-8, 1987 with two additional samples taken on December 22, 1987. The sampling locations are shown in Figure 27.

liter Nalgene All samples were taken using a 1 decontaminated as outlined below. The beaker was attached to a telescoping aluminum pole, where necessary, and lowered into the surface water body with the opening facing upstream, where flow was The sample was poured directly into the sample bottles provided by the laboratory from the Nalgene beaker. The samples bottles provided by the laboratory were described in Section A.3.2 (Ground-Water Sampling), except that no one-half gallon bottle was used because the surface water samples were not filtered. The samples were then placed in a cooler with ice to maintain an even, cool temperature.

After filling the sample bottles, another beaker-full of sample was taken to obtain measurements of pH, conductance and temperature.

These measurements were made directly in the sampling beaker.

The Nalgene beaker was decontaminated prior to each use by scrubbing the beaker with an Alconox/tap water solution, thoroughly rinsing the beaker with tap water followed by a distilled water rinse, with methanol spray and a final distilled water rinse.

All information pertaining to sample color, turbidity, stream flow, and sampling location, in addition to sampling time and other observations, were recorded in a bound field book with indelible ink. Chain-of-custody procedures were followed. They are included in

Appendix F. At several locations, stream flow measurements were made using a flow meter as described in the following section.

A.4.2 Stream Flow Measurements

Stream flow measurements were taken by Blasland & Bouck Engineers, P.C. personnel on December 3 and 4, 1987 and March 11, 1988. Stream flow measurements, obtained by direct field measurement and through information gathered by the US Geological Survey at stream gaging stations, were utilized to determine the relative contribution of major tributaries to Onondaga Lake. The flow data, combined with chemical analytical results, allow for determination of chemical loading to the lake. Stream flow measurements were also obtained for selected minor tributaries to the lake, on tributaries to Nine Mile Creek, and at an upstream location of Nine Mile Creek in order to determine flow and chemical loading at these locations.

The methodology used to measure stream flow is reviewed in detail in Linsley, et. al, 1982. In summary, this method involves dividing the total width of the stream into vertical sections such that no section contained more than ten percent of the overall stream flow. Flow velocity measurements were then obtained in each vertical section at two-tenths and eight-tenths depth below the surface. The average of these two measurements has been shown to approximate the average velocity for the section. In shallow water, a single measurement at six-tenths depth was taken, which under these conditions, closely approximates the mean flow velocity.

Velocity measurements were made using a Marsh-McBirney Model 201D Portable Velocity Meter. The meter sensor is connected to the meter by a 20-foot long insulated cable. The sensor was affixed to the end of a galvanized pipe with a metal clamp which enabled the operator to accurately place the sensor at the appropriated stream depth. The stream velocity, in feet/second, is displayed on the meter. This value was recorded in a bound field book in indelible ink, along with the width and depth of the section measured. Computation of the discharge in the vertical section is completed by averaging the flow velocities from the two depths and multiplying the resultant velocity by the vertical section depth and width to obtain discharge in cubic feet per second. The contributions from each respective vertical section were then totalled to obtain the total stream discharge.

TABLE A-1
SUMMARY OF WELL DEVELOPMENT RESULTS

Well No.	Development Method	Volumes Removed	Appearance of Water Before Development	Appearance of Water After Development
WB-1U	Bailed	6	Lt. brown, high turbidity	Lt. brown, high turbidity
WB-1L	Bailed & Air Lifted	5	Lt. brown, high turbidity	Lt. brown, high turbidity
WB-2U	Bailed	6	Brown, high turbidity	Lt. brown, medium turbidity
WB-2L	Air Lifted	5	Brown, high turbidity	Lt. brown, medium turbidity
WB-3U	Bailed & Air Lifted	30	Lt. gray to brown	Lt. brown, medium turbidity
WB-3L	Bailed & Air Lifted	5	Lt. gray to brown, high turbidity	Gray to brown, medium turbidity
WB-4U	Bailed & Air Lifted	10	Gray to brown, high turbidity	Lt. brown, medium turbidity
WB-4L	Air Lifted	8	Gray to dk. brown, high turbidity	Gray to brown, medium turbidity
WB-5U	Bailed	20	Dk. gray to black	Dk. gray to black
WB-5M	Bailed	5	Dk, to lt. brown	Dk. to 1t. brown
WB-5L	Air Lifted	6	Lt. brown, medium turbidity	Lt. brown, medium turbidity
WB-6L	Bailed & Air Lifted	5	Clear	Lt. brown, medium turbidity
WB-7U	Bailed	5	Dk. brown, high turbidity	Brown, high turbidity
WB-7L	Bailed & Air Lifted	5	Gray to brown, high turbidity	Brown, high turbidity
WB-BU	Bailed	5	Clear	White, translucent
WB-BL	Air Lifted	5	Dk. brown	Lt. brown, medium turbidity

APPENDIX B RESISTIVITY DATA

TABLE B-1

EARTH RESISTIVITY SURVEY DATA

ALLIED-SIGNAL INC.

					Resistance Reading		Resistivity (ohm.ft)		
Station	"a" Spacing	Self Potential	Current	Range	(ot	inis)		Full	Partial
Number	(feet)	(millivolts)	(Volts)	(microamperes)	To ward	Reverse	Apparent	Correction	Correction
1a	20	247	32	0.1	022	025	295	284 7	295
· -	40	045	33	0.1	045	017	779	1.7×10′	11,493
	80	125	22	0.1	009	011	503	285	343
	160	257	17	0.01	061	075	684	1,249	948
1b	20	028	30	0.1	033	031	402	383	402
	40	018	30	0.1	018	017	440	503	478
	80	028	32	0.1	016	011	679	2,042	1,123
	160	061	34	0.1	008	007	754	885	833
1c	20	004	28	0.1	029	029	364	340	364
, 0	40	071	30	0.1	016	017	415	507	470
	80	005	34	0.1	012	011	578	1,144	827
	160	047	38	0.1	007	008	754	1,227	993
2	20	040	32	0.1	020	020	251	279 6	251
-	40	025	32	0.1	025	025	628	4.8×106	5,374
	80	055	32	0.1	013	012	628	628	628
	160	033	33	0.1	800	007	754	1,017	903
3a	20	032	22	0.01	140	140	176	158	176
	40	034	22	0.01	086	083	212	291	256
	80	132	24	0.01	044	045	224	240	235
	160	123	30	0.01	016	016	161	105	121
3b	20	042	34	0.1	017	017	214	194	214
	40	105	18	0.01	101	100	253	331	298
	80	047	23	0.01	056	055	279	323	307
	160	034	24	0.01	020	020	201	132	151

TABLE B-1 (Cont'd.)

	•				Resistance	e Reading		Resistivity (oh	n.ft)
Station Number	"a" Spacing (feet)	Self Potential (millivolts)	Current (Volts)	Range (microamperes)	forward [ot	Reverse	Apparent	Full Correction	Partial Correction
4a	20	007	28	0.01	037	035	45	53	45
	40	071	28	0.01	013	013	33	21	25
	80	004	29	0.01	011	011	55	328	107
	160	006	28	0.01	800	800	80	185	122
4b	20	045	28	0.01	032	032	40	43	40
	40	015	23	0.01	014	014	35	29	31
	80	125	20	0.001	085	085	43	59	52
	160	032	18	0.001	061	061	61	134	91
5a	20	059	22	0.001	141	141	18	13	18
36	40	024	20	0.001	133	130	33	807	78
	80	800	34	0.001	070	070	35	39	37
	160	030	30	0.001	042	045	4 प	64	54
5b	20	022	24	0.01	082	082	103	118	103
	40	040	22	0.01	031	031	78	54	61
	80	085	28	0.001	116	116	58	40	45
	160	090	24	0.001	047	048	48	37	40
5c	20	005	24	0.01	011	011	14	12	14
	40	053	22	0.01	013	013	33	85,969	189
	80	053	26	0.01	007	006	33	33	33
	160	085	22	0.01	004	004	40	57	50
5d	20	020	30	0.01	023	023	29	25	29
-	40	009	28	0.01	014	015	36	55	46
	80	018	28	0.01	007	800	38	39	39
	160	034	21	0.001	042	042	42	50	47
5e	20	047	24	0.01	054	054	68	74	68
	40	003	22	0.001	228	226	57	45	49
	80	028	20	0.01	014	014	70	101	87
	160	066	19	0.001	068	800	68	66	67

TABLE B-1 (Cont'd.)

•					Resistance			Resistivity (ob	n.ft)
Station Number	"a" Spacing (feet)	Self Potential (millivolts)	Current (Volts)	Range (microamperes)	Forward	nus) Reverse	Apparent	Full Correction	Partial Correction
5f	20	026	24	0.01	081	081	102	122	102
	40	086	20	0.001	274	274	69	42	49
	80	044	24	0.001	144	144	72	78	76
	160	052	28	0.001	046	046	46	26	31 .
6	20	042	24	0.001	195	193	24	25	24
ŭ	40	014	24	0.001	027	027	7	1	1
	80	008	24	0.001	033	033	17	82,705	120
	160	010	30	0.001	012	012	12	8	9
7a	10	045	22	0.001	543	568	35	36	35
, ,	20	017	30	0.001	262	262	33	30	31
	40	007	30	0.001	181	181	45	87	64
	80	128	28	0.001	113	113	57	84	71
	160	147	27	0.001	043	043	43	30	34
7b	10	025	30	0.01	084	084	53	59	5 1
	20	018	20	0.01	033	033	41	30	34
	40	251	26	0.01	019	019	48	60	55
	80	151	20	0.001	121	121	61	93	78
	160	252	24	0.001	056	056	56	50	52
7 c	10	059	24	0.01	154	159	98	126	98
	20	115	32	0.001	458	433	56	26	34
	40	055	22	0.001	197	195	49	42	44
	80	027	22	0.001	117	117	59	79	70
	160	207	32	0.001	046	046	46	34	37
7d	10	158	24	0.01	126	126	79	93	79
• • •	20	136	40	0.01	045	045	57	37	42
	40	104	36	0.01	030	030	75	130	102
	80	064	26	0.01	016	016	80	88	85
	160	218	22	0.001	063	063	63	46	51

TABLE B-1 (Cont'd.)

					Resistance			Resistivity (oh	m.ft)
Station	"a" Spacing	Self Potential	Current	Range		ims)		Fulf	Partial -
Number	(feet)	(millivolts)	(Volts)	(microamperes)	Forward	Reverse	<u>Apparent</u>	Correction	Correction
7 e	10	114	28	0.01	190	190	119	155	119
	20	004	20	0.01	035	035	44	7	15
	40	112	36	0.01	024	024	60	113	85
	80	148	22	0.001	174	174	87	199	132
	160	243	26	0.001	050	050	50	24	31
7f	10	045	36	0.01	110	112	70	98	70
• •	20	040	40	0.01	022	022	28	4	11
	40	030	24	0.001	191	191	48	372	98
	80	020	28	0.001	143	139	71	173	110
	160	126	26	0.001	062	062	62	53	55
8 a	20	024	32	0.01	119	119	150	168	150
	40	150	38	0.01	048	048	121	90	100
	80	305	30	0.001	173	173	87	57	65
	160	174	32	0.001	028	028	28	4	7
8Ն	20	040	28	0.01	235	235	295	345	295
	40	148	27	0.01	085	085	214	141	161
	80	146	30	0.01	064	064	322	858	512
	160	158	20	0.001	028	028	28	2	0
8c	20	282	28	0.01	189	189	237	255	237
0 2	40	007	40	0.01	082	082	206	171	181
	80	025	28	0.01	020	020	101	34	52
	160	028	22	0.001	023	023	23	3	1
8d	20	055	32	0.01	184	184	231	261	231
• • •	40	073	32	0.01	072	072	181	132	146
	80	095	28	0.01	015	015	75	15	32
	160	036	24	0.001	014	014	14	1	0

TABLE B-1 (Cont'd.)

					Resistance	Reading		Resistivity (ohm	
Station	"a" Spacing	Self Potential	Current	Range		ms)		Full -	Partial
Number	(feet)	(millivolts)	(Volts)	(microamperes)	Forward	Reverse	<u>Apparent</u>	Correction	Correction
8e	20	038	30	0.01	126	126	158	166	158
••	40	145	26	0.01	058	058	146	130	135
	80	237	24	0.001	139	139	70	23	36
	160	278	25	0.001	031	031	31	8	15
8 f	20	041	24	0.01	119	119	150	152	150
	40	042	30	0.01	057	057	143	136	138
	80	090	28	0.001	151	151	76	31	43
	160	005	24	0.001	019	019	19	3	1
8 g	20	120	22	0.01	103	103	129	131	129
•9	40	129	26	0.01	050	050	126	121	122
	80	041	22	0.001	125	125	63	23	34
	160	014	24	0.001	015	015	15	2	1
ن 9	20	066	40	0.01	013	013	16	22	16
	40	421	20	0.01	003	003	8	2	4
	80	082	20	0.001	017	017	9	10 20	10 30
	160	235	35	0.001	270		271	1.4×10 ²⁹	3,8×10 ²⁴
9b	20	004	32	0.01	010	010	13	17	13
2	40	078	20	0.001	025	025	6	2	3
	80	142	24	0.001	016	016	8	13	10
	160	340	18	0.001	015	015	15	464	36
9c	20	098	34	0.01	008	008	10	10	10
- -	40	091	36	0.01	004	004	10	10	10
	80	001	28	0.001	016	016	8	6	7
	160	220	22	0.001	012	012	12	31	19

TABLE B-1

EARTH RESISTIVITY SURVEY DATA

ALLIED-SIGNAL INC.

					Resistance	Reading		Resistivity (oh	
Station	"a" Spacing	Self Potential	Current	Range		nms)		Full	Partial
<u>Number</u>	(feet)	(millivolts)	(Volts)	(microamperes)	Forward	Reverse	Apparent	Correction	Correction
1a	20	247	32	0.1	022	025	295	284 -	295
	40	045	33	0.1	045	017	779	1.7×10 ⁷	11,493
	80	125	22	0.1	009	011	503	285	343
	160	257	17	0.01	061	075	684	1,249	948
1b	20	028	30	0.1	033	031	402	383	402
. –	40	018	30	0.1	018	017	440	503	478
	80	028	32	0.1	016	011	679	2,042	1,123
	160	061	34	0.1	008	007	754	885	833
1c	20	004	28	0.1	029	029	364	340	364
	40	071	30	0.1	016	017	415	507	470
	80	005	34	0.1	012	011	578	1,144	827
	160	047	38	0.1	007	800	754	1,227	993
2	20	040	32	0.1	020	020	251	229 _	251
	40	025	32	0.1	025	025	628	4.8×10°	5,374
	80	055	32	0.1	013	012	628	628	628
	160	033	33	0.1	800	007	754	1,017	903
3a	20	032	22	0.01	140	140	176	158	176
	40	034	22	0.01	086	083	212	291	256
	80	132	24	0.01	044	045	224	240	235
	160	123	30	0.01	016	016	161	105	121
3 b	20	042	34	0.1	017	017	214	194	214
	40	105	18	0.01	101	100	253	331	298
	80	047	23	0.01	056	055	279	323	307
	160	034	24	0.01	020	020	201	132	151

TABLE B-1 (Cont'd.)

					Resistance	Reading		Resistivity (ohi	
Station Number	"a" Spacing (feet)	Self Potential (millivolts)	Current (Volts)	Range (microamperes)	(of Forward	Reverse	Apparent	Full Correction	Partial Correction
4a	20	007	28	0.01	037	035	45	53	45
	40	071	28	0.01	013	013	33	21	25
	80	004	29	0.01	011	011	55	328	107
	160	006	28	0.01	800	008	80	185	122
4b	20	045	28	0.01	032	032	40	43	40
	40	015	23	0.01	014	014	35	29	31
	80	125	20	0.001	085	085	43	59	52
	160	032	18	0.001	061	061	61	134	91
5a	20	059	22	0.001	141	141	18	13	18
	40	024	20	0.001	133	130	33	807	78
	80	800	34	0.001	070	070	35	39	37
	160	030	30	0.001	042	045	44	64	54
5 b	20	022	24	0.01	082	082	103	118	103
	40	040	22	0.01	031	031	78	54	61
	80	085	28	0.001	116	116	58	40	45
	160	090	24	0.001	047	048	48	37	40
5c	20	005	24	0.01	011	011	14	12	14
	40	053	22	0.01	013	013	33	85,969	189
	80	053	26	0.01	007	006	33	33	33
	160	085	22	0.01	004	004	40	57	50
5d	20	020	30	0.01	023	023	29	25	29
	40	009	28	0.01	014	015	36	55	46
	80	018	28	0.01	007	008	38	39	39
	160	034	21	0.001	042	042	42	50	47
5e	20	047	24	0.01	054	054	68	74	68
	40	003	22	0.001	228	226	57	45	49
	80	028	20	0.01	014	014	70	101	87
	160	066	19	0.001	068	068	68	66	67

TABLE B-1 (Cont'd.)

					Resistance	Reading		Resistivity (ohi	m.ft)
Station	"a" Spacing	Self Potential	Current	Range		nms)		Full	Partial
Number	(feet)	(millivolts)	(Volts)	(microamperes)	Forward	Reverse	Apparent	Correction	Correction
5f	20	026	24	0.01	081	081	102	122	102
J.	40	086	20	0.001	274	274	69	42	49
	80	044	24	0.001	144	144	72	78	76
	160	052	28	0.001	046	046	46	26	31
6	20	042	24	0.001	195	193	24	25	24
J	40	014	24	0.001	027	027	7	1	1
	80	008	24	0.001	033	033	17	82,705	120
	160	010	30	0.001	012	012	12	8	9
7a	10	045	22	0.001	543	568	35	36	35
74	20	017	30	0.001	262	262	33	30	31
	40	007	30	0.001	181	181	45	87	64
	80	128	28	0.001	113	113	57	84	71
	160	147	27	0.001	043	043	43	30	34
7b	10	025	30	0.01	084	084	53	59	53
,,,	20	018	20	0.01	033	033	41	30	34
	40	251	26	0.01	019	019	48	60	5 5
	80	151	20	0.001	121	121	61	93	78
	160	252	24	0.001	056	056	56	50	52
7c	10	059	24	0.01	154	159	98	126	98
70	20	115	32	0.001	458	433	56	26	34
	40	055	22	0.001	197	195	49	42	44
	80	027	22	0.001	117	117	59	79	70
	160	207	32	0.001	046	046	46	34	37
7d	10	158	24	0.01	126	126	79	93	79
, u	20	136	40	0.01	045	045	57	37	42
	40	104	36	0.01	030	030	75	130	102
	80	064	26	0.01	016	016	80	88	85
	160	218	22	0.001	063	063	63	46	51

TABLE B-1 (Contid.)

					Resistance			Resistivity (ohm	.ft)
Station	"a" Spacing	Self Potential	Current	Range	(ol	nms)		Full	Partial
Number	(feet)	(millivolts)	(Volts)	(microamperes)	Forward	Reverse	Apparent	Correction	Correction
8e	20	038	30	0.01	126	126	158	166	158
	40	145	26	0.01	058	058	146	130	135
	80	237	24	0.001	139	139	70	23	36
	160	278	25	0.001	031	031	31	8	15
8 f	20	041	24	0.01	119	119	150	152	150
	40	042	30	0.01	057	057	143	136	138
	80	090	28	0.001	151	151	76	31	43
	160	005	24	0.001	019	019	19	3	1
8g	20	120	22	0.01	103	103	129	131	129
- 3	40	129	26	0.01	050	050	126	121	122
	80	041	22	0.001	125	125	63	23	34
	160	014	24	0.001	015	015	15	2	1
9a	20	066	40	0.01	013	013	16	22	16
	40	421	20	0.01	003	003	8	2	4
	80	082	20	0.001	017	017	9	10 20	10
	160	235	35	0.001	270		271	1.4×10 ²⁹	3.8×10 ²⁴
9b	20	004	32	0.01	010	010	13	17	13
	40	078	20	0.001	025	025	6	2	3
	80	142	24	0.001	016	016	8	13	10
	160	340	18	0.001	015	015	15	464	36
9c	20	098	34	0.01	800	008	10	10	1.0
	40	091	36	0.01	004	004	10	10	10
	80	001	28	0.001	016	016	8	6	7
	160	220	22	0.001	012	012	12	31	19

(INCHES) N	COLUMN	SUBSURFACE LOG WB-5U	-
) N	G F C	DESCRIPTION	WB-5M
-		Note: WB-5U was installed in a borehole located within approximately 20 feet of WB-5L. The geology shown on this log represents what was encountered in WB-5L and no samples were taken for this boring.	/ithin on this
		Black CINDERS. Brown to black CINDERS with variable amounts of gravel, sand and silt.	/el,
		- FILL	
		Brown CLAY, trace silt.	
			sand
			silt,
'ATION 386.1 D10/23/87 FTED 10/23/87 Y KLR, GMT	SHEET.	Allied-Signal Inc. 1 OF 1 WB-5U BLASLAND & BOUCK ENGINEERS, P.C.	BOUCK P.C.

	SAMPLES	SAMPLE NO.	RECOVERY INCHES	z	WELL	GEOLOGIC	SUBSU	IRFACE LOG	WB-5M (CONT'D.)
	s,	SA	RE		- 0	19	DE	SCRIPTION	
45					Ni				_
		_							4
				'		، ن م			
									4
]			
							Dark gray coars to fine o	200110	CAMP
						0 0	Dark gray coarse to fine g to trace silt and clay.	ravelly coarse to fine	SANU, little
55									
					- <u> -</u>	0			4
						3.			_
					~ <u> </u>	, °			4
					~	\$ 10 M			
			\vdash	\vdash			Bottom of boring 63.0 feet.		4
~ 5) 			-
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	<u>ر</u>	ELEV	AT1011	<u>ـــــا</u>	6.1	250 :==	Allieds:conl to		
		RTED					T Allied-Signal Inc. 2 OF 2	 /	
		MPLET				NO		BLA	NOUGE & DOUCK
			rG					ENG	INEERS, P.C.

			Ö	<u> </u>	Γ			
	DEРТН	SAMPLES	SAMPLE NO.	RECOVERY (INCHES)	z	WELL	GEOLOGIC	SUBSURFACE LOG (CONT'D)
*******		SA	SAN	3 = E		≠ 8	GE C	DESCRIPTION
	_	7	5-24	15	13			_
-	_							
	50		S-25	24	4		· · · · ·	-
-	_ ~		<u>5-26</u>	11	2			-
	Ľ		S-27	8	29		3 .	
	— 55	<u> </u>	S - 28	15	37		0	Dark gray coarse to fine gravelly coarse to fine SAND, little to trace silt and clay.
	-	<u> </u>	S-29	19	26	/ /	3 3 d	-
		_					0	_
سينين	60		S-30		19	\ \ \		
	_		S-31	14	24			-
سسنو	F		5-32	19	35			-
	– 65		S - 33	11	47		ا ا ز	-
-	F		S-34	13	85		٠,	
	F	-	S-35	14	54			Red SILT, little coarse to fine gravel, trace clay.
******	70							Red and green coarse to medium SAND, trace fine gravel, silt.
	E		S-36	12	109+		·	
	_		S-37	2	100+		o 5	Gray gravelly coarse to fine SAND little silt gradational to gray silty coarse to fine SAND, little fine gravel,
	75	4	S-38		62+		0 0	slight stratification in some areas.
******	L		S-39	12	91	\ \		
	-		S-40	18	62			
*******	80	4						•
	Ļ	\angle	S-41	16	51			
*******	F						_	
	85	7	5-42	18	49		-	•
	F	<u> </u>	J - 4 Z	118	77			
	Ļ						-	
	90		S-43	19 _	54			-
	F	4						
zwięcznie	F	֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓		—			_	
	SURFACE ELEVATION 386.0					5.0	PROJEC	Allied-Signal Inc.
	DATE STARTED 10/19/87						SHEET2	
	DATE COMPLETED 10/22/87						NOW	BLASTAND & BOUCK ENGINEERS, P.C.
-	CLASSIFIED BY KLR. CMT							

-	DEРТН	SAMPLES	AMPLE NO.	RECOVERY (INCHES)	z	WELL	COLUMN	SUBSURFACE LOG WB-5L (CONT'D)
-		S,	S			- 0	၁	DESCRIPTION
-	100		S-44	9.5	86			Gray brown to reddish brown to red silty fine SAND stratified, — occasional lenses with medium to fine sand grading downward to:
	— — — — 105		S-45	13	146			
	- -		S-46	7	101		- -	Red and green fine SAND, little silt, fine gravel,
	— 110 — — —	/	S-47	9	78			stratified.
	- 115 120	7	S-48	16	73			
	- - -	Z	S-49	9	130			Coarse to fine GRAVEL, little silt. Red SILT, little coarse to fine gravel, trace clay, TILL.
	125	Z	S-50	6	80+			
-	135		S-51	4	122+			Top of rock at 134.5. Cray fissle SHALE.
	140		S-52 core		200+ 7 min 5.5 min 7.5 min 6.5 min			Interbedded dark and light gray horizontally bedded SHALE with numerous subhorizontal to subvertical thin (typically less than 1/16 inch thick) joints filled with gypsum.
							PROJEC	Bottom of boring 141.0'. Allied-Signal Inc.
	DATE DATE	DATE STARTED 10/19/87 DATE COMPLETED 10/22/87 CLASSIFIED BY KLR, CMT				37		_OF_3

	DEPTH	SAMPLES	SAMPLE NO.	RECOVERY (INCHES)	z	WELL	GEOLOGIC	SUBSU	URFACE LOG WB-6	
		SA	SAM	REC (1)		≯ 00	G E	DI	ESCRIPTION	
}	_									\Box
	_									\exists
ł	- 0			-		1				-
[1	S-1	12	9	1	1911/11/11	Topsoil over brick chips,	cinders, coal chips.F!LL.	_
	 	1	S-2	12	17	[Brown to redbrown varved downward to:	SILT and silty CLAY grading	_
			S - 3	18	10			downward to:		
	<u> </u>					\ \ \ \				_
-	_		S-4_	20	8					
	_		S - 5	12	12					_
	- 10	 	S-6	24	7			Varved fine SAND, little	silt and clayey SILT grading	_
			S - 7	18	12			downward to:		_
	 -	 								_
	– 15		S-8	18	9					_
-	_		S-9	14	6			Gray to purple-brown with	CAND .	_
	-		S-10		9			Gray to purple-brown silty	y rine SAND, laminated.	_
	- 20	-	S-11_	NR	7					_
	-						_			-
-	_		S-12	12	9		· -			_
	- 25		<u>S-13</u>	12	7					_
	_	7	S-14	18	13	1				_
	-	<u>/</u>	S-15	18	13					_
*******	- 30		S-16	18	10					_
	<u> </u>									_
			S-17	24	25			•		
	35	ļ	S-18	5	8					_
	_	1	S-19	18	8	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \				_
		<u> </u>	S-20	24	9					_
	40	<i>:</i>	S-21	18	7		_ 			_
										_
	_		S-22		13					
	6115		5-23		8 391			Allied-Signal Las		_
				PROJECT Allied-Signal Inc. SHEET 1 OF 3						
				ED_			NO	WB-6	BLASLAND & BOUCK ENGINEERS, P.C.	
	CLASS	SIFI	ED B	Y	GMT				ENGINEERS, F.C.	•

- [ОЕРТН	SAMPLES	SAMPLE NO.	RECOVERY (INCHES)	z	WELL	GEOLOGIC	SUBSURFACE LOG WB-6L (CONT'D)
-		SA	SAM	REC		≯ 0	CC CC	DESCRIPTION
Į	_							
			5-24	18	50			Gray-brown coarse to fine gravelly coarse to fine SAND, little silt, slight to moderate stratification.
Ţ	_	7	S- 25	12	44			- The street of
	- 50			10		/ /	. ° °	I
_			S-26	12	68		P. 5 -	\dashv
	_		S-27	18	28			
-		<u>/</u>	S-28	14	19			
ŀ	— 55	\angle	3 20	14	15	M E	. J	4
	_							
ŀ	-		5-29	12	19			_
	- 60	Ц						
	_	//	S-30	18	15		: •	Gray coarse to fine SAND, little silt, fine gravel, grading downward to:
ŀ	_		S-31	19	19			grading downward to:
- [_							Ī
	- 65		S-32	18	18			4
-			S-33_	12	21			7
•		<u> </u>		 			·]
i		1	S-34	14	15	,		-
_	– 70		S-35	7	14			Gray silty medium to fine SAND, little gravel.
	_	\vdash					_	-
	1					: :		-
	- 75		5.56	4-			. –	
	_		S-36	17	34			Red silty coarse to fine SAND, little coarse to fine gravel.
	_						_	The stray course to true state, strate course to true graver.
	_	١.						- - -
	– 80	7	5-3 7	17	76		. · · ·	Red coarse to fine SAND, little silt.
	_					K K K		Top of rock at 83.0'.
	- -		-					
	— 85 ·		0.5-			 .		
	L		S - 38	4	73+			Black to gray weathered SHALE with 2-inch thick, subhorizontal joint filled with green, red, gray, yellow, coarse to fire
	_							sand in matrix of clay.
	-							-
	9 0		S-39	2	100+			Green weathered SHALE.
	-	Ħ	core	2.8'	8 min			Green soft weathered SHALE with numerous subhorizontal
	-				6 min			to subvertical joints filled with gypsum.
		1.1 min						
	SURFACE ELEVATION 381.8 DATE STARTED 10/27/87							Allied-Signal Inc.
						/87	SHEET_	WB-6 BLASLAND & BOUCK
	DATE COMPLETED 10/29/87 CLASSIFIED BY GMT						NO	ENGINEERS, P.C.
	<u> </u>							

•	DEРТН	SAMPLES	AMPLE NO.	RECOVERY (INCHES)	z	WELL	GEOLOGIC	SUBSU	URFACE	LOG	WB-6L (CONT'D)
-	Ò	SAR	SAMF	REC (IN		3 €	G E O C O	DE	ESCRIPTION	_	
F					9 min 7 min			Gray shale with frequent s joint fillings of gypsum.	suphorizontal	to subvert	ical
-					7 11111			Bottom of boring 96.7 feet			
-								•			
- [- 100 -										-
-	•										-
- [-										_
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			ELEV				PROJECT	Allied-Signal Inc.			
			RTED					OF_3_		- Bi A E I	AND & BOUCK
	DATE COMPLETED 10/29/87 CLASSIFIED BY CMT					87	NOWE	1 -6		ENGIN	IEERS, P.C.

	DЕРТН	SAMPLES	LE NO.	RECOVERY (INCHES)	z	WELL	GEOLOGIC COLUMN	SUBSURFACE LOG WB-7La
	DE	SAM	SAMPLE	RECO	_	W E COL	G EOI	DESCRIPTION
}	_		0)					
								
	_							
	- 0	7	5-1	10	a,		7000 11 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Black silty CINDERS, little coarse to fine sand, FILL.
-		/	5-2	1	3			<u> </u>
	- 5	1	S-3	12_	Q,			
	_		5-4	6	10			
		/	S - 5	10	9			Red to brown CLAY, moist. Occasional lenses of black organic silt.
	— 10	! 	5-6	13	17			
	-	-						
-			S-7	11	55			Red to red-brown silty CLAY to clay with little silt. Laminated occasionally with fine silty sand partings.
اسم	- 15		S-8	24	21			-
	_		S-9	24	37			_
	_		S-10	19	6			Brown CLAY interbedded with silty fine sand.
	- 20	/	5-11	24	5			Brown varved silty fine SAND interbedded with brown CLAY
	-	/	S-1 2	12	10			grading downward to:
	— — 25		5- 13	6	5			
-	 		5-14	18	4			_
	_	-	S-15	12	3			
	30	_	S-16	12	5			-
	- -			18	6		-	Brown silty fine SAND
	<u> </u>		5-18		3			Brown silty fine SAND, grading downward to:
	— 35 °			18	10			-
		_		NR	5			
	- 40	·						
-	<u>-</u>	_	S-21	13	11			Brown to gray-brown fine SAND, little silt.
	-	<u></u> [12	9			<u>-</u>
_	SURFA		<u>5-23</u> ELEV	12 ATION	12 377	7.5±	PROJEC	Allied-Signal Inc.
	DATE	STA	RTED		11/2	/87	SHEET_	1 OF 3 RIASIAND & BOUCK
	DATE COMPLETED 11/6/87 CLASSIFIED BY CMT					5/87	NO <u>WB</u>	ENGINEERS, P.C.

	DЕРТН	SAMPLES	SAMPLE NO.	(INCHES)	z	WELL	GEOLOGIC	SUBSURFACE LOG (CONT'D)			
	0	SA	SAM	REC (IN		> 0	6 E C	DESCRIPTION			
F	-	7					-	_			
-	-							·			
_	- - 50	/	5-24	8	16		•				
-	-	/	S-25	11	15			Brown coarse to fine SAND, little fine gravel, trace silt.			
	- -		S-26	8	27						
_	- 55	<u></u> -	S-27	18	5			Brown to red-brown interbedded silty CLAY, silty coarse to fine SAND and fine silty SAND.			
-	- -	$\overline{/}$	S-28	24	6						
-	-	/	S-29	16	26						
-	- - 60	$\frac{1}{2}$	S - 30	6	10		20.00 20.00	Gray coarse to fine sandy GRAVEL, little silt to gray fine gravelly coarse to fine SAND, trace silt, occasional silt			
-	- -	· 						lense.			
-	- -	·/	S-31_	18	16		, , ,				
-	- 65	<i>'</i>	S-32	18	15		• 000	_			
	- 	/	S-33	22	80	X ((()		Red silty coarse to fine SAND, little clay, fine gravel, TILL.			
	-	Z	S-34	14	99			_			
_	- 70 -	7	S-35	18	115	.~	0 00				
_ [-	7	S-36	18	91		, , , , ,	Gray-brown gravelly coarse to fine SAND, little silt.			
		<u> </u>	S - 37	12	106	$ \sim $, , , , , , , , , , , , , , , , , , ,				
	- 75 	/ =	S-38	2	50+		0.0				
-	-			6							
	– – 80				57+	· ~		Red silty coarse to fine SAND, little fine gravel, TILL.			
}	-		5-40	3	50+			<u>-</u>			
- -	_					1					
	- 85 ·	2	S-41	6	65+	-		_			
_	_] .					
-	- -			†	†	1					
	- 90	Z	S-42	6	71+	1		-			
	-				 	<u> </u>					
			ELEV			7.5±	1	OJECT Allied-Signal Inc.			
			ARTED MPLE		12/8/			2 OF 3 WB-7L2 BLASLAND & BOUCK ENGINEERS, P.C.			
	CLASSIFIED BY CMT							ENGINEERS, P.C.			

1		Т	Т	O.		T	г				
	DEPTH		SAMPLES	AMPLE NO.	RECOVERY (INCHES)	z	WELL	GEOLOGIC	SUBSU	URFACE LOG	WB-7La (CONT'D)
			န	SAN	RE (II		> 8	6 E	DI	ESCRIPTION	
		T	7	S-43	4	100+			· · · · · · · · · · · · · · · · · · ·		·
س	-	-	}			 					_
1		١	ŀ		l	 					
	— 10	0									_
	<u> </u>	Ì		S-44	6	118+					
	-	1	ŀ		 	├	\$ 0.55.6.00	. — —	Top of rock at 103 feet.		
-		- (t			<u> </u>					
	10	5 -	\int								
	- 1		7	S-45		 			Green fissile weathered Sh	HALE.	
	<u> </u>		3, 1	core	3.851	11 min					
		j.				5 min			Red gradational downward moderately weathered SHAL	E same subborizontal to	_
	- 11	0		_	<u> </u>	7 min	1///////		subvertical joints, joint stained with iron oxide.	surfaces are occasional	lly —
	-		71 21			7 min 10 min	r / /				-
		, i	*			10 man					
	_	1	Į]		Bottom of boring 112.4 fee	et.	_
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	SUR	FAC	Έ	ELEV	ATION	3	77.5±	PROJECT	Allied-Signal Inc.		
-		DATE STARTED 11/2/87 SHE							3_OF_3_		·
	DAT	DATE COMPLETED NO							WB-71 a	BLAS	Land & Bouck Neers, P.C.
-	CLA	CLASSIFIED BY CMT									VEERO, P.W.
	<u> </u>										

	DEPTH	SAMPLES	SAMPLE NO.	RECOVERY INCHES	z	WELL	G E O L U M N	SUBSURFACE LOG WB-7U		
		SA	SAN	RE(≯ ႘)) 39	DESCRIPTION		
	-							Note: WB-7U was installed in a borehole located within approximately 20 feet of WB-7La. The geology shown on this log represents what was encountered in WB-7La and no samples were taken for this boring.		
مست								Black silty CINDERS, little coarse to fine sand, FILL.		
	- 5							Red to brown CLAY, moist.		
	— 10							Occasional lenses of black organic silt.		
	- 15							Red to red-brown silty CLAY to clay with little silt. Laminated occasionally with fine silty sand partings.		
	20							Brown CLAY interbedded with silty fine sand.		
	1 1 1							Brown silty fine SAND interbedded with brown CLAY - VARVES _ grading downward to:		
	25 —									
	30									
	35·							Brown silty fine SAND, grading downward to:		
	- 40									
	-							Brown to gray-brown fine SAND, little silt.		
	45	Ц								
-	SURFA							Allied-Signal Inc.		
	DATE							DIASLAND & BOUCK		
	DATE COMPLETED 11/10/87 NO					°/	NO	B-70 ENGINEERS, P.C.		
2000	OLAS:	# 1 F 1 E		'	<u> </u>					

ОЕРТН	SAMPLES	E NO.	RECOVERY INCHES	_	WELL	COLUMN	SUBSURFACE LOG WB-7U	
DEF	AMP	SAMPLE	EC O	Z	WEL	COLUMN	(CONT D.)	
1.5	S	SA	8		\ 	9	DESCRIPTION	
45	-				<u> </u>			_
								-
}	}				\equiv			_
 50] [-
] [Brown coarse to fine SAND, little fine gravel, trace silt.	_
-								_
- 55						!	Bottom of boring 53.3'.	
] -							_
F 1								_
								_
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			.5	PROJEC	CT_Allied-Signal Inc.			
	DATE STARTED 11/10/87 SHEET					2 OF 2		
DATE COMPLETED 11/10/87 NO			87		WB-7U BLASLAND & BOUCK ENGINEERS, P.C.			
CLASS	CLASSIFIED BY CMT						Little Li	

	DEPTH	SAMPLES	AMPLE NO.	RECOVERY (INCHES)	z	WELL	COLUMN	SUBSURFACE LOG WB-7L
		\ '`\	Ś	~				DESCRIPTION
								Note: WB-7L was installed in a borenole located within approximately 20 feet of WB-7La. The geology snown on this log represents what was encountered in WB-7La. No samples were taken for this boring.
-								Black silty CINDERS, little coarse to fine sand, FILL.
·	- 5							
-								Red to brown CLAY, moist. Occasional lenses of black organic silt.
	— —							Red to red-brown silty CLAY to clay with little silt. Laminated occasionally with fine silty sand partings.
	– – 15 –							-
	<u> </u>		-					Brown CLAY interbedded with silty fine sand.
	 							Brown varved silty fine SAND interbedded with brown CLAY — grading downward to:
name.	25							
	— — — 30							
*****	1 1 1							Brown silty fine SAND, grading downward to:
	- 35 ·							
	40							Brown to gray-brown fine SAND, little silt.
	<u>_</u> _					777		
	SHEE	المباد الماد	ELEV	ATION.	377.	5		Allied-Signal Inc.
-					/6/87			
		CON	APLET	TED YGMT	11/9	/87	NOWB	1 OF 2 -7L BLASLAND & BOUCK ENGINEERS, P.C.
-			0	·	-			

ОЕРТН	SAMPLES	AMPLE NO.	(INCHES)	Z	WELL	GEOLOGIC		PRFACE LOG WB-7	7L ''D)
•	'S	SA	Α. Ε.		- 0	9	DE	SCRIPTION	
-	}								
	t					1.2			4
_			ļ						\exists
50			 -						4
-							Brown coarse to fine SAND,	little fine gravel, trace silt.	
-			 -	 -					\dashv
		-					Brown to red-brown interped	ided silty CLAY, silty coarse to	
F			ļ				fine SAND and fine silty SA	NU.	\exists
]				4
				<u> </u>	\				
- 60			 	-			Gray coarse to fine sandy (CRAVEL, little silt to gray fine	
							lense.	W, trace stit, occasional stit	
_			}	 -	. ``	3		•	긕
			╁	 		, — · —			-
65						- ° 0.7			
		 	┨	{			Red silty coarse to fine Si	AND, little clay, fine gravel, T	111.
<u> </u>				<u> </u>			Red Stricy Coarse to Time Sr	ind, tructe cray, time graver, i	,
70			-						_
_	Ì		┼	 		2 °0	Gray-brown gravelly coarse	to fine SAND, little silt.	-
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75			 -	 	\~=·	o _g			
-]~亖~	,			_
-		}	╁	}			Red silty coarse to fine S	AND, little fine gravel, TILL.	
80			1_			1	Bottom of boring 79 feet.	<u> </u>	
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F	}		-	 	4		1		_
;119E	ACF	FIF	VATION	377	.5	PROJEC	Allied-Signal Inc.		
	TOATE STARTED 11/6/87						2 OF 2		
	DATE COMPLETED 11/9/87						WB-7L	BLASLAND & B ENGINEERS, P.	
LAS	LASSIFIED BY GMT								

	DЕРТН	SAMPLES	AMPLE NO.	ECOVERY INCHES	z	WELL	GEOLOGIC	SUBSU	URFACE LOG	WB-BU
		SA	SAM	REC		× 00	00 99	DE	ESCRIPTION	
- - -	- - -							Note: WB-BU was installed approximately 20 feet of W log represents what was er were taken for this boring	WB-BL. The geology sno ncountered in WB-BL and	wn on this \rightarrow
	- -							Road bed gravel.		
	-						~ 1999/1988 ~ 1999/1988 ~ 1999/1989 ~ 1999/1999 ~ 1999/1999 ~ 1999/1999	White SOLVAY WASTE occasio	onal dark lenses.	
	-						2/13/3 12/3/3/3 2/2/3/3/3 2/2/3/3/3/3 2/3/3/3/3/			
	-						19999999999999999999999999999999999999			
- - - -	-							Bottom of boring 24.3 feet		-
	-									- - - - -
- - - - - -	-									- - - -
	SUDEA	CE	FLEY	ATION	382		DD0 175	TAllied-Signal Inc.		-
-	DATE STARTED Nov. 20, 1987 DATE COMPLETED Nov. 20, 1987 CLASSIFIED BY KLR				20, ov. 20	987		OF1	BLAS	SLAND & BOUCK INEERS, P.C.

	ОЕРТН	SAMPLES	SAMPLE NO.	RECOVERY (INCHES)	z	WELL	GEOLOGIC	SUBSURFACE LOG WB-BL	
		SA	SAM	REC S		> 8	6. E	DESCRIPTION	1
1	_								1
-								-	┧
	}-		<u> </u>	 					1
-	0					大大		Road bed gravel.	1
	}-			}				_	}
								White SOLVAY WASTE occasional dark lenses.	1
	5		S-1	15	1_			-	┨
-	F						73/2. 712 - 33		1
				<u> </u>			7,977 3.7 0,77 3.7	-	}
	10				2		20.50 20.50		1
			S-2	21				-	$\frac{1}{1}$
	 -						/]
	– 15							_	1
	-		S-3	24	1		97 97 77	-]
- Maring				 				_	1
	-	}		 			737	_	}
	- 20	1	S-4_	24	1			-	1
	L	}-		 	L		1 11/2 1 11/2	-	┨
49-000	F			ļ			9 1 1/4/4		1
	 25	-	5-5	24	1	N		-	┨
-	_	-	5-6	24	1		~	Green MARL with shells.	1
			3:0	-					$\frac{1}{2}$
-	- 30		S-7	24	1		3 - 3	-	$\frac{1}{2}$
	F						v		1
وسيد	L		S-8 S-8a	24	1		<u> </u>	-	1
	- 35 ·	/	S-9	24	9			Dark gray SILT, little dark gray and black fine sand.	4
	<u> -</u> -			24	27				1
	L		S-10a S-11		19_			-	7
-	40					\ \ \ \		_	1
	上		S-12		5				$\frac{1}{2}$
****	,_ 1		<u>5-13</u>	24	16			-	7
	<u> </u>		S-14		14			_	f
iding				ATION		2		T Allied-Signal Inc.	
	1			<u> 11/18</u> [ED1		17	SHEET_ NO	TOF 2 WB-BL BLASLAND & BOUCK	
-				Y KLR				ENGINEERS, P.C.	
	<u> </u>								

-	ОЕРТН	SAMPLES	SAMPLE NO.	RECOVERY (INCHES)	z	WELL	COLUMN	SUBSURFACE LOG WB-BL (CONT'D)				
-		SA	SAN	RE(≯ ö	G E	DESCRIPTION				
E	- -	/_ ;	S-15	24	11			Dark gray SILT occasional thin clay lenses, one fine sand lens.				
╼├	-		5 - 16	15	5			4				
F	- -50							Dark gray fine sangy CLAY, little silt, occasional fine				
-	- -	<u></u>	5 - 17	16	WOR			sand lens.				
-	-	_	S -1 8	18	2			-				
	 55		S -1 9	24	2			Fine to medium SAND little clay., Dark gray CLAY.				
_	- -		S-20	24	3			7				
	-	/	5-21	24	wон			Dark gray varved CLAY and SILT gradational to:				
_	- 60 -	7	5-22	24	2							
}		-	5-23	24	3_			_				
	-		S-24	24	3			_				
ţ	- 65											
	_		5-25	24	2	\ \ \		Brown varved CLAY, little silt.				
		1	5-26	24	2							
*****	70		S-27	18	2							
1	-		S-28	24	2			-				
-	7 5	1/	5-29	18	2							
	-	1	/S-30	24_	3							
	F	1	/5-31	12	20]						
-	80	1	S-32	18	28	}		Red medium to fine sandy CLAY, little gravel.TILL.				
		V		1		1 =						
	E ₈₅	Z	5-33	12	54+	1 = 1						
	⊢ 85			#=	<u> </u>			Debter of the 'co OF the fact				
***	F			 		1		Bottom of boring 85.4 feet.				
						1						
	F					}						
,					-	-		_				
	<u> </u>				3.00	$\frac{1}{2}$	\	Allied Signal Inc				
			E ELE Tarte			<u> </u>		OJECT_Allied-Signal Inc.				
	DATE	C	OMPLE	TED_	11/19	/87		WB-BL BLASLAND & BOUCK ENGINEERS, P.C.				
	ASSIFIED BY KLR											

APPENDIX D
GRAIN SIZE ANALYSIS

GRAIN SIZE ANALYSIS SAMPLES1

Well	Sample Number(s)	Analysis ²	Report Number
WB-1L	S2	P,H	1
	S12, S13	S,H	2
	S19b, S20	S,H	3
	S22, S23	S	20
WB-2L	S19	S,H	4
	S31, S32	S,H	5
	S35, S36	S	21
WB-3L	S11	P,H	6
	S19	S,H	7
	S33	P,H	8
WB-4L	S17, S18	S,H	9
	S26, S27	S,H	10
	S40	S,H	11
WB-5L	S5	S	22
	S10	P,H	12
	S30, S31	S	23
	S48	P,H	13
WB-6L	S2	P,H	14
	S27	S,H	15
	S36	S	24
WB-7L	S26	S	25
	S34	S,H	16
	S36, S37	S	26
WB-8L	S4	P,H	17
	S20	P,H	18
	S32	S,H	19

Refer to following page for the depth intervals of the samples and a summary of the grain size distribution.

P:

H: Hydrometer Analysis

Sieve Analysis Prewash S:

Project Title Laboratory Testing File #131.02 #2

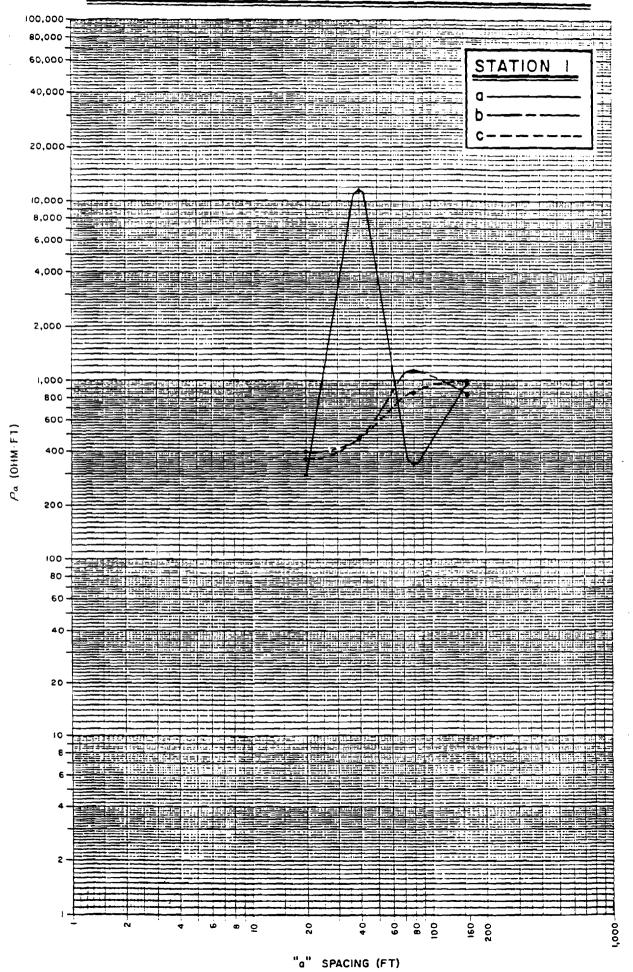
Sieve Analysis ASTM D-422

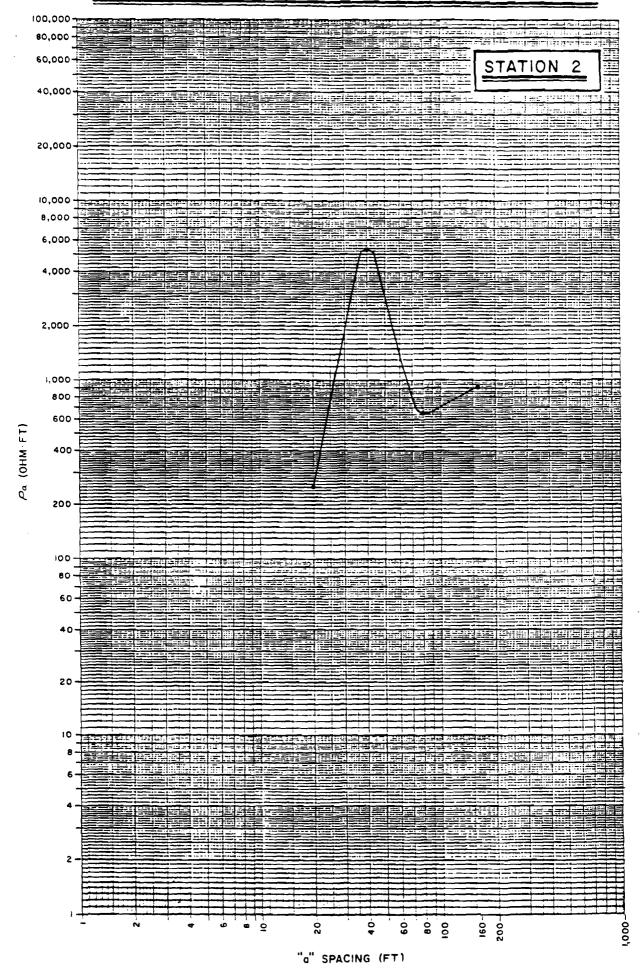
			Sieve Size - Percent Passing Sieve														
Well Boring #	Sample ##	Depth In Feet	2"	1"	3/4"	<u>}</u> "	3/8"	#4	#10	#30	#40	#60	#100	#200			
11(1)	S-2_	5-7									100			99.3			
11_	S-12&S-13		100	85.3	85.3	83.6	81.5	70.0	50.8	36.3	33.9	30.6	28.4	25.8			
1L	S-19B&S-20			100	82.6	81.0	77.9	68.3	57.5	45.8	43.2	37.7	33.9	29.8			
11	S-22&S-23	68-69.5 70-72	100	81.5	69.2	59.8	50.9	41.5	32.8	21.9	20.0	16.9	15.0	13.2			
2L	S-19	40-42	1	100	90.6	85.9	84.9	75.4	50.7	31.3	28.3	24.3	22.0	19.8			
2L	S-31&S-32	68-69.8 70-71.5	100	87.2	81.4	72.9	64.6	52.3	41.5	30.6	28.2	25.2	23.5	21.7			
2L	S-35&S-36	85-86.5 90-91.5	100	92.8	70.5	61.7	55.4	43.7	32.6	22.6	20.6	17.9	16.5	15.2			
3L ⁽¹⁾	S-11	20-22									100			98.5			
3L	S-19	36-38			100	92.3	85.1	75.6	59.7	36.6	31.1	25.2	22.5	19.8			
3L ⁽¹⁾	S-33	68-70	1								100			76.0			
4L	S-17&S-18	32-34 34-36	1	100	89.0	85.6	77.1	59.8	47.2	37.7	35.8	33.3	32.1	31.1			
AL.	S-26&S-27	50-52 52-54	100	89.9	85.6	76.0	71.2	60.0	48.8	37.2	35.1	32.4	30.9	29.4			
4L	S-40	90-92		+ +	100	94.2	85.2	63.8	48.4	34.0	31.1	27.3	25.6	23.9			
5L	S-5	8-10		100	90.5	78.0	71.2	60.9	47.3	30.9	27.4	22.1	18.3	14.8			
_{δL} (i)	S-10	18-20	1			1		100			98.9			98.3			
δL		58-60 60-62	100	89.9	84.4	70.2	61.9	50.3	38.2	23.0	20.2	16.9	15.3	13.9			
5L ⁽¹⁾	S-48 1	16-118					100				81.9			35.1			

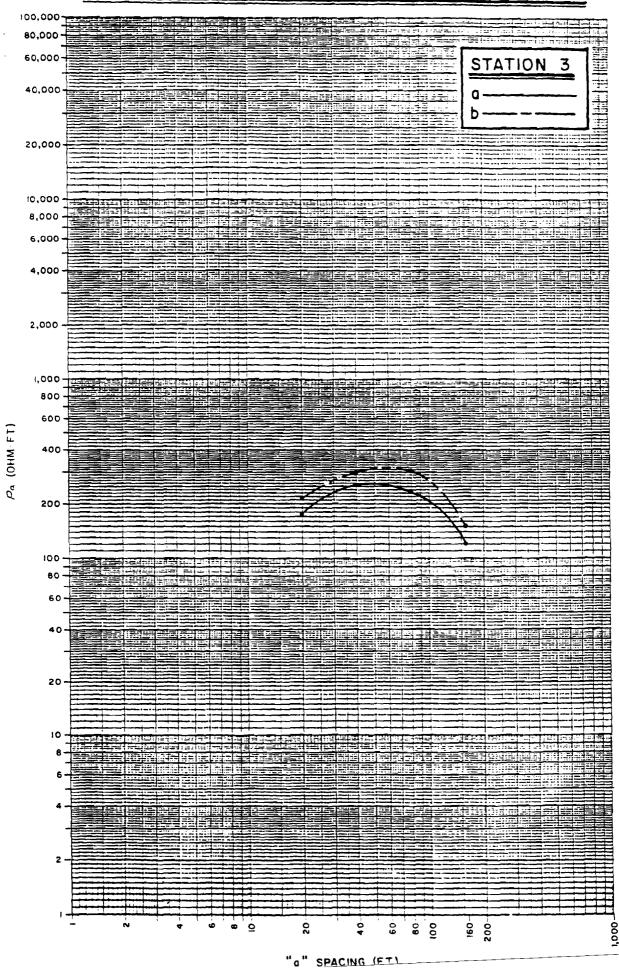
Remarks: (1) Partial Sieve Analysis, used in calculations for hydrometer

analysis

Performed By Willing







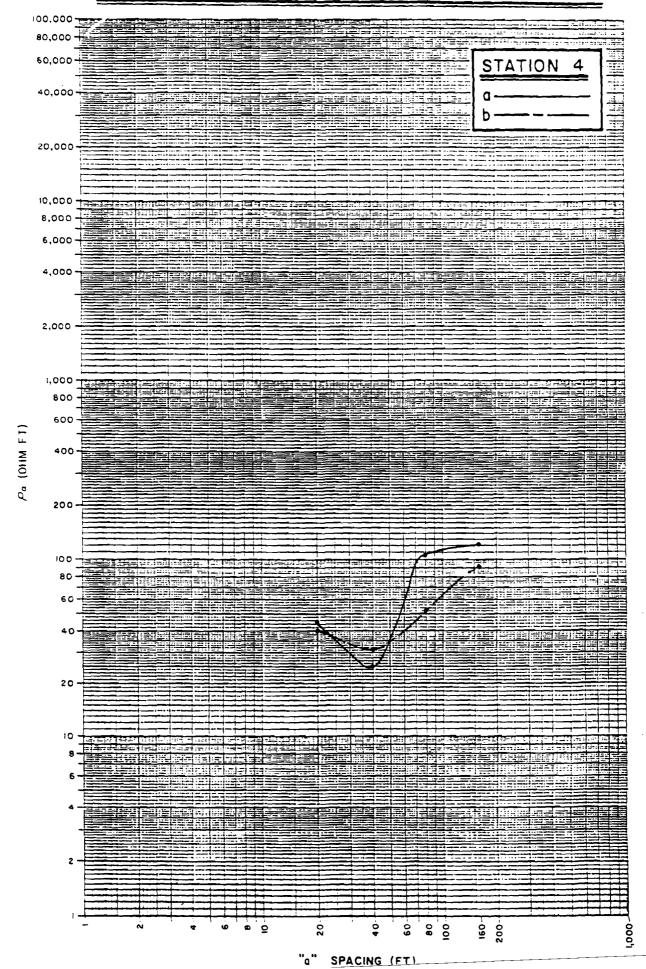
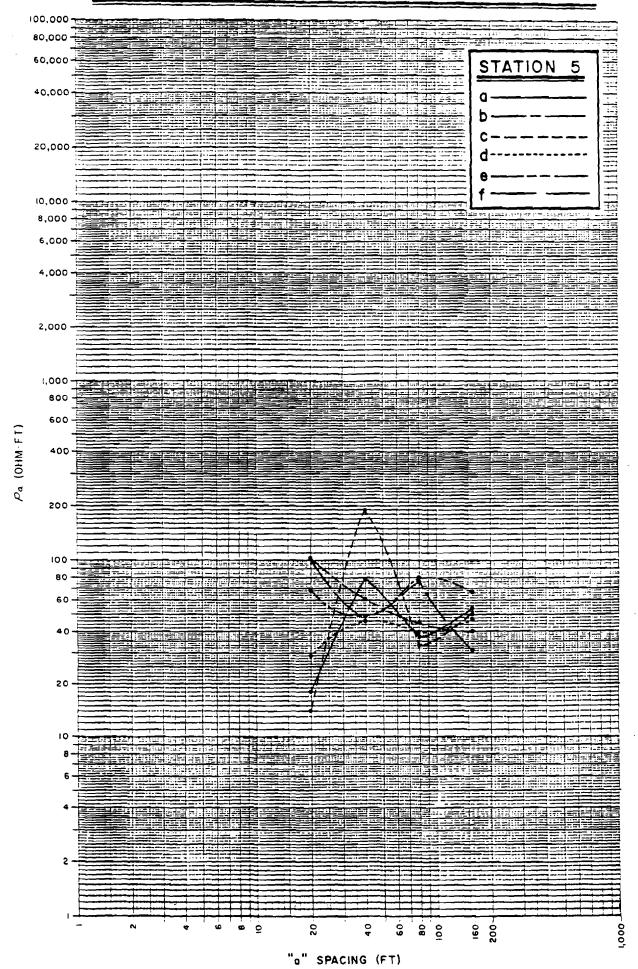
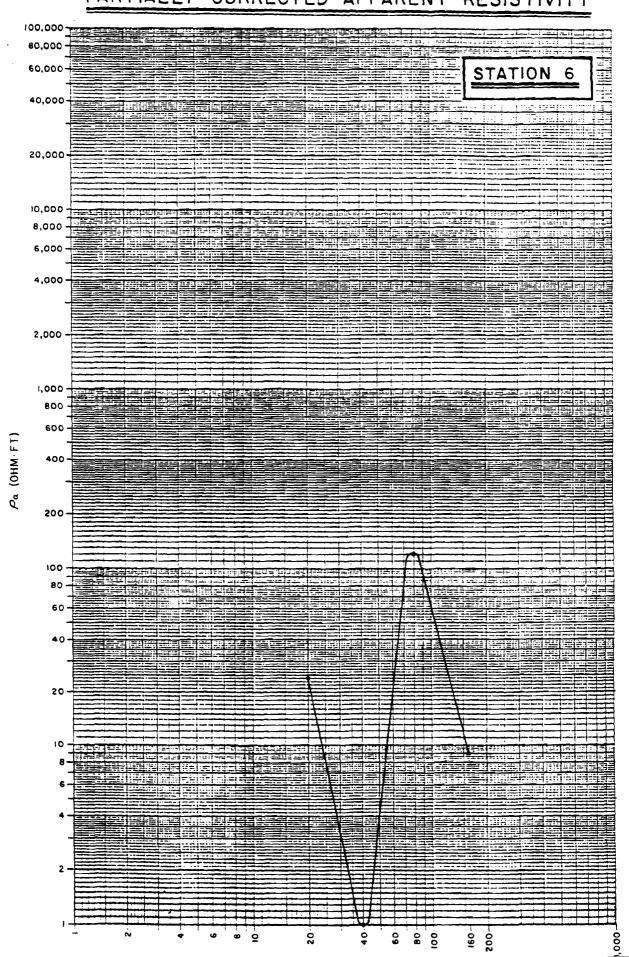
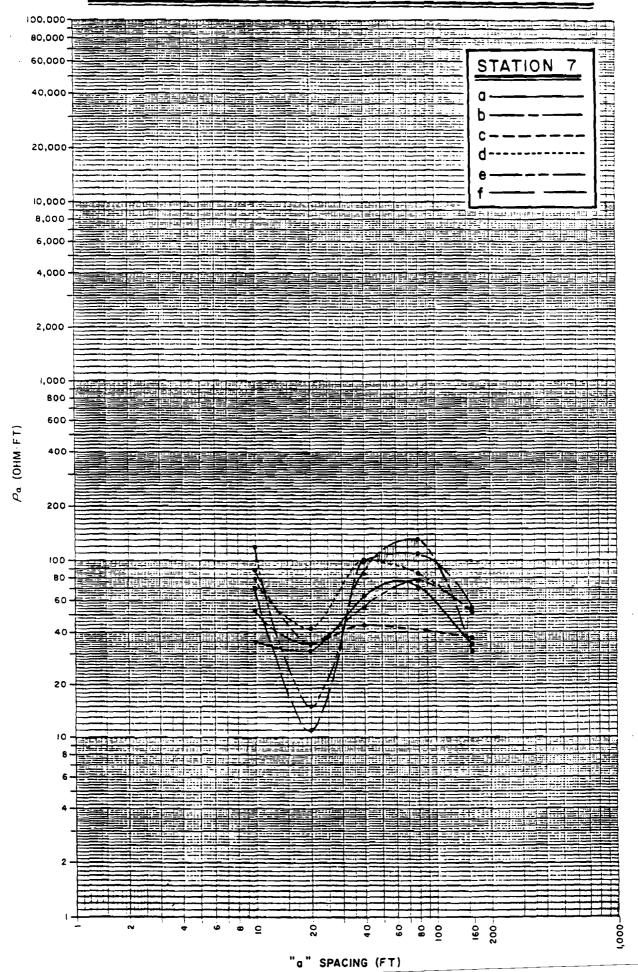
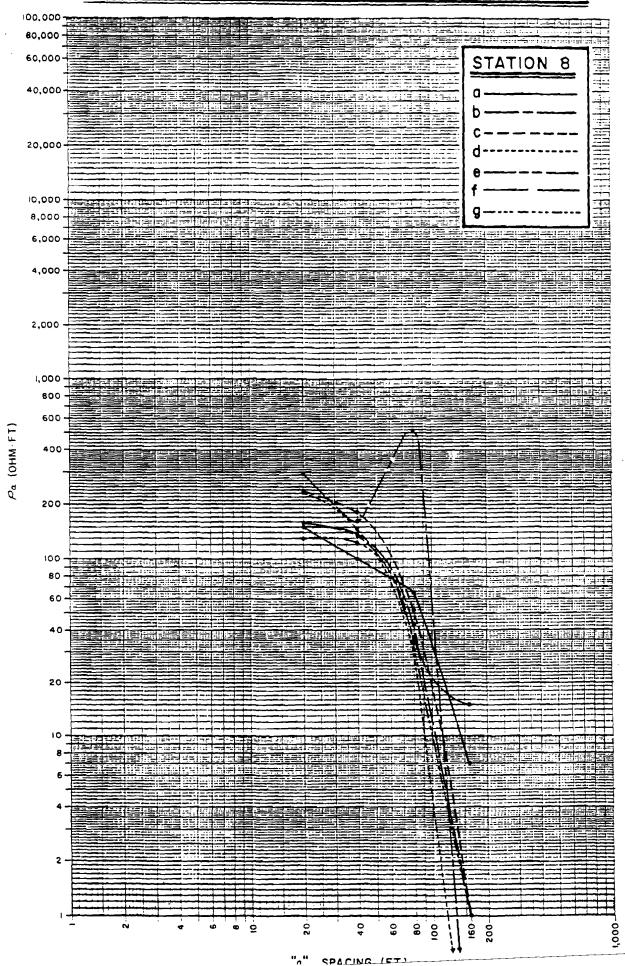


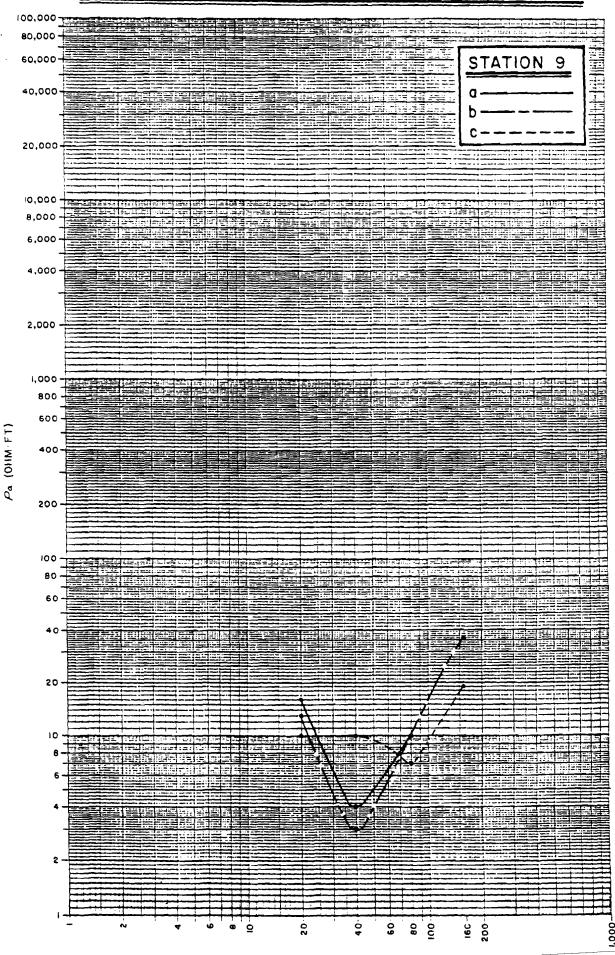
FIGURE B-6
PARTIALLY CORRECTED APPARENT RESISTIVITY











APPENDIX C
SUBSURFACE LOGS

	7	\sim	Ţ				
EPTH	SAMPLES	AMPLE NO.	(INCHES)	z	WELL	EOLOGIC COLÜMN	SUBSURFACE LOG WB,-
٥	SA	SAM	REC (IN		≯ %	GE (DESCRIPTION
_ ^							Well or boring designation.
-			 -				The number of blows delivered by a 140-1b. nammer dropped 30 inches to drive a 2 inch (OD) split spoon sampler from 6 to 18 inches (Standard Penetration Test) in a 24-inch drive.
-	/ /						The length of the sample (recorded in inches) recovered after driving a split spoon sampler 24 inches or the length (in feet) of the rock core recovered from a five-foot core run.
-							The interval through which the split spoon sampler was driven, or the interval that the core barrel was drilled in rock.
							Depth below ground surface (0) in feet.
							Protective casing: 4-inch ID steel casing,2 feet in length with locking cover.
							Grout: Portland cement/bentonite mixture at 20/1.
F						<u> </u>	Well casing: 2-inch ID, flush threaded, Schedule 40 PVC
-[-							Seal: non-stick bentonite pellets.
						_	Borehole: nominal 8½ inch, advanced with hollow stem augers.
						<u> </u>	Well pack: grade O sand.
						<u> </u>	- Well screen: 2-inch ID, flush threaded PVC with machine -
- -							cut 0.010 inch slots. Natural formation, collapsed into borehole.
-			 				_
					ĺ		
					}		Geology
+			!			11/1/1/1/1/1/1/1/1/1/1/1/1/1/1/1/1/1/1	Fill materials Marl
-							Clay
							Silt Sand
F			-			2002-07:5 	Gravel Limestone
- -							Shale
1_			 -	ļ			-
<u> </u>							Datum is National Geodetic Vertical Datum of 1929.
SURFA	CE	ELEV	ATION		¹ ∳	PROJEC	T Allied-Signal Inc.
OATE						1	OF
DATE CLASS						NO	BLASLAND & BOUCK ENGINEERS, P.C.

	DEРТН	SAMPLES	SAMPLE NO.	RECOVERY (INCHES)	z	WELL	GEOLOGIC	SUBSURFA	ACE LOG WB-ILa	
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	-		-							コ
	- °	1/	S-1	12	12			Two-inch brown TOPSOIL, wet.		\dashv
	<u> </u>	+	S-2	10	18			Brown to reddish brown mottled CL	AY.	7
	_	\mathbb{Z}								\exists
	5	V	S-3	24	7			Brown to red-brown to purplish va CLAY, wet.	rved silty fine SAND and	4
			5-4	18	8					
	<u></u>	-	S-5	10	2					4
فتجيها	- 10	-	S - 6	24	2					ゴ
			3-6		3					\exists
	-		S-7	22	19					7
	15		S-8	23	21					士
	-	}-	5-9	20	29					\exists
								Brown silty fine SAND to SILT, lar	minated, wet.	7
	<u></u>		S-10	12	6		:			4
	20		5-11	12	5					ゴ
	L	\vdash	5-12	22	4			Brown to purplish brown varved SII	IT and CLAY occasional lense	\dashv
***************************************	-	-	S-13	24	14			of silty fine sand, wet.	2. and carr occasional lense	コ
	- 25	_	3-13	24	14					ㅓ
-	i	1/	S-14	18	20			Brown silty fine SAND occasional	silt and clay laminations.	\exists
	-	1-	S-15	20	6					1
	F 30	\ <u></u>	S-1 6	24	7					4
	<u>-</u>	-	S - 17		10		_			1
	ŗ.	1			10		===			+
	35		5-18	NR	5		_			7
-	Ē		S-19	14	12		· <u>-</u> -			\exists
	⊢	-	5-20	6	12					4
-	40	-	5-21	1.0	10					1
	<u> </u>		5-21		10		_			1
-	Ľ		5-22	18	17					7
	Γ		5-23		12			<u> </u>		ユ
*			ELEV ARTED			.3		Allied-Signal Inc.	 //	Í
	i		MPLET		-	87	SHEET_	1 OF 2	BLASLAND & BOUCK	
			IED B						ENGINEERS, P.C.	•

		Т	T	<u> </u>							
سین	DEPTH	1	SAMPLES	SAMPLE NO	RECOVERY (INCHES)	z	WELL	G EOLOGIC COLUMN	SUBSU	URFACE LOG	WB-ILa (CONT'D)
		- 1	'n	SAI	RE (> 0	0 E	DI	ESCRIPTION	
		1	7								
-			<u> </u>	5-24	22	30	```	_			7
			1	S-25	18	51) 	,	Yellow silty charse to fir Top of rock at 50.0 ft.	ne SAND, little fine gra	vel.
	- 50		, 51	S-26 core		50+ 5 min			Upper three feet of core: (subhorizontal to subvertic	dark gray fine grained L	IMESTONE with
				core	4.2	5 min			2.2 feet from top of core with a calcium carbonate :	. Joints open from 0.1- cemented fine gravelly c	0.2 feet.filled 🗂
	- 5:	5				7 min 6 min			fine sand. Lower 1.2 feet SHALE with numerous subhor	t of core red. soft	, weathered
	<u> </u>		-			5.5min			Potter of basis of Cl		
-	-	- }	┝						Bottom of boring 55.6'.		-
		- [ľ				4
	<u> </u>	-	<u> </u>								
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	SUR	FAC	E F	LEV	ATION	40	4.3	PPO IEM	Allied-Signal Inc.	 _	
******						/30/87			OF2		
						10/30				PLASI	AND & BOUCK
					C			NO	B-1La	ENGIN	EERS, P.C.
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_	DEPTH	SAMPLES	AMPLE NO.	ECOVERY INCHES	z	WELL	GEOLOGIC	SUBSURFACE LOG WB-IU
		Š	SAN	æ ⊒ _		≯ ŏ	9 S	DESCRIPTION
								Note: WB-1U was installed in a borehole located within approximately 20 feet of WB-1L. The geology snown on this log represents what was encountered in WB-1L and no samples were taken for this boring.
								Red-prown silty CLAY, mottled, slight laminations, moist.
	5							Red-brown CLAY interbedded with brown fine sandy SILT, laminations 2 - 3 inches thick, moist, varves.
	– 10							Light brown silty fine SAND, dry.
	_			 			0.0	Pushed gray brown siltstone COBBLE.
	1 5						1	Light brown fine SAND, trace medium sand and silt, laminated, moist gradational to brown silty fine SAND with lenses of silty CLAY, laminated, moist to damp.
	20							-
-4000								- - -
اجميون	25							Reddish brown fine SAND, trace medium to coarse sand, silt, wet
-	30							Brown fine SAND interbedded with silt-clay layers, varves.
***************************************	35 .							
	È						0000	Very difficult augering 34.8 - 36.9. Dark gray ROCK CHIPS in matrix of silty fine sand. Brown and gray silty coarse to fine GRAVEL, little coarse to
-	40					\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	0000	fine sand, wet. Gravel subangular. Brown silty coarse SAND, little fine gravel.
	`- F					,		Bottom of boring 40.5'.
;	SURFA	CE	ELEV	ATION	404.1		PROJEC	Allied-Signal Inc.
	DATE	STA	RTED	<u>11/1;</u>	7/87_			1_0F_1
-				Y				ENGINEERS, P.C.

	ОЕРТН	AMPLES	AMPLE NO.	RECOVERY (INCHES)	z	WELL	GEOLOGIC	SUBSU	JRFACE LOG WB-IL	7
L		S.A	SAN	RE (IN		* ŏ	9	DE	ESCRIPTION	
ŀ	_									7
- [_									\exists
Ì	-									7
. [- 0		51	12	10	1 1		Red-brown silty CLAY, mott	led, slight laminations, moist.	7
ŀ	-									\dashv
. }										コ
	- 5	/	52	24	6			Red-brown CLAY interpedded	with brown fine sangy SILT,	\dashv
. }	_	<u> </u>						varves 2 - 3 inches thick,	moist.	7
	_									$\frac{1}{2}$
.	- 10		\$3	12	49			Light brown silty fine SAN		\dashv
-	_	_						•		1
_	_		54	1/2	82			Pushed gray brown siltston	e COBBLE.	\dashv
	- 15		S5	24	48			Light brown fine SAND, tra	ce medium sand and silt, laminated,	
ŀ	_	}_	S6	18	48		-	CLAY, laminated, moist to	silty fine SAND with lenses of silty damp.	4
•	-		67	1.7	34					1
t	- 20		57	17	31		_			\dashv
	_		S8	24	23					
ļ	-						_			\exists
-										4
	- 25 -		S9	21	27	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \				7
				<u> </u>				Reddish brown fine SAND, t	race medium to coarse sand, silt, wet.	4
-	_									1
-	→ 30 −		S10	19	27	\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.\.				\dashv
ł	-							Brown fine SAND interbedde	ed with silt-clay layers, varves.	7
-	- -									1
}	35		S11	2	60/0.3	, , , , , , , , , , , , , , , , , , ,		Very difficult augering 34	9.8 - 36.9.	뉙
- [_	<u> </u>	S12	24	78			Dark gray ROCK CHIPS in ma	strix of silty fine sand.	1
ļ	- 	<u>/</u>		• 1			0 30	Brown and gray silty coars fine sand, wet. Gravel su	se to fine GRAVEL, little coarse to	$\frac{1}{2}$
}	- 40	7	S13	10	80		00000]
ļ	-	<u>/_</u>						of red silty coarse SAND, l	ittle fine gravel, one 1-inch lense ne sand, till-like material.	1
- [_									\dashv
}	45	7	S14	12	81	a			SAND, wet, faintly laminated.	ゴ
_	SURFA DATE							Allied-Signal Inc.		
{			MPLET			87		1_OF2 WB-1L	BLASLAND & BOUCK	I
_	CLASSIFIED BY GMT								ENGINEERS, P.C.	l

	DEPTH	SAMPLES	AMPLE NO.	RECOVERY (INCHES)	z	WELL	COLUMN	SUBSURFACE LOG (CONT'D)
. [٥	SAI	SAM	REC (IN		≥ 00	GE (DESCRIPTION
-	45	1/				·	-	
,	_	_						1
}	-		<u>\$15</u>	10	18		_]
• [~ 50 ~		516	1.2	38		} · _′	-
ŀ	- 	-				<u>}</u>		-
• }		-	S17	-	27	\. ·.]
	- 55	<u> </u> _			<u> </u>		-	<u> </u>
•			 -	 			-	-
ļ		/	S18_	18	88] ,		
- [- 60	-	S19	19	76	: ,		Gray brown coarse to fine SAND, little fine gravel, silt. One
}	-	}-				\		
-	~	_				`. · .		Red coarse to fine sandy SILT. TILL
ŀ	- 65		S20	24	29			Gray to reddish brown coarse to fine sandy SILT.
-	_		521	24	48	SSI 1989	- 3 0	Reddish brown silty coarse to fine GRAVEL.
	~		522	18	83	عجية المحم		4
_ {	- 70	F	502	2.	-]
Ì	~ ~	\angle	523	24	80		آه در دان (مدر دان (د تارون	_
_	-		ļ				_	Gray brown silty coarse to fine SAND, little fine gravel.
	~ 75		S24	É	75/.5	_=_	_]
}	_		}	 				
·	~		S25	14	100/0.7			Boulder? at 78' - very difficult augering.
}	 80				100/11/			Dark red-purple silty coarse to fine SAND, little fine gravel.
	-		526	1	50/.1	ار		Gray broken coarse gravel.
	-		527	4	110/0.5	 	<u> </u>	
{	-					1		Bottom of boring 82.8 '. Unable to advance boring to bedrock due to adverse drilling conditions.
-						}]
	-							
	-					1		-
	-					1		
						}		-
	SURF	ACE	ELEV	ATION	403	.9	PROJEC	T Allied-Signal Inc.
			ARTED		_		1	BLASLAND & BOUCK
			MPLET		_	87	NOWB	ENGINEERS, P.C.
-	}		J					

DEPTH	SAMPLES	SAMPLE NO.	RECOVERY (INCHES)	z	WELL	GEOLOGIC COLUMN	SUBSURFACE LOG WB-2La
	SA	SAM	REC		≯ 00	0 E	DESCRIPTION
-							
 -							
- 0		S-1_	10.5				Black to brown organic silt and clay. TOPSOIL.
	\angle	J - 1	10.5	<i></i>			Red to brown silty CLAY.
<u> </u>	7	S - 2	15_	23		· /	Prove to car have fire CAND 11111
<u> </u>	· /	5-3	14	7			Brown to red brown, fine SAND, little silt, trace clay, moist.
- 5					0000		
-		5-4	12	6	ລັດ⊹ລິດັ່ ພູ້ລິ່ວ		
	,	S - 5	11	4			
10		6.5					
-		S-6_	4	71		oc 200	Gray to brown sandy coarse to fine GRAVEL, little silt, dry, occasional sand lenses.
		S-7	12	38		6 0 0	occasional sand lenses.
- '		S - 8	10	42			
- 15			10	72		0,000,3	
		S - 9	7	38	/~~~		
<u> </u>		S-10	18	38			
20		0 .0	ı ğ	30		04 2 60 50 2 ,	-
		S-11	10	35		0 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
- !		S-12	11	28			
_							
25		S-13	9	15	、		
		S-14	7	14	/~~~/		Wet at 26' <u>+</u> .
-		S - 15	8	22		[2, ²]],	
– 30		- -			,		
 		S-16	12	15		20,23	
		S-17	17	19	<i>`</i>		
-					ار_را	0.000000000000000000000000000000000000	
— 35 ·		S-18	4	24	ĺ		
E l					/	000000	
<u> </u>							
L 40					$ \!$		
-		S-19	18	31			Gray coarse SAND, little medium to fine sand, trace silt and clay.
E I							and Gray.
-							
SURFA	CE	ELEV	ATION	400.	.5±	PROJEC	TAllied-Signal Inc.
DATE							1 OF 3
DATE	CON	APLET	ED	_10/9/		NOWE	I III RASIAND A BOUCK

	DEPTH	SAMPLES	AMPLE NO.	RECOVERY (INCHES)	z	WELL	GEOLOGIC	SUBSURFACE LOG WB-2La (CONT'D)
	٥	SAI	SAM	REC (IN	ļ	≥ 0	G E C	DESCRIPTION
F	_	/	·S-20	24	71_	, ~ _	====	
	_	/	5-21	20	67	1		Red-brown sandy SILT, trace fine gravel. Red-brown to gray coarse to fine sandy GRAVEL, little
Ţ	_							to trace silt and clay.
}	 50		S-22	14	89			
Į	-	,						-
	_	1	<u>5-23</u>	20	38		0 0 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3 3	
Ì	 55	1	5-24	10	39	<u> </u>		_
}	-	H	S-25	13	74		<u> </u>	
_								Gray coarse SAND, little fine sand, silt.
	_		S-26	18	38			Death and the second se
-	- 60		5-27	15	30	· ・ ノ		Dark red to dark gray, sandy coarse to fine GRAVEL, little to trace silt and clay.
ŀ			S-28	24	100	}		
	_	L	3-26	24	100	_		-
}	- 65		5-29	17	80]		
_	-	7	5-30	9	50+			-
- {	_	/						- -
			5-31	12	100	ţ		Occasional lenses of TILL-like gray to greenish clayey SILT,
- [- 70 -	7	5-32	13	212+		22.2000	little coarse to fine sand and coarse to fine gravel from 69-74 feet.
						ł		-
	_	L	2.22				91 c 6.0 9,6 3.70	
`. 1	- 75	/_	S-33	18	185		0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
	_							
Į,	_	l				1		
7	80	<u> </u>	S - 3 /s	10	110	·'	000000000000000000000000000000000000000	
ļ	-	K	S-34	18	118	ļ		
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ł	- 85 ·	_					0 0000	-
-1	-		S-35	15	99_			
l	_						000000	-
-	,							
	90	7	S- <u>3</u> 6	14	106			-
	-							
	_]
	SURFA	CE	ELEV	ATION	400.	.5±		T Allied-Signal Inc.
٦	DATE						l	2_0F_3
•			MPLET				NOWB	RIASIAND & BOUCK
٦	CLAS	SIFI	ED B	′	SPS			

١		S	Ö	>			v			
	DEPTH	SAMPLES		RECOVERY (FEET)	z	WELL	GEOLOGIC	SUBSU	JRFACE LO	OG (CONT'D)
	DE	SAM	SAMPLE	ECO (FE)	W E COL	COL			(CONT D)
	95	"	5 - 37	4	66+		0 3 3 %		SCRIPTION	
	- ا		3-37	1417	00+			No recovery. Bottom of boring 95.5 ft.		
								Unable to advance boring conditions.	to bedrock due to	adverse drilling —
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جنس	ļ-			-						-
	<u> -</u>									-
-	SURF	ACE	ELEV	ATION	400.	5±	PROJEC	Allied-Signal Inc.		
	l .		ARTED					3_0F3_		BI 4 21 4 M A BALLAN
	ı		MPLET			 !	NO	¥B-21.a	4/7	BLASLAND & BOUCK ENGINEERS, P.C.
	I CLAS	SIF	ED B'	Y SE	25				<i> </i>	

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	DEPTH	SAMPLES	AMPLE NO.	ECOVERY INCHES	z	WELL	G EOLOGIC COLUMN	SUBSURFACE LOG WB-2U
		s,	SA	RE		> 0	9 9	DESCRIPTION
تسييونية	- - -							Note: #B-2U was installed in a borenole located within approximately 20 feet of WB-2La. The geology shown on this log represents what was encountered in WB-2La and no samples were taken for this boring.
	_ 0		_		_	 	Company of	Black to brown organic silt and clay. TOPSOIL.
	_					1/2 1/2		Red to brown silty CLAY.
-	_							Brown to red brown, fine SAND, little silt, trace clay, moist.
	— 5							
	_				_	7		_
	_							-
	_							
*******	- 10					~ ~	0 6 3 .	Converse to the converse of th
	_					~ -		Gray to brown sandy coarse to fine GRAVEL, little silt, dry, occasional sand lenses.
Unique	_					~ .	6000000	_
	15					~! ~	00000	
****	-					 ~ ; ~	20,000	-
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	_					- ~	2000000	
-	20					_ _~	000000	-
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-	-		-			~ ;	0 7 5 0 5	-
	- 25					~ ~		
-	-		_			~		 Wet at 26'+_
	_					~		
ومعيوب	L						00000	_
,•	30							
	H			-				-
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	- 35 ·			 		· ,	0000	
-							00000	<u>-</u>
	-							· -
خسب	- 40						ر و و و	
	-			 				Gray coarse SAND, little medium to fine sand, trace silt and clay.
***						\equiv		
	45					\sim		Bottom of Boring 45.0'.
		CE	ELEV	ATION.	400	. 4	PROJEC	TAllied-Signal Inc.
	DATE	STA	RTED	10/			SHEET_	1_0F 1
	DATE				10/12	/87	NO	WB-2U BLASLAND & BOUCK ENGINEERS, P.C.
-	CLAS	SIFI	ED BY	/SP	<u>'S</u>			

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	DEPTH	AMPLES	SAMPLE NO.	RECOVERY INCHES	z	WELL	GEOLOGIC	SUBSURFACE LOG WB-2L
-		SA	SAN	REC		≯ 00	ງວ ອ ຶ່ອ	DESCRIPTION
								Note: Borehole for WB-2L is a nominal 6-1/2 inches advanced with an air rotary rig using the Odex System. No samples taken above 97 ft. Samples taken below 97 ft. were cuttings. Geology above 97 feet is from 2La.
-								Black to brown organic silt and clay. TOPSOIL. Red to brown silty CLAY.
	5 -							Brown to red brown, fine SAND, little silt, trace clay, moist.
- Philosophia	1 0							Gray to brown sandy coarse to fine GRAVEL, little silt, dry, occasional sand lenses.
	20 - 25 - 30 - 35							Wet at 26'±.
	40 45))) (F		AT1/23	1.6			Gray coarse SAND, little medium to fine sand, trace silt and clay.
	DATE	STA	RTED APLET	ATION.	1/23/8			BLASLAND & BOUCK ENGINEERS, P.C.

	DEPTH	SAMPLES	AMPLE NO.	ECOVERY INCHES	z	WELL	GEOLOGIC	SUBSURFACE LOG WB-2L (CONT'D)
		S	SA	A. E.		- 0	5 °	DESCRIPTION
-	÷5 -	 		 	 -		===	
	-	1 }	 .	 			300000	Red-brown sandy SILT, trace fine gravel. Red-brown to gray coarse to fine sandy GRAVEL, little
	-							to trace silt and clay.
-	- 50			 	ļ			
-	-	1 1		 	 		000000	
	-	1				1	000000	-
-	_						00000000	
-	- 55	} }		-	<u> </u>		0000	
-	-			 			55.0 h G 6	Gray coarse SAND, little fine sand, silt.
1	-							dray coarse sand, freche fille Sand, Stre.
				┼	 -	∦ `.∤	0 0 0 0	
	- 60 - - - - - - 65	1		 	 	∰ `J		Dark red to dark gray, sandy coarse to fine GRAVEL, little to trace silt and clay.
	-]]		-
	-	1)	020000	
T	-	1		 			00000	_
 - -	65						00000	-
-	<u>.</u>						0.000	
Ţ	-	1 }		 -	ļ	 	00000	_
				 	 		C 0 c 0 0 6.	Occasional lenses of TILL-like gray to greenish clayey SILT,
	70 -						00.0000	little coarse to fine sand and coarse to fine gravel from 69-74 feet.
ı		1 1		 			ه و د راد	- 69-74 Teet.
-	•			 			0.000 0.000	-
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	, 3					∦ }		
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,	85 .			 			00000	<u> </u>
_		} {					500000	-
-	-	1		 	 	}} : `}	0.0000	6-inch steel casing installed during advancement of boring
				 -	 	$\parallel \ \ $	10-0000	using the Odex System. Casing pulled back to 92 feet at completion of boring.
-	90 -	1					00000	
		1		 	<u> </u>	图图	00000	
	-			†	 	~ [] ~ [] ?	600000	-
•	95	Ш		1		~ ~	0,0,0,0,0	
:	-			ATION		0.7	PROJEC	T. Allied-Signal Inc.
				1			1	BLASLAND & BOUCK
				TED	11/25 GMT	/87	NO	WB-21 ENGINEERS, P.C.
	(ıs	31F	בט 8	Y	uri i		<u> </u>	

	DEPTH	SAMPLES	SAMPLE NO.	RECOVERY	z	WELL	GEOLOGIC		JRFACE LOG	WB-2L (CONT' D)
		╁╾┤	S	α		O should	্ত হতাত সভাৱত			
	95 		NA	NA	NA.			Gray GRAVEL, little silt,	, drilling became hard	er at 97'.
	— — — — — 105		NA	NA	NA					- - - -
	— 103 —	 		-				Red fine sandy SILT and C	LAY. TILL	
	_	H	NA NA	NA	NA			Top of rock at 108 ft.		-
	_	1				20 8 X		Green to gray weathered t	o unweathered SHALE.	
	 110							in the gray was successful to		
	_					1.777				
		ļ						Bottom of boring 111.6'.		
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	- 115	Ì								
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	SURFA	CE	ELEV	ATION	400	.7	PROJECT	Allied-Signal Inc.		
	DATE	STA	ARTED MPLET	1	1/23/8 11/25/	7	SHEET_	3_OF_3_ 3-2L		SLAND & BOUCK HINEERS, P.C.
	LLAS	3171	ובט א	Y	GHT.					

DEPTH	AMPLES	AMPLE NO	RECOVERY INCHES	Z	WELL	G EOLOGIC COLUMN	SUBSURFACE LOG WB-3U	
	SA	SAN	REC		≯ ຽ	SE CC	DESCRIPTION	7
-	1		 				Note: WB-3U was installed in a borenoie located within approximately 20 feet of WB-3L. The geology shown on this	ゴ
	1 [log represents what was encountered in WB-3L and no samples were taken for this boring.	4
-	} }						seve sellen for simp borning.	\exists
0					+ +		Brown organic silty fine sand, TOPSOIL.	
					1 1		Light brown silty CLAY.	4
-	}		╂					\exists
			 -					4
5	[_
-	1 }		-			\ <u></u> _	Light brown silty fine SAND, laminated with fine sandy SILT.	
								4
10			-					
-			 -		\ \			4
							·	4
-]
15	1 }		 		\ \\			4
	lt							4
<u> </u>	1 }		\					I
_	}		$\{\}$				•	4
20					$\langle \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \$		Brown sandy CLAY, moist.	-=
L	} }						Brown samuy CEAT, MOTSE.	
· -	} }		1-1				Coarse to fine CRAVEL in silty CLAY matrix.	7
25							The state of the s	ㅓ
_	} }							7
1			╅┪		, ,			4
_							Brown to purplish fine sandy SILT, little to trace gravel, moist	=
- 30	}		-		28 - 22 			7
30	lt				$\overline{\Omega}$			4
								1
E 35 .	1		+				Brown medium to fine SAND, little silt, moist.	\dashv
	1 [0	Brown, reddish brown and gray fine grayelly, coarse to fine	\dashv
Ē	} }		 		, <u>=</u> .	00.	SAND, little silt, wet with minor amounts of coarse gravel and clay.]
۲.					$\dot{x} \equiv \dot{x}$	2 :0		\dashv
40	} }				=			
F 40	 		╂╼╌┨			, o 0		7
-	<u> </u>					୬.୬ ପ୍ର		\dashv
F	 					9,0	Bottom of boring 45.0'.	\exists
URF	CF	ELEV	ATION.	401	.7		T Allied-Signal Inc.	\dashv
TDATE							1_OF_1	1
PATE					37		BLASLAND & BOUCK	į
			Y GM1				ENGINEERS, P.C.	.

	DEPTH	SAMPLES	SAMPLE NO.	ECOVERY INCHES	z	WELL	GEOLOGIC	SUBSURFACE LOG WB-3L
- Manageries		SA	SAN	RE		≯))] 9	DESCRIPTION
	_		<u>-</u>					-
	_	1						-
	_							
-	- 0	7	5-1	10	4			Brown organic silty fine sand, TOPSOIL.
	-	-	S-2	14_	10			Light brown silty CLAY.
	<u> </u>				10	1 1		
	5		S-3	24	Ġ			
-	_		S-4	12	13			Light brown silty fine SAND, laminated with fine sandy SILT.
	-	-	S - 5	6	9			- Solidy Steries
	10	_						
-	-		<u>S-6</u>	8	12			
			5 - 7		14			
-	-	-	S-8	11	18	`		
	└ 15							
****			<u>5-9</u>	12	19	•		_
	_		S-10	12	15			
water	20	-	S-11	15.5	7			Brown sandy CLAY, moist.
	-	-						Showir Sandy CLAY, moist.
•	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,			17	76			Coarse to fine GRAVEL in silty CLAY matrix.
	- 25		S-13	18	81			
1000	<u>-</u>		S-14	NR	25+			_
	<u>_</u>	-	S-15	14	53			Brown to purplish fine sandy SILT, little to trace gravel, moist.
-	30							
	-		S-16	17	28		 - -	
4	-		S-17	24	45_			
	- .35 ·		S-18	24	87			Brown medium to fine SAND, little silt, moist.
*		-	S - 19	18	95		0 0 0	Brown, reddish brown and gray fine gravelly, coarse to fine SAND. Fittle silt, wet with minor amounts of coarse gravel
	Ė	/_					3 0	and clay.
	-	<u> </u>	S-20	10	100+		- 	_
	40	Z	S-21	11	100+		, o ;	<u> </u>
	الإنجزين	-	S-22	14	79			_
	-	4	S-23	24	51		10	
	JRFA	CE		ATION.		.5	PROJEC	Allied-Signal Inc.
,	DATE	STA	ARTED	10/5	8/87			1_0F.2_
	i .			ED		87	NO	BLASLAND & BOUCK ENGINEERS, P.C.
	- A3	31 T l	בט אַ	Y_KLR.	uri i			

_	H	LES	E NO.	RECOVERY INCHES		M. F.)6IC		SUBSURFACE LOG WE-3L	\neg
	DEPTH	SAMPLES	SAMPLE	ECO1	Z	WELL	GEOLOGIC		(CONT D)	_
		Ļ	78	æ			9		DESCRIPTION	
	_	7	S-24	24	54					\dashv
	-	\Box) - .			4
			S-25	24	54		7.			4
-	5 0	1	S-26	14	33		_	-		\dashv
			S-27	24	120		÷ ;			4
	_	4					_			\dashv
	 55		5-28	17	55					\Box
	_	,	S-29	15	88			, 1	Purplish brown fine SAND, little silt.	\dashv
		<u>/ </u>	S - 30		66		•			1
	- 60	/			0.6					\dashv
	-		S-31	24	68					
[٠			\dashv
-	-	_								1
	- 65		5-32	24	118	1				4
	_					[. =	-			1
	_	-	S-33	22	120	=				4
	70				1,20	=			-	\exists
	-		L			· <u> </u>	٠.			7
l	_					\equiv				4
-	_	7	5-3/	211	60			•		7
	- 75	/_	3-34	24	69		=		Gray brown fine to medium SAND, trace silt. Cray-purple sandy SILT, trace gravel, clay.	
	_		S-35	8	125+				Top of rock at 77.5'.	7
			S-36	NR	50+					뒥
	80	140								1
	<u> </u>		core	3.6'	8 min 7 min				Light gray soft weathered shale, with numerous subhorizontal joints, open joint at 79.7-79.8 filled with clay and rock	4
	-				2 min	$ \sim $			fragments. Very soft zone, recovered gray clay.	1
	- 85 ·				8 min 8 min				Dark gray unweathered shale with numerous subhorizontal joint fillings of gypsum, numerous subhorizontal drilling breaks.	님
•	-								Bottom of boring 84.6'.	1
-	<u> </u>									4
,	-									1
	90									4
l	!_									1
-	<u>-</u>							Ì		+
į		لــا ءَ								コ
-	SURFA DATE					1.5	l .		Allied-Signal Inc.	-
	DATE					87			WB-31 BLASLAND & BOUCK	
				KLR/			NU.		ENGINEERS, P.C.	, ·
~~	<u> </u>									ĺ

ng the state	ОЕРТН	SAMPLES	LE NO.	RECOVERY (INCHES)	Z	WELL	GEOLOGIC COLUMN	SUBSURFACE LOG WB-4U
	30	SAN	SAMPL	REC (W E	G EO	DESCRIPTION
. Errore	- 							Note: WB-4U was installed in a borehole located within approximately 20 feet of WB-4L. The geology shown on this log represents what was encountered in WB-4L and no samples were taken for this boring.
-	。 -						0	Light gray fine gravelly coarse to fine SAND, little silt, damp to dry.
فتنت	– – 5						o	
MANNET.	10						0	
النسبو النسبة	- -							Light gray to brown with flecks of green and red clayey SILT, little sand, fine gravel.
	15							
-	20							- - -
-	- - -							- - - -
,	25							-
اليحدي	30							
-	- - -							- -
	—35 —							
•	<u>_</u> 40							Bottom of boring 39.0'.
****	<u></u>							
	SURFA DATE				396 6/87	3.2		Allied-Signal Inc.
	DATE	COI	MPLET	ED	10/1	6/87	NOW	BLASLAND & BOUCK ENGINEERS, P.C.
	T CLAS	SIFI	FD B	YKL	.к			

Harris	DEРТН	AMPLES	SAMPLE NO.	RECOVERY (INCHES)	Z	WELL	GEOLOGIC	SUBSURFACE LOG WB-4L
-		SA	SAN	R E		× 55	6 E	DESCRIPTION
	E							
-	F							
-	F		S - 1	14	49	N I	0	Light gray fine gravelly coarse to fine SAND, little silt, damp to dry.
		Z	S-2	3	50+	N	3,	
-	-		S-3	8		1	\$ 3	-
	5		S-4	10	24		D 1	•
-		\angle	 -	l	24))	-
	-		S-5	10	_33		5 3	<u>-</u>
***************************************	10		S-6	12	31			Light gray to brown with flecks of green and red clayey SILT, little sand, fine gravel.
			S-7	10	38			rittle Sand, Time graver.
***************************************	-		S-8	ς	30			_
	15		5-9	NR				-
اسين	L		3-9	IVIK	20		====	
	-		5-10	8	12			
اسين	20	_	3-11	8	12			-
	<u> </u>		5-12	10	13			
-	+		5-13	17	17			
	25							
100	L		5-14	15	25			
	<u></u>		S-15	11.	16			
است	– 30		S-16	15	21			•
	<u> </u>		S-17	15	20			
-	.		S-18	17	23			
	- 35 ·	K,						•
-	F	Ź,	S-19		32			
			S - 20	15	27		=====	
-	F- 40		S-21	19	41		3	Gray coarse to fine gravelly coarse SAND, little green
	F		S-22	15	33		jo	and red clay, trace silt.
-			S-23	21	27)····	•
				ATION.		4	PROJEC	
***	DATE							OF 3 BLASLAND & BOUCK
				SPS		(B/	NOWB	ENGINEERS, P.C.
1	fee.					l		

	DEPTH	SAMPLES	PLE NO.	RECOVERY (INCHES)	z	WELL	G EOLOGIC COLUMN	SUBSURFACE LOG WB-4L (CONT'D)	7
	Id	SAA	SAMPLI	REC (IN		3 00 × 00	G E O	DESCRIPTION	-
į	-		·						+
			S-24	14	29		2 1 7 1		7
	F		S-25	12	21			Brown to gray, with red and green flecks gravelly CLAY, little	\exists
			S-26	8	23			coarse sand, silt, wet.	4
	_	-	6 07		ļ				1
			S-27	11	106				\dashv
البدن.	 55		S-28	NR	50+				コ
		1	S-29	NR					\dashv
-	_		S-30	NR	75+				7
	60								\exists
***************************************	E	-	S-31	12	66+			Dark gray gravelly coarse SAND, trace silt, clay.	4
	F					٠.	ą "		7
	65	\vdash	S-32	20_	97				\dashv
	F 3					` \		Brown to gray, with red and green flecks, gravelly CLAY, little coarse sand, trace silt.	コ
						1			4
	 -		S-33	15	83+	/ /		Red and green medium to coarse SAND, little clay, trace silt, fine gravel, wet.	\exists
	70		S-34	NR	50+				ㅓ
	-								7
	F								1
	- 75		S- 35	12	63+			Brown-gray gravelly coarse to medium SAND, little clay.	4
-	F								1
	- -	\geq	S-36	6	100+		÷ , ;		\dashv
لتسبي	80		S-37	6	96+				4
	_				70+				1
-	<u> </u>		L				0.		7
	_ 85 ·	سنسير	S- 38	4.8	100+				コ
	L					\overline{Z}	. *		+
	-	\neq	5-39	9	50+				7
,	- 90						5 5 ° .		
	L		S-40	18	62_	=			7
-	-	\angle	S-41	11	115				7
		\mathbb{Z}	5-42		61		,		1
				ATION.				Allied-Signal Inc.	
	DATE					17	i.	BLASLAND & BOUCK	
				SPS			NO	ENGINEERS, P.C.	.
-	t							I	

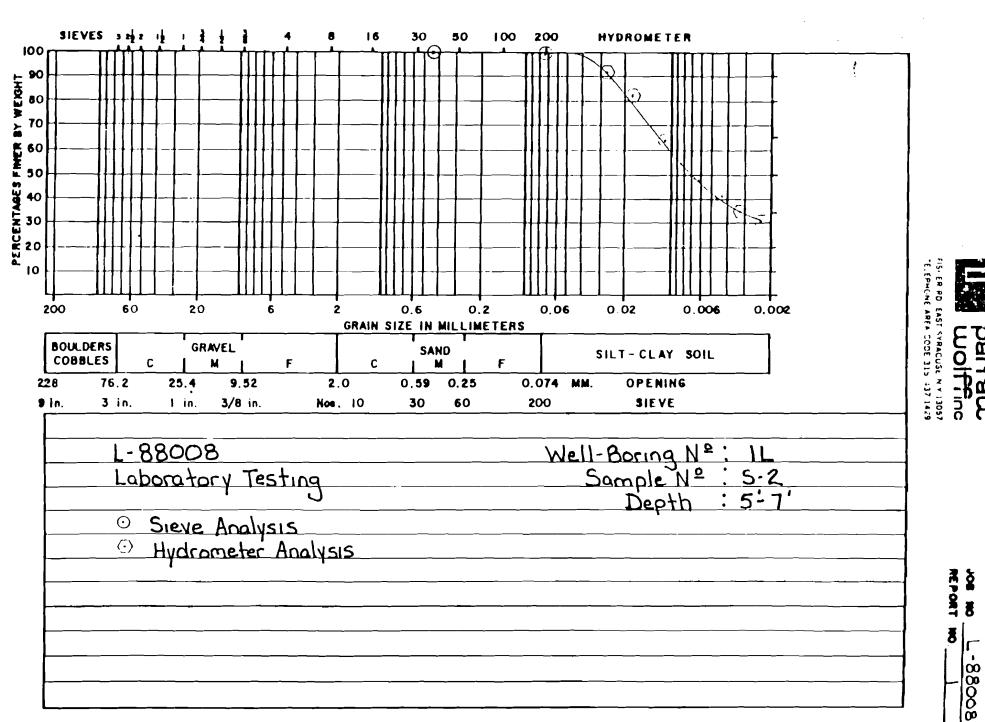
- DE010	1	SAMPLES	LE NO.	(INCHES)	Z	WELL	G E O L O G I C	SUBSU	URFACE LOG	WB-4L (CONT'D)				
_	3	SAM	SAMPL	RECC (INC		W E COL	GEO COL	DE	ESCRIPTION	(CONT D)				
-	1	4	S-43	13	130	= :				ㅋ				
	Ì	寸		l			, ÷]				
	- 1	-		 -			្ន			4				
	100	Z	5-44	10	<u>37</u> +			B-L CLAV 111.1						
_	l							Red CLAY, little gravel,	sand, trace silt, IILL.	7				
}-	- 1									7				
- -,	}				ļ									
<u> </u>	105	4	S-45	7	50+	 ,				4				
<u> </u>	l	-		-]				
-	{	-								4				
!		İ								-				
	110	7	S-46	7.5	50+	,				7				
	1	-												
 -	ł	ł						Top of rock at 113.5'.						
-	115	ł		 				Green weathered SHALE.						
	115	\exists	S-47	4.2	100+	(i);i)				-				
			core	4.5'	6 min			115.8'-116.8' green SHALE numerous platey shale frag	weathered to silty clay	with				
	- [6 min 7.5 min	1 × × / /// '		116.8'-117.6' dark gray St	HALE, relatively unweath	ered with				
<u> </u>		=4		 	7.5 mr 9 min			occasional subhorizontal _ ½-inch thick.	Joints filled with gypsu	m up to				
	20	XII			9 min			7117 61 440 6111						
<u> </u>	- {	- }						117.6'-118.8'light gray Sh gypsum, one broken zone w	HALE with several thin s ith gypsum filled voids	tringers of /				
_	}	}		 				118.8'-120.6' green SHALE	weathered and unweather	ed zones.				
T	1	Į					}	numerous subhorizontal jo- Bottom of boring 120.6'.	firts or breaks along bed	ding plane.				
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<u> </u>	RFA	I CE	ELFV	ATION	3	96.4	ppnism	- Allied-Signal Inc.						
	DATE COMPLETED 10/15/87							PROJECT Allied-Signal Inc. SHEET 3 CF 3						
1								NO. WB-41 BLASLAND & I						
				SPS					ENGIN	EERO, F.G.				

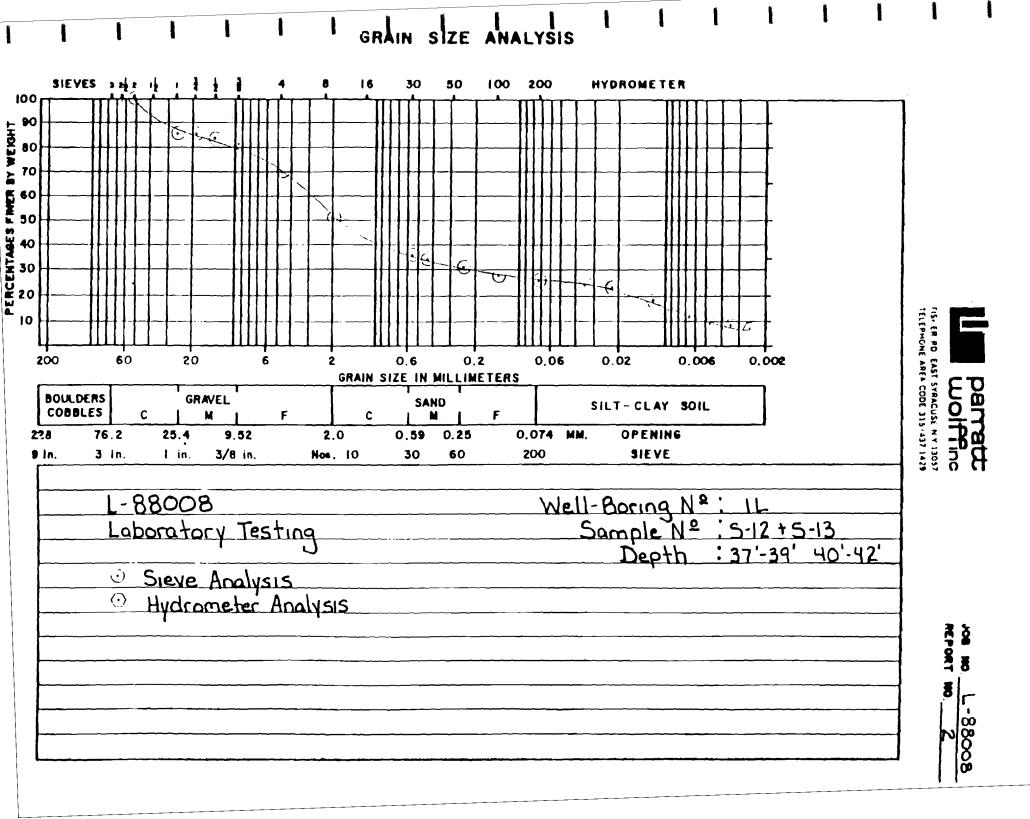
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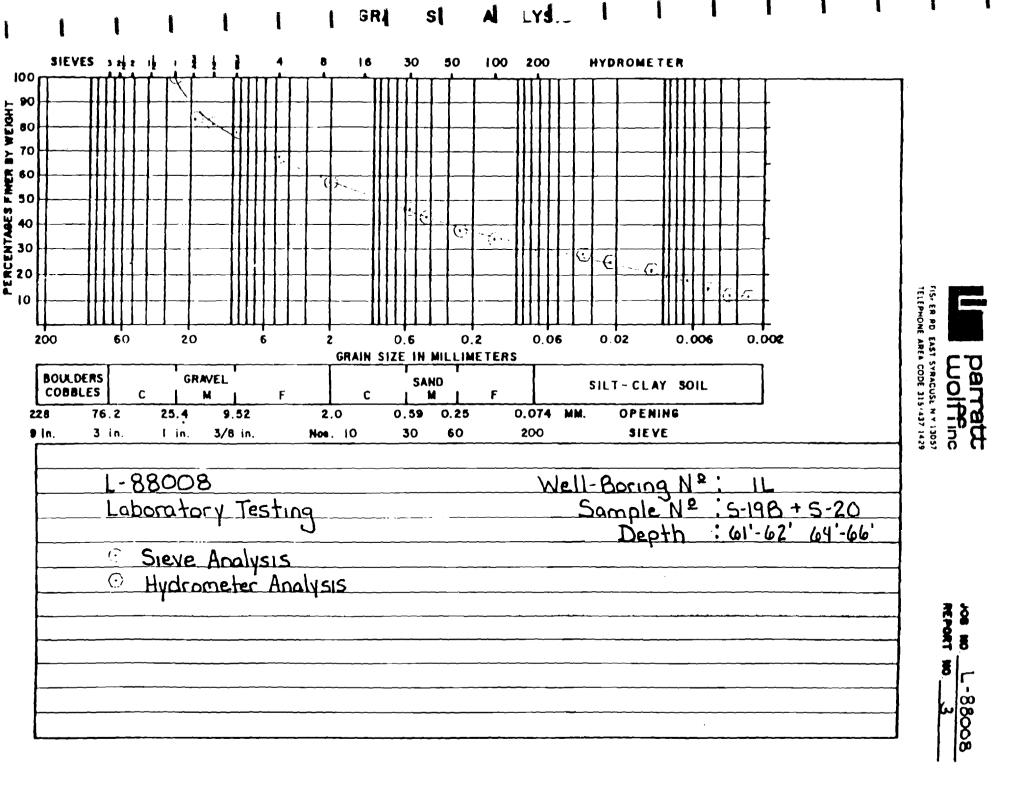
				Sieve	Ab	alvsis	AS	TM	D-47	22						
					Siev	e 'Sr	ze.	-	Perce	ent f	assır	19 S	ieve			
Sample #	Depth in Feet	2"	1"	3/4"	<u>j</u> "	3/8"	#4	#10	#30	#40	#60		[
S-2					_==_				100	99.8			98.9			
S-27	52-54			100	88.6	84.8	78.1	61.5	38.7	30.6	23.9	21.4	19.3			
S-36	75-77			100	90.9	84.2	73.9	65.4	52.9	45.7	30.9	24.2	18.6			
S-26	52-54				100	92.4	74.9	54.8	34.1	28.6	23.0	20.3	17.9			
S-34	68-69.5			100	98.5	95.3	88.3	80.8	72.1	68.9	60.2	50.2	37.5			
S-36&S-37			100	94.4	0.63	84.1	66.0	48.8	30.1	24.5	19.1	16.9	14.9			
S-4	20-22						100			92.2			88.6			
S-20	56-58						100			99.6			98.6			
S-32	80-82		100	96.1	96.1	92.5	88.8	83.5	73.5	66.8	49.3	38.9	30.8			
															 	
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	# S-2 S-27 S-36 S-26 S-34 S-36&S-37 S-4 S-20 S-32	# in Feet S-2 S-27 52-54 S-36 75-77 S-26 52-54 S-34 68-69.5 72-73.5 S-36&S-37 74-76 S-4 20-22 S-20 56-58 S-32 80-82	# in Feet 2" S-2 S-27 52-54 S-36 75-77 S-26 52-54 S-34 68-69.5 72-73.5 S-36&S-37 74-76 S-4 20-22 S-20 56-58 S-32 80-82	Sample Depth in Feet 2" 1" S-2 S-27 52-54 S-36 75-77 S-26 52-54 S-34 68-69.5 S-34 68-69.5 72-73.5 100 S-4 20-22 S-20 56-58 S-32 80-82 100	Sample Depth	Sample Depth in Feet 2" 1" 3/4" 4" S-2 100 88.6 S-36 75-77 100 90.9 S-26 52-54 100 98.5 S-34 68-69.5 100 98.5 S-36&S-37 74-76 100 94.4 89.0 S-4 20-22 S-20 56-58 100 96.1 96.1	Sample Depth in Feet 2" 1" 3/4" 1" 3/8" S-2	Sample Depth in Feet 2" 1" 3/4" 1" 3/8" #4	Sample Depth in Feet 2" 1" 3/4" 1" 3/8" #4 #10 S-2 100 88.6 84.8 78.1 61.5 S-36 75-77 100 90.9 84.2 73.9 65.4 S-26 52-54 100 98.5 95.3 88.3 80.8 S-34 68-69.5 100 98.5 95.3 88.3 80.8 S-36&S-37 74-76 100 94.4 89.0 84.1 66.0 48.8 S-4 20-22 100 96.1 96.1 92.5 88.8 83.5 S-32 80-82 100 96.1 96.1 92.5 88.8 83.5	Sample # Depth in Feet 1 2" 1" 3/4" 4" 3/8" #4 #10 #30 S-2 100 88.6 84.8 78.1 61.5 38.7 S-36 75-77 100 90.9 84.2 73.9 65.4 52.9 S-26 52-54 100 98.5 95.3 88.3 80.8 72.1 S-34 68-69.5 100 98.5 95.3 88.3 80.8 72.1 S-36&S-37 74-76 100 94.4 89.0 84.1 66.0 48.8 30.1 S-4 20-22 100 100 100 100 100 100 100 <td>Sample # in Feet 2" 1" 3/4" 1" 3/8" #4 #10 #30 #40 S-2 100 99.8 S-27 52-54 100 88.6 84.8 78.1 61.5 38.7 30.6 S-36 75-77 100 90.9 84.2 73.9 65.4 52.9 45.7 S-26 52-54 100 92.4 74.9 54.8 34.1 28.6 S-34 68-69.5 100 98.5 95.3 88.3 80.8 72.1 68.9 S-36&S-37 74-76 100 94.4 89.0 84.1 66.0 48.8 30.1 24.5 S-4 20-22 100 99.6 S-20 56-58 <</td> <td>Sample Depth fin Feet 2" 1" 3/4" 1" 3/8" #4 #10 #30 #40 #60 #60 S-2 -</td> <td>Sample Depth in Feet 2" 1" 3/4" 1" 3/8" #4 #10 #30 #40 #60 #100 S-2</td> <td>Sample Depth in Feet 2" 1" 3/4" 1" 3/8" #4 #10 #30 #40 #60 #100 #200 S-2 100 88.6 84.8 78.1 61.5 38.7 30.6 23.9 21.4 19.3 S-36 75-77 1- 100 90.9 84.2 73.9 65.4 52.9 45.7 30.9 24.2 18.6 S-26 52-54 100 98.5 95.3 88.3 80.8 72.1 68.9 60.2 50.2 37.5 S-368S-37 74-76 100 94.4 89.0 84.1 66.0 48.8 30.1 24.5 19.1 16.9 14.9 S-32 80-82 100 96.1 96.1 92.5 88.8 83.5 73.5 66.8 49.3 38.9 30.8 S-32 80-82 100 96.1 96.1 92.5 88.8 83.5 73.5 66.8 49.3 38.9 30.8</td> <td>Sample Depth in Feet 2" 1" 3/4" 1" 3/8" #4 #10 #30 #40 #60 #100 #200 S-2 100 88.6 84.8 78.1 61.5 38.7 30.6 23.9 21.4 19.3 S-36 75-77 100 90.9 84.2 73.9 65.4 52.9 45.7 30.9 24.2 18.6 S-26 52-54 100 98.5 95.3 88.3 80.8 72.1 68.9 60.2 50.2 37.5 S-368S-37 74-76 100 94.4 89.0 84.1 66.0 48.8 30.1 24.5 19.1 16.9 14.9 S-4 20-22 1- 100 96.1 96.1 92.5 88.8 83.5 73.5 66.8 49.3 38.9 30.8 S-32 80-82 100 96.1 96.1 92.5 88.8 83.5 73.5 66.8 49.3 38.9 30.8</td> <td>Sample Bepth in Feet 2" 1" 3/4" 1" 3/8" #4 #10 #30 #40 #60 #100 #200 S-2</td>	Sample # in Feet 2" 1" 3/4" 1" 3/8" #4 #10 #30 #40 S-2 100 99.8 S-27 52-54 100 88.6 84.8 78.1 61.5 38.7 30.6 S-36 75-77 100 90.9 84.2 73.9 65.4 52.9 45.7 S-26 52-54 100 92.4 74.9 54.8 34.1 28.6 S-34 68-69.5 100 98.5 95.3 88.3 80.8 72.1 68.9 S-36&S-37 74-76 100 94.4 89.0 84.1 66.0 48.8 30.1 24.5 S-4 20-22 100 99.6 S-20 56-58 <	Sample Depth fin Feet 2" 1" 3/4" 1" 3/8" #4 #10 #30 #40 #60 #60 S-2 -	Sample Depth in Feet 2" 1" 3/4" 1" 3/8" #4 #10 #30 #40 #60 #100 S-2	Sample Depth in Feet 2" 1" 3/4" 1" 3/8" #4 #10 #30 #40 #60 #100 #200 S-2 100 88.6 84.8 78.1 61.5 38.7 30.6 23.9 21.4 19.3 S-36 75-77 1- 100 90.9 84.2 73.9 65.4 52.9 45.7 30.9 24.2 18.6 S-26 52-54 100 98.5 95.3 88.3 80.8 72.1 68.9 60.2 50.2 37.5 S-368S-37 74-76 100 94.4 89.0 84.1 66.0 48.8 30.1 24.5 19.1 16.9 14.9 S-32 80-82 100 96.1 96.1 92.5 88.8 83.5 73.5 66.8 49.3 38.9 30.8 S-32 80-82 100 96.1 96.1 92.5 88.8 83.5 73.5 66.8 49.3 38.9 30.8	Sample Depth in Feet 2" 1" 3/4" 1" 3/8" #4 #10 #30 #40 #60 #100 #200 S-2 100 88.6 84.8 78.1 61.5 38.7 30.6 23.9 21.4 19.3 S-36 75-77 100 90.9 84.2 73.9 65.4 52.9 45.7 30.9 24.2 18.6 S-26 52-54 100 98.5 95.3 88.3 80.8 72.1 68.9 60.2 50.2 37.5 S-368S-37 74-76 100 94.4 89.0 84.1 66.0 48.8 30.1 24.5 19.1 16.9 14.9 S-4 20-22 1- 100 96.1 96.1 92.5 88.8 83.5 73.5 66.8 49.3 38.9 30.8 S-32 80-82 100 96.1 96.1 92.5 88.8 83.5 73.5 66.8 49.3 38.9 30.8	Sample Bepth in Feet 2" 1" 3/4" 1" 3/8" #4 #10 #30 #40 #60 #100 #200 S-2

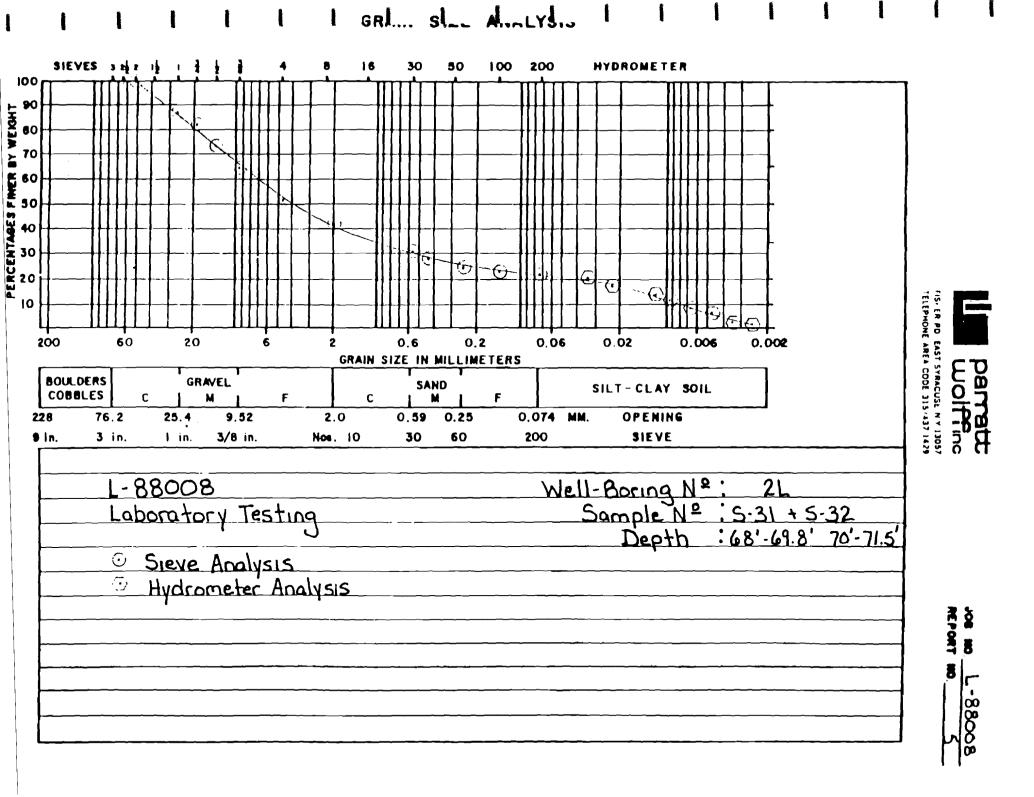
Remarks: (1) Partial Sieve Analysis, used in calculations for hydrometer Prewashed ASTM C-117

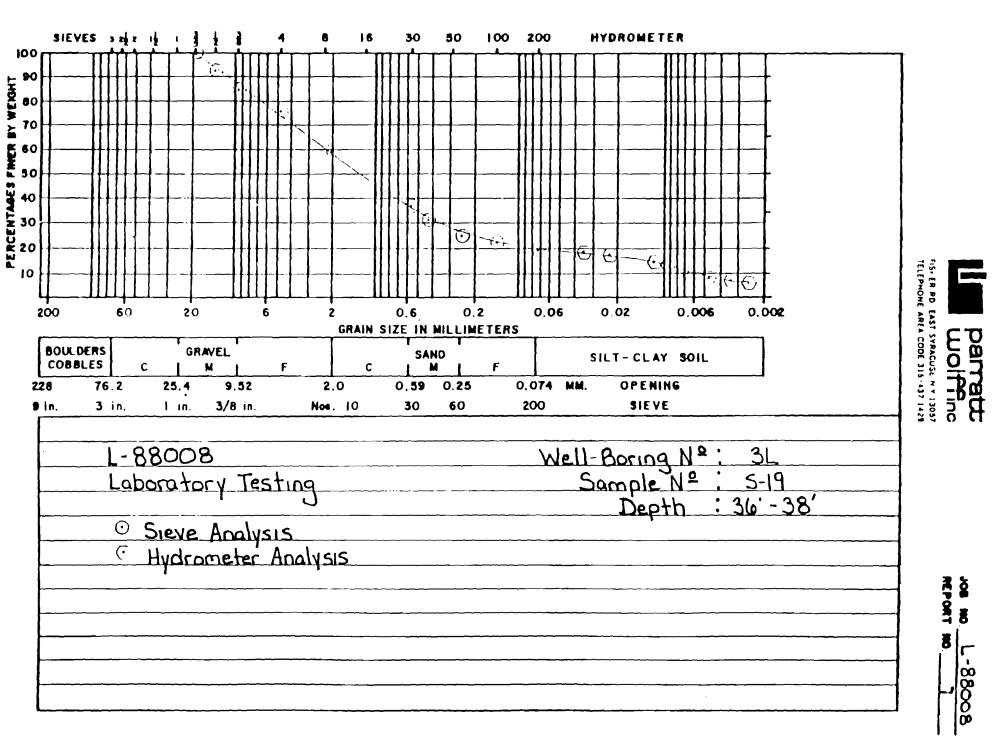
analysis Yes X No Performed By VJT&JG

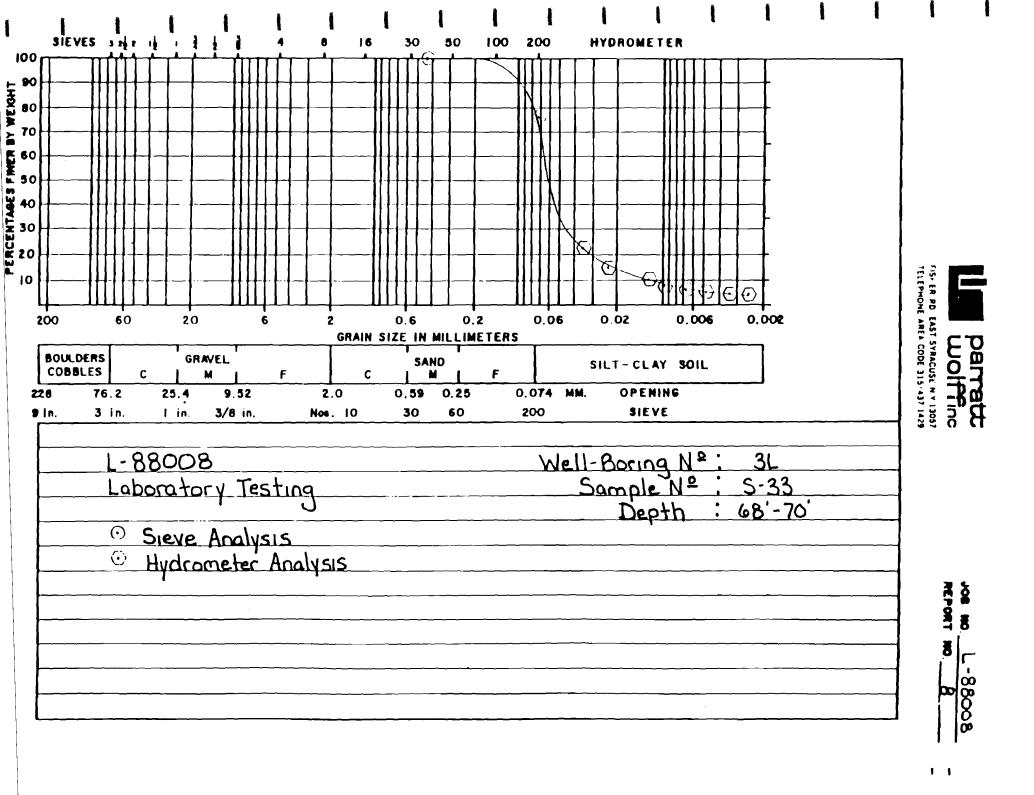


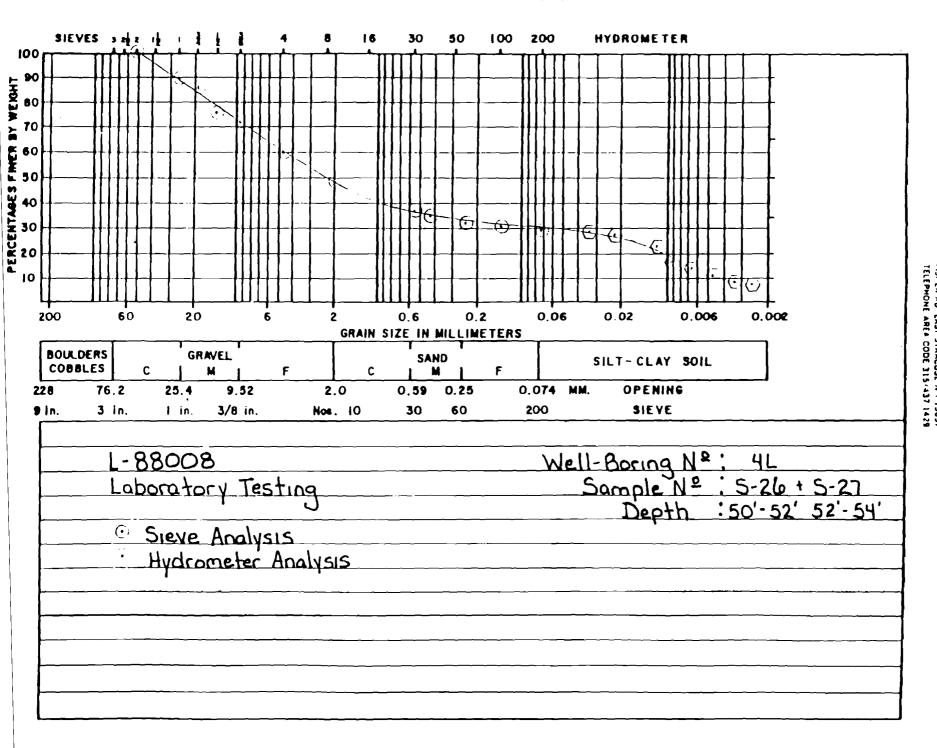


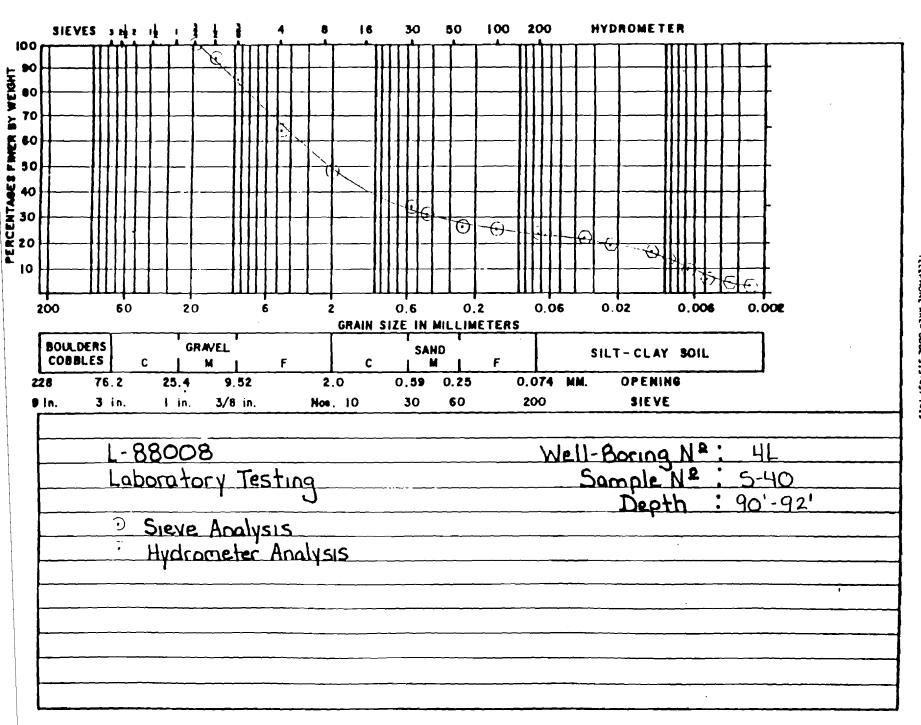




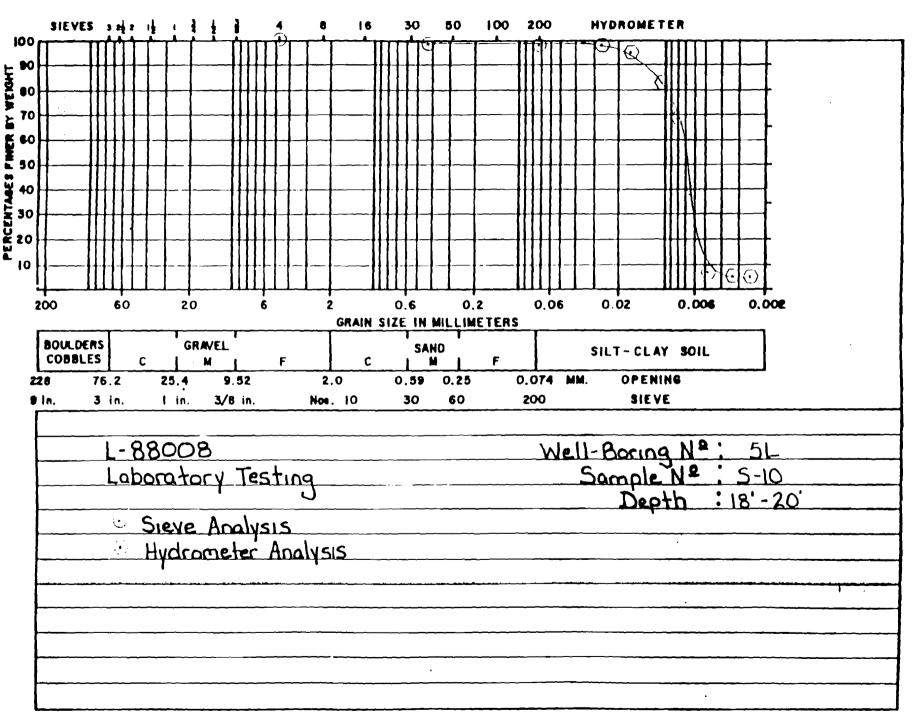






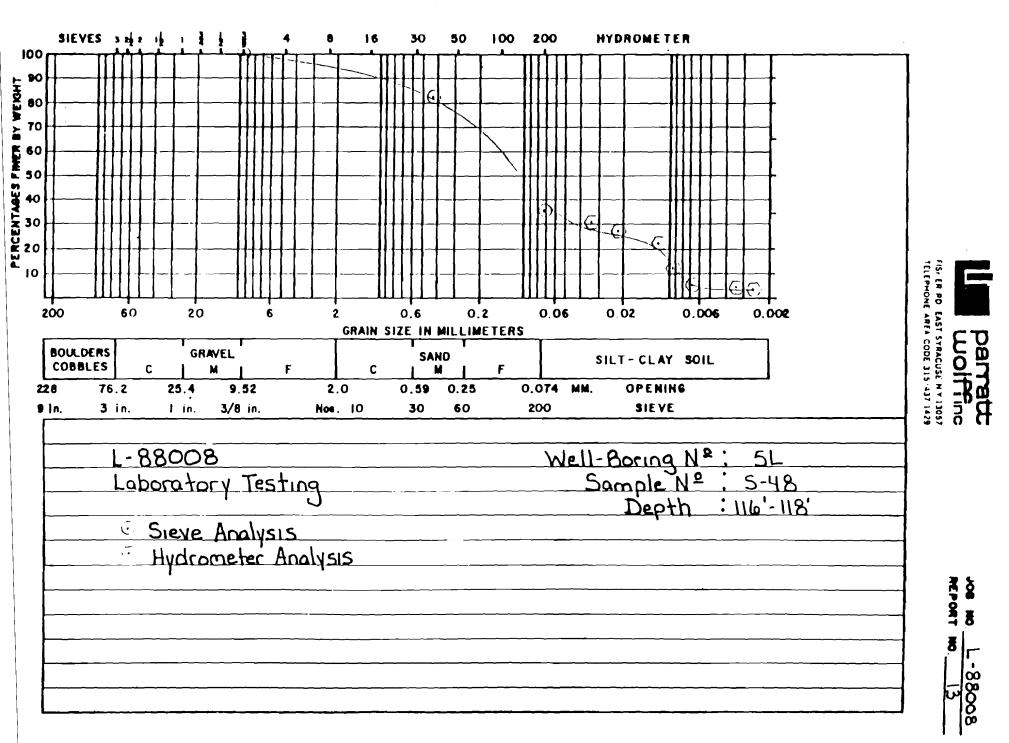


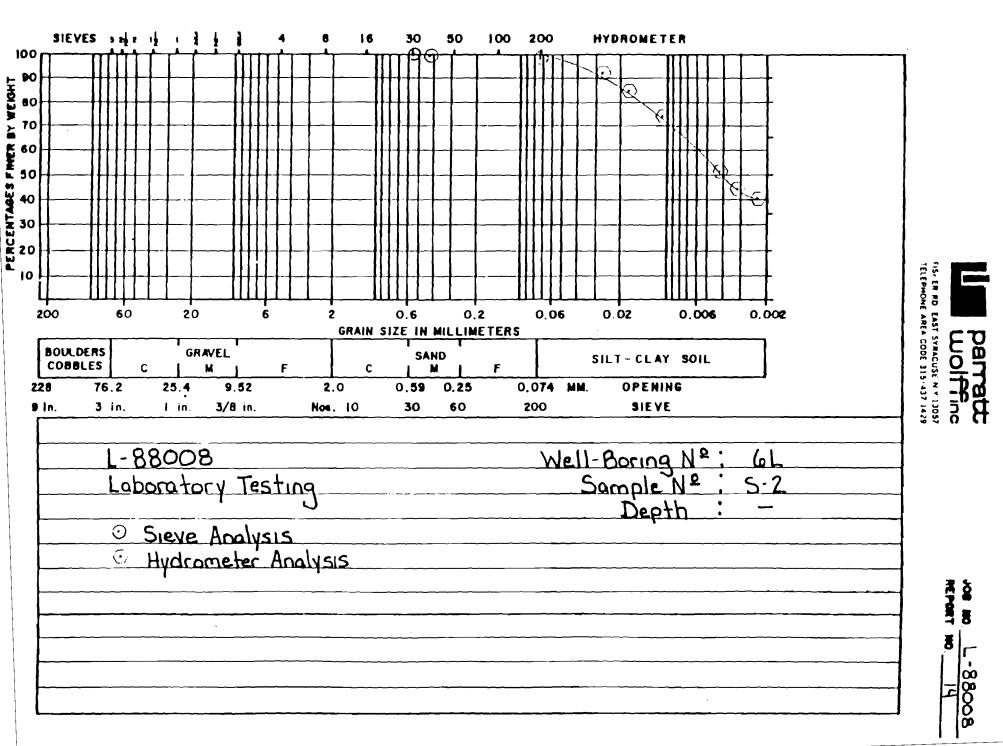


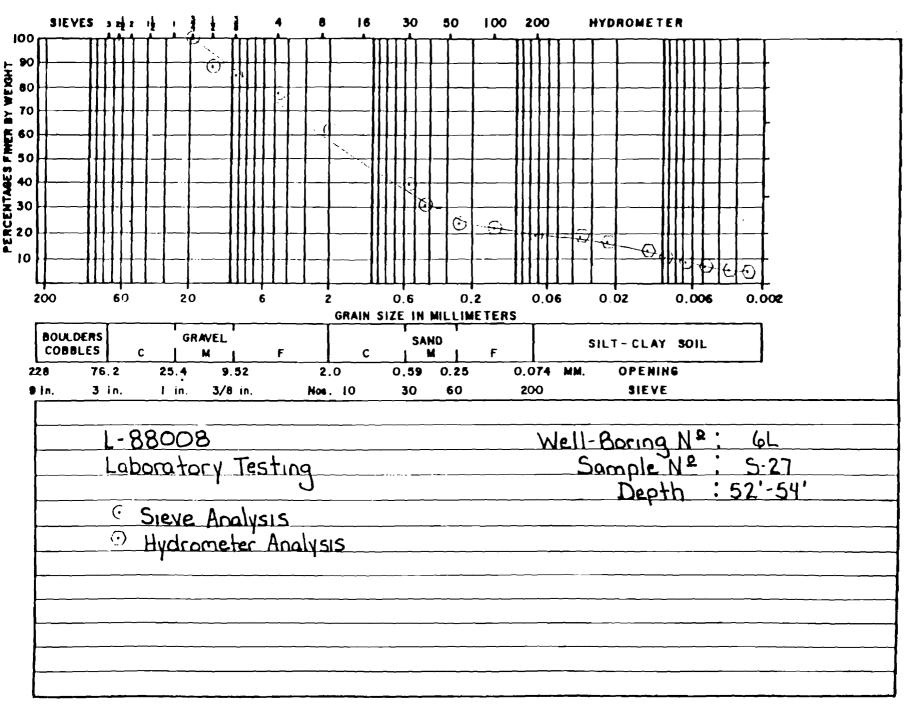




METORY NO. 12

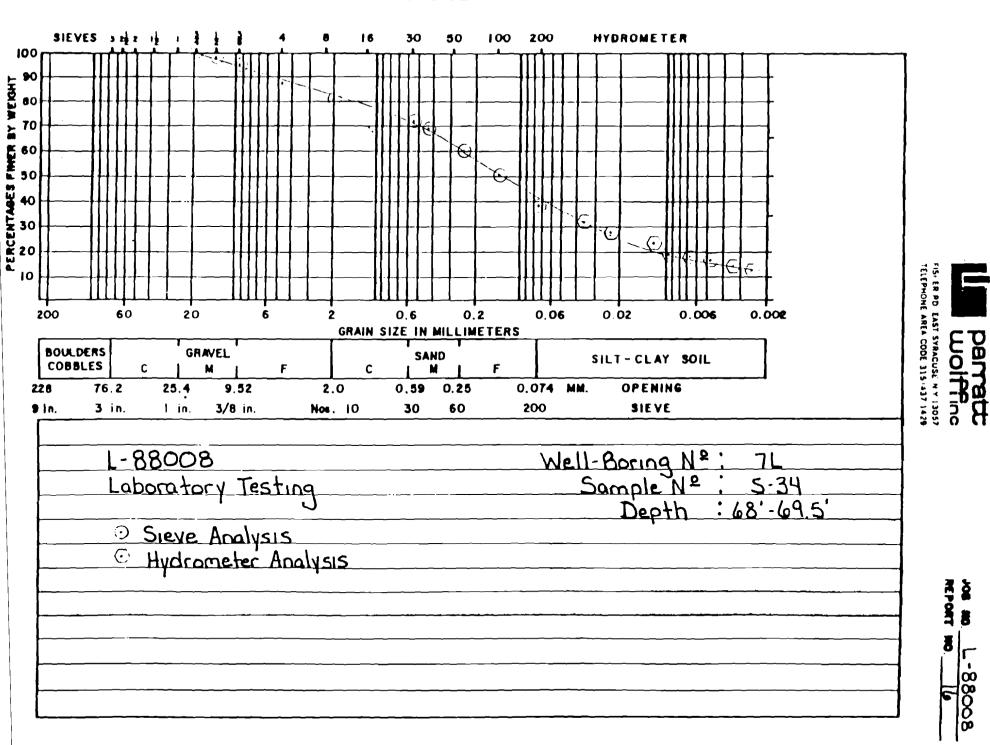


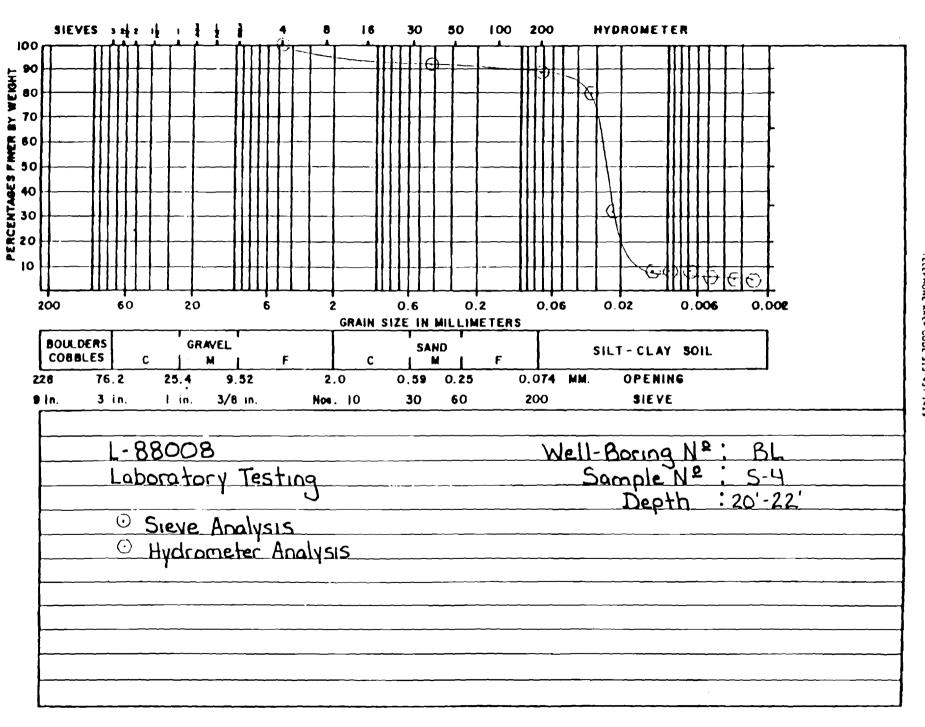




TELEPHONE AREA CODE 315 437 1429

MEPORT NO. 15



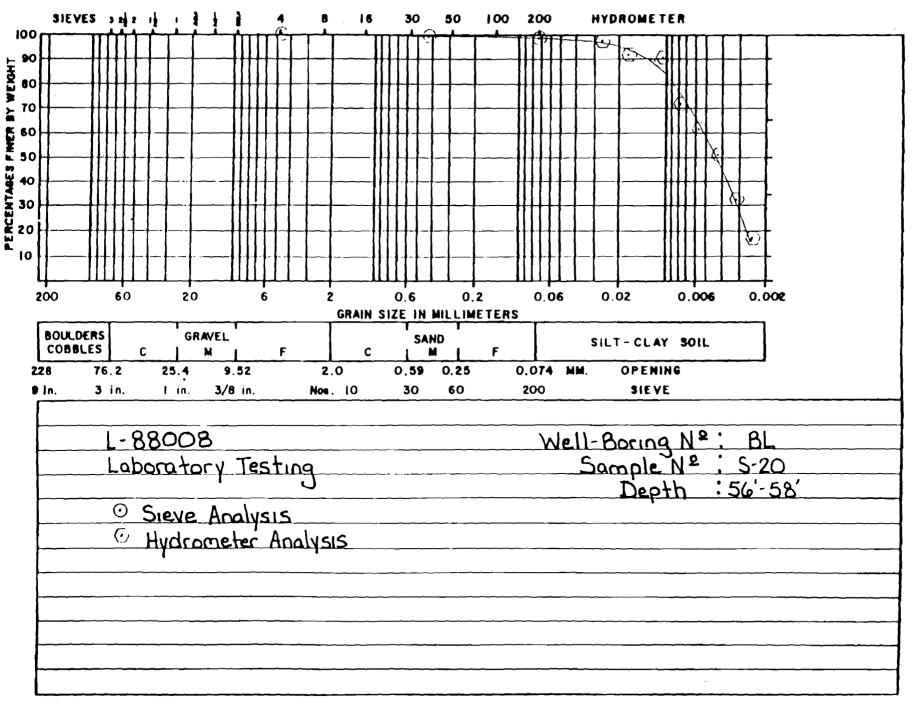


Paratte Molffine

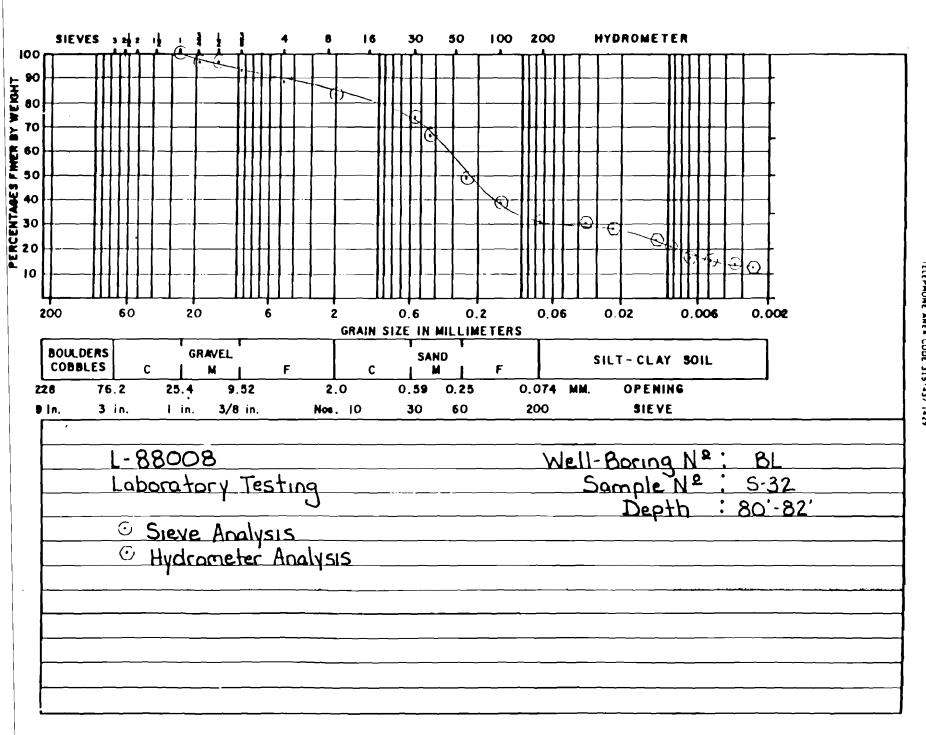
(15) ER PO EAST SYRACUSE NY 13057

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BY WEIGHT

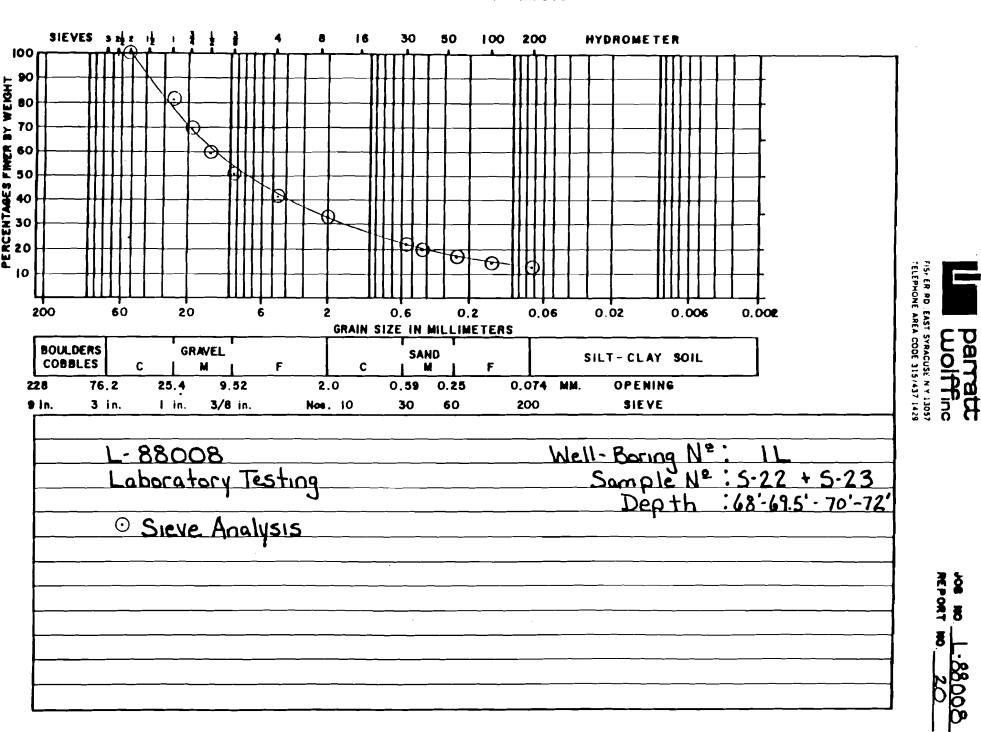


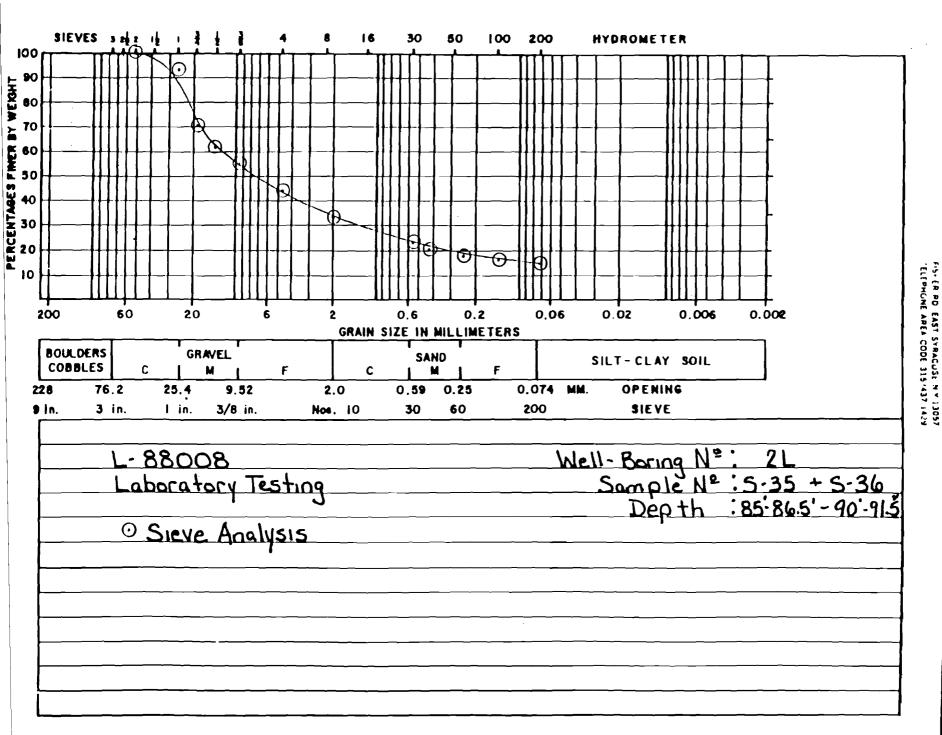




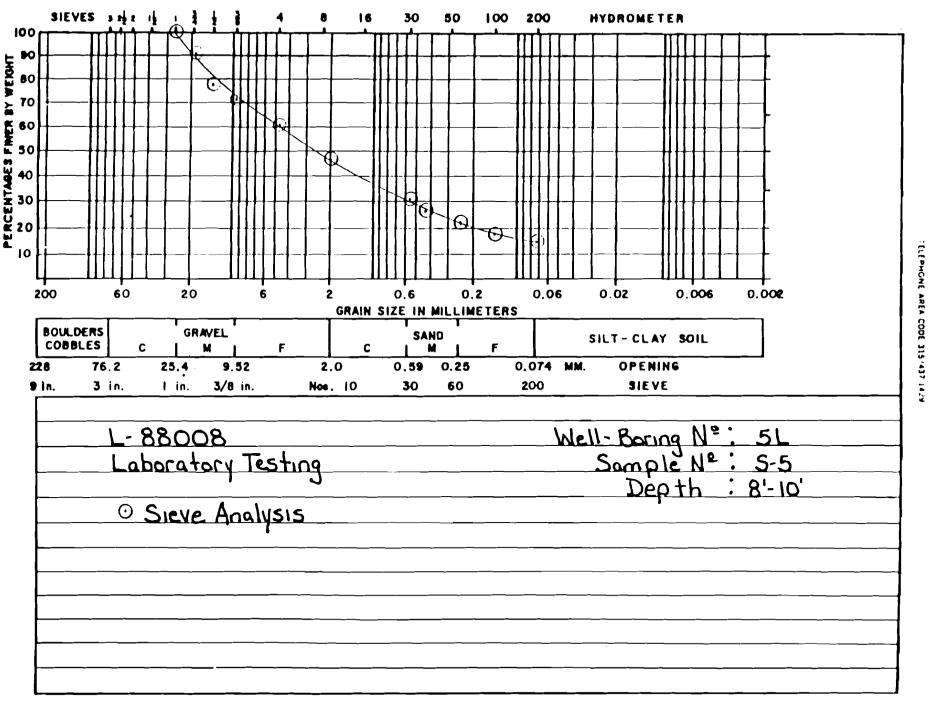


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parratt wolffine



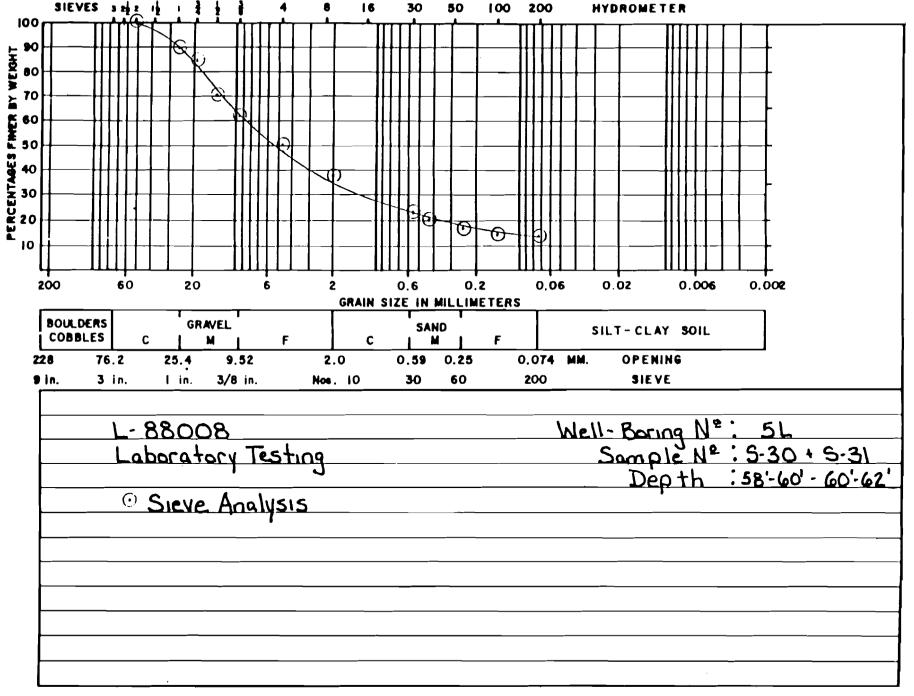
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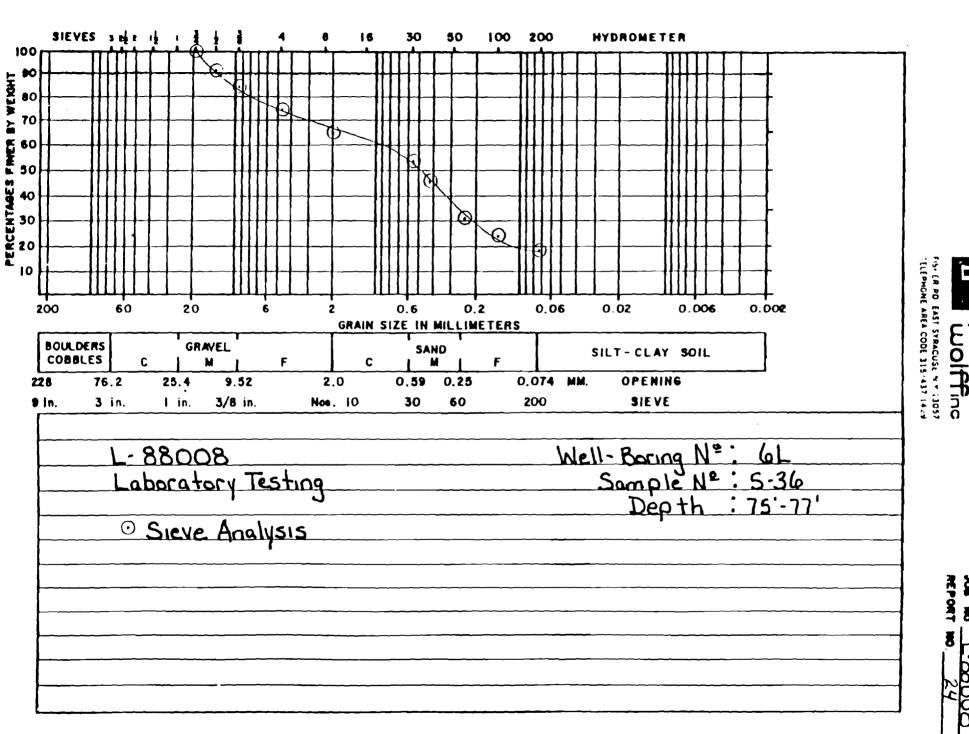
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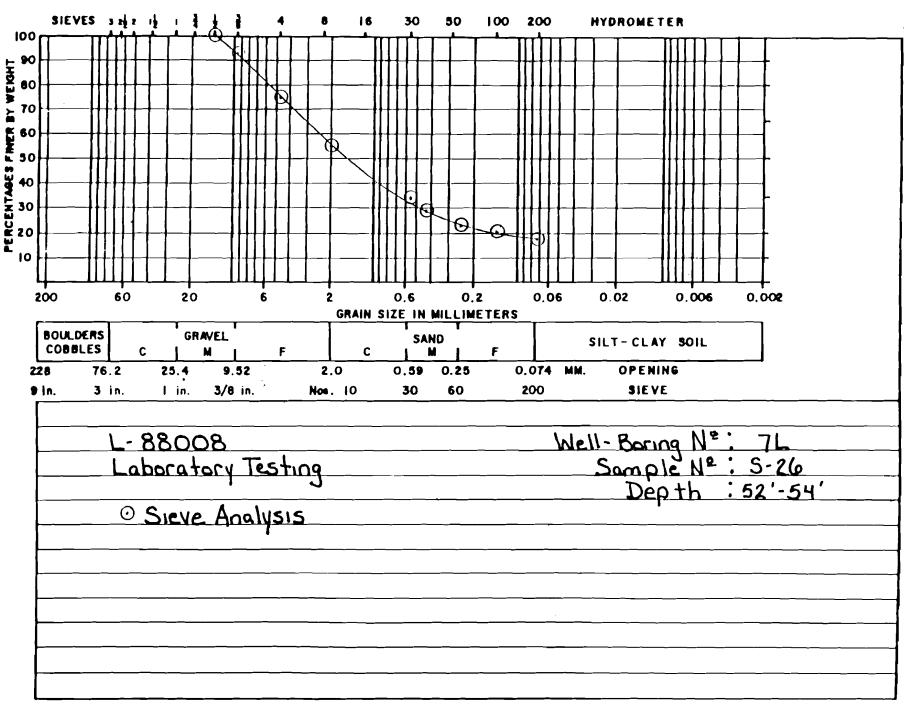
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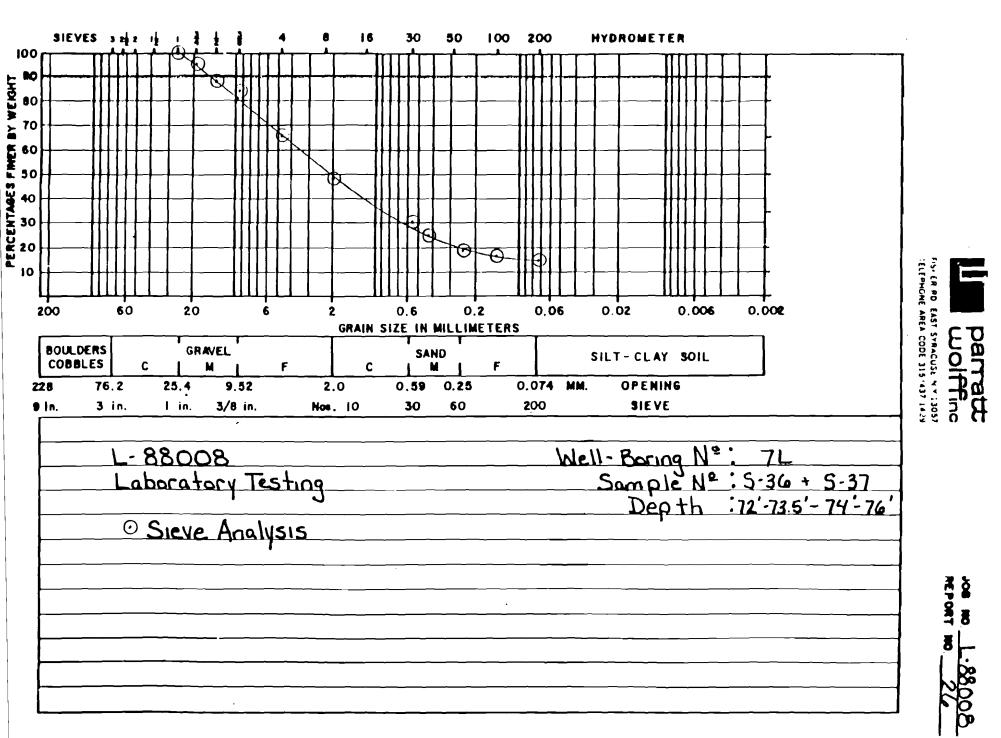
MEPORT NO. 23







1.88002 REPORT NO 25



APPENDIX E SEISMIC REFRACTION INVESTIGATION

Box 6, Dunstable, Mass. 01827 (617) 649-6650

SEISMID REFRACTION INVESTIGATION
FOR A HYDROGEOLOGIC ASSESSMENT
OF THE ALLIED WASTE BEDS
IN THE SYRACUSE AREA

prepared for

Blasland & Bouck Engineers, P.C. 5793 Widewaters Parkway Box 65 Syracuse, New York 1321!

SEISMIC REFRACTION INVESTIGATION FOR A HYDROGEOLOGIC ASSESSMENT OF THE ALLIED WASTE BEDS IN THE SYRACUSE AREA

Introduction

A seismic refraction investigation was completed on properties containing the Allied Waste Beds in an area west of Syracuse. New York by John Rick, geophysicist.

The purpose of the work was to determine depth to bedrock and other detectable interfaces, and the nature of sucsurface materials. The information is needed to support a hydrogeologic assessment of the Allied Waste Beds being conducted by Plasland & Houte Engineers, 2.1. of Syracuse, Jew Fore.

Seismic Field Work

Eleven seismid lines (17 shot points) covering 4335 linear feet of traverse were completed October 21, 22, and 23, 1987. Locations of lines and shot points are shown on the map of Figure 1. Each line is included between two shot points. As shown on the map, the traverse was broken at several places because of obstacles such as an active railroad, marshes, and streams.

The map of Figure 1 is based on an enlarged (scale approx. 1" = 1000') version of a portion of the Camillus and Syracuse West quadrangle topographic map, provided by Mr. George Thomas, geologist for Blasland & Bouck Engineers, P.C. Mr. Thomas also directed the investigation, as well as furnishing useful information and providing considerable support.

A S.I.E. Model RS-4, 12 channel seismic system was used to obtain the data. Each seismic line is made up of a string of 12 detectors (geophones) planted in the ground along a straight line. The geophones are used to detect a seismic wave generated by the use of small explosive charges placed in holes at each end of the line (at shot points). The outputs of the 12 geophones are fed to a seismograph, which records the signals on film. The arrival times are read from the film and plotted on time-distance graphs

Data Interpretation

Data interpretation was accomplished by use of the critical distance method which is based on the analysis of graphs of travel time versus distance in combination with formulae based on refraction theory. Every opportunity was utilized to integrate geological knowledge of the site and thus increase the accuracy of the results.

Accuracy - In general, experience shows that the computed seasmid depths at shot points are within ten percent of the true depths. Accuracy between shot points, or for depths less than 15 feet, or for unusual, inforeseen ground conditions may be somewhat less.

Results

The interpreted results are presented in the form of profile cross sections on Figures 1 and 2, and in the written discussion celow. The profiles show overburden (soils) and bedrock setsmic velocities, and the position of the bedrock surface as related to the surface of the ground.

Seismic Velocities - Seismic waves travel at different velocities in different materials. When interpreted with due care these velocities can provide useful information on soil and rock characteristics. Below are listed correlations of material types with seismic velocities encountered on this project.

Telocity (ft/sec)	Interpretation
1500 - 2000	Thin surficial layers of unsaturated sand, gravel, or fill - often too thin to be accurately recorded.
3200 - 3400	Unsaturated material, usually more compact and/or fine grained than the above.
4500 - 5300	Commonly saturated sands and gravels, but can also include fine grained sands, silts, clays, or various admixtures of these as well as some types of till.

Seismic Velocities (cont.)

Velocity (ft/sec)	Interpretation
5900 - 7000	Compact till materials.
9800 - 13400	Bedrock - paleozoic sedimentary rock, most likely shale. Degree of weathering and/or fracturing generally increases as velocity decreases.

Discussion of Profiles

SP (shot points) 1-4 - Extends from near Rte. 595 to a drain channel south of the Conrail right of way. Calculated depths to bedrock range from 34 feet near SP 1 to over 65 feet near SP 3. The degree of upward slope of the rock surface from SP 1 - 1 is greater than shown, because the ground surface slopes upward to the south at this location.

 \overline{SP} 5 - 6 - An isolated (untied) line between the railroad and a zone of marsh. Calculated bedrock depths range from 66 to 78 feet, sloping downward to the north.

3P.7-8 - Extends from the north side of the above mentioned marsh to the southern shoreline of Nine Mile Creek. Interpreted bedrock depths vary from 84 feet near SP 7, to 91 feet near SP 8.

<u>3P 9 - 13</u> - Mostly along a dirt access road (Brewery Road). SP 9 is on the southern shore of Nine Mile Creek, but the geophone spread begins on the north shore and extends northward, leaving an 80 foot water covered space. Calculated depths to rock range to slightly over 100 feet at 2 localities, but could be somewhat more or less depending on the thickness of the intermediate till layer, and the accuracy of the slope calculations.

<u>SP 14 - 16</u> - Extends from a marshy tract of land on the south, to higher ground on the northerly end. Bedrock depths range from 82 feet near SP 14 to less than 50 feet as SP 16 is approached. The bedrock slopes upward to the north to a greater degree than shown because the ground surface also slopes upward.

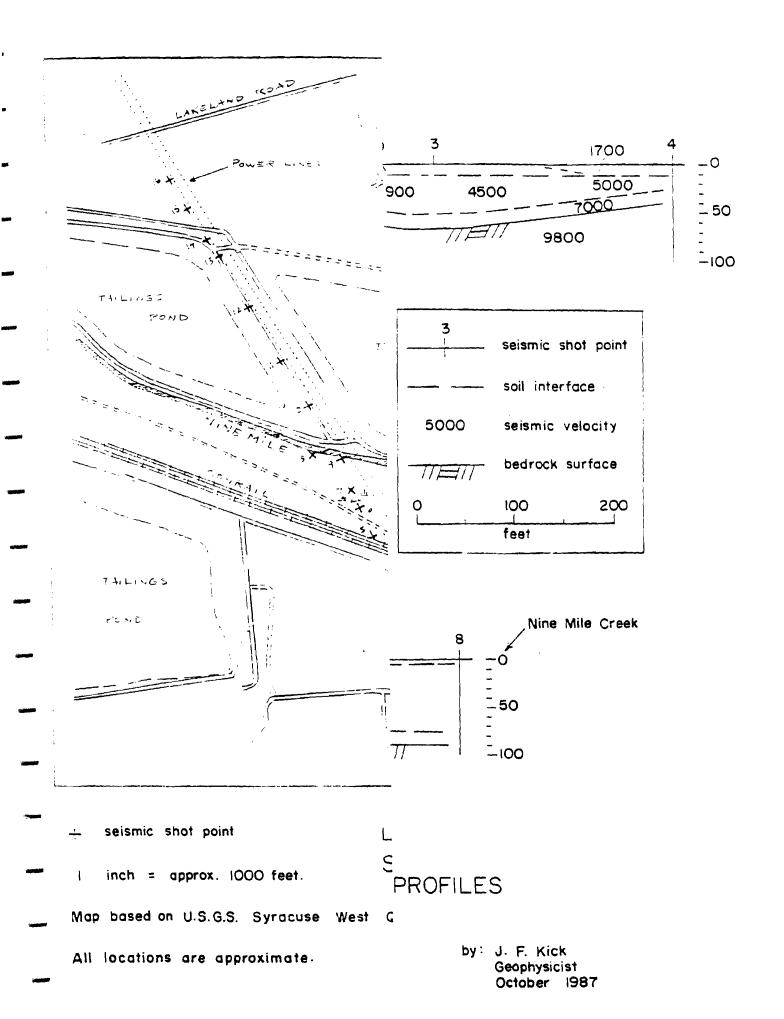
General Comment - Except on the northern and southern ends, much of the survey traversed areas of fill.

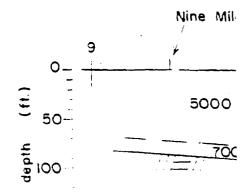
Discussion

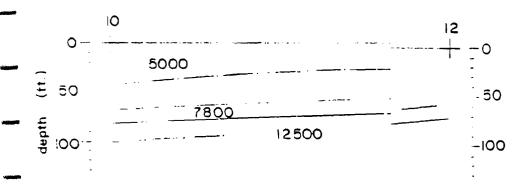
A source of error common with seismic refraction work is that relatively thin intermediate layers with intermediate velocities may not be recorded. Omission of such layers from calculations results in computed depths to bedrock that are somewhat less than the actual depths.

In the case of this project, an intermediate layer with till velocity (5900 - 7000 ft/sec) was recorded in a few places, but on most lines no evidence for such a layer was seen. In order to increase the accuracy of the depth to rock calculations, a layer of till of constant (15 feet) thickness, with estimated velocity of 7000 ft/sec was added into the final calculations. The computations were made using a computer program which deals with such "hidden layer" problems. The 15 foot estimated thickness was taken from drilling and geologic observations. Where till is greater in thickness than 15 feet the calculated depths will be too shallow. Where till is thin or missing, the calculated depth is slightly greater than the actual.

In places where some evidence exists for an intermediary till layer, the depth to till and bedrock is indicated by a symbol shown in the legend on Figure 2.

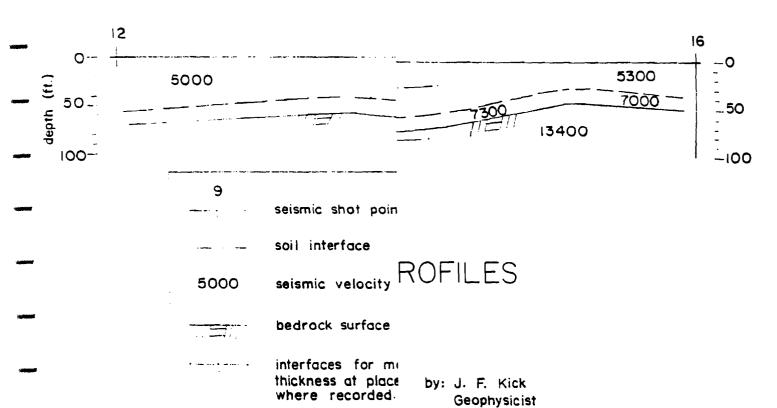






100

feet



200

October 1987

APPENDIX F
ANALYTICAL RESULTS



ATE	COLLECTED 12-17-87	DATE REC'D.	12-17-87	, 	_DATE ANALYZE	0	
	Description		WB-Bu	WB-BL	WB-6		
	Sample #		G3978	G3979	D3980		
•	SPECIFIC CONDUCTIVITY		6600.	13000.	80000.		
: -	PH, LABORATORY		12.4	7.2	6.4		
	CALCIUM	, , ,	1200.	315.	19000.		
	CHLORIDE		1300.	7200.	56000.		.
L.	FLUORIDE	••	0.69	0.57	0.14		
_	IRON		0.06	0.62	39.		
<u>.</u>	MAGNESIUM	-	<0.05	56.	120.		-
	NITRITE NITRATE NITROG	EN	1.4	<0.01	<0.01	7	
	POTASSIUM		21.	36.	280.		
	SODIUM		200.	1100.	9500.		
	STRONTIUM		6.2	32.	42.		
	SULFATE		66.	630.	49.		
	TOTAL DISSOLVED SOLIDS	}	3500.	11000.	87000.		
	HYDROXIDE ALKALINITY		1200.	<1.	<1.		
	CARBONATE ALKALINITY		400.	<1. <1.	<1.		
	BICARBONATE ALAKLANITY	•	<1.	280.	54.	. }	
				1.		,	

Methodology: Federal Register — 40 CFR. Part 136. October 26, 1984

Units: mg/ℓ (ppm) unless otherwise noted

Comments:

Authorized: | India



DESCRIPTION	LAND & BOUCK ENGI Allied	NEEK, P.C	•		JOB NO	2887.013.517
DATE COLLECTED	12-18-87	DATE REC'D.	12-18-87		DATE ANALYZE	D
			}			}
Descrip	tion		Metro 1			
Sample	#		G3999			
PH, LAB	ORATORY		7.6			
••	C CONDUCTIVITY		990.			
CALCIUM	· 	. , ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	140.		1	
CHLORID			130.	. Names and another over a reduc-		
FLUORID	DE		1.1	and a warm of the	1	
IRON			0.15	m is a manifest		
MAGNESI	UM	- 30 mm mg.42 grade	28.			
NITRITE	NITRATE NITROGE	ν.	0.16			
POTASSI	I UM	-	12.			
SODIUM		•	74.	•		
STRONTI	IUM		0.88			
SULFATE	Ē		260.			
TOTAL I	DISSOLVED SOLIDS		830.			
HYDROX	IDE ALKALINITY		<1.	_		
CARBON	ATE ALKALINITY		<1.			
BICARBO	ONATE ALKALINITY		220.	. .		
		-				
	·					-

Methodology: Federal Register — 40 CFR. Part 136, October 26, 1984

Units: mg/{ (ppm) unless otherwise noted

Comments:

Authorized:

ORG Laboratories Inc.



CLIENT BLASLAND & BOUCK ENGINEERS	, P.C.		JOB NO	2887.013.517
DESCRIPTION Allied				
DATE COLLECTED 12-21-87 DATE R	EC'D. 12-21-87		DATE ANALYZED _	
	1		<u> </u>	1
Description	P-1	P-2		
Sample #	G4032	G4033		
PH, LABORATORY	5.1	7.0		
SPECIFIC CONDUCTIVITY	41000.	2700.		Plants Commonweal and American and American and American
- CALCIUM	8400.	660.		
CHLORIDE	22000.	900.	and the same of th	Murry
FLUORIDE	<0.1	0.14		**************************************
IRON	330.	6.0		
MAGNESIUM	91.	71.		
NITRITE NITRATE NITROGEN	<0.01	<0.01		
POTSSSIUM	25.	11.		
SODIUM	5000.	170.		
STRONTIUM	23.	12.	1	
SULFATE	64.	960.		
TOTAL DISSOLVED SOLIDS	39000.	2900.		
HYDROXIDE ALKALINITY	<1.	<1.		
CARBONATE ALKALINITY	<1.	<1.		
BICARBONATE ALKALINITY	32.	210.		
				
	}	1		

thodology: Federal Register - 40 CFR, Part 136, October 26, 1984

Units: mg/{ (ppm) unless otherwise noted

Comments:

Authorized: 1. 1. Similar





Blasland, Bouck Engineers P.C. Syracuse II

DATE COLLECTED 12-14-87	DATE REC'D.	12-14-87	DATE ANALYZ	ZED		
Description	WB-2u	WB-2L	WB-4u	WB-4L	DW-101	104.1MS
Sample #	G3803	G3804	G3805	G3806	G3807	G3808
ALKALINITY AS	-					200
HYDROXIDE ALKALINITY	<1.	<1.	<1.	<1.	<1.	<1.
CARBONATE ALKALINITY	<1.	<1.	<1.	<1.	<1.	360.
BICARBONATE ALKALINITY	60.	70.	60.	50.	120.	20.
PH, LABORATORY	8.3	6.4	8.0	6.6	6.6	9.9
CALCIUM	68.	19000.	3300.	15000.	23000.	23000.
CHLORIDE	350.	51000.	11000.	43000.	59000.	51000.
FLUORIDE	0.16	<0.10	0.12	<0.10	<0.10	0.25
IRON	<0.05	8.3	0.18	22.	130.	1.3
MAGNESIUM	11.	690.	220.	1000.	250.	2.0
NITRITE NITRATE NITROGEN	1.7	<0.01	<0.01	<0.01	<0.01	<0.01
POTASSIUM	12.	180.	82.	250.	250.	150.
SODIUM	120.	8800.	2300.	10000.	15000.	12000.
STRONTIUM	1.5	35.	13.	41.	150.	110.
SULFATE	190.	440.	130.	150.	6.	39.
COTAL DISSOLVED SOLIDS	890.	93000.	17000.	76000.	101000.	83000.
SPECIFIC CONDUCTIVITY	1200.	79000.	19000.	68000.	89000.	84000.
				-		
		}			-	

sthodology: Federal Register — 40 CFR, Part 136, October 26, 1984

Comments:

Units: mg/((ppm) unless otherwise noted



	T BLASLAND & BOUCK ENGINEERS			JOB N	o. <u>2887.0</u>	15.517
ESCR	Hydrogeo, Assessment	Allied Waste	Beds			
	Syracuse, NY	12.0.0	7			
DATE	COLLECTED 12-9-87 DATE R	EC'D. 12-9-8	/	_DATE ANALYZ	ED	
				}		
	Description	WB-3U	WB-3L	WB-1U	WB-1L	
				}		
	Sample #	G3576	G3577	D3578	G3579	
-	t for the control of the grander of the control of	marketing of a committee committee			., ,	management, education trans
	SPECIFIC CONDUCTIVITY	1000.	\$8000	530.	i	
F	PH, LABORATORY	1	6.5	7.4	7.2	
	CALCIUM	150.	1000.	110	270.	·
9	CHLORIDE	500.	39000.	7.	45.	
	FLUORIDE	0.15	<0.1	0.25	0.25	
	IRON	<0.05	29.	<0.05	0.87	
\$ ~ .	MAGNESIUM	76.	500.	53.	57.	
	NITRITE NITRATE NITROGEN	<0.01	<0.01	<0.01	<0.01	
	POTASSIUM	2.0	48.	5.4	2.9	
	SODIUM	110.	8300.	13.	24.	
į į	STRONTIUM	1.6	0.64	0.49	2.9	
	SULFATE	59.	590.	98.	560.	
i i	TOTAL DISSOLVED SOLIDS	1500.	650 00.	800.	1300.	
	HYDROXIDE ALKALINITY	<1.	<1.	<1.	<1.	
<u> </u>	CARBONATE ALKALINITY	<1.	<1.	<1.	<1.	
	BICARBONATE ALKALINITY	210.	290.	370.	250.	
1						
		}				
1						
F	•	1	İ	1	1	1

Methodology: Federal Register — 40 CFR, Part 136, October 26, 1984

Units: mg/t (ppm) unless otherwise noted

Comments:

Authorized: 11. Dindus

OBG Laboratories, Inc.

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B & B SAMPLE NO.	LABORATORY SAMPLE NO.	SAMP	PLING	SAMPLE DEPTH	SAMPLE TYPE	V0 A	BNA	METALS	PEST/PCB 3	36c 1		Removitis S				NO. OF	COMMENTS (SPECIAL INSTRUCTIONS, CAUTIONS, ETC.)
SW-1 SW-Z 5W-3	63272 63273 63274	3 De; 81	1045		unter											3 3	
5W-4 5W-5 5W-6	63275 63276 63277		1230 1310 1325				_									3 3	
.sw-7	53278	Y	13.5.5		<u> </u>											<u>3</u>	
I. SAMPLED AND	RELINQUISHED BY	I, RECEIVE	D BY		VOA VIAL											_	REMARKS: (SAMPLE STORAGE, NONSTANDARD SAMPLE BOTTLES)
SIGN SO 761 PRINT GEORGE FIRM BA TS DATE 3 DCG 15 1 II. RELINQUISHED	TIME (500	PRINT LON	1 PE/ISE G 2/87 TIME		GLASS BOTTLE PLASTIC BOTTLE PRESERVATIVE				 	x 2;		×				. 0 1 0 0 1	All samples to be analyzed for: Alkalinity as: lybnoxide Carbonate Calcium Bicarbonate
SIGN PHINT FIRM DATE	TIME	SIGN PRINT FIRM DATE	TIME		CONTAINER VOLUME					int	, t	rint					chloride Fluoride
III. RELINQUISHE SIGN PRINT FIRM	ED BY	III. RECEIVI SIGN PRINT FIRM	ED BY		GLASS JAR PLASTIC JAR				 							L 1 D	Evon Magnesium Nitrate Potassium
DATE IV. RELINQUISHE SIGN PRINT	TIME ED BY	DATE IV. RECEIV SIGN PRINT	TIME ED BY	PRESERVATIVE CONTAINER VOLUME	-	 									0 8	Sulfate	
FIRM DATE EVIDENCE SAM	ATE TIME DATE TIME							NOTE: SAMPLE BOTTLES SUPPLIED BY LAB, UNLESS INDICATED PRESERVATION KEY: A- SAMPLE CHILLED, B - FILTERED,									TDS ronductance 7H
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5W-10 SW-11	G3336 G3337		1010							_				_	_	_	
SW-13	G3338		1220				_			-			-				
<u>SW-141</u>	G3340		1035										-				
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EVIDENCE SAMP	PRESERVATION KEY: A- SAMPLE CHILLED, B - FILTERED, C,- ACIDIFIED WITH HESON C- WINE WINDERS D-NOOH, E-NOTHIOSULFATE, F-OTHER.									於	Sodium						

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888	LABORATORY	SAMP		SAMPLE	, SAMPLE			ALS	m O	NAL	78.B	NO				O. OF TAINERS	COMMENTS
	SAMPLE NO.	DATE	TIME	DEPTH	TYPE	40>	BNA	METAL!	PEST/	SOF			ŀ			CONT	(SPECIAL INSTRUCTIONS, CAUTIONS, ETC.)
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SW - 16	G3446	7 pro 55	12.30		Water					×	<u> </u>	×				3	
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III. RELINQUISHE		III. RECEIVE			VOA VIAL	_	├ -		 			 		_			Chloride
SIGN		SIGN			GLASS JAR	_	 			<u> </u>			 			۵	Fluoride
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APPENDIX G - AERIAL PHOTOGRAPHS

The aerial photographs included with this Assessment were flown on March 28, 1981 for the Onondaga Planning Agency by Kucera & Associates, Inc., Mentor, Ohio. The scale of the photographs is approximately 1"=800'.